

USPS/PB-T1-1 On page 15 of your rebuttal testimony (USPS-RT-13) on behalf of the Postal Service in Docket No. R97-1, you testified (Tr. 34/18457) as follows:

There may be good reasons to depart from this Efficient Discount Policy when setting rates. For example, as Witness Bernstein points out, Ramsey optimal prices may involve different discounts (footnote).

Footnote: In other words, efficient “discounts” do not necessarily yield efficient “rates.” Logically, this is not surprising, as the scope of the inquiry involved in exploring efficient discounts does not address the broader issue of the efficiency of the base rate to which the discount is applied.

Do you still agree with this portion of your previous testimony? If not, why not?

RESPONSE

Yes.

USPS/PB-T1-2 During oral cross examination on your rebuttal testimony in Docket No. R97-1 (Tr. 34/18465-66), you defined “efficient discount policy” as “the situation where the discount between a full-service sub-class of mail and one for which work sharing provided is equal to the per unit postal cost saved,” and when asked if you support and recommend utilization of that policy, you replied:

A As I explained in the testimony, it's the starting point for ensuring cost efficiency -- that is, ensuring that mailers engage in work sharing only when they are at least as efficient as the Postal Service at the margin in providing that work.

So, in that sense, I recommend it, but there may be demand side reasons or reasons in accordance with the Postal Statute for deviating from that efficient discount policy.

To further elaborate, I guess, if I could – you might want to rename it the cost-efficient discount policy, because that's what the term "efficiency" should refer to.

Do you still agree with this portion of your previous testimony? If not, why not?

RESPONSE

Yes.

USPS/PB-T1-3 During oral cross examination on your rebuttal testimony in Docket No.

R97-1 (Tr. 34/18481), you were asked if there is a tension between the “efficient discount policy rate” and the “efficient rate.” You responded that:

A. There’s a pricing tension between demand-side considerations, value of service, elasticity of demand, and cost efficiency considerations. There’s certainly a tension there, anytime the rate is not consistent with the efficient discount policy.

The following exchange then occurred (Tr. 34/18482-84):

Q And in terms of pricing and determining prices, would you agree that it is necessary to examine both the efficient rate as well as the efficient discount policy rate before making a final judgment?

A I would say that it would be desirable to examine both in the following sense.

The "efficient" rate -- I would like to put the term in verbal quotes -- in order to do that, let me use the term Ramsey rate that comes from maximizing some well-understood total surplus function.

That rate takes into account this trade-off between the supply side and the demand side that I have been discussing, so if I were charged with the task of maximizing total surplus, I would want to know the Ramsey rate and that rate would reflect -- in some cases it will depart from the efficient discount rate, but that rate will reflect the right trade-off between the cost considerations and demand considerations.

But that is only -- now for the Commission's purposes I would think that would be useful information, but their statutory responsibility isn't as simple as maximizing total surplus.

They may be willing to trade off demand side considerations against cost side efficiencies as well, and I would think they would want to know both numbers.

If they were just interested in Ramsey-like total surplus calculations they wouldn't have to pay any great attention to the efficient discount policy because the Ramsey calculation has made that trade-off automatically.

So I guess that's saying yes, I would like -- if I were in the position of setting the rates I would like to see both numbers.

Q And you wouldn't simply by rote choose the efficient discount policy rate over the efficient or Ramsey rate?

A No.

Do you still agree with these portions of your previous testimony? If not, why not?

RESPONSE

Yes.

USPS/PB-T1-4 Would you agree that application of ECPR will lead to no improvement in cost efficiency if, relative to the status quo, it leads to no change in mailer behavior? If not, please identify the change in cost efficiency in the following scenario. Assume that a particular activity can be performed by the Postal Service at a unit cost of 10 cents, and further assume that there are two sets of mailers for whom it is feasible to conduct this activity themselves. The first set constitutes 60 percent of mailers, and for those mailers it costs 6 cents to conduct the activity. The second set constitutes 40 percent of mailers, and for them it costs 12 cents to conduct the activity. The current status quo discount is 7 cents, and therefore 60 percent of the mailers engage in the worksharing activity. Application of ECPR would increase the discount to 10 cents. Please confirm that increasing the discount from 7 cents to 10 cents under this scenario would not lead to any change in mailer behavior, or in the cost efficiency of the postal system. Please explain your answer fully.

RESPONSE

Yes, but I believe it unlikely that application of ECPR will not change behavior given how discounts have changed behavior in the postal arena to date. The Cohen *et al.* paper I cite in my testimony shows that in 2004, almost 150 billion pieces of mail of the total 206 billion pieces of mail availed themselves of worksharing discounts.

USPS/PB-T1-5 Please consider the following scenario. Assume that a particular activity can be performed by the Postal Service at a unit cost of 10 cents, and further assume that there are three sets of mailers for whom it is feasible to conduct this activity themselves. The first set constitutes 60 percent of mailers, and for those mailers it costs 6 cents to conduct the activity. The second set constitutes 5 percent of the mailers, and for them it costs 9 cents to perform the activity. The third set constitutes 35 percent of mailers, and for them it costs 12 cents to conduct the activity. The current status quo discount is 7 cents, and therefore 60 percent of the mailers engage in the worksharing activity. Application of ECPR would increase the discount to 10 cents. Please confirm that increasing the discount from 7 cents to 10 cents under this scenario would lead to the mailers in the second set (5 percent of the total) to start worksharing, and that this change in mailer behavior would improve the cost efficiency of the postal system. Please also confirm, however, that the mailers in the first set (60 percent of the total) will receive a rate reduction of 3 cents without any effect on their behavior, that this lost revenue (assuming sub-unitary elasticity) will need to be made up by higher rates for some other mailers, and that the higher rates charged elsewhere could lead to an overall loss in efficiency notwithstanding the increase in cost efficiency relating to the 5 percent of the mailers in the second set. Please explain your answer fully.

RESPONSE

Confirmed that mailers in the second set would change behavior and begin worksharing. Also confirmed that mailers in the first set will receive a rate reduction with no change in behavior. Also confirmed that lost revenue will need to be made up from elsewhere. Since my testimony is focused on the application of the ECPR discount regime at the subclass level, the lost revenue

would presumably come from mailers within the subclass. If higher rates are also required elsewhere this could (but doesn't necessarily have to) lead to a decrease in overall welfare. Also, my testimony sets forth the arguments in favor of instituting a system of cost-based discounts at the subclass level. It does not specifically address the issue of how one makes changes from an existing system of discounts that are less than avoided cost. Note that in the above example, and under ECPR more generally, the issues of "lost revenues" does not arise when one considers introducing an avoided cost discount of 10 cents for the first time.

USPS/PB-T1-6 On page 26 of your testimony, you note that Cohen, et al. (2006) “argue that the end result of this process is an increase in volume far greater than what would be predicted on the basis of price elasticities alone.” Do you agree with their argument? Why, or why not?

RESPONSE

I do not know the precise basis for their argument, so I can neither agree nor disagree. My interpretation of their statement is that the introduction of worksharing discounts set off a dynamic process of learning on the part of mailers and consolidators that has accelerated the growth of worksharing.

USPS/PB-T1-7

- a. Would you agree that, with respect to ECPR, the issue is how much worksharing activity changes when discounts change, and that if a higher discount results in little additional worksharing activity, then its primary effect is to give away money to mailers who are already worksharing, while raising the rates for other mailers (nonworksharing mailers, or mailers of another subclass)? If not, why not?
- b. Would you agree that the magnitude of the response by mailers to a change in a worksharing discount is a function of the price elasticity in some form or another, and it is therefore not advisable generally to attempt to ignore demand factors when setting worksharing discounts as part of an omnibus postal rate proceeding? If not, why not?

RESPONSE

- a. I believe that the issue with ECPR is that it encourages productive efficiency. As to whether or not it gives money away, please see my response to USPS/PB-T1-4 above.
- b. The magnitude of the response is a function of the distribution of the mailers costs to perform the activity. The price elasticities of workshared products, are themselves, in large part determined by this distribution. In general, productive efficiency is important. If I knew I would get no response to a discount, I might carefully consider whether to implement it but usually discounts have elicited responses and I would not take as the starting position that the discount will not

induce a response. Again, the arguments in my testimony refer to the desirability of a system of cost based discount, not on the practical details of moving toward them from some other system of discounts. (See my answer to USPS/PB-T1-5).

USPS/PB-T1-8 Is the 2006 Bern conference paper cited in footnote 24 on page 36 of your testimony the same as the paper ““Clean” Mail and “Dirty” Mail: Efficient Work-Sharing Discounts with Mail Heterogeneity,” previously circulated in draft form? If so, please provide a copy of a version of that paper that can be cited and quoted.

RESPONSE

The paper cited in my testimony is a revised version of the Bern conference paper. I have attached a copy to my response.

USPS/PB-T1-9 Your section heading on page 45 indicates your intent to present the case for basing *intra-subclass* rate differences on Postal Service cost differences. Why does not the same case apply to basing *inter-subclass* rate differences on Postal Service cost differences? Please explain fully.

RESPONSE

The arguments in favor of cost based rate differences apply any time mailers can make use of price differences to efficiently alter their behavior. However, as earlier citations to my past testimony have revealed, there is generally a tension between cost efficiency considerations and Ramsey-style, demand side factors. If price elasticities within a subclass are assumed to be approximately equal, then the issue of different elasticity based markups does not apply as strongly within the subclass as it might across subclasses. Thus, the issue of demand is less important within a subclass than across subclasses and the case for ECPR does not need to consider the tensions described earlier.

USPS/PB-T1-10 On page 49, you state that Ramsey Pricing weighs surplus dollars equally, and that this neutrality would not allow postal ratemakers to exercise independent judgment with respect to the non cost factors specified in the Act.

- a. Is your concern only applicable to mechanistic application of Ramsey Pricing (i.e., rates are automatically and invariably set at the levels calculated by the Ramsey model), or would it also apply to a procedure where the price levels suggested by the Ramsey model are considered as useful information for ratemakers, but do not preclude subsequent adjustment based on consideration of other factors of the Act? Please explain fully.
- b. Would you agree that if one has reservations about weighing surplus dollars equally, one might have the same type of reservations about imposing an equal unit contribution requirement (what you refer to on page 48 as the “same nominal markup”) on different mailers? If not, please explain fully.
- c. Would you agree that if one has reservations about weighing surplus dollars equally, one might have the same type of reservations about imposing a strict obligation on each type of mailer to cover the costs they impose on the Postal Service, regardless of their unique financial circumstances.? If not, please explain fully.
- d. Would you agree that if one starts down the road of thinking about dollars from different mailers differently, such an approach can call into question some of the most basic types of economic analysis that are routinely applied in ratemaking proceedings? If not, please explain fully.

RESPONSE

- a. My concern is the former.
- b. No. The equal markup condition is a required to provide incentives for cost efficiency, not as an end in itself.
- c. No. The restrictions on cross-subsidy also have a role in ensuring productive efficiency by not creating incentives for inefficient entry.
- d. No. As suggested in part (a), such an approach may be required so as to “not preclude subsequent adjustment based on consideration of other factors of the Act.”

USPS/PB-T1-11 On page 49, you note that Ramsey pricing requires demand elasticity estimates, and ECPR pricing does not. Is your point that, for instances in which separate demand elasticities are not routinely estimated (e.g., the 3-digit mail and 5-digit mail in your example on page 48), a substantial hurdle is presented to any attempt to use Ramsey Pricing at that level, or is your point that, even in situations in which the demand elasticity estimates are available, it is better to ignore them and focus exclusively on cost differences at the margin? Please explain fully.

RESPONSE

As a practical issue, I believe there is a substantial hurdle to estimating the demand elasticities for each class, subclass, rate category, and rate element of mail. Given the uncertainties that would be inherent in these estimates, I would prefer to establish prices that one can be reasonably confident will maximize productive efficiency rather than merely attempt to maximize total surplus based upon much less reliable estimates. Also, remember that my testimony focuses on the desirability of applying ECPR at the subclass level, where elasticity differences (and any theoretical gain from applying them to rates) are presumably quite small.

USPS/PB-T1-12 On the top of page 50, you discuss the constantly changing and evolving postal industry, changing worksharing technology, and changing demand elasticities.

- a. Would you agree that changing technologies may cause shifts in demand curves, without necessarily causing material changes in the price elasticities? If not, please explain fully.
- b. If evolving technology is causing changes in demand elasticities, are those not likely to be circumstances in which it is most critical to know the magnitude of the effect that setting discounts at a particular level is going to have on mailers' choices to workshare or not (which is precisely the type of information encompassed in the price elasticities), rather than relying on a procedure which ignores that information? Please explain your answer fully.

RESPONSE

- a. I agree that this is possible, but it is far from certain.
- b. I disagree with the conclusion that applying ECPR to discounts within a subclass need in any sense ignore information about changing demand elasticities. Recall that ECPR relates to differences between rates. Elasticity considerations would still be required to determine the overall rate level of a subclass. And, again, the arguments in my testimony refer to the desirability of a system of cost based discount, not on the practical details of moving toward them from some other system of discounts. (See my answer to USPS/PB-T1-5).

USPS/PB-T1-13 Please refer to page 49 of your testimony. There you indicate that Ramsey Pricing does not automatically ensure that prices are free of cross-subsidization. On behalf of Valpak, witness Mitchell in his testimony in this case makes the same point, but also states that the “argument that cross subsidies are bad and should be avoided is a fairness argument, not an economic one,” and that “[n]othing in notions relating to the efficiency of resource allocation argue that cross subsidies are bad or explain how to avoid them.” VP-T-3 at 10-11. Do you agree with these statements? Are they consistent with your previous testimony on this subject, USPS-T-11 at 8-12 (Docket No. R97-1)? Please explain fully.

RESPONSE

I do not agree with the last quoted statement of Witness Mitchell. As noted above, there is an important economic efficiency reason to avoid cross-subsidization. Cross-subsidization creates incentives for inefficient entry. I do not believe the statement is consistent with my cited prior testimony.

USPS/PB-T1-14 Please refer to page 36 of your testimony, where you state:

The basic theoretical result [of your recent Clean Mail/Dirty Mail paper] was that an efficient allocation of mail processing activity between the Postal Service and mailers requires a worksharing discount equal to the average Postal Service processing cost of the type of mail just at the margin of being profitable for mailers to workshare.

- a. Would you agree that the profitability of worksharing for a specific type of mail is a function of the specific level of the workshare discount, and, therefore, in order to be able to identify the type of mail just at the margin of being profitable for mailers to workshare, it is necessary to have a particular discount in mind already? If not, why not?
- b. Please explain how the theoretical result described above can be practically applied to aid in the determination of the most appropriate worksharing discount.

RESPONSE

- a. Yes.
- b. The theoretical analysis described above establishes the conditions that must be satisfied for a discount to minimize postal sector costs. Given sufficient information about the worksharing cost curves of mailers and the Postal Service, it would be possible to calculate the cost efficient discount. Even with less information, it might be possible to design an iterative procedure that would converge to the desired result. Perhaps the most “practical” application of the analysis lies in understanding why using a “benchmark” mail type such as BMM would not lead to the cost efficient discount.

Efficient Work-Sharing Discounts with Mail Heterogeneity

John C. Panzar

Northwestern University and the University of Auckland

I. Introduction

The United States Postal Service (USPS) induces mailers to perform work-sharing through the use of discounts. That is, mailers perform part of the work involved in the end-to-end mail service and pay less than full price to USPS for completing the job.

Work-sharing is critically important in the United States because it is unlikely for both political and technical reasons that large portions of the market could be liberalized by entry in downstream mail delivery markets. Work-sharing discounts give competitive providers of transportation, sortation, and other non delivery service components access to USPS's natural monopoly delivery network.

Work-sharing discounts are important to the productive efficiency of the postal sector.¹ They account for a sizable portion of the debate in postal rate cases and have been the subject of an extensive theoretical literature. See, for example, Billete de Villemeux et. al. (2003a), (2003b); Crew and Kleindorfer (2002), (2003); De Donder et. al. (2003); Panzar (1993), (2002); Postal Services Commission (2003); and Sherman (2001). The theoretical literature has tended to view work-sharing discounts as part of a larger optimal pricing problem for the postal sector. In particular, much of the analysis has focused upon the extent to which optimal work-sharing discounts should satisfy the Efficient Component Pricing Rule (ECPR).

¹ For a recent discussion of the quantitative importance of work-sharing, see Cohen, et. al. (2006).

In contrast, practical implementation of the theory has tended to be more narrowly focused. The U. S. Postal Rate Commission (PRC) has essentially adopted the policy position that work-sharing discounts should be set equal to the per unit avoided cost of USPS; i.e., according to ECPR (Cohen et al 2006). This means that the focus in rate cases is not the level of any Ramsey-Boiteux style mark-up, but rather determining the magnitude of the unit avoided costs of any particular work-sharing activity. Beginning with the paper by Armstrong et. al. (1996), the theoretical literature has established that work-sharing discounts based upon ECPR do not, *in general*, lead to the maximization of total economic surplus for network industries. Nevertheless, a PRC policy based on ECPR may have substantial merit. This is because, in standard work-sharing models, discounts set on the basis of avoided cost assure that mailers will perform work if and only if they can do it more cost effectively than USPS and that USPS will perform the work if and only if it can do it more cost effectively than the mailers. Thus, discounts comporting with ECPR lead to the lowest combined cost for the postal sector.

This paper develops a theoretical framework for dealing with *mail processing cost heterogeneity*, the major practical problem involved in the implementation of the avoided cost, ECPR methodology for setting work-sharing discounts. Typically, theoretical analysis of work-sharing assumes that mail of a given category has the same avoided cost to USPS.² However, in practice such mail is heterogeneous and would have different

² Sherman (2001) is an exception. He discusses the problems posed by heterogeneity but does not incorporate heterogeneity into his derivation of optimal pricing rules.

levels of avoided cost if it were to be sorted by USPS. What is the appropriate basis for determining work-sharing discounts in this more realistic setting? Advocates of Ramsey-Boiteux pricing would have a straightforward answer: introduce heterogeneity into the model and “grind out” the formulae for the set of (constrained) optimal prices. In contrast, advocates of the avoided cost approach find themselves in a somewhat awkward position. By definition, it is not possible to “set discounts equal to unit avoided cost” because avoided costs vary significantly. Therefore, my theoretical framework adopts the following approach: I introduce mail heterogeneity into the analysis, but replace the infeasible ECPR rule with the development of a discount rule that continues to result in the minimization of postal sector costs, *given* the limitations of a uniform work-sharing discount.

II. Theoretical framework

I analyze a stylized model of the postal sector in which the incumbent USPS possesses a downstream delivery monopoly, but induces senders to perform various upstream activities by offering work-sharing discounts. To simplify the analysis, I assume that these upstream activities consist of a single “sorting” function that can be performed by either USPS or by senders.

A. Mail “types”

Each piece of mail that might *potentially* be submitted for delivery is identified by two characteristics, $(s, t) \in [0, \bar{s}] \times [0, \bar{t}]$. The parameter s measures the cost of sorting that piece of mail if the sorting is done by its sender; either directly or through a consolidator.

The parameter t measures the cost of sorting that piece of mail if the sorting is done by USPS.³ The volume of mail with characteristics (s,t) is assumed to be jointly distributed according to the density function $v(s,t)$.⁴ Let $V(s)$ denote the total volume of mail with self-sorting cost s . That is,

$$(1) \quad V(s) = \int_0^{\bar{t}} v(s,t) dt .$$

B. Postal sector costs

For simplicity, USPS is assumed to provide a single end-to-end service, including both sorting and delivery, at the uniform stamp price p . The incumbent incurs delivery costs of $C_D = F_D + cM$, where F_D and c denote the fixed and marginal costs of delivery, respectively; and M is the volume of mail passing through the postal sector.⁵ More formally,

$$M = \int_0^{\bar{s}} \int_0^{\bar{t}} v(s,t) dt ds = \int_0^{\bar{s}} V(s) ds .$$

³ Here, I have associated the cost parameters with individual *pieces of mail* rather than individual *mailers*. This allows for the possibility that a mailer may choose to work-share a portion of its volume while submitting the remainder to USPS for end-to-end service.

⁴ Note that I have not specified how the volume of mail of various types may depend upon the stamp price or the work-sharing discount. Therefore, v should *not* be viewed as a demand function. Rather, it reflects the joint distribution of the sorting cost characteristics over various individual pieces of mail.

⁵ Since there is assumed to be no delivery bypass, all mail is delivered by USPS.

USPS also incurs upstream sorting costs. I assume that the upstream sorting costs consist of a fixed cost, F_S , and volume variable costs. Most analyses assume that the incumbent's unit sorting cost is the same for all mail types, and thus its volume variable sorting costs are simply a constant times the mail volume sorted. However, the volume variable costs are more complicated when, as in the present analysis, USPS incurs different sorting costs for different types of mail.

To deal with this issue, let $T(s)$ denote the total sorting cost that USPS would incur if it sorted *all* of the mail with self-sorting cost s :

$$(2) \quad T(s) = \int_0^{\bar{t}} tv(s,t) dt .$$

Next, let s_m denote the *threshold* value of self-sorting costs. For reasons that will become apparent, assume that all the mail with self-sorting costs greater than s_m will be sorted and delivered by USPS. Mail with self-sorting costs less than s_m is assumed to be sorted by its sender and presented as work-shared mail to USPS for delivery. Now, the total upstream sorting costs of USPS can be written as:

$$(3) \quad C_S = F_S + \int_{s_m}^{\bar{s}} T(s) ds = F_S + \int_{s_m}^{\bar{s}} \int_0^{\bar{t}} tv(s,t) dt ds .$$

Finally, USPS may incur additional costs, F_N , of operating the postal network that cannot be attributed to either sorting or delivery. I assume that these are mail volume insensitive fixed costs. Thus the total costs of USPS are given by $C = F_N + C_S + C_D$. It is sometimes

useful to let F denote the sum of USPS's fixed costs: i.e., $F = F_N + F_S + F_D$.

The remainder of postal sector costs are sorting costs incurred by senders. For a given value of s_m , the total sorting costs of mail that is sorted by its sender is given by:

$$(4) \quad N_S = \int_0^{s_m} \int_0^{\bar{t}} v(s,t) dt ds = \int_0^{s_m} s V(s) ds .$$

It is now possible to express the total costs of the postal sector as a function of the threshold value s_m . These include the sorting, delivery, and network costs of USPS as well as the sorting costs of mailers:

$$P = C + N_S = F + \int_{s_m}^{\bar{s}} \int_0^{\bar{t}} tv(s,t) dt ds + \int_0^{s_m} \int_0^{\bar{t}} v(s,t) dt ds + cM .$$

Upon substituting in the definitions from equations (1) and (2), this becomes:

$$(5) \quad P = F + \int_{s_m}^{\bar{s}} T(s) ds + \int_0^{s_m} s V(s) ds + cM .$$

C. Cost minimizing work-sharing allocations

Ideally, one would divide up the mail sorting function on a piece by piece basis, allocating those pieces for which $t \geq s$ to senders for sorting and leaving the remainder to USPS. Figure 1 illustrates an efficient allocation of the sorting function. Below the 45-degree line are those pieces of mail which are less costly for USPS to sort. Above the 45-degree line are those pieces of mail that are less costly for senders to sort. The total sorting costs of the postal sector would clearly be minimized if all the mail

above the 45-degree line were sorted by senders and all the mail below the 45-degree line were sorted by USPS.

[Insert Figure 1 about here]

However, work-sharing occurs as a result of the decentralized decisions of individual mailers. In the absence of any work-sharing discount, mailers have no incentive to utilize the work-sharing arrangement. Now suppose that a discount of $\delta > 0$ is offered to mailers that sort their mail before presenting them for delivery. There are now *two* categories of mail to consider. The first category of mail is sorted and delivered by USPS at the uniform stamp price. The volume of this undiscounted mail is the total of all mail for which the cost of self-sorting (s) is greater than or equal to the discount (δ). The senders of such mail will not find work-sharing advantageous, and will continue to offer their unsorted mail to USPS. The second category of mail, in contrast, is sorted by mailers and presented to USPS for delivery. For this category, the mailers find it advantageous to self-sort because the self-sorting cost (s) is less than the discount offered (δ).⁶

⁶ To simplify the exposition, I do not distinguish between customers who actually presort their mail themselves and those who hire outside consolidators to presort it for them. As long as the consolidation market is competitive there is no need to model it explicitly. Presumably, the same characteristics of a customer's mail stream which make it relatively cheap to presort its mail itself, for example, a large volume of computer addressed envelopes, would also make it relatively inexpensive to contract out its presorting tasks. It is these intrinsic features that differ across mailers that the customer specific variable s is designed to capture.

This discount-mediated allocation of sorting activity is illustrated in Figure 2. There, all of the mail types to the right of the vertical line at δ will be sorted by USPS because their self-sorting costs are greater than the discount. Similarly, all of the mail types to the left of the vertical line will be self-sorted by senders because the discount exceeds the sorting costs incurred. Clearly, when a discount policy is used to determine who performs the sorting function, the threshold level of the previous section is determined by the amount of the discount: i.e., $\delta = s_m$.

[Insert Figure 2 about here]

Figure 3, which is the overlay of Figures 1 and 2, allows one to see the tradeoffs involved in choosing an appropriate level of the discount used to induce work-sharing. The 45-degree line of efficient choice and the vertical line at δ that determines the sorting split under a discount policy divide the $\{s, t\}$ rectangle into four regions. Regions A and D consist of those mail types which receive an efficient sorting allocation. In Region A, $t > s$ and $\delta > s$. Senders choose to do the sorting, as required for efficiency. In Region D, $t < s$ and $\delta < s$. The self-sorting costs are higher than both the discount and the sorting cost that would be incurred by USPS. Thus mailers choose not to self-sort, and mail is sorted by USPS, as required for efficiency. However, mail types in Regions B and C are inefficiently sorted. In Region B, $t < s$ and $s < \delta$. Mail in Region B would be most efficiently sorted by USPS, because $t < s$. But, the self-sorting cost is also low relative to the discount ($s < \delta$) and senders are induced to self-sort. In Region C, $t > s$ and $s > \delta$. The sorting costs of USPS are high relative to the costs of self-sorting and it would be

efficient for senders to self-sort. However, the discount is low relative to the self-sorting costs, and insufficient to induce senders to do the sorting. The tradeoffs involved in determining the work-sharing discount are now evident. Increasing the discount increases the sizes of Regions A (good) and B (bad), while decreasing the sizes of Regions C (good) and D (bad). Put simply, a higher discount increases the amount of mail that is work-shared but should not be, while a lower discount discourages senders from work-sharing mail that should be.

[Insert Figure 3 about here]

The mathematical formulation of the previous section allows me to characterize the resolution of the tradeoffs in (relatively) simple terms. Work-sharing discounts induce a sorting threshold of $s_m =$. Therefore, it is possible to characterize a discount level that leads to a threshold that minimizes the total costs of the postal sector by minimizing P with respect to s_m . The Necessary and Sufficient Conditions for a (local) minimum to occur at a positive threshold level are given by:

$$(6) \quad \frac{P}{s_m} = T(s_m^*) + s_m^* V(s_m^*) = 0 \quad s_m^* = \frac{T(s_m^*)}{V(s_m^*)} A(s_m^*).$$

and

$$(7) \quad \frac{\partial^2 P}{\partial s_m^{*2}} = T'(s_m^*) + s_m^* V'(s_m^*) + V(s_m^*) > 0 \quad A'(s_m^*) < 1.$$

Equation (6) establishes the important result that the threshold level that

minimizes the sorting costs of the postal sector equates the self-sorting cost of senders, s_m^* , to USPS's average cost of sorting mail of that type, $A(s_m^*)$. This "rule" makes intuitive sense. At any other threshold value (i.e., $s_m \neq A(s_m)$), the postal sector sorting costs can be reduced by either raising or lowering the threshold value. For example, for a threshold level $s_m < A(s_m)$, the postal sector sorting costs can be reduced by increasing the threshold value. This is because raising the threshold induces senders to sort mail that would otherwise be sorted by USPS but should be sorted by the senders because the self-sorting costs are lower than the average USPS sorting costs. In contrast, at a threshold value $s_m > A(s_m)$, lowering the threshold level would lower the postal sector sorting costs by discouraging the senders from sorting mail that should be sorted by USPS because it would cost USPS less on average to sort mail of these types. Therefore, $s_m = A(s_m)$ must hold at the cost minimizing sorting threshold. Figure 4 illustrates this argument. It is similar to Figures 1-3 except that per unit sorting costs (i.e., s and $A(s)$) are plotted on the vertical axis. The cost minimizing threshold level, s_m^* , occurs at the intersection of the $A(s)$ curve and the 45-degree line.

Equation (7) states the Second Order Condition sufficient for a (local) minimum. It requires that the average USPS sorting cost curve $A(s)$ intersect the 45-degree line *from above*. The import of this requirement can also be illustrated using Figure 4. Clearly, raising the threshold value above s_m^* would increase the postal sector sorting costs by inducing senders to self-sort mail that *should be* and would otherwise be sorted by USPS because it is less costly for USPS to sort (i.e., $A(s)$ lies below the 45-degree line).

Likewise, lowering the threshold value below s_m^* would increase the postal sector costs as well, but by discouraging the senders from sorting mail that *should be* and would otherwise be sorted by them because it is less costly to self-sort (i.e., $A(s)$ lies above the 45-degree line). Therefore, the Second Order Condition in (7) guarantees that s_m^* is a (local) minimum. In summary, postal sector sorting costs are minimized when the self-sorting threshold type is set equal to the average USPS sorting costs for mail of that type, *and* USPS average sorting cost curve intersects the 45-degree line from above.

[Insert Figure 4 about here]

III. Toward application: discounts based upon the avoided costs of “benchmark” mail types

The issue of mail processing cost heterogeneity is not new to USPS, the Postal Rate Commission, or Rate Case interveners. All routinely struggle with defining the appropriate measure of avoided cost to use as the basis of work-sharing discounts. In this section, I will attempt to relate portions of this ongoing debate to the theoretical analysis presented above. For purposes of this discussion, I assume that mail that is more costly to self-sort is, on average, also more costly for USPS to sort: i.e., $A(s) > 0$.

Haldi and Olson (2005) argued that the Postal Rate Commission has established work-sharing discounts that are too low because they are less than the average cost incurred by USPS on all its upstream functions. My analysis shows that this argument is incorrect. The discount that induces a cost-minimizing division of sorting activity equates self-sorting costs to the average USPS cost of the mail on the *margin*: i.e., mail

for which the sender is indifferent between self-sorting and not. As long as average USPS sorting costs increase with self-sorting costs, the *average* USPS sorting costs for *all* mail receiving end-to-end service will be higher than the work-sharing discount. This point can be illustrated using Figure 5. Suppose that the work-sharing discount is set at $= s_m^*$, so that there is a cost-minimizing allocation of sorting activity. Clearly, the average USPS sorting cost of mail receiving end-to-end service would be greater than $= s_m^*$ because the level of the average USPS cost curve $A(s)$ lies above s_m^* for all mail submitted to USPS for sorting.

[Insert Figure 5 about here]

On the other hand, the benchmarking methodology proposed by USPS in R2005 would seem to result in a benchmark mail type that is too “clean,” and a benchmark unit cost that is too low. USPS proposed using bulk metered mail (BMM) letters⁷ as the cost avoidance benchmark for most First-Class Mail pre-sort letters because it believes that BMM is the most likely mail to convert to work-sharing.⁸ That is, USPS proposed to use the type of mail *most likely to be work-shared* as the “benchmark” from which to

⁷ For the purposes of computing cost avoidances, BMM letters are “generally considered to be ‘clean,’ machinable, homogeneous, non-barcoded mail pieces with machine printed addresses that are entered, properly faced, in trays.” MMA/USPS-T21-7.

⁸ PRC, Docket R2005, USPS-T-21, page 11 at 22-25.

calculate the costs savings of USPS.⁹ It is not entirely clear what the term “most likely to be work-shared” would mean in the context of the theoretical model presented above, but, such mail would presumably have self-sorting costs lower than s_m^* , the mail type at the work-sharing margin. From Figure 5, we see that the average USPS cost of sorting mail of type $s (< s_m^*)$ is $A(s)$. As long as $A(s)$ is increasing in s , we have $A(s) < A(s_m^*) = s_m^*$. The average sorting costs of “most likely to be work-shared” mail would be lower than s_m^* as well. Thus the discounts based on the sorting costs of “most likely to be work-shared” mail would lead to a level of work-sharing discounts that is lower than the discount that induces a cost-efficient allocation of sorting activity.

The recent paper by Cohen et. al. 2006 comes closer to the correct conclusion. On pages 149-50, they present an example in which they assume that non work-shared mail costs an average of 23 cents for USPS to sort, transport and deliver, while a *subset* of that mail with characteristics similar to work-shared mail (non-work-shared bulk) costs 20 cents, and work-shared mail costs 15 cents. Next, they demonstrate that a discount equal to the 8 cent cost difference between work-shared and non work-shared mail would not encourage the most efficient behavior.

They illustrate this possibility by considering the case of a hypothetical mailer of bulk non work-shared mail for whom it costs 7 cents to do the work needed to qualify for the 8 cent discount. Such a mailer would have an incentive to work-share, gaining 1 cent

⁹ PRC, Docket R2005, USPS-T-21 page 3 at 1-5.

per piece. Cohen et. al. correctly point out that, as a result, the total cost to society of the mail increases from 20 cents per piece, USPS cost, to 22 cents per piece, 15 cents incurred by USPS plus 7 cents incurred by mailer. Their example effectively refutes the argument of Haldi and Olson. In addition, they claim that the mailer incentive problem would be solved in their example by using a discount equal to 5 cents, the costs saved by USPS when processing work-shared bulk rather than the “clean” non work-shared bulk. However, this is not the case. Consider another hypothetical mailer whose profile exactly matches the average for USPS: i.e., only 5% in trays, 10% handwritten, and 2% non machine-able. Yet suppose that, say, through updating its computer system, this mailer can also satisfy the requirements for a work-sharing discount for *all* his mail at an average cost of 7 cents per piece. Clearly, it would be socially efficient if he did so: an 8 cent discount would induce him to work-share, a 5 cent discount would not.

Cohen et. al. are certainly correct in concluding that “If the cost differences within non-workshared mail are to be addressed, it should be through other rate elements. For example, non-machinable mail is currently subject to a surcharge and it would be possible (though unlikely) to impose an additional surcharge on mail with handwritten addresses to reflect the additional cost of processing it.” However, if such remedies are not available in practice, the solution to the benchmarking problem *must* involve a tradeoff. It is simply not the case that the use of the “correct” benchmark to establish avoided costs will result in perfectly efficient sorting decisions. The theoretical analysis shows that using discounts to induce an allocation of sorting activity will generally lead to two kinds of inefficiencies: some mail will be work-shared even though its costs are

too high; the senders of other mail will inefficiently choose not to work-share. The best that can be attained is to balance these inefficiencies so that postal sector sorting costs are as low as possible.

IV. Caveats and conclusions

There are important limitations to the above analysis, primarily because I have largely ignored the demand side of the market. The minimization analysis, does indeed, characterize the only discount policy that will lead to a cost minimizing allocation of sorting activity *for the resulting mail volumes*. However, in general, work-sharing discounts will typically *increase* mail volumes.¹⁰ Therefore, while the sorting costs associated with the volumes resulting from setting a discount of $\delta > s_m^* = A(s_m^*)$ will not be minimized, the total mail volume (and, presumably, benefits) will be greater. As mentioned at the outset, one way to proceed would be to carry out a full scale Ramsey-Boiteux pricing analysis. However, the likely outcome of that would be a complicated set of equations yielding results highly dependent upon unknown (and perhaps unknowable) demand elasticities. An alternative, intermediate approach might be to characterize the optimal *unconstrained* surplus maximizing prices. (In the homogeneous mail case, this problem has as its solution the avoided cost, ECPR work-sharing

¹⁰ See, for example, the work-sharing demand systems developed in Billette de Villemeur, et. al. (2003a) or in Panzar (2005).

discount.) This would establish (an almost) cost based benchmark for policy consideration.¹¹

I shall conclude by summarizing the results of the preceding analysis of work-sharing discounts. In the presence of heterogeneity of USPS mail processing costs, *any* discount policy will lead to *some* mail being processed inefficiently. On the one hand, a discount equal to the average processing cost of mail *actually* processed by USPS is too high to result in an efficient allocation of mail processing activity. Alternatively, a discount based upon the avoided cost of mail *most likely to be work-shared*, is likely to be too low to result in an efficient allocation of mail processing activity. An efficient allocation of mail processing activity between the USPS and mailers requires a work-sharing discount equal to the average USPS processing cost of the *marginal* mail type.

¹¹ Either approach would require explicit modelling of mail demand. I suggest the following reasonably general formulation. Let $f(s,t)$ denote a function measuring the underlying distribution of mail with the self-sorting costs s and Postal Service sorting costs t . Let $D(\cdot)$ be a common measure of the number of pieces of mail associated with a “full mailing cost” equal to \cdot . For end-to-end mail, this is just the stamp price. For work-shared mail, however, the full mailing cost is the stamp price *less* the work-shared discount, *plus* the self-sorting cost: $v = p - d + s$. That is, $v = \min \{p, p - d + s\}$. Then, for end-to-end mail, $v(s,t) = D(p)f(s,t)$, while, for work-shared mail, $v(s,t) = D(p - d + s)f(s,t)$.

References

- Armstrong, Mark, Chris Doyle and John Vickers. 1996. "The Access Pricing Problem: A Synthesis." *Journal of Industrial Economics* 44: 131-150.
- Billete de Villemeur, E., H. Cremer, B. Roy and J. Toledano. 2003a. "Optimal Pricing and Global Price Cap in the Postal Sector," *Journal of Regulatory Economics* 24: 49-62.
- Billete de Villemeur, E., H. Cremer, B. Roy and J. Toledano. 2003b. "Access and (Non-) Uniform Pricing in the Postal Sector." In *Competitive Transformation of the Postal and Delivery Sector*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.
- Cohen, Robert H., William W. Ferguson, John D. Waller and Spyros S. Xenakis. 2002. "Impacts of Using Worksharing to Liberalise a Postal Market." In *Liberalisation of Postal Markets*, edited by Gabrielle Kulenkampff and Hilke Smit. Bad Honnef: WIK.
- Cohen, Robert H., Matt Robinson, John Waller and Spyros Xenakis. 2006. "Worksharing: How Much Productive Efficiency? At What Cost? At What Price?" In *Progress Toward Liberalization of the Postal and Delivery Sector*, edited by Michael A. Crew and Paul R. Kleindorfer. Springer.
- Crew, M. A. and P. R. Kleindorfer 2002. "Balancing Access and the Universal Service Obligation." In *Postal and Delivery Services: Delivering on Competition*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.
- Crew, M. A. and P. R. Kleindorfer 2003. "Access and the USO for Letters and Parcels." In *Competitive Transformation of the Postal and Delivery Sector*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.
- De Donder, Philippe, Helmuth Cremer, Jean-Pierre Florens, André Grimaud and Frank Rodriguez. 2001. "Uniform Pricing and Postal Market Liberalization". In *Future*

Directions in Postal Reform, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

De Donder, Philippe, Helmuth Cremer, Jean-Pierre Florens, André Grimaud and Frank Rodriguez. 2003. "Access Pricing and the Uniform Tariff in the Postal Sector". In *Competitive Transformation of the Postal and Delivery Sector*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Haldi, John and W. J. Olson. 2003. "An Evaluation of USPS Worksharing: Postal Revenues and Costs From Workshared Activities. In *Competitive Transformation of The Postal and Delivery Sector*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston: Kluwer Academic Publishers.

Panzar, J. 1993. "Competition, Efficiency, and the Vertical Structure of Postal Services." In *Regulation and the Evolving Nature of Postal and Delivery Services: 1992 and Beyond*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Panzar, J. 2002. "Reconciling Competition, Downstream Access and Universal Service in Postal Markets." In *Postal and Delivery Services: Delivering on Competition*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Panzar, J. 2005, "Combining Liberalization and Unbundling Policies in Postal Markets," paper presented at 13th CRRRI Postal Conference, Antwerp Belgium. Available on Conference CD.

Postal Services Commission. May 2003. *Notice of a Proposed Direction on Downstream Access, by UK Mail, to Royal Mail's Postal Facilities: Reasons*. London.

Sherman, R. 2001. "Optimal Worksharing Discounts," *Journal of Regulatory Economics*, 19 1: 81-92.

United States Postal Rate Commission, Docket R2005, USPS-21.

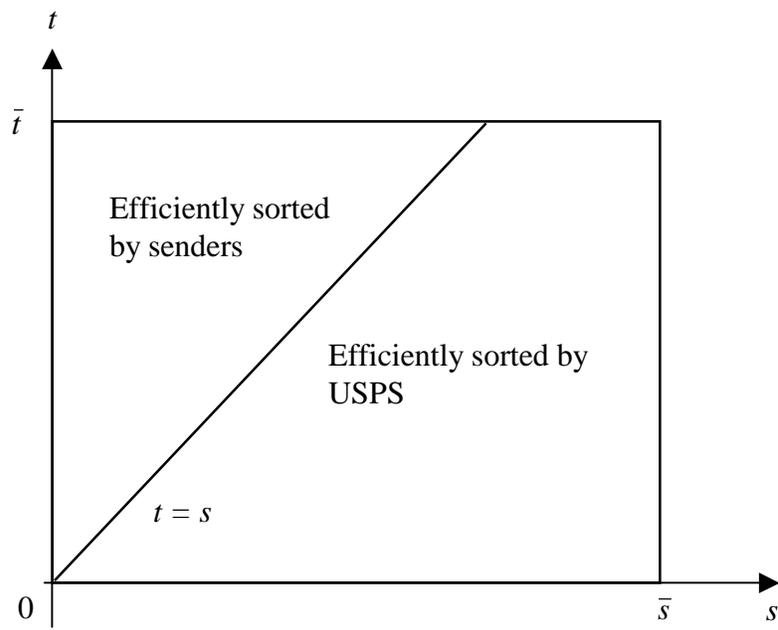


Figure 1: Efficient sorting allocation

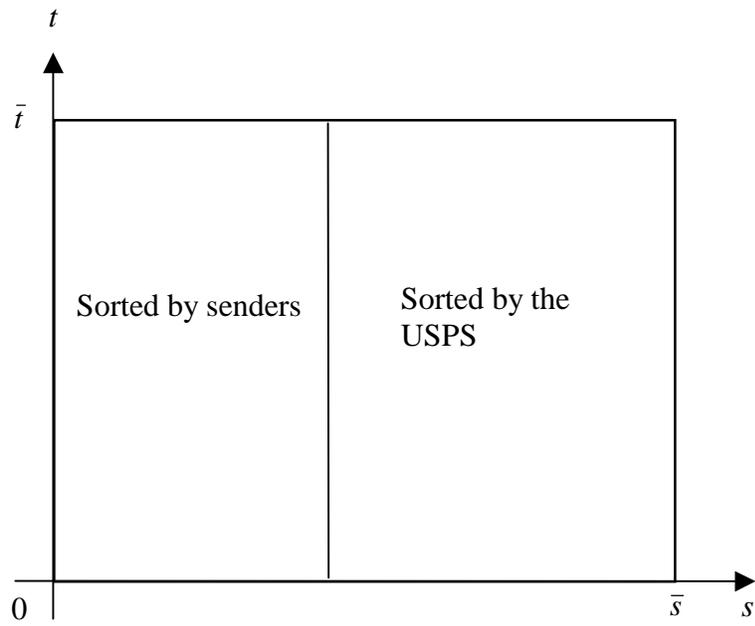


Figure 2: Sorting allocation resulting from work-sharing discount

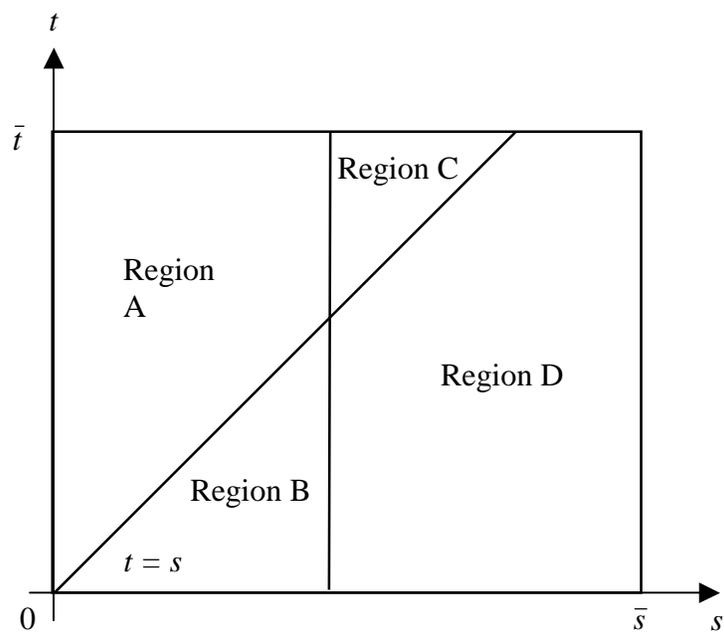


Figure 3: Tradeoffs

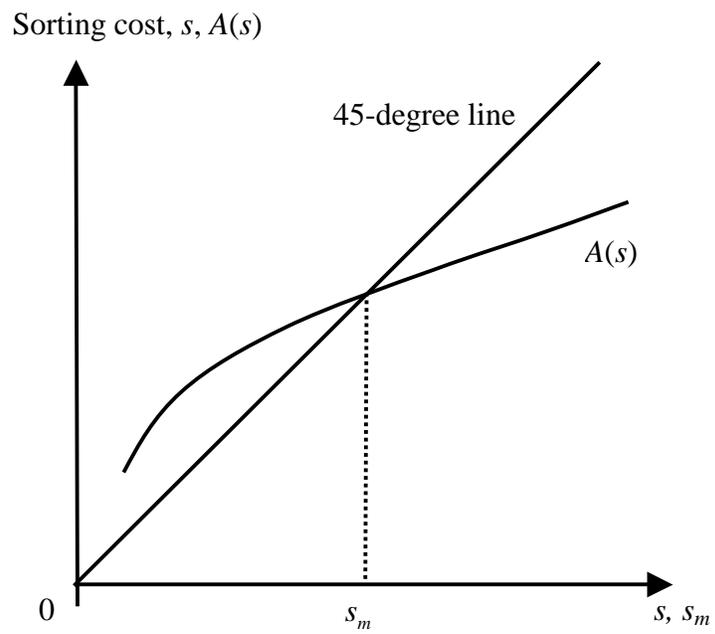


Figure 4: Cost minimizing self-sorting threshold

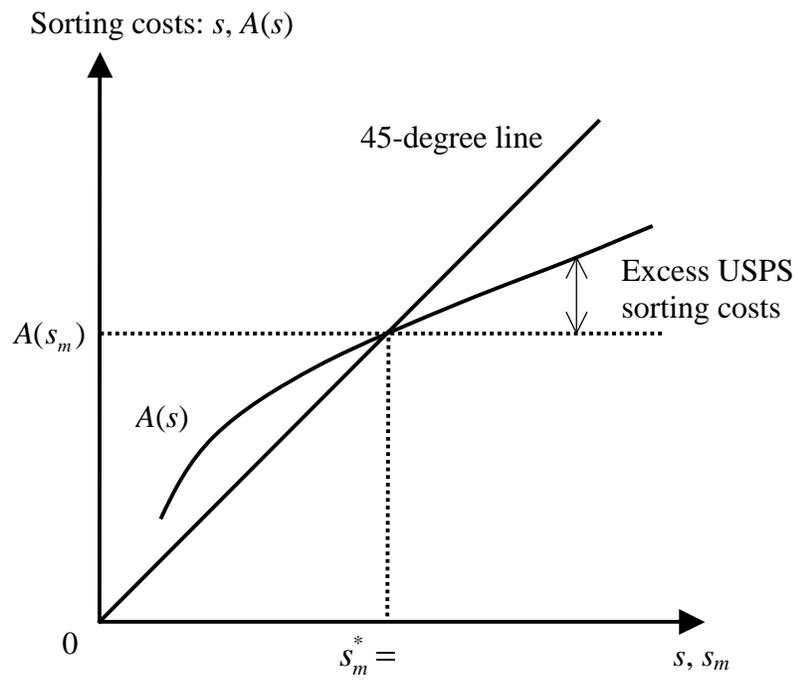


Figure 5: AC of USPS exceeds efficient discount