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Evaluating the Effects of Reductions in the Quality of Postal Services

Edward S. Pearsall and Charles L. Trozzo[*]

[*] Both authors are economists. Edward S. Pearsall is a self-employed consultant for the U.S. Postal Regulatory Commission. Charles L. Trozzo is a consultant with Charles River Associates. Edward S. Pearsall is the corresponding author. His web address is espearsall@verizon.net. The views expressed in this paper are solely attributable to its authors.

1. Introduction

As mail volumes have contracted during the global recession, national postal services have explored measures to cut costs by reducing the quality of service, primarily by decreasing the weekly frequency of deliveries. Cohen and McBride (2009), Cohen *et al* (2010), and IBM Global Business Services (2008) have all estimated the savings from reducing the frequency of delivery for the U.S. Postal Service (USPS) as part of larger studies of the costs of elements of the Universal Service Obligation (USO) using the "profitability" definition. This definition equates the cost of the USO to the difference in a national post's profit with and without it.[2] On March 30, 2010 USPS filed for an advisory opinion from the PRC as a preliminary to a request to the U.S. Congress for permission to eliminate Saturday carrier deliveries starting in 2011 (USPS 2010c and 2010d).

National posts within the European Union (EU) have an added incentive to explore the effects of reductions in service. The most recent postal directive of the EU allows its member governments to compensate their national posts, following full market opening in 2011, for losses incurred to provide service under the EU's USO.[3] This has led to a number of studies of the prospective costs of the elements of the USO. Boldron *et al* (2006) and, more recently, Borsenberger *et al* (2010) have applied the profitability definition to make estimates of the costs of various reductions in the weekly frequency of delivery service for EU member states and others, including the U.S.

All of the studies cited above proceed from conjectures with respect to the demand effects that would result from reductions in the frequency of delivery service. Although the cost estimates depend critically upon these conjectures, there is little agreement regarding the likely magnitude of the demand effects. IBM Global Services acknowledged the existence of demand effects but treated them as negligible. Cohen and McBride, and Cohen *et al* assumed that the elimination of Saturday deliveries would cause a two percent loss in mail volumes across all categories of mail; that delivery four

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[2] This is not the only way to define the cost of the USO and it is not the most appropriate definition for comparing the welfare benefits and costs of universal service. See Cigno *et al* (2010) for a critique of the profitability definition.

[3] See Borsenberger *et al* (2010) for a discussion of Article 7.3 of the Third European Postal Directive.

days a week would reduce volumes by five percent; and that deliveries three days a week would cause volume losses of between six and ten percent. Boldron *et al* assume a "loss of traffic" of 15 percent in areas where deliveries are reduced from five to three times a week; and a loss of 20 percent where the reduction is from six to three times a week. Borsenberger *et al* hedged by considering "low", "medium" and "high" "demand scenarios" in which the losses ranged from zero to eight percent for delivery frequencies that descended from six or five times a week to between five and three times a week. USPS relied on a survey of mailers made by the Opinion Research Corp. for estimates of demand effects in its recent filing with the PRC. The overall change in volume "if five-day delivery had been implemented in FY 2009" was estimated at -0.70 percent.

In this paper we adapt conventional econometric curve-fitting to the task of statistically estimating the effects on mail volumes of changes in the qualitative aspects of postal service. Our method relies on a previous finding by Fenster *et al* (2006) that the U.S. postal tariff can be accurately represented by a hedonic price equation (HPE) fit to postal rates over the entire range of U.S. mail service categories. The HPE relates postal rates to indexes of several qualitative properties of the mail, including the time to delivery. It enables us to convert changes in the indexed qualitative properties of the mail into equivalent changes in postal rates. The demand effects of the rate changes can then be estimated using an appropriate econometric demand model relating postal volumes to rates. This method for estimating the demand effects of reductions in service quality should be feasible, not only for USPS, but for any national post whose tariff can be represented by an HPE, and whose volumes have been fitted econometrically to demand equations.

The overall logic of our method is described graphically in Section 2. In the remaining sections of the paper we demonstrate the method by estimating the effects that reductions in the frequency of delivery would have had on USPS volumes, revenues and costs in FY 2009. We assume that the delivery frequency would be reduced to five days-a-week by eliminating Saturday deliveries, and that further reductions would be made by staggering the days when each route is served so that an equal number of routes are served each day from Monday through Friday.

Reducing frequency reduces the cost of delivering a given volume of mail primarily because of route-level economies of density and because part of the cost of servicing a route (e.g. transportation costs) is mostly unrelated to volume. When the frequency of service is reduced the volume of mail is increased each time a route is served but the route is served less often. The volume-variable costs of delivering a given quantity of mail during the week are mostly unaffected by the rescheduling, but the fixed costs are incurred only on the days when the route is actually served. The relaxed delivery schedule may also promote secondary economies in transportation, processing, window service and other postal functions.

However, there are two effects that offset the reduction in cost. First, a postal route must usually be served by a postal carrier working normal hours in a single business day. This constraint, which has mostly been overlooked by previous studies, would require USPS to increase the number of routes in its delivery network as part of any efficient plan to reduce the frequency of delivery. Second, postal customers would respond to slower delivery service in a way that is equivalent to the demand response to an increase in postal rates. They would reduce their use of the post.

In Section 3 we exhibit the HPE as a restricted trans-log fit to the average USPS tariff in FY 2009. Delivery time elasticities from this HPE are matched to a set of estimates of the own-price elasticities of postal demands by subclasses to derive elasticities of demand with respect to delivery time. These elasticities show that the expedited categories of mail such as Express, Priority and First-Class are generally the most vulnerable to changes in delivery time.

In Section 4 we explore incremental reductions in the weekly frequency from six days-a-week down to one day-a-week service to each address receiving city carrier or rural carrier delivery service in FY 2009. All of our cases assume that when Saturday deliveries are eliminated, the expedited Saturday mail would be delivered on the next day each route is served. The delivery of un-expedited mail would be rescheduled to equalize daily carrier hours. USPS would avoid peak load problems by redistributing the un-expedited mail to smooth the daily delivered volumes from Monday through Friday.

We project average daily volumes without demand effects, with un-averaged demand effects and with averaged demand effects. The un-averaged effects approximate the responses of mailers who can predict the specific delivery delays for their mailings, while the averaged effects apply if mailers are only aware of a general slowdown in service.

In Section 5 we consider how USPS would reconfigure its delivery network to compensate for increases in volumes per delivery point and changes in the composition of the mail stream. A simple econometric model was fit to historical data and used to predict the number of city carrier and rural carrier routes that USPS would add to its delivery network. These models reveal, not just that the overall number of routes would increase, but that the composition of the delivery network would shift from city to rural carrier routes.

Estimates of volumes, routes, revenues, costs and savings for the various reductions in delivery frequency are presented in Section 6. USPS costs are estimated by applying the PRC's cost model at the route level as described previously in Cigno *et al* (2010). For this application city routes and rural routes are grouped by type, and delivery costs are obtained by scaling the cost for the average route of each type.

Our results tend to confirm assumptions that the overall effect on USPS volumes of reducing service would, at first, be small. Eliminating Saturday deliveries has a unaveraged demand effect of -0.75 percent for all categories of mail and services combined.[4] This is quite close to the recent USPS survey-based estimate of -0.70 percent (USPS 2010d). But we have also found that the demand effects would escalate rapidly as further reductions are made in weekly deliveries. Furthermore, the demand effects are very unequally distributed among the different categories of mail. Elimination of Saturday deliveries would change volumes by about -11.9 percent for Express mail, -9.6 for Priority mail and -8.6 percent for Parcel Post, while the demand effects are only -1.23 percent for Standard ECR mail, for 0.6 percent for Standard Regular mail and -0.50 percent for Periodicals.

Our prediction of the FY 2009 cost saving to USPS from eliminating Saturday deliveries is about $2.28 billion per year without demand effects, and about $2.03 billion with demand effects. These numbers fall close to comparable estimates made by USPS

[4] This percentage is the volume-weighted average of "unaveraged" demand effects for five days-a-week delivery from Table 6.

(2010d) of $3.3 billion and $3.1 billion. The USPS estimates include $0.6 billion in indirect savings from mail processing, transportation, post office operations etc. that we have omitted.[5] The remaining difference is mostly explained by an assumption, implicit in USPS calculations, that the numbers of city and rural carrier routes is fixed.

Finally, the delivery frequency that would maximize USPS net revenue is quite low – two deliveries per week. This frequency is lower than the frequency of three days-a-week that other researchers have commonly used as the counterfactual for profitability measurements of the cost of the USO. When a two days-a-week delivery frequency is used to measure the added cost to USPS of delivering six days-a-week in FY 2009, this cost is around $7.7 billion.

2. The General Idea

Our method for predicting the demand effects from a reduction in the quality of postal service is illustrated in Figures 1-3. We begin with an HPE representing the average FY 2009 USPS postal tariff. Since postal rates are administered prices, the HPE is just an analytic representation of the tariff (see Fenster *et al* 2006). It relates the postal rate for an individual piece of mail to variables that index the hedonic properties of the piece such as its shape, weight, automation prep, presort level, destination entry, distance transported, delivery time and so on.

Figure 1 illustrates how the postal rate for a weighted average piece of U.S. mail varies along the HPE for FY 2009.[6] For example, the red curve in Figure 1 reveals that U.S. postal rates vary almost linearly with weight per piece except for very light pieces. Also, the average piece is at the very low end of the weight spectrum (about 6 oz). This point is located by the box on the red curve. The green line exhibits the distance taper of rates with respect to the distance the average piece is transported. The black curve for delivery time relates revenue per piece to an index of the speed of service. This index is the number of days from origin to destination for a piece traveling the same distance as

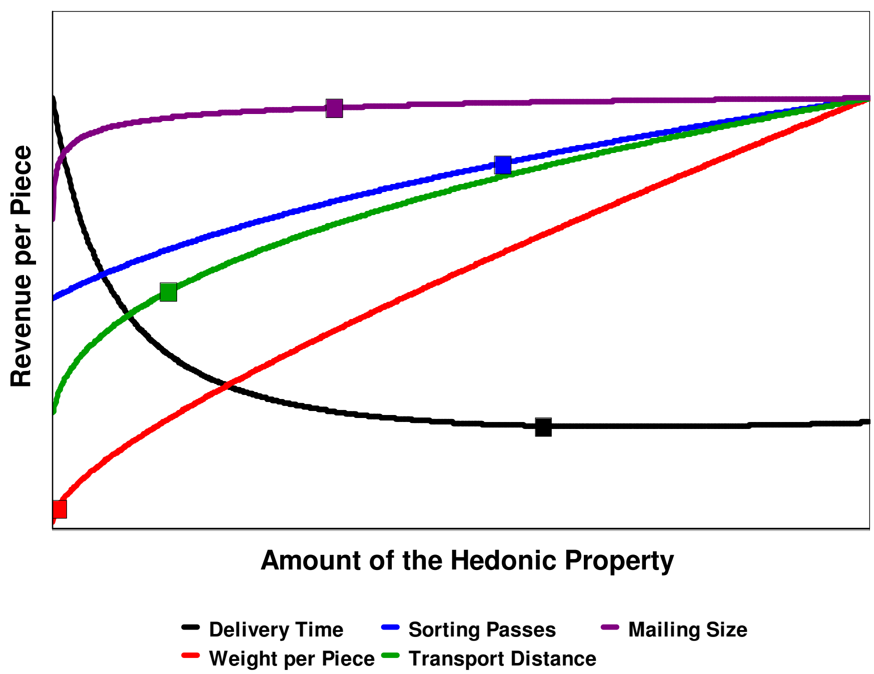
[5] In addition to halting Saturday carrier deliveries, USPS assumes that there will be no street (blue box) collection, no outgoing mail processing and no transportation of the mail on Saturdays. These curtailments are mostly responsible for their estimated indirect savings. USPS plans to continue deliveries of box mail and window service on Saturdays.

[6] The curves in Figure 1 are drawn to different scales so they should not be directly compared.

an average piece of First-Class mail (about 575 miles). The postal rate decreases sharply at first as we progress from overnight delivery of Express mail on the far left to less expedited services like Priority and First-Class. The curve eventually flattens out so that there is little reduction in revenue per piece as we reach un-expedited services on the far right such as Standard mail and Package Services.

The HPE for the FY 2009 tariff reappears in Figure 2 as the curve labeled "status quo". When Saturday deliveries are discontinued the HPE shifts to the right by a uniform amount equal to the average increase in delivery time. The average increase is 0.43 days, so the red curve which represents the HPE for five days-a-week deliveries is just the black curve shifted 0.43 days to the right. The other curves continue the progression of shifts in the HPE for four, three, two and one day-a-week delivery frequencies.

Figure 1: Revenue per Piece versus Hedonic Properties
Weighted Average Piece of U. S. Mail
(Box Located at the Average Amount of the Hedonic Property)

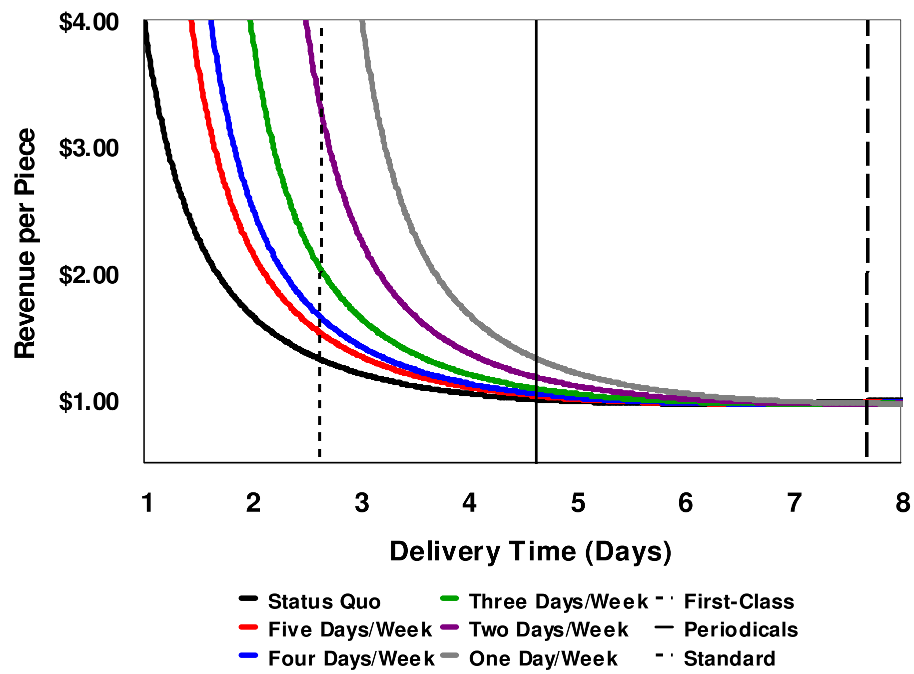


The shifted HPEs in Figure 2 show that increases in delivery times have effects that are equivalent to rate increases of different magnitudes for the established categories of mail. The vertical lines in Figure 2 are located at the average delivery times for the three largest classes: First-Class (2.9 days), Periodicals (4.6 days) and Standard mail (7.7

days). As the HPE shifts to the right it intercepts these vertical lines at successively higher revenues per piece. These higher revenues per piece are the higher prices that postal customers in each class would have to pay to buy back their original average speed of service.

Our method presumes that postal customers can choose their speed of delivery by making service choices that move them along a continuous HPE. At first glance this assumption may seem fanciful since the FY 2009 tariff did not offer mailers a series of nearly seamless choices of delivery times for individual pieces as it did for other hedonic properties such as weight per piece. Nevertheless, mailers collectively are able to continuously vary the delivery time of components of the mail stream by varying the proportions of mail sent with different speeds of delivery. For example, as a group First-Class mailers can buy back the loss of 0.43 days by sending as Priority mail and single-piece a proportion of the pieces formerly sent as First-Class and at the presort rate.

Figure 2: Revenue per Piece versus Delivery Time
Weighted Average Piece of U. S. Mail
Curve Shifts for Number of Weekly Delivery Days



The HPE is a convex function with respect to delivery time. This makes the equivalent rate increase for a mail category with a short delivery time larger than the rate increase for a mail category that USPS takes longer to deliver. Borsenberger *et al* (2010) point out that "the loss of demand will be primarily the 'higher-price' items (urgent mail) as opposed to 'lower-price items' (non-urgent mail or direct mail)". This effect can be seen easily in Figure 2. The curve shifts cause rate increases for First-Class (urgent mail) that are larger than those for Periodicals (non-urgent), which are larger than those for Standard mail (direct). In fact Figure 2 suggests that the equivalent rate increases for Standard mail are negative but very close to zero.

Figure 3: Predicting the Volume Response to a Delivery Delay of One Day

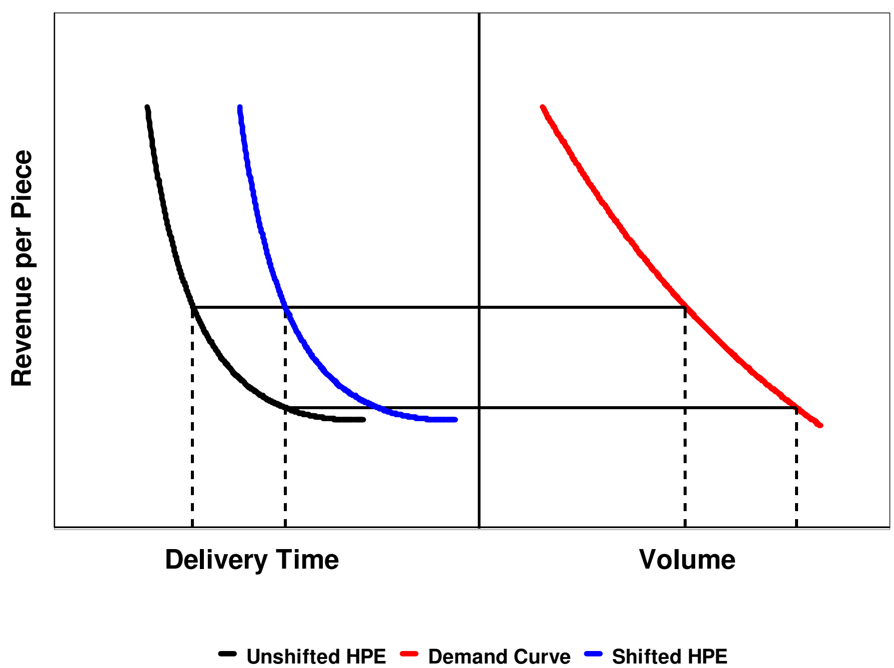


Figure 3 shows that the demand effects from a reduction in service quality are identical to the effects from an equivalent rate increase. In the left-hand panel the HPE has been shifted to exhibit the equivalent rate increase from a one-day increase in delivery time. The black curve is the HPE before an assumed reduction in delivery service increases the average delivery time by one day. The blue curve is the black curve shifted to the right a uniform horizontal distance of one day. The equivalent price increase can be found in two ways. First, the increase can be found by determining the higher price that must be paid to obtain the same service. This is done by observing the higher price for the same service on the blue curve. Second, it can be found by moving backwards up the un-shifted HPE. In Figure 3 we move leftward along the black curve a horizontal distance equal to one day.

The right-hand panel displays the demand curve for the postal service. Horizontal lines have been drawn across from the left to the right panel at levels corresponding to the prices before and after the equivalent rate increase. The vertical lines in the right-hand panel have been dropped from the points of intersection with the demand curve. These vertical lines mark on the horizontal axis the volumes of mail before and after the equivalent rate increase. The drop in volume shown in Figure 3 is the predicted demand response to a delivery delay of one day.

3. The Hedonic Price Equation

Previous research by Fenster *et al* (2006) demonstrated that the U.S. postal tariff can be approximated by an econometrically fit HPE. Their research identified the essential hedonic properties reflected in all USPS tariffs since 1972, explored alternative indexes and other variables to measure these properties, and econometrically fit every USPS tariff from 1972 to 2006 with high accuracy using an HPE in the form of a restricted trans-log. We have followed but refined Fenster *et al*'s method to fit an HPE to the average USPS tariff in FY 2009.[7] The results are shown in Appendix Table 1.

Following Fenster *et al* we have fit the HPE to rates with the margin on attributable cost removed. When fit in this way, the HPE for an ideal tariff would replicate USPS attributable costs per piece as a function of the indexes of the hedonic properties and other variables. The sample consists of a large cross-section of pieces of mail that are treated distinctly under the FY 2009 postal tariff, *e.g.*, First-Class Single-Piece QBRM letters weighing between 0.0 and 0.5 ounces. All categories of mail except USPS Penalty mail, Free-for-the-Blind mail and International mail are represented in the sample. The principal sources for the rates and other data are the most recent rate history (USPS 2009a) and billing determinants (USPS 2009b). Some information was also

[7] For most categories of mail there were two postal tariffs in FY 2009 - usually for the two periods from 10-01-2008 to 05-11-2009 and from 05-11-2009 to 09-30-2009. Average revenue per piece was used as the rate wherever revenue and volume data were available for the year; otherwise, the rate was assumed to be the time-weighted average of the rates in the two tariffs.

extracted from older sources cited in Fenster *et al.* Altogether, the sample comprises 2279 observations of mail categories with non-negligible volumes during FY 2009.

The hedonic indexes used to fit the HPE are: weight per piece in ounces, the number of sorting passes remaining to be made by USPS mail processing before delivery, distance transported in miles, service measured as origin-to-destination delivery time over a standard distance, and an index of postal customers' size. The other variables consist of a set of dummy variables for piece shape (letter, card, flat, parcel or small parcel), dummy variables for shape-related characteristics of the piece (non-machinable, balloon parcel, oversized parcel), variables related to the entry and/or processing characteristics of the piece (automation-ready, destination entry, zoned rate, within-county rate, palletized and classroom rate), and variables that identify special properties of the service or tariff (sealed from inspection, commercial rate, competitive (versus market-dominant) mail, negotiated service agreement (NSA), parcel return service). All of the variables were mean-centered using FY 2009 volume-weighted sample averages prior to the fit. The trans-log was fit after taking natural logarithms of revenue per piece and of the hedonic indexes. All of the variables appear in the trans-log equation in un-interacted form. The trans-log also includes cross-products constituting a complete set of interactions between the hedonic indexes. Cross-product terms for the hedonic indexes and the other variables were introduced selectively based upon the statistical significance of the resulting coefficients. There are no cross-products that do not include at least one of the hedonic indexes. The fitted trans-log has 64 terms and no intercept.

The HPE was fit by ordinary least squares to the sample with results that are displayed in Table 1. The R-squared of the fit is 0.9863 and most of the coefficient estimates are statistically significant at very high levels. Various graphs were drawn along the lines of Figure 1 to verify that the HPE generally related rates to hedonic properties in accordance with expectations. The residuals from the fit did not include any serious outliers.

Service elasticities of revenue per piece can be derived from the fitted HPE and combined with demand elasticities to exhibit the marginal sensitivities of the demand for various postal services to changes in delivery service time. The HPE and its derivative with respect to service time are evaluated for values of the variables corresponding to volume-weighted averages for each category. After combining terms and adjusting for the mean centering and the margin on attributable cost, the HPE for each category can be expressed in simplified form as: $\ln(P) = A + B\ln(S) + C\ln(S)^2$. $\ln(P)$ and $\ln(S)$ are, respectively, the natural logarithms of revenue per piece, *P*, and service delivery days, *S*. The service elasticity of revenue per piece is the negative of the derivative of the HPE: $d\ln(P)/d\ln(S) = -B - 2C\ln(S)$. The sign reversal occurs because we move backwards along the un-shifted HPE as shown in Figure 3 to evaluate the higher price that mailers would have to pay to offset an increase in service time.

The general formula for calculating the demand effects is: $d\ln(Q)/d\ln(S) = \sum_i [\partial\ln(Q)/\partial\ln(P_i)] * [d\ln(P_i)/d\ln(S)]$. This formula accounts for the own-price and all cross-price elasticities of demand with respect to other postal services by summing over all categories of mail indexed by "*i*". If postal services are assumed to be neither substitutes nor complements for each other, then the cross-price elasticities are zero and the service elasticity of demand may be calculated by simply multiplying together the service elasticity of revenue per piece and the corresponding own-price elasticity of demand: $d\ln(Q)/d\ln(S) = [d\ln(Q)/d\ln(P)] * [d\ln(P)/d\ln(S)]$.

This arithmetic has been done in Appendix Table 2 for market-dominant mail categories using own-price elasticities drawn from the current USPS demand model (USPS 2010a); and, for competitive mail categories, using elasticities from the model USPS filed for the R2006-1 omnibus rate proceeding (USPS 2006). Use of the current demand model in this context should not be construed as any kind of endorsement of the model or the methods used to fit it. All cross-price and discount terms have been removed by USPS from its current volume equations for mail although such terms appeared frequently in the equations for earlier versions of the model. It is impossible to reconcile this omission with the generally accepted view that many categories of mail are readily substitutable for each other. For example, cards versus letters, workshared versus un-workshared mail, and Priority mail versus Parcel Post. Nevertheless, the own-price elasticities taken from the current USPS model remain roughly representative of values that have been estimated in earlier USPS studies (USPS 2006) and by other non-USPS researchers (Pearsall 2005). They are also the only estimates that have been derived using the most recent data.

The results in Table 2 generally confirm the conjecture of Borsenberger *et al* (2010) that mail receiving expedited service is more sensitive to changes in the speed of delivery service. The elasticities for Express mail and Priority mail are larger in magnitude than those for other categories while the elasticities for most categories of Periodicals and Standard mail are small. However, Table 2 includes several important anomalies such as relatively high elasticities for Standard ECR mail and low elasticities for workshared First-Class letters and cards.

4. Reductions in Delivery Frequency

There are many ways that USPS might have reduced the frequency of delivery on postal routes in FY 2009. For this paper we consider only one such scheme for reducing the frequency to five days-a-week. We assume the reduction is made entirely by eliminating deliveries on Saturdays. Further reductions in frequency are assumed to be made by staggering deliveries so that an equal number of routes are served on each day from Monday to Friday. For example, delivery four days-a-week would be accomplished by skipping service on each route on one of the days from Monday to Friday. However, the delivery schedule would be arranged so that different routes would skip service on different days. Altogether, the same number of routes would be served every day. To do this, a carrier working a normal five day week would be scheduled to serve his usual route four days-a-week and a second route one day each week.

Carrier-route and non-route volumes have been estimated by service category for FY 2009 as shown in Appendix Table 3. These estimates were made by applying proportions from a FY 2007 route sample as described in Cigno *et al* (2010). Non-route volumes would be unaffected by changes in delivery frequencies on rural and city carrier routes.[8] The rural and city carrier route volumes for FY 2009 were obtained from the

[8] Non-route mail consists of mail placed in post office boxes plus a small volume delivered under highway contracts. None of this mail would necessarily be delayed by reductions in the frequency of delivery on postal routes. Moreover, mailers can distinguish a non-route piece of mail by its address so there should be no demand response for this component of the mail stream.

response of a USPS witness to an information request from the PRC (USPS 2010e). The table of volumes updates and disaggregates a table for FY 2007 found in IBM Global Business Services (2008).[9] We assume that the distribution of mail to be delivered each day would be unaffected by changes in delivery frequency except for the losses in volume caused by demand responses to increases in delivery time.

Saturday's mail cannot simply be delivered on the following Monday without creating a highly unbalanced pattern of daily delivery volumes. Monday's volumes would be roughly double those of any other day of the week. This peak load would make it inefficient, if not infeasible, for USPS to continue to deliver all of the mail as soon as possible. USPS is assumed to give first priority to delivering only expedited mail on the following Monday.[10] The proportion of each category we have assumed comprises the expedited mail is shown in Table 3. Route mail that is not expedited would be held and delivered later in the week. USPS would schedule the delivery of this mail to smooth the hours spent by rural and city carriers.

All expedited Saturday mail is delivered on Monday, and non-expedited mail is spread to equalize carrier hours for every day from Monday through Friday. Appendix Table 4 shows how the redistribution of Saturday's mail works out both before and after demand effects. The percentages in Table 4 are the ratios of daily route volumes after elimination of Saturday deliveries to daily volumes before the elimination. The mail distribution shown in Table 4 is the approximate result of a smoothing process that would face several difficulties, and, in practice, might not even be attempted by USPS. Among the difficulties, the delayed mail would have to be stored somewhere along the distribution chain. If the storage space cannot be found, or is expensive, USPS would probably not smooth delivered volumes as much as we have assumed.

Demand effects from reductions in delivery frequency can be projected in two ways. First, if mailers are able to tell how individual pieces of mail will be delayed, then only mail that is delayed will be affected. This assumption is most appropriate when mailers can accurately predict when their mail will be delivered. The demand effects calculated for only the mail that is actually delayed are labeled "unaveraged" in Table 4

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[9] The updated volumes were obtained from USPS in response to an informal request from the PRC staff.
[10] USPS refers to this mail as "commitment" mail without designating the included categories.

and elsewhere. Second, if mailers are unable to tell which pieces will be delayed, because they cannot accurately predict delivery dates, then they will perceive and react only to a generalized expectation that the mail takes longer to deliver. In this instance the average delay for all route mail is applied to every piece. These results are labeled "averaged" in Table 4.

In viewing our results the un-averaged effects are the most reasonable for five day-a-week deliveries. Elimination of only Saturday deliveries should not deprive mailers of their current ability to predict delivery dates. On the other hand, the averaged effects are the most appropriate for cases with deliveries fewer than five days-a-week. In these cases we have assumed that delivery days would be staggered so that an equal number of routes are served on each day. Mailers would typically not know which day is to be skipped on the delivery route for any given piece of delivered mail.

Appendix Table 5 displays the average added delay in days for delivery frequencies down to one day-a-week. These delay times are averages for all of the mail including non-route mail. It is noteworthy that the average delay varies considerably by category of service, particularly for the case of five day-a-week delivery. The scheme we have assumed for eliminating Saturday deliveries succeeds quite well at mitigating delays for expedited mail. For instance, the average delay for single-piece First-Class letters is only 0.103 days. However, this success is largely at the expense of un-expedited mail. For example, the average delay for Standard Regular mail is 0.758 days.

In general, our treatment of delays presumes that the mail is collected, processed and transported approximately as it was with six day-a-week deliveries. The delays in Table 5 are assumed to emanate entirely from delivery. They do not include any additional delays that might occur from slower collection of mail. Such additional delays could easily result from reductions in the frequency of collection from blue boxes when the collection is performed by carriers. Nor do the delays account for any changes that USPS would undoubtedly try to make to lengthen processing runs and to shift to slower but less costly modes of transport. Finally, they do not include any additional delays that would be likely to result if USPS chose to eliminate street collections, outgoing mail processing and transportation on Saturdays.

The demand effects of the delays are shown in Appendix Table 6. The changes in volumes are expressed as percentages of total volumes in FY 2009 including non-route mail. The demand effects for rural carrier mail and city carrier mail were calculated separately following the method described in Section 2. The demand effects were then combined for presentation in Table 6. The un-averaged demand effects in the top section were calculated by applying the method separately to delays and delivery volumes for each day of the week. The averaged demand effects in the bottom section were calculated for each day using the average delay for delivered mail over the entire week.

The volume-weighted averages at the bottom of each section of Table 6 can be directly compared to the conjectures made in previous studies. Our aggregate results appear to agree most closely with the percentages found in studies made for USPS. In particular, our estimates of an aggregate volume change of -0.75 percent (un-averaged effects) is close to the volume loss of -0.70 percent cited by USPS in its recent filing with the PRC (USPS 2010d).

With respect to the range of values proposed by other researchers, our average estimates tend to fall at the low end. The demand effect for four days-a-week deliveries indicates an overall loss in volume of only -1.31 percent (averaged). The loss for three days-a week is -3.50 percent (averaged). These are somewhat smaller losses than those assumed by Cohen and McBride (2009), Cohen *et al* (2010), Boldron *et al* (2006) and Borsenberger *et al* (2010)

Table 6 shows that an average loss in volume should not be applied "across the board" as has been done by most previous researchers. The volume-weighted average percentage losses are not often representative of those for any single category. The CRA service categories used in Tables 3, 5 and 6 conform roughly to subclasses of U.S. mail. At this level there is considerable variation in the demand effects for different categories of service. There is also only a very loose correspondence between our results and those for specific postal products found in USPS (2010d).

All of the volume changes in Table 6 represent losses except those estimated for Standard Regular mail. Our estimates exhibit a slight gain in volumes for Standard Regular mail over all of the cases. This result occurs because the equivalent price changes are computed along the right-hand tail of the trans-log HPE as it appears in

Figure 2. This tail has a small positive slope with respect to delivery time at the average service index (7.75 days) for Standard Regular mail. The positive slope of the HPE at this point is statistically insignificant so the small increases shown in Table 6 do not constitute evidence that the volumes of Standard Regular mail would actually rise.

Two other properties of the demand effects are evident in Table 6. First, the averaged demand effects are substantially smaller than the un-averaged effects except for the extreme case of one day-a-week delivery. And, second, the overall demand effects tend to grow almost geometrically as the delivery frequency drops. Each reduction of one day in the delivery frequency approximately doubles the volume-weighted average loss.

5. The Delivery Network

Rural-carrier and city-carrier delivery routes are mostly designed by USPS so that they can be served by a single carrier working normal hours in a single day. This includes the preparation time spent by the carrier in-office, the time spent traveling to and from the route, the time spent actually delivering the mail, and the time the carrier is allowed on breaks. Most of this time is somewhat related to the daily volume of mail that must be delivered. Even with the offsetting demand effects, reductions in the weekly frequency of deliveries can be expected to increase the volumes that carriers are expected to deliver each day on routes that are actually served. Therefore, USPS will be obliged to redesign its delivery network by shortening carrier routes and by laying out more of them in order to preserve the single-carrier single-day standard.

We have used a simple econometric model to predict how USPS would adjust its delivery network as weekly delivery frequencies are reduced. The model consists of two equations, one each for the number of rural carrier routes and the number of city carrier routes. The model was fit to annual time series of rural and city delivery routes from 1976 to 2008.[11] The same regressors are used in both equations. These are: the total number of possible deliveries calculated as the sum of possible city carrier deliveries and

[11] We are indebted to R. Kevin Harle of the PRC staff for compiling these statistics over the years from various USPS sources and making them available to us.

rural boxes; the ratio of city carrier to rural carrier labor price indexes from a recent set of total factor productivity tables (USPS 2010b).; the aggregate annual volumes of First-Class mail, Periodicals, Standard mail, Packages, and all other mail; and, the annual number of special (auxiliary) service transactions.

The equations were fit in log-log form with an intercept so the coefficients are constant elasticities. The estimated equations are shown in the top half of Appendix Table 7. Both equations are good fits to their time series. As expected the numbers of rural and city carrier routes increases with the number of possible deliveries. Also, USPS reconfigures the delivery network partly in response to the relative cost of using rural versus city carriers. Finally, it is apparent that the composition of the mail stream, as well as its volume, is an important determinant of the mix of routes in the delivery network. City carrier routes are preferred when First-Class volumes grow while rural routes are chosen when package volumes increase.

The numbers, *N*, of rural carrier and city carrier routes are predicted by applying the estimated elasticities, ε^i, for mail volumes and transactions to the ratios of average daily volumes and transactions, V^i / V_0^i, on the days that the routes are served. The formula for the calculation is: $N = N_0 \prod_i \left(V^i / V_0^i \right)^{\beta^i}$ where the superscript "i" indexes the mail or service category and the subscript "0" is used to indicate the base values of routes and daily volumes in FY 2009.

The adaptations that would be made to the USPS delivery network in FY 2009 for the various cases are shown in Appendix Table 8. The number of rural carrier routes increases with each decrease in delivery frequency both with and without the offsetting demand effects. The number of city-carrier routes also increases monotonically without the demand effects. However, with the demand effects, the number of city carrier routes begins to decrease when we reach two days-a-week. This occurs because volumes of First-Class mail are seriously reduced by the longer delivery times. USPS would alter its network in response by reducing the number of city carrier routes. At one day-a-week the delivery network is fully adapted to delivering mostly un-expedited mail and packages. The change in the composition of the mail stream has caused a large shift from city carrier to rural carrier routes.

6. Estimated Savings

Appendix Table 8 summarizes the results of applying the PRC cost model to the various cases. The application of this model at the route level has been fully described in Cigno *et al* (2010) where it was implemented with FY 2007 and FY 2008 data. We have updated the model to use data from the market-dominant portions of the FY 2009 annual compliance report (PRC 2010) without changing its structure.

Cigno *et al* applied the PRC cost model route-by-route to a large sample of USPS routes in FY 2007 to obtain the cost of geographic universal service as a cross-subsidy. We have chosen instead to group routes according to categories used by USPS as shown in the lower half of Table 7. Revenues and costs were estimated using average FY 2009 revenues per piece. Costs were derived using average route volumes by category for each day of the week. The resultant route-level revenues and costs were then scaled up using the numbers of routes in each category after the adjustments above for delivery frequency and demand effects.

Volumes, revenues, costs and savings were scaled to obtain the annual values presented in Table 8 using the number of days in the year that each route was served. Two sets of cost and savings estimates were produced from two alternative sets of cost drivers.[12] Our estimates of cost savings from elimination of Saturday deliveries are modestly lower than those currently being used by USPS to advance the proposal with the PRC and the U.S. Congress. Our estimates of the FY 2009 savings with and without demand effects are around $2.03 billion and $2.28 billion; the USPS estimates are $3.10 billion and $3.30 billion. The differences between the estimates can mostly be explained by $0.60 billion of additional savings that USPS includes from non-delivery operations such as mail processing, transportation, post office operations, etc. These further savings are mostly attributable to a difference in assumptions. USPS intends to eliminate street

[12] Cigno *et al* found that the choice of driver sets had very little effect on their estimates of USO costs. This also appears to be true of the total costs and savings shown in Table 8, and especially for the higher delivery frequencies.

collections, outgoing mail processing and transportation on Saturdays while we have assumed that these non-delivery activities would continue.

Most of the remaining differences in the savings estimates can be explained by the added cost of serving an increased numbers of postal routes. Our route model shows that USPS would add 3,904 rural and 1,951 city carrier routes to its delivery network without the demand effects. With the un-averaged demand effects 2,475 and 1,041 are added. USPS and others have assumed that there would be no changes in the numbers of rural and city carrier routes in the USPS delivery network following the elimination of Saturday deliveries.

According to Table 8 the savings from reductions in delivery frequency continue to increase as the number of delivery days per week is reduced down to about two days-a-week. At this point the demand effects become so severe that a further reduction to one day-a-week causes a decrease in net revenue (using the averaged demand effects). This result suggests that most previous studies of the cost of the USO using the profitability definition have not employed the correct counterfactual. None of these studies consider frequencies of delivery of less than three days-a-week. If our results extend to posts other than USPS, then the relevant benchmark for measuring the cost of five and/or six day-a-week delivery service should be lower than three days-a-week.

When the volumes, revenues and costs for averaged demand effects for two days-a-week deliveries are used as the relevant counterfactuals for a profitability measurement of the cost of the USO, then this cost is around $7.7 billion in FY 2009. Under the Third European Postal Directive this is the maximum amount that USPS could claim following full market opening as a subsidy for providing service six days-a-week. It is an amount that greatly exceeds the USPS loss in FY 2009 of $3.8 billion, so only part of the cost could have been reimbursed following full market opening under the directive.

7. Conclusion

In this paper we have described a practical method for statistically estimating the demand effects that would result from changes in the hedonic properties of postal services. The feasibility of the method is demonstrated by estimating the demand effects and savings to USPS of various reductions in the weekly frequency of delivery service over its network of rural and city carrier routes.

Our method fills a technical lacuna in existing studies of the cost of the USO. This lacuna takes the form of assumptions, typically unsupported by any empirical evidence whatsoever, regarding the effects that changes in service quality would have on the demand for postal services. We show that the changes in demand resulting from a change in service can be derived in two simple steps. First, the equivalent price change that compensates for the change in service is derived from an HPE fitted to the postal tariff. And, second, the demand effects of the equivalent price change are inferred from a suitable econometric model relating postal volumes to rates.

Our demonstration of the method brings together previous research from two sources. The USPS tariff is represented by an HPE fitted by methods developed by Fenster *et al* (2006). Own-price elasticities were extracted from USPS econometric demand models (USPS 2006 and 2010a). Our estimates and findings depend on the accuracy of our re-estimation of the HPE, the accuracy of the current USPS estimates of own-price elasticities, and the decision apparently made by USPS econometricians to entirely omit cross-price and discount elasticities from their demand functions.

For USPS, the quantitative results indicate that the overall demand effects of eliminating Saturday deliveries would be small. However, these effects compound rapidly for further reductions in the weekly frequency of delivery and are unevenly distributed among the different mail categories. Our research also reveals that major changes would occur in the USPS delivery network in the form of increases in the number of routes and shifts from city carriers to rural carriers.

For the national posts of the EU, the results indicate that the appropriate benchmark delivery frequency for estimating the government subsidy allowed after full market opening may be as low as one or two days-a-week. On this basis the cost to USPS of the USO was about $7.7 billion on revenues of $68.1 billion in FY 2009. This represents the added cost to USPS of making deliveries six days-a-week in FY 2009 rather than at the two days-a-week frequency that would have maximized USPS net revenue.

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Table 1: Hedonic Price Equation Fitted as a Restricted Translog
FY 2009 U.S. Postal Revenue per Piece Divided by Subclass Markup
(All Variables are Mean-Centered Using the Volume-Weighted Sample Average)

	Uninteracted:		Interacted with:									
			ln Wgt/Pc		ln Sort		ln Distance		ln Service		ln Size	
Variable	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
ln Wgt/Pc	0.406	47.71	0.035	18.32								
ln Sort	0.308	5.59	-0.047	-3.88	0.023	0.94						
ln Distance	0.259	16.42	0.047	18.60	0.004	0.41	0.023	9.42				
ln Service	-0.114	-2.24	-0.076	-10.03	0.324	4.01	-0.025	-2.84	0.437	10.27		
ln Size	0.025	2.11	0.002	1.49	0.487	15.69	0.006	4.13	0.095	7.78	-0.004	-1.65
Letter shape	-1.447	-47.12										
Card shape	-1.044	-10.78										
Flat shape	-0.635	-23.40			0.487	15.69						
Parcel shape	0.566	3.93			0.210	0.92						
Small Parcel shape	0.128	3.56			0.577	14.45						
Flat or Parcel shape			-0.080	-6.11			-0.025	-1.86	-0.097	-1.54	-0.065	-5.79
Automation-ready	0.103	6.08	0.147	11.36	-0.172	-2.99			0.075	1.61		
Non-Machinable	0.121	9.07							0.269	6.10		
Balloon Parcel	0.020	0.38					-0.019	-3.12	-0.233	-2.93		
Oversized Parcel	1.208	32.38							-0.762	-11.12		
Destination Entry	0.231	9.26	-0.086	-9.34	0.147	4.68						
Zoned Rate	-0.157	-5.31	-0.077	-6.55	0.188	3.71	-0.197	-13.17	0.115	1.57		
Within-County Rate	-0.407	-6.67										
Palletized Fraction	-0.225	-6.73	-0.071	-2.76								
Classroom Rate	-0.121	-4.91										
Sealed	0.282	5.59			0.036	0.25					-0.092	-6.45
Commercial Rate	-0.038	-1.28			0.218	1.20						
Competitive	-0.598	-4.16			0.306	1.27					0.079	4.22
NSA Rate	-0.667	-5.66										
Return Service	-0.349	-9.91										

Standard Error	0.2038	No. of Observations	2279
R Squared	0.9863	Degrees of Freedom	2215

Table 2: Marginal Effects of a Change in Service

Demand Model Category	Translog Hedonic Price Equation Parameters at Category Average: Constant	ln Service	(ln Serv)^2	FY 2009 Revenue per Piece	Margin on Attributable Cost	Service Elasticity of Rev/Pc	Own-Price Elasticity of Demand	Service Elasticity of Demand
First-Class Single-Piece Letters	0.459	-1.609	0.437	0.523	66.9%	80.9%	-19.2%	-15.6%
First-Class Workshared Letters	-0.418	-1.041	0.437	0.355	189.0%	1.6%	-43.6%	-0.7%
First-Class Single-Piece Cards	-0.390	-1.521	0.437	0.273	3.3%	85.3%	-39.7%	-33.9%
First-Class Workshared Cards	-1.020	-0.956	0.437	0.214	176.5%	0.5%	-142.7%	-0.7%
First-Class International	1.588	-1.583	0.437	1.657	66.9%	78.3%	-19.2%	-15.1%
Standard Regular	0.336	-1.747	0.437	0.244	72.1%	-4.0%	-24.4%	1.0%
Standard ECR	1.485	-2.449	0.437	0.186	106.4%	67.9%	-83.9%	-56.9%
Standard Nonprofit	-0.268	-1.734	0.437	0.137	6.7%	-6.8%	-16.5%	1.1%
Standard Nonprofit ECR	0.920	-2.430	0.437	0.109	18.7%	65.5%	-52.4%	-34.3%
Market Dominant Parcel Post	4.289	-1.920	0.437	9.127	-8.2%	23.6%	-19.6%	-4.6%
Bound Printed Matter	2.260	-2.027	0.437	1.125	33.3%	60.2%	-65.1%	-39.2%
Media Mail	2.101	-1.394	0.437	2.815	-15.9%	-28.3%	-90.3%	25.6%
Periodicals Regular Rate	0.763	-1.984	0.437	0.286	-24.3%	64.6%	-8.2%	-5.3%
Periodicals Within-County	-0.602	-1.751	0.437	0.107	-13.7%	46.7%	-20.7%	-9.7%
Periodicals Nonprofit	0.272	-1.821	0.437	0.221	-28.0%	44.2%	-27.6%	-12.2%
Priority Mail	3.092	-1.888	0.437	6.978	30.0%	124.6%	-102.3%	-127.5%
Express Mail	3.253	-1.849	0.437	18.866	59.9%	169.4%	-164.5%	-278.6%
Competitive Parcel Post	3.634	-2.165	0.437	3.180	90.1%	59.7%	-139.9%	-83.5%
Competitive International				1.868	50.5%		-59.0%	
All Mail ex Penalty, Free & Int'l	0.400	-1.583	0.437	0.358	97.1%	11.4%	-39.2%	-4.5%

Notes Own-Price Elasticity of Demand
Own-price elasticities for market-dominant categories are from USPS (2010a).
Own-Price elasticities for Priority Mail, Express Mail and Competitive Parcel Post are from USPS (2006).
The own-price elasticity for First-Class International is assumed to be the same as the own-price elasticity for Single-Piece Letters.
The own-price elasticity for all mail ex Penalty and Free is the volume-weighted average of the elasticities for all rate-paying categories.
None of the demand equations for mail found in USPS (2010a) include cross-price terms or discounts as explanatory variables.

Table 3: FY 2009 Carrier-Route and Non-Route Volumes

Service Category	FY 2009 Rural Carrier Volume	FY 2009 City Carrier Volume	FY 2009 Non-Route Volume	Delivery Service Index (Days)	Assumed Expedited Proportion
First-Class Single-Piece Letters	6,252,364	13,461,728	14,049,171	2.498	100%
First-Class Presort Letters	13,808,030	29,064,829	1,934,842	3.227	100%
First-Class Single-Piece Cards	531,041	919,369	166,345	2.147	100%
First-Class Presort Cards	799,776	1,488,380	837,860	2.970	100%
Priority Mail	192,041	352,647	245,382	2.083	100%
Express Mail	11,428	20,985	14,602	1.195	100%
Periodicals	2,720,702	4,700,392	532,621	4.638	50%
Standard Enhanced Carrier-Route	8,754,963	18,358,054	185,943	7.581	0%
Standard Regular Mail	17,003,102	34,596,620	3,807,528	7.754	0%
Parcel Post	80,827	148,098	92,977	6.259	0%
Bound Printed Matter	149,143	272,436	87,843	5.102	0%
Media and Library Rate Mail	32,679	74,603	32,857	6.810	0%
USPS Penalty Mail	108,588	296,831	49,446	5.366	50%
Free-for-the-Blind Mail	11,747	23,558	26,653	5.366	50%
International Mail (Inbound)	68,736	201,177	331,520	3.641	100%
Registry	567	1,211	1,404	2.498	100%
Certified	47,470	101,440	117,581	2.498	100%
Insurance	12,039	21,931	9,798	6.259	0%
Collect-On-Delivery	279	509	227	6.259	0%
Other Auxilliary Services	370,502	762,485	168,752	5.366	0%

Table 4: Redistribution After the Elimination of Saturday Deliveries

Category	Monday	Tuesday	Wednesday	Thursday	Friday
Without Demand Effects					
First-Class	185.7%	100.0%	100.0%	100.0%	100.0%
Priority/Express	198.8%	100.0%	100.0%	100.0%	100.0%
Periodicals	113.7%	131.0%	119.5%	115.7%	115.7%
Standard Mail	24.4%	136.2%	136.8%	153.9%	136.0%
Package Services	24.7%	172.3%	147.7%	148.8%	132.5%
Other Mail	131.0%	116.4%	109.8%	112.3%	109.3%
Services	42.6%	158.3%	138.6%	137.7%	127.2%
With Unaveraged Demand Effects					
First-Class	177.5%	100.0%	100.0%	100.0%	100.0%
Priority/Express	117.4%	100.0%	100.0%	100.0%	100.0%
Periodicals	112.5%	130.0%	118.8%	115.3%	115.5%
Standard Mail	24.5%	136.0%	136.9%	153.9%	136.0%
Package Services	23.1%	155.2%	137.5%	143.5%	130.3%
Other Mail	129.6%	116.4%	109.8%	112.3%	109.3%
Services	40.8%	152.7%	135.7%	136.3%	126.7%
With Averaged Demand Effects					
First-Class	183.7%	98.8%	98.8%	98.9%	98.9%
Priority/Express	159.7%	80.3%	80.3%	80.3%	80.3%
Periodicals	113.2%	130.5%	119.0%	115.2%	115.2%
Standard Mail	24.5%	136.4%	137.0%	154.1%	136.2%
Package Services	23.5%	164.1%	140.2%	140.8%	125.1%
Other Mail	130.5%	116.2%	109.6%	112.1%	109.1%
Services	41.9%	155.8%	136.4%	135.6%	125.2%

Table 5: Average Added Delays in Delivery Service

	Average Added Delay in Days without Saturday Deliveries Number of Delivery Days per Route per Week				
Service Category	5 Days	4 Days	3 Days	2 Days	1 Day
First-Class Single-Piece Letters	0.103	0.243	0.520	0.934	1.480
First-Class Presort Letters	0.167	0.396	0.849	1.517	2.395
First-Class Single-Piece Cards	0.157	0.371	0.797	1.435	2.278
First-Class Presort Cards	0.131	0.304	0.647	1.154	1.822
Priority Mail	0.118	0.283	0.611	1.102	1.744
Express Mail	0.118	0.283	0.611	1.102	1.744
Periodicals	0.439	0.665	1.118	1.793	2.342
Standard Enhanced Carrier-Route	0.743	0.981	1.463	2.197	2.443
Standard Regular Mail	0.758	0.982	1.433	2.103	2.282
Parcel Post	0.582	0.759	1.112	1.588	1.789
Bound Printed Matter	0.704	0.902	1.302	1.884	2.031
Media and Library Rate Mail	0.700	0.883	1.249	1.756	1.863
USPS Penalty Mail	0.383	0.600	1.032	1.681	2.224
Free-for-the-Blind Mail	0.269	0.410	0.687	1.099	1.432
International Mail (Inbound)	0.068	0.173	0.381	0.690	1.101
Registry	0.099	0.232	0.498	0.893	1.416
Certified	0.099	0.232	0.498	0.893	1.416
Insurance	0.665	0.855	1.232	1.765	1.921
Collect-On-Delivery	0.665	0.855	1.232	1.765	1.921
Other Auxilliary Services	0.711	0.924	1.351	1.961	2.161

Table 6: Changes in Volume from Reductions in Service

	Number of Delivery Days per Route per Week				
Demand Effects	Unaveraged	Averaged	Averaged	Averaged	Averaged
Service Category	5 Days	4 Days	3 Days	2 Days	1 Day
First-Class Single-Piece Letters	-1.20%	-2.24%	-5.77%	-14.75%	-58.39%
First-Class Presort Letters	-1.24%	-2.13%	-5.93%	-15.75%	-44.79%
First-Class Single-Piece Cards	-4.35%	-8.14%	-21.03%	-52.54%	-89.71%
First-Class Presort Cards	-2.87%	-4.68%	-13.24%	-33.74%	-68.25%
Priority Mail	-9.60%	-27.97%	-51.92%	-67.98%	-68.94%
Express Mail	-11.79%	-58.14%	-68.87%	-68.94%	-68.94%
Periodicals	-0.50%	-0.67%	-1.41%	-3.19%	-5.62%
Standard Enhanced Carrier-Route	-1.32%	-1.50%	-2.89%	-6.06%	-7.47%
Standard Regular Mail	0.61%	0.83%	1.10%	1.32%	1.33%
Parcel Post	-8.64%	-10.86%	-16.72%	-25.44%	-29.37%
Bound Printed Matter	-3.15%	-3.63%	-6.53%	-12.89%	-14.99%
Media and Library Rate Mail	-0.35%	-0.22%	-1.05%	-3.21%	-3.85%
USPS Penalty Mail	0.00%	0.00%	0.00%	0.00%	0.00%
Free-for-the-Blind Mail	0.00%	0.00%	0.00%	0.00%	0.00%
International Mail (Inbound)	-0.34%	-0.72%	-1.84%	-4.25%	-10.19%
Registry	-1.26%	-2.36%	-6.08%	-15.39%	-55.88%
Certified	-1.26%	-2.36%	-6.08%	-15.39%	-55.88%
Insurance	-10.38%	-13.04%	-19.67%	-29.90%	-33.07%
Collect-On-Delivery	-14.49%	-18.44%	-27.17%	-39.74%	-43.39%
Other Auxilliary Services	-1.44%	-1.57%	-3.02%	-6.30%	-7.80%
Volume-Weighted Average	-0.75%	-1.31%	-3.50%	-8.96%	-25.88%

Table 7: Route Model and FY 2009 Benchmarks

Dependent Variable: ln Number of Routes
Sample: Annual Time Series FY 1976 to FY 2008

	City-Carrier Routes		Rural-Carrier Routes	
Variable	Estimate	t-value	Estimate	t-value
Intercept	4.018		-4.441	
ln Possible Deliveries	0.397	1.46	0.916	3.13
ln City/Rural Price Ratio	-0.380	-1.95	0.470	2.22
ln First-Class Volume	0.539	2.68	-0.078	-0.36
ln Periodicals Volume	-0.241	-1.59	0.014	0.09
ln Standard Mail Volume	-0.100	-1.41	0.089	1.16
ln Packages Volume	0.005	0.11	0.240	4.89
ln Other Mail Volume	-0.003	-0.18	0.004	0.20
ln Service Transactions	-0.062	-1.99	0.064	1.91
Standard Error	0.017		0.019	
R Squared	0.9802		0.9968	
No. of Observations	33		33	
Degrees of Freedom	24		24	

Route Category	FY 2009 Estimated No. of Routes	FY 2009 Estimated Volume/Rte
Rural Carrier	76,667	1,937
City Carrier Business Foot	850	1,197
City Carrier Business Motorized	2,010	1,555
City Carrier Residential Foot	8,887	1,903
City Carrier Residential Curb	87,935	1,901
City Carrier Residential Park and Loop	49,739	2,190
City Carrier Mixed Foot	674	1,417
City Carrier Mixed Curb	9,136	1,891
City Carrier Mixed Park and Loop	1,500	2,422

	Annual Volume	Percent
Rural Carriers All Mail and Services	44,993,023	25.1%
City Carriers All Mail and Services	96,648,533	54.0%
Non-Route All Mail and Services	37,480,993	20.9%

Table 8: Estimates of Routes, Volumes, Revenue, Cost and Savings FY 2009

Case	Demand Effects	Rural-Carrier No. of Routes	City-Carrier No. of Routes	Rural-Carrier Volume (000)	City-Carrier Volume (000)	Total Volume (000)
Six Delivery Days per Week	None	76,667	160,732	50,956,023	104,867,282	178,516,658
Five Delivery Days per Week	None	80,571	162,683	50,956,023	104,867,282	178,516,658
(No Saturday Deliveries)	Unaveraged	79,142	161,773	50,523,765	103,963,002	177,180,120
Four Delivery Days per Week	None	85,792	165,501	50,956,023	104,867,282	178,516,658
	Averaged	82,056	163,543	50,189,295	103,304,282	176,186,929
Three Delivery Days per Week	None	93,287	169,778	50,956,023	104,867,282	178,516,658
	Averaged	85,066	163,871	48,909,557	100,658,470	172,261,379
Two Delivery Days per Week	None	105,435	176,919	50,956,023	104,867,282	178,516,658
	Averaged	91,156	159,520	45,744,316	94,076,181	162,513,849
One Delivery Day per Week	None	131,067	191,733	50,956,023	104,867,282	178,516,658
	Averaged	116,533	115,681	36,033,455	73,590,843	132,317,650

	Demand	Total	Sample Drivers		Scaled Drivers	
Case	Effects	Revenue ($000)	Total Cost ($000)	Saving ($000)	Total Cost ($000)	Saving ($000)
Six Delivery Days per Week	None	67,640,585	71,645,397		71,645,397	
Five Delivery Days per Week	None	67,640,585	69,370,363	2,275,033	69,368,390	2,277,007
(No Saturday Deliveries)	Unaveraged	66,392,263	68,343,335	2,053,739	68,365,470	2,031,604
Four Delivery Days per Week	None	67,640,585	66,880,028	4,765,369	66,878,854	4,766,543
	Averaged	64,608,249	64,441,826	4,171,234	64,494,635	4,118,425
Three Delivery Days per Week	None	67,640,585	64,097,650	7,547,746	64,097,117	7,548,280
	Averaged	61,662,822	59,426,498	6,241,135	59,521,875	6,145,758
Two Delivery Days per Week	None	67,640,585	60,844,379	10,801,018	60,844,229	10,801,168
	Averaged	56,872,881	53,048,021	7,829,671	53,209,414	7,668,277
One Delivery Day per Week	None	67,640,585	56,639,140	15,006,257	56,639,140	15,006,257
	Averaged	43,414,844	41,168,992	6,250,662	41,616,223	5,803,431