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Estimating the Financial Impact of Discontinuing Saturday Delivery of Letters and Flats in the U.S.[†]

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1. Introduction and overview

In 2013, the U.S. Postal Service (USPS) announced plans to discontinue the delivery of letters and flats on Saturdays, while continuing parcels delivery ("plan 5+"). This would lead to sharply reduced street times on Saturdays, and to a shift of workload from Saturdays to other weekdays, in particular Mondays. Understanding the net effects of modified delivery schedules and reduced delivery frequency concerns an increasing number of postal operators worldwide. This contribution may hence shed some light on the issue optimizing delivery frequency as a response to declining letter volumes.

To estimate the effect of plan 5+ on delivery cost, USPS' largest component of total cost, the adapted street times and increases of overtime hours are calculated based on the bottom-up delivery model from Trinkner et al. (2012) and Haller et al. (2014) for a subsample of 16,000 USPS' routes. To assess the net impact of plan 5+ on profits, we first find the amount of reduced demand that would have to occur in response to the change in service to offset the direct cost savings. Sensitivity of yearly profits is estimated under alternative demand assumptions. The paper ends with a discussion about whether the findings constitute net costs of the USO.

The paper is structured as follows. Section 2 presents the methodology and defines the details of the modified delivery schedules that are analyzed. Section 3 contains the bottom-up delivery model, its calibration to USPS city routes, and the induced net effects on street, office and overtime hours. Section 4 summarizes the analysis of the financial effects of plan 5+ on the USPS and contrasts the findings with USPS' estimates. Section 5 discusses whether the computed savings constitute USO net costs. Section 6 concludes and presents possible further applications.

[†] This paper is derived from a study conducted by Swiss Economics for the Postal Regulatory Commission. www.prc.gov. The views expressed in this paper are those of the authors and do not necessarily represent the opinions of the U.S. Postal Regulatory Commission.

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2. Methodology and Plan 5+ Scenarios

Analysis of direct and indirect effects

The net effects of a modified delivery schedule on yearly USPS profits π compute as $\Delta\pi = \pi^1 - \pi^2 = (R^1 - C^{fa1}) - (R^0 - C^0)$. Rearranging and extending for processes i and products j yields:

$$\Delta\pi = \underbrace{\sum_{i=1}^{I} C^{i,0}(x^{j..J,0}) - C^{i,1}(x^{j..J,1})}_{\substack{\text{per process i,}\\ \text{avoided cost (C0>C1)}\\ \text{or incremental cost (C0<C1)}}} - \underbrace{\sum_{j=1}^{J} R(x^{j,0}) - R(x^{j,1})}_{\substack{\text{per product j,}\\ \text{forgone revenue (R0>R1) or}\\ \text{additional revenue (R0<R1)}}}. \quad (1)$$

Effects on the cost side are computed per process; whereas, net revenue effects are calculated per product category (Jaag et al., 2011). Calculating $\Delta\pi$ requires knowledge on the costs per process $C^{i...I,1}(x^{j..J})$ and the demand effects $x^{j..J,0}$-$x^{j..J,1}$ per product. From (1) it follows that the demand functions are not only relevant to compute the net effect on revenues, but also for assessing the net effects on process costs.

The effect on process costs can be decomposed into a direct and an indirect component. The direct effect is the change of the cost function assuming no demand response (unchanged quantities) and computes as $\sum_{i=1}^{I}(C^{i,0}(x^{j..J,0}) - C^{i,1}(x^{j..J,0}))$. The indirect effect is the effect of the demand response within the new cost function, formally $\sum_{i=1}^{I}(C^{i,1}(x^{j..J,0}) - C^{i,1}(x^{j..J,1}))$.

To compute the indirect effect, cost elasticities or variable costs of all affected products need to be determined. In the analysis, attributable costs as reported by the USPS are used as a proxy for variable costs.

Little is known about the likely magnitude of how plan 5+ would impact demand, so boundaries for induced demand effects under which the delivery schedules are still profitable are calculated, formally, $\min(x^{j..J,0})$ s.t. $\Delta\pi = 0$. If the results suggest volume losses that can be considered as unrealistically high, then plan 5+ very likely increases USPS's profit. In addition, equation (1) will be evaluated for selected demand scenarios $x^{j..J,1}$ that are based on quantitative analysis made publicly available by the USPS in its 2010 filing of "plan 5" (Docket No. N2010-1), eliminating Saturday parcel delivery as well.[1] Because plan 5+ preserves service levels for parcels, the demand effect on parcels is excluded.

Plan 5+ scenarios

The operational details of Plan-5+ were not made public by USPS. To reflect the impact of potential details about how its implementation, two possible scenarios of plan 5+ are analyzed. "Plan 5+ high" adopts the changes in sortation and transportation that were projected by the USPS for plan 5. (Details are available in Docket No. N2010-1 materials.) In contrast, "plan 5+ low" is much closer to the status quo, implying lower savings.

For collection, plan 5+ low assumes that Saturday retrieval of mail from collection boxes would continue, while plan 5+ high assumes it would not. Both scenarios assume retail post offices would not be affected. Similarly, plan 5+ low assumes the status quo sorting of outgoing mail and transportation of collection mail to sorting facilities on Saturdays continues, whereas for plan 5+ high these processes are eliminated.

The most substantial operational change is in delivery, where both plan 5+ scenarios assume that home delivery of letters and flats is discontinued and the former Saturday volumes are delivered

[1] USPS press release No. 13-019 from February 06, 2013.

on Mondays and Fridays. This shift of workload (with Monday volumes being about twice the weekly average) may have implications for delivery productivity and may also lead to increased overtime. For plan 5, USPS assumed that volumes moving to Monday delivery will be delivered at the current Monday delivery productivity (which is higher than delivery productivity on Saturdays). Plan 5+ high adopts the plan 5 productivity assumption, and assumes that potential overtime increases can be fully mitigated by management. In contrast, plan 5+ low assumes that the variable costs of delivery are not affected, and that the potential increased overtime cannot be avoided.

As noted above, little is known about the likely impact of these changes on demand, but it is likely that the more substantial operational changes of plan 5+ high may have a greater effect on service and in turn, on demand. The scenarios reflect this reasoning by adopting the demand impact of plan 5 for plan 5+ high, and assuming a smaller demand impact for plan 5+ low.

3. Bottom-up delivery model

Load, access and route time

Delivery carriers typically spend the first hours of the day in the office to prepare the mail for the route ("office time"). Once finished, the carrier leaves the office and delivers the mail along the route. The time spent leaving the route to access a recipient mailbox is referred to as "access time." "Load time" is the time required to insert the mail into the mailbox. The time on the route itself is referred to as "route time" (Cohen and Chu, 1997). Route and access times constitute a significant cost driver for postal services. The sum of the three components is referred to as "street time" by the USPS. For city carriers, street time accounts for more than 75% of overall delivery time.[2] While load time is essentially variable with respect to the number of mail items delivered, access and route times are quasi-fixed costs. For a given delivery point, access time is variable with the first mail item, after which it is fixed. For a given (independent) route section, route time is variable with the first mail item for that section; thereafter, it is fixed up to the most remote delivery point receiving mail.

In this framework, plan 5+ thus means: (1) on Saturdays, route times are fundamentally different and much more variable, as the probability that a given household gets a (parcel) delivery is reduced sharply (leading to different routes every Saturday); (2) from Monday to Friday, the probability that a household is served is increased slightly. In countries with high volumes per capita such as the U.S., route times can be considered as effectively constant, and access times as mostly constant (Haller et al., 2014), which could be confirmed in Trinkner and Haller (2014).[3] It is therefore assumed that route and access time remain constant from Monday to Friday.

A bottom-up model

The assessment of the first (Saturday) effect requires a model to predict the changes to route and access times. Such a prediction can be obtained from an application of the model presented by Trinkner et al. (2012) and Haller et al. (2014). The model computes bottom-up route and access times for different delivery schedules, and allows letter and parcel volumes to be taken explicitly into account. In the model, the location of the delivery center is fixed, but the number of delivery days and/or the percentage and location of delivery points to be served can be varied. To determine the route costs as a function of the distribution of the households around the delivery cen-

[2] Own calculations based on the USPS DOIS data provided.

[3] The assumption of fixed routes on regular delivery days was validated for 230 randomly chosen USPS routes.

ter, the delivery process is treated as a routing problem (minimizing the total route time to deliver all the mail to the served delivery points) and solved by numerical methods (hereafter referred to as "shortest path").

To keep the model tractable, it is assumed that the mail deliverer can move freely in the area, i.e., it is abstracted from spatial obstacles and roads. This approach does not deliver route costs directly. Instead, it computes linear distances that can serve as proxies for the real route costs. The model therefore requires calibration to determine effective route times and/or distances. Calibration can take place either by actual (measured) route times or actual distances, or both. In Haller et al. (2014), the model could on average explain 95.36 % of Swiss Post's route times per delivery region, with high values independent of the specific delivery areas. Once calibrated, the model allows comparisons of delivery costs across various delivery plans (e.g. plan 5+) or Universal Service Obligations (USO) definitions and letter volumes.

Data

The model is computationally intensive. With 224,000 routes in the U.S., it is time-consuming to apply the model to all routes. To get an accurate estimate, a representative sample of 20,000 city routes was chosen as a starting point. The calibration is based on the following data:

(1) Data from the USPS' Address Management System (AMS) for a randomly selected sample of 19,958 city carrier routes, containing for each delivery point coordinates and additional information such as delivery type (e.g., curb line) and USPS sequence number. ArcGIS software was used to identify the coordinates of each address. Prior to the simulations, the data was validated and classified. In total, 16,572 routes could be selected for further use.

(2) Data from the USPS' Delivery Operations Information System (DOIS), containing office and street times as well as volume data for 141,436 city carrier routes for every delivery day of FY 2012. In addition, DOIS information for the type of delivery and base mileage for each route was available. In FY 2012, there were 303 delivery days.

From the selected 16,572 AMS routes, 16,274 could be identified in DOIS data. 77 observations with negative values in either hours or volume variables were excluded. With 303 delivery days in FY2012, a sample with 4.9 million observations was used for the calibration exercise. Calibration per delivery type is only partially possible because from the 16,274 routes from AMS and DOIS data, there are 2,251 routes for which it was not possible to recover information on the delivery type.

Simulation of street time

For the 16,274 sample routes, route and access times are simulated with an algorithm computing the shortest path, resulting in the proxy "shortest path." In 7 % of all routes, the standard algorithm failed to converge in a reasonable time horizon and a greedy algorithm was used instead .[4] To validate these results, a second proxy for the length of the routes was constructed by summing the linear distances between the delivery points along the original USPS sequence provided in the AMS data. This proxy is referred to as the "sequence path."

Calibration of street time

The calibration exercises for route and access times are performed with and without distinguishing different delivery types (e.g., curb or foot). In the base calibration, actual street times have been regressed as follows:[5]

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[4] The "greedy" algorithm moves from one point to the nearest unvisited neighbor.

[5] Regressions were run with log(.) and quadratic specifications. These were not superior to this simple linear model.

$$actual\ street\ hours = \beta_0 distance\ proxy + \beta_1 letters + \beta_2 flats + \beta_3 parcels.$$

First, three distance proxies have been tested in the base calibration and compared to a benchmark with a constant as a proxy: (1) Shortest path, (2) sequence path, and (3) "base mileage", measuring actual miles per route as reported by the USPS (from DOIS data set). Table 1 (upper part) provides an overview of the results. In terms of quality of fit, the model with the proxies "base mileage" and "shortest path" perform equally well, and both do better than the "sequence path" proxy. This implies that the simulated distances perform equally well in explaining street hours as actually measuring the effective miles per route. The simulation model is therefore "as good as it can get." Moreover, the shortest path algorithm has two advantages: it is available for all routes (not the case for base mileage), and it is possible to simulate alternative volume and delivery point scenarios, which is of particular value for this study.

Table 1: Performance of proxies

Proxy β_0	N	Coefficient β_0	t-Value	Adj. R2
Benchmark: Constant	4.9 M	5.567	3492.95	6%
Linear distance shortest path	4.9 M	**0.00014**	**981.45**	**87%**
Linear distance sequence path USPS	4.9 M	0.00000592	265.84	85%
Base Mileage USPS	3.9 M	0.1288	937.74	87%
Linear distance shortest path with dummies	4.9 M	0.00009	682	91.5%
Linear distance foot routes	0.2 M	0.00012	161	82%
Linear distance park and loop routes	2.1 M	0.00019	806	89%
Linear distance dismount routes	0.7 M	0.00013	370	88%
Linear distance curb routes	1.1 M	0.00012	629	91%
Linear distance other routes	0.02 M	0.00028	81	79%

Second, the calibration is performed differentiating the delivery methods, i.e., running the regression of actual street times on simulated shortest paths, observed volumes, and the type of delivery. The results are reported in Table 1 (lower half). The delivery type was included as a dummy in the above global regression, followed by a separate regression for every delivery type subsample. The errors made with the global approach without dummies seem not to be excessively large. Comparing the two global regressions with and without dummies, R^2 is reduced to a minor extent in the benchmark regression without dummies, but the "shortest path" coefficient is more consistent with the individual coefficients by delivery type. Moreover, the global approach without dummies implies a calibration of load times that is independent of the delivery method. Compared to the individual regressions by delivery type, the global approach allows using the entire sample. For these reasons, the subsequent calculations are based on the global calibration without delivery dummies.

Calibration of office time

To estimate the effect of volumes on office time, it is assumed that only cased items cause office time and that all such costs are variable. Therefore, the following model is estimated:

$$office\ time = \beta_1 casedletters + \beta_2 casedflats + \beta_3 parcels.$$

The regression results for the sample of 4.9 M observations are again highly significant and lead to coefficients β_1 = 0.035, β_2 = 0.025 and β_3 = 0.084, all being consistent with expectations—parcels

cause more office time than letters and flats. Based on the calibrated model, time and cost differentials on Saturdays, Mondays and Fridays for city carriers[6] can be computed for route and access time, load time, and office time. Taking the three together, the impact on overtime hours can be calculated.

New Saturday routes

Saturday parcel-only delivery routes are simulated in the calibrated model for all Saturdays of FY2012.[7] It is assumed that a delivery point is served on a Saturday if it receives at least one parcel. To determine the parcel distribution across delivery points, the actual parcel volumes on a given Saturday are randomly assigned to the addresses of a route.[8] That is, if there were n parcels on a given Saturday, then n addresses of a route are randomly drawn (with delivery points with multiple addresses being more likely to receive a parcel on a given Saturday). The delivery points served are then the points which have at least one address receiving a parcel.[9] This is done for every Saturday in FY2012, assuming no further reorganization of routes, resulting in the new proxy $shortest\ path\_SAT$.

Applying the regression coefficients from the calibration of street and office time, the new street and office hours on Saturdays can be computed as

$$street\ hours = \underbrace{0.00014 * shortest\ path\_SAT}_{route\ and\ access\ time} + \underbrace{0.014 * parcels}_{load\ time}.$$

$$office\ hours = .0084 * parcels.$$

As introduced above, we are primarily interested in changes on route and access times to estimate avoided costs of plan 5+. The net saving is the difference in route and access times multiplied by the average piggy-backed hourly rate of USD 59.42,[10] which accounts for the hourly costs of city carriers including labor and vehicle use.

All other costs shift to other days. Assuming constant productivity along labor days as in plan 5+ low, the shifts are relevant if these cause increased or decreased overtime work. Therefore, total street hours and office hours per route are calculated to estimate the effects on overtime costs. The results are provided in Table 3 further below. The focus on overtime hours implies that the existing full time equivalents (FTE) per route can be reduced proportionally to the new work load.

The resulting avoided cost relative to the status quo (reduced route and access time, reduced overtime) and incremental cost relative to plan 5 from discontinued Saturday delivery of letters and flats is shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**. The financial effects of route and access time changes on all city carriers are obtained from scaling up the time estimates with the piggy-backed hourly rate and a scale factor of 8.69. The scale factor inflates our sample of 16,274 routes to represent the 141,469 total city routes in the system. Compared to the status quo, route and access times are USD 634 million lower under plan 5+. Compared to plan 5, the corresponding incremental cost is USD 270 million[11].

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6 In contrast to city carriers, rural carriers are paid by the item delivered. As a consequence, savings in route and access times translate into USPS savings for city routes only and hence the calculations focus on city routes.

7 There are 53 Saturdays in FY 2012.

8 This is as accurate as possible as we do not have any information on address level.

9 A delivery point can have several addresses.

10 See USPS-LR-FY12-44 for productive hourly wage rate and USPS-LR-FY12-24 for piggyback factors.

11 521k additional hours for parcels delivery times 59.42 times 8.69.

Table 2: Effects of plan 5+ on street time cost on Saturdays

	Route and access time	Load time
Status quo hours (sample)	1,750,150	3,314,941[12]
Plan 5+ hours (sample)	521,837	194,885
Avoided costs (all city carriers, USD)	**634,466,665**	
Incremental costs compared to plan 5 (all city carriers, USD)	**269,546,784**	

Overtime

For the effects on overtime, actual USPS working hours for every day and route are known from the DOIS data. The new working hours on Fridays, Saturdays, and Mondays are calculated as the actual working hours in FY2012 plus/minus the additional/reduced working hours from the changes in street time and volume shifts. Overtime is then defined as total working hours minus 8 hours.

Assuming Saturday street times of **Fehler! Verweisquelle konnte nicht gefunden werden.** and that the routes on Friday and Monday are not redesigned due to the additional volumes, the additional hours on Friday and Monday can be calculated as follows:

$$\Delta streethours_{Friday} = 0.0018 * 0.25 * letters_{Saturday} + 0.0015 * 0.25 * flats_{Saturday}$$

$$\Delta streethours_{Monday} = 0.0018 * 0.75 * letters_{Saturday} + 0.0015 * 0.75 * flats_{Saturday}.$$

As DOIS provides data on every delivery day, the volume shifts are done for every Saturday in FY 2012 for each route. Thus, the entire FY 2012 volume shifts are simulated under the new delivery regime.

The same is done for the office hours by using the coefficients of the office hours regression, i.e.,

$$\Delta officehours_{Fr} = 0.003 * 0.25 * casedletters_{Saturday} + 0.0025 * 0.25 * casedflats_{Saturday}$$

$$\Delta officehours_{Mo} = 0.003 * 0.75 * casedletters_{Saturday} + 0.0025 * 0.75 * casedflats_{Saturday}$$

The upper bound of the additional overtime hours is shown in Table 3 by applying constant productivity per piece, independent of the weekday, as it is assumed in plan 5+ low. An assumed hourly surcharge of USD 13.92 results in incremental overtime costs of USD 378 million. In plan 5+ high, it is assumed that overtime can be managed by flexible workforce and hence no overtime costs occur.

Table 3: Financial effect of additional overtime hours

[USD]	Additional overtime hours	Cost effect in plan 5+ high [USD]	Cost effect in plan 5+ low [USD]
Friday (25% of letters and flats from Saturday)	6,870,268	0	95,634,131
Saturday (no letters and flats)	-1,983,070	0	-27,604,328
Monday (75% of letters and flats from Saturday)	22,289,669	0	310,272,196
Total	**27,176,868**	**0**	**378301,999**

[12] DOIS does not differentiate access and load times. The reported load time here is an estimate from the calibrated model.

4. Financial impact analysis

The above findings are now incorporated into an estimation of the annual overall financial effect on USPS. First, the direct effects are summarized. These are then complemented with the indirect effects caused by consumers' response, leading to lower volumes.

Direct effects of plan 5+ in delivery

Based on the bottom-up model, the following estimates on direct effects on USPS' operational delivery cost for city carriers emerge. As revealed in **Fehler! Verweisquelle konnte nicht gefunden werden.** above, the direct savings are USD 634 million before overtime effects, assuming that the cost for load times for letters and flats are shifted from Saturdays to other weekdays with no change in productivity. If the plan 5 assumption of higher productivity on Mondays is applied, the savings are USD 892 million. The figure is the plan 5 savings of 1162 (which already includes assumed USPS productivity savings of shifted load time) less the incremental cost of route and access time for standalone parcel delivery on Saturdays of 270 million (from **Fehler! Verweisquelle konnte nicht gefunden werden.** above). The more conservative estimate of USD 634 million is taken for plan 5+ low, and the higher value of USD 892 million for plan 5+ high incorporates USPS assumption of higher productivity on Mondays.

In terms of overtime, the street time calculations for Friday, Saturday and Monday for FY 2012 translate into an upper bound of incremental overtime costs of USD 378 million. The recent American Postal Workers Union contract allows greater use of workers with more flexible work schedules. This may allow USPS to handle peak loads with fewer overtime hours. If all overtime hours were managed this way, zero additional paid overtime hours could occur. As the scenario plan 5+ high aims at providing an upper bound in terms of saving, it is assumed that additional overtime hours can be fully managed with this flexible work force (resulting in zero additional costs). In contrast, in plan 5+ low, it is assumed that additional overtime hours are required of the carrier in place, i.e., a surcharge on the daily rate is incurred and causes an additional cost of USD 378 million.

For rural carriers, no such savings or incremental costs relative to plan 5 are assumed, as rural carriers are paid by the number of various workload elements (e.g., pieces, miles, and delivery points) each route requires. For incremental express delivery costs, plan 5 estimates are adopted. For administrative "indirect" carrier costs, the approach used by USPS for plan 5 is applied, leading to an estimated additional savings of USD 265 million (plan 5+ high) and USD 238 million (plan 5+ low). In total, the estimated direct savings of plan 5+ in delivery range between USD 0.9 and 1.7 billion. **Fehler! Verweisquelle konnte nicht gefunden werden.** provides an overview and compares with plan 5.

Direct effects of plan 5+ on other processes

For processes other than delivery (collection, sorting, and transportation), it is assumed that in the plan 5+ high scenario, the same operational changes are made as in plan 5 (because the plan 5 processing architecture is compatible with plan 5+). The PRC estimated these savings at about USD 290 million.[13] In plan 5+ low, it is assumed that Saturday dispatch continues as in the status quo; therefore, no adaptations take place in these processes compared to the status quo, and there are no savings. However, continuing the dispatch would lead to faster end-to-end delivery times, implying a somewhat reduced secondary effect of consumer response.

In total, the estimated direct effects of plan 5+ range from USD 0.9 billion for plan 5+ low to 2 billion for plan 5+ high.

[13] For further information see Trinkner and Haller (2014).

Overall financial impact

The yearly impact on USPS' profits is computed as the combination of the direct effects of cost reductions, and indirect effects of volume changes as customers respond to the changed level of service. If consumers respond to plan 5+ by sending fewer mail items, the resulting loss of revenue will partially offset savings. To indicate the magnitude of these effects, profitability boundaries are calculated and illustrative demand scenarios are evaluated.

The profitability boundaries are computed by solving for the magnitude of reduced mail demand that would offset savings. For plan 5+ high, this results in a maximum volume loss of 7.5% on average. For plan 5+ low, an average volume loss of 3.5% would offset savings.

For the illustrative demand scenarios, demand responses are assumed to be smaller in plan 5+ low compared to plan 5+ high because of less severe effects on quality. The results are shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**. In plan 5+ high, indirect effects caused by the assumed volume loss of 2.20% on average would reduce profits by about USD 570 million. In plan 5+ low, consumers respond less sharply, leading to a decrease of USD 287 million. The illustrative demand scenarios hence indicate plan 5+ net savings ranging between USD 0.6 and 1.4 billion. This compares to the expected savings of USD 1.7 billion for plan 5 and estimated USPS savings of USD 2 billion for plan 5+. As no details are known, it remains unclear where the differences are stemming from.

Table 4: Financial effects of plan 5+ compared to plan 5

M USD	Plan 5	Plan 5+ high	Plan 5+ low
Direct effects (direct avoided cost)	**2'276**	**1'966**	**912**
Savings Collection/Sorting/transport	290	290	-
Savings Delivery	1'987	1'677	912
City carrier direct street time	1'162	892	634
City carrier direct in-office costs	102	102	-
City carrier adjustment for cost of overtime hours	-	-	(378)
Rural carriers all and city carrier Saturday expres	418	418	418
Indirect cost for city and rural carriers	305	265	238
Indirect effects for FY2012 (lost contribution)	**(571)**	**(573)**	**(287)**
Average volume response	-2.22%	-2.20%	-1.10%
Foregone revenue*	(1234)*	(1'169)	(585)
Avoided cost*	663*	596	298
Total Savings	**1'705**	**1'393**	**625**

Aadapted to FY2012 figures

A final assessment would require additional details of the plan and its calculations, and market research on consumers' response to the plan. The estimated impact on USPS finances, which measures the impact on producers' surplus, may be complemented with an assessment of the impact on consumers' surplus to estimate the overall economic effects. If such a comprehensive analysis would point toward the elimination of Saturday delivery, this may then as well imply a similar result for eliminating delivery on other days of the week.

5. Implications for the net cost of the USO

According to the profitability cost approach pioneered by Panzar (2000) and Cremer et al. (2000), the "net cost of the USO" N is the difference in profits in a competitive environment without USO π^1 and with USO (status quo) π^0:

$$N^{Profitability\ Cost} \equiv \pi^1 - \pi^0 = \underbrace{(R^1 - C^1)}_{\text{Profit without USO}} - \underbrace{(R^0 - C^0)}_{\text{Profit with USO}} = \underbrace{(C^0 - C^1)}_{\text{Avoided Cost}} - \underbrace{(R^0 - R^1)}_{\text{Foregone Revenue}}. \qquad (2)$$

If a modified delivery schedule is not feasible due to the US USO, then equations (1) and (2) are equal.[14]

Therefore, if plan 5 or plan 5+ are not feasible because of USO constraints, then the results above may qualify as (a component of) net costs of the USO. For such a classification, an analysis of the legal framework, other USO dimensions, the hypothetical behavior of USPS, and potential benefits of the USO would be necessary. Moreover, the calculations from plan 5 would require a thorough validation and adaptation to more recent data. A comprehensive discussion is beyond the scope of this paper. However, some indications can be provided.

Currently, the net additional cost of maintaining six days of delivery instead of five days is considered to be an element of the cost of the USO, because six-day delivery is required by law and PRC has judged that with fewer than 5 delivery days a week it would be difficult for the mail to remain an attractive channel for bills, remittances, and date-specific advertising.[15] The selection of five-day delivery as the level of service an operator would provide in the absence of the six-day mandate predates the proposal by USPS to retain Saturday parcel delivery. It is possible that the demand for parcel delivery would justify the continuation of Saturday delivery of parcels if the six-day obligation were removed – with USPS' plan 5+ providing a strong indication. If this is the case, it would follow that the estimate of this element of the cost of the USO should be modified to reflect the cost of discontinuing Saturday delivery of letters and flats, as opposed to discontinuing all Saturday delivery service.

6. Conclusions

The USPS perceives increasing pressure to cut costs. Discontinuing the delivery of letters and flats on Saturdays while maintaining parcels delivery, as announced by the USPS in 2013, may be a way to go for the postal service. This "plan 5+" contrasts to "plan 5", a failed attempt of USPS to discontinue the delivery of parcels on Saturdays as well.

In this paper, a methodology is presented to evaluate the financial effects of modifications in the delivery process. In a first step, the shortest path to serve of each carrier route is calculated bottom-up, resulting in a proxy for route and access time per route. In a second step, the proxy is (together with delivered volumes per route and day) regressed against measured USPS street time. Based on the procedure of the first step, different volume and delivery scenarios such as parcel-only delivery on Saturdays of plan 5+ can be evaluated.

The calculations for plan 5+ lead to an estimate of net savings ranging between USD 0.6 and 1.4 billion. USPS' plan 5+ hence appears to make sense from a business point of view. From an economic point of view, plan 5+ should be implemented if the estimated savings are not offset by decreases in consumer surplus. Such a weighing up would require a more thorough demand analysis. The estimated net savings may however qualify as net cost of the USO and should be reflected accordingly in future costing exercises related to net costs.

The model can be modified to evaluate a variety of possible scenarios that would alter the number and location of addresses served by a route on a given day, as well as a more general examination of the behavior of street delivery costs. The study currently used by the USPS and PRC to estimate the volume variability of city carrier street time costs predates many recent operational changes. It is currently being reviewed, and the USPS is collecting data on parcel delivery costs to be used in combination with data on regular delivery and mail collection to develop an

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[14] Technically, this is limited to the special case where no other plans exist where one or several universal service obligations are binding. If there are other service modifications that are profitable but not feasible because of the USO, then the net costs are higher and the net costs of plan 5+ are one element of the net costs.

[15] Postal Regulatory Commission, Report on Universal Postal Service and the Postal Monopoly, December 19, 2008, page 123.

updated analysis of total street time costs. The model presented in this paper may prove useful in validating the results of that analysis and providing additional insight.

To respond to recent volume declines and financial difficulties, the USPS may also consider potential changes in delivery operations other than (or in addition to) reduced delivery frequency. Possible changes could include converting routes where deliveries are made to the door into curbline routes, or delivering to centralized neighborhood locations instead of delivering to each address. The model used in this report could be modified to evaluate the likely impacts of these types of operational changes.

In addition to potential changes to USPS operations, the model may allow for a refinement to the estimated value of the letter and mailbox monopolies. The current method is based on the contribution that would be lost due to volume captured by a hypothetical competitor if the monopolies were lifted. It is assumed that if a competitor could profitably deliver the contestable mail on a given delivery route, that USPS would lose that volume to the competitor. This restricts the hypothetical competitor to the route design currently used by the Postal Service. However, a competitor would have a different mix of mail to deliver and would probably deliver less frequently than USPS, suggesting that its optimal route design could potentially be very different. The model could be used to identify the most profitable route design for a competitor, which would allow for the development of an improved estimate of the value of the letter and mailbox monopolies.

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