The Calculation of Postal Inframarginal Costs
Charles McBride

1. Introduction

In this task, we develop and apply methodologies for calculating inframarginal costs by cost component.   We first present a review of the literature on using the USPS accounting system to calculate marginal, volume variable, specific fixed, attributable, incremental, and inframarginal costs in Section 2.2 below. Since the constant elasticity function plays a pivotal role in USPS cost analysis, we describe this function and its properties in Section 2.3. In Section 2.4, we describe our methods for calculating inframarginal costs. We present our results for Fiscal Years 2007 and 2013 in Section 2.5.   Finally, we provide a summary of our Excel workpaper in an Appendix.

2. Review of Relevant Literature

The purpose of this section is to review the history of the development and calculation of USPS incremental costs in the formal economics literature and in earlier PRC rate cases. This review will serve to introduce the extensive (and sometimes confusing) terminology used by economists and the Postal Service in this area, and will also be used as the starting point for our calculations of inframarginal costs.

Bradley, Colvin and Smith, 1993

USPS inframarginal costs were first mentioned publicly in a 1993 paper by Bradley, Colvin, and Smith.[1] The authors noted that marginal costs vary with the level of output, but do not incorporate "any truly fixed cost or infra-marginal cost" (see page 135, last partial paragraph). They also mentioned that inframarginal cost "…is the amount of variable cost that has been incurred in producing all the previous units of output up to the current level of production" (see page 136, first partial paragraph). The authors then address how the postal product cost structure can be estimated from USPS accounting data. Because of the complexities involved in estimating an aggregate top-down cost function, "postal product costing, including econometric cost estimation, is conducted on a disaggregated basis" (see page 138, third full paragraph). This bottom-up approach involves estimating volume-variable cost[2] for each cost component within the twenty USPS cost segments. The importance of incremental costs in product pricing to avoid cross-subsidization is also discussed, but the authors note that the USPS accounting system was not being used to estimate incremental costs at that time.

Bradley, Colvin and Panzar, 1999

Further developments in the use of the Postal Service accounting system for product pricing were described in a 1999 paper by Bradley, Colvin, and Panzar.[3] They described the USPS cost

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[1] Bradley, Michael; Jeff Colvin and Mark Smith (1993), "Measuring Product Costs for Ratemaking: The United States Postal Service," in M.A. Crew and P.R. Kleindorfer eds*., Regulation and the Nature of Postal and Delivery Services*, Kluwer Academic Publishers.

[2] The authors note that volume variable cost is a term used by the Postal Service to refer to the product of marginal cost and output and that it does not refer to the "textbook concept of (total or average) variable cost."

[3] Bradley, Michael; Jeff Colvin and John Panzar (1999), "On Setting Prices and Testing Cross-Subsidy Using Accounting Data*," Journal of Regulatory Economics*, 16: 83-100.

system in terms of a "bottom-up" cost component structure, which incorporates both economies of scale and economies of scope. Each cost component j may have fixed costs F_j, which include both product specific and common costs; and/or variable costs $VC_j(D_j)$, which are solely a function of the total amount of a cost driver D_j. For each component, the driver D_j is a weighted sum of the product volumes, where the weight for a given product is the amount of the driver required for one unit of the product.[4] The authors then show analytically that volume variable cost VVC_j for a component is the product of total cost C_j times the elasticity e_j of cost with respect to the driver.

Although not explicitly stated in the paper, this functional form for C_j, which reflects economies of scale and scope, is the constant elasticity function. After use of some algebra and differential calculus, the authors demonstrate that $C_j = e_j C_j + (1-e_j)C_j$, where the first term of this equation is the component's volume variable cost and the second term "includes both the component's fixed cost and any infra-marginal costs generated by increasing returns to scale in the driver" (see page 89, last paragraph) Product incremental costs can also be calculated for this cost function. Let D_{ij} be the reduction in the driver for component j when product i is removed from the system. Then the incremental cost IC_{ij} for product i and component j $= F_{ij} + VC_j(D_j) - VC_j(D_j-D_{ij})$, where F_{ij} is the specific fixed cost for product i and component j.

PRC Docket R97-1

The Postal Service first presented the concept of incremental costs for regulatory review in PRC Docket R97-1. The theoretical development was described in testimony by John Panzar (USPS-T-41) and was very similar to the later version described in the 1999 Bradley et al paper. Calculations of product incremental cost for the 1996 base year were provided in the testimony of William Takis (USPS-T-41). Witness Takis used the component-by-component "bottom-up" approach to calculating incremental costs. He first classified each component as *independent* or *dependent*, depending on whether or not the component had its own distribution key and a variability estimate. Next, he used one of the three following methods for calculating the incremental costs for each independent component:

- *Equation-Based*: incremental costs are calculated using a specific functional form for the cost function. The functional form is developed econometrically and usually has more than one elasticity parameter. In Docket R97-1, econometric methods were used to estimate cost functions for mail processing labor, purchased transportation, and city carrier load time.
- *Constant Elasticity:* used for independent components that have variability estimates and distribution keys but do not meet the requirements for equation-based calculation.
- *Other:* used for independent components that are based on single-subclass stops, specific fixed costs for more than one product, or are 100 percent volume variable costs.

To calculate the incremental costs of the dependent components, Takis uses the "burden" method, which distributes costs based on the distribution of the sum of one or more independent components.

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[4] For example, the driver might be employee manhours in a particular mail processing operation, or the cost of the employee manhours.

PRC Docket R2000-1

In Docket R2000-1, the Postal Service again presented theoretical testimony (Michael Bradley, USPS-T-22) and empirical calculations (Nancy Kay, USPS-T-23) for incremental costs, but with somewhat different procedures than those used in Docket R97-1. First, witness Bradley specifies the difference between a "calibrated" cost model and an "estimated" cost model. An estimated model has econometrically-estimated parameters using a single set of data. A calibrated model has parameters that are determined from a variety of sources, including econometric studies, engineering studies and even informed judgment. The calibrated model has a constant elasticity structure.[5] A single volume variability for a component can be calculated directly from the parameters of an econometric model or simply as the ratio of volume variable costs and accrued costs; this volume variability estimate is then used as the elasticity parameter in the constant elasticity cost function. Witness Bradley's R2000-1 approach to calculating incremental costs is different from the earlier R97-1 method in that he uses *only* calibrated models instead of a combination of estimated and calibrated models.

As shown in witness Kay's workpapers,[6] the Excel workbook WPTables.xls provides a complete description of her calculation of incremental cost for each cost component. For components that include multiple cost pools within a component (e.g., mail processing and window service), she provides this same information on a more detailed (subcomponent) level.

Docket R2006-1 and After

The Postal Service continued its calculations of incremental costs in Dockets R2001-1, R2005-1, and R2006-1. The same procedure established in Docket R2000-1 was used in each case, but minor changes in the accounting system, such as changing the number of cost pools in various cost components, were incorporated. In Docket R2006-1, Witness Dion Pifer presented the most recent public version of the USPS methods for calculating incremental costs in USPS-T-18 and library reference USPS-LR-L-72.

In 2006, the postal regulatory landscape was changed dramatically by the passage of the Postal Accountability and Enhancement Act. The new regulatory focus was primarily on whether the USPS prices for market-dominant products stayed under a CPI-based price cap. For purposes of changing rates, the USPS filed detailed annual reports to the PRC in "ACR" Dockets instead of omnibus rate case filings. Much of the annual data submitted in these reports were similar to the data presented in earlier omnibus rate cases. However, incremental costs for non-competitive products were no longer published, except for product specific fixed costs which were considered to be attributable costs. Incremental costs for competitive products were also submitted to the PRC, but with confidentiality restrictions.

3. Constant Elasticity Cost Function

Since the constant elasticity function[7] plays such an important role in USPS costing, we present a short summary of the function and its properties in this section. In mathematical terms, the

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[5] Described above in the summary of the 1999 Bradley et al paper.
[6] See the Support Materials folder in USPS-LR-I-150.
[7] This function is also known as the "isoelastic" function. For more information on its properties, see the Wikipedia article at http://en.wikipedia.org/wiki/Isoelastic_function.

Figure 1
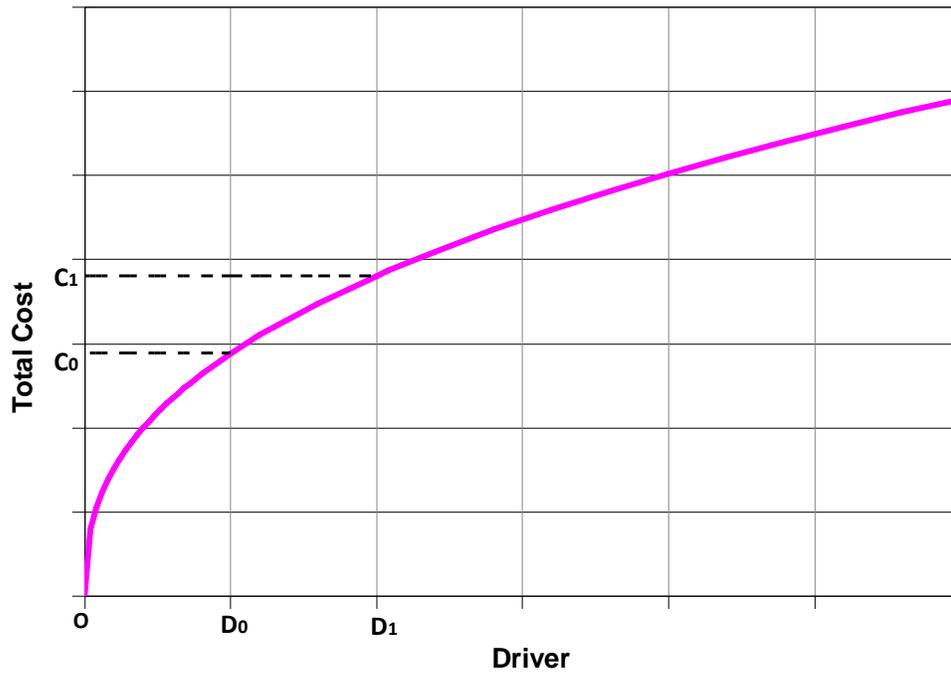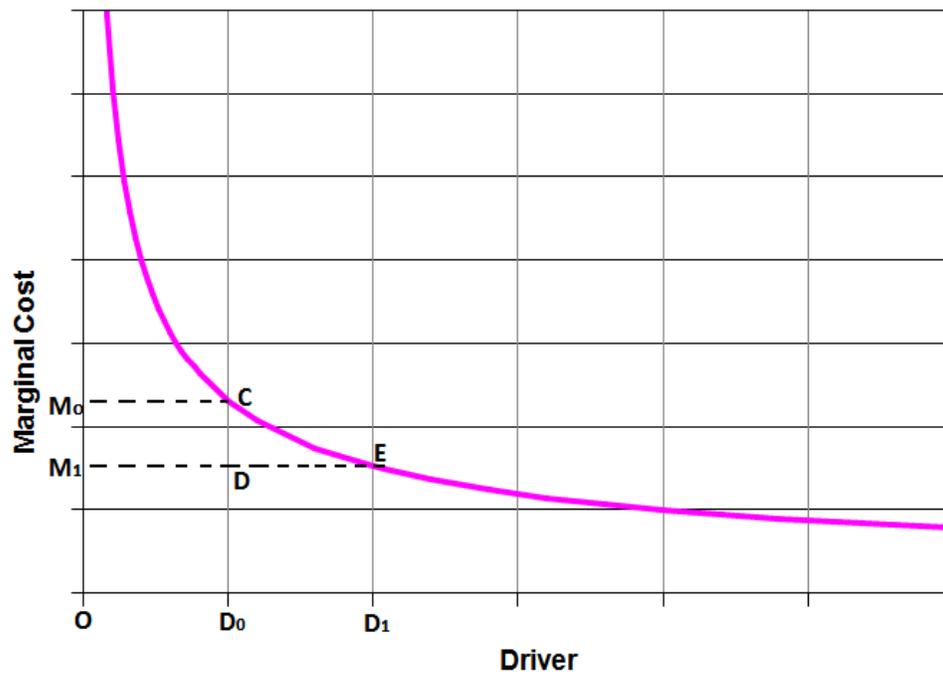**Example of Constant Elasticity Cost Function**

Total Cost

C_1

C_0

O D_0 D_1

Driver

Figure 2
Example of Constant Elasticity Marginal Cost Function

Marginal Cost

M_0 — — — C

M_1 — — — E
            D

O D_0 D_1

Driver

constant elasticity function is defined by $C = AD^e$, where C is total cost, A is a constant, D is a cost driver, and e is the elasticity parameter. Plots of a typical constant elasticity (e = 0.6) cost function and its slope (marginal cost function) are shown in the two figures above.

It can be seen from Figure 1 that the constant elasticity function passes through the origin and thus has no fixed cost; this means that all costs are variable costs (in the economic sense). Figure 2 can be used to show how total costs are segmented into volume variable costs[8] and inframarginal costs. As an example, the total costs at driver level D_0 are equal to the area under the marginal cost curve from the origin O to D_0. The volume variable portion is the rectangular area under the line M_0-C from the origin O to D_0. The infra-marginal portion is the area between the marginal cost curve and the line M0-C. As noted in Section 2.2 above, the volume variable costs are equal to $eAD_0^e = eC_0$, so by simple algebra, inframarginal costs are equal to $(1-e)C_0$.

These relationships also hold for changes in the driver level and the resulting changes in costs. Note in Figure 1 that the effect of increasing the driver level from D_0 to D_1 is to increase total costs from C_0 to C_1. It can be shown with some algebra and calculus that the exact difference in cost is

$$\Delta C = C_1 - C_0 = C_0 \left[\left(\frac{D_1}{D_0} \right)^e - 1 \right]$$

It should be noted that if the change in the driver $\Delta D = D_1 - D_0$ is small compared to D_0, then it can be shown that approximately, $\Delta C/C_0 = e(\Delta D/D_0)$. Thus the percentage change in costs is approximately equal to the elasticity e times the percentage change in the driver.[9]

The difference in total costs ΔC is the area enclosed by the points D_0-C-E-D_1. The inframarginal cost difference is the area C-D-E, and the volume variable cost difference is the area D_0-D-E-D_1. The change in volume variable and inframarginal costs can shown to equal $e\Delta C$ and $(1-e)\Delta C$, respectively.

The constant elasticity function plays a major role in postal costing because it is a simple one-parameter function that can reflect the economies of scale and scope inherent in many postal activities. As noted above, it has the useful analytical property that the change in volume variable equals $e\Delta C$, and so the change in inframarginal costs equals $(1-e)\Delta C$. This means that volume variable costs and inframarginal costs are proportional for all levels of the driver.

4. Approach for Calculating Inframarginal Costs

In this section we describe the steps and data sources used to calculate inframarginal costs for Fiscal Years 2007 and 2013. We will illustrate the process for FY 2007, but the same process is used for FY 2013.

Our approach incorporates the same USPS constant elasticity structure[10] used to calculate volume variable and incremental costs. We will use the same bottom-up calculation method

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[8] Recall from the above literature review that USPS volume variable costs do *not* correspond to the economic concept of variable costs. It is apparently a term used only by the Postal Service to indicate the product of marginal costs and product volume.

[9] This approximation is based on the first-order term of the Taylor Series expansion for the function $(1+x)^e$ and is reasonably accurate for values of x up to 0.20.

described in Section 2.2 above, so we need source data that contains the maximum amount of cost component detail. This detailed data is contained in the USPS CRA Model Public B Cost Matrix, which is provided as a USPS library reference for the various ACR dockets, starting with Docket ACR2007.[11] This cost matrix is an Excel workbook that contains cost data by cost segment, cost component, and product.

For purposes of calculating inframarginal costs for a cost component, we do not need the product detail, so we use only the attributable, Other,[12] and total costs from the CRA Cost Matrix. Also, we do not need to know the product specific fixed costs that are used in calculating incremental costs. Since FY 2007, the Postal Service has considered product specific fixed costs to be part of attributable costs, along with volume variable costs. But attributable costs have already been calculated and are included in the CRA cost matrix, so our task is simplified considerably. To calculate inframarginal costs, we need only to split Other costs into inframarginal and fixed portions, as summarized below:

- For independent cost components that use the constant elasticity cost function, Other costs are inframarginal.
- For non-constant elasticity components, Other costs are fixed.[13]
- For dependent cost components, Other costs will usually be part inframarginal and part fixed, because dependent components are based on a sum of components, some of which have inframarginal costs while others have fixed costs.

Independent Components

Independent components that are 100 percent fixed are easily identified in the CRA Cost Matrix. To classify the other independent components, we use the approach introduced by witnesses Bradley and Kay in Docket R2000-1 and updated by witness Pifer (USPS-T-18) in Docket R2006-1. Table 1 below contains excerpts from Pifer's worksheet WPTable1.xls.[14] The column labeled "IC Model Reference" lists the R2006-1 Pifer worksheet(s) used to calculate the costs for each component.

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[10] The constant elasticity structure may not refer only to cost components that use the constant elasticity function. It may also apply to other components that have a volume variability that is considered constant over time even though there are fixed costs. A more apt term might be "constant variability structure."

[11] USPS-LR-5 – FY 2007 CRA Model (Model Files, Cost Matrices, and Reports).

[12] For pricing purposes, the term "contribution to institutional costs" is used to indicate the difference between the revenue and the attributable cost for a product, so it is similar to the business term "product profitability." In USPS cost analysis, the term "other" costs is used to mean the difference between total costs and attributable costs. To avoid confusion, in this paper we will assume that institutional costs are equal to other costs, but we will use both terms depending on the subject under discussion. To reduce confusion, we will capitalize the term "Other."

[13] Again, this approach was used by the Postal Service to calculate incremental costs before FY 2007, and, *with serious reservations*, we adopt the same approach for calculating inframarginal costs in this paper.

[14] The complete version of Pifer's Table 1 is included in our Excel workpaper.

Table 1. Examples of Inframarginal Cost Calculations

Cost Segment	Cost Component/ Description	CRA Model Component Number	Source of Cost Pool	Incremental Cost Treatment, R2006-1	R2006-1 IC Model Reference
1	Postmasters EAS 23 and Below	1		CE	ConsElas.xls, ICSummary.xls
2	Higher Level Supervisors	30		CE	ConsElas.xls
	Central Mail Mark-Up Supervision	677		IC=VVC	ICSummary.xls
3	Admin Clerks – Claims and Inquiry	66		IC=VVC	ICSummary.xls
	Admin Clerks – Data Collection	421		CE	ConsElas.xls
	Admin Clerks Other	41		IC=VVC, PS	ICSummary.xls
	Admin Clerks Specific Fixed	227		PS	ICSummary.xls
11	Operating Equip. Maintenance Personnel	75	Distributed to cost pools using keys		ICSummary.xls
	OCR		1233	CE	Equip.xls
	MPBCS		1234	CE	Equip.xls
	CSBCS		1235	CE	Equip.xls
	DBCS		1236	CE	Equip.xls
	MERLIN		1237	CE	Equip.xls
	FSM		1238	CE	Equip.xls
	LTR Cancel		1240	CE	Equip.xls
	Flats Cancel		1241	CE	Equip.xls
	Cull		1242	CE	Equip.xls
	RBCS		1243	IC=VVC	Equip.xls
	CFS		1231	CE	Equip.xls

The first row in the table shows that costs for the Segment 1 component Postmasters EAS 23 and Below are based on the constant elasticity function, so all of the Other costs for this component are inframarginal. The same is also true for the Segment 2 component Higher Level Supervisors. However, the Segment 2 component Central Mail Markup Supervision is considered part attributable and part Other, so Other costs are assumed fixed for this component. Similarly, the Other costs for the Admin Clerks Other component in Segment 3 are fixed, since this component's incremental costs are equal to the sum of its volume variable costs and product specific fixed costs.

The Operating Equipment Maintenance Personnel component in Segment 11 requires a more complex classification method, because it is based on the sum of costs from several cost pools, each with its own variability estimate and distribution key. Fortunately, all of the cost pools except for the RBCS pool use the constant elasticity method, and so the sum of Other costs for these pools will be inframarginal. Given the fact that our goal in this paper is to calculate a relatively accurate estimate of system-wide inframarginal costs, it seems appropriate to assume the RBCS pool is also a constant elasticity pool if the error caused by this approximation is small. Because the FY 2007 CRA Cost Matrix contains the distribution keys for these cost pools, we can estimate the size of this error. RBCS fixed costs amount to less than 0.1 percent of total costs for these pools, so the effect of assuming this amount is inframarginal rather than

fixed is negligible. Multiple cost pools are also used for other components, including mail processing and window service, but the constant elasticity pools are much greater in magnitude than the non-constant elasticity pools, so the same approximation will be used for these components.

Dependent Components

Attributable and Other costs for dependent components are calculated based on the proportions of attributable and Other costs in a distribution key which is the sum of one or more independent components. However, to calculate inframarginal and fixed costs for dependent components, it is necessary to first total up the inframarginal and fixed costs in the various components in the distribution key. The specific cost components used to form these keys are listed in the USPS documentation for the CRA Cost Model in the various ACR dockets.[15] The details of these calculations are provided in the Task 2 Excel workpapers, which are described in the Task 2 Appendix.

5. Results of Inframarginal Cost Calculations

There are about 250 cost components in the USPS cost accounting system, too many to list in this paper, but the data for each component are included in our workpaper.

Results Based on USPS R2006-1 Method

Our results are based on the R2006-1 Postal Service assumptions regarding the classification of all cost components as far as the level of volume-variable cost variability and whether or not the component was considered to be in the constant elasticity family of cost functions. Table 2 below shows summary FY 2007 and FY 2013 results for attributable, Other, total, inframarginal and fixed costs by cost segment. Table 3 shows summary FY 2013 results in the same format, but these costs are in real 2007 dollars to account for the 12.4 percent CPI change over that period. [16]

We feel obliged to say that we have serious reservations about the lack of a consistent approach as well as documentation for the criteria used by the Postal Service to decide which components would be designated as constant elasticity components and which would not. This problem may be due to the fact that the concept of incremental cost was rejected by the Commission in this early period, and that this lack of interest resulted in the absence of the usual litigation-based scrutiny of any new costing concept. It should be kept in mind when reviewing the numerical results for inframarginal costs presented in Tables 2 and 3 and elsewhere in this paper.

The results shown in the above tables have been adjusted to remove the distortions caused by recent large changes in Worker's Compensation and Retiree Health Benefits costs over the FY 2007-2013 time period. The italicized rows labeled "unadj" for CS 18 and All Segments are included to show the large difference in results with and without this adjustment.

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[15] For example, the ACR2007 keys were based on USPS-LR-4, workbook FY07.cntl.xls, sheet DK Addends.

[16] BLS CPI Inflation Calculator, http://data.bls.gov/cgi-bin/cpica.

Table 2. Summary of FY 2007 Segment Costs (no WC/RHB)

Cost Segment	FY07 Total Attributable	FY07 Other Costs	FY07 Total Costs	FY07 Attrib Cost %	FY07 InfMar Costs	FY07 Fixed Costs	FY07 Total Cost Share
C/S 1 Postmasters	389,082	1,799,296	2,188,378	17.78%	1,745,221	54,075	3.2%
C/S 2 Supervisors & Technicians	2,293,693	1,789,004	4,082,697	56.18%	903,980	885,024	5.9%
C/S 3 Clerks & Mailhandlers CAG A-J	15,663,709	3,004,184	18,667,893	83.91%	2,780,389	223,795	27.0%
C/S 4 Clerks CAG K	2,935	1,776	4,711	62.30%	1,776	0	0.0%
C/S 6 City Delivery Carriers Office	4,310,057	867,344	5,177,402	83.25%	0	867,344	7.5%
C/S 7 City Delivery Carriers Street	4,107,048	6,981,595	11,088,642	37.04%	5,401,234	1,580,361	16.0%
C/S 8 Vehicle Service Drivers	397,499	260,177	657,676	60.44%	260,177	0	1.0%
C/S 10 Rural Carriers	2,584,381	3,777,322	6,361,703	40.62%	0	3,777,322	9.2%
C/S 11 Custodial & Maint Services	2,325,875	996,398	3,322,273	70.01%	996,398	0	4.8%
C/S 12 Motor Vehicle Service	324,959	883,828	1,208,787	26.88%	284,797	599,031	1.7%
C/S 13 Misc Local Operations	61,331	672,645	733,976	8.36%	98,372	574,273	1.1%
C/S 14 Transportation	5,764,377	737,651	6,502,028	88.66%	633,712	103,939	9.4%
C/S 15 Building Occupancy	1,333,251	602,706	1,935,957	68.87%	264,319	338,387	2.8%
C/S 16 Supplies & Services	1,339,143	1,427,414	2,766,557	48.40%	627,007	800,406	4.0%
C/S 17 Research & Development	0	19,792	19,792	0.00%	0	19,792	0.0%
Unadj C/S 18 Admin and Area Operations	*3,459,948*	*6,526,167*	*9,986,116*	*34.65%*			*14.4%*
Adj C/S 18 Admin & Area Ops (no WC/RHB)	173,217	1,795,687	1,968,904	8.80%	23,127	1,772,560	2.8%
C/S 19 General Management Systems	0	50,575	50,575	0.00%	0	50,575	0.1%
C/S 20 Other Servicewide Expenses	1,706,522	695,100	2,401,622	71.06%	394,475	300,624	3.5%
Unadj All Segments	*46,063,811*	*31,092,974*	*77,156,785*	*59.70%*			
Adj All Segments (no WC/RHB)	42,777,080	26,362,493	69,139,573	61.87%	14,414,984	11,947,510	100.0%
Category % for Adj All Segments	61.87%	38.13%	100.00%		20.85%	17.28%	

Table 3. Summary of FY 2013 Segment Costs (2007$, no WC/RHB)

Cost Segment	FY13 Total Attributable	FY13 Other Costs	FY13 Total Costs	FY13 Attrib Cost %	FY13 InfMar Costs	FY13 Fixed Costs	FY13 Total Cost Share
C/S 1 Postmasters	318,002	1,476,512	1,794,514	17.72%	1,426,386	50,126	3.2%
C/S 2 Supervisors & Technicians	1,533,153	1,292,062	2,825,215	54.27%	707,969	584,093	5.1%
C/S 3 Clerks & Mailhandlers CAG A-J	10,220,412	1,998,069	12,218,481	83.65%	1,874,618	123,451	21.9%
C/S 4 Clerks CAG K	3,727	1,409	5,136	72.56%	1,409	0	0.0%
C/S 6 City Delivery Carriers Office	2,735,784	459,626	3,195,410	85.62%	0	459,626	5.7%
C/S 7 City Delivery Carriers Street	4,012,868	6,700,689	10,713,557	37.46%	5,223,174	1,477,515	19.2%
C/S 8 Vehicle Service Drivers	324,955	212,694	537,649	60.44%	212,694	0	1.0%
C/S 10 Rural Carriers	2,024,106	4,004,495	6,028,601	33.58%	0	4,004,495	10.8%
C/S 11 Custodial & Maint Services	1,918,113	801,201	2,719,314	70.54%	801,201	0	4.9%
C/S 12 Motor Vehicle Service	367,835	971,741	1,339,577	27.46%	286,032	685,709	2.4%
C/S 13 Misc Local Operations	61,275	486,835	548,110	11.18%	93,905	392,930	1.0%
C/S 14 Transportation	5,210,289	781,401	5,991,690	86.96%	653,677	127,724	10.7%
C/S 15 Building Occupancy	1,145,144	427,106	1,572,250	72.83%	211,788	215,318	2.8%
C/S 16 Supplies & Services	1,153,825	1,240,899	2,394,724	48.18%	451,077	789,822	4.3%
C/S 17 Research & Development	437	18,647	19,084	2.29%	0	18,647	0.0%
Unadj C/S 18 Admin and Area Operations	*2,655,460*	*7,714,287*	*10,369,747*	*25.61%*	*0*	*0*	*18.6%*
Adj C/S 18 Admin & Area Ops (no WC/RHB)	159,342	1,726,541	1,885,884	8.45%	13,224	1,713,317	3.4%
C/S 19 General Management Systems	91	40,952	41,043	0.22%	0	40,952	0.1%
C/S 20 Other Servicewide Expenses	1,501,559	524,965	2,026,525	74.10%	321,020	203,946	3.6%
Unadj All Segments	*35,187,035*	*29,153,590*	*64,340,625*	*54.69%*	*12,264,950*	*9,174,353*	
Adj All Segments (no WC/RHB)	32,690,918	23,165,844	55,856,762	58.53%	12,278,174	10,887,670	100.0%
Category % for Adj All Segments	58.53%	41.47%	100.00%		21.98%	19.49%	

Effect of Cost Changes between FY 2007 and FY 2013

Implementation of the R2006-1 USPS calculations of incremental costs required many assumptions about the variability structures of the independent cost components. For example, assigning a component to the constant elasticity family is tantamount to assuming the component is 100 percent variable in the economic sense. As discussed in the paragraph above, it is not clear to us what criteria were used by the Postal Service to make those choices for FY 2005. However, there were some inconsistencies.

For example, Higher Level Supervisors used the constant elasticity method and so were 100 percent variable (in the economic sense), while Other Supervisors and Technicians were considered fixed. Window Service components used the constant elasticity method, while Contract Stations were assumed to be 100 percent fixed.

Possibly, many of these decisions about volume variabilities were based on the favorable postal economic environment at the time. Volume was slowly but consistently growing, and The number of mid- and higher-level management employees changed very slowly during the typical three-year period between rate cases, so it made sense to consider these and other costs to be fixed. However, the unprecedented volume decline from FY 2005 to FY 2013 and the associated 30 percent reduction in the size of the USPS work force (including not only craft employees, but higher-level EAS and PCES employees) has shown that many of these assumptions were overly optimistic. Of course, we have the advantage of 20/20 hindsight, but the numbers show that costs for many of these so-called fixed or near-fixed cost components declined even more than the system-wide total cost, as shown in Table 4 below.

Table 4. FY13/FY07 Percent Change in Real Total Cost for Selected Components								
Component	Comp No.	Comp Category*	FY07 Total Costs	FY07 Attrib Cost %	InfMar Cost %	FY07 Fixed Costs	FY13 Total Costs (2007$)	%Chg Total FY13/FY07
Adj All Segments (no WC/RHB)			69,139,573	61.9%	20.8%	12,000,257	55,856,762	-19.2%
C/S 2 Prod Specific & Other S&T	0033	PSPF	594,581	0.0%	0.0%	594,480	391,544	-34.1%
C/S 3 General Office & Clerical	0422	IND 294	812,451	64.8%	20.3%	121,854	440,521	-45.8%
C/S 13 Employee Awards	0115	100F	365,498	0.0%	0.0%	365,498	237,284	-35.1%
C/S 13 Communications	0168	PSPF	102,272	0.0%	0.0%	102,249	64,111	-37.3%
C/S 15 Building Projects Expense	0169	100F	234,635	0.0%	23.6%	234,635	151,740	-35.3%
C/S 16 ADP Supplies & Services	0174	PAPF	466,503	0.3%	0.0%	464,874	576,304	23.5%
C/S 16 Misc Postal Sup& Serv	0177	IND 526	1,088,926	60.4%	0.0%	177,753	786,021	-27.8%
C/S 18 Inspection Serv Field Support	0195	100F	458,386	0.0%	0.0%	458,386	408,175	-11.0%
C/S 18 Supplies & Services	0210	PSPF	233,544	10.2%	0.0%	209,735	198,086	-15.2%
C/S 18 Area Administration	0193	100F	179,879	0.0%	0.0%	179,879	93,460	-48.0%
C/S 18 Headquarters	0191	PSPF	733,521	1.9%	8.0%	719,894	689,041	-6.1%
Total (w/o first row)			5,270,196	23.2%	8.0%	3,629,237	4,036,287	-23.4%

*This column contains abbreviations showing the method of calulcation for each component. "PSPF" means part specific fixed, part fixed;
"100F" means 100% fixed, and IND# means component # is the distribution key.

It can be seen from the table that real total costs declined by 19.2 percent between FY 2007 and FY 2013. Most of the other eleven components in the table declined much more. These eleven components are normally considered in the CRA system to be system-wide indirect costs which are distributed using some sort of system-wide distribution key, such as all USPS labor or all costs. The first row of the table shows that the economic variability of all (adjusted) costs in 2007 was 82.7 percent. The economic variability was only 31.2 percent for the sum of these

eleven components. Moreover, their combined fixed cost was $3.6 billion, which is 30 percent of total fixed costs, so these non-standard variability assumptions have a significant effect on the level of system-wide fixed costs. As an illustration, if this set of components was assumed to have the same economic variability as all costs (82.7 percent), their fixed costs would be reduced by about $2.7 billion, which in turn would reduce the 2007 system-wide fixed cost percentage to (17.28-3.92) = 13.36 percent.

Discussion of Results

Table 5 below shows summary results for FY 2007 and FY 2013 based on the Postal Service's R2006-1 method for classifying the various components.[17] It can be seen by that the overall attributable cost share declined from 61.87 percent in FY 2007 to 58.53 percent in FY 2013. From the last two columns of those rows, it can be seen that most of this 3.34 percentage point decrease was due to the increase in the fixed cost share from 17.28 to 19.49 percent, with the remainder due to an increase in the inframarginal cost share from 20.85 to 21.98 percent.

Table 5. Summary of Results for FY 2007 and FY 2013					
Year	Attrib Cost %	Other Cost %	Total Cost %	InfMar Cost %	Fixed Cost %
2007	61.87%	38.13%	100.00%	20.85%	17.28%
2013	58.53%	41.47%	100.00%	21.98%	19.49%

With the "bottom-up" USPS cost structure, changes in system-wide variability percentages over time are rarely due to large changes in component-level variability parameters.[18] More often they are due to the fact that each year the various cost components have different proportions of total accrued costs, and so the system-wide volume variability is in effect an accrued cost-weighted sum of the volume variability parameters of all components. The 2007-2013 change in system-wide fixed cost share provides a good example of this phenomenon. The large drop in volume over this period caused a significant drop in accrued cost shares for the Cost Segment 3 (Clerks and Mailhandlers) components (27.0% to 17.7%), because they are highly variable with volume. However, the accrued cost shares for the Cost Segment 7 (City Delivery Street Time) components remained about the same (16.0% to 15.5%), because these components are much less variable with volume.

Based on this information, several cost components that are now classified as fixed or mostly fixed could be considered to be system-wide indirect costs with their economic variabilities based on system-wide cost variability. A thorough examination of these and other components could lead to lower system-wide fixed costs shares, perhaps by four or five percentage points.

Aside: The Cost Rollforward Model and the USPS Constant Elasticity Structure

The Cost Rollforward Model has been used by the Postal Service to forecast future "test year" costs starting with a historical "base year" cost matrix since at least the late 60's, possibly long before the USPS constant elasticity structure was first mentioned. The model has undergone a

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[17] As noted previously, we have serious concerns about the accuracy of these Postal Service classifications.
[18] See the review of the history (1980-present) of USPS cost methodology changes in the Task 3 Report.

long series of programming language rewrites,[19] starting with Cobol, then Fortran, then C and C++, and finally to the Excel Visual Basic for Applications (VBA) language, but the basic forecasting algorithms have remained essentially unchanged. The model uses a series of forecasting "effects" to make updates in an organized manner. These include cost level changes, volume-related changes, non-volume workload changes, productivity changes, and other system-wide level changes.

Surprisingly, it appears that the method used in the Rollforward Model to incorporate volume changes into the forecast is compatible with the constant elasticity cost structure. The Rollforward Model "test year" volume effect for a given component is calculated as the product of the component's volume variability times its base year accrued cost.

It is useful to clarify the difference between a component's "volume variability" and the component's "elasticity." This confusing terminology issue was described in footnote 15 of witness Bradley's R2000-1 USPS-T-22 testimony. As noted earlier, the term volume variability is unique to the USPS, and its value is often less than total volume variability in the economic sense. However, for the constant elasticity function used for many postal cost components, the volume variability and the elasticity have the same value. In fact, if one substitutes the term "elasticity" for "volume variability," the approximate change in cost due to a percentage change in the driver defined in footnote 7 on page 4 of this paper is the same formula as used by the Rollforward Model. Another confusing aspect of this terminology issue is that it often happens that a USPS component has a total volume variability of 100 percent, but an elasticity much less than 100 percent. It is the elasticity value that is most important for forecasting component costs as a function of volume, and the Cost Rollforward Model does that job in a reasonably accurate manner.

The issue of whether or not inframarginal costs should be used in pricing is discussed at some length by Prof. Panzar in the Task 1 Report. The fact that USPS economic (total) variability includes both attributable and inframarginal costs does have favorable implications for the ability of the Postal Service to cope with decreasing volumes in the future. Previously, institutional costs were considered to be unaffected by volume, so about 40 percent of total costs would remain if volume declines further. With the addition of inframarginal costs to attributable costs, less than 20 percent of total costs are fixed so, *ceteris paribus,* the Postal Service's ability to shed additional costs is improved.

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[19] This author performed several of these rewrites while employed by or consulting for the Postal Rate Commission.

Appendix

Description of Excel Workpaper and VBA Program

Our Task 2 workpaper consists of one Excel workbook, which includes an Excel Visual Basic for Applications (VBA) program (also called "macro" or "module"). The workbook IM07-13.xls is used to calculate inframarginal costs by component for seven fiscal years – 2007 through 2013. We describe the various worksheets used in the workbook in Section A-1 below. Details on the approach used to calculate inframarginal costs in the VBA program are presented in Section A-2.

A-1. Description of Excel Workbook IM07-13.xls

This workbook contains all data required for calculating inframarginal and fixed costs for Fiscal Years 2007 and 2013 as well as an Excel VBA program named "FindIM" used to perform most of the required calculations. Each worksheet in the workbook is briefly described below.

UserDat: This sheet contains some parameters needed to run the VBA program.

ComponentsIn: This sheet is used as a template for other sheets that contain the various inframarginal cost results. It contains the attributable, Other, and total costs for each cost component in the USPS CRA Model Public B Cost Matrix library reference for Fiscal Years 2007-13. Rows for subtotals as shown in the CRA Cost matrix are included but are blanked out to avoid double counting. The first three columns of this sheet give the cost segment number, the component name and CRA component number. The fourth column indicates the variability type of the component: ConsElas (uses the constant elasticity function), 100F (100% fixed), 100A (100% attributable), PSPF (part specific fixed and part fixed), PAPF (part attributable and part fixed), and IND # (dependent component distributed according to component #). Besides the CRA data, this sheet contains all the formulas required to calculate the cost segment and system-wide cost totals shown in rows 281-303.

Case1: This sheet contains the component-level inframarginal and fixed cost results for Fiscal Years 2007 (columns E-J) and 2013 (columns AU-AZ) that are used in the Task 2 Report. Similar results for the years 2008-12 are shown in the intermediate columns, and are included for use in the Task 3 Report. Results for all years are based on the component variability types shown in column D. Rows 265-279 contain the calculations for the various distribution keys defined in the worksheet Keys1.

Keys1: This sheet shows the specific cost components used to calculate the various distribution keys required for the Case1 sheet.

Table 2&3, Table 4 and Table 5: These sheets show the calculations used to create the corresponding tables in the main Task 2 Report.

Table 1 (Pifer): This sheet contains the complete Table 1 from witness Pifer's incremental cost model workpapers in R2006-1. Excerpts for this table are shown in Table 1 of the main report.

AppTables: This sheet contains several tables presented in the Task 2 Appendix.

A-2. Calculating Inframarginal Costs by Cost Component Using Excel VBA

General Approach

In this section the data and algorithms used in the VBA program FindIM() are described, and a listing of the program module is provided.

The inframarginal cost calculation algorithm is very similar to the one used in the CRA Rollforward Model for pre-2007 omnibus rate cases. Tables A-1 and A-2 below are presented to illustrate the process.

	Table A-1. FY 2007 Input Data for a Sample of Cost Components (Case 1 Sheet)							
Case 1 Row	Segment	Component	Comp No.	Comp Category	Attributable Costs	Other Costs	FY07 Total Costs	Attrib Cost %
3	Seg 1	Postmasters EAS 24 & Above	0002	100F	0	54,075	54,075	0.00%
6	Seg 2	Mail Processing Supervision	0004	IND 35	934,472	56,649	991,121	94.28%
29	Seg 2	Joint Supervision Clerks & Carriers	0678	IND 694	466,972	209,401	676,373	69.04%
37	Seg 3	Mail Processing	0035	ConsElas	13,786,809	835,773	14,622,582	94.28%
43	Seg 3	Training	0470	IND 473	109,019	19,482	128,501	84.84%
57	Seg 6	In-Office Direct Labor	0043	PAPF	3,357,514	510,588	3,868,102	86.80%
65	Seg 7	Product Specific Deliv Activities	0048	100S	5,311	0	5,311	100.00%
143	Seg 14	International	0146	100A	815,558	0	815,558	100.00%
267	Seg 21	C/S 3 Training Other	473	Key	14,997,575	2,680,144	17,677,719	84.84%
273	Seg 21	Supervision Clerks & Carriers (3,6,7)	694	Key	23,523,699	10,548,565	34,072,264	69.04%

	Table A-2. Sample of Distribution Key Definitions (Keys1 Sheet)										
Keys1 Row	Segment	Component	CRA Key Number	# of Addends	Addend 1	Addend 2	Addend 3	Addend 4	Addend 5	Addend 6	Addend 7
3	Seg 21	CS 3 Training Other	473	7	3:35	3:227	3:40	3:41	3:421	3:423	3:66
9	Seg 21	Supervision Clerks & Carriers (3,6,7)	694	10	21:473	3:470	6:43	6:44	6:604	7:54	7:47
		"			Addend 8	Addend 9	Addend 10				
		"			7:48	7:50	7:53				

Table A-1 presents a sample of the component input data used by the VBA program. This data was copied from the FY07 columns (A-J) of the Case1 sheet of workbook IM07-13.xls described above. The source of the data in the last four columns of the table is the USPS CRA Model Public B Cost Matrix, a USPS library reference for Docket ACR2007. For convenience, the Case1 row number is also included as the first column in Table A-1.   The "Comp Category" column is based on the categorization of cost components used by witness Pifer in Docket R2000-1 (see Table 1 in the main Task 2 report).

The first row of Table A-1 is an example of an independent component that is categorized as 100 percent fixed (Postmasters EAS 23 & Below, USPS component number 0001), and its category type is denoted by "100F." The fourth row of the table shows an independent constant elasticity component (Mail Processing, number 35), denoted as "ConsElas." The sixth row of Table A-1 illustrates a component (Segment 6 In-Office Direct Labor, number 43), which is categorized as part attributable and part fixed, denoted by the abbreviation "PAPF." Row 7 of the table shows an independent component (0048) which is categorized as 100 percent product specific fixed,

denoted by "100S." Row 8 shows another independent component (0146) which is categorized as 100 percent attributable, denoted by "100A."

The second row of Table A-1 shows a dependent component (Mail Processing Supervision, component 0004) whose distribution of costs is based on component number 0035, and its category is denoted by "IND 35." From the fourth row of the table, we see that component 0035 is actually Mail Processing, and that Mail Processing Supervision has the same percent attributable value as Mail Processing (as it should). The fifth row of Table A-1 shows another dependent component (Cost Segment 3 Training, number 470), which is distributed according to the distribution key 473. The second row of Table A-2 shows that distribution key 473 is the sum of seven independent cost components.[20] Finally, the third row of Table A-1 shows a dependent component (Joint Supervision Clerks & Carriers, number 678) that uses component 694 as its distribution key. The last row of Table A-2 shows that distribution key 694 is the sum of distribution key 473 and nine other components. Eight of these nine components are independent, but component number 470 (in Segment 3) is a dependent component itself. This means that key 694 cannot be calculated until another dependent component has been calculated. For this reason, a multi-pass algorithm must be used to ensure that all components and keys have been calculated.

Computational Algorithm

The first step in the process for calculating inframarginal costs is to loop through each cost component in rows 2-263 of the Case1 sheet. For each component, the Comp Category string is used to determine the proper method of determining the split of Other costs into inframarginal and fixed components. This will generally not be possible during the initial pass for the dependent components, because their inframarginal costs cannot be calculated until the inframarginal and fixed costs associated with each cost component addend included in their distribution keys have been calculated. The next step in the process is to cycle through the distribution keys in rows 265-279 of the Case1 sheet, checking to see if all addend components have already been calculated for a particular key. If the inframarginal/fixed cost calculations have been completed for a component or key, the component/ key itself is marked as complete; if not, the component/key is marked as incomplete.

The steps in the above paragraph are repeated until the inframarginal and fixed costs for all distribution keys and cost components have been calculated.

Introduction to the Excel VBA Programming Language

VBA contains the normal high-level programming language constructs, such as typed variables, for and do loops, file reading/writing, subroutines and functions, if statements, case and switch statements, dimensioned arrays, and so on. It also includes the standard string and arithmetic functions found in most Basic languages. However, VBA also uses object-oriented programming language statements to emulate virtually all of the functions provided by Excel. Excel objects include such items as workbooks, worksheets, cells, ranges of cells, and menus.

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[20] As noted earlier in footnote 15, all distribution keys are based on the worksheet DK Addends, which is part of the Excel workbook FY07.cntl.xls submitted as a library reference in Docket ACR2007. The keys for other years are based on the corresponding worksheet submitted in other ACR Dockets.

These objects also have a variety of associated "properties," such as fonts, names, and sizes, which can be changed by the programmer. Excel objects also have associated "methods," which are used to change objects or properties. For example, the worksheet object has a method called "open", which is used to open a worksheet.

The Excel/VBA programs described below make extensive use of the Excel object model. A good reference book for learning how to use Excel VBA object-oriented programming features is Learn Microsoft Excel VBA 2000 Programming, by Julitta Korol (Wordware Publishing, Inc., 2000). The Help files provided with the Excel VBA editor are also very useful; for example, information on using any VBA language item can be obtained by placing the cursor over the item and pressing the F1 function key.

In the VBA language, lines (or sections of lines) that follow the single-quote character (') are comments only, and have no effect on the program. Also, VBA uses the underscore character (_) to flag a line in the program that will be continued on the next line. Note also that the "Immediate Window," which is helpful with program debugging, can be opened using a VBA View menu command, and that the "Debug.Print" statement is used in VBA programs to print useful information to this window during the execution of an Excel/VBA program.

VBA Program FindIM Description and Listing

This section summarizes the operations performed in various sections of the FindIM VBA program code. These remarks are keyed to the line numbers shown on the four-page program listing shown below in Table A-3.

Lines 13-16: The four worksheets used by the program are defined for use by VBA. For example, OutSht is the Case1 sheet.

Lines 18-40: Various parameters are read from the UserDat sheet, including the desired year JYear and the number of distribution keys NKeys. The starting worksheet column for that year is calculated based on the value of JYear. At lines 22-24, three Excel-style cell ranges are defined using the VBA function ExcelCol() defined at lines 191-202 (see the description for this function below). The columns reserved for inframarginal and fixed costs are cleared, as are the data columns for the NKeys distribution keys defined on the Keys1 sheet.

Lines 43-50: A row mapping array CompRow(CompNo) is defined for the Case1 sheet. For example, the value of CompRow for CompNo 0004 is row number 6. The array CompCat(CompNo) stores the Comp Category for component number CompNo for later retrieval. The array CompSt(CompNo) sets the completion status for each component CompNo to zero.

Lines 56-188: Major loop to allow calculation of IM/fixed costs for more than one year during a single run of the program. Our Task 2 results were calculated one year at a time, so this feature was not used.

Lines 58-61: Starting point for each loop through the components. The variable NBad is the number of components that could not be calculated during the current pass, and is initialized to zero.

Lines 62-127: I1 loop through each non-key component. Details provided below.

Lines 63-79: The loop starts with $I1 = -5$ to allow early calculation of the six single-component distribution keys (CompNo's 428, 74, 35, 57, 40, 83, and 54). The Case1 row number for each of these keys is set to a new row variable I. Starting with $I1 = 1$, $I = I1$.

Lines 80-126: Calculation of inframarginal and fixed costs for each component row I.

At lines 80-83, the IM variable is initialized to zero; the CompNo variable is set to the value in column C of row I; and the variable Cat is set equal to the value in the Comp Category column D. At rows 84-86, a check is made to see whether the Cat variable for row I is blank or has already been calculated (CompSt(CompNo) = 1); if so, program control is transferred to the end of the I1 loop at row 128.

At lines 90-113, an If/ElseIf/Else test performs various actions according to the value of Cat and Cat3 (the first three characters of the variable Cat). If Cat = ConsElas, the component is a constant elasticity component. The code at lines 88-89 sets the variable IM = 1 and CompSt(CompNo) = 1, then passes program control to line 115.

If Cat3 = IND, the component is dependent and is calculated using the distribution key method, where the key number is specified by the last two or three characters of the variable Cat (set to IndNo at line 91). In this case, the Other costs of the component will be part infra-marginal and part fixed, with the percentage of the two categories set equal to the corresponding percentages in the distribution key IndNo. At row 92, a check is made to see if CompSt(IndNo) = 1, indicating that calculation of the distribution key has been previously completed. If not, program control passes to line 105, where an error message (Debug.Print etc.) is printed and program control is passed to the end of the I1 loop. If true, the VBA code at lines 93-102 determines the inframarginal and fixed portions of Other costs based on the corresponding ratios from the key itself. At rows 93-98, the variable F is calculated as the ratio of inframarginal to Other costs for the distribution key. At rows 100-101, the ratio F is used to split the Other costs of the current component into inframarginal and fixed portions.

If the component is neither a constant elasticity or dependent type, then it will either be a 100 percent fixed component, indicated by "100F" in the Comp Category column, or a product specific fixed component, indicated by "100S." In this case, IM is set to 2, CompSt(CompNo) is set to 1 at line 112, and program control passes to line 115.

At lines 115-118, the inframarginal and fixed cost cells of row I are initialized to 0. Then the Other costs of row I are copied to the inframarginal cost column of row I if the previously indicator variable IM = 1, and to the fixed cost column of row I if IM = 2.

At lines 122-125, a check is made to determine whether the row I allocation of Other costs to inframarginal and fixed categories have been calculated correctly. If not, the program stops so that the error can be traced and corrected.

Lines 131-179: The program code used to calculate the NKeys = 15 multiple-input distribution keys needed to distribute various dependent cost components are shown at rows 265-279 of the Case1 sheet. The definitions of these keys are shown at rows 1-15 of the Keys1 sheet (called KeySht in the VBA program). For each key, Column C of KeySht shows its component number; column D shows its number of addend components; and the remaining columns define each addend in Segment#:Component# format. Calculation of these distribution keys must be done in several stages, since many of them depend on the results of calculating earlier distribution keys.

At lines 138-141, the SumInd(I1,K) array is initialized to zeroes, where I1 is the Keys1 row number (1-15), and K = 1 thru 6, corresponding to the column order for the Case1 sheet (attributable costs, other costs, total costs, attributable cost %, inframarginal costs, and fixed costs). NCom is the number of input components for the key.

At lines 142-164, the SumInd array is summed over the corresponding NCom input components as defined in the Keys1 sheet. At lines 146-151, the status of each input component is checked to see whether it has been previously calculated. If it has not, an error message is printed, the variable NBad is incremented by one and program control passes to the end of the I1 For loop at line 179. If it has, program execution continues. At line 153, a check is made to see if the key = 525 and the dependent column = 74, 79, or 194. For this particular situation, the USPS treatment is nonstandard. Components 74, 79, and 194 (three of the so-called PESSA components) are considered fixed with respect to volume *only for purposes of calculating this particular distribution key*. So at lines 155-157, only the other, total, and fixed columns of SumInd are incremented instead of all six column categories. In all other situations, all six columns are incremented in the usual manner at rows 160-163.

At lines 165-170, the completed SumInd results are stored in the matching six columns of the particular distribution key row (with component number IndNo) and the CompSt(IndNo) indicator is set to one, indicated completion of the key's calculation.

At lines 171-177, a check is made for the calculated dependent component to see if the absolute value of the difference (Dif) between its Other costs and inframarginal costs is within one unit of its fixed costs. If not, its fixed costs are set equal to Dif.

Lines 183-189: A check is made to see if NBad is greater than zero, indicating that some components have not yet been calculated. If so, program control loops back to line 58, labeled "start0." If not, the program run is finished and execution stops at line 189.

Lines 191-202: This is a VBA function named ExcelCol that has an integer argument representing a column number. It returns the Excel-style column designator (e.g., Column BV) at line 200.

```
1     Public Sub FindIM()
2     Dim InSht As Worksheet, MainWkBk As String, SumInd(100, 9)
3     Dim I As Integer, J As Integer, K As Integer, II, temp
4     Dim UserSht As Worksheet, KeySht As Worksheet, OutSht As Worksheet
5     Dim StartCol, SkipCol, CatCol, NYear, MaxRow, CompNo, IndNo
6     Dim Cat, CompCat(2000), IM, JOCol, JIMCol, Cat3, NCom, I2
7     Dim CompSt(2000), CompRow(2000), F, I1, NKeys, CompStr, J1
8     Dim NBad, NPass, rConstants As Range, JYear, Dif, tempa, tempb
9
10    'Set up Userdata and Component sheets, working directory
11    ActiveWindow.Zoom = 75
12    MainWkBk = ThisWorkbook.Name
13    Set InSht = Workbooks(MainWkBk).Worksheets("ComponentsIn")
14    Set OutSht = Workbooks(MainWkBk).Worksheets("Case1")
15    Set UserSht = Workbooks(MainWkBk).Worksheets("Userdata")
16    Set KeySht = Workbooks(MainWkBk).Worksheets("Keys1")
17
18    'Get parameters, clear IM/fixed columns, clear Key rows 265-279
19    JYear = UserSht.Cells(9, 2) - 2006
20    SkipCol = Int(UserSht.Cells(4, 2))
21    JOCol = 4 + (JYear - 1) * SkipCol
22    temp = ExcelCol(JOCol + 5) + "2:" + ExcelCol(JOCol + 6) + "310"
23    tempa = ExcelCol(JOCol + 1) + "265:" + ExcelCol(JOCol + 3) + "279"
24    tempb = ExcelCol(JOCol + 5) + "2:" + ExcelCol(JOCol + 5) + "2"
25    Stop
26    OutSht.Range(tempa) = 0
27    OutSht.Range(tempb) = 0
28    Set rConstants = OutSht.Range(temp).SpecialCells(xlCellTypeConstants)
29    rConstants.ClearContents
30    OutSht.Range(temp).NumberFormat = "#,##0"
31    OutSht.Rows(303).NumberFormat = "0.00%"
32    OutSht.Application.ActiveWindow.Zoom = 75
33
34    'Get additional parameters
35    StartCol = Int(UserSht.Cells(3, 2))
36    CatCol = Int(UserSht.Cells(5, 2))
37    NYear = Int(UserSht.Cells(6, 2))
38    MaxRow = Int(UserSht.Cells(7, 2))
39    NKeys = UserSht.Cells(8, 2)
40    NPass = 0
41
42    Create component# to row index, get component category & clear status
43    For I = 2 To MaxRow
44      CompNo = Int(OutSht.Cells(I, 3))
45      Cat = OutSht.Cells(I, CatCol)
46      If CompNo <> "" And Cat <> "" Then
47        CompRow(CompNo) = I
48        CompCat(CompNo) = Cat
49        CompSt(CompNo) = 0
50      End If
51    Next I
```

```
52   'Stop
53
54   'Separate IM and fixed costs by component
55
56   For J = JYear To JYear
57   'Begin next pass through Case1 rows
58   start0:
59     NPass = NPass + 1
60     NBad = 0
61     For I1 = -5 To MaxRow - Nkeys
62       If I1 = -5 Then    'start with single-component dist keys
63         I = 11           'Comp 428
64       ElseIf I1 = -4 Then
65         I = 81           'Comp 74
66       ElseIf I1 = -3 Then
67         I = 37           'Comp 35
68       ElseIf I1 = -2 Then
69         I = 72           'Comp 57
70       ElseIf I1 = -1 Then
71         I = 38           'Comp 40
72       ElseIf I1 = 0 Then
73         I = 67           'Comp 83
74       ElseIf I1 = 1 Then
75         I = 63           'Comp 54
76       Else
77         I = I1
78       End If
79
80       IM = 0
81       CompNo = Int(OutSht.Cells(I, 3))
82       Cat = OutSht.Cells(I, CatCol)
83       Cat3 = Left(Cat, 3)
84       If Cat = "" Or CompSt(CompNo) = 1 Then
85         GoTo nexti2:
86       End If
87       If Cat = "ConsElas" Then      'Other costs are IM
88         IM = 1
89         CompSt(CompNo) = 1
90       ElseIf Cat3 = "IND" Then      'Other costs are part IM, part fixed
91         IndNo = Int(Right(Cat, Len(Cat) - 4))
92         If CompSt(IndNo) = 1 Then
93           II = CompRow(IndNo)
94           If OutSht.Cells(II, JOCol + 6) = 0 Then
95             F = 1
96           Else
97             F = OutSht.Cells(II, JOCol + 5) / OutSht.Cells(II, JOCol + 2)
98           End If
99   '       Stop
100          OutSht.Cells(I, JOCol + 5) = F * OutSht.Cells(I, JOCol + 2)
101          OutSht.Cells(I, JOCol + 6) = (1 - F) * OutSht.Cells(I, JOCol + 2)
102          CompSt(CompNo) = 1
103          GoTo nexti:
104        Else
```

20

```
105        temp = Format(I1) + "(" + Format(CompNo) + ")" + ", missing comp "
106        Debug.Print Format(NPass) + ", Can't calc line " + temp + Format(IndNo)
107        NBad = NBad + 1
108        GoTo nexti2:
109      End If
110    Else
111      IM = 2              'Other costs are fixed
112      CompSt(CompNo) = 1
113    End If
114
115    OutSht.Cells(I, JOCol + 5) = 0
116    OutSht.Cells(I, JOCol + 6) = 0
117    JIMCol = JOCol + 4 + IM
118    OutSht.Cells(I, JIMCol) = OutSht.Cells(I, JOCol + 2)
119 '   Stop
120 nexti:
121 'Check whether IM + fixed = Other; if not, stop
122    Dif = OutSht.Cells(I, JOCol + 2) - OutSht.Cells(I, JOCol + 5)
123    If Abs(Dif - OutSht.Cells(I, JOCol + 6)) > 1 Then
124      Stop
125    End If
126 nexti2:
127    Next I1
128 nextii:
129 '  Stop
130
131 'Calculate indirect costs
132  For I1 = 1 To NKeys
133    IndNo = KeySht.Cells(I1, 3)    'Component number for this key
134    If CompSt(IndNo) = 1 Then
135      GoTo nexti1:
136    End If
137    I = CompRow(IndNo)
138    For K = 1 To 6               'Initialize SumInd array to zero
139      SumInd(I1, K) = 0
140    Next K
141    NCom = KeySht.Cells(I1, 4)
142    For J1 = 1 To NCom            'Sum up NCom input keys
143      CompStr = KeySht.Cells(I1, J1 + 4)
144      CompNo = Int(Mid(CompStr, InStr(CompStr, ":") + 1))
145      I2 = CompRow(CompNo)
146      If CompSt(CompNo) = 0 Then  'Can't calculate this component
147        temp = " " + Format(I) + "(" + Format(IndNo) + ")" + ", Can't calc line "
148        Debug.Print Format(NPass) + temp + ", missing compi " + Format(CompNo)
149        NBad = NBad + 1
150 '      Stop
151        GoTo nexti1:
152      End If
153      If IndNo = 525 And (CompNo = 74 Or CompNo = 79 Or CompNo = 194) Then
154 '        Stop          'Check calculation of key 525, update partial sum
155        SumInd(I1, 3) = SumInd(I1, 3) + OutSht.Cells(I2, JOCol + 3)
156        SumInd(I1, 2) = SumInd(I1, 2) + OutSht.Cells(I2, JOCol + 2)
157        SumInd(I1, 6) = SumInd(I1, 6) + OutSht.Cells(I2, JOCol + 6)
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158  '        Stop
159       Else
160          For K = 1 To 6    'Update partial sum for key
161             SumInd(I1, K) = SumInd(I1, K) + OutSht.Cells(I2, JOCol + K)
162           Next K
163        End If
164      Next J1
165      For K = 1 To 6         'Write key results into OutSht row (from 265 to 279)
166         OutSht.Cells(I, JOCol + K) = SumInd(I1, K)
167      Next K
168      OutSht.Cells(I, JOCol + 4) = OutSht.Cells(I, JOCol + 1) _
169       / OutSht.Cells(I, JOCol + 3)  'Check attrib cost %
170      CompSt(IndNo) = 1
171      Dif = OutSht.Cells(I, JOCol + 2) - OutSht.Cells(I, JOCol + 5)
172  '   Stop
173      If Abs(Dif - OutSht.Cells(I, JOCol + 6)) > 1 Then
174  '      Stop
175         OutSht.Cells(I, JOCol + 6) = Dif    'Key fixed cost = Other - IM
176  '      Stop
177      End If
178  nexti1:
179   Next I1
180
181   Debug.Print "NPass=" + Format(NPass) + ", NBad=" + Format(NBad)
182  ' Stop
183   If NBad = 0 Then GoTo nextj: 'Check for any incomplete components or keys
184   Debug.Print
185   GoTo start0:                      'If so, go to beginning of next pass
186  nextj:
187   Stop
188  Next J
189  End Sub
190
191  Public Function ExcelCol(ColNo)
192  ' Convert numeric column number to Excel format
193  Dim E1 As String, Colm26 As Integer, Cold26 As Integer
194  If ColNo <= 26 Then
195    ExcelCol = Chr(Asc("A") + ColNo - 1)
196  ElseIf ColNo > 26 Then
197    Colm26 = ColNo - 26 - 1
198    Cold26 = Int(Colm26 / 26)
199    E1 = Chr(Asc("A") + Cold26)
200    ExcelCol = E1 + Chr(Asc("A") + (Colm26) Mod 26)
201  End If
202  End Function
```