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POSTAL RATE COMMISSION
WASHINGTON, D.C. 20268-0001

Postal Rate and Fee Changes, 1997

Docket No. R97-1

DIRECT TESTIMONY OF
MICHAEL D. BRADLEY
ON BEHALF OF
UNITED STATES POSTAL SERVICE

TABLE OF CONTENTS

AUTOBIOGRAPHICAL SKETCH

My name is Michael D. Bradley and I am Professor of Economics at George Washington University. I have taught economics there since 1982 and I have published many articles using both economic theory and econometrics. Postal economics is one of my major areas of research. I have presented my research at the various professional conferences and I have given invited lectures at both universities and government agencies. Beyond my academic work, I have extensive experience investigating real-world economic problems, as I have served as a consultant to financial and manufacturing corporations, trade associations, and government agencies.

I received a B.S. in economics with honors from the University of Delaware and as an undergraduate was awarded both Phi Beta Kappa and Omicron Delta Epsilon for academic achievement in the field of economics. I earned a Ph.D. in economics from the University of North Carolina and as a graduate student I was an Alumni Graduate Fellow. While being a professor, I have won both academic and nonacademic awards including the Richard D. Irwin Distinguished Paper Award, the American Gear Manufacturers ADEC Award, a Banneker Award and the Tractenberg Prize.

I have been studying postal economics for more than twelve years, and I participated in several Postal Rate Commission proceedings. In Docket No. R84-1, I helped in the preparation of testimony about purchased transportation and in Docket No. R87-1, I testified on behalf of the Postal Service concerning purchased transportation. In Docket No. R90-1 and the Docket No. R90-1 remand, I presented testimony concerning city carrier costing. I returned to transportation costing in Docket No. MC91-3. There, I presented testimony on the existence of a distance taper in postal transportation costs. In Docket No. R94-1, I presented an econometric model of access costs.

Besides my work with the U.S. Postal Service, I serve as a consultant to Canada Post Corporation. I give it assistance in establishing and using its product costing system and provide expertise in the areas of cost allocation, incremental costs, and cross-subsidy. Recently, I provided expertise about postal costing to the International Post Corporation.

PURPOSE AND SCOPE

The purpose of my testimony is to update and refine the analysis of purchased highway transportation done by the Postal Rate Commission ("the Commission"). The Commission performed its analysis in Docket No. R87-1 and both the Commission and the Postal Service currently use it in calculating volume-variable purchased highway costs.

My testimony improves upon the Commission's analysis in Docket No. R87-1 in three ways. First, it uses more recent data. By using more recent data, my empirical estimates embody any changes that have occurred in the purchased transportation network since Docket No. R87-1. Second, my testimony uses a more extensive database than was available in the past. In 1995, the Postal Service constructed an electronic highway contract management system. I use this system to generate an electronic version, for each highway contract, of the same data collected in hardcopy for the analysis in Docket No. R87-1. Moreover, the system generates data for all contracts in the purchased highway network.

The third area of improvement is analytical. My testimony improves the specifications of the econometric equations used by the Commission through incorporating region-specific, non-volume cost characteristics. In addition, it disaggregates the analysis for those account categories that are heterogeneous, to provide more accurate variability estimates. Finally, for the first time, my testimony presents a variability analysis for plant-load contracts.

I. A REVIEW OF THE PURCHASED HIGHWAY TRANSPORTATION VARIABILITY ANALYSIS PERFORMED BY THE COMMISSION IN DOCKET NO. R87-1.

A. The Commission's Analysis was Performed by Account Category.

The Postal Service's system of cost accounts for purchased highway transportation segregates accrued costs by type of transportation. Separate accounts, for example, are kept for local and long distance transportation in the bulk mail facility network. The Postal Service calls these accounts intra-BMC and inter-BMC accordingly. Similarly, there are separate accounts kept for transportation within a given SCF area as opposed to transportation across SCFs. The Postal Service calls these accounts intra-SCF and inter-SCF.

The analysis presented by the Commission in Docket No. R87-1 was segregated by these account categories.[1] The Commission estimated separate equations for inter-BMC, intra-BMC, inter-SCF, and intra-SCF. Moreover, in the intra-SCF account, the Commission further subdivided the analysis into three different types of contracts: regular intra-SCF, intra-City, and box route contracts. The Commission performed a separate regression analysis for each of these contract types.

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[1] See PRC Op. R87-1, App. J, CS XIV, at 24.

B. The Commission Estimated a Translog Equation Using Mean Centered Data.

The Commission's analysis used a translog equation in two variables, cubic foot-miles and route length.[2] In addition, the Commission estimated the equation on mean-centered data. This was convenient because it allowed the relevant elasticity to be derived easily from the estimated equation. Evaluation of an equation estimated on mean-centered data is equivalent to evaluation of the econometric equation at the sample means of the independent variables. Consequently, when the data are mean-centered, the desired variability is simply the first-order coefficient on cubic foot-miles (or the first-order coefficient on boxes for box route contracts). Moreover, the Commission clearly articulated the advantages of calculation of the elasticity at the sample mean:[3]

> When an econometric analyst estimates functional forms which provide variabilities as functions of output, like the quadratic, Higinbotham, and translog models, he is faced with the decision of selecting a level of output at which the variability will be evaluated. For his model, witness Higinbotham computed the "overall variability" as a cost-weighted average of the variabilities estimated at all sample values of output. Witness Lion, on the other hand, computed the variabilities for the five models at the sample mean value of output. We accept Witness Lion's method for several reasons. In the first place, the sample mean is an estimate of the population mean and reflects the central tendency of data. Its significance can be measured statistically. Additionally, under normal conditions, cost functions behave better around the mean values.

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[2] <u>See</u> PRC Op., R87-1, App. J, CS XIV, at 22.

[3] <u>See</u> PRC Op., R87-1, App. J, CS XIV, at 26-27

> Moreover, it is standard practice in econometric cost studies of transportation industries to report elasticities at the sample mean, particularly when the translog cost function is used.
>
> However, witness Higinbotham's weighted average variability has no such antecedent in the econometric literature. Finally, deviating from the standard practice by moving to a weighting scheme introduces ambiguity as to the final result. For example, witness Higinbotham has weighted variabilities by the cost of each contract, although other reasonable weighting schemes could also be chosen which would yield a different result. Thus, choosing a weighted variability in lieu of the standard sample mean introduces an arbitrary element, which one could manipulate according to the desired result.

The specification of the econometric equation estimated by the Commission is thus given by:

$$\ln Cost_j = \alpha + \beta_1 \ln\left(\frac{CFM_j}{\overline{CFM}}\right) + \beta_2 \ln\left(\frac{CFM_j}{\overline{CFM}}\right)^2 + \beta_3 \ln\left(\frac{RL_j}{\overline{RL}}\right) + \beta_4 \ln\left(\frac{RL_j}{\overline{RL}}\right)^2 + \beta_5 \ln\left(\frac{CFM_j}{\overline{CFM}}\right) \ln\left(\frac{RL_j}{\overline{RL}}\right) \quad (1)$$

The value of the β_1 coefficient is the variability.

C. The Commission Analysis used a Sample of the Highway Contracts.

The econometric analysis performed by the Commission was based upon a sample of the highway contracts in force in Fiscal Year 1986. Contracts were collected in hardcopy form, by account category, and an electronic database was constructed. The database had the following number of observations for each contract type:[4]

Contract Type	Number of Contracts
Intra-City	285
Intra-SCF	496
Inter-SCF	360
Intra-BMC	302
Inter-BMC	163
Box Delivery	493
Total	2,099

The total number of contracts used in the Docket No. R87-1 analysis represented about 15% of the 12,846 total contracts in force in 1986.[5]

D. The General Approach Followed by the Commission in Docket No. R87-1 is Still Applicable.

To determine if the Commission's analysis is an appropriate starting place for investigating current purchased transportation costs, I assessed whether the basic structure of the purchased highway contract network has remained stable since that analysis was done. Conversations with transportation experts within the Postal Service revealed that the general structure of the

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4 See PRC Op., R87-1, App. J, CS XIV, at 3.

5 See, R87-1, USPS-T-9, WP-1, at 2-3

highway transportation network is basically the same as in 1986. This is true for both the administration of the network and its operational use.[6]

Highway contracts are still classified by the same account categories, and approximately the same number of contracts is in force. The contracts within each account category are still used for the same basic purposes and still have the same basic operating characteristics in terms of schedules, truck sizes, and miles traveled per year. Contracts continue to be bid in the same way; contracts still last for four years. Finally, re-estimation of the Commission's econometric models with the new data shows very little change in the results.

Although there have been some operational changes since Docket No. R87-1, I am informed that they have not had a major impact on the purchased transportation network. The three major changes in operations that have a potential impact on transportation are the advent of automation, the attempt to move First-Class Mail to surface transportation when appropriate, and dropshipping. I discuss each of these three changes below.

The Postal Service automates more mail processing today than during Docket No. R87-1. Thus far, however, automation has not had a major impact on transportation costs. Automation could potentially alter dispatch windows and

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[6] This is not to say that the same amount of mail was transported over the purchased highway transportation network in 1996 as in 1986. All else being equal, as mail volume grows, so does the capacity of the highway network. The Commission's Docket No. R87-1 analysis was designed to capture the cost response to changes in network capacity. Thus, it is an appropriate framework for investigating the effects of capacity growth.

thus place pressure on the transportation network. I am informed that transportation managers have been involved in the decisions to deploy equipment, however, and have worked to integrate transportation into automation planning. I have been told by postal transportation experts that the result of this coordination is that the impact of automation on transportation schedules has been relatively minor.

I also have been told that since Docket No. R87-1, the Postal Service has tried to divert First-Class Mail from air transportation to surface transportation when feasible. This has been done by examining service requirements and identifying volume that would make the service standard on the ground. In addition, there must be sufficient volume to justify adding the ground transportation. From the perspective of the surface transportation network, this is simply an increase in volume and not a change in operating structure. The way the network is used has not been changed because of this diversion of volume. Rather, it is just the addition of more volume to the existing network. Because the Commission's analysis was designed to measure the impact of volumes on cost, this operational change is consistent with that analysis.

When mailers dropship their mail at destination facilities, less Postal Service transportation is required. The growth in dropshipping thus holds the potential to reduce the size of certain parts of the purchased highway transportation network. Because the dropship discounts do not apply to all classes of mail, the effects of dropshipping will not necessarily be spread evenly across all accounts. However, unless the effects of dropshipping are severe, they can be handled within the Commission's framework. The effect of dropshipping is to limit growth in those parts of the network that are subject to diversions. That is, dropshipping will retard the growth in the amount of mail transported by the Postal Service network in those areas in which private sector transportation is used.

A comparison of the accrued costs from 1990, before dropshipping began, and 1995 will reveal if there has been any radical realignment of the network due to dropshipping. The accrued cost in each of the major account categories grew from 1990 to 1995, although their relative growth rates were different. In contrast, the plant-load cost account showed a reduction in accrued cost from 1990 to 1995. This is consistent with dropshipping replacing plant-load shipments. A comparison of the proportions of total accrued cost in each of the major accounts in 1990 and 1995 shows only minor changes:[7]

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[7] Different accrued cost growth rates, across the cost accounts, will cause the percentages of accrued cost to change even though all cost accounts are experiencing an increase in cost.

Account	1990 % of Accrued Cost	1995% of Accrued Cost
Intra-SCF	41.4%	42.7%
Inter-SCF	21.7%	20.9%
Intra-BMC	14.4%	17.4%
Inter-BMC	17.7%	15.6%
Plant Load	3.9%	2.4%
Other	0.9%	0.9%

The structure of the purchased highway transportation network has not changed in a dramatic way. Thus, the general approach followed by the Commission in Docket No. R87-1 is a good starting point for the current analysis.

II. THE HIGHWAY CONTRACT SUPPORT SYSTEM

A. HCSS is a Highway Contract Management System and it Contains Useful Data.

In 1995, the Postal Service initiated a new contract management system entitled Highway Contract Support System (HCSS). This system includes, *inter alia,* an electronic database covering the entire set of purchased highway transportation contracts. HCSS is a tool that is useful in managing contracts. It is not a tool used for managing transportation. For example, it can be used to project information on contract specifications.

Despite the fact that Postal Service designed the HCSS for contract management rather than transportation management, investigation of the HCSS database revealed that it contains the key variables required for a variability analysis. These key variables are:

1. The annual cost for the contract.
2. The annual miles traveled on the contract.
3. The number of trucks on a contract.
4. The cubic capacity of the trucks on the contract.
5. The Highway Contract Route Identification number (HCRID) for each contract.
6. A route length measure for the contract.
7. The highway cost account for the contract (inter-SCF, intra-BMC, intra-SCF, etc.)

With these variables, the HCSS can produce a database that will support the econometric estimation of cost variabilities. Furthermore, the existence of HCSS data raises the possibility of pursuing an econometric analysis on virtually all contracts in existence, not just a sample of contracts.

In Docket No. R87-1, only a sample of the contracts was available for analysis. There were approximately 12,000 purchased highway transportation contracts in force in 1986. A sample of these contracts was required because of the burden associated with collecting and keypunching the hardcopy contracts. However, because HCSS data are already in electronic form, no such sampling is necessary; data for nearly all contracts in force can be collected. This is a major advantage for three reasons.

First, it improves the efficiency of the estimation. The precision of the estimates increases as the data available increases. Second, because we have data on virtually all contracts, we do not have to be concerned about the possibility of drawing an unrepresentative sample.

The third advantage of having such a comprehensive set of recent data relates to possible changes in the parameters of the underlying cost generating processes. While the structure of the transportation network has not changed, it is possible that values for the individual parameters, such as the variability coefficient, have changed. By using all contracts in place in Fiscal Year 1995, we can be sure that the more recent data are capturing any changes in the transportation system that have taken place since Docket No. R87-1.

B. An Analysis Database Can be Constructed from the HCSS.

The HCSS is not a national system. In fact, it draws from 12 different databases, each in a transportation region. There is a separate HCSS database at each of the Distribution Network Offices (DNOs). In addition, HCSS is a live data system in the sense that it changes as the contracts themselves change.

To put together an analysis data set for investigating the purchased highway transportation cost variability, two steps had to be taken. First, data from the area DNOs had to be combined in a national data set. Second, the data had to be extracted at a single point in time to produce a national cross section.

These steps were accomplished by requesting each of the 12 DNOs to extract the relevant information from their respective HCSS database during the first week of August 1995. The data from the individual DNO's were then sent to the St. Louis data center for collating into one file. Finally, the collated data set was sent to Postal Service headquarters in Washington, D.C.

Workpaper WP-1 contains a complete description of my extract from the HCSS database, but a summary is presented here.[8] The data cover all contracts in force as of August 1995 and represent their Fiscal Year 1995 annual values at that point in time. There are 15,714 observations in the data set, but this number

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[8] The workpapers and Library References discussed in this testimony were submitted in Docket No. MC97-2. The workpapers were attached to my testimony in that docket, USPS-T-4.

is larger than the number of contracts in force.

The number of observations exceeds the number of contracts for two reasons. First, the basic unit of observation in the HCSS is the route part / cost segment. A route part / cost segment is a separation of an HCRID into payment types, primarily tractor trailer and straight body.[9] For example, I present data from an actual inter-SCF contract that has two route part / cost segments in Table 1.

Table 1
Data From Two Cost Segments of an Inter-SCF Contract

HCRID	Cost Segment	Annual Cost	Truck Size	Number of Trucks	Annual Miles
19910	A	$245,000	2,700	2	162,013
19910	B	$119,686	1,200	1	106,417

The additional detail is useful because it permits breaking a relatively heterogenous contract into two relatively homogenous cost segments. The cost of each route part / cost segment (and thus type of transportation) is associated with just the cubic foot miles on that route part / cost segment. I can thus treat each cost segment as if it were a separate contract. This disaggregation provides information that is a degree finer than the contract level. The finer

[9] Route part / cost segments can also arise if there is more than one payment type on a contract. For example, there could be an annual pay route part/ cost segment and a per-trip pay route part / cost segment on a single contract.

detail allows for the possibility that discrete types of transportation can be specified and paid for separately within a single contract. Most important, this separation allows us to split the tractor-trailer portion of transportation from the straight body portion of transportation on the same contract.

The other reason that there are more observations in the HCSS data set than highway contracts is because sometimes there are multiple truck sizes on a given contract cost segment. On rare occasions, a single contract cost segment will contain different sized trucks.[10] In these instances, the HCSS data set lists multiple records. The only difference between the records is the different truck capacities.

Following the Commission's approach in Docket No. R87-1, I organized the set data by account category. Table 2 presents the number of observations in each account category.

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[10] There are 240 such observations out of a data set of 15,714 observations.

Table 2
HCSS Data set By Account Category

Account Number	Account Description	Number of Observations
53119	Transportation of Stamps	26
53121	Intra-SCF	11,678
53122	Intra-SCF Exceptional	1
53123	Intra-SCF Emergency	645
53124	Inter-SCF	1,725
53126	Inter-SCF Emergency	227
53127	Intra-BMC	351
53129	Intra-BMC Emergency	13
53131	Inter-BMC	171
53132	Inter-BMC Exceptional	1
53133	Inter-BMC Emergency	13
53134	Plant- Load Annual	77
53135	Plant-Load Trip	611
53136	Intra-BMC Leased Trailer Fleet	37
53137	Highway Damage	1
53139	Area Bus	2
53151	Unknown	1
53183	Domestic Inland Water	63
53184	Offshore Domestic Water	2
53191	Empty Equipment	46
53194	Empty Mail Equipment Terminal	1
No Account #	---	22
TOTAL		15,714

C. Constructing Cubic Foot-Miles from HCSS Data

Most purchased highway transportation contracts contain several trips, which may occur on different routes and at different frequencies. In Docket No. R87-1, each of the hard-copy contracts was examined to decide which vehicle on the contract performed each trip. Using this information, cubic foot-miles were then calculated in two steps. The first step multiplied, at a route trip level, the cubic capacity of each truck times the annual miles that it traveled. This produced annual cubic foot-miles for that route trip. The second step summed the cubic foot-miles over all route trips on the contract.

This type of detailed information does not currently exist in HCSS. Although the truck capacity and the total annual miles exist in HCSS, there is no way to link an individual truck size with an individual trip. The Postal Service does not require this detailed routing for managing the contracts as that management does not require calculation of total annual cubic foot-miles for the contract. Consequently, I calculate cubic foot-miles by multiplying the average truck size on each cost segment by the annual miles on that cost segment. Because this is an approximation in a few cases, it raises the issue of the implications of this approximation. If there is only one truck size on a contract cost segment, then this 'approximation' is exact. In these cases, the same sized truck is traveling on all route trips on the contract cost segment and both methods calculate the same amount of cubic foot-miles.

Only when there are multiple truck sizes on a given contract cost segment is there a potential difficulty. In that case, the HCSS data base structure precludes matching each truck with a single route, and an approximation must be used. However, because HCSS already splits contracts into cost segments by truck type, there are very few instances of a contract cost segment with multiple truck sizes. The following table shows the distribution of such instances. Moreover, because the contracts are split into straight body and tractor trailer cost segments, the diversity of trucks sizes within a given cost segment is reduced.

Table 3
Frequency of Contract Cost Segments with Multiple Vehicle Capacities

Contract Type	No. Of Observations	No. Of Observations with Multiple Vehicle Capacities
Intra-SCF	12,323	183
Inter-SCF	1,952	44
Intra-BMC	364	7
Inter-BMC	184	4
Plant Load	688	2

Despite the small frequency of this occurrence, I performed an analysis on the Docket No. R87-1 data to measure the degree of approximation. The cubic foot-miles for the inter-SCF account in that data set were recalculated using the same procedures currently used in the HCSS data set. The Commission's original equations were re-estimated and the results were not affected. Results are presented in Workpaper WP-2.

III. ECONOMETRIC ANALYSIS

The econometric analysis proceeds in six steps. Each step embodies a refinement of the Commission's Docket No. R87-1 method and advances the analysis toward my recommended variabilities. The six steps are:

Step 1: Estimate the Commission's model on the new HCSS data set.

Step 2: Allow for region-specific effects.

Step 3: Estimate a plant-load equation.

Step 4: Adjust for within-account heterogeneity.

Step 5: Correct for heteroscedasticity.

Step 6: Investigate unusual observations.

I describe below the methods that I used in each step and the results I generated by employing those methods.

A. Estimation of the Commission's Model on the Data Generally Replicates the Docket No. R87-1 Results.

In the first step of the analysis, I estimated the Commission's model on the HCSS data set. This exercise yields two benefits. The first benefit of re-estimating the Commission's model is that it provides additional evidence that further establishes the validity of the data set. The data used by the Commission in Docket No. R87-1 were carefully scrutinized and judged to be valid. As the

Commission stated:[11]

> All parties agree that the data presented by the Postal Service in this case are suitable for estimating the variability of purchased transportation costs.

The HCSS data set is similar in form and more extensive than the data set used in Docket No. R87-1. The HCSS data set essentially represents the population from which the Docket No. R87-1 data were drawn. If estimation of the Commission's model on the HCSS data set provides generally similar results, then it stands to reason that the HCSS data set is also suitable for estimating the variability of purchased transportation costs.

The second benefit of performing this first step is that it provides a benchmark for evaluating the refinements made in subsequent steps. When both the data and the methods of estimation are changed, determining the responsibility of each in causing results to change is difficult. Estimating the Commission's Docket No. R87-1 model on the HCSS data set cuts through this difficulty. By carefully estimating the *same* model on new data, any changes in the estimated variabilities must come from the new data. In addition, any subsequent changes in the variabilities must come from changes in method.

The Commission's Docket No. R87-1 analysis included both regular and 'emergency' contracts in the data set. I follow the same procedure here. Emergency contracts are temporary in the sense that they can last from one day

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[11] See PRC Op., R87-1, App. J, CS XIV, at 4.

up to sixty days. However, the Postal Service can extend them up to 1 year. Emergency contracts are just like regular contracts in all other respects. In fact, an emergency contract is sometimes used as a quick replacement for a regular contract and takes on all of the specifications of a regular contract.[12]

A second issue arises in preparing the data for the econometric exercise. Many intra-BMC contracts are 'power-only' contracts.[13] These are contracts in which the contractor provides the tractor, but the Postal Service provides the trailer from its leased trailer fleet. Postal transportation experts said that the cost of the trailer represents less than 5 percent of the total cost of a tractor-trailer contract. As a result, small inaccuracies in estimating the size of the trailers will not affect the econometric results. Approximating the cubic capacity for trailers on power-only contracts is thus an appropriate exercise.

Price Waterhouse surveyed the BMCs to find out which use leased trailer fleets and the sizes of the trailers in their fleets. The survey is described in Docket No. MC97-2 Library Reference PCR-13. Seven of the areas (identified

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[12] The term "exceptional" is used for contracts that cover what is typically thought of as emergency service (a truck breaks down, a truck driver is ill, etc.). The costs for these contracts are in another account and are not included in this analysis. The variability for these costs is assumed to be one hundred percent. This treatment is identical to how both the Postal Service and the Commission treated these contracts in Docket No. R87-1.

[13] These contracts were identified with vehicle capacity that is in "Vehicle Group 12." Being in this group signifies that the capacity of the vehicle used in the contract has zero cubic feet, suggesting the possibility that only a power unit was provided.

by the DNOs) were found to have BMC's that use leased trailer fleets. The survey requested data on the number of trailers of each size in the fleets of each of the BMCs that have leased trailer fleets. Cubic capacities for power-only contracts for the areas containing these BMCs were calculated using the average trailer size in each of the BMC's fleets. I list the seven areas and the average vehicle capacity for each area below:[14]

Table 4
Average-Size Trailers in Leased Trailer Fleets

Area	Average Trailer Capacity (cubic feet)
Allegheny	2,649
Great Lakes	2,817
New York	2.433
Mid-West	2,918
Northeast	2,700
Pacific	2,854
Western	2,320

The last issue in preparing the data for econometric estimation is the identification of the intra-City and box contracts. Both types of contracts, as well as regular intra-SCF contracts, have the same account numbers. A different method must be used to identify the individual types of contracts within the

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[14] In some areas, more than one BMC uses a leased trailer fleet. The average vehicle capacity was calculated using all of the BMCs in an area.

account.

City contracts can be identified by their HCRID. Any contract that is in the intra-SCF account but whose HCRID ends in either the letter "A" or the letter "G" is classified as an intra-City contract.[15]

Box routes can be identified as follows. For each contract cost segment, the HCSS data set includes information on the type of route in addition to its account number. In HCSS, the Postal Service identifies each contract/cost segment as one of six route types:

1. Transportation - Tractor/Trailer
2. Transportation - Straight Body
3. Transportation - Tractor/Trailer and Straight Body
4. Box Delivery
5. Combination - Transportation/Box Delivery
6. Combination - Box Delivery/Transportation

Contract cost segments that the Postal Service classifies as route type 4 can easily be identified as box route contracts. More difficult are those contracts that the Postal Service classifies as either route type 5 or route type 6. Because these are combination route types, they could be primarily transportation contracts that include just a few boxes or they could be primarily box route contracts that provide some ancillary transportation between facilities.

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[15] This is described in Management Instruction DM-150-83-2 which is attached as Exhibit A.

The designations of a contract cost segment as either route type 5 or route type 6 is not illuminating either. This classification is based upon the first activity on the contract's schedule, not on the preponderance of activities performed throughout the schedule. Discussions with transportation experts from the Postal Service lead to the following standard. If the Postal Service classifies a contract/cost segment as route type 4, I designate it a box contract. If they classify a contract/cost segment as route type 5 or route type 6, it is eligible to be classified as a box route contract. To be designated as a box route, the contract cost segment must record serving some boxes and have a vehicle capacity that is less than 300 cubic feet. If the contract cost segment does not record serving boxes or has a vehicle of 300 cubic feet or more, I classify it as a transportation contract.

Table 5
Distribution of HCSS Data Across Route Types

Route Type	Transportation Type	Number
1	Transportation: Tractor/Trailer	2,643
2	Transportation: Straight Body	6,664
3	Transportation: Mixed	220
4	Box Route	4,747
5	Combination: Type I	724
6	Combination: Type II	460

The results of estimation of the Commission's Docket No. R87-1 models on the HCSS data set are presented in Table 6 and are compared with previous results. Three of the variabilities estimated on the HCSS data set are virtually the same as the variabilities estimated on the Docket No. R87-1 data. These variabilities are for the inter-SCF, intra-BMC, and Box Route categories. The Inter-BMC variability is five percentage points higher in the HCSS analysis. The intra-SCF and intra-City variabilities are about ten percentage points lower in the HCSS data. Overall, the general pattern of variabilities across the route types is the same in the HCSS data set as it was in the Docket No R87-1 data. The SCF variabilities are well below the BMC variabilities, which are close to 100 percent.

Table 6
Results of Estimating the PRC Docket No. R87-1 Model on the HCSS Data Set

ACCOUNT	Estimated Variability		Number of Observations	
	PRC R87-1	HCSS	PRC R87-1	HCSS
Intra-SCF	64.25%	54.21%	285	6,034
Inter-SCF	65.42%	66.32%	360	1,683
Intra-BMC	95.11%	91.96%	302	344
Inter-BMC	90.45%	95.40%	163	177
Intra-City	74.50%	61.03%	496	421
Box Route	23.86%	22.95%	493	5,503

B. Accounting for Possible Regional Variations in Cost.

The results based upon the Commission's Docket No. R87-1 data and the results based on the HCSS data set both show that the primary driver of purchased highway transportation cost is cubic foot-miles. It is possible, however, that other factors could also help explain those costs. One important possibility is regional variation in cost. If transportation costs are higher in certain parts of the country, the Postal Service's payments for a given amount of cubic foot-miles of transportation would be higher in those areas. Of course, omitting this regional variation in cost does not bias the estimate of the variability coefficient unless the regional cost variation is correlated with the regional variation in cubic foot-miles. The HCSS data allow us to investigate this issue.

The DNO's are regional offices. Thus, the DNO in which the Postal Service administers a contract, determines the region of the country in which that contract operates. I can use this information to account for the possibility of non-volume related regional variation in cost by including dummy variables for each region in the econometric specification.[16]

Not all of the dummy variables are statistically significant. I included in each equation, on the basis of F-tests, only those dummies that are significant.

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[16] Formally, we include dummy variables for areas two through twelve. The cost effect for area one is thus captured by the intercept. The estimated coefficient on a dummy variable is the amount by which that area's non-volume related cost is above or below the same cost for area one.

The econometric results of including the regional variation are presented in Tables 7 and 7A.[17]

Seventeen variables are listed in Table 7. The first variable is the intercept, which is used as a general control for non-volume cost drivers. The next eleven variables are regional dummy variables, each representing a separate region. (No variable is included for the Allegheny region to avoid inducing a singular matrix.). A positive entry in a cell for any of these area dummies means that the non-volume related costs are higher in that region. A negative coefficient has the opposite connotation. For example, in the intra-SCF equation, the New York Metro area has the highest regional costs and the Southeast has the lowest regional costs.

As one might expect, the greatest regional non-volume variation in cost comes in local transportation. In particular, the intra-SCF transportation equation shows that virtually every area has a different level of non-volume costs. BMC transportation, in contrast, shows much less regional non-volume variation in cost.

The twelfth variable is CFM which stands for cubic foot-miles. Because the data are mean-centered, this estimated coefficient is the measure of variability. In the intra-SCF equation it is 0.5209. The number under the

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[17] This is the correct approach. However, including all of the dummies does not significantly affect the estimated variabilities. Results with all of the dummies included are presented in Workpaper WP-3.

estimate coefficient is the t-statistic for testing the null hypothesis that the estimated coefficient is zero. The thirteenth variable is the square of cubic foot-miles. This variable completes the higher order term for cubic foot-miles. The next two variables are route length (RL) and the square of route length. These are included to account for distance-related variations in transportation cost. The last variable is the cross product between cubic foot-miles and route length. This variable completes the translog.

Table 7 also present the most common measure of fit, the R^2 statistic and an F-test of the null hypothesis that the coefficients on the regional dummy variables are jointly zero.

Comparison of the variabilities estimated in these equations with the variabilities calculated without including the regional variation shows little difference. The similarity in the results means that excluding the regional effects does not bias the variability calculation. The regional variations are statistically significant, and they are important for a complete understanding of the generation of postal transportation costs. However, because the regional variation in cost is not correlated with the regional variation in cubic foot-miles, omitting these effects does not bias the estimated variabilities.

Table 7A has a similar format, but is for box routes. The regional dummies play the same roles as in the transportation equations, but the cost drivers are slightly different. Here there are three cost drivers, the number of boxes on the route (BOX), the annual miles traveled on the route (YR MILE), and the route length (RL). Following the Commission's approach in Docket No. R87-1, the variability is the estimated coefficient on the BOX variable. In Table 7A, the estimated variability is 0.2951.

Table 7

Allowing for Region Specific Effects in the Transportation Equations

	Intra-SCF	Inter-SCF	Intra-BMC	Inter-BMC	Intra-City
INTERCEPT	11.1679 622.460	12.0143 447.991	13.1290 377.064	14.0274 776.839	11.02073 240.177
Great Lakes	0.0979 3.704	0.1792 3.181			
Mid-Atlantic	0.1167 4.744	0.1533 2.945			
Midwest	-0.0507 -2.214			-0.0607 -1.939	
New York Metro	0.4514 10.322	0.2925 3.318	0.4557 2.946	0.1841 2.063	
San Juan					
Northeast	0.1259 4.931	0.0975 1.663			
Pacific	0.2222 6.855	0.3306 4.691			
Southeast	-0.0896 -3.775				-0.3014 -4.427
Southwest	-0.0778 -3.042				
Western	0.1111 3.528	0.3132 4.806		-0.1023 -1.918	
Seattle	0.0758 2.2428	0.1642 2.096	0.2662 1.982	-0.2199 -2.088	
CFM	0.5209 84.874	0.6464 38.568	0.9321 24.711	0.9485 37.967	0.6488 28.302
CFM^2	-0.0034 -2.195	.00094 2.605	0.0097 1.586	-0.0024 -0.519	0.0312 4.750
RL	-0.0607 -5.163	-0.0409 -1.535	-0.1710 -3.207	-0.0339 -1.246	-0.2074 -6.004
RL^2	0.0483 6.164	0.0108 0.673	-0.1209 -3.360	0.0365 2.569	0.0111 0.536
CFM*RL	-0.0288 -4.848	0.0329 2.2611	0.0446 1.583	0.0031 0.288	-0.0270 -1.550
R^2	.7963	.7528	.8597	.9727	.8274
F, H_0: $A_i = 0$	32.7787	7.9988	6.0867	3.7738	19.6021

Table 7A

Allowing for Regions Specific Effects in The Box Route Equation

INTERCEPT	10.078 1553.808
Great Lakes	
Mid-Atlantic	
Midwest	-0.1114 -10.961
New York Metro	
San Juan	-0.6349 -28.313
Northeast	0.1006 6.358
Pacific	0.0949 6.963
Southeast	-0.0122 -0.690
Southwest	-0.1089 -8.915
Western	0.0324 3.102
Seattle	
BOX	0.2951 48.135
BOX^2	0.0558 19.660
YR MILE	0.5005 32.254
YR $MILE^2$	0.1166 8.246
RL	-.0667 -4.431
RL^2	0.01745 1.304
BOX * RL	0.0133 1.484
BOX * YR MILE	-0.1627 -18.955
YR MILE * RL	-0.3329 -1.480
R^2	.7184
F, H_0: $A_i = 0$	176.3115

C. A Plant-Load Econometric Equation Can Be Estimated Using the Data from HCSS.

The HCSS includes plant-load contracts as well as regular purchased highway transportation contracts. Data of this type were not in the data set used by the Commission in Docket No. R87-1 and it was not possible to estimate a variability equation for plant-load contracts. With the HCSS data, it is now possible to do so.

As with other contract types, the Postal Service can pay plant-load contracts on a per-trip basis or on an annual basis. In the other accounts, the per-trip contracts were converted to an annual basis by multiplying the per-trip cost by the number of trips per year. I followed the same process for plant-load contracts. In the HCSS data set, there are more observations for the per-trip plant-load contracts (611) than there are for annual contracts (77).

I estimate the same equation for the plant-load contracts that I estimated for the other parts of the transportation network. The Commission's model, modified to include regional dummy variables, was thus applied to the plant-load data. The results are presented in Table 8. The variables and their estimated coefficients have the same interpretations in Table 8 as they did in Table 7.

Plant-load contacts typically require tractor trailers. More than 95 percent of the observations in the analysis data set are for tractor trailer transportation. The estimated variability is 88 percent, which is quite similar to other tractor trailer types of transportation.

Table 8
Results of Estimating a Plant-load Equation

	Excluding Regional Effects	Including Regional Effects
INTERCEPT	9.1269 67.491	8.7122 58.648
Great Lakes		0.6465 2.794
Mid-Atlantic		0.9136 5.300
Midwest		
New York Metro		
San Juan		
Northeast		
Pacific		1.1911 2.254
Southeast		-0.9767 -4.220
Southwest		1.1895 3.713
Western		
Seattle		
CFM	0.8946 16.063	0.8784 15.852
CFM^2	0.0529 3.340	0.0593 3.872
RL	-0.1213 -1.407	-0.3152 -3.502
RL^2	0.1638 5.512	0.1238 4.324
CFM*RL	-0.1141 -3.553	-0.1220 -3.836
R^2	.6511	.6948
F, H_0: $A_i = 0$		15.4439

D. Adjusting for Within Account Heterogeneity.

A maintained hypothesis underlying the Commission's Docket No. R87-1 analysis is that the cost-generating process within each account category is relatively homogenous. If so, a single equation can be used to estimate the variability for all costs in the account. If this hypothesis is not true, then there is more than one cost-generating process, and accurate measurement of variability may require separate identification and estimation of the individual cost generating processes. The parameters of the cost generating processes may not be the same. If they are not, a more accurate variability calculation will be accomplished through separate estimation of the individual parameters.

This is not to say that every cost pool should be split, willy nilly, into smaller subpools in a misguided search for different variabilities. Rather, a dissagregated analysis should be followed only when there are good operational reasons to do so. In the instant case, the operational basis is the existence of substantial use of two different transportation technologies within one account. Purchased highway transportation contracts that use the tractor-trailer technology have materially higher variabilities (intra-BMC and inter-BMC) than those use straight body trucks (intra-SCF and inter-SCF).

Some contracts have just tractor trailer transportation, some just have straight body transportation and some are mixed. Because the HCSS data are collected at a more detailed level than the contract, i.e., at the contract cost segment level, the mixed contracts can be separated into their tractor trailer and straight body portions. A review of the HCSS data set reveals that only inter-

SCF and intra-SCF accounts have many of both tractor trailer and straight body cost segments. Other account categories are more homogeneous. For example, box route contracts have no tractor trailers and all but one of the inter-BMC contracts specify tractor trailers.

Table 9
Distribution of Contract Cost Segments by Truck Type

Transportation Type	# of Straight Body Cost Segments	# of Tractor Trailer Cost Segments
Box Route	5,503	0
Intra-City	392	29
Intra-SCF	5,464	570
Inter-SCF	997	683
Plant-Load	22	488
Intra-BMC	10	334
Inter-BMC	1	176

Given that accounts that are predominantly tractor trailer transportation have a higher variability than those that specify straight body transportation, the measurement of variability might be improved by splitting, where possible, accounts into smaller technology-defined cost pools. In the inter-SCF and intra-SCF accounts there is significant heterogeneity. Furthermore, sufficient data exist to estimate separate variabilities for those contract cost segments that use straight body trucks and for those contracts that use tractor trailer contracts. If the estimated variabilities come out to be the same, such a division is unnecessary and a single equation should be used for the entire account. If the estimated variabilities are different, and make sense individually, then two variabilities for the cost pool should be calculated. In essence, two smaller cost pools will be formed and the variability for each will be derived from its own econometric equation.

The multiplication of the estimated variability times the accrued costs for the cost pool generates the volume variable costs for the cost pool. The variability for the entire account category is then found by dividing the total volume-variable costs from both cost pools by the total accrued costs for the account category. This is algebraically equivalent to a weighted average variability for the account where the weights are the accrued cost in each of the smaller cost pools.

The average values for the characteristics of the tractor trailer and straight body cost segments give further evidence in favor of pursuing a split approach of each account. In fact, as Table 10 shows, the two straight body and the two tractor trailer portions of the accounts look more like each other than do the two individual portions within either account category. Both tractor trailer and straight body contract cost segments are bigger in the inter-SCF account than in the intra-SCF account, yet, in both accounts the tractor trailer contract cost segments are much larger than the straight body contract cost segments. Not surprisingly the cost per cubic foot-mile is also much smaller for the tractor trailer contract cost segments in both accounts.

Table 10 Differences Within Account by Truck Type				
	Intra-SCF Vans	Intra-SCF Trailers	Inter-SCF Vans	Inter-SCF Trailers
# of Obs	5,464	570	997	683
Avg. Cost	$56,875	$168,612	$81,871	$311,388
Avg. CFM	43.1	291.4	74.4	746.5
Avg. RL	49.1	60.0	94.3	221.9
Cost Per CFM	$1,320	$579	$1,100	$417

The results of estimating separate equations by truck type for the intra-SCF and inter-SCF accounts are given in Table 11. The estimated variabilities are similar across accounts for the same the truck types but different across truck types within a single account. The intra-SCF straight body variability is 51.04 percent but the intra-SCF tractor trailer variability is 86.34 percent. Similarly, the inter-SCF variability for straight body trucks is 56.90 percent but the inter-SCF tractor trailer variability is 93.49 percent.

Table 11 Allowing for Within Account Heterogeneity				
	Intra-SCF Vans	Intra-SCF Trailers	Inter-SCF Vans	Inter-SCF Trailers
INTERCEPT	10.9557 596.985	12.0019 495.474	11.1072 352.925	12.5486 845.432
Great Lakes	0.0674 2.403	0.1898 4.262	0.1419 1.677	0.1188 3.897
Mid-Atlantic	0.1042 4.137			
Midwest	-0.0704 -2.975			
New York Metro	0.4332 9.784	0.5742 2.752	0.2191 3.107	0.2783 5.532
San Juan				
Northeast	0.1259 4.813	-0.1806 -2.819	0.1401 1.699	
Pacific	0.2543 6.986		0.3501 0.1116	0.0863 2.373
Southeast	-0.1036 -4.162	-0.1427 -3.569		-0.1002 -3.254
Southwest	-0.0933 -3.554	-0.2070 -3.220		
Western	0.1029 3.139		0.2819 3.609	0.0517 1.019
Seattle	0.0745 2.260		0.3778 3.569	0.1523 3.187
CFM	0.5104 72.827	0.8634 37.497	0.5690 25.177	0.9349 56.635
CFM^2	-0.0053 -2.929	0.0016 0.319	0.0395 6.700	0.0027 1.003
RL	-0.5052 -3.787	-0.1815 -8.202	0.0107 0.258	-0.1078 -6.262
RL^2	0.0512 6.161	0.0610 3.213	0.1499 5.544	0.0485 5.048
CFM*RL	-0.0.09 -4.551	-0.0784 -3.944	-0.1376 -6.528	0.0063 0.503
R^2	.7772	.8604	.6311	.9420
F, H_0: $A_i = 0$	31.9690	17.4527	6.0193	12.3684

These differences suggest that a split variability approach is appropriate for these two account categories. Multiplying each truck type variability times the accrued cost for those contracts used in calculating the variability calculates the overall variability for the account. That calculation is given in Exhibit B.

The combined variabilities are substantially higher than the variabilities calculated under the assumption of a homogenous cost generating process in these accounts. The intra-SCF variability is increased by 7.3 percentage points and the inter-SCF variability is increased by 18.7 percentage points.

Although the estimated variabilities for the truck types are similar in the two accounts, the percentage of accrued cost generated by each truck type is different in the two accounts. This difference is the reason that the inter-SCF variability rises by more than the intra-SCF variability. The tractor trailer variabilities are much higher than the straight body variabilities. In the intra-SCF account, tractor trailer costs in the HCSS analysis data set are only 24 percent of the total accrued costs in that account. In contrast, 72 percent of the accrued cost in the inter-SCF account (in the HCSS data set) is generated by tractor trailer contract cost segments. Thus, the higher variability gets a much larger weight in the inter-SCF cost pool.

Table 12 Effect on the Estimated Variability from Splitting the Cost Pool		
	Intra-SCF	Inter-SCF
Single Variability	52.09%	64.64%
Straight Body Variability	51.04%	56.90%
Tractor Trailer Variability	86.34%	93.49%
Combined Variability	59.30%	83.33%

E. Correcting for Heteroscedasticity

When an econometric equation is estimated on cross-sectional data, there is always the possibility that the residuals will be heteroscedastic. Heteroscedasticity is the condition of non-constant variance in the residuals. Ordinary Least Squares (OLS) estimates will be unbiased and consistent in the presence of heteroscedasticity, but they will be inefficient.

In practical terms, this means that the OLS point estimates or estimated coefficients are not influenced by heteroscedasticity, but their estimated standard errors are. It can be shown that, under heteroscedasticity, the standard errors estimated by OLS will be biased downward. This means that inferences using those standard errors may be invalid. In particular, understated standard errors imply overstated t-statistics. Thus, heteroscedasticity may cause the analyst to attribute causality to variables where it is not justified. The equation may include variables that are not statistically significant.

There are methods for re-estimating the equation taking into account the heteroscedasticity. In particular, Generalized Least Squares (GLS) can be used to re-estimate the equation when the form of heteroscedasticity is known. The form of the heteroscedasticity is rarely known, however, and this reduces the applicability of GLS. Fortunately, there is a method for correcting for the effects of heteroscedasticity even when its form is unknown. This method, based upon the work of Halbert White[18]calculates a variance/covariance matrix that is consistent.[19] The variance/covariance matrix can then be used to calculate the heteroscedasticity-corrected standard errors (HCSE). White's method depends upon re-estimating the variance/covariance matrix using the OLS residuals for each row of the matrix. Specifically, let the heteroscedastic variance/covariance matrix be given by:

$$E[\varepsilon \varepsilon'] = \sigma^2 \Omega. \qquad \textbf{(2)}$$

In this equation Ω is a matrix of weights such that $\sigma_i^2 = \sigma^2\omega_i$. Given this formulation, the variance/covariance matrix of the estimated coefficients is given by:

$$V(\beta) = (X'X)^{-1}\left[X'(\sigma^2\Omega)X\right](X'X)^{-1}. \qquad \textbf{(3)}$$

This requires an estimate of $\sigma^2\Omega$, but Ω is unknown. However, to calculate the variance/covariance matrix one need only calculate Γ, which is given by:

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[18] White, Halbert, "A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," Econometrica, Vol. 48, 1980, pp. 817-838.

[19] Consistency is the property of an estimator to have its density concentrated, as the sample size increases, above the true value.

$$\Gamma = \sigma^2 X'\Omega X = \sum_{i=1}^{N} \sigma_i^2 X_i X_i'. \qquad (4)$$

where X_i is the i[th] row of X. White demonstrated that the squared OLS residuals can be used to estimated the unknown variances, allowing Γ to be calculated:

$$\Gamma = \sum_{i=1}^{N} e_i^2 X_i X_i'. \qquad (5)$$

With this result, the variance/covariance matrix of the estimated coefficient can be calculated as:

$$V(\beta) = \left(X_i'X_i\right)^{-1} \left[\sum_{i=1}^{N} e_t^2 X_i X_i'\right] \left(X_i'X_i\right)^{-1} \qquad (6)$$

The variance/covariance matrix can then be used to calculate standard errors and t-statistics for the estimated coefficients.

Because my analysis, like the Commission's Docket No. R87-1 analysis, employs a mean-centered translog equation, only one coefficient is necessary to calculate the variability. It is easy to show that the coefficient on cubic foot-miles (or boxes in the case of the box route equation) is the required elasticity. This means that we are very concerned about inferences drawn on this coefficient and we want to be sure that the cost causality ascribed to cubic foot-miles (or boxes) is accurate. To that end, I calculated the heteroscedasticity-corrected standard errors for the cubic foot-mile coefficients in each of the estimated equations. The statistical tests of significance were then redone using the corrected standard errors.

The results of correcting for the effects of heteroscedasticity are presented in Table 13. The heteroscedasticity-corrected standard errors are all larger than the OLS standard errors, as expected. The heteroscedasticity corrected t-statistics are all lower, sometime substantially lower, than the OLS t-statistics. Nevertheless, the results of the statistical tests are never overturned and the inferences drawn on cubic foot-miles and boxes remain valid.

Table 13
Heteroscedasticity Corrected Statistical Tests

Equation	Estimated Coefficient	OLS Standard Error	OLS t-statistic	H.C.S.E. Standard Error	H.C.S.E t-statistic
Intra-City	0.6488	0.0229	28.302	0.0546	11.873
Box Route	0.2951	0.0061	48.135	0.0095	31.087
Intra-SCF Van	0.5104	0.0070	72.827	0.0155	33.010
Intra-SCF Trailer	0.8634	0.0230	37.497	0.0369	23.418
Inter-SCF Van	0.5690	0.0226	25.177	0.0462	12.315
Inter-SCF Trailer	0.9349	0.0165	56.635	0.0169	55.342
Intra-BMC	0.9321	0.0377	24.711	0.0451	20.646
Inter-BMC	0.9485	0.0250	37.967	0.0288	32.989
Plant Load	0.8784	0.0554	15.852	0.0603	14.562

There is one other set of inferences that should be checked. The significance of the regional dummy variables was evaluated by a series of F-tests. The F-statistic was used to test the null hypothesis that the estimated coefficients for the dummy variables are significantly different from zero. The analogous test using the heteroscedasticity corrected variance covariance matrix is a chi-square test.

Table 14 contains the calculated chi-square statistics for the null hypotheses that the dummy variables are significantly different from zero. In all of the eight cases, the null hypothesis can be rejected with a high degree of confidence. The lowest calculated chi-square statistic is for the intra-BMC cost account. Its value is 6.0137. The critical value for the chi-square distribution with one degree of freedom at the 95 percent level is 3.481.

Table 14
Chi Square Tests for Significance of the Region Dummy Variables

Equation	Degrees of Freedom	Calculated χ^2 Statistic
Box Route	7	1,053.37
Intra-City	1	9.98
Intra-SCF Van	10	334.47
Intra-SCF Trailer	6	142.97
Inter-SCF Van	6	37.93
Inter-SCF Trailer	6	68.66
Intra-BMC	1	6.01
Inter-BMC	4	12.35
Plant Load	5	55.33

F. Accounting for Unusual Observations

The HCSS replaced the system of paper contracts. Because of availability of data in electronic form, the current variability analysis did not require collecting and keypunching the data from more than two thousand hard copy contracts. This allowed a more complete data set to be constructed and allowed more detailed analyses to be performed. However, the absence of hard copy contracts precluded review of the specific characteristics of each contract cost segment. This raises the possibility that some of the contract cost segments may be atypical of the general cost-generating function.

To investigate this possibility, I manually reviewed the data used in each of the econometric equations presented above. That review revealed that there are a small number of observations in each account category that seem to be quite different from the other observations.

These observations are different along the following dimensions. They have:

a. Extremely low annual cost;

b. Extremely low annual CFM;

c. Extremely short or long (for the account) route length;

d. Extremely low annual miles;

e. Extremely low or high cost per CFM;

f. Extremely low or high cost per mile.

The existence of these observations raises a difficult problem. The fact they are different does not imply that they are necessarily wrong or contain incorrect data. Yet, if their characteristics are not common to the general population, their inclusion in the econometric equation *could* cloud the identification of the true cost variability.[20]

Eliminating data from an analysis should only be done with great caution. On

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[20] A request was made to the DNO's to provide feedback on these contracts. The DNO's were asked to verify the information, submit any corrected information or provide an explanation of the unusual nature of the contracts. Review of those response shows that these contracts do indeed contain some unusual circumstances like the transportation of baby chicks, the use of windsled transportation, short-length plant load contracts and low cost, "as needed" contracts. See Library Reference H-181, Responses Concerning Unusual Observations in the HCSS Data Set.

one hand, there should always be a presumption for using valid observations, even if the values for a particular observation are not typical of the rest of the data. On the other hand, if the data are from special cases, or do include data entry errors, their use could, potentially, lead to misleading results.

Finally, there is the issue of identifying what are "unusual" observations, a process which should always be done *before* the effect on the estimated equations is known. In addition, care should be taken that only truly unrepresentative observations are removed.

After examining the data and identifying the small number of unusual observations in each cost pool, I re-estimated all of the econometric equations. The complete results are presented in Workpaper WP-7, but a summary of those results is presented in Table 15.

In five cases, Box Route, Intra-City, Intra-SCF trailers, Inter-SCF trailers, and inter-BMC, the elimination of these observations did not affect the results. In these cases, the new estimated variability was within 2 percentage points of the old estimated variability. Elimination of the unusual observations is not important in these cases. The remaining four cases, Intra-SCF vans, Inter-SCF vans, Intra-BMC, and Plant Load, were quite different because elimination of a small number of observations has a large impact. In each case, the estimated variability rises by a large amount. The most extreme case was the intra-SCF van category where the elimination of 30 observations out of 5,464 observations caused the variability to rise by 10.5 percentage points. In addition, in three of these four cases, the fit of the equation was significantly improved by eliminating the unusual observations. In the last case, the fit was improved but not by a large amount.

Although both the previously reported results and these results have merit, I recommend that the Commission use the variabilities calculated on the data set with the unusual observations removed. My judgment is based upon three factors: the great difference between the characteristics of the omitted observations and the rest of the data, the material increase in certain of the variabilities from omitting the observations, and the material increase in the goodness of fit of several equations from omitting the observations.

Table 15
Effects of Eliminating a Small Number of Unusual Observations

	# Of Observations			R^2			Variabilities		
Category	Before	After	Change	Before	After	Change	Before	After	Change
Box Route	5,503	5,474	-29	0.7341	0.7184	-0.0157	27.76%	29.51%	1.75%
Intra-City	421	385	-36	0.6100	0.8274	0.2174	63.52%	64.88%	1.36%
Intra-SCF Vans	5,464	5,434	-30	0.7772	0.8515	0.0743	51.04%	61.51%	10.47%
Intra-SCF Trailers	570	559	-11	0.8604	0.8514	-0.0090	86.34%	87.73%	1.39%
Inter-SCF Vans	997	982	-15	0.6311	0.8437	0.2126	56.90%	65.74%	8.84%
Inter-SCF Trailers	683	669	-14	0.9420	0.9073	-0.0347	93.49%	95.34%	1.85%
Intra-BMC	344	328	-16	0.8597	0.9520	0.0923	93.21%	97.43%	4.22%
Inter-BMC	177	172	-5	0.9727	0.9473	-0.0254	94.85%	94.88%	0.03%
Plant Load	510	476	-34	0.6948	0.8790	0.1842	87.84%	94.66%	6.82%

EXHIBIT USPS-13A
TRANSPORTATION MANAGEMENT INSTRUCTION

This exhibit presents Postal Service Management Instruction DM-150-83-2. It is used to identify Intra-City routes. Intra-City routes are in the Intra-SCF cost account and are identified by their HCRIDs. Intra-City routes have an alphabetic character with a value from "A" through "G" in the fifth digit of their HCRIDs.

This management instruction was first submitted in Docket No. R87-1, but is reproduced here for convenience.

Management Instruction

Date Issued	Filing Number
11-11-83	DM-150-83-2
Effective Date	**Obsoletes**
Immediately	
Originating Organization & OCC Code	
Mail Processing/MP310	
Signature	

Title: Highway Contracts—Assignment of Contract Route Numbers

I. PURPOSE

To provide instructions for the assignment of highway contract route (HCR) numbers.

II. INTER-CITY ROUTES - (REGULAR SERVICE CONTRACTS)

A. Assigning Numbers

Five digit numbers are assigned to each route. The first three numbers must adhere to one of the following:

1. MSC Head-Out

The three-digit ZIP Code prefix of the management sectional center (MSC) if the MSC is the head-out point.

2. AO Head-Out

The three-digit ZIP Code prefix of the MSC in which an associate office (AO) is located, if the AO is the head-out point.

3. BMC Head-Out

The three digit ZIP Code prefix of the originating bulk mail center (BMC) if the BMC is the head-out point.

B. Assigning Identification Numbers

The fourth and fifth digits of an HCR number identify the type of route and are assigned as indicated in Exhibit I, Chart A.

C. Rules for Assigning HCR Numbers

The following rules must be observed when HCR numbers are assigned:

1. MSCs with Multiple ZIP Code Prefixes (Same States)

The lower MSC number must be used first in MSC service areas having more than one three-digit number if the major portion of the route operates within the same state as that designated by the identification number.

2. MSCs with Multiple ZIP Code Prefixes (Different States)

MSCs having ZIP Code prefixes for more than one state' must assign route numbers to identify the state in which the major portion of the route provides transportation services.

Note: Rock Island, IL, MSC provides transportation services into two states and one city using three different MSC identification numbers (527, 528, and 612): (1) 527 identifies routes serving a portion of the state of Iowa; (2) 528 identifies routes serving the zoned city of Davenport, Iowa; and (3) 612 identifies routes serving portions of the state of Illinois. Iowa routes out of the Rock Island MSC or its AOs located in Iowa would have 527 for their

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Standard distribution plus MSCs and BMCs.	Organizations listed under distribution may order additional copies. Use Form 7380, Requisition for Supplies; specify the filing number; and send it to the Eastern Area Supply Center. You may photocopy but do not paraphrase or rewrite any of this instruction.

first three numbers. Illinois routes out of the Rock Island MSC or its AOs located in Illinois would have 612 for their first three numbers. Routes out of the Rock Island MSC serving the city of Davenport, Iowa, would have 528 for the first three digits.

III. INTRA-CITY ROUTES (Regular Service Contracts)

A. Route Numbering (Chart Use)

These routes must be numbered as indicated in Exhibit I, Chart B.

B. Assigning Identification Numbers

Route or contract designation must consist of five positions: three numbers and two letters. The three numbers must be the same as the three-digit ZIP Code prefix of the MSC in which the route operates. The fourth position must be a serial code within the MSC designation, with capital letters A through Z assigned in alphabetical order. The fifth position shows the type of service by alpha code. In assigning codes for the fifth position, use the alpha characters as indicated in Exhibit I, Chart B.

IV. OTHER TYPES OF CONTRACT SERVICE (REGULAR SERVICE)

A. Route Numbering (Chart Use)

These contracts must be numbered in accordance with Exhibit I, Chart C.

B. Assigning Identification Numbers

See paragraph III-B for explanation of the assigning of contract numbers, except that MSC number assignment must be from the MSC where the route emanates, if inter-MSC routes are involved.

V. EMERGENCY CONTRACT

A. Route Numbering (Chart Use)

These contracts must be numbered in accordance with Exhibit II, Chart D.

B. Assigning Identification Numbers

See paragraph III-B for explanation of assigning contract numbers, except that MSC assignments must be from the MSC where the route emanates, if inter-MSC routes are involved.

VI. MIXED SERVICE ROUTES

Routes providing incidental transportation services, such as inter MSC route providing box delivery services, which would normally be performed under a different route identification number will be assigned route numbers that identify the dominant type of service performed on the route.

VII. TRIP NUMBERS (BMC)

To properly identify all costs related to BMC transportation service on those routes having multiple segments, all trips serving a BMC will be assigned a three-digit trip number. The first of the three digits will always be an "8"; i.e., 801, 812, 815.

VIII. ASSIGNMENT OF FIFTH DIGIT ALPHA CHARACTERS:

Fifth-digit characters must be assigned as indicated in sections III.B, IV.A and V.A. Characters must be used as directed by the explanation that is provided on the charts. Those characters reserved for future use are unassigned and, therefore, must not be used without the prior approval of the Director, Office of Transportation and International Service, Mail Processing Department.

IX. ADJUSTMENT OF EXISTING HCR NUMBERS

If an existing contract HCR number is inconsistent with the provisions of this Management Instruction, Contracting Officers must immediately adjust the route number to insure compliance.

Chart A Inter-City Routes (Regular Service Contracts)

POSITION CHART

Fourth and Fifth digit	Type Route
00-----02	Water Routes
03-----05	Area Bus Routes
06-----09	(Reserved for future use)
10-----29	Inter MSC or Inter BMC Routes
30-----59	Intra MSC Routes
60-----89	Associate Office (Head-outs)
90-----98	Intra-BMC Routes
-------99	BMC leased vehicles

Chart B Intra-City Routes (Regular Service Contracts)

POSITION CHART

(1)	(2)	(3)	(4)	(5)	Facility
0	0	0	A	A	P-PO Station or Branch
1	1	1	↓	B	P-Piers
2	2	2		C	P-RR Depot
3	3	3		D	P-Airport
4	4	4		E	P-Piers
5	5	5		F	Rail yard drayage
6	6	6		G	(Reserved for future use)
7	7	7			
8	8	8			
9	9	9	Z		

Chart C Other Types of Contracts (Regular Service)

POSITION CHART

(1)	(2)	(3)	(4)	(5)	Contract Type
0	0	0	A	H	Reserved for future use
1	1	1	↓	J	Truck Terminal
2	2	2		K	Mail Equipment Facility
3	3	3		L	(Reserved for future use)
4	4	4		M	(Reserved for future use)
5	5	5		N	Experimental Contracts
				P	(Reserved for future use)
				Q	Unusual Basic Surface Transportation Contract
6	6	6		R	Plant-load
7	7	7		S	Plant-load
8	8	8		T	(Reserved for future use)
9	9	9	Z		

Exhibit I

Chart D Emergency Contracts

POSITION CHART

(1)	(2)	(3)	(4)	(5)	Contract Type
0	0	0	A	U	Inter-City
1	1	1		V	Intra-City
2	2	2		W	Plant-load
3	3	3		X	Plant-load
4	4	4		Y	(Reserved for future use)
5	5	5		Z	(Reserved for future use)
6	6	6			
7	7	7			
8	8	8			
9	9	9	Z		

Chart E BULK MAIL CENTER THREE-DIGIT TRANSPORTATION CODES

REGION	BULK MAIL CENTER	1st 3 DIGITS
Northeast	New York, NY	102
Northeast	Springfield, MA	011
Eastern	Pittsburgh, PA	151
Eastern	Philadelphia, PA	192
Eastern	Washington, DC	202
Central	Cincinnati, OH	452
Central	Detroit, MI	483
Central	Des Moines, IA	503
Central	Minneapolis, MN	552
Central	Chicago, IL	608
Central	St. Louis, MO	632
Central	Kansas City, KS	663
Southern	Greensboro, NC	274
Southern	Atlanta, GA	303
Southern	Jacksonville, FL	322
Southern	Memphis, TN	381
Southern	Dallas, TX	751
Western	Denver, CO	802
Western	Los Angeles, CA	901
Western	San Francisco, CA	941
Western	Seattle, WA	981

Exhibit II

EXHIBIT USPS-13B
CALCULATION OF VARIABILITIES FOR SPLIT COST ACCOUNTS

The Intra-SCF and Inter-SCF cost accounts are split into subsets for the calculation of volume variabilities. To create variabilities for the entire cost account, these subset variabilities must be combined. The calculations used to compute the combined variabilities are presented in this Exhibit.

As explained in my testimony, the combined variability is calculated in three steps:

Step 1: Multiply each subset variability times the accrued cost for the contract cost segments used to estimate that variability.

Step 2: Sum the products found in Step 1.

Step 3: Divide the sum found in Step 2 by the total accrued costs for all contracts used in Step 1.

Mathematically, these steps can be expressed as:

$$\varepsilon_C = \frac{\sum_{j=1}^{n} \varepsilon_j C_j}{\sum_{j=1}^{n} C_j},$$

where ε_C is the combined variability, ε_j is a subset variability, and C_j is a subset accrued cost.

The calculations are presented on the next page of this Exhibit.

CALCULATING THE VARIABILITIES FOR THE SPLIT COST ACCOUNTS

ACCOUNT	GROUP	HCSS ACCRUED COST	SPLIT VARIABILITY	VV COST	OVERALL VARIABILITY
INTRA-SCF	Box Route	$126,793,824	29.512%	$37,419,393	
INTRA-SCF	Intra-City	$25,120,180	64.879%	$16,297,671	
INTRA-SCF	Intra-SCF Vans	$310,245,916	61.510%	$190,831,642	
INTRA-SCF	Intra-SCF Trailers	$95,234,611	87.733%	$83,552,086	**58.863%**
INTER-SCF	Inter-SCF Vans	$79,045,108	65.740%	$51,964,254	
INTER-SCF	Inter-SCF Trailers	$207,532,510	95.343%	$197,866,684	**87.177%**

Sources for Costs

Box Route	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 5
Intra-City	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 11
Intra-SCF Van	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 16
Intra-SCF Trailer	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 21
Inter-SCF Van	Workpaper WP-7, TRANSEQ.INTERSCF.FIN.LISTING at page 5
Inter-SCF Trailer	Workpaper WP-7, TRANSEQ.INTERSCF.FIN.LISTING at page 10

Sources for Variabilities

Box Route	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 6
Intra-City	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 12
Intra-SCF Van	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 17
Intra-SCF Trailer	Workpaper WP-7, TRANSEQ.INTRASCF.FIN.LISTING at page 22
Inter-SCF Van	Workpaper WP-7, TRANSEQ.INTERSCF.FIN.LISTING at page 6
Inter-SCF Trailer	Workpaper WP-7, TRANSEQ.INTERSCF.FIN.LISTING at page 11