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Costs and Returns to Scale in U.S. Post Offices

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This article treats post offices as multiproduct firms, specifying a production correspondence, behavioral formulation and resultant cost and derived-demand functions. These functions are estimated over 156 offices. Overall returns to scale parameters are estimated, but it appears advisable to break the national sample into three subsamples. An optimally efficient size of office is found. Deviations from the cost function indicate costliness which varies significantly over postal regions. This suggests a geographical influence on productivity probably due to differences in labor quality. Marginal costs for several types of mail are derived.

1. OBJECTIVES

This article specifies a production correspondence for "intra post-office activity" of U.S. post offices.¹ Intra post-office activity or processing of mail and retailing represents 41 percent of Post Office Department (POD) expenditures of \$8 billion per year [8, p. 22].

We estimate derived-demand and cost functions cross sectionally over 156 large offices in Postal Fiscal Year (PFY) 1966. Once a norm has been established, each can be rated on costliness in terms of deviations from the norm. Shadow prices for the several classes of output are estimated. Findings bear on the advisability of consolidating or decentralizing operations of several offices. Unsuspected at the outset was a very strong regional influence on productivity which appears to indicate variation in labor quality over the country.

2. FORMULATION

Assume that the POD behaves to minimize the cost of handling the mail. Output is determined exogenously: the POD must deliver what the people of the United States deposit in the mailboxes. Output prices and wages are determined by Congress; rental prices by the market. Overall cost minimization need not imply cost minimization at each office. For example, one office may do the work of others if that is less costly than for each office to sort its own mail. Quality of service may also vary among offices. For purposes of this study we assume that offices endeavor to minimize cost and that quality of service is uniform. Postmasters do not have autonomy in their

choice of factor inputs. These are determined by Regional Offices. Nevertheless we may analyze the performance of individual offices.

Each post office in the sample produces the following outputs (all variables were measured in thousands except postal revenues which were measured in millions):

- X_1 Incoming letters and outgoing cancelled letters, in "first-handling" pieces, largely first class, some third class,
- X_2 "Second-class" mail,² in first-handling pieces,
- X_3 Outgoing noncancelled letters, in first-handling pieces, largely third class, but some first-class metered mail,
- X_4 Fourth-class: incoming, outgoing parcels, in first-handling pieces,
- X_5 Window services, measured by postal revenues in dollars,

Each office uses the following inputs:

- V_6 General Services Administration (GSA) floor space, in square feet,
- V_7 Inside labor, in man-hours,
- V_8 Inside + $\frac{1}{2}$ platform space, leased and rented, in square feet,
- O_9 Imputed outlay on equipment, in dollars of depreciation plus imputed interest at seven percent on the undepreciated book value of capital stock.

Each office takes as given the outputs it must produce, the prices, w_7 and w_8 , at which it can purchase factors 7 and 8 and its endowment of the fixed factor 6.

We assume that each office endeavors to minimize³ variable factor costs or to maximize

$$-w_7V_7 - w_8V_8 - O_9, \text{ "cost savings,"} \quad (2.1)$$

subject to: the production correspondence,

$$\prod_{i=1}^5 X_i^{\alpha_i} \leq A \prod_{j=6}^8 V_j^{\beta_j} \left(\frac{O_9}{w_9} \right)^{\alpha_9}, \quad (2.2)$$

output constraints,

$$X_i \geq \bar{X}_i; \quad (i = 1, \dots, 5) \quad (2.3)$$

and the limited endowment of fixed factor

$$V_6 \leq \bar{V}_6, \quad (2.4)$$

where a bar over a symbol denotes a given value of the variable, and A is a constant.

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¹ Terminology will be used as follows: The POD administers operations of 32,260 post offices, or labor, machinery, and floorspace under the supervision of postmasters through 15 regional offices. Each post office may have many stations.

² This does not correspond exactly to the POD definition of second-class mail. X_2 is the following weighted average: .189 Outgoing flats + .358 Outgoing small parcels and rolls (SPCRs) + .193 Incoming flats + .259 Incoming SPCR's. The weights are derived from POD time and motion studies, POD Form 2345, "Operation Analysis," November 1966.

³ This is a roughly tenable behavioral assumption. It is not applicable to all activity in the nonprofit-maximizing sector, for example, hospitals.

1. DERIVED DEMANDS FOR FACTORS CONSTRAINED TO SATISFY CERTAIN PROPERTIES OF THE COBB-DOUGLAS MODEL*

Factor	C_j	Independent variable								$s = \sum_{i=1}^6 b_i$	r
		$\ln X_1$	$\ln X_2$	$\ln X_3$	$\ln X_4$	$\ln X_5$	$\ln V_6$	$\ln w_7$	$\ln w_8$		
$\ln V_7$	-5.48 ^b	.462 ^b	.529 ^b	-.102 ^b	.180 ^b	.052	-.065 ^b	1.13 ^b	.170 ^b	1.0565 ^c	.95
$\ln V_8$	-7.02 ^b	.462 ^b	.529 ^b	-.102	.180 ^b	.052	-.065 ^b	.374	-.199	1.0565	.95
$\ln O_9$	-7.03 ^b	.462 ^b	.529 ^b	-.102	.180 ^b	.052	-.065 ^b	.012	.262	1.0565	.95

* Estimated from observations on 156 offices.

^b Regression coefficients significantly different from zero at the .05 level.^c Significantly different from one at the .05 level.

Let $Q(X)$, the left side of (2.2) be called the *transformation function* and $Y(V)$, the right side, the *production function*.⁴ Call $Y(V)$ an intermediate product, "composite output" or "output potential," into which inputs are first transformed and then is itself transformed into outputs $\{X_i\}$ in a second stage. Then the $\{\alpha_i\}$ $i=6, 7, 8, 9$ are elasticities of "output" with respect to inputs.

In the LaGrangean expression, where (m_i) are undetermined multipliers:

$$L(V; m) = -w_7V_7 - \dots - O_9 + m_0[Y(V) - Q(X)] \\ + m_1(X_1 - \bar{X}_1) + \dots + m_6(X_6 - \bar{X}_6) \quad (2.5) \\ + m_6(\bar{V}_6 - V_6).$$

where m_0 is the marginal cost savings of increasing composite input, m_1 is the marginal cost of output 1, $\dots$, and m_6 is the marginal cost savings or shadow price of a unit of GSA floor space.

The structural form of the model is⁵

$$Hv = Bx, \quad (2.6)$$

where

$$H = \begin{pmatrix} -1 & 1 & 0 \\ -1 & 0 & 1 \\ \alpha_7 & \alpha_8 & \alpha_9 \end{pmatrix},$$

$$B = \begin{pmatrix} (A_8 - A_7) & 0 & \dots & 0 & 0 & 1 & -1 \\ (A_9 - A_7) & 0 & \dots & 0 & 0 & 1 & 0 \\ (\alpha_9 W_9 - a) & \alpha_1 & \dots & \alpha_5 & -\alpha_6 & 0 & 0 \end{pmatrix}$$

$$v = (v_7, v_8, o_9)^T \quad \text{and} \quad x = (1, \bar{x}_1, \dots, \bar{x}_6, \bar{v}_6, W_7, W_8)^T.$$

* There are theoretical arguments that could be made against this generalized Cobb-Douglas correspondence. Especially vulnerable is the transformation function. These must be deferred to another paper. The production function is a generalization of the venerable Cobb-Douglas function, linear in the logarithms of the three factors, with unconstrained returns to scale.

* The three equations in (2.6) are obtained as the solution to the constrained maximization problem in (2.1), (2.2), (2.3) and (2.4). Practically, they are obtained by taking first partial derivatives of (2.5) with respect to the choice variables V_7 , V_8 and O_9 and setting them equal (strictly, less than or equal) to zero. These three

Lower-case letters such as $\bar{x}_1$ represent the natural logarithm of the upper-case counterpart and vice versa, e.g., $A_9 = \ln \alpha_9$; $a = \ln A$. Call this the *case-logarithm convention*.

The reduced form can be either the set of derived demand equations for the inputs or the cost function. The first is more natural:

$$v = H^{-1}Bx, \quad (2.7)$$

where

$$H^{-1}B = \frac{1}{\Sigma} \begin{pmatrix} C_7 & \alpha_1 & \dots & \alpha_5 & -\alpha_6 & -(\alpha_8 + \alpha_9) & \alpha_8 \\ C_8 & \alpha_1 & \dots & \alpha_5 & -\alpha_6 & \alpha_7 & -(\alpha_7 + \alpha_9) \\ C_9 & \alpha_1 & \dots & \alpha_5 & -\alpha_6 & \alpha_7 & \alpha_8 \end{pmatrix},$$

$$\Sigma = \alpha_7 + \alpha_8 + \alpha_9$$

and, e.g., $C_7 = (\alpha_8 + \alpha_9)A_7 - \alpha_8A_8 - \alpha_9A_9 + \alpha_9W_9 - a$.

3. STATISTICAL RESULTS FROM DERIVED DEMANDS

Derived demand equations were estimated econometrically through cross-sectional observations on 156 offices' inputs, outputs and factor prices. Results are available in [5] and are omitted for brevity because of their similarity to those of Table 1.

Certain constraints are implied by the economic theory of derived demand under cost-minimization when a Cobb-Douglas hypothesis is maintained. Examples of these constraints can be seen from examining (2.7). For example, the first output enters all derived demand equations in the same form and so on for all outputs.⁶ Constraints on output coefficients imply that each derived demand equation is homogeneous of the same degree in

inequalities say that the marginal outlay on each factor must equal its marginal value product in cost savings (or the former is greater than the latter in which case the factor will not be used). We assume that an interior solution exists such that all choice variables are positive at their optimal levels. To obtain three independent equations, the second and third are divided by the first to yield the first two equations in (2.6) and the third equation of (2.6) is simply the logarithmic form of the production correspondence.

* Further constraints on the coefficients of prices might have been imposed but were not, e.g., each derived demand is theoretically homogeneous of degree zero in factor prices. One factor price, that of equipment, is unobservable and embodied in the constant term for each equation.

outputs, $\sum_{i=1}^5 \alpha_i / \Sigma$. Least-squares estimates which satisfy these constraints are given in Table 1.

The returns-to-scale parameter,

$$\rho = \sum_{i=6}^9 \alpha_i / \sum_{i=1}^5 \alpha_i, \quad (3.1)$$

is simply the degree of homogeneity of the production correspondence. It can be estimated as

$$r = (1 - b_6) / \sum_{i=1}^5 b_i,$$

where the $\{b_i\}$ are regression coefficients of outputs ($i=1, \dots, 5$) and GSA floor space ($i=6$). Calculated values of r are given in the last column in Table 1 and in Columns 5 and 9 of Table 3.

Sampling theory is more easily derived for the statistic $s = \sum_{i=1}^5 b_i$. Let us consider the case of decreasing returns to scale (DRTS), $\rho < 1$, i.e.,

$$\Sigma + \alpha_6 < \sum_{i=1}^5 \alpha_i$$

or

$$\sum_{i=1}^5 \alpha_i / \Sigma - \alpha_6 / \Sigma > 1$$

which would be estimated as $s > 1$.

Similarly, $s < 1$ indicates IRTS and $s = 1$ indicates CRTS, the null hypothesis. The standard error of s can be calculated from the variances and covariances of the regression coefficients.

The constrained reduced-form estimates suggests DRTS with an estimated returns parameter, which is the same for each equation, of .95 (last column in Table 1). The constrained estimates are more precise than either the unconstrained derived demand equations or the cost function.⁷ If we use the estimated standard error of s in the cost function, .015, we can reject the null hypothesis of CRTS in favor of decreasing returns.

The coefficients of the outputs in, e.g., the labor equation, are interpretable as elasticities of demand for labor with respect to an increase in one of the five outputs. As such, they should always be positive, assuming positive marginal productivities of each factor. All but third class are positive as estimated. Outgoing third-class mail is not demanding on intra post-office resources.

The demand for labor is significantly greater where the floor space price is high, suggesting some substitution of labor for floor space. Additional labor can move mail more quickly through the office so that a smaller mail inventory need be accommodated. Outlay on mechanization is positively affected by floor space costs, suggesting some substitution there too.

Quantity of labor demanded is greater in cities where the wage is high. This is a counter-intuitive effect suggesting either that post offices are intentionally uneconomic, or, more likely, that labor quality available to an office is lower in high-wage cities. If labor quality is lower and price higher, then the cost-minimizing post office should

use less of the dear, poor labor. Constraints, however, bias the choice of factors in favor of labor. Labor can be hired (if not retained) relatively easily. Increasing floor space involves a long lead time. Rental prices tend to be high where wages are. Congress has been niggardly with mechanization so that it is not available to all offices that can justify its use.⁸ The floors in some GSA buildings will not hold the weight of letter sorting machines. These institutional, motivational and technical constraints hamper postal management from free choice of factor proportions. The Kappell Commission recognized this phenomenon of "no control" [8, pp. 33-6]. Since constraints prevent use of floor space or mechanization, more labor, albeit of lower quality, must be hired to move the mail.

The coefficient of GSA space is of the expected sign. The more an office is endowed with, the less it need use the other factors of production.

4. RESULTS FROM COST FUNCTIONS

The other reduced form is the cost function. The cost function implied by the Cobb-Douglas model is

$$c = \frac{1}{\Sigma} [(-\alpha_7 A_7 - \alpha_8 A_8 - \alpha_9 A_9 + \alpha_9 W_9 - a) + \sigma + \alpha_1 x_1 + \dots + \alpha_5 x_5 + \alpha_6 v_6 + \alpha_7 W_7 + \alpha_8 W_8], \quad (4.1)$$

where c is the natural logarithm of total labor, floor space and equipment costs. One of the ways (4.1) can be derived is by adding up the derived-demand functions in (2.7); each, except 0_9 , is multiplied by its corresponding price. A Sectional Center dummy variable has been included in the cost functions and is equal to one if an office is a Sectional Center.

In the overall intra post-office cost function shown in the first line of Table 2, all estimated regression coefficients are significantly different from zero at the .05 level except those of third class, GSA space and the Sectional Center dummy.

The statistic, s , again serves as a test statistic for returns to scale. Table 3 shows in Column 5 that the overall cost-function point estimate of returns to scale, r , is .905 and in Column 3 that we can reject the hypothesis of CRTS in favor of DRTS. This corroborates previous results from derived demands.

The degree of returns to scale may not be independent of the level of output. It may be an oversimplification to posit a single production function throughout the range of output variation. We may try, as Nerlove did [6, 7], to approximate the actual cost function by a series of segments linear in logarithms. To do this we can take advantage of the economy of parameters and stratify the sample of 156 offices into three subsamples of 52 offices

⁷ Each standard error of output and GSA floor space coefficients (but not those of factor prices) is smaller than its counterpart in the unconstrained derived-demand functions.

⁸ Only in the latter half of the 1960's has Congress started funding mechanization. Political motivations made hiring labor (rewards) and building structures (incentives) more likely.

2. INTRA POST-OFFICE COST FUNCTIONS

Group	b_0	$\ln X_1$	$\ln X_2$	$\ln X_3$	$\ln X_4$	$\ln X_5$	$\ln V_6$	$\ln w_7$	$\ln w_8$	SC ^a	R ²	SSE
All 156 offices	-4.96 ^b	.461 ^b	.428 ^b	.027	.075 ^b	.124 ^b	-.009	1.87 ^b	.134 ^b	-.041	.980	3.235
52 small offices	-1.95	.397 ^b	.324 ^b	.010	.036	.007	-.001	1.29 ^b	.060	-.039	.735	.550
52 medium offices	-2.81	.287 ^b	.214	.073	.137	.160	-.014	2.46 ^b	.198	.031	.771	1.118
52 large offices	-4.59 ^b	.399 ^b	.359 ^b	.105	.109	.068	.005	1.89 ^b	.204 ^b	-.092	.976	.772

^a Sectional Center dummy variable equal to one if post office is a Sectional Center.

^b Regression coefficients significantly different from zero at the .05 level.

3. RETURNS TO SCALE IN POST OFFICES

Group (1)	Without regional adjustment				With regional adjustment			
	s (2)	t (3)	Returns (4)	r (5)	s (6)	t (7)	Returns (8)	r (9)
All	1.106 ^a	7.1	Decreasing	.905	1.122 ^a	8.0	Decreasing	.892
Large	1.045	1.3	Decreasing	.957	1.082 ^a	2.9	Decreasing	.924
Medium	.857	-1.4	Increasing	1.164	.918	-.8	Increasing	1.088
Small	.773	-2.4	Increasing	1.293	.774 ^a	-2.4	Increasing	1.292

^a Indicates ability to reject the null hypothesis of CRTS at the .05 level.

each on the criterion of authorized employee complements [10].

To test for the statistical validity of the stratification, compare the sum of squared errors in the stratified model with that in the simpler model in which a single cost function is posited for the entire sample. The maintained hypothesis is that cost can be explained by 30 regressors; the hypothesis to be tested is that all offices have the same cost function independent of size. Let S_{10} represent the sum of squared errors when ten regressors are used. Now if the error terms are normally distributed, independent and homoscedastic, then

$$F = \frac{(S_{10} - S_{30})/20}{S_{30}/126}$$

is distributed as F with 20 and 126 degrees of freedom. The data to calculate this test statistic are in the last column of Table 2. The calculated value is 2.05 which is significant at the .01 level. The stratification is valid.

Column 5 of Table 3 gives point estimates of IRTS in the group of small offices persisting in medium-sized offices and finally DRTS in the largest offices.⁹ This suggests that the optimal size office would be in the medium or large group, near the border. Our "small" offices are still roughly among the largest 160 of the country's 32,000. Offices among the largest 100 in the nation are,

⁹ Small: Garden City through Fort Wayne, 250-630 employees; Medium: Arlington, Va. through Toledo, 630-1,422 employees; Large: Nashville through New York, 1,511-38,360 employees.

therefore, most efficient. Others should be agglomerated where possible, eliminating smaller offices.

The overall cost function is very similar to the labor derived-demand equation because labor is the overwhelming component of postal costs (80 percent).

Regression coefficients are interpretable as elasticities of cost with respect to increases in outputs and factor prices. Cost is most elastic to first- and then to second-class mail. It is not surprising that outgoing noncancelled letters should not influence costs very much. Bulk-rate mail must be delivered to the office by sender presorted by ZIP code so that it takes very little effort on the part of the office of origin.

5. SHADOW PRICES

The model also gives shadow prices for the several types of mail service as functions of the exogenous variables [5, pp. 35f.]. The original problem was a nonlinear programming model with objective function (2.1) and constraints (2.2), (2.3) and (2.4). The LaGrangean expression (2.5) includes shadow prices $\{m_i\}$ for which we can solve in terms of the exogenous variables and the parameters of the problem as part of the reduced form.

Marginal costs were also obtained by multiplying each regression coefficient by the C/X_i value obtaining in that office. Average figures agree very well with shadow prices (Table 4). We shall later find it necessary to amend the cost function because of a geographical variable not included at first. Column 4 lists marginal costs derived from that cost function.

The price of "second-class" mail appears inordinately high and requires further explanation. Recall from Footnote 2 that X_2 is a weighted average of four different types of mail. Hence $dC/dX_2 = .1269$ but, e.g., $dX_2/dOf = .189$ where Of represents outgoing flats. Multiplying these factors we get marginal costs per first handling piece, e.g., outgoing flats, \$.0240.

The shadow price of GSA space was estimated to be 75 cents per square foot per year. This implies that an office endowed with a square foot of GSA space saves \$.75 by having it. The mean price of leased and rented

4. MARGINAL COSTS OF SELECTED TYPES OF MAIL SERVICE PER FIRST-HANDLING PIECE

(1)	From cost function (2)	Shadow price (3)	From amended cost function ^a (4)
x_1	\$.0123	\$.0125	\$.0140
x_2^b	.1240	.1269	.1168
x_3	.0017	.0017	.0023
x_4	.0475	.0461	.0703
x_5^c	71.30	79.42	32.20

^a With NEFW variable included.

^b See text and the Tabulation a (Section 7) for costs of component types of mail.

^c Per \$1,000.

interior floor space over the sample was \$1.20. Thus a square foot of GSA space is not an equivalent substitute for one of leased and rented space because having the former does not save \$1.20 per year, but only \$.75. GSA buildings tend to be older and less well located to serve current population and to exploit currently used transportation modes.

6. PERFORMANCE INDICATORS

An overall measure of office performance is costliness, the ratio of actual cost to predicted cost based on the estimated cost function. Since the F test established that the stratified cost functions are preferable to the overall cost function, costliness is calculated as the ratio of actual cost to predicted cost based on the stratified cost functions. An analysis of variance indicated that there was no significant difference in costliness among regions of the country. Although the differences were not statistically significant, the Boston, Denver, San Francisco and Seattle regions had higher mean costliness indices than other regions. There was no significant difference in costliness between mechanized and nonmechanized offices in PFY 1966.

Costliness can be analyzed into technical and economic efficiency [1, 4, 6] or productivity and input efficiency [2]. The first is the quality of being on the efficient isoquant, not using any more of either factor than is required to produce a given output. The second is that of choosing cost-minimizing factor proportions, given relative prices.

To investigate productivity a simple production function was fit to the entire sample. A scalar measure of output, Q , was the dependent variable,¹⁰ and the factors of production and the Sectional Center dummy were the regressors. A simple Cobb-Douglas function was rejected in favor of a Taylor's series approximation [3] to a constant elasticity of substitution function:

$$q = 7.83 + .328v_7 + .510 \ln(V_6 + V_8) + .035o_9 \\ + .120[v_7 - \ln(V_6 + V_8)]^2 + .018[v_7 - o_9]^2 \\ - .013[\ln(V_6 + V_8) - o_9]^2 + .072SC \\ R^2 = .978. \quad (6.1)$$

Although not all coefficients are significantly different from zero, (6.1) had smaller mean square error than a Cobb-Douglas model.

The ratio of actual output to output predicted by (6.1) is an index of productivity. An analysis of variance (available in [5, p. 98]) yields a calculated $F=1.90$ with 14 and 141 d.f., rejecting the hypothesis of uniform productivity among regions at the .05 level. Scheffé's method of multiple comparisons [9, p. 80] allows us to say that the Northeast and Far West are significantly less productive than the South and Midwest. One hypothesis to explain this phenomenon is: where superior opportunities abound, the POD must accept higher turnover, more absenteeism and generally a lower quality of labor. Postal pay is more attractive in a southern city where nonpostal wages are considerably lower and fewer alternative employment opportunities are available.

Corroboration for this hypothesis is given by the following estimated equation

$$\text{Productivity} = 1.096 - .0038 \text{ Labor turnover} \\ (.02) \quad (.0008) \quad R^2 = .11 \quad (6.2)$$

Labor turnover was reported for PFY 1966 by the POD Internal Audit Division and serves as an inverted measure of labor quality. The numbers in parentheses are standard errors so that productivity is significantly lower where labor turnover is high. Further corroboration is given by the labor derived demand equation of Table 1 which shows that offices use significantly more labor where the wage is high. This uneconomic behavior can be rationalized if the labor is of lower quality. More man-hours must be procured to get an equivalent labor input in efficiency units.

7. REESTIMATION TAKING ACCOUNT OF LABOR QUALITY VARIATION

Geographic location¹¹ did prove to be a significant factor affecting costs. The reestimated cost function including it is

$$c = -5.42 + .52x_1 + .40x_2 + .04x_3 + .11x_4 \\ (.51) \quad (.04) \quad (.05) \quad (.03) \quad (.03) \\ + .06x_5 - .01x_6 + 1.57W_7 + .12W_8 \\ (.03) \quad (.01) \quad (.30) \quad (.05) \quad (7.1) \\ - .02SC + .08NEFW \quad R^2 = .981 \\ (.04) \quad (.03) \quad SSE = 3.07$$

¹⁰ The scalar measure of output was derived using POD-supplied weights based on time and motion studies which represent the labor requirement of the typical piece of each of nine categories of mail. See Footnote 2.

¹¹ NEFW (Northeast or Far West) is measured as a dummy variable equal to one if an office is in the Boston, New York, Philadelphia, San Francisco, Seattle or Denver regions; zero in the other nine postal regions.

This may be compared to line 1 of Table 2. There is a significant reduction in the sum of squared errors. Now $s = 1.12$ with a standard error of .015, which very definitely rejects CRTS in favor of DRTS as before. Offices in the Northeast or Far West have on the average eight percent higher costs than offices elsewhere *ceteris paribus*.¹² The real improvement in precision of estimation comes in the stratified sample. Now we have a pattern of IRTS in small offices followed by CRTS in the medium range and finally DRTS in the largest 52 offices. The results are precise enough to be statistically as well as economically significant (see Table 3).

These regional differences in the quality of labor make it advisable to reestimate marginal costs of the several types of mail using the new estimated cost elasticities. This has been done and the estimated marginal costs are listed in Column 4 of Table 4. Translating X_2 back to original units, we may give, in the tabulation, our best estimates of marginal intra post-office costs of each handling of the several components of X_2 .

Marginal Costs of Components of X_2
Per First-Handling Piece

Outgoing flats	.0221
Outgoing small parcels and rolls	.0418
Incoming flats	.0225
Incoming small parcels and rolls	.0303

8. SUMMARY AND CONCLUSIONS

Our model of post-office behavior shows that one-way cost functions for multiproduct firms can be specified. The cost and derived-demand functions suggested decreasing returns to scale over 156 offices.

Breaking the sample into parts showed that to posit a single production correspondence holding throughout the range of size variation is an oversimplification. Returns to scale increased in small offices, continued to increase in the medium and finally decreased in large offices. The optimal size of office for productive efficiency was therefore somewhere near 1,400 employees. When POD management is free of political constraints, it should amalgamate management of many small-town offices. Offices in the 50 largest cities are probably too large. Their managements ought to be decentralized.

Factor prices and quantities of first-, second- and fourth class mail which offices are required to handle all influence costs significantly.

Several indices of performance over the 15 postal regions were compared. Costliness was used as a comprehensive measure of an office's technical efficiency and

input efficiency. It appeared that offices in the Northeast and Far West were less productive because they were able to attract lower quality labor. Area wage boards to adjust wage rates to local market conditions would seem advisable [12]. When cost functions were reestimated, it was clear that the geographical dummy variable did indeed affect cost significantly and made the statistical results more precise.

Marginal costs were calculated for the intra post-office activity component of handling the several classes of mail and window services. Notable here was the low marginal cost of third-class mail reflecting many services rendered by the sender.

Extra post-office activity reported elsewhere [5, pp. 101-18] also showed increasing returns to scale in small and medium offices. Coupled with our previous conclusion, this suggests that most of the country's 32,000 post offices should be combined where geographically and demographically possible. On the other hand, Congress has recognized that small post offices render nonpostal public services.

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¹² Dividing the cost function of an office with NEFW = 1 by that of an office with NEFW = 0 yields $\exp(.08)$ which is 1.0833.