SCALE AND SCOPE EFFECTS ON ADVERTISING AGENCY COSTS

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ABSTRACT

How important are economies of scale and scope in advertising agency operations? This paper reports an econometric study undertaken to address this question. Cost models are formulated which represent how the principal component of agency costs, employment level, varies according to the mix of media and services an agency provides and the total volume of advertising it produces. These models are estimated and tested cross-sectionally utilizing data pertaining to the domestic operations of 401 US agencies for 1987.

The empirical evidence reported here indicates that both scale and scope economies are highly significant in the operations of US advertising agencies. We find that of the 12,000 establishments comprising the industry in 1987, approximately 200-250 had domestic gross incomes of $3-4 million or more (or equivalently, billings of $20-27 million) and therefore had service mixes and operating levels sufficiently large to take full advantage of all available size-related efficiencies. Furthermore, the overall structure of the industry is one where these large, fully efficient firms created and produced more than half of all the national advertising utilized in the US during 1987. At the same time, vast numbers of very small agencies appear to operate with substantial cost disadvantages compared to large firms as a consequence of these scale and scope economies.

These findings carry important implications concerning possible future changes in the industry structure. It seems highly doubtful that scale economies could motivate further mergers among the largest 200-250 agencies. On the other hand, for small agencies, mergers and acquisitions might be attractive as means of mitigating their size-related cost disadvantages. Finally, our findings demonstrating the existence of scale and scope economies are consistent with the diminishing reliance on fixed rates of media commissions as the principal basis of agency compensation. They also cast strong doubts on size-related economies in operating costs as a viable explanation for the limited degree of vertical integration of agency services by large advertisers.

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I. INTRODUCTION

How significant are economies of scale and scope in advertising agency operations? This question bears directly on several fundamental and interrelated issues relating to the organization of the advertising agency industry, including: (1) the magnitude of cost advantages associated with increasing agency size; (2) the breadth of the line of services agencies can efficiently deliver to clients; (3) the economic rationale underlying agency mergers and acquisitions; (4) the potential for vertical integration of agency services into client organizations; and (5) the viability of alternative agency-client compensation arrangements. Controversy surrounding these matters is scarcely new, and indeed, as is clear from the industry's history (Pope [1983]), these issues have played a central role in how the industry has evolved.

In recent years concern about agency scale and scope has once again arisen as conditions affecting the demand for agency services in the U.S. have undergone important changes. Growth in aggregate domestic advertising expenditures has slackened, especially in real terms (Coen [1990]). In several key sectors, client merger and acquisitions have elevated concentration levels (Winski [1990]) and the shares of marketing budgets allocated to consumers and trade promotions have risen at the expense of expenditures on media advertising (Edel [1987]). Responding to these developments, the agency industry is presently in the midst of a re-structuring process and there is much speculation and debate about how the nature of agency operations and the industry's organization may ultimately be re-configured (Bernstein [1989], Economist [1990], Jones [1989], O'Toole [1990]).

Advertising agencies are multi-product firms and the behavior of costs as firm size and service mix change is one of the critical factors influencing an industry's competitive structure (Scherer [1980]). An understanding of cost behavior may contribute to resolving conflicting views and uncertainties which presently surround several facets of the industry re-structuring.

Many of the mergers and takeovers which occurred in the past decade involved the largest firms in the industry and served not only to increase the scale of their operations, but also to expand the range of services available to clients (Business Week [1986], Millman [1988]). This raises questions about the magnitude of cost advantages that large agencies are able to realize as a result of both their greater size (economies of scale) and their ability to engage in the joint production of a broad as opposed to a more narrow line of services (economies of scope). Given limited growth in aggregate advertising expenditures, whether future concentration may occur will depend, in part, on the particular levels of output at which economies of scale and scope are effectively exhausted.

The design of agency compensation arrangements, a major source of agency-client discord throughout the industry's history (Haase [1934], Young [1933]) is also affected by the presence of scale and scope economies. There is evidence that, at least among very large advertisers, reliance on the longstanding practice of setting agency compensation at 15% of a client's media expenditures is eroding (Weilbacher [1989]). Weilbacher [1990] attributes this change to client pressure for negotiated rates as a result of their recognizing a "fundamental flaw" in the flat 15% commission, namely, the fallacious underlying assumption of no economies of scale in agency operations. Weilbacher [1990, p. 7] argues that scale economies are realized at the account level ("agency costs tend to decline proportionately as the size of the advertising appropriations for a brand or an advertising account grows") and predicts growing acceptance of a sliding scale of media commission rates. To the best of the authors' present knowledge, no empirical evidence of account-specific scale economies has appeared in the public domain, although experienced agency management are on record as acknowledging the phenomenon (McNamara [1990, p. 82], Morgan [1990b]).

Client preferences for negotiated and cost-based compensation arrangements are often coupled with demands for the "unbundling" of agency services (Achenbaum [1990], Economist [1990]). Thus, the policy alternatives for a client are to employ a full-service agency or to utilize some combination of specialized in-house or outside agencies for particular functions such as creative and media buying services. Similar demands arose in the adverse climate of the early 1970's (Loomis [1972]) and led full-service agencies to modify their strategies such as by offering á la carte services and emphasizing their creative product (Claggert [1988], Jones [1990]). Clearly, the extent to which agency operations are subject to scale and scope economies affects the feasibility of these organizational alternatives.

Despite the persistence of these institutional issues, there has been little economic analysis of the advertising agency industry since the Frey-Davis [1955] and Gamble [1959] studies, save surveys of industry practices by professional associations and trade publications.[1] The only econometric study addressing the question of agency scale and scope economies known to the present authors is that due to Schmalensee, Silk and Bojanek [1983] (hereafter referred to as SSB). They estimated nonlinear cost functions using 1977 data for a cross-section of 91 U.S. agencies and concluded that over 200 US agencies were large enough to exhuast essentially all economies of scale.

The present paper extends and updates the earlier work of SSB. We estimate a similar set of cost models to that analyzed by SSB, employing a data base covering 1987 operations for a much larger sample of 401 US agencies.

Application of a series of specification tests leads to selection of a preferred model from which we derive measures of the importance of economies of scale and scope on agency costs. The plan of the paper is as follows.

We begin in section II by setting forth alternative specifications for two plausible classes of cost functions which we refer to as "scale" and "scope" models. Section III discusses the sample of agencies and measures of the variables used in econometric estimation. Section IV summarizes the results from various specifications, describes the model selection procedure employed, and presents several measures of scale and scope effects derived from the preferred models. Implications of the results relating to the organization of the advertising agency industry are discussed in section V. The final section summarizes the main findings and conclusions.

II. SPECIFICATION OF ALTERNATIVE COST FUNCTIONS

We begin with a theoretical overview of alternative specifications for cost functions, repeating in part the discussion given in SSB. For the moment, let us suppose we are dealing with a single-product industry, whose average cost function is approximately L-shaped, with average cost approaching an asymptotic lower bound as a scale-related Z-variable approaches infinity. As SSB note, a reasonable specification for a cost function having such a shape is:

$$U = \alpha + \beta e^{-\gamma Z}, \tag{1}$$

where U is a measure of average cost, Z is a scale-related variable, and α, β and γ are (assumed positive) parameters. This function is illustrated in Figure 1, and as SSB observe, its shape is broadly consistent with the literature on economies of scale in many industries (Johnston [1960, Chapter 4]).[2]

{Insert Figure 1 Near Here -- See Page 43}

Given positive values of the parameters, equation (1) implies that U is an everywhere-decreasing function of Z, so there is no finite Z at which scale economies are completely exhausted. Note that as $Z \to \infty$, $U \to \alpha$. We will say that scale economies are essentially exhausted for a firm of size Z^* if $U(Z^*) = (1+\epsilon)\alpha$, where ϵ is a small number. Solving for Z^*, we obtain an indicator of minimum efficient scale as:

$$Z^* = -(1/\gamma)\ \ln(\alpha\epsilon/\beta). \qquad (2)$$

In this paper we set $\epsilon = .01$, so that a scale of Z^* corresponds to costs one percent above the asymptotic minimum.

Another measure of the importance of scale economies is the cost penalty incurred by firms operating at inefficiently small scales. If a firm's scale is kZ^*, where $0 < k < 1$, its cost disadvantage relative to a firm of scale Z^* is given by:

$$D^* = \frac{[U(kZ^*) - U(Z^*)]}{U(Z^*)} = \frac{[\epsilon^k(\beta/\alpha)^{1-k} - \epsilon]}{[1 + \epsilon]}. \qquad (3)$$

In this paper we set $k = 0.5$, in order to permit comparability with similar estimates for other industries.[3] Illustrative values for Z^* and D^* are displayed in Figure 1.

Instead of producing but one product, now assume a firm produces N outputs and that equation (1), with j subscripts everywhere, refers to the unit cost of the j^{th} product where the unit cost term U is now defined as total costs divided by gross income Y_i. Multiplying by the revenue share S_j and summing, we can obtain the basic equation for long-run costs as:

$$U = \sum_{j=1}^{N} \alpha_j S_j + \sum_{j=1}^{N} \beta_j S_j \exp(-\gamma_j Z_j). \qquad (4)$$

Depending on the specification, Z can take on alternative functions of all the output levels.

Following SSB, we specify the term in equation (4) involving Z_j in two alternative and polar ways. We do not have any prior assumption that one or the other must be *the* true specification, but rather regard these two specifications as likely to bracket the truth. In particular, if on the basis of our specification tests (discussed later in this paper) we are led to reject one of them, the other might sensibly be treated as a good approximation to the correct specification. If not, our assumption that they bracket the truth implies that any qualitative statement supported by both specifications is likely to be correct.

The first polar case is one we call a <u>scope</u> model, in which the scale variable for all products is simply the overall size of the i^{th} agency, measured by gross income Y_i, where $Y_i = \sum_j Y_{ij}$ and Y_{ij} is the i^{th} firm's gross income from medium j. Following SSB, we specify five partially nested scope models:

$$U_i = \alpha + \beta \exp(-\gamma Y_i) + u_i \tag{5.1}$$

$$U_i = \sum_{j=1}^{9} \alpha_j S_{ij} + \beta \exp(-\gamma Y_i) + u_i \tag{5.2}$$

$$U_i = \sum_{j=1}^{9} \alpha_j S_{ij} + \sum_{j=1}^{9} \beta_j S_{ij} \exp(-\gamma Y_i) + u_i \tag{5.3}$$

$$U_i = \sum_{j=1}^{9} \alpha_j S_{ij} + \beta \sum_{j=1}^{9} S_{ij} \exp(-\gamma_j Y_i) + u_i \tag{5.4}$$

$$U_i = \sum_{j=1}^{9} \alpha_j S_{ij} + \sum_{j=1}^{9} \beta_j S_{ij} \exp(-\gamma_j Y_i) + u_i \tag{5.5}$$

where the u_i are assumed to be normal disturbance terms with all the usual desirable properties.

To see why we call these five specifications scope models, it is useful to consider the notion of returns to scope, and to distinguish it from returns to scale. Briefly, what scope economies refer to is the cost savings to a firm from producing multiple outputs, rather than splitting the firm up into N smaller firms, each specializing in producing one and only one output.[4] More specifically, let C be total (not average) cost, and define total costs C_{Split} for the notional split-up multiproduct firm as the sum of costs from producing each of the N outputs at N distinct single-product subsidiaries:

$$C_{Split} = C(Y_1,0,\ldots 0) + C(0,Y_2,0,\ldots 0) +\cdots+ C(0,\ldots,0,Y_N) \tag{6}$$

where the subscript on Y refers to the j^{th} output. Total costs for the multiproduct firm jointly producing all N outputs is $C_{Joint} = (Y_1,Y_2,\ldots,Y_N)$. Returns to scope (RSP) are then simply computed as the percent cost savings due to producing jointly rather than being split up, i.e.,

$$RSP = \frac{C_{Split} - C_{Joint}}{C_{joint}} . \tag{7}$$

Hence, when RSP are positive, $C_{Joint} < C_{Split}$, and there are cost advantanges to being a multiproduct firm, deriving perhaps from the joint utilization of shared inputs. When RSP are zero, no such cost advantages emerge, and if RSP were negative, the firm could reduce its costs by splitting up. The fact that very few firms produce only a single product may well imply that RSP are available.

Consider, for example, the most general of the five scope models above, namely, that in equation (5.5). Noting that $S_{ij} = 1$ for the firm producing only the j^{th} output, that for such firms $Y_i = Y_{ij}$, and setting the $u_i = 0$, for this model C_{split} turns out to be:

$$C_{Split} = \sum_{j=1}^{9} \alpha_j Y_{ij} + \sum_{j=1}^{9} \beta_j Y_{ij} \exp(-\gamma_j Y_{ij}) . \tag{8}$$

On the other hand, noting that since $S_{ij} = Y_{ij}/Y_i \Rightarrow Y_i S_{ij} = Y_{ij}$, it follows that for equation (5.5), C_{Joint} equals:

$$C_{Joint} = \sum_{j=1}^{9} \alpha_j Y_{ij} + \sum_{j=1}^{9} \beta_j Y_{ij} \exp(-\gamma_j Y_i). \tag{9}$$

Note that the expression in the numerator of (7), $C_{Split} - C_{Joint}$, will in general not depend on the α's, but will typically be non-zero because $\exp(-\gamma_j Y_{ij}) \neq \exp(-\gamma_j Y_i)$.

The traditional measure of returns to scale is ambiguous in the context of multiproduct firms. To see this, recall that in the case of a single product firm, the traditional measure of returns to scale is $1/\epsilon_{CY}$, where ϵ_{CY} is the elasticity of total costs with respect to output, i.e. $\epsilon_{CY} \equiv (\partial C/\partial Y)(Y/C)$. In the single product case, it can also be shown that returns to scale equals the ratio of average cost (C/Y) to marginal cost ($\partial C/\partial Y$). In the multiproduct case, however, the notion of average cost is not well-defined (by which output does one divide total costs?), and product mix could change with overall size (by how much does one change the various outputs?). To overcome this problem, in the multiproduct context one can define a returns to scale notion as based on the effects on total costs when all outputs are increased proportionately, i.e. holding output mix constant. This concept is called ray-returns to scale (overall size expands on a linear ray in output space; see Bailey and

Friedlaender [1982]). In our context, define ray returns to scale (RRS) as one over the elasticity of total costs with respect to Y_i, holding output mix fixed:

$$RRS = \frac{1}{\frac{\partial C}{\partial Y_i}\frac{Y_i}{C}} \Bigg|_{S_{ij} = \bar{S}_{ij}} \tag{10}$$

For the scope model in equation (5.5), ray returns to scale turn out to be:

$$RRS\ (5.5) = \frac{\sum_{j=1}^{9}\alpha_j S_{ij} + \sum_{j=1}^{9}\beta_j S_{ij}\exp(-\gamma_j Y_i)}{\sum_{j=1}^{9}\alpha_j S_{ij} + \sum_{j=1}^{9}\beta_j S_{ij}\exp(-\gamma_j Y_i) - \sum_{j=1}^{9}\gamma_j\beta_j Y_{ij}\exp(-\gamma_j Y_i)}\ . \tag{11}$$

A polar opposite case of the scope models 5.1 to 5.5 above assumes the complete absence of scope economies, that is, it assumes that no interactions occur among the agencies' outputs in determining costs. If all activities are independent, then the natural scale variable for activity j for the i^{th} firm is Y_{ij}, and thus Y_{ij}, not Y_i, appears in the exponential term of equation (4).[5] Using the same notation as above, we refer to the following as five <u>scale</u> models:

$$U_i = \alpha + \beta\sum_{j=1}^{9} S_{ij}\exp(-\gamma Y_{ij}) + u_i \tag{12.1}$$

$$U_i = \sum_{j=1}^{9}\alpha_j S_{ij} + \beta\sum_{j=1}^{9} S_{ij}\exp(-\gamma Y_{ij}) + u_i \tag{12.2}$$

$$U_i = \sum_{j=1}^{9}\alpha_j S_{ij} + \sum_{j=1}^{9}\beta_j S_{ij}\exp(-\gamma Y_{ij}) + u_i \tag{12.3}$$

$$U_i = \sum_{j=1}^{9} \alpha_j S_{ij} + \beta \sum_{j=1}^{9} S_{ij} \exp(-\gamma_j Y_{ij}) + u_i \tag{12.4}$$

$$U_i = \sum_{j=1}^{9} \alpha_j S_{ij} + \sum_{j=1}^{9} \beta_j S_{ij} \exp(-\gamma_j Y_{ij}) + u_i \;. \tag{12.5}$$

Using the definition of returns to scope given in equation (7) above, it can easily be verified that for each of these scale models 12.1-12.5, the numerator in (7) is zero, i.e. RSP and scope economies are zero. However, using the fact that $Y_{ij} = S_{ij}Y_i$, ray returns to scale (RRS) for the most general scale model in equation 12.5 can be shown to equal:

$$\text{RRS (12.5)} = \frac{\sum_{j=1}^{9} \alpha_j S_{ij} + \sum_{j=1}^{9} \beta_j S_{ij} \exp(-\gamma_j Y_{ij})}{\sum_{j=1}^{9} \alpha_j S_{ij} + \sum_{j=1}^{9} \beta_j S_{ij} \exp(-\gamma_j Y_{ij}) - \sum_{j=1}^{9} \gamma_j \beta_j S_{ij}^2 Y_i \exp(-\gamma_j Y_{ij})} \;. \tag{13}$$

Several other comments are worth noting here, before completing this discussion of alternative cost function specifications. First, for each medium and provided estimated parameters have expected signs, one can employ parameter estimates of the α's as the large-scale limiting values of medium-specific unit cost, thereby generating medium-specific cost curves similar to that in Figure 1. Second, the Z^* minimum efficient scale statistics for the scope models reveal the minimum agency size (Y_i) for each product to be produced at nearly minimum cost, while those computed from the scale models will yield the minimum medium-specific incomes (Y_{ij}) necessary for the corresponding products to be efficiently produced. Third and finally, since the D^* cost penalties are in the same units, they have identical interpretations in the scope and scale models.

III. VARIABLE DEFINITIONS AND DATA BASE DESCRIPTION

In this section, we describe the variables used in the cost models, the source of the data used to measure them, and the sample of the agencies for which observations of the measures were obtained. The notation and variable definitions employed are as follows:

Y = agency gross income for U.S. operations (10 millions of 1987 dollars

E = agency employment in U.S. operations (number of employees in 1987)

U = $E/(Y \cdot 10^3)$ or number of employees per $100,000 of 1987 gross income

S_j = share of an agency's billings volume derived from source or activity j, where $j = 1,\ldots,8$ are alternative media and $j=9$ denotes billings and capitalized fees for all non-media specific services

$Y_j = S_j \cdot Y$ = estimated gross income from source or activity j.

The unit of analysis throughout is an individual agency, which, when relevant, is denoted by the subscript, i.

Data Sources

The source of the data used to measure the above variables was the 1988 edition of Advertising Age's (1988a, pp. 4-26) annual "U.S. Advertising Agency Profiles," a compilation of agency operating results for 1987. A noteworthy feature of the data collection procedure was that participating agencies were asked to submit a statement signed by an independent accountant verifying the data reported. Among the sample of agencies analyzed here, 63.84% complied with the request and tests indicated that this compliance was not significantly related to agency billings volume, gross income, or employment. These results suggest that the verification request may have served to limit the problems of unreliability which have sometime been noted in other sources of agency operating data (e.g., Morgan [1990a]).

Agency Sample

The 1987 data base assembled by Advertising Age covered operating results for 500 agencies. Missing information on one or more variables forced the elimination of 36 agencies. The remaining 464 observations included a substantial number of agencies which specialized in only a few minor media and therefore had zero billings in the majority of media categories. SSB [1983] found that large numbers of zero shares were a source of computational problems in applying non-linear estimation procedures to the models of interest here. In order to minimize these difficulties, we chose to eliminate from the sample those agencies with billings in only one or two of the 16 billings categories or with less than 10 employees. These selection criteria eliminated 63 observations and resulted in a final sample size of 401 agencies which comprise the data base used in the subsequent analyses reported here.

It should be noted that the measures for all variables only pertain to US operations and do not include results for international activies. In the case of ten holding companies or "mega-agencies," the results for their subsidiaries were excluded from the parent firm data in line with the information on these relationships reported in Advertising Age [1988a, pp. 4 and 96]. As noted there, these adjustments may be the source of some measurement errors.

Summary sample statistics for the variables defined above are presented in Tables 1 and 2. As can be seen from these tables, the sample is a diverse one in terms of size and media mix. The median 1987 gross income per agency is $3.23 million with a range from $380,000 to $284.7 million. Total billings volume ranged from $1.63 million to $1.96 billion, with a median of $23.25

Table 1

Summary Statistics for Agency Output and Cost Variables
(n = 401 Agencies)

Variable	Mean	Median	Upper Limit	Lower Limit
Gross Income ($10 Million)	1.351	0.323	28.470	0.038
Employment	151.365	43	3723	10
Employees/Gross Income (Employees/$100,000 GI)	1.443	1.377	3.196	0.339
Volume ($10 Million)	9.427	2.325	196.243	0.163
Media Billings	6.990	1.289	167.900	0.011
Non-Media Billings	2.437	0.821	50.520	0.000

million. In terms of employment, the median level was 43 with the smallest work force consisting of 10 employees while the largest had 3,723.

Clearly, the distributions of these variables are highly skewed, reflecting the level of concentration in the agency industry. The 1987 Census of Service Industries reports that for the 12,335 advertising agencies (establishments) operating in that year, their total gross income (receipts) was $10.213 billion (U.S.Bureau of the Census [1989], Table 1a). The corresponding figure for the present sample of 401 agencies was $5.417 billion or 53.04% of the industry total, which includes both national and local advertising. Collectively, the billings volume of these 401 agencies amounted to $37.8 billion which represents 62.35% of the total amount of $60.6 billion expended on national advertising in the U.S. during 1987 (Coen [1988]). While large agencies are overrepresented, the sample does contain a broad distribution of agencies of different sizes producing advertising for a wide variety of media.[6]

Gross Income

An agency's gross income is best understood as the equivalent of the usual accounting definition of "gross margin" or the difference between sales receipts and cost of goods sold. More specifically, an agency's gross income is the sum of revenues it receives from three basic sources: (1) commissions earned from purchases of media time and space made on behalf of clients; (2) markups on materials and services purchased from other suppliers and then charged to clients; (3) fees paid by clients for agency services in addition to or in lieu of the aforementioned commissions and markups. Gross income is regarded within the industry as the preferred measure of agency size or output because it is more meaningful for comparative or cross sectional analysis than other indicators such as billings volume or capitalized billings (Gardner [1976], Paster [1981]). The latter quantities may give a misleading picture of output or scale due to variations across agencies in media and service mixes and compensation methods.

Historically, the principal source of agency gross income has been media commissions. Over time, as the mix of agency services and compensation arrangements have changed, income from fees has grown in importance. Data from the most recent Census of Business [1982] for which a breakdown of gross income is available indicate that for the advertising agency industry as a whole, 59.4% of gross income was derived from media commissions, 16.2% from markups on materials and services purchased, 22.1% from service fees, and 2.3% from other sources (U.S. Bureau of Census [1982], Table 6, p. 5-51). It is generally recognized that reliance on media commissions as a source of gross income tends to increase with increasing agency size (Paster [1981]). Summary data reported by the American Association of Advertising Agencies ([1987], p. 13, hereafter, 4A's) indicates that the proportion of gross income accounted for by media commissions is 75% for "large" agencies and 35% for "small" agencies. Detailed current data bearing on this relationship are not available in published sources; earlier evidence is reviewed in SSB ([1983], p. 456).

Number of Employees per Hundred Thousand Dollars of Gross Income

This ratio is employed as a proxy for an agency's average cost. As noted by Mayer [1959, p. 74]: "In the cliche of the trade, 'an advertising agency is nothing but people.'" Estimates show that payroll, bonuses, profit-sharing, and related employee benefits (insurance and retirement) average about 67% of an agency's gross income (4A's [1987], p. 13).[7] Consistent with the presence of scale economies, partial evidence that has been released from surveys of agency cost structures conducted annually among the membership of the 4A's indicates that payroll expense as a percentage of gross income tends to decline cross-sectionally as agency billings rise (McDonald [1989], Exhibit II, and McNamara [1990], Exhibit 9-3, p. 145). While this ratio of employees to gross income is clearly not an ideal measure of unit cost, it has advantages over "employees per million dollars of billings" (for reasons discussed above) which has often been used as an indicator of agency "productivity" (Advertising Age [1988], p. 96; Gamble [1959], Loomis [1972], and Seligman [1956] and we have no reason to suspect that its use will introduce substantial bias here.[8]

Share of Billings Volume by Media/Service Category

The principal services which agencies supply to their clients are those associated with the planning of campaigns and the creation, production, and placement of advertising messages in different media vehicles. As shown by SSB [1983], variations in media mix are a major source of interagency cost differentials. To measure the composition of an agency's output, we use the share of its billings volume emanating from each of the nine categories of activities listed in Table 2, eight of which relate to different media while the ninth covers "non-media services."

Table 2

Summary Statistics for Media Shares, 1987
(n = 401 Agencies)

Abbreviation	Medium	Percent Share of Agency Volume: Mean	Median	Zero Shares	Share of Sample's Total Billing Volume
TVL	Network Television	7.46%	0.21%	45.89%	23.90%
	Major	(6.87%)	(0.00%)	(64.09%)	(22.81%)
	Cable	(0.59%)	(0.00%)	(65.34%)	(1.09%)
TVH	Spot Television	12.44%	7.48%	22.94%	18.10%
MGL	General Magazines	9.40%	6.60%	8.73%	11.04%
PTH	Special Print	5.81%	1.69%	33.17%	2.78%
	Business	(3.53%)	(0.36%)	(46.63%)	(1.35%)
	Farm	(0.44%)	(0.00%)	(89.28%)	(0.22%)
	Medical	(1.43%)	(0.00%)	(87.03%)	(0.94%)
	Supplements	(0.40%)	(0.00%)	(87.78%)	(0.27%)
NPH	Newspapers	8.95%	5.88%	4.74%	7.87%
DRH	Direct Response	4.64%	0.91%	35.41%	2.70%
RDH	Radio	5.99%	4.63%	11.47%	5.63%
OTH	Other	2.38%	1.04%	19.95%	2.13%
	Outdoor	(1.17%)	(0.52%)	(30.92%)	(1.52%)
	Point of Sale	(0.84%)	(0.00%)	(69.83%)	(0.47%)
	Special Events	(0.24%)	(0.00%)	(90.52%)	(0.06%)
	Transit	(0.13%)	(0.00%)	(82.29%)	(0.08%)
XMB	Non-Media Services	42.94%	42.13%	9.23%	25.85%
					100.00%

The data reported in Advertising Age [1988a] covered billings in the fifteen separate media categories identified in Table 2. As indicated there, we combined some of the minor media to arrive at the final set of nine categories shown in Table 2. "Specialty Print" and "Other" are both composites, each consisting of four of the original fifteen media categories. The median share value for each of these eight media was less than 0.5% and zero shares were recorded for 60% or more of the agency sample for six of these eight categories--the exceptions were "business publications" and "outdoor" where the percentages of zero shares were 46.6 and 30.9, respectively. Initial efforts to include all fifteen media categories as separate variables in the cost models proved to be computationally infeasible and led us to form these more aggregate categories for the minor media. For similar reasons, "cable" was combined with "major" to create the "Network Television" category.

The last share category list in Table 2, "Non-Media Services" is also a heterogeneous one. The data available for each agency included its "volume of total billings" which is the sum of billings in different media categories plus "capitalized billings." The latter includes billings to clients for materials and services purchased from outside sources and marked up (usually at 17.65%) plus "capilalized fees" which are calculated by multiplying fee income times 6.67--a practice favored in the industry as a means of treating income from fees as the equivalent of the traditional 15% commission earned on media billings (Garnder [1976], Advertising Age [1988a], p. 4). Hence, the share term for "non-media services" shown in Table 2 is the proportion of "total billings volume" accounted for by "capitalized billings."

Non-media share of billings volume encompassess a broad spectrum of services, the composition of which may vary widely among agencies according to the mix of functions performed and method of compensation. Included here are ad production and specialized services or projects such as marketing research, new product development, public relations, and sales promotion. This category may also contain, in some instances, other functions for which an agency is compensated by fees rather than media commissions, such as creative and media planning services.

In the analysis that follows, we treat the shares of an agency's billings volume in each media/service category as an unbiased measure of the share of its gross income attributable to that category of output. This assumption is strictly valid only if the ratio of gross income to billings is a constant for all categories of output <u>within each agency</u> (but not necessarily fixed across agencies). Note that while margins may vary among accounts served within a particular agency (according to client size and method of compensation), in general clients tend to favor constant margins across media in order to remove any incentive for the agency to favor one medium over another. Unfortunately, the information required to check this condition directly is not available. However, there is some reason to suspect that the ratio of gross income to billings for at least some media may vary systematically with agency size. While the standard commission rate granted agencies varies little by medium (4A's [1987], p. 12), compensation arrangements and media mix appear to be somewhat related to agency size.

First, as noted above, there is some evidence to suggest that the importance of media commissions as a source of gross income tends to increase as agency gross income increases (4A's [1987] and SSB [1983], pp. 456-457). Secondly, within our sample of agencies, we find weak cross-sectional relationships between gross income and share of billings for selected media categories. Table A3 in our Appendix summarizes the results obtained when share for each of the nine categories (S_j) was regressed on the natural logarithm of gross income (Y). The slope coefficient for gross income was found to be statistically significant (at the .05 level or beyond, two-tail test) for five of the nine categories. The results indicated that, on average, the larger an agency, the larger the share of its billings volume from network television, spot television, and general magazines but the smaller its share from direct response and non-media billings. The only regressions with R^2's above .076 were for network television and non-media services where the values were .266 and .141, respectively. Hence, there is a substantial amount of variation in media/service mix that is unrelated to agency size. While these pieces of indirect evidence suggest the possibility that some systematic errors may arise from taking an agency's share of its billings volume in a media/service category as a proxy for its share of gross income in that category, we are unable to make any firm inferences from this limited information about the consequences of departures from the assumption that the margin of gross income earned on billings is a constant across categories within any given agency.

Estimated Gross Income by Media/Service Category

Estimates of gross income by media/service category (Y_j) were calculated by simply multiplying the share of an agency's billings volume in each category (S_j) by its total gross income (Y). These quantities are used in our scale model basic specification as proxy measures for the scale of agency operations or output in each media/service category. The preceding discussion of possible measurement problems with the S_j shares also applies here.

IV. RESULTS

We now discuss empirical findings, summarizing results from various specifications, the model selection procedure employed, minimum efficient scale, cost penalties, and estimated scope and scale economies.

Choice of Preferred Specifications

To each of the ten alternative cost function specifications (5.1)-(5.5) and (12.1)-(12.5), we appended an independently and identically normally distributed stochastic disturbance term, having mean zero and covariance matrix Σ. With this stochastic specification, equation-specific maximum likelihood estimation is numerically equivalent to nonlinear least squares. To carry out estimation for our alternative models, therefore, we employed the nonlinear least squares algorithms in the Time Series Processor (TSP) statistical software, Version 4.1C, using an AT&T 6386 microcomputer.[9] Since optimal properties of the nonlinear least squares estimator rely on large sample distribution theory, we compute "asymptotic t-statistics" as ratios of parameter estimates to estimated asymptotic standard errors; joint hypotheses involving sets of parameters are tested using the likelihood ratio test criterion.

Our model selection procedure consisted of three steps. In the first stage, we estimated the five versions of the scope model, five of the scale model, and then, using the likelihood ratio test criterion, determined which scope model and which scale model was most parsimonious in the number of parameters estimated, yet consistent with our data. Given the initial selection of preferred scope and scale models from Stage 1, in Stage 2 we then examined parameter estimates and asymptotic standard errors, imposing and testing whether even more parsimonious parameterizations were consistent with the data. This yielded one preferred scope model and one preferred scale model. Finally, since the scope and scale models are non-nested, we attempted to choose between them using a variety of model selection procedures, ranging from informal comparisons of fit, empirical plausibility, a Bayesian criterion, and a P-test procedure due to Davidson and MacKinnon [1981]. We now summarize results we obtained from this three-stage model selection procedure.

Maximum likelihood estimates and asymptotic t-statistics for parameters in each of the five scope and five scale models, along with equation-specific summary test statistics, are presented in Tables A-1 and A-2 in the appendix to this paper. Based on the sample maximized log-likelihood values for each of these ten estimated models, we conducted a number of hypothesis tests to select the most parsimonious representations which were consistent with our data. The results from this Stage 1 procedure are summarized in Figure 2. There, the adjusted R^2 statistics are shown in parentheses, arrows point from the restricted model (null hypothesis) to the unrestricted (alternative hypothesis) model used in each test, and the numbers beside each arrow indicate the value of the chi-square likelihood ratio test statistics (and degrees of freedom in parentheses) associated with each of the models being tested. Next to each arrow is also shown the coefficient or coefficients whose equality across media is being tested. Finally, in the center of Figure 2 we indicate the number of free parameters estimated for each model.

{Insert Figure 2 Near Here - See Page 44}

We begin with the scope models (5.1)-(5.5), summarized in the left-side of Figure 2. The first important result observed in Figure 2 is that parameter restrictions with Models 5.3 and 5.4 as special cases of Model 5.5 are not rejected, nor are the parameter constraints in Model 5.2 rejected as special cases of either Model 5.3, 5.4 or 5.5; the significance levels of each of these test results (indicating the significance value at which the null hypothesis would be rejected) are all small -- less than 90%, indicating that imposing these more parsimonious parameterizations on the scope model does not entail losing a statistically significant amount of goodness of fit. Recall that with Model 5.2, the β's and γ's are each constrained to be equal across media, although the α's (estimated media-specific asymptotic average costs) are not restricted. Results change, however, when we attempt to constrain the α's to be equal across media as well; as in seen in Figure 2, the χ^2 test statistic for the eight restrictions is 76.50, which turns out to be greater than the critical value at even the 99.9% level of significance. Based on the results in Figure 2, therefore, we conclude that Model 5.2 is the most parsimonious parameterization of the scope models consistent with our data, having eleven parameters.

Results from our estimated scale models are summarized on the right-side of Figure 2. There it is seen that although Model 12.4 is not rejected as a special case of Model 12.5 at reasonable significance levels, the parameter constraints on the γ's associated with Model 12.3 as a nested case of Model 12.5 are rejected; the significance level for this rejection is between 97.5% and 98%. Moreover, if one then tests the restrictions of Model 12.2 as a special case of Model 12.4, the very large χ^2 test statistic of 40.954 indicates rejection at significance levels even larger than 99.9%. Various other hypotheses are also rejected, as is shown in Figure 2. We conclude, therefore, that based on these test results, Model 12.4 is the most parsimonious parameterization of the scale models consistent with our data, having nineteen parmeters.

Given that this first stage of our model selection procedure has yielded two models -- 5.2 for scope and 12.4 for scale -- whose restrictions are consistent with the data, we now embark on Stage 2 of the model selection process, assessing whether any further parameter restrictions on these two models can help in obtaining a most preferable parsimonious parameterization.

{Insert Figure 3 Near Here -- See Page 45}

Our Stage 2 results are summarized in Figure 3. Based on parameter estimates for Model 5.2 reported in Table A-1, we imposed and tested five additional restrictions on the media-specific α's in Model 5.2, and called this Model 5.1A, since it augmented the number of parameters from Model 5.1; the chi-square test statistic for these five restrictions in Model 5.1A as a special case of Model 5.2 is 2.128, which is significant only at low levels such as 10-25%. Model 5.1A is therefore our preferred scope model, having but six free parameter estimates. The estimated parameters and asymptotic t-statistics, as well as other summary statistics from Model 5.1A, are presented in Table 3. To allow for possible heteroscedasticity, we present asymptotic t-statistics based on both the traditional and heteroscedasticity-robust standard errors.[10]

We then examined the scale model 12.4 that initially emerged from our Stage 1 model selection process (see Appendix Table A-2), and based on its estimated parameters and asymptotic t-statistics, we formulated a model incorporating eleven additional restrictions; since this model augments the number of parameters associated with Model 12.2, we call this Model 12.2A. As is shown in Figure 3, the eleven parameter constraints associated with Model 12.2A as a special case of Model 12.4 yield a very low χ^2 test statistic of 3.014, which is significant only at very small levels less than 1.5%. Model 12.2A is therefore our preferred scale model, having eight free parameters; these parameter estimates, asymptotic t-statistics (based on both traditional and heteroscedasticity-robust standard errors) and equation summary statistics for Model 12.2A are presented in Table 3.

Although traditional statistical inference procedures have helped us choose one preferred scope (5.1A) and one preferred scale (12.2A) model, and although these two models have the same dependent variable, they are non-nested, and thus choice between them is a bit more problematic.

One possible criterion is based on <u>a priori</u> plausibility. For example, estimated asymptotic average costs (α's) should all be positive; this occurs for both the preferred scope and the preferred scale model, as is seen in Table 3. It is worth noting, moreover, that the number of α's whose point estimate was negative was usually less (and never more) for the various scope models than for the alternative scale models; see Appendix Tables A-1 and A-2.

Table 3

Maximum Likelihood Estimates of Parameters for Preferred Models
(Ratio of Parameter Estimate to Asymptotic Standard Error in Parentheses)
[Ratio of Parameter Estimate to Robust Standard Error in Square Brackets]

Parameter	Scope Model 5.1A	Scale Model 12.2A
$\alpha_{TVL} = \alpha_{TVH} = \alpha_{MGL} = \alpha_{PTH}$	0.7438 (11.707) [13.573]	0.7383 (11.502) [13.805]
$\alpha_{NPH} = \alpha_{DRH}$	1.3159 (11.210) [10.034]	1.3965 (12.029) [10.656]
$\alpha_{RDH} = \alpha_{OTH}$	2.1667 (8.535) [8.441]	2.1736 (8.307) [9.060]
α_{XMB}	1.5745 (30.862) [30.447]	1.4499 (18.372) [19.366]
$\beta_{TVL} = \beta_{TVH} = \beta_{RDH} = \beta_{MGL} = \beta_{NPH} = \beta_{PTH} = \beta_{DRH} = \beta_{OTH}$	1.9535 (5.721) [6.397]	6.2069 (2.601) [2.402]
β_{XMB}	1.9535 (5.721) [6.397]	1.0431 (2.747) [2.863]
$\gamma_{TVL} = \gamma_{TVH} = \gamma_{RDH} = \gamma_{MGL} = \gamma_{NPH} = \gamma_{PTH} = \gamma_{DRH} = \gamma_{OTH}$	14.524 (6.022) [6.079]	302.01 (3.126) [3.048]
γ_{XMB}	14.524 (6.022) [6.079]	12.438 (2.448) [2.599]
ln L	-167.776	-169.578
SER	.3705	.3731
R^2(Adj)	.4718	.4643
SSR	54.2104	54.6998
No. Parameters	6	8
Sample Size	401	401

Moreover, as we shall see later, the estimated ray returns to scale with the preferred scale model are somewhat erratic, and thus we have a slight preference on plausibility grounds for the scope model.

A second possible criterion, motivated in part by the fact that the scope and scale models have the same dependent variable, is based on goodness-of-fit. An examination of equation summary statistics in Appendix Tables A-1 and A-2 reveals that for any given number of parameters being estimated (e.g., 3, 11, 19 or 27), in each case the goodness of fit as measured either by the adjusted R^2 or the sample maximized log-likelihood is larger for the scope than for the corresponding scale model. Further, as seen in Table 3, goodness of fit as measured by the ln L, standard error of the regression (SER), or the sum of squared residuals (SSR), is uniformly higher for the preferred scope Model 5.1A than for the preferred scale Model 12.2A, even though the number of parameters in the scale model (8) is larger than in the scope model (6).

A related procedure for choosing among non-nested models is a Bayesian criterion due to Zellner and Plosser [1975], implemented empirically by Berndt, Darrough and Diewert [1977]. If the investigator's prior were diffuse so that fixed prior weights of one-half had been assigned to Model 5.1A and to Model 12.2A, then the posterior odds would favor the scope Model 5.1A, for its <u>a posteriori</u> sample maximized log-likelihood is larger, -167.776 vs. -169.578. An alternative method for measuring the extent to which the scope model is preferred <u>a posteriori</u> is to compute the necessary fixed prior weights or odds for the two models that, together with the sample information, would have made equal their posterior odds. Zellner and Plosser [1975] have developed an approximation to the necessary prior odds calculation, which in this context simply involves subtracting from ln L of the scope model 5.1A the ln L of the scale model 12.2A, and then exponentiating this difference (exp (1.802) =

6.062). Hence, one would have needed to prefer the scale model 12.2A by a 6.062:1 prior odds ratio in order for the scale and scope models to have had equal posterior odds ratios; alternatively, the a priori weights would have needed to be 0.1416 (scope) and 0.8584 (scale) in order that a posteriori odds would have been equal. Based on this Bayesian criterion, therefore, we conclude that the scope model 5.1A is preferred to the scale model 12.2A.

As a final procedure for choosing among the scope and scale specifications, we have implemented the procedure for nonlinear models outlined by Davidson and MacKinnon [1981], which they call a P-test. In this framework, if the null hypothesis is that Model 1 is true and the alternative is that some other non-nested Model 2 is false, one runs a linear regression in which the residuals from Model 1 are regressed on partial derivatives of Model 1 with respect to each of the parameters in Model 1, and the difference between fitted values from Models 1 and 2; call this difference DIF12. If the null hypothesis is true, then the coefficient on DIF12 should be insignificantly different from zero, and Model 1 would clearly be preferred to Model 2, for Model 2 adds no significant information. If the coefficient on DIF12 is statistically significant, however, Model 2 adds some significant information to Model 1, and choice between models is not clear. In the Davidson-MacKinnon P-test procedure, one then also simply reverses this procedure, testing the null hypothesis that Model 2 is true and that some other non-nested Model 1 is false. In this symmetric regression, one runs a linear regression in which the residuals from Model 2 are regressed on partial derivatives of Model 2 with respect to each of the parameters in Model 2, and the difference between fited values from Models 2 and 1; call this difference DIF21. If the null hypothesis is true, the coefficeitn on DIF21 should be insignificantly different from zero; else, choice between models is not clear.

We have applied the Davidson-MacKinnon procedure here. When the null hypothesis is that the scope Model 5.1A is true, the coefficient on the DIF12 variable has a t-statistic of 2.237, which is significant at the 95% level of significance, but not at the 99% level. Apparently, differences in fitted values between the scope and scale models add explanatory power to the scale model in a marginally significant way; alternatively, that the scope model is true is not clear. However, when the null hypothesis is that the scale Model 12.2A is true, the coefficient on the DIF21 variable has a t-statistic of 3.224, which is significant at levels even greater than 99.9%. We conclude, therefore, that although the evidence is not decisive, there is considerably more support for the notion that the scope model 5.1A is true, than for the hypothesis that the scale model 12.2A is correct. While we therefore have a clear preference for the scope model, in the remainder of this paper we will present results from both the scope Model 5.1A and the scale Model 12.2A. We now discuss minimum efficient size estimates based on these two models.

Minimum Efficient Size

In Table 4 we present estimates of Z^*, minimum efficient size (MES) for our two preferred scope and scale models, measured in millions of 1987 dollars of gross income. These quantities have been calculated for each media category using equation (2) above, along with parameter estimates shown in Table 3 for Models 5.1A and 12.2A.

First we comment on the precision of these estimated MES. For our preferred scope model 5.1A, although the various entries in Column (1) of Table 4 appear rather similar in magnitude, in fact these media-specific MES are estimated quite precisely, and most MES estimates are statistically different from one another. In particular, referring to 3.836 as MES_1, 3.443 as MES_2, 3.099 as MES_3 and 3.319 as MES_4, we find that differences between all pairs are statistically significant (MES_1 - MES_2, t - 3.589; MES_1 - MES_3, t - 4.751; MES_1 - MES_4, t - 5.275; MES_2 - MES_3, t - 2.576; MES_3 - MES_4, t - 2.394), except that between MES_2 and MES_4, where the t-statistic on the no-difference null hypothesis is 1.716. Interestingly, the media for which MES is largest (particularly network television (TVL), spot television (TVH) and general magazines (MGL)) are also those media whose share of agency revenue increases most with agency log gross income (see Appendix Table A-3). Hence, in our scope model, media mix interacts with agency size.

Estimated MES for the preferred scale model are given in Column (4) of Table 4. Call the 0.223 value, MES_5; 0.202, MES_6; 0.187, MES_7; and 3.438, MES_8. Although the large MES_8 value is statistically different from MES_1 (t - 2.646), MES_2 (t - 2.665) and MES_3 (t - 2.680), the t-values for the no difference null hypothesis between MES_1 and MES_2 (2.695) and between MES_1 and MES_3 (2.966) are similar in magnitude; only the t-value for no difference between MES_2 and MES_3 (2.020) is marginal at conventional significance levels. Note that with this scale model, although the MES for the XMB category (non-media services) is very large -- 3.438 -- it is estimated imprecisely, reflecting perhaps the heterogeneity of services included in this composite category. It is also of interest to note that the very large MES estimate for this XMB category has distinct implications for overall agency size, since according to Appendix Table A-3, the XMB share is significantly negatively correlated with log agency gross income.

Recall that for the scope models, the scale or size variable is total agency gross income. Hence, the MES estimates shown in Table 4 for Model 5.1A represent the levels of total gross income required for an agency to operate with a unit cost 1% above the estimated asymptotic minimum (α_j) for some

Table 4

Maximum Likelihood Estimates of Minimum Efficient Agency Size (Z^*)
$ Millions of Income (1987)
(Asymptotic Standard Errors in Parentheses)

	Scope Model 5.1A			Scale Model 12.2A				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Media Category	MES Agency Income	% Sample GI > MES	Implied Medium Income[a]	MES Medium Income	% Sample GI > MES	% GI>MES Non-Zero Shares[b]	% Total Billings by GI>MES[c]	Implied Agency Income[d]
TVL	3.836 (0.539)	45.39%	.28613	0.223 (0.062)	28.93%	53.46%	99.54%	2.989
TVH	3.836 (0.539)	45.39%	.47714	0.223 (0.062)	48.88%	63.43%	99.15%	1.792
MGL	3.836 (0.539)	45.39%	.36054	0.223 (0.062)	50.37%	55.19%	97.88%	2.372
PTH	3.836 (.539)	45.39%	.22285	0.223 (0.062)	30.67%	45.90%	92.40%	3.838
NPH	3.443 (0.488)	48.38%	.30813	0.202 (0.056)	49.38%	51.83%	96.73%	2.256
DRH	3.443 (0.488)	48.38%	.15974	0.202 (0.056)	22.44%	34.88%	93.31%	4.351
RDH	3.099 (0.440)	52.12%	.18565	0.187 (0.051)	47.63%	53.80%	96.44%	3.126
OTH	3.099 (0.440)	52.12%	.07377	0.187 (0.051)	22.44%	28.04%	90.05%	7.867
XMB	3.319 (0.462)	49.38%	1.42528	3.438 (1.205)	19.70%	21.70%	75.24%	8.006

[a]MES agency income multiplied by mean media share shown in Table 2.
[b]Percentage of agencies with non-zero shares in a category with income from medium greater than the MES estimate.
[c]Percentage of sample's total billings volume produced by agencies with GI>MES
[d]MES medium income divided by mean media share shown in Table 2.

medium j, assuming the agency's entire output was concentrated in that medium.[11] To view these MES estimates of total agency gross income from the perspective of a "typical" agency operating as a multiproduct firm, we computed the "Implied Medium Income" by multiplying each estimate of MES total agency gross income by the corresponding mean share of billings volume reported in Table 2. The values of these implied medium incomes are shown in Column 3 of Table 4.

The median gross income for the entire sample of 401 agencies is $3.233 million, and as may be seen from Table 4, that value falls within two standard errors of the MES point estimate for each of the nine media categories. The latter range from $3.099 million for each of radio and the "other" category to $3.836 million for each of network TV, spot TV, general magazines, and special print. Note that the difference in MES estimates between media categories are in all cases within two standard errors of one another -- i.e., twice the value of the asymptotic standard errors which vary from $0.44 to $0.539 million, resulting in a 95% confidence region of $0.88 to $1.078 million.

In line with the observation that the MES estimates lie close to the sample's median gross income, when these MES point estimates are located within the distribution of the entire sample's gross incomes, we find that at least 45% of the agencies had gross incomes which exceeded the MES estimates for the various media categories (see Column (2) of Table 4). Thus, our preferred scope model indicates that slightly less than half of the sample (or, 180-210 agencies) are of sufficient size to operate at minimum efficient scale. Furthermore, the share of the entire sample's billings accounted for by agencies with gross incomes greater than the upper and lower values of the MES estimates for the scope model 5.1A are 92.56% (for MES = $3.836 million) and 94.26% (for MES = $3.099 million). In light of the fact noted earlier that the total billings of this sample of 401 agencies represents more than 60% of total US national advertising expenditures in 1987, we conclude that the majority of all national advertising is produced by agencies operating at minimum efficient scale, i.e. a representative transaction is most likely to emanate from efficient firms.

Table 4 also presents the estimates of MES derived from the preferred scale model 12.2A, where medium-specific income (Y_j) replaces total gross income (Y) as the size variable. Except for non-media services, the media-specific MES income estimates (see Column (4)) all fall within a standard error of one another, varying from $0.187 to $0.223 million, with the values of the estimated asymptotic standard errors ranging from $0.051 to $0.062 million.

Although the variability of the medium-specific MES estimates may appear limited, the percentage of the agency sample with incomes above these levels varies markedly among categories. As reported in Column (5) of Table 4, for each of spot television, radio, general magazines, and newspapers, approximately 50% of the agency sample had incomes from these media which exceeded the estimated MES levels. For the other five categories, the relevant percentages were considerably smaller: special print (30.67%), network television (28.93%), direct response (22.44%), other (22.44%), and non-media services (19.70%).

Consistent with the findings for the scope model, agencies with medium-specific incomes exceeding these MES estimates collectively account for the overwhelming share of the total sample's billings in each category. For the nine media categories, the relevant percentages (shown in Column (7) of Table 4) range from a low of 90.05% for "other" to 99.54% for network television. However, agencies operating above the MES income for non-media services in toto represent only 75.24% of the total sample's billings in that category -- a condition which reflects the tendency for smaller agencies to depend more heavily on fee-based income than larger agencies.

Agencies tend to be specialized with respect to media, as evidenced by the substantial percentages of the sample with zero shares in several categories (Table 2). In light of this, we have calculated the share of agencies with non-zero shares whose incomes exceeded the medium-specific MES estimates for each category; results are shown in Column (6) of Table 4. For three categories (direct response, other, and non-media services), the percentage of agencies with any billings in these categories who also operated with volumes that exceeded the relevant medium-specific MES is 35% or less. Interestingly, these three categories are those where billings share tended to be negatively related to agency size, although in the case of the "other" category, the relation was not statistically significant (see Appendix Table A3).

A comparison of these medium-specific MES estimates for the scale model 12.2A (Column 4) with the corresponding "Implied Medium Income" obtained from the scope model 5.1A (Column 3) indicates that the income for a firm with a media share equal to that of the sample mean would equal or exceed that required to operate at minimum efficient scale for six of the nine categories -- network and spot television, general magazines, special print, newspapers and radio.

This pattern is reversed for direct response, but the difference between the two values is less than one standard error of the medium-specific MES estimate. The media-specific MES estimates also exceed the implied values for both the "other" cateogry ($0.187 vs. $0.074) and non-media services ($3.438 vs. $1.425), and here the differences are substantial. This suggests that scale economies may be important for these two categories in the sense that such economies are not exhausted by agencies with media shares equal to the sample means. This inference is also consistent with the finding noted above that the percentages of sample agencies with non-zero billings whose incomes exceeded the medium-specific MES were the lowest of the nine categories, 28.04% for "other" and 21.70% for non-media services. However, it should also be noted that these two categories are composites and their aggregate MES estimates may be unstable.

Dividing the medium-specific MES estimates from the scale model 12.2A by the corresponding mean media share, we obtain values of the "Implied Agency Income", shown in Column (7) of Table 4. These values may be compared with the estimates of MES agency income derived for the scope model 5.1A, shown in Column (1). For six of the nine categories, the estimate of MES agency income obtained directly from the scope model was either above or less than one standard error below the corresponding value "implied" by the scale model.

The discrepant cases are direct response, other, and non-media services. For each of these categories, the level of total agency income implied by the medium-specific MES estimate for an agency operating with a share equal to the sample mean exeeded the estimate from the scope model by a considerable margin: $4.35 vs. $3.44 for direct response; $7.87 vs. $3.10 for other; and $8.01 vs. $3.32 for non-media services. The difference for direct response is less than twice the standard error of the MES estimate for the scope model ($0.488), but for both the "other" category and non-media services, the differences are more than ten times the relevant standard errors.

Overall, then, the scale and scope models yield a similar picture of the efficiency of agency operations. For most media categories, income of $3-4 million is required for an agency to attain minimum efficient scale, and roughly half of the agencies in the sample were operating at that level, representing more than 90% of the sample's total billings. The scale and scope models yielded inconsistent results for the "other" and non-media services categories. Given that both of these categories are composites, problems of underlying heterogeneity may have resulted in unreliable estimates of the parameters entering into the calculations of MES.

Cost Penalties

The preceding results indicated that a substantial fraction of agencies operate at less than minimum efficient scale, and therefore it becomes important to ask what magnitude of cost disadvantage results from this condition. Accordingly, using equation (3) above, we have calculated the cost penalty borne by an agency operating at an output level equal to half that required to achieve minimum efficient scale for both of our preferred scale and scope models. Estimates of these average cost penalties are presented in Table 5, along with their asymptotic standard errors.

In general, these penalties are of a considerable magnitude in absolute terms, and larger than similar estimates for several manufacturing industries reported in the literature (Scherer [1980], pp. 96-97). Consistent with the presence of significant scope economies, the estimates of the cost penalties given by the scale model are higher than those obtained from the scope model, for all media categories except non-media services.

The penalties for operations at less than MES are highest for network and spot television, general magazines, and special print. The first three of this latter set of media are those for which larger agencies tend to have higher shares. Thus it would appear that small agencies can face a substantial cost disadvantage relative to large agencies in producing and placing advertising for network and spot television and general magazines. As noted earlier, smaller agencies tend to have higher shares in direct response and non-media services, and while the cost penalties for these categories are somewhat lower than those associated with the major media, they are still of sufficient size to represent a serious cost disadvantage for the multitude of very small agencies operating in this industry.

Table 5

Maximum Likelihood Estimates of Average Cost Penalty Incurred at Half Efficient Scale (D^*), In Percentage Points (Estimated Asymptotic Standard Error in Parentheses)

Abbreviation	Media Category	Penalty with Scope Model 5.1A	Penalty with Scale Model 12.2A
TVL	Network Television	15.06% (1.35)	27.72% (5.95)
TVH	Spot Television	15.06% (1.35)	27.72% (5.95)
MGL	General Magazines	15.06% (1.35)	27.72% (5.95)
PTH	Special Print	15.06% (1.35)	27.72% (5.95)
NPH	Newspapers	11.07% (1.12)	19.88% (4.49)
DRH	Direct Response	11.07% (1.12)	19.88% (4.49)
RDH	Radio	8.41% (0.86)	15.74% (3.42)
OTH	Other	8.41% (0.86)	15.74% (3.42)
XMB	Non-Media Services	10.04% (0.87)	7.41% (1.45)

Returns to Scope

The possible cost advantages accruing to an agency with a broad media mix as compared to a narrow one may be evaluated by estimating returns to scope.[12]

This quantity represents the percentage cost saving realized from the joint production of some mix of agency services over the cost of producing the elements of that mix separately, as defined above in equations (7)-(9). We have calculated estimates of these savings using parameter values from our preferred scope model 5.1A; the results are summarized in histogram form in Figure 4.

{Insert Figure 4 Near Here -- See Page 46}

We find that scope economies are substantial. The median cost saving from joint production is 26.43% (mean: 29.53%), with a range from essentially zero to 86.45%. Moreover, as is evident from Figure 4, the distribution is highly skewed in the direction of large cost savings. To explore how these scope economies vary with agency size, we constructed the scatter diagram (see Figure 5) where cost savings percentages are plotted against agency gross income.

{Insert Figure 5 Near Here -- See Page 47}

Clearly, a marked tendency exists for the cost savings percentage to decline as agency gross income increases. Scope economies appear to be virtually exhausted for the handful of very large agencies with gross incomes of $100 million or more. However, among the smallest agencies (e.g., those with gross incomes of $2 million or less and hence below half minimum efficient scale), there is a very large amount of variation in the cost savings percentage that is unrelated to size. Thus, although scope economies are exhausted for the very largest firms, we also find strong evidence that scope economies are of considerable consequence to small firms, for their costs are particularly sensitive to the mix of media services provided.

<u>Ray Returns to Scale</u>

Earlier in Section II we noted that for multiproduct firms the concept of returns to scale is inherently ambiguous. One possible measure of size-related economies, however, is the notion of ray returns to scale (RRS), defined in equation (10). Essentially, RRS is one over the elasticity of total costs with respect to total output Y_i, holding fixed the output mix, i.e., $S_{ij} = \bar{S}_{ij}$.

Using equation (11) with the parameter restrictions from model 5.1A imposed, we have computed agency-specific RRS based on our preferred scope model. Our results are summarized in histogram form in Figure 6. A number of findings are worth noting.

{Insert Figure 6 Near Here -- See Page 48}

First, the mean value of RRS is 1.182, but the median is less, being only 1.065. This reflects a rather skewed distribution, with 192 of our 401 agencies (47.9%) having RRS in the region of 1.00 to 1.05. Indeed, 77 of these 192 agencies display RRS that are virtually constant, being in the range of 1.000 < RRS < 1.001. Second, since RRS can be envisaged as the ratio of average to marginal cost, the large number of RRS near one suggests again that a very substantial number of advertising agencies in our sample are sufficiently large to have exhausted virtually all available scale economies and are producing at minimal marginal cost. Third and finally, although many agencies are efficient, a considerable number are small and as a consequence, they have been unable to exploit potential scale economies; 47 of our 401 agencies (11.72%), for example, display RRS of greater than 1.50 (the largest value is 1.873), and for these agencies the ratio of average to incremental cost is significant. Of the 401 agencies, 71 (17.71%) have RRS in the range of 1.25 to 1.50, while 91 (22.69%) fall in the 1.05 < RRS < 1.25 range.

We have also computed RRS using parameter values from our preferred scale model 12.2A, based on equation (13) with appropriate restrictions imposed. Unlike the case for our preferred scope model, however, with our preferred scale model values of RRS are extremely volatile. Although mean and median values of RRS are 1.555 and 1.020, respectively, for the preferred scale model the standard deviation of RRS is 12.700, almost sixty times larger than the 0.214 value for the preferred scope model; the estimated RRS for the scale model range from -153.571 to 123.546.

The reason such extreme variability occurs with the preferred scale model can be seen by examining equation (13) and values of the estimated γ_j parameters in Table 3 for model 12.2A. The large positive value of γ_j for eight of the nine media (302.01, with an asymptotic standard error of almost 100) implies that for those agencies having large S_{ij} media shares, the last term in the denominator of (13) becomes volatile and occasionally negative, resulting in erratic and even negative estimated RRS. Note that because the troublesome γ_j parameter has a large standard error, the confidence region of our estimated RRS for the preferred scale model is also very large.[13]

We conclude therefore that, unlike the case of our preferred scope model 5.1A, for the preferred scale model 12.2A we are unable to obtain reliable and plausible estimates of RRS.

Discussion

Our results suggest several conclusions regarding the importance of scale and scope economies. First, approximately 200-250 agencies had gross incomes of $3-4 million or more in 1987 and hence were large enough to have realized essentially all size-related efficiencies.[14] At least half of the total amount expended in the US on national advertising in 1987 was the product of agencies operating at minimum efficient scale. It is well-known that agencies compete fiercely with one another in bidding for accounts, and these findings indicate that the majority of the industry's output is produced by efficient agency operations.

Second, very small agencies (gross incomes of $1.5-2.0 million or less in 1987) appear to bear substantial cost disadvantages that are related to both the scale and scope of their operations -- a condition of considerable consequence given the existence of more than 12,000 agencies in the US, according to the count from the 1987 Census of Services.

Third, large agencies tend to derive larger shares of their incomes from media and services with lower asymptotic costs than do smaller agencies. In particular, three of the four media categories with the lowest asymptotic unit costs and highest cost penalties (network and spot television, and general magazines) are those for which the cross-sectional associations between media share and total agency gross income are positive (see Appendix A3). Although we lack the data necessary to investigate this matter in detail, informed industry opinion would support the conjecture that these size-related differences in agencies' media mixes are more a reflection of size-related differences in clientele served than a consequence of any cost advantage due to scale economies. Clients with large budgets are those most likely to expend substantial amounts on national campaigns in television and magazines and for various reasons, they also tend to favor large agencies over small ones. SSB ([1983, pp. 471-473) present some earlier evidence consistent with this line of argument.

The results obtained here have implications for a number of issues raised in the introduction concerning the organization of the advertising agency industry. First, it appears unlikely that any benefits due to scale economies in domestic US operations per se are to be realized by mergers among the largest 200 or so agencies, since they have already achieved minimum efficient scale. However, our estimates concerning the significance of scope economies suggest the possibility that additional efficiency gains might still be realized by some large agencies who expand the mix of services offered through acquisitions. In light of our inability to disaggregate "non-media services" into more homogeneous elements, such a suggestion remains speculative. Clearly, our results indicate that economies of both scale and scope offer substantial incentives for mergers and acquisitions among smaller agencies.

Also, economies of scale and scope in operating costs would not appear to offer a viable explanation for the low incidence of in-house agencies, as has sometimes been suggested. The estimates of minimum efficient agency size obtained from our preferred scope model are in the $3-4 million range, which implies that advertisers with billings of $20-26.7 million could operate fully efficient house agencies. Each of the largest 200 national advertisers in the US had expenditures which exceeded these levels in 1987, but less than 5% of them operated in-house agencies (Advertising Age [1988b,c]).

Further, our evidence of economies of scale is consistent with the trend away from reliance on fixed commission rates in agency compensation arrangements. If all the scale economies captured in our cost model held at the individual account level, then our estimates imply that, on average, larger accounts would be less costly to serve than smaller ones, up to billings levels of $20-26.7 million. However, since our estimates are based on data from a cross section of agencies and not from individual accounts, such a conjecture must be taken as speculative.

Finally, although the evidence is not decisive, on the basis of *a priori* plausibility, goodness of fit, and the Davidson-MacKinnon specification tests, we conclude that our estimated preferred scope model 5.1A dominates the preferred scale model 12.2A. In the advertising agency industry, economies of scope appear to be important.

VI. CONCLUSIONS

How important are economies of scale and scope in advertising agency operations? This paper reported an econometric study undertaken to address this question. Cost models were formulated which represent how the principal component of agency costs, employment level, varies according to the mix of media and services an agency provides and the total volume of advertising it produces. These models were estimated and tested cross-sectionally utilizing data pertaining to the domestic operations of 401 US agencies for 1987.

The empirical evidence reported here indicates that both scale and scope economies are highly significant in the operations of US advertising agencies. We find that of the 12,000 establishments comprising the industry in 1987, approximately 200-250 had domestic gross incomes of $3-4 million or more (or equivalently, billings of $20-27 million) and therefore had service mixes and operating levels sufficiently large to take full advantage of all available size-related efficiencies. Furthermore, the overall structure of the industry is one where these large, fully efficient firms created and produced more than half of all the national advertising utilized in the US during 1987. At the same time, vast numbers of very small agencies appear to operate with substantial cost disadvantages compared to large firms as a consequence of these scale and scope economies.

These findings carry important implications concerning possible future changes in the industry structure. It seems highly doubtful that scale economies could motivate further mergers among the largest 200-250 agencies. On the other hand, for small agencies, mergers and acquisitions might be attractive as means of mitigating their size-related cost disadvantages. Finally, our findings demonstrating the existence of scale and scope economies are consistent with the diminishing reliance on fixed rates of media commissions as the principal basis of agency compensation. They also cast strong doubts on size-related economies in operating costs as a viable explanation for the limited degree of vertical integration of agency services by large advertisers (Silk [1989]).

The structure and behavior of advertising agency costs are clearly subjects which deserve further attention. Access to more detailed and disaggregated cost data could facilitate investigation of several issues left unresolved here, and also would permit analysis of additional questions of importance which have not yet been addressed in this study. Cost measures which go beyond the proxy for payroll expenses generally relied upon in discussions of agency economics would certainly be welcome. It would also be desirable to be able to decompose "non-media services" into more specific components. Examination of costs at a more micro level could cast considerable light on the efficiencies which may be associated with recent agency efforts to offer broader and more integrated services to clients. The availability of cross-sectional data at the level of individual accounts or clients (rather than entire agencies) would support development of more complex structural models to test the hypothesis noted above that the greater efficiency of large agencies arises from the size and media/service mix of the clients they serve. As Weilbacher [1990] has suggested, an understanding of account level cost behavior could contribute much to addressing contemporary questions and concerns about the economics of alternative agency compensation plans. Finally, the present focus on domestic agency activities leaves entirely open the question of how scale and scope economies may affect multinational agency operations.

FIG. 1.—Basic exponential cost function

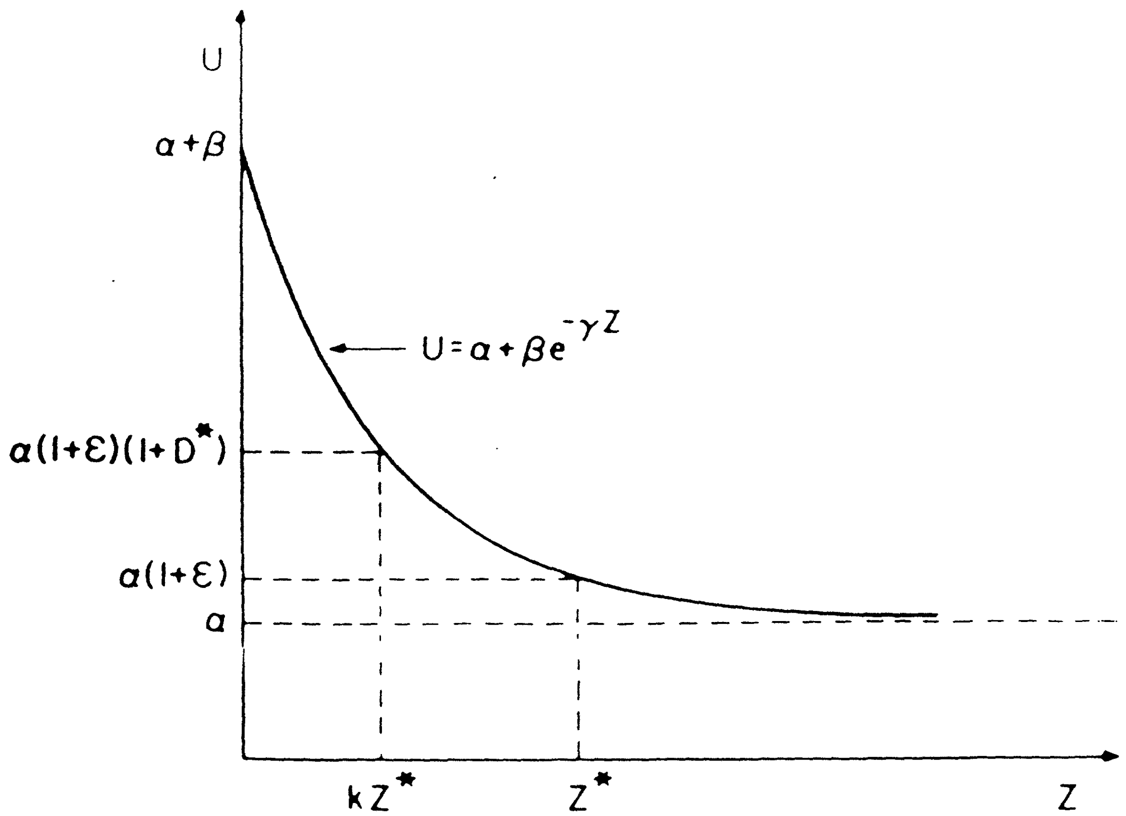


FIG. 2 LIKELIHOOD RATIO TESTS OF NESTED SPECIFICATIONS

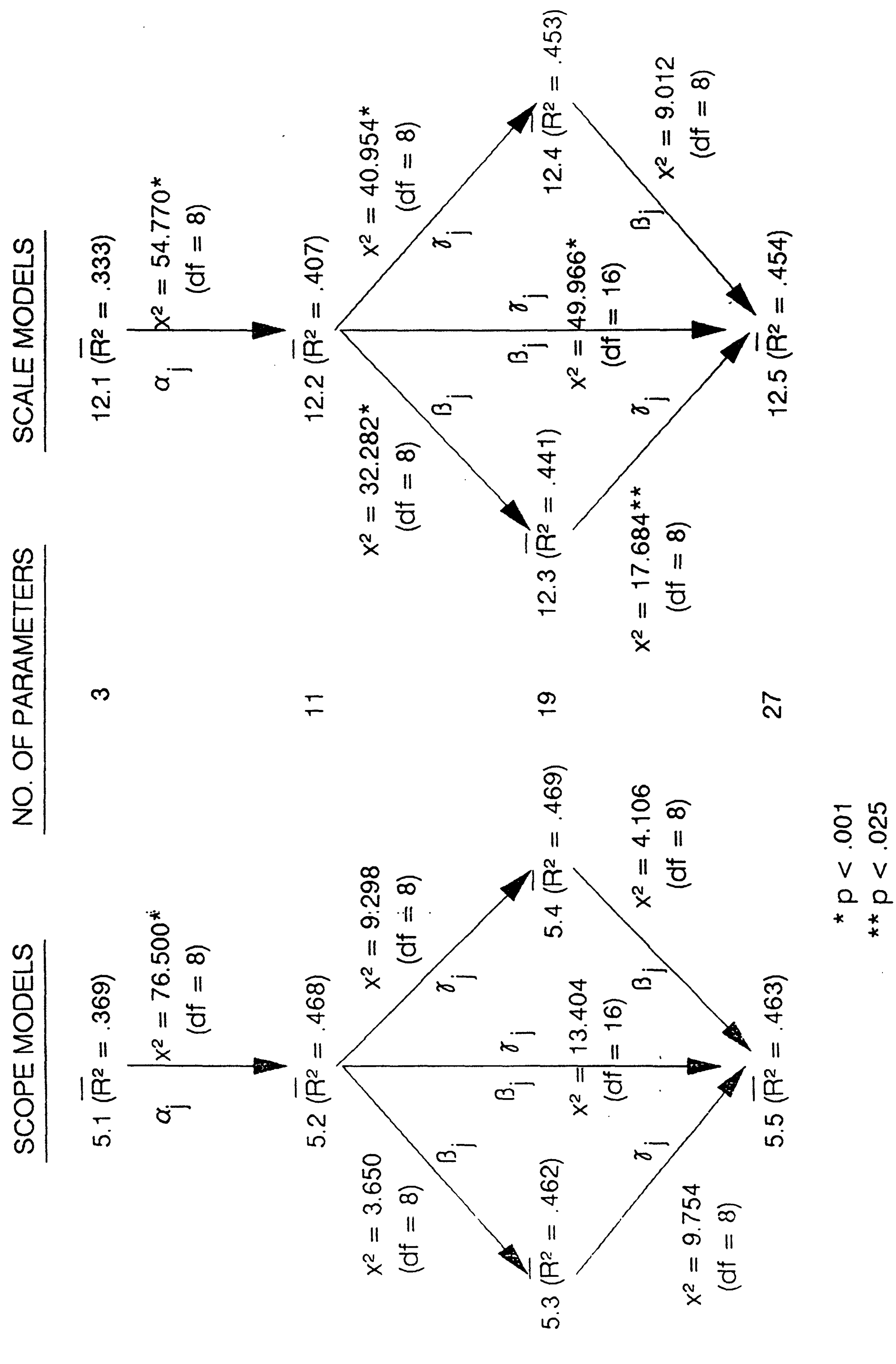
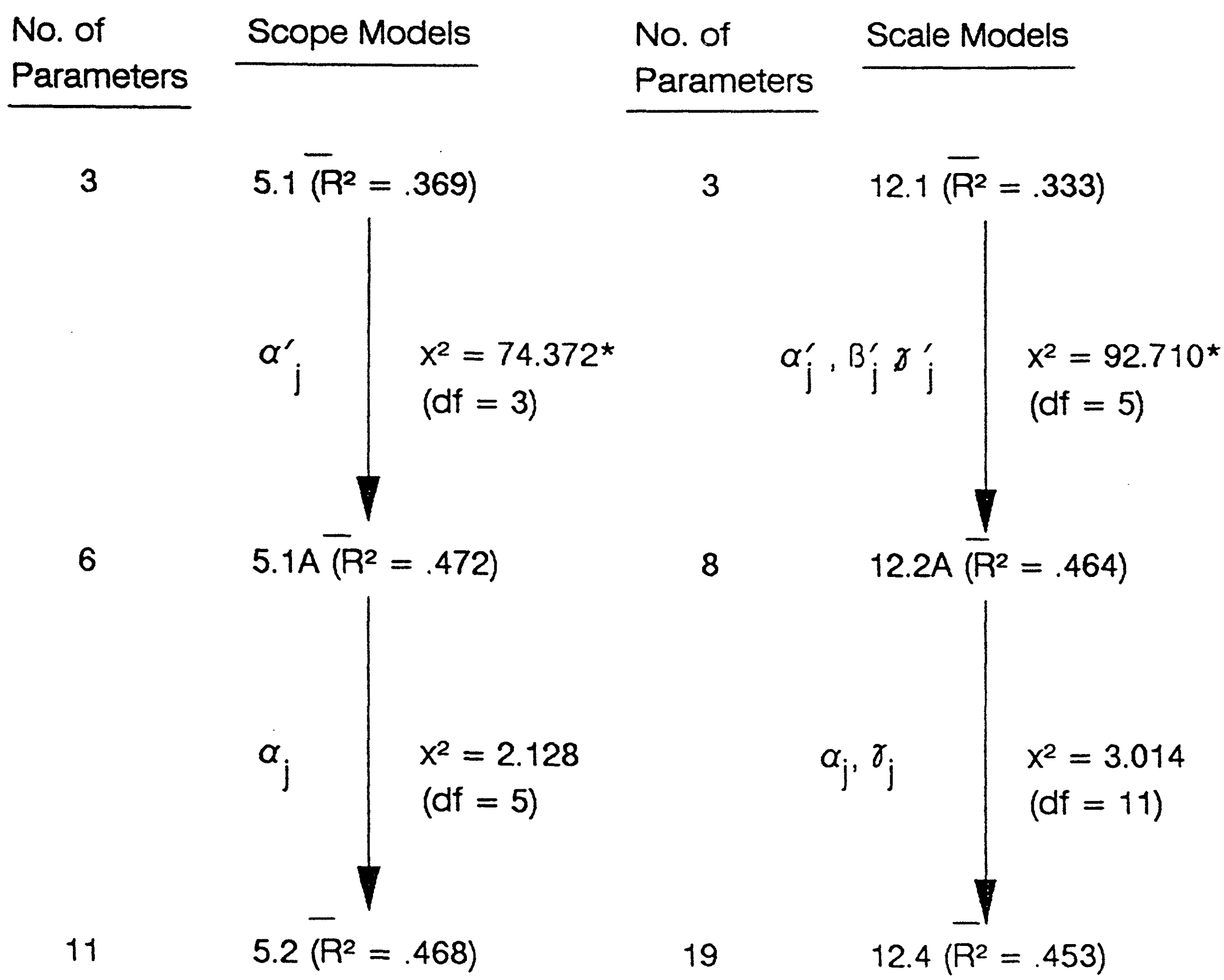


FIGURE 3. LIKELIHOOD RATIO TESTS FOR RESTRICTED NESTED SPECIFICATIONS



* $p < .001$

FIGURE 4

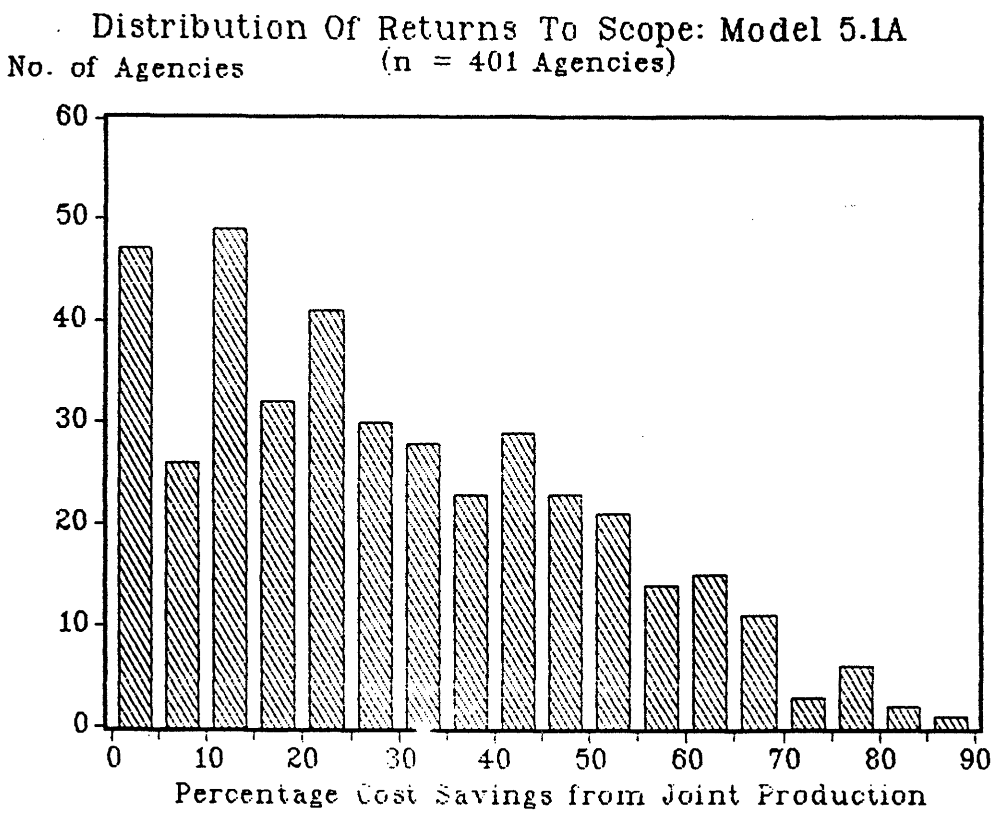

Distribution Of Returns To Scope: Model 5.1A
(n = 401 Agencies)
No. of Agencies
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
Percentage Cost Savings from Joint Production

FIGURE 5

Degree of Scope Economies vs. Agency Size: Model 5.1A

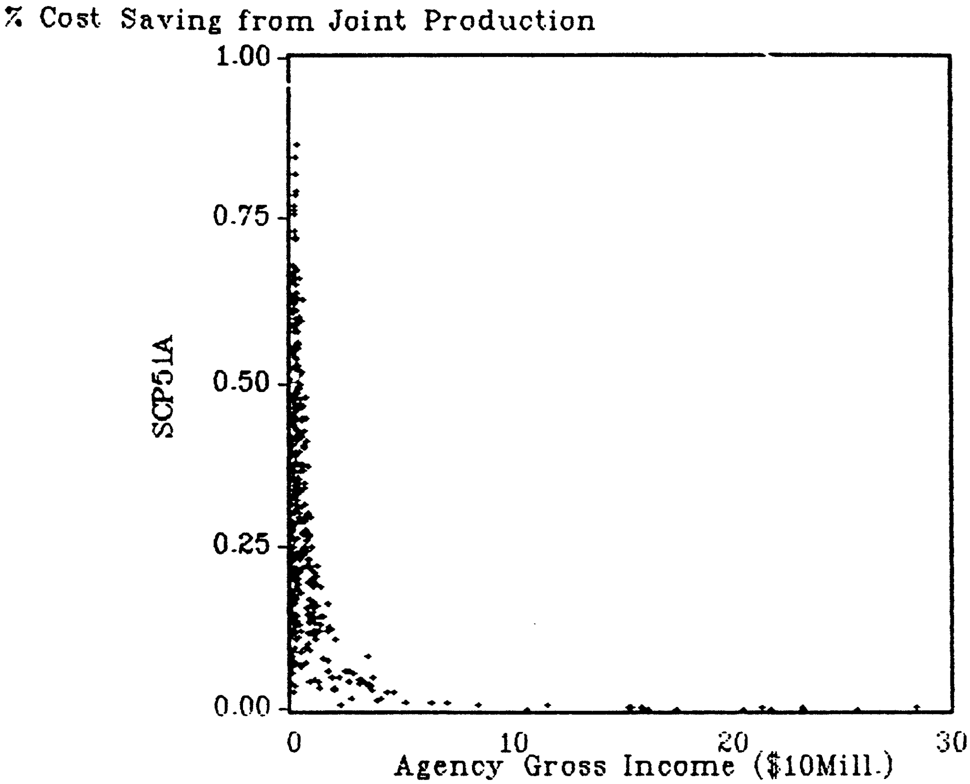
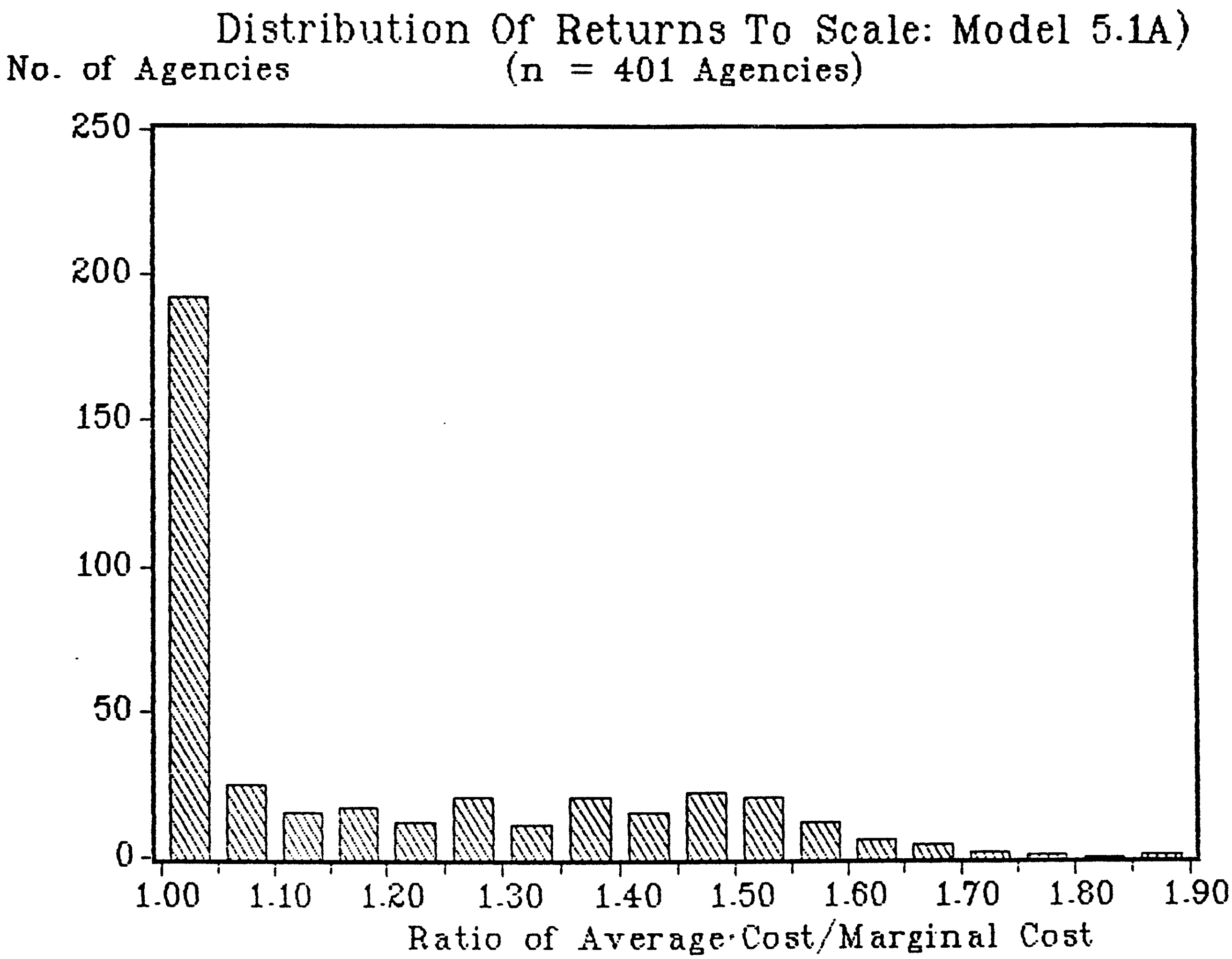


FIGURE 6


Distribution Of Returns To Scale: Model 5.1A)
No. of Agencies
(n = 401 Agencies)
250
200
150
100
50
0
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
Ratio of Average Cost/Marginal Cost

APPENDIX TABLE A-1

Maximum Likelihood Estimates of Parameters for Alternative Scope Models
(Ratio of Parameter Estimate to Asymptotic Standard Error in Parentheses)

Parameter	Model 5.1	Model 5.2	Model 5.3	Model 5.4	Model 5.5
α	1.187 (37.06)				
α_{TVL}		0.748 (5.533)	0.750 (5.069)	0.791 (5.151)	0.835 (5.034)
α_{TVH}		0.845 (6.512)	0.839 (5.582)	0.909 (5.894)	0.943 (6.306)
α_{MGL}		0.539 (2.832)	0.509 (2.096)	0.501 (1.859)	0.532 (1.707)
α_{PTH}		0.832 (4.581)	0.956 (4.344)	0.941 (4.788)	0.916 (4.792)
α_{NPH}		1.429 (8.245)	1.543 (7.574)	1.519 (8.173)	1.509 (8.191)
α_{DRH}		1.210 (6.822)	1.068 (4.423)	0.698 (1.767)	0.803 (1.882)
α_{RDH}		2.009 (5.531)	2.025 (4.342)	1.948 (3.661)	1.933 (3.329)
α_{OTH}		2.270 (4.532)	2.360 (3.277)	0.887 (0.950)	-1.684 (0.473)
α_{XMB}		1.573 (30.36)	1.511 (21.87)	1.542 (21.53)	1.513 (18.86)
β	1.636 (9.166)	1.902 (5.781)		2.020 (5.380)	
β_{TVL}			1.380 (0.402)		5.621 (0.141)
β_{TVH}			1.785 (1.400)		6.279 (0.312)
β_{MGL}			1.742 (1.224)		1.300 (0.546)
β_{PTH}			-0.068 (0.041)		43.298 (0.188)
β_{NPH}			-0.211 (0.153)		75.561 (0.139)

β_{DRH}			2.528 (2.388)		1.627 (2.425)
β_{RDH}			1.545 (0.479)		1.198 (0.229)
β_{OTH}			1.880 (0.562)		4.865 (1.379)
β_{XMB}			1.929 (5.898)		1.648 (3.702)
γ	8.264 (7.031)	14.044 (5.894)	11.726 (5.459)		
γ_{TVL}				15.902 (0.724)	22.546 (0.350)
γ_{TVH}				17.433 (1.492)	34.301 (0.576)
γ_{MGL}				12.496 (1.569)	9.663 (0.481)
γ_{PTH}				33.029 (0.605)	57.985 (0.672)
γ_{NPH}				38.775 (0.555)	78.623 (0.625)
γ_{DRH}				4.356 (1.348)	3.996 (0.934)
γ_{RDH}				12.007 (0.801)	9.257 (0.258)
γ_{OTH}				0.625 (0.387)	0.404 (0.673)
γ_{XMB}				13.310 (4.330)	10.663 (3.031)
ln L	-204.962	-166.712	-164.887	-162.063	-160.101
SER	.4049	.3718	.3740	.3714	.3734
R^2 (Adj)	.3690	.4679	.4617	.4692	.4634
SSR	65.257	53.924	53.435	52.688	52.151
No. of Free Parameters	3	11	19	19	27

APPENDIX TABLE A-2

Maximum Likelihood Estimates of Parameters for Alternative Scale Models
(Ratio of Parameter Estimate to Asymptotic Standard Error in Parentheses)

Parameter	Model 12.1	Model 12.2	Model 12.3	Model 12.4	Model 12.5
α	1.259 (49.49)				
α_{TVL}		0.852 (5.929)	0.775 (5.132)	0.768 (5.451)	0.743 (5.000)
α_{TVH}		0.814 (5.962)	0.813 (5.665)	0.841 (6.272)	0.861 (6.392)
α_{MGL}		0.255 (1.219)	0.417 (1.674)	0.519 (2.596)	0.579 (2.921)
α_{PTH}		0.663 (3.407)	0.792 (3.564)	0.812 (4.277)	0.890 (4.695)
α_{NPH}		1.327 (7.171)	1.530 (7.597)	1.391 (7.748)	1.350 (7.536)
α_{DRH}		1.224 (6.433)	1.101 (4.537)	-0.108 (0.209)	0.578 (0.650)
α_{RDH}		1.046 (2.566)	1.724 (3.123)	1.770 (4.469)	2.399 (1.127)
α_{OTH}		1.617 (2.971)	1.277 (1.212)	1.731 (1.387)	1.471 (1.027)
α_{XMB}		1.630 (31.48)	1.526 (23.27)	1.500 (22.08)	1.453 (17.72)
β	17.171 (6.229)	1.375 (4.941)		1.908 (4.982)	
β_{TVL}			0.262 (0.221)		73.450 (0.756)
β_{TVH}			1.073 (1.334)		7.096 (2.071)
β_{MGL}			0.729 (0.893)		18.864 (0.445)
β_{PTH}			0.094 (0.127)		11.311 (1.126)
β_{NPH}			-1.156 (1.284)		**** (0.005)
β_{DRH}			1.428 (1.820)		1.215 (1.613)

β_{RDH}			0.002 (0.001)		-0.742 (0.387)
β_{OTH}			2.554 (1.321)		2.325 (1.199)
β_{XMB}			2.359 (5.390)		1.210 (3.108)
γ	359.49 (6.693)	28.457 (3.299)	18.590 (4.869)		
γ_{TVL}				226.320 (0.238)	2344.6 (0.931)
γ_{TVH}				63.698 (1.226)	102.99 (2.489)
γ_{MGL}				96.970 (1.028)	1091.2 (0.689)
γ_{PTH}				203.750 (0.589)	298.19 (1.535)
γ_{NPH}				273.460 (0.428)	**** ****
γ_{DRH}				1.222 (1.216)	2.791 (0.509)
γ_{RDH}				146.610 (0.551)	3.412 (0.179)
γ_{OTH}				32.527 (0.464)	27.058 (0.520)
γ_{XMB}				17.501 (3.995)	12.063 (2.747)
ln L	-215.933	-188.548	-172.407	-168.071	-163.565
SER	.4162	.3926	.3811	.3770	.3767
R^2 (Adj)	.3335	.4067	.4411	.4530	.4538
SSR	68.928	60.128	55.477	54.290	53.084
No. of Free Parameters	3	11	19	19	27

NOTE: **** implies that due to near singularity, parameter value could not be computed.

APPENDIX TABLE A-3

Regression Results: Media Share on Log Gross Income

Abbreviation	Media Category Share	Slope Coefficient (t-Statistic)	R^2
TVL	Network Television	0.0552 (12.022)*	0.266
TVH	Spot Television	0.0316 (5.741)*	0.076
MGL	General Magazines	0.0094 (2.599)*	0.017
PTH	Special Print	-0.0051 (1.320)	0.004
NPH	Newspapers	0.0020 (0.479)	0.001
DRH	Direct Response	-0.0087 (2.090)**	0.011
RDH	Radio	0.0020 (0.904)	0.002
OTH	Other	-0.0022 (1.454)	0.005
XMB	Non-Media Services	-0.8426 (8.082)*	0.141

Two-tail test of significane (n = 401 for all regressions):

* P < .01   ** P < .05

FOOTNOTES

[1]The exceptions are Leffler and Sauer [1984], Palda [1988], and Simon [1970, Chapter 6].

[2]We contemplated using "flexible" functional forms such as the well-known translog function (see Berndt [1991], Chapter 9), but found them to be impractical since in our sample, for many agencies a number of outputs take on zero values. With zero values, one cannot employ logarithmic forms such as the translog, and use of other polynomial transformations is also problematical.

[3]See, for example, F. M. Scherer [1980, pp. 96-97].

[4]A useful discussion of scope economies and references to literature is given in Bailey and Friedlaender [1982].

[5]As detailed below, the Y_{ij} are estimated, based on billings, not gross income.

[6]Details of how the agencies were selected are not reported.

[7]For several decades, the American Association of Advertising Agencies released summaries of their annual agency cost surveys which showed that payroll and related expenses averaged about 65% of gross income and tended to be stable over time (Advertising Age [1983, p. 84]). Regrettably, after 1982, that practice ceased and since then only occasionally have portions of these data appeared in published sources (e.g., McDonald [1989] and McNamara [1990].

[8]Summary data published from surveys of compensation levels of agency personnel show average compensation per employee increasing with agency billings size (Cole and Sizing [1988]. This effect may be explained, at least partially, by the tendency for large agencies to be located in large, high wage metropolitan areas. Also, reported salaries for incorporated agencies may be higher as a result of firms seeking to avoid double taxation of dividends. To the extent that average compensation per employee does increase with agency size, then we may overestimate the importance of scale economies by taking employees as a proxy of cost.

[9]As a practical matter, we estimated the most restrictive models first, and then used parameter estimates from these converged models as starting values for the more general models. Although we cannot be absolutely certain that we have found the global minimum sums of squared residuals for each of these models, we have obtained the same converged values for each model using several different starting values. The only model for which we experienced substantial convergence difficulties was Model 12.5.

[10]The heteroscedasticity-robust standard errors have been calculated using the formulae developed by White [1980]. We examined residuals from our various estimated models, and found that for all models, larger variances tended to be more common for the smaller firms. However, we attempted various ways of modelling this heteroscedasticity, and none yielded statistically significant findings.

[11]For our preferred scope model 5.1A, it can be shown that for some media category j, the expression (2) for the gross income of an agency operating at

minimum efficient scale becomes: $Z^* = - (1/\gamma) \ln (0.01\alpha_j S_j/\beta)$. The estimates of MES shown in Table 4 have been calculated by setting $S_j = 1$ in the above expression. That is, the MES estimates for model 5.1A assume that an agency's total output is concentrated in a single medium.

[12]For a discussion of industry structure implications of economies of scope in a somewhat different context, see Chiang and Friedlaender [1985].

[13]For other variants of the estimated scale models, we also found large variability and correspondingly huge standard errors for the media-specific γ_j parameters (see Appendix Table A-2), much larger than those for the estimated scope models (see Appendix Table A-1).

[14]Advertising Age's [1988a] "U.S. Advertising Agency Profile" for 1987 lists 248 agencies with U.S. gross incomes over $3 million and 207 with gross incomes above $4 million.

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