The Impact of Scale and Media Mix on Advertising Agency Costs*

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Abstract

Nonlinear cost functions are employed to study the effects of scale and client media allocations on advertising agency costs. Over 200 U.S. agencies in 1977 were apparently large enough to exhaust essentially all economies of scale, though very small agencies may have had substantial scale-related cost disadvantages. Agencies' costs seem to be sensitive to the mix of media in which their clients advertise. On average, larger agencies' clients advertise in media that are apparently more profitable for the agencies. Implications for a number of issues in marketing and industrial organization are briefly explored.

> We want to do the best work possible for our clients, make sure our people are well-paid, and see our stockholders make money. None of that has anything to do with size.
>
> John V. Kinsella, Leo Burnett Co. (Business Week, 1981, p. 196.)

I. INTRODUCTION

This study attempts to answer a simple question: how important are economies of scale in advertising agency operations? Advertising agencies, like most other businesses, are multiple-product firms. An agency's costs may depend on how their clients allocate their advertising budgets across media and there is considerable variation in media mix among agencies. (Section II provides some quantitative information on this variation.) Accordingly, we use nonlinear estimation techniques to examine the influences of both scale and media mix on advertising agency costs. We find evidence that scale economies may not be as important as many have argued and that media mix is a significant determinant of costs. Differences in media mix between large and small agencies seem typically to lower the costs of the former relative to the latter even if all economies of scale have been exhausted.

The question of scale economies underlies a number of current and long-standing controversies related to advertising agency operations. First, the ability to exploit economies of scale is often given as a rationale for agency mergers.[1] However, much skepticism has also been expressed about the realization of such an advantage through mergers and acquisitions (Kanner 1979) and the Federal Trade Commission reportedly did not view several mergers involving large agencies as serious threats to competition (Gordon 1979).

Secondly, the issue of economies of scale underlies the problem of designing an equitable agency compensation scheme (Calantone and Drury 1979, Gross 1972). Both agencies and clients have voiced dissatsifaction with the traditional agency compensation arrangement, wherein the agency's fee is a fixed percentage, typically 15 percent, of the client's gross spending on advertising media (Booz, Allen & Hamilton 1965, Frey and Davis 1958). This dissatisfaction is usually based on the perception of economies of scale at least with respect to account size: agencies complain that they are underpaid by small accounts, and clients are suspicious of being overcharged for large campaigns. Still, the most recent study bearing on this issue conducted by the Association of National Advertisers (1979) found that the commission system continues to be the dominant method of compensation with 57 percent of the 236 advertisers surveyed reporting they utilized media commissions plus markups on production costs, while another 18 percent employed a combination of commissions and fees. Finally, evidence on scale economies might contribute to a satisfactory explanation of the limited incidence of "in-house" as opposed to "independent" agencies.[2]

Advertising agency cost structures are also of interest to specialists in industrial organization. The importance of scale economies in advertising generally has been much debated in the literature.[3] Any such economies must reflect both the nature of consumer response to advertising messages and the cost of delivering those messages. Advertising agency fees are a part of this cost from the advertiser's point of view, while the agency's costs represent part of the social cost involved. Even ignoring the advertising debate, advertising agencies are highly visible multiple-product firms engaged in what sometimes appears to be intense competition. The implications of cost conditions for the nature of market interaction in such a setting merits study in its own right.

Despite the relevance of information on advertising agency cost structures to a broad range of important questions, there are no published econometric studies of the effects of scale and media mix on agency costs.[4] Section II discusses the data we employ to study those effects, and Section III presents the cost function specifications we estimate. Section IV describes our empirical results which are further discussed in Section V. Section VI summarizes the conclusions and implications we draw from them.

II. VARIABLE DEFINITIONS AND DATA BASE DESCRIPTION

The variables and measures used in the analysis reported below are defined as follows:

Y = Agency gross income from U.S. operations (millions of dollars in 1977),

E = Agency employment in U.S. operations (number of employees in 1977),

U = E/Y or number of employees per million dollars of gross income in 1977,

S_j = Share of an agency's billings derived from medium j, $j=1,\ldots,10$.

Y_j = S_jY = Estimated gross income from medium j.

The unit of analysis throughout is an individual agency.

<u>Gross Income (Y)</u>. An agency's gross income represents its "sales receipts minus cost of goods sold" and is the sum of revenues obtained from three sources: (1) commissions earned from purchases of media time and space made on behalf of clients; (2) markups on materials and services purchased from "outside" suppliers and charged to clients; and (3) fees paid by clients for agency services as an addition to or in lieu of commissions and markups. Gross income is generally accepted in the advertising

industry as the preferred measure of agency size or output since it is better suited to comparative analyses than other aggregate indicators such as billings or capitalized billings. These may give a misleading picture of output due to variations in media mix and compensation arrangements (O'Gara 1978, Paster 1981). Historically, media commissions have accounted for the bulk of agencies' gross income. Data from the 1967 Census of Business (Table 4, p. 8.22) indicate that for 1,380 advertising agencies with annual payrolls of $50,000 or more, 83.6 percent of their gross income came from commissions on media billings. For the industry as a whole, the ratio of media commissions to media billings appeared to be just under 15 percent.

These 1967 Census results also show that reliance on media commissions as a source of gross income tends to be related to agency size -- the relevant percentage increasing from 66.6 for agencies with receipts of less than $1 million to 88.6 for those with receipts of $25 million or more. Summary data from the American Association of Advertising Agencies' (1975, p. 22) studies of its membership show a similar relationship.

Number of Employees per Million Dollars of Gross Income (U). We employ this ratio as a proxy for an agency's average cost. Published summaries of cost data collected annually by the American Association of Advertising Agencies from approximately 250 of its member agencies show that payroll and related employee benefits (insurance and retirement) average about 65 percent of agency gross income or about 70 percent of total expenses (Marshall 1981). The latter percentage has remained stable over time (Marshall 1981) and appears to vary little with agency size cross-sectionally (Edwards 1973). However, there is only sparce evidence to be found in published sources on the cross-sectional variation in payroll expense.[5] Thus while the ratio of employees to gross income is clearly not an ideal measure of unit cost, it is the best proxy available to us.[6] We have no reason to suspect that its use will introduce substantial bias here.[7]

Share of Billings by Media Category (S_j) Agencies generally create, produce, and place advertising in several different media, and variations in the media mix their clients employ are a likely source of inter-agency cost differentials. As an indication of the composition of an agency's output, we use the share of its total billings to clients associated with each of the ten categories listed below in Table 1. An agency's total billings to its clients consists of charges for media time and space, for other materials and services purchased from outside suppliers, and for services performed within the agency, inclusive of all commissions, markups, and fees. The "Other" category in Table 1 thus covers a diverse set of non-media-related activities: its composition varies from agency to agency according to the nature of specialized services each performs. Examples of services typically included in the "Other" category are public relations, new product development, sales promotion, and marketing research.

In the analysis that follows, we treat the shares of an agency's billings in each media category as unbiased measures of the shares of its gross income attributable to those media. (In other contexts, this would correspond roughly to treating shares of "sales" as measures of shares of "sales minus costs of goods sold".) This is strictly valid only if the ratio of gross income to billings is constant for all media within each agency. Unfortunately, the information required to check this condition directly is not available in our data base, and we have been unable to find other relevant evidence in any published sources. Industry sources do indicate that the commission rate allowed agencies on space and time purchases varies little by medium, the standard being 15 percent. However, two other pieces of evidence combine to suggest that the ratio of gross income to billings for at least some media may vary systematically with agency size. First, the importance of media commissions as a source of gross income tends to increase as agency gross income increases. In addition to the 1967 Census results noted above, the American Association of Advertising Agencies, which regularly surveys its membership on their compensation practices, reports that the ratio of gross income to billings decreases from 30 percent in the "smallest" agencies to 15 percent in the "largest agencies" (Paster, 1981). Second, as is discussed below, we find evidence of weak cross-sectional relationships between media share of billings and agency gross income for three of the ten media categories studied. These two bits of evidence suggest that some systematic errors may arise from using a medium's share of billings as a proxy for that medium's share of gross income, but they do not permit us to assess the likely importance of such errors. We return to this problem in the discussion of our statistical results and their implications below.

<u>Estimated Gross Income by Media Category (Y_j)</u> These quantities were obtained by multiplying the share of an agency's billings in each medium (S_j) by its total gross income (Y). They are used in one of our two basic specifications as proxy measures of the scale of agency operations or output in each medium. The discussion above of possible measurement problems with the S_j clearly also applies here.

In all of our cost function analysis, gross income (Y), media shares (the S_j), and media incomes (the Y_j) are treated as exogenous. Agencies may, of course, affect all these variables, but as long as employment levels are freely variable in response to changes in agency size and media mix, no statistical problems result. And advertising agencies are well-known to make substantial staffing changes quickly in response to gains and losses of business.

The source of the above data used here was the 1978 edition of <u>Advertising Age</u>'s annual compilation of operating results for individual agencies.[8] Knowledgeable industry personnel who have spot checked portions of these data from time to time indicate they are reliable. For 1977, data were reported for 583 agencies, listed in order of their billing size.[9] This list was sampled systematically by choosing a starting point randomly and then selecting every sixth agency appearing thereafter. In a few cases, data missing from *Advertising Age*'s reports were obtained from the June 1978 edition of the *Standard Directory of Advertising Agencies*. This procedure resulted in a sample of 91 agencies for which the required information on gross income, number of employees, and share of total billings by media was available with reference to their U.S. operations in 1977.

The mean 1977 U.S. gross income in our final sample of 91 agencies is $4.90 million, with a standard deviation of $14.12 million. (Using the standard 15 percent commission rate, the sample mean gross income corresponds to total billings of about $32.7 million.) The distribution of agency gross incomes (Y) is clearly highly skewed; the range is from $48 thousand to $92.8 million. In terms of total U.S. billings, the range is from $440 thousand to $619 million. The mean number of employees (E) is 112.57, the standard deviation is 311.5, and the range is from 2 to 2190.[10] The distribution of employees per million dollars of gross income (U) is much less skewed: the mean is 30.67, the standard deviation is 12.60, and the range is from 9.26 to 84.51.

Information on the S_j, the 1977 media shares, is provided in Table 1. The second and third columns give some indication of the relative importance of the different media to the agencies in our sample. Note that the first four media account for 70 percent of the gross income of an average agency (column 2) and 85 percent of the aggregate gross income in our sample (column 3). The difference between these two figures indicates that there is a tendency for these four media to be more important, on average, for larger than for smaller agencies. The first four media listed in Table 1 (and in all subsequent tables) are referred to as *major* media in what follows; the others are labeled *minor* media.

Insert Table 1 Here

In order to explore variations in media mix with size, we regress share for each media category (S_j) on the natural logarithm of gross income (Y).[11] The slope coefficients and the corresponding t-statistics are given in the fourth column of Table 1. On average, the larger an agency, the larger the share of revenue received from television advertising, and the smaller the share of newspaper and radio advertising, with declines in the relative importance of direct mail and farm publications also likely. None of these regressions has an R^2 above 0.12. There is thus considerable variation in media mix that is unrelated to agency size.

The last two columns in Table 1 give some feel for the extent of variation in media shares. While nine agencies report no billings from magazine advertising, for instance, one agency reports no billings from any other source! Note in particular the large numbers of agencies reporting no billings from the less important media. Without aggregation over these media, this limits the precision with which we can expect to estimate coefficients that relate to them. However, we have no *a priori* information that permits us to aggregate with any confidence. Indeed, since, for example, spot and network television differ in certain respects (Porter, 1976), we would elect to disaggregate further if it were possible to do so.

Our use of cross-section data to estimate a long-run cost function requires some discussion. Because advertising agencies employ relatively little firm-specific capital and their employment levels are notoriously flexible, deviations from long-run equilibrium in any single year should be relatively minor. Thus Friedman's (1955) classic critique of this approach has relatively little force in this case. Since price competition is apparently relatively unimportant in this industry, it seems sensible to model agencies as minimizing the cost of meeting the exogenously-determined demand for their services. Given product differentiation and the importance of regional markets, at least for some agencies, a cross-section sample such as ours can be expected to contain a range of equilibrium firm sizes and media mixes. Finally, it should be noted that with no available data on input and output prices, there is no obvious way to use the profit-maximization or cost-minimization assumption to improve estimation efficiency.

III. COST FUNCTION SPECIFICATION

Suppose, for the moment, that we are dealing with a single-product industry and are concerned with estimation of the importance of scale economies. A reasonable specification would then be the following:

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

where U is a measure of average cost (as here), Z is a scale-related variable, and α, β, and γ are positive constants. This function is illustrated in Figure 1. Its shape is broadly consistent with the empirical literature on economies of scale in many industries.[12] A quadratic specification would also involve only three parameters, but if it implied declining average costs at small scale, it would also imply either that U is negative at very large scales or that U is increasing after some point, and neither implication is plausible.[13] If U were a log-linear function of Z and scale economies were estimated, it would follow that U approached zero for large Z, which is also implausible.[14] Thus, even though equation (1) requires non-linear estimation, it seems more sensible than the obvious alternatives.

Insert Figure 1 Here

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. Once U is near its asymptotic value, α, however, further increases in scale are of no quantitative importance. We can thus say that scale economies are essentially exhausted for a firm of size Z* if $U(Z^*) = (1+\varepsilon)$, where ε is a small number. Solving for Z*, we obtain an indicator of minimum efficient scale:

$$Z^* = -(1/\gamma)\ln(\alpha\varepsilon/\beta). \tag{2}$$

In what follows we use $\varepsilon = 0.01$, 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

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

In what follows, we set $k = 1/2$ in order to permit comparability with similar estimates for other industries.[15] The determination of Z* and D* is illustrated in Figure 1.

Now suppose a firm produces N products and that equation (1), with j subscripts everywhere, refers to the unit cost of the jth product. Multiplying by S_j and summing, we obtain our basic equation for long-run average cost:

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

Depending on the details of the technology involved, the Z_j might be complex functions of all output levels.

Since we had 10 "products" (media) here and only 91 observations, we could not hope to obtain unrestricted estimates of the cost complementarities or economies of scope that might be present.[16] Instead, we investigated two relatively simple polar case specifications of the way an agency's output levels interact to determine its average cost. We did not begin with a prior assumption that one or the other must be the true specification. Rather, our view was that these specifications bracket the truth. If the specification tests described in Section IV below were to reject one of them, the other might sensibly be treated as a good approximation to the true specification. If not, our assumption was that they bracket the truth in such a way that qualitative statements supported by both are likely to be correct.

The first polar case assumes essentially that scale economies arise in those agency activities, like client contact and concept development, that are essentially independent of media mix allocations. Under that assumption, the most plausible scale variable for all "products" is the overall size of the agency, measured here by gross income, Y. Considering natural restrictions on the parameters in (4), we obtain a set of five partially nested models:

I.1 $$U_i = \alpha + \beta\exp(-\gamma Y_i) + u_i$$

I.2 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \beta\exp(-\gamma Y_i) + u_i$$

I.3 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \sum_{j=1}^{10} \beta_j S_{ij}\exp(-\gamma Y_i) + u_i$$

I.4 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \beta\sum_{j=1}^{10} S_{ij}\exp(-\gamma_j Y_i) + u_i$$

I.5 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \sum_{j=1}^{10} \beta_j S_{ij}\exp(-\gamma_j Y_i) + u_i$$

Here i is an agency subscript, and the u_i are assumed to be normal disturbance terms with all the usual desirable properties. Models I.1 - I.5 are referred to collectively as Model I in what follows.

The polar opposite specification assumes no economies of scope. That is, it assumes no interaction among the agencies' outputs in determining unit cost. If all activities are independent, the natural scale variable for activity j is Y_j, estimated gross income from the corresponding medium. Recall that the Y_j are only estimates since the S_j refer to billings, not gross income. Using the same notation as above, the models that together are identified as Model II are the following:

II.1 $$U_i = \alpha + \sum_{j=1}^{10} S_{ij}\exp(-\gamma Y_{ij}) + u_i$$

II.2 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \beta\sum_{j=1}^{10} S_{ij}\exp(-\gamma Y_{ij}) + u_i$$

II.3 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \sum_{j=1}^{10} \beta_j S_{ij}\exp(-\gamma Y_{ij}) + u_i$$

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II.5 $$U_i = \sum_{j=1}^{10} \alpha_j S_{ij} + \sum_{j=1}^{10} \beta_j S_{ij}\exp(-\gamma_j Y_{ij}) + u_i$$

In both Models, one can go from the parameter estimates to a long-run average cost equation of the form of (1) for each medium. The α's from all specifications can thus be interpreted (provided estimated parameters have expected signs) as the large-scale limiting values of medium-specific unit cost. Similarly, the D*'s computed from the various specifications are in the same units. In Model I, however, the Z* statistics give the minimum <u>agency size</u> (Y) necessary for each product to be produced at nearly minimum cost, while the Z* computed from Model II estimates give the minimum <u>medium incomes</u> (Y_j) necessary for the corresponding products to be produced efficiently.

IV. ESTIMATION RESULTS

The nonlinear least-squares routine in the TROLL system at MIT was employed to obtain parameter estimates for these 10 long-run average cost functions. Experimentation with starting values for models I.3, I.4, II.3, and II.4 revealed the existence of multiple local minima of the sums of squared residuals. The corresponding parameter values were often markedly different, though the sums of squared residuals were generally not. Because of what seems to be a close analog of the multicollinearity problem in ordinary least squares, we thus cannot be absolutely certain that we have found the global minimum sums of squared residuals for these models. This same problem was even more severe for models I.5 and II.5, and considerable experimentation was required to obtain even one well-behaved local minimum for each. The program was unable even to compute an estimated covariance matrix for model I.5. We suspect that at least one reason for these computational difficulties was the large number of zero values for the S_j in this sample. (See Table 1.)

We employed F-tests within Models I and II to select specifications for further study.[17] The results of thoses tests are shown in Figure 2. The R^2 statistics for each model are shown in parentheses, arrows point from the restricted model to the unrestricted model used in each test, and the numbers beside each arrow given the significance level (expressed as a percentage) at which the null hypothesis of the validity of the restrictions involved was rejected. In parentheses next to each arrow is shown the coefficient or coefficients whose equality across media is tested. In both Models, the hypothesis of equal α's is decisively rejected; different media clearly have different cost implications. Similarly, the comparisons of models I.2 and II.2 with less restrictive alternatives indicates that there is no justification for assuming $\beta_j = \beta$ and $\gamma_j = \gamma$ for all j. Once either one of these is relaxed, however, little extra explanatory power is gained by relaxing the other. In view of the numerical problems noted above, it thus seemed sensible not to use the fully unrestricted specifications, models I.5 and II.5, but rather to focus on models I.3, I.4, II.3, and II.4.

Insert Figure 2 Here

Comparisons of these four specifications do not provide adequate grounds for dropping any of them. They have essentially equivalent explanatory power, as the R^2 statistics in Figure 2 indicate. All except I.4, which has the lowest R^2, produce a number of coefficient estimates with signs contrary to our expectation. (Available estimation routines did not permit us to impose non-negativity constraints on the coefficients.) These estimates and their interpretation are discussed below. Observations are ordered by gross income (Y), so that low values of the Durbin-Watson statistic might serve to signal misspecification. But all four of these statistics are above 1.93, and all except that for model II.4 are above 1.98.

Insert Figure 3 Here

A comparison of R^2's suggests that it may be more appropriate to restrict the γ's (models I.3 and II.3) than to restrict the β's (models I.4 and II.4), though the differences are slight. Similarly, differences in the explanatory power of the assumptions that scale effects relate to agency size (Model I) and that they relate to media-specific income (Model II) are slight. In an attempt to shed more light on these issues, we used the P-test for specification recently proposed by Davidson and MacKinnon (1981).[18] In this test, one rejects the null hypothesis that any particular model is correctly specified if the fitted values from any other model significantly enhance its explanatory power. Results are shown in Figure 3: arrows point away from models being tested and toward the models used to generate fitted values, and the numbers next to arrows give the significance levels (expressed as percentages) at which the null hypothesis of correct specification is rejected.[19] All specifications except model I.4, which has the least explanatory power, are rejected at least once at conventional significance levels. This is at least consistent with our prior belief that none of these are likely to be <u>the</u> correct model, but the pattern of results does not seem to provide much additional information.

In short, the data do not permit us to drop either Model I or Model II as distinctly inferior to the other. We are thus unable to say anything about the appropriate scale variable or, more generally, about the way outputs interact to determine cost. Accordingly, we concentrate on inferences consistent with all four sets of estimates.

Table 2 presents the estimates of the α_j from all four models, along with standard errors and precision-weighted means for summary purposes.[20] Only four of these estimates, all produced by model II.4 for minor media, are negative. Aside from those estimates, all of which have very large standard errors, there is considerable agreement among alternative specifications as to the pattern of differences among media. The substantial difference between the limiting costs associated with newspapers and television is of particular interest and is discussed further below. The differences among the minor media (compare business and farm publications in particular) would seem to confirm our fear that aggregation might be misleading.

Insert Table 2 Near Here

Inspection of the estimated β's and γ's from our four specifications does not provide much information about the importance of scale economies. Accordingly, we present instead estimates of the Z* and D* statistics developed in Section 3, along with their asymptotic standard errors.[21]

Table 3 gives the estimates of Z*, minimum efficient agency gross income, from Model I. As before, we summarize with precision-weighted means. In order to permit comparisons with the results from Model II, these means are translated into media incomes using the mean shares given in Table 1. The corresponding estimates from Model II, in which Y_j replaces Y as the scale variable for medium j, are given in Table 4.

Insert Tables 3 & 4 Near Here

All specifications indicate that scale economies in the four major media are essentially exhausted by agencies with gross incomes of less than a million dollars. (A gross income of $1 million corresponds to total billings of about $6.7 million.) Advertising Age (1978) reports that 240 agencies had gross incomes above a million dollars in 1977 and thus had very likely exhausted all scale economies associated with the four most important media. Because of the tendency of large agencies to have disproportionately more television-related income than small agencies, one might expect television to show especially important economies of scale. But the results in Tables 3 and 4 are not consistent with this expectation. The Z*'s for television, general magazines, and newspapers cannot be confidently ordered on the basis of our results. It appears that any scale economies associated with radio are exhausted at very small output levels, and there is reason to doubt (see models I.3 and II.3) that any such economies exist.

The Model I estimates in Table 3 show exhaustion of scale economies at small agency size for the minor media as well as for the major media. The minor-media statistics from Model II, which are much less reliable because of the large number of incorrectly-signed estimates, are somewhat more suggestive of the possibility of non-trivial economies of scale.[22] Such economies would be consistent, at least, with the large number of agencies receiving no income at all from each of the minor media. (See Table 1.) But this same fact makes these estimates particularly unreliable. In any case, only one Model II estimate in Table 4 implies that an agency would need to have much over a million dollars in gross income, on average, in order to exhaust all economies of scale. The results in Tables 3 and 4 do not permit one to compare Z*'s among the minor media with any confidence.

Even though economies of scale appear to be relatively unimportant in the sense that many (over 200) U.S. advertising agencies are apparently large enough to have exhausted them, it does not follow that very small agencies do not operate under significant scale-related cost disadvantages. Table 5 presents estimates of D*, the cost penalty borne as a consequence of operating at one-half minimum efficient scale (Z*), for each medium from our four models.[23] On the whole, these estimated penalties are substantial in absolute terms and large relative to similar estimates in the literature for other industries.[24] Among the major media, it appears that penalties for operation at very small scale are more important for television and general magazines than for newspapers and radio. (Again, there are reasons to doubt the existence of any scale economies for radio.) The results for the minor media do not seem to permit any statements about relative values of D* to be made with much confidence.

Because the S_j are imperfect measures of gross income shares, and the Y_j reflect those imperfections, the estimated differences among media shown in Tables 2 - 5 must be interpreted with caution. If, for some medium, the ratio of S_j to the corresponding share of gross income is negatively correlated with agency size, the increase in Y_j with agency size will be understated, and scale economies will tend to be underestimated as well.[25] If this happens for some media, however, it follows that scale economies associated with other media will be understated on average. Since we find that scale economies for all media are essentially exhausted at gross incomes of around a million dollars, systematic errors in the S_j are unlikely to have biased our overall conclusions regarding minimum efficient agency sizes.[26] Similarly, one must treat differences in the D* estimates in Table 5 with caution, but the general pattern of substantial cost penalties for small-scale operation is unlikley to be affected by measurement problems with the S_j.

Insert Table 5 Here

V. DISCUSSION

Our results indicate that larger agencies derive larger shares of their billings from media with lower unit costs. The media mix effect on total costs is apparently quantitatively important. Neglecting any scale effects, we can use the regression coefficients given in Table 1 along with the precision-weighted α's from Table 2 to examine the impact of size-related shifts in client media mix on agency costs. We find that an agency that increases its gross income by one standard deviation over the sample mean (from Y = 4.90 to Y = 19.02) can expect a fall of 2.00 in U. This is about 6.7% of the sample mean of that variable and thus appears likley to have a substantial effect on agency profits.

Our medium-specific cost function estimates do not suggest a satisfactory explanation of scale-related changes in media billing shares. The computations described in the preceeding paragraph are dominated by the effects of a general rise in the share of television and a general fall in the share of newspapers as agency size increases. But we do not find scale economies in television to be more important than those associated with newspaper advertising, so it is not clear that large agencies do more television because they have a comparative cost advantage in that medium.

A tentative explanation of these scale-related differences in media mix and unit cost is suggested by Porter's (1976) discussion of differences among media. Briefly, Porter argues that the size of the "effective threshold," the minimum level of advertising expenditure required, varies by medium because of differences in their "divisibility" with respect to the size and characteristics of the audiences they reach. National media, such as network television, are highly indivisible and thus useable mainly by large, national advertisers. At the other extreme, newspapers are highly divisible because their audiences are confined to small geographic areas, and their correspondingly low effective thresholds make them attractive to small advertisers. Other media fall somewhere between these extremes. If larger advertisers use less divisible media, agency media mixes should reflect the sizes of their clients' advertising budgets.

To pursue these ideas, we obtained a count of the number of accounts served by 87 of the 91 agencies in our sample.[27] Regressing the logarithm of agency gross income (Y) on the logarithm of the number of accounts per agency (A), we obtained the following results:

$$\ln(Y) = -3.620 + \underset{(.125)}{1.179} \ln(A) + \varepsilon \qquad R^2 = .510 \quad SE = 1.125$$

Based on the standard error of the slope coefficient (shown in parentheses), we can reject the hypothesis that that coefficient equals unity at the 10% level on a one-tailed test. This indicates that larger agencies tend to have larger accounts than smaller agencies, not just more accounts. (Number of accounts per agency in our sample varied from 2 to 339 with a mean of 34.17, while gross income per account varied from $4,000 to $418,000 with a mean of $86,520.)

Table 6 shows the results of regressing each of the S_j on the logarithm of gross income per account (Y/A) for each agency. For only two media, television and general magazines, do we find that increases in mean account size are associated with increases in the corresponding share of billings, and the coefficient for general magazines is insignificant. For the remaining six categories, for which billings share was negatively related to mean account size, three of the corresponding coefficients (those for newspapers, radio, and business publications) are significant at the 10% level or beyond. These patterns seem quite consistent with Porter's arguments about effective thresholds and divisibility.

Insert Table 6 Here

These results suggest that size-related differences in agencies' media mixes may be determined more by size-related differences in client characteristics than by any advantage arising from economies of scale. Larger agencies tend to serve advertisers who compete in large geographically extensive markets and who accordingly make heavy use of national media such as network television and general magazines. In contrast, small agencies primarily serve firms that operate in markets of more limited scope and that efficiently spend their smaller budgets in local or specialized media such as newspapers, radio, and business publications. One would expect agencies considered to be especially effective, for reasons unrelated to scale economies, to attract large clients and thus grow large themselves. Large clients should be willing to pay a premium to deal with such agencies, and those premia may show up here as scale-related unit cost declines generated by media mix effects. Another important factor at work here is the industry norm of an agency not serving competing accounts -- i.e., products/services that compete directly with one another. We hasten to add that our evidence for the above explanation is less than conclusive. Better tests might be obtained if we could distinguish between network and spot shares for radio and television and between national and regional shares for magazines.

VI. CONCLUSIONS AND IMPLICATIONS

To our knowledge, this is the first econometric study of advertising agency cost functions. Clearly, there is more useful work to be done here. Data limitations constrained our choice of specifications and made it impossible for us to reach any conclusions on a number of questions. In particular, we were not able to learn anything about the way in which agencies' media mixes (or levels of output of advertising in the various media) interact with overall scale to determine unit costs, and our results on medium-specific scale effects must be treated with caution. Our two extreme models seem roughly equally consistent with the data. We encountered multicollinearity-like computational problems and obtained generally imprecise paramater estimates for the minor media. Availability of data from the American Association of Advertising Agencies' annual studies would likely permit some of these problems to be overcome.[28]

On the other hand, our empirical analysis does suggest a number of conclusions with interesting implications for marketing and economics. First, economies of scale are exhausted at output levels small relative to many existing agencies. In particular, over 200 U.S. agencies were large enough in 1977 to have realized essentially all scale-related efficiencies.[29] Second, very small agencies (with gross incomes under, say $0.5 million in 1977) may have substantial scale-related cost disadvantages relative to larger agencies. Third, agencies' costs appear to be sensitive to the mix of media in which their clients advertise. While measurement problems associated with the S_j and the Y_j call for caution here, the highly significant test results shown in Figure 2 for both our polar-case Models argue strongly for the presence of media mix effects. Moreover, the asymptotic unit cost estimates in Table 2 do not differ noticeably among alternative specifications that should be affected differently by the media share measurement problem, and they are generally consistent with the impressions of industry observers. Finally, larger agencies tend to derive larger shares of their billings from media with lower unit costs than do smaller agencies. Further examination of this matter led us to suggest that 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 arising from economies of scale.

These conclusions have implications for a number of the controversies discussed in the introduction. First, our results suggest that, contrary to a good deal of discussion in the trade press, mergers among the top 200 or so U.S. agencies are unlikely to yield efficiency gains based on scale economies. Second, if all scale economies were account-specific, our estimates suggest that up to billings of around $6.7 million in 1977 dollars, large accounts would be cheaper to handle than small accounts on average.

Our data do not permit us to say anything about the plausibility of this conjecture. Third, economies of scale do not seem sufficient to explain the low incidence of "in-house" advertising agencies. Model I implies that firms spending more than $7 million on advertising (in 1977 dollars) should be able to operate fully-efficient in-house agencies, though firms with substantially smaller budgets would have substantially higher costs. Model II implies that even firms with budgets well below $7 million concentrated in a few media can fully exploit available scale economies. Fourth, scale economies in advertising agencies do not seem sufficiently important to be a major source of economically significant scale economies in advertising generally. Finally, the analysis of Section V provides some clues about the nature of competitive interactions among agencies, though the picture that emerges there must be regarded more as an attractive hypothesis than as a definite conclusion.

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Footnotes

1. Bojanek (1980) presents a history of agency merger activity and an analysis of publicly-stated rationales for agency mergers. See also Berstein (1979) and Zeltner (1979).

2. Sethi (1975) provides background and analysis.

3. For a survey, see Comanor and Wilson (1979).

4. Findings from a study of profit and employees in relation to gross income revenue for agencies of various sizes conducted by Rubel and Humphrey, Inc. are summarized in Advertising Age (1979). The results presented there suggest that scale economies may not be exhausted by agencies with 6 million dollars in gross income in 1978. (Using the standard 15% compensation formula, this corresponds to total billings of about 40 million dollars.) However, no allowance is made for media mix effects, nor are tests of significance presented or any breakdown of agencies with gross incomes above 6 million dollars given.

5. Advertising Age (1981) presents some summary tabulations from a survey of agency salaries carried out be Rubel and Humphrey in 1978. Those results (p. 99) show a tendency for average salary per employee to increase with agency size. Informed industry sources indicate that this is largely a reflection of the tendency of large agencies to be located in large, high-wage metropolitan areas. It does suggest, though, that we may over-estimate the importance of scale economies by taking number

of employees as a proxy for cost. It is also worth noting, however, that reported salary expenses for incorporated agencies may be significantly increased because firms seek to avoid double-taxation of dividends.

6. It bears noting that detailed data on the structure of agency income and costs do exist from separate cross sectional surveys of agencies conducted annually by the American Association of Advertising Agencies and tri-annually by Rubel and Humphrey. Although highly aggregated summaries appear regularly in Advertising Age (e.g. 1979, Marshall 1981), both studies are proprietary. Despite several efforts, we have been unable to gain access to these data. Hopefully, at some future time, these organizations will see fit to make their unique data available for statistical analyses.

7. In particular, conversations with industry participants do not suggest a tendency for cost/employee to vary systematically with media mix.

8. We are indebted to Crain Communications, Inc. for permission to use these copyrighted data which appeared in the March 13, 1978 issue of Advertising Age.

9. Details pertaining to how these agencies were selected are not reported. Mention is made of the fact that "more than 125 agencies" returned questionnaires that were incomplete and therefore were excluded from the listing (O'Gara 1978, p. 38).

10. Data from the 1977 Census of Business reported in Advertising Age indicates that 5,973 agencies were operating in 75 standard metropolitan areas, and employed a total of 70,043 persons or an average of 11.73 employees per agency.

11. We also regressed media share (S_j) on gross income (Y) itself, but the semi-log specification generally had more explanatory power.

12. For a survey, see Scherer (1980, ch. 4).

13. That is, suppose $U = a + bZ + cZ^2$. If average cost is declining with Z for Z near zero, b must be negative. But then U must be negative for large Z if c is non-positive or there must be diseconomies at large scales if c is positive. The empirical work surveyed in Scherer (1980, ch. 4) suggest that such diseconomies are rare indeed.

14. Bojanek (1980) reports some generally unsatisfactory experiments with this specification.

15. See, for example, Scherer (1980), pp. 96-7.

16. For the sorts of specifications that might be employed to obtain such estimates, see, for instance, Caves, Christensen and Tretheway (1980). Baumol, Panzar and Willig (1982, ch. 4) provide a useful discussion of economies of scope and other multi-product cost concepts.

17. Because estimation is nonlinear, hypothesis tests have only asymptotic validity. One could thus employ chi-squared tests, which effectively treat the standard error of the unrestricted model as known for certain. We have chosen instead to use F-tests, which are asymptotically equivalent and reflect both models' degrees of freedom (though not necessarily appropriately) in finite samples.

18. We also attempted to use their J-test but, as they predicted, ran into insurmountable computational problems.

19. The test statistic is the ratio of a regression coefficient to its standard error. Asymptotically, this statistic follows a standard normal distribution under the null hypothesis, and only the asymptotic properties of this test are known exactly. Consistent with the discussion in footnote 17, above, however, we follow the conservative procedure of reporting significance levels derived from a two-tailed t-test, with 69 degrees of freedom.

20. As nonlinear estimation has been employed, the standard errors have asymptotic significance only. The precision-weighted average would be the minimum variance unbiased pooled estimator if each specification provided an independent, unbiased estimate with known sampling variance. It is clearly inappropriate to treat these estimates as independent, however, so that the precision-weighted average serves here merely as a convenient summary statistic that reflects estimation precision in a natural way.

21. The latter were computed following the (standard) procedure clearly described by Goldberger (1964, pp. 122-5).

22. All the precision-weighted means in Table 4 are below the corresponding mean Y_j's except for outdoor media, direct mail, and farm publications.

23. It should be noted that the constraint $\beta_j = \beta$ for all j that is imposed in models I.4 and II.4 causes the relative values of the medium-specific D*'s from those models to depend only on the estimated α's; larger α's imply smaller D*'s from (3).

24. See, for instance, Scherer (1980, pp. 96-7).

25. Recalling the discussion in Section II, since television's share of billings tends to increase with agency size, while the ratio of billings to gross income decline with size, this sort of underestimation is most likely for television. Conversations with industry observers lead us to expect that disaggregation of the television share into network and spot components would likely reveal significant scale economies associated with network television advertising, along with a lower α than we find for television as a whole.

26. It is worth noting that Model I.1, which does not employ the S_j or the Y_j in any fashion, produces an estimated Z* of $.932 million. A comparison with the estimates in Table 3 suggests that this figure, which supports our overall conclusions about minimum efficient scale, is too large because it confounds media mix and scale effects.

27. See footnote 6.

28. As the discussion in footnote 5 indicates, there is some likelihood that our estimates overstate the general importance of scale economies in this industry.

29. Counts were made from the lists of agency accounts reported in the Standard Directory of Advertising Agencies (1978).

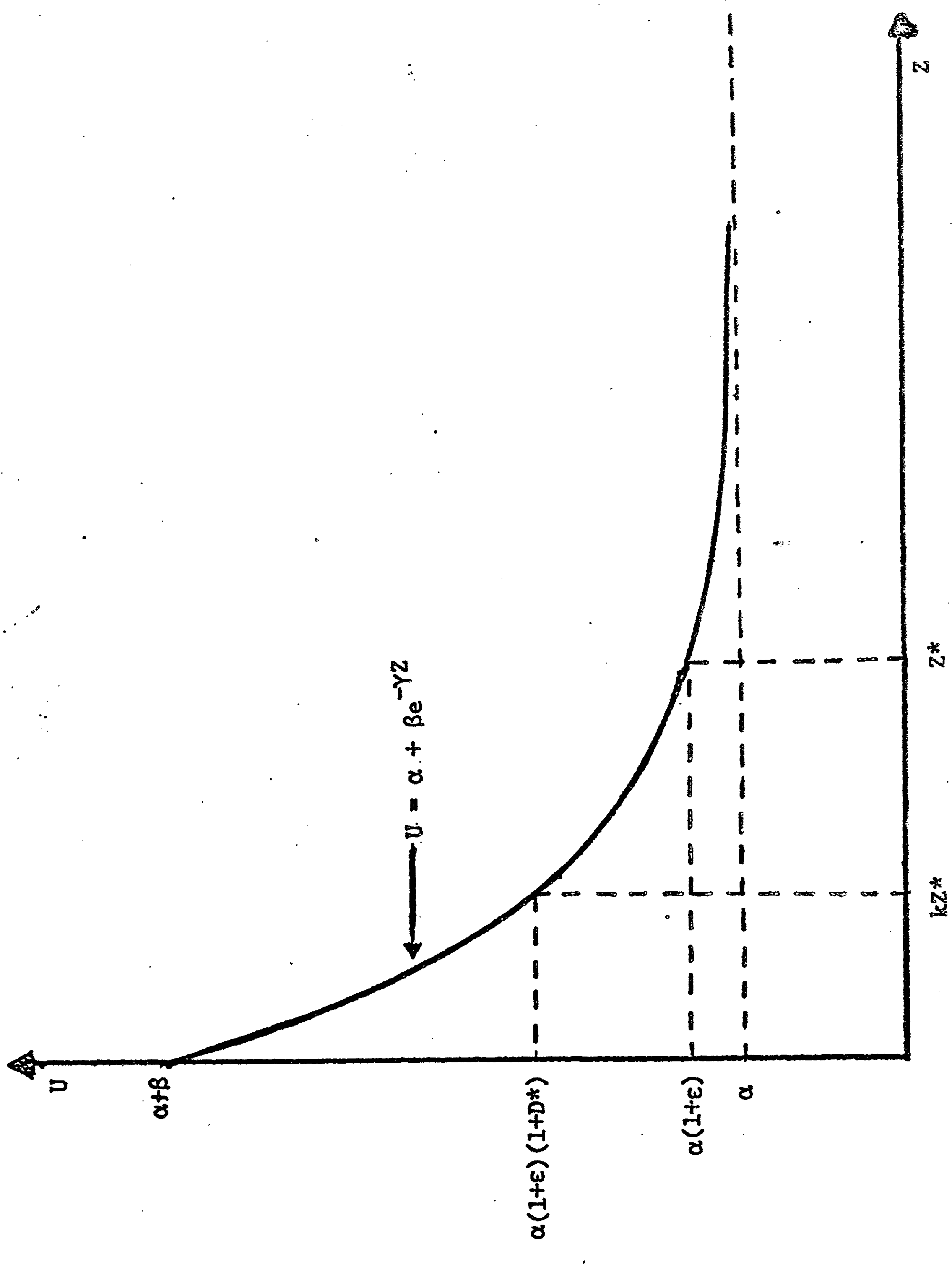

Fig. 1. — Basic Exponential Cost Function

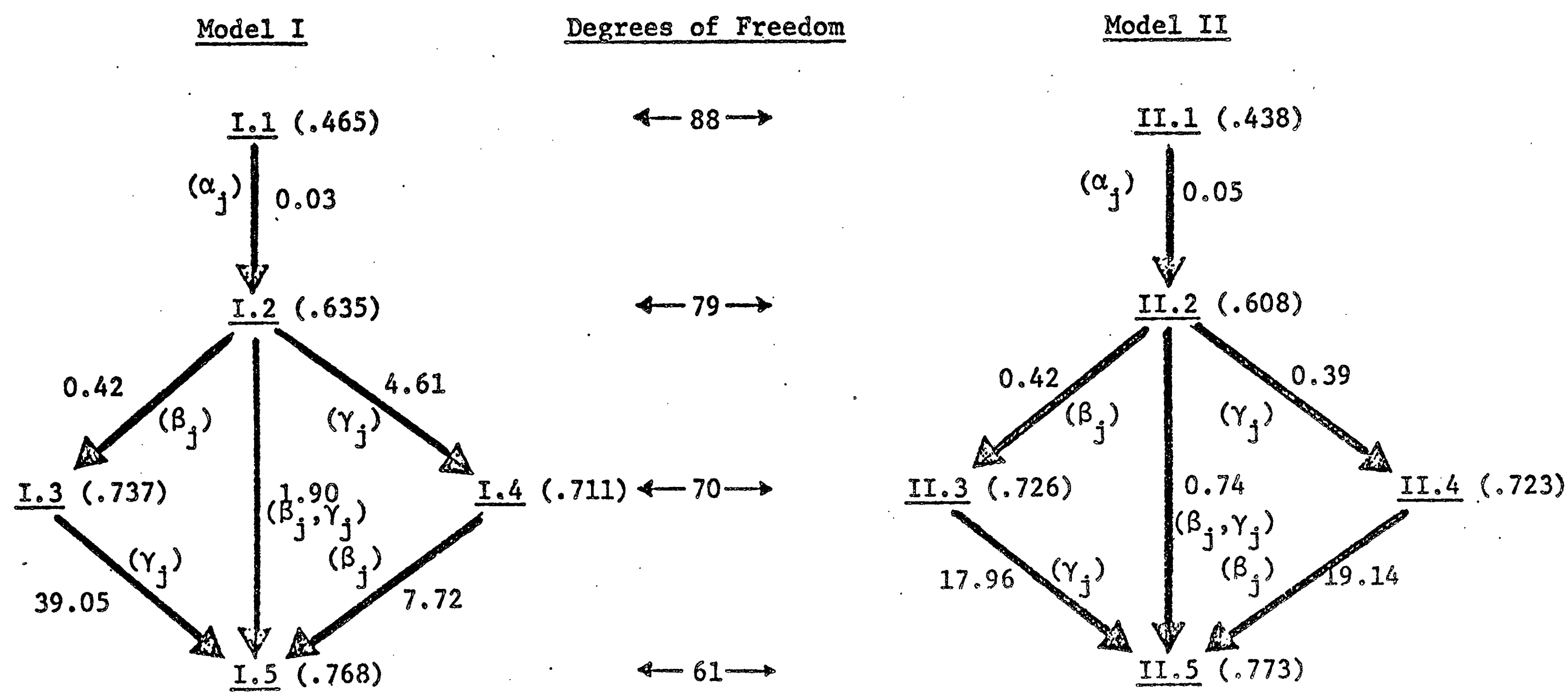

Fig. 2. — F-tests of Nested Specifications

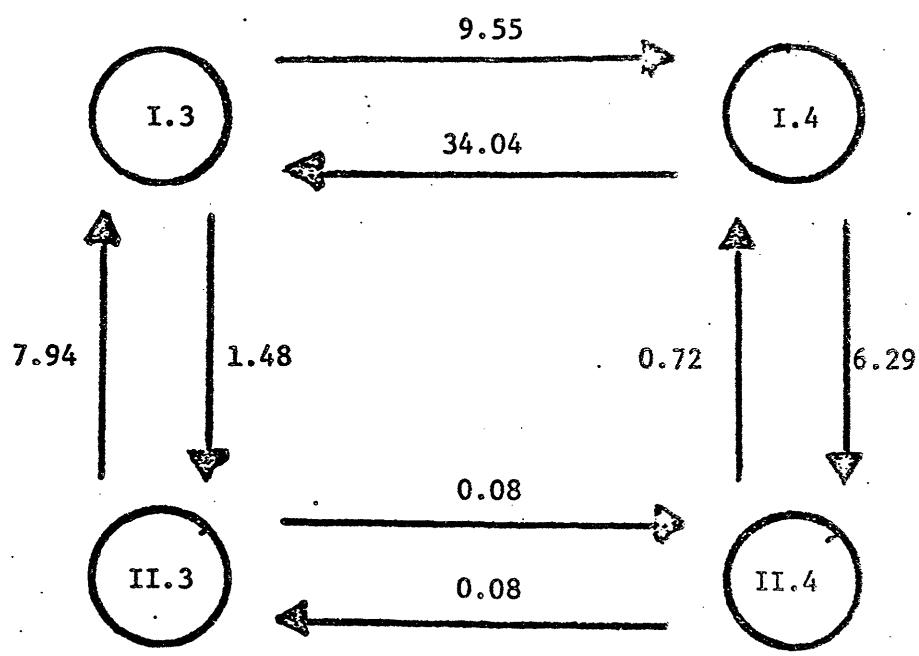

Fig. 3. -- Non-Nested Specification Tests

Table 1

SUMMARY SAMPLE STATISTICS FOR SHARE OF BILLINGS BY MEDIA CATEGORY
(n = 91)

Medium	Mean Share (%)	Estimated Share (%) of Total Sample's Gross Income †	Regression Results*	Number of Zero Shares	Maximum Share (%)
Television	25.57	48.65	.077[b] (5.91)	13	79.0
General Magazines	17.10	17.61	-.0003 (0.03)	9	100.0
Newspapers	14.74	9.52	-.025[b] (2.87)	4	86.0
Radio	12.60	9.50	-.013[a] (1.80)	10	55.0
Other	10.83	7.62	-.011 (0.96)	35	83.0
Business Publications	9.55	3.55	-.008 (0.87)	32	75.0
Outdoor	2.84	1.95	.001 (0.38)	36	45.0
Point of Purchase	1.30	0.67	-.002 (1.19)	65	18.0
Direct Mail	3.12	0.54	-.010 (1.56)	77	60.0
Farm Publications	2.33	0.39	-.008 (1.58)	74	60.0
		99.97			

*Slope coefficients, with t-statistics in parentheses, for simple regressions of media shares on the natural logarithm of gross income (Y). Superscripts denote coefficients significantly different from zero at 10% (a) and 1% (b) levels (two-tailed t-tests).

† Computed for media category, j as $\sum_i S_{ij}Y_i \Big/ \sum_i Y_i$, where the summation is over the 91 agencies in our sample. Does not add to 100 percent due to rounding.

Table 2

ESTIMATES OF ASYMPTOTIC UNIT COSTS (α's)*

Medium	Specification I.3	I.4	II.3	II.4	Precision-Weighted Mean†
Television	17.89 (3.00)	19.57 (3.19)	17.58 (2.96)	16.74 (2.99)	17.89
General Magazines	9.85 (5.28)	8.90 (7.67)	14.98 (4.36)	15.22 (4.46)	13.21
Newspapers	41.08 (9.90)	40.02 (14.18)	35.53 (9.64)	48.73 (6.18)	43.68
Radio	44.96 (8.62)	40.29 (7.46)	39.33 (7.92)	33.35 (7.54)	38.52
Other	28.01 (4.66)	26.57 (7.32)	30.50 (4.73)	-186.78 (98.93)	28.58
Business Publications	15.30 (6.19)	16.55 (6.22)	16.92 (6.01)	12.43 (5.68)	15.19
Outdoor	51.08 (14.67)	53.23 (14.98)	56.40 (14.47)	43.74 (15.28)	51.27
Point of Purchase	67.54 (36.06)	56.69 (37.58)	53.79 (29.22)	-236.17 (116.29)	50.55
Direct Mail	41.59 (11.47)	31.27 (8.23)	39.81 (9.28)	-209.17 (99.11)	35.76
Farm Publications	52.22 (15.03)	39.93 (9.92)	66.21 (14.06)	-200.74 (100.79)	48.22

* In employees per million dollars of gross income. Figures in parentheses are asymptotic standard errors.

† Weighted average across all specifications, using reciprocals of squared standard errors as weights.

Table 3

MINIMUM EFFICIENT AGENCY SIZES (Z*): MODEL I*

Medium	Specification I.3	Specification I.4	Precision-Weighted Mean†	Corresponding Medium Income‡
Television	0.700 (0.331)	0.044 (0.009)	0.045	0.012
General Magazines	0.629 (0.206)	0.802 (0.444)	0.660	0.113
Newspapers	0.550 (0.234)	0.592 (0.467)	0.558	0.082
Radio	0§	0.032 (0.005)	0.032	0.004
Other	0.622 (0.235)	1.646 (1.448)	0.649	0.070
Business Publications	0.708 (0.347)	0.518 (0.250)	0.583	0.006
Outdoor	0.685 (0.295)	4.070 (1.074)	0.923	0.026
Point of Purchase	0.537 (0.512)	0.405 (1.514)	0.523	0.007
Direct Mail	0§	0.051 (0.005)	0.051	0.002
Farm Publications	0§	0.064 (0.010)	0.064	0.001

* Estimated agency gross income, in millions of dollars, at which medium specific unit cost is 1% over its limiting value, computed using eq. (2) with $\varepsilon = 0.01$. Figures in parentheses are asymptotic standard errors.

† Computed as in Table 2

‡ Precision-weighted means multiplied by mean media share from Table 1.

§ Estimated β negative, implying decreasing returns to scale everywhere.

Table 4

MINIMUM EFFICIENT MEDIUM INCOMES (Z*): MODEL II*

Medium	Specification II.3	Specification II.4	Precision-Weighted Mean†	Corresponding Agency Size ǂ
Television	0.038 (0.007)	0.043 (0.020)	0.039	0.152
General Magazines	0.038 (0.006)	0.050 (0.035)	0.039	0.228
Newspapers	0.026 (0.011)	0.029 (0.021)	0.026	0.176
Radio	0§	0.008 (0.015)	0.008	0.063
Other	0§	-#	-	-
Business Publications	0§	0.108 (0.051)	0.108	1.131
Outdoor	0.029 (0.005)	0.145 (0.125)	0.029	1.021
Point of Purchase	0.029 (0.008	-#	0.029	2.231
Direct Mail	0.036 (0.006)	-#	0.036	1.154
Farm Publications	0.026 (0.018)	-#	0.026	1.116

* Estimated medium-specific income, in millions of dollars, at which medium-specific unit cost is 1% over its limiting value, computed using eq. (2) with $\varepsilon = 0.01$. Figures in parentheses are asymptotic standard errors.

† Computed as in Table 2.

ǂ Precision-weighted average divided by mean media share from Table 1.

§ Estimated β negative, implying decreasing returns to scale everywhere.

\# Estimated α negative, Z* undefined.

Table 5

COST PENALTY INCURRED AT HALF EFFICIENT SCALE (D*)*

Medium	Specification				Precision-Weighted Mean†
	I.3	I.4	II.3	II.4	
Television	27.76 (15.75)	16.78 (2.50)	106.98 (26.70)	36.44 (8.24)	19.16
General Magazines	19.47 (12.28)	25.35 (11.69)	108.03 (24.93)	38.27 (9.09)	34.41
Newspapers	12.99 (5.48)	11.43 (2.20)	21.60 (24.59)	20.95 (5.12)	13.75
Radio	-‡	11.39 (1.91)	-‡	25.53 (5.99)	12.70
Other	18.84 (3.61)	14.26 (2.46)	-‡	-#	15.71
Business Publications	29.01 (18.58)	18.33 (4.21)	-‡	42.44 (11.74)	21.45
Outdoor	25.87 (10.74)	9.78 (2.10)	31.72 (11.81)	22.16 (6.11)	12.11
Point of Purchase	12.16 (26.29)	9.45 (3.43)	34.84 (25.04)	-#	9.95
Direct Mail	-‡	13.07 (2.39)	76.77 (12.61)	-#	15.28
Farm Publications	-‡	11.45 (1.99)	24.24 (56.75)	-#	11.47

* Excess cost, expressed as a percentage, incurred at one-half minimum efficient scale, computed using eq. (3) with $\varepsilon = 0.01$ and $k = 0.5$. Figures in parentheses are asymptotic standard errors.

† Computed as in Table 2.

‡ Estimated β negative, implying decreasing returns to scale everywhere, D* undefined.

\# Estimated α negative, D* undefined.

TABLE 6

RESULTS FOR REGRESSIONS OF SHARE OF AGENCY BILLINGS IN EACH MEDIA CATEGORY ON THE LOGARITHM OF MEAN SIZE OF AGENCY ACCOUNTS*

(n = 87 agencies)

$$S_j = \alpha_j + \beta_j \ln(\text{Income/Acct.}) + \varepsilon_j$$

Dependent Variable: Share of Agency Billings in Media Category j(S_j)	Regression Results			
	Constant Term	Coefficient for Log Mean Account Size**	R^2	Std. Error of Est.
Television Share	0.643	.122[c] (6.38)	.324	.201
General Magazines Share	0.188	.006 (0.39)	.002	.172
Newspaper Share	-0.003	-.047[c] (3.94)	.154	.125
Radio Share	0.066	-.020[a] (1.79)	.036	.116
Outdoor Share	0.026	-.001 (0.22)	.0006	.059
Business Publications Share	0.011	-.027[b] (2.08)	.048	.136
Point of Purchase Share	0.0003	-.004 (1.43)	.024	.030
Farm Publications Share	0.003	-.006 (0.76)	.007	.085
Direct Mail Share	0.023	-.001 (0.11)	.0001	.084
Other Share	0.042	-.023 (1.11)	.014	.215

* Mean size of an agency's accounts measured in units of millions of dollars of Gross Income per account. Based on data for 87 agencies.

**t-statistic in parentheses. Superscripts denote coefficients significantly different from zero at 10% (a), 5% (b), and 1% (c) levels (2-tailed test).