# Revisiting the Advertising - Concentration Issue

By

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Increases in advertising efforts are reasonably well documented among most U.S. industries [Nelson, p.43]. Yet the economic controversy relating to the causal linkage between advertising intensity and changing market structures has by no means been settled. Advertising can represent a major barrier to entry via its role in achieving product differentiation. In contrast advertising may enhance competition with the dissemination of information through competitive advertising. While the advertising issues are varied and complex, this paper will setforth additional empirical evidence showing the relationship between advertising intensity and changing industry structure. In particular, the intensity of advertising across industry levels of concentration will be addressed and reference given to the food industries.

Studies suggesting that advertising leads to increased concentration have at the best been mixed [Blair]. The argument suggesting that the advertising intensity varies positively (or negatively) with concentration has been slightly more definitive. Schmalensee argued that as concentration increases and profits rise, the marginal unit of sales becomes more profitable and it pays more to advertise to capture these additional sales [Mann, p.150]. Strickland and Weiss developed a simultaneous equa-

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tion model with one equation relating advertising intensity to concentration where both variables are endogenous. Their analyses show that little bias is evident when the advertising intensity equation is estimated as a single equation in contrast to the simultaneous equation results [p.1116]. Since the primary focus of this analysis is to gain a better understanding of changing advertising intensity, the relationship is estimated in a single equation framework relying on Strickland and Weiss's conclusions as to the degree of bias that may occur.

The basic arguments for concentration influencing advertising intensity are: (1) with increased concentration, firms recognize their rival's advertising reaction curve and will thus decrease their advertising effort on the assumption that it only has a neutralizing effect on the rival's advertising, or (2) with increased concentration firms will substitute nonprice competition via advertising for price competition. The second argument implies a positive association between advertising and concentration, while the first argument suggests a negative relationship. These effects in turn lead to the public policy dialogue concerning the net social benefits derived from price versus nonprice competition. In this article we provide further evidence on the advertising-concentration linkage, deferring the net benefits to later papers.

Advertising-Concentration Linkage

Dorfman-Steiner's studies of price and nonprice decisions provide a clear linkage establishing the static optimal advertising decision rule to be related to both price and nonprice decisions [Needham, p.87; Ward, p.500]. If $\varepsilon_a$ and $\varepsilon_d$ are the firm's elasticities of advertising and de-

mand, then $A/S = \varepsilon_a / |\varepsilon_d|$ according to the static rule.

The current issue is how the advertising intensity (A/S) changes with industry concentration (C) and how concentration influences both $\varepsilon_a$ and $|\varepsilon_d|$. The advertising and concentration relationship is obviously confounded in the effect concentration has on both elasticities. If concentration leads to greater economies of scale to advertising and increased product differentiation (i.e., $\partial\varepsilon_a/\partial C > 0$) and a corresponding reduction in substitutes (i.e., $\partial|\varepsilon_d|/\partial C < 0$), then it always follows that advertising intensity will increase with concentration. The adjustments in $\varepsilon_a$ and $\varepsilon_d$ are not altogether clear, however.

The firm's advertising elasticity has further been shown to be related to the rival's advertising response [Needham, p.85]. Assuming that the industry structure is such that rival response is not apparent, then the arguments for a neutralizing and/or retalitory advertising response are not relevant. However, as concentration increases anticipated rival response can not go unnoticed.

The concentration-intensity linkage is further confounded when one turns to the effects of concentration on the elasticity of demand. Price elasticity of demand is related to the rival's response and this response is influenced by the level of concentration. With no rival response it is relatively easy to show that the firm's demand becomes less elastic with increased concentration. If increased rival response to firm price changes is anticipated, advertising will be substituted for price competition. However, as concentration increases, rival impact may be lessened and the need to substitute nonprice for price competition would be reduced.

The problem with hypothesizing the advertising-concentration relationship is illustrated in table 1 where the alternatives signs for $\partial(A/S)/\partial C$ are shown. Given the difficulties in determining the signs from the effects of concentration on $\varepsilon_a$ and $\varepsilon_d$, an alternative would be to directly estimate the relationship between advertising and concentration. The empirical results may then suggest the relative importance of $\varepsilon_a$ and $\varepsilon_d$ to the advertising-concentration issue.

Table 1. Hypothesized effects of concentration on advertising intensity $[\partial(A/S)/\partial C]$.[a]

| $\partial\lvert\varepsilon_d\rvert/\partial C$ | $\partial\varepsilon_a/\partial C$ | | |
|---|---|---|---|
| | + | 0 | − |
| + | ? | − | − |
| 0 | + | 0 | − |
| − | + | + | ? |

[a]The signs within the table follow from the relationship where $\partial(A/S)/\partial C = (1/\lvert\varepsilon_d\rvert)\{\partial\varepsilon_a/\partial C - (A/S)\partial\lvert\varepsilon_d\rvert/\partial C\}$ as derived using the Dorfman-Steiner theorem.

Advertising-Concentration Model

The analysis from the above section indicates that the advertising-concentration relationship will ultimately depend on empirical models. To date mixed results have been reported when estimating the model where $A/S = f(C)$ [Mann, p.142-156]. While the theoretical problems cannot be compromised, much of the difficulties with previous studies can be related to model mispecification, incompleteness in data classification,

and inappropriateness of the estimation techniques. Recent studies by Ornstein have addressed the empirical problems of relating advertising and concentration. His studies show a positive but statistically weak relationship between concentration and advertising. Additional studies by Brush provide support for the validity of the data series developed by Ornstein.

For the present problem concentration and advertising data are taken from the SIC for four digit industries. The value of shipments of the top four firms relative to total shipments is used as a measure of concentration and the advertising data from Ornstein's study are used [p.45]. Shepherd provided an adjusted data series for the 1966 four firm concentration ratios for the purpose of correcting what was believed to be a problem with the data similar to that used by Ornstein. Brush's studies of Ornstein's models using the corrected data led him to conclude that..."correction of errors in the official Census concentration ratios has had little effect on the statistical estimation of the advertising concentration relationship"...[p.985]. For this reason, the initial data reported by Ornstein will be used. The advertising and concentration levels are measured across industries and the SIC codes are classified according to consumer versus producer goods, and durable versus nondurable goods. Many of the consumer nondurables are food industries. The cross sectional data of four digit industries are recorded over the years of 1947, 1963, and 1967.

Both Ornstein's and Strickland and Weiss' models are specified such that the intensity may decline with high levels of concentration. Ornstein's results supporting a declining intensity are statistically

weak. Whereas, while Strickland and Weiss' statistical results are strong, there appears to be some difficulty with changes in the signs of their advertising relationship as they change the specification of their model [p.1116]. In the current model, the specification facilitates a nonlinear relationship initially assuming that the effect of concentration at least approaches some upper limit. The alternative where the intensity may decline is considered. The asymptotic function follows as the adjustments in $\varepsilon_a$ and $|\varepsilon_d|$ can be expected to approach limits such that $\lim \partial\varepsilon_a/\partial C = 0$ and $\lim \partial|\varepsilon_d|/\partial C = 0$.

The response to concentration may differ across industries simply because of the differences in both advertising and price elasticities for particular product categories. Finally, there may be reason to suspect that advertising intensity has increased since 1947 as a partial result from increased availability of advertising media. Each of the adjustments above have been ignored in most model specifications or at least have been treated in separate models.

Using the above arguments, the model specification below can be used to test the advertising - concentration relationship.

$$(1) \qquad \frac{A}{S} = \exp^{\{\tau_0 + \tau_1/C + \mu\}}$$

where $\tau_0 = \beta_0 + \beta_1 PRO + \beta_2 DUR + \beta_3 T_1 + \beta_4 T_2$,

$$\tau_1 = \alpha_0 + \alpha_1 PRO + \alpha_2 DUR + \alpha_3 T_1 + \alpha_4 T_2,$$

and A/S is the advertising-sales ratio (i.e., $0 \leq A/S \leq 100$)[1]; C is the four digit SIC industry classification ($0 \leq C \leq 100$); PRO is the type of good (-1, Producer; +1, Consumer); DUR is a perishability measure (-1, Durable; +1, Nondurable); T is year where ($T_1 = 1$, $T_2 = 0$, for 1947;

$T_1 = 0$, $T_2 = 1$ for 1963; $T_1 = 0$, $T_2 = 0$, for 1967. Note that $\tau_0$ and $\tau_1$ include the effects of PRO, DUR, and T and both the level of advertising intensity and the response of advertising intensity to levels of concentration. Finally, the relationship has the asymptotic property where $\lim_{C \to 100} A/S = \exp^{\{\tau_0 + .01\ \tau_1\}}$ and the limit will directly change depending on the time and product classifications.

Equation (1) is estimated over a sample of 914 observations drawn from the Census of Manufacturing. Industries differ within the four digit classification and, hence, the effect of concentration may vary across industries. Therefore, in addition to the classifications by type and perishability, the concentration parameter may have a random component giving $\alpha_0 + \nu$ where $\nu$ is an error term having the traditional properties. The dummy variables were defined such that both $\beta_0$ and $\alpha_0$ represent some average effect and the differences in type are calculated as some adjustment to this average. The randomness in the concentration coefficient is calculated only for this average and not each parameter in (1). The error in (1) is now $\mu + \nu(1/C)$ and the variance is $\sigma^2_\mu(1 + \rho/C^2)$ letting $\rho = \sigma^2_\nu/\sigma^2_\mu$[Maddala, p.390].

Equation (1) is estimated by maximizing the concentration likelihood function over values of $\rho$ and the results are shown in table 2. The random coefficient model adds little to the analysis since the maximum value of the likelihood function occurs when $\rho = 0$. Pooling the data across four digit concentration levels after explicitly accounting for time, type, and perishability does not create estimation problems that might have been initially expected given the diverse nature of the industries included in the sample.

The statistical results shown in table 1 are probably the strongest to date in support of the relationship between advertising intensity and concentration. The t values for $\alpha_0$ and $\alpha_1$ show the relationship to be significant at the 99 percent confidence level. Furthermore, response among consumer industries is statistically different from those producer goods industries. This difference is of particular interest since much of agricultural manufacturing relates to consumer goods in the form of food and kindred products. No statistical difference between durable and nondurable goods is evident. Finally the coefficient of determination shows that .39 percent of the variation in advertising intensity has been explained. Other factors some of which are likely unique to each industry must be addressed in order to further explain intensity. What is important at this stage in the advertising-concentration dialogue is that the relationship has been established.[2]

Product Classifications

As suggested above, a large number of the nondurable industries relates to food and kindred industries. Attempts, however, to explicitly separate out the advertising intensity relationship for this subset of four digit industries have not proven significant. Rather the broad product class of consumer versus producer goods is the most important distinction. This would be expected since buyers of producer goods should be less susceptible to product image created by advertising [Mann, p.139; Strickland and Weiss, p.1111]. Producer products are purchased in sufficient volume and frequency that the alternatives can be appraised. Also, consumer goods are generally more differentiable. Generally, the number of potential buyers are less for the producer

Table 2. ML estimates of the advertising - concentration relationship with $\rho = 0$[a].

| | | Parameter Estimates | t Statistic |
|---|---|---|---|
| Intercept | $\beta_0$ | .47938 | 4.4040 |
| PRO | $\beta_1$ | .94502 | 13.1690 |
| DUR | $\beta_2$ | .05811 | .8742 |
| $T_1$ | $\beta_3$ | -.95036 | -6.6267 |
| $T_2$ | $\beta_4$ | -.10597 | - .8016 |
| 1/C | $\alpha_0$ | -10.20310 | -4.0863 |
| PRO/C | $\alpha_1$ | -7.14310 | -4.1137 |
| DUR/C | $\alpha_2$ | -1.14322 | -0.7183 |
| $T_1$/C | $\alpha_3$ | 2.8201 | .8711 |
| $T_2$/C | $\alpha_4$ | 1.5114 | .5678 |

$R^2$ = .3982

F(9,904) = 59.82

OBS = 914

[a]The model is estimated as a log-reciprocal equation with the dependent variable A/S (see eq. 1) The concentrated likelihood function was maximized when $\rho = 0$.

versus consumer goods and, hence, the cost of reaching the buyers of producer goods should be less.

When comparing the effects of concentration on consumer versus producer goods, one would intuitively expect the elasticity of demand to change less among those producer versus consumer goods since the product is judged primarily on its characteristics and less on image. Hence, the significance of $\alpha_1$ in table 2 seems plausible from a theoretical perspective. We are still left with the issue of what happens to $\varepsilon_a$ for both product categories. If consumers are more susceptible to the image effect in consumer goods as suggested by Mann, then $\partial\varepsilon_a/\partial C$ for consumer goods is likely to exceed that of producer goods and the advertising intensity for consumer goods should exceed that of producer goods.

The relationship between producer and consumer goods is illustrated in figure 1 for the nondurable category. Obviously advertising plays a small role in the very low concentrated industries regardless of the product category. As concentration increases the advertising intensity rise rapidly for both goods. Beyond the 20 percent level very little increase among producer goods industries is evident. Whereas, advertising continues to rise rapidly for the consumer goods. The durable category is not shown since the relationship does not differ significantly from that shown in figure 1.

Adjustment Over Time

Figure 2 illustrates the adjustments that have taken place since 1947 and the increased use of advertising for each concentration level is most apparent. Advertising intensity has increased and one important consideration is how much increase would have occurred without

any change in concentration. Increased intensity with more concentration suggest substitution of nonprice for price competition. Increased intensity over time holding concentration levels fixed does not preclude the substitution for price competition, but it does indicate that greater effort to establish information flows has occurred.

The changing slopes of each response in figure 2 is of special importance in that they clearly show that the effects of structural change on advertising intensity have increased since 1947. The rate of increase in advertising intensity to increases in concentration nearly doubled between 1947 - 1967. While advertising has become more important to concentrated industries, the results still do not totally show how much of this change represented substitution for price competition. A useful extension of the analysis would be to explore an index of price changes among the same industries included in this study.

Figure 3 is useful for depicting the adjustment that has occurred since 1947, holding all concentration levels fixed at their 1947 values; The vertical axis gives the estimated percentage adjustments that would have occurred due to the time alone and is calculated as:

$$(2)\quad \frac{(A/S)_{67}}{(A/S)_{47}} - 1 = \exp^{-\{\beta_3 + \frac{\alpha_2}{C_{47}}\}} - 1$$

where $C_{47} = C_{67}$ is assumed (see eq. 1).

Advertising intensity would have declined over time for those industries with concentration under two percent. Whereas, for industries having initial concentration levels in excess of three percent, there could be substantial adjustments relative to the 1947 intensity level. Consider the case for C = 20. Advertising intensity would have increased

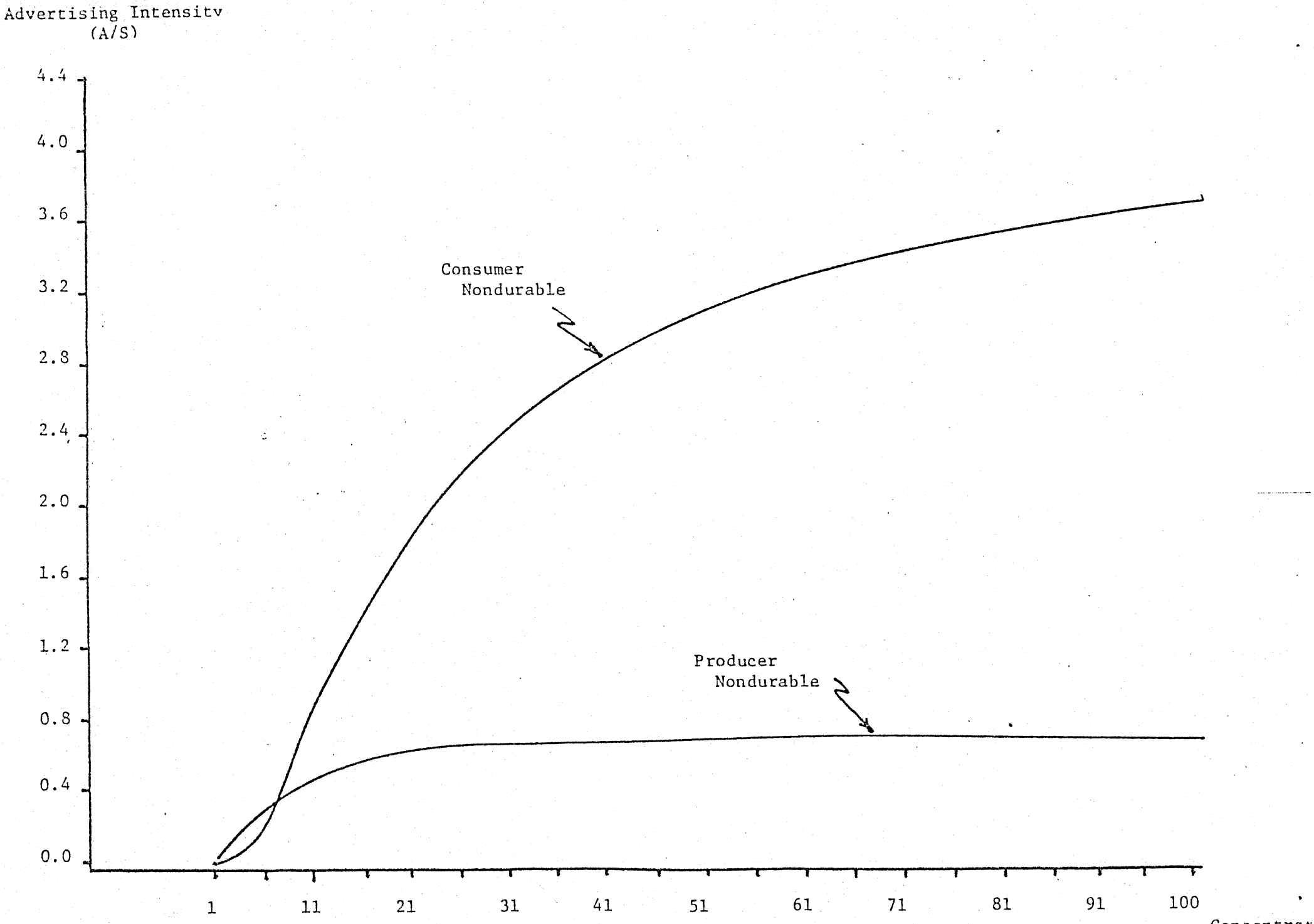


Figure 1. Advertising intensity - concentration relationship for consumer and producer nondurables (1967).

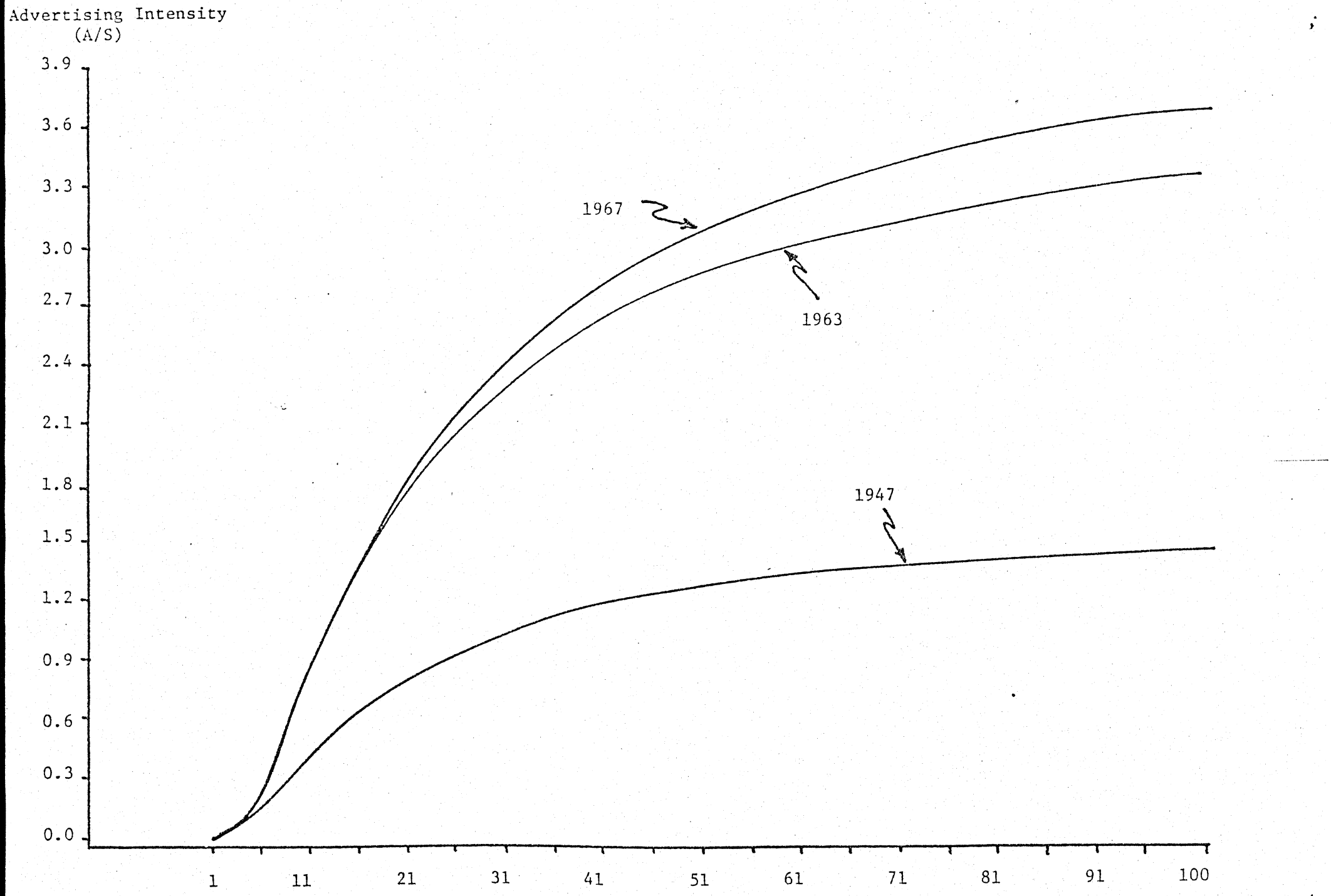


Figure 2. Advertising intensity - concentration relationship for consumer nondurables across time (1947, 1963, and 1967).

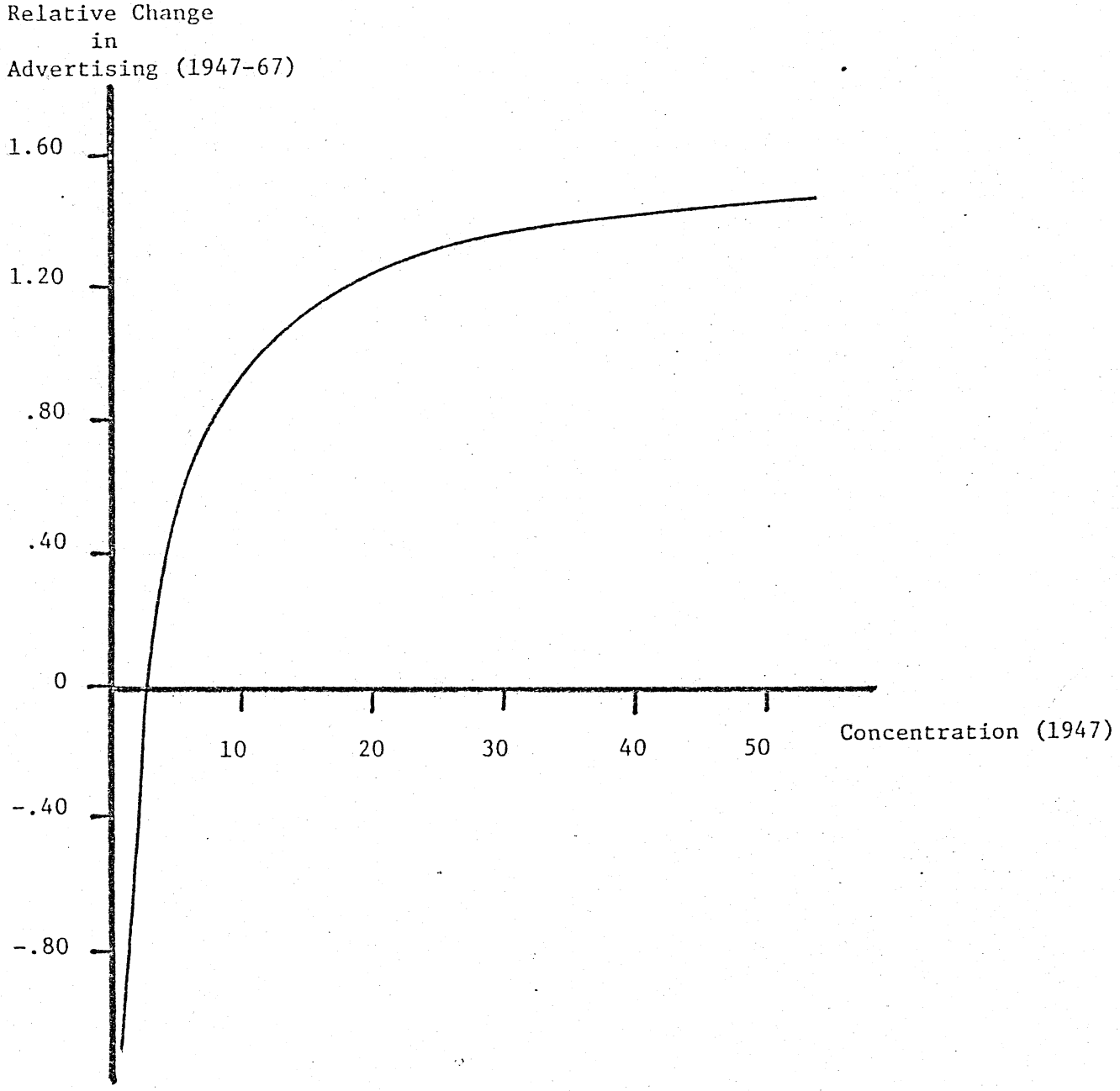


Figure 3. Relative change in advertising intensity from 1947 to 1967 holding concentration levels fixed (see eq. 2).

125 percent over that of 1947 with no change in concentration. What is apparent in figure 3 is the increased importance of advertising across most industry structures.

Conclusion

The estimates in table 2 provide stong support to the positive relationship between advertising and concentration. A mapping of the empirical results back to table 1 provides some insight as to the alternative effects concentration may have had on both $\varepsilon_a$ and $\varepsilon_d$. Clearly the alternatives to the right of the diagonal in table 1 are now deleted. The argument that advertising is reduced as concentration increases could only occur if advertising is substituted for price competition indicating that $\partial|\varepsilon_d|/\partial C < 0$. It does, however, appear somewhat contradictory to argue that advertising declines in response to rival advertising and simultaneously argue that advertising is substituted for price competition. In contrast, the positive relationship between intensity and concentration is consistent with increases in advertising effectiveness (i.e., $\partial\varepsilon_a/\partial C > 0$) and increased nonprice competition (i.e., $\partial|\varepsilon_d|/\partial C < 0$). While the empirical evidence is clear as to the final intensity response, conclusions relating to the elasticity response are still tentative.

The empirical evidence failed to show any unique adjustments for food industries that differed significantly from the broader category of durable and nondurable products. Advertising intensity has increased across all concentration levels. The model does facilitate separation of the importance of advertising among manufacturing industries as a

result of structural change within industries versus technical changes with the advertising industries where at least part of the shifts over time are due to technical changes in the advertising industry. It is relatively easy to calculate how much of the adjustment in intensity was due to concentration changes versus the time proxy variable. This in turn suggest where public advertising policy emphasis should be directed, assuming that such policy exists and/or is needed. Likewise, the significant difference between consumer and producer goods suggests that if greater governmental scrutiny of advertising is forthcoming, it will most likely be directed toward the consumer goods industries.

## FOOTNOTES

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[1]Advertising was not deflated over the three time periods since both sales and advertising are influenced by inflation and the effects of inflation should be netted out in the intensity ratio.

[2]An alternative to model (1) where substantial concentration could eventually lead to less advertising has been specified as:

$$\frac{A}{S} = \exp^{\{\tau_0 + \tau_1/C + \mu\}} C^{\tau_2}.$$

If $\tau_2 < 0$ and $\tau_1 < 0$ advertising intensity could both increase and decrease with C. This function has the property that $A/S \geq 0$, whereas many of the polynomial functions reported could yield $A/S < 0$. This model was estimated and the empirical results failed to yield any improvements over those in table 1, thus adding more credence to the asymptotic function [Ornstein, Strickland and Weiss].

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