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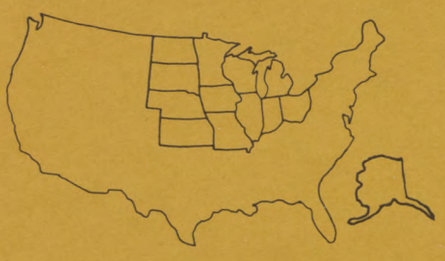

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* University of Wisconsin-Madison and U.S. Department of Agriculture, respectively. The views expressed here are those of the authors and not necessarily of the U.S.D.A. This research was supported by the College of Agriculture and Life Sciences, University of Wisconsin and the U.S. Department of Agriculture.

CHANGES IN MARKET CONCENTRATION OF MANUFACTURING INDUSTRIES 1947-1977

Willard F. Mueller and Richard T. Rogers*

This article reports the results of an updating of two earlier articles (Mueller-Hamm 1974 and Mueller-Rogers 1980) examining the causes of changing concentration in manufacturing industries and responds to several criticisms of those articles. The major finding of the 1980 study was that between 1947 and 1972 changes in market concentration were positively and significantly related to advertising, especially electronic media advertising. An analysis that includes the 1977 census data is important because some economists have speculated that the positive relationship between advertising and concentration change ceased, or even reversed, sometime in the 1960s, as industries reached a new equilibrium. This change might have occurred if the introduction of television advertising after World War II had caused only a short-lived disequilibrium in industrial market structures.

Although Scherer (1980, p. 116) found results similar to Mueller and Rogers (1980) for the period 1947 to 1972, his results for the 1963 to 1972 period showed an insignificant negative effect from advertising intensity on concentration change. Asch (1979) studying the 1963 to 1972 period with a different sample of manufacturing industries found considerable instability in the advertising-concentration change relationship with the only significant finding showing a negative relationship. Scherer (p. 116) suggests that "...the concentration-

increasing impact of intense advertising appears to have peaked and perhaps reversed by the early to mid-1960s, perhaps coinciding with both consumers' and advertisers' increased maturity in relating to television as a medium of information and persuasion." Asch (p. 295) acknowledges this possibility as well when he states, "...the major effect of advertising on concentration may have occurred prior to the periods examined." Finally, Caves and Porter (1980), analyzing the 1963-1972 period, questioned all previous studies of changes in concentration that used level variables to explain concentration change and failed to use lagged regression models.

The inclusion in our model of the 1977 concentration data may help test the validity of the arguments made by Asch and Scherer. Also, by using a lagged model we shall examine whether our previous results were spurious for the reasons suggested by Caves and Porter.

Table 1 shows the overall concentration trends for 165 U.S. four-digit Standard Industrial Classification (SIC) industries for which comparable data were available for the period 1947-1977. The overall trends during the first 25 years appear to have continued since 1972. Whereas in the aggregate the level of four-firm concentration was remarkably stable over the three decades, there were substantial differences between producer goods industries and consumer goods industries, especially in those industries making substantial advertising outlays.

A multiple regression model was used to explore more fully the apparent relationship between advertising intensity and changes in concentration. Because they were discussed in more detail in earlier papers (Mueller and Rogers, 1980; and Mueller and Hamm, 1974), we shall mention only briefly the variables used in the analyses.

Table 1. Average Unweighted Four-Firm Concentration Ratios by Degree of Product Differentiation for 165 U.S. Manufacturing Industries, 1947-1977

	Total Industries[a] (165)	Producer Goods (95) A/S = 0.1%[b]	Consumer Goods: Degree of Differentiation			
			All (70) A/S = 2.3%[b]	Low (21) A/S = 0.3%[b]	Moderate (33) A/S = 1.6%[b]	High (16) A/S = 6.4%[b]
	(1)	(2)	(3)	(4)	(5)	(6)
1977	42.3	42.1	42.5	27.6	42.3	62.4
1972	41.8	42.0	41.4	27.0	41.4	60.6
1967	41.1	42.1	39.7	25.2	39.2	59.9
1963	41.0	42.3	39.3	24.8	39.6	57.8
1958	39.8	42.3	36.3	22.7	36.7	53.4
1954	39.8	42.5	36.0	23.8	35.9	52.3
1947	40.4	43.8	35.7	26.0	36.2	47.7
Change 1947-1977	+1.9	-1.7	+6.8	+1.6	+6.1	+14.7

[a] These industries are all those manufacturing industries that had comparable data for the period 1947 to 1977.

[b] This is the average advertising-to-sales ratio for all industries in this group. This includes advertising expenditures for eight measured media in 1967.

THE VARIABLES

Change in Concentration (CR_4): The dependent variable measures the change in four-firm concentration (CR_4) between 1947 and 1977 and during several sub-periods. The change is measured in percentage points, e.g., CR_4 1977 minus CR_4 1947.

Initial Level of Concentration (ICR): Initial level of concentration is measured by the beginning year's CR_4. Economic theory suggests that, ceteris paribus, leading firms in concentrated industries are likely to lose market share over time or to increase less rapidly than less concentrated industries. The variable is expected to have a negative sign.

Industry Growth Rate (G): Growth in industry demand affects the opportunity for entry by new firms and expansion of fringe firms already in the market. The variable is expected to be negatively related to change in concentration. Percentage change in value added in current dollars is used to measure industry growth.

Industry Size (S): Other things being the same, the larger the absolute size of an industry the lower its entry barriers (Mueller and Hamm, 1974, p. 514). Industry size is measured by the natural logarithm of the industry's total value added (VA) in the period's initial year. It is expected to have a negative sign.

Advertising Intensity (A): Advertising-created product differentiation is a major source of market power for an individual firm and of industry entry barriers (Comanor and Wilson, 1974). If there are substantial advantages (pecuniary or real) of large-scale advertising, and especially if these advantages increased over the period studied, advertising would cause increased concentration in industries most susceptible to advertising.

Television advertising grew from virtually nothing in 1947 to become the new primary advertising medium in the country. Thus the introduction of this new advertising medium created a potential disequilibrium in the structure of many industries. This disequilibrium will cause considerable change in industry structure if there are substantial advantages to large-scale advertising. Because all economists are not agreed as to the existence of large-scale advantages and, if they exist, their affects (Brown 1979, and Shapiro 1982), this remains an important area of empirical inquiry.

Models that use only total advertising implicitly assume that all forms of advertising have the same impact on structure, which is very unlikely. Porter (1976) has recognized that advertising is not fungible and has shown that different types of advertising media have different implications for market performance. We extend this reasoning to suggest that the use of different advertising media have different implications for the structure of an industry over time.

We therefore introduce advertising into our models in two ways. First, we focus on total industry advertising measured in eight media, using the industry's total advertising-to-sales ratio (TA). Our second method focuses on the importance of television advertising. We separate TA into a television-plus-radio (TVR) and an all other category consisting of newspaper, outdoor, and magazine advertising (NOM). All advertising data are for the year 1967.

Caves and Porter (1980) expressed reservations about the use of level variables to explain changes in concentration, such as the advertising variables used in our model. However, they state that such a model is theoretically appropriate under either of two assumptions.

Our television/radio advertising variable (TVR) meets their first theoretical requirement: "the measured disturbance variable...has shifted from its (unobserved) level at an earlier time, and the sampled industries are observed out of equilibrium and in the process of adjusting to a new equilibrium level of concentration." The examination of different time periods should provide information about the adjustment process toward the new equilibrium.

Caves and Porter's second condition that justifies the use of a level variable in a change model requires that: "...the presence of the disturbance variable is believed a priori to cause concentration to rise without limit, although at a constrained rate of adjustment per unit of time." Following Weiss, we believe that concentration would increase more (or decrease less) the greater the variance in individual firm growth rates. For this to be the case "the risks borne by firms within an industry must be high and the gains and losses must fall on different firms unequally" (Weiss 1963, p. 71). Whereas Weiss felt this reasoning applied most directly to differentiated durable industries, we believe this reasoning applies to all industries that use advertising as a primary form of rivalry (Rogers 1982, pp. 65-84). Therefore, we conclude that our advertising level variables meet both of the conditions given by Caves and Porter and, hence, we have no reservations about their use in a concentration change model.

We hypothesize that total advertisint (TA) is positively associated with change in CR_4 mainly because television advertising accounts for 64% of TA in the data used here. We hypothesize that changes in CR_4 will be positively associated with changes in TVR, and will not be significantly associated, or, at most, weakly positively associated with other advertising (NOM).

EMPIRICAL RESULTS

The empirical findings from the principle multiple regression analysis are displayed in Table 2. Equation 1a estimates the basic model using the industry's total advertising-to-sales ratio (TA) as the measure of product differentiation. The coefficients of all three concentration eroding forces in the model are significant at 1%, and all have higher significance levels than they had for 1947-72 (Mueller and Rogers, p. 92). Indeed, although growth had the predicted negative sign for 1947-72, it was not statistically significant over that period. The only opposing force in our model to offset the deconcentrating factors is TA, which is significant at 1%.

Equation 1b is identical to equation 1a except that TA is separated into electronic media (TVR) and printed media (NOM). The estimated coefficients for the three eroding factors as well as the constant are virtually identical to those found in equation 1a. TVR is positive and more significant than TA and its estimated coefficient is larger. NOM is insignificant and has an unpredicted negative sign.

To test if the relationships between structure and changing concentration were stable over the entire 1947 to 1977 period we separated the data into three sub-periods, 1947 to 1958, 1958 to 1967, and 1967 to 1977. To further examine the behavior of the model over longer sub-periods, the data were separated into the sub-periods, 1947-1963 and 1963-1977. All of the variables (independent as well as dependent) except the advertising variables were recalculated according to the appropriate year(s). Since we did not have advertising data for other years, we assigned the 1967 figures to each period. This procedure is less than ideal; however, the 1967 A/S ratios should be

Table 2 Results of Multiple Regressions Explaining Changes in Four-Firm Concentration of 165 U.S. Manufacturing Industries Between 1947 and 1977.

Equation	Dependent Variable	Constant	Initial CR4 (ICR)	Industry Size (S)	Industry Growth (G)	Total A/S (TA)	TV and Radio A/S (TVR)	Newspapers Outdoor Mag A/S (NOM)	R^2
1a	ΔCR4 1947-77	33.80[b]	-.26[b] (6.37)	-2.75[b] (2.79)	-.007[b] (3.79)	1.60[a] (4.08)			.30 (17.18)
1b	ΔCR4 1947-77	33.25[b]	-.25[b] (6.19)	-2.68[b] (2.77)	-.007[b] (3.99)		2.42[b] (4.85)	-.61 (.66)	.33 (15.56)
2a	ΔCR4 1947-58	1.95	-.08[b] (3.05)	.16 (.24)	-.012 (1.47)	.54[a] (2.08)			.10 (4.30)
2b	ΔCR4 1947-58	1.85	-.08[b] (2.88)	.17 (.27)	-.014 (1.64)		.82[b] (2.45)	-.23 (.37)	.11 (3.80)
3a	ΔCR4 1958-67	16.40[b]	-.11[b] (4.86)	- 1.47[b] (2.98)	-.007 (.72)	.51[b] (2.50)			.17 (8.19)
3b	ΔCR4 1958-67	16.68[b]	-.10[b] (4.80)	- 1.50[b] (3.08)	-.007 (.71)		.88[b] (3.31)	-.45 (.92)	.19 (7.62)
4a	ΔCR4 1967-77	20.51[b]	-.08[b] (2.74)	- 1.77[b] (3.23)	-.026[b] (3.87)	.65[b] (2.58)			.18 (8.86)
4b	ΔCR4 1967-77	20.75[b]	-.08[b] (2.76)	-1.80[b] (3.29)	-.025[b] (3.80)		.92[b] (2.84)	-.06 (.11)	.19 (7.47)
5a	ΔCR4 1947-63	16.67[b]	-.15[b] (4.97)	-1.37[a] (-1.88)	-.013[a] (2.15)	1.18[b] (4.09)			.21 (10.52)
5b	ΔCR4 1947-63	16.60[b]	-.14[b] (4.74)	-1.35[a] (1.87)	-.015[b] (2.46)		1.70[b] (4.57)	-.21 (.30)	.23 (9.56)
6a	ΔCR4 1963-77	22.93[b]	-.13[b] (3.80)	-1.88[b] (2.73)	-.015[b] (3.14)	.55[a] (1.81)			.17 (7.91)
6b	ΔCR4 1963-77	23.29[b]	-.13[b] (3.80)	-1.93[b] (2.80)	-.014[b] (3.05)		.93[b] (2.39)	-.46 (.64)	.18 (6.86)

Note: The t-value for each regression coefficient appears below it and F value appears below the R^2.
a The t-value is statistically significant at 5% using a one-tail test.
b The t-value is statistically significant at 1% using a one-tail test.

reliable proxies for the other periods insofar as the 1967 advertising data capture the relative opportunities for product differentiation in an industry.[1]

The results from the three sub-periods suggest that the model was generally stable across the three successive decades. The estimated coefficients on ICR remained very steady across the three periods. Size had an unexpected insignificant effect in the 1947-58 period but returned to a significant negative effect in the last two periods. The estimated coefficients on growth were negative in all three periods but were only significant in the 1967-77 period. The estimated coefficients on TA displayed remarkable similarity across the three sub-periods. Separating TA into TVR and NOM (equations 2b, 3b, and 4b) revealed the larger, more significant coefficient for TVR versus TA, as was the case in comparing equation 1a and 1b. Again, the estimated coefficient for TVR remained nearly constant over the three sub-periods. NOM was negative, but insignificant, in each of the sub-periods.

The results from separating the 30 year period into roughly three successive decades strongly suggest that the relationship between measured media advertising (both TA and TVR) and concentration change had not leveled off over the full period as would be expected if a new equilibrium had been reached during the 1960s. The strong positive finding for the 1967-77 decade is evidence that electronic advertising had not lost its ability to further restructure industries by the mid-1960s.

When we separated the 30 year period into only two sub-periods, 1947-63 and 1963-77, the stability of the advertising-concentration relationship was less clear. The results of the deconcentrating forces

were generally the same across the two sub-periods, but the effect of TA and TVR had a larger, more significant effect in the 1947-63 period. The estimated coefficient on TA was halved in the latter period with its significance falling to the 5% level. TVR experienced a similar reduction but remained significant at the 1% level in the 1963-77 period. These results are consistent with the view that the effect from television advertising was leveling off over the 30 year period. However, the positive and significant effect of TVR in the 1963-77 period stops far short of supporting the hypothesis that the concentrating effect of television advertising had been played out by the 1960s. Alternatively, these results may suggest that the year 1963 is a particularly atypical year in terms of concentration change. More will be said on this possibility below; suffice it to say here that those authors that have found results conflicting with Mueller-Rogers have examined periods beginning in 1963.[2]

As mentioned earlier, Caves and Porter place little confidence in models where the independent variables are measured over the same time period as the dependent variable. They state (p. 14): "...we strongly suspect that those robust-looking unlagged results may in fact reveal little about fundamental causal relations." We examined this concern by re-estimating those equations where we could lag the independent variables to a period preceding the period of the dependent variable (Table 3). Since we only had advertising data for the year 1967, advertising was not measured prior to the dependent variables' period except in one equation.

Equations 1 and 2 of Table 3 correspond to equations 3b and 4b of Table 2, except that the independent variables are lagged to a previous

census year(s). In equation 1, ICR and S were measured in 1954 and growth was measured over the 1947-58 period. The results were generally equivalent to the unlagged version (equation 3b, Table 2). Interestingly, growth was significant at the 1% level in the lagged model whereas it was totally insignificant in the unlagged model. Such increased 'robustness' with the lagged model is directly opposite that hypothesized by Caves and Porter. We feel that this result is more related to the imprecision of measuring growth by changes in value-added in different census years, rather than holding any significance for lagged or unlagged models.

The results of the lagged model for the 1967-77 period were again similar to the unlagged version (equation 4b, Table 2). ICR and S were measured in 1958 and growth was measured over the 1958-67 period. Again, all of the independent variables, except NOM, were significant at the 1% level. The estimated coefficient on TVR was similar in both periods, suggesting that no leveling off of its effect had occurred.

To further examine the effects of the independent variables over the entire period we estimated the model for each census period that could be lagged. Hence, the 1947-54 period was dropped and in each period the independent variables, with the exception of TVR and NOM, were measured in the preceding census year or in the case of growth, over the previous census period.

Table 3. Results of Multiple Regressions Explaining Changes in Four-Firm Concentration, Various Periods, Lagged Models, 165 U.S. Manufacturing Industries.

Equation	Dependent Variable	Constant	Initial CR4 (ICR)	Industry Size (S)	Industry Growth (G)	TV and Radio A/S (TVR)	Newspapers, Outdoor, Magazine A/S (NOM)	R^2
1	CR4 1958-67	14.5	-.09[b] (-4.10)	-1.20[b] (-2.42)	-.018[b] (-2.78)	.89[b] (3.40)	-.67 (-1.39)	.21 (8.54)
2	CR4 1967-77	16.0	-.08[b] (-3.00)	-1.30[b] (-2.13)	-.033[b] (-2.69)	.81[b] (2.45)	-.18 (0.29)	.14 (5.00)
3	CR4 1954-58	4.6	-.03[a] (-1.94)	-.46 (-1.27)	-.010 (-1.30)	.11 (.61)	.22 (.63)	.048 (1.59)
4	CR4 1958-63[1]	12.6	-.06[b] (-3.77)	-1.26[b] (-3.43)	-.024 (-1.52)	.61[b] (3.11)	.14 (.39)	.170 (6.37)
5	CR4 1963-67[1]	3.8	-.04[b] (-3.09)	-.18 (-.56)	-.015 (-1.09)	.30[a] (1.66)	-.56 (-1.72)	.092 (3.21)
6	CR4 1967-72	8.8	-.04[b] (-2.43)	-.80[a] (-2.06)	-.010 (-0.65)	.39[a] (1.78)	-.44 (-1.11)	.074 (2.56)
7	CR4 1972-77	11.4	-.04[a] (-1.94)	-1.09[b] (-2.83)	-.035[b] (-2.75)	.47[a] (2.07)	.42 (1.00)	.116 (4.18)

[1] A re-estimated CR4 for SIC 3942 was used in this equation. See footnote 2 of text.

Note: The t-value for each regression coefficient appears below it and the regression's F-value appears below the R^2.
[a] The t-value is statistically significant at 5% using a one-tail test.
[b] The t-value is statistically significant at 1% using a one-tail test.

Since structural change is seldom rapid, we hesitate to examine such short periods of time. The results are likely to be unstable and lacking much explanatory power. However, with this caution in mind we proceeded in hopes that the results would help us trace the adjustment process (if any) over the longer time period. We also wished to compare our results to those of Asch who examined both the 1963-67 period and the 1967-72 period.

The results of the five separate time periods were much more stable than expected. ICR had nearly the same effect in each period. S and G also tended to display similar effects but less so than was true for ICR. Perhaps the most interesting result involves TVR. TVR reached its maximum effect and significance in the 1958-63 period. This result suggests that those who felt that the effect of television advertising on concentration change would reach a new, higher equilibrium in the mid-1960s had merit to their argument. During the 1958-63 period TVR's restructuring effect was greater than in any other period. Its complete insignificance in the 1954-58 period is perplexing, however. In the 1963-67 period TVR's estimated coefficient fell to one-half the level found in the 1958-63 period and barely reached the 5% level of significance. The estimated coefficient on TVR continued to gain magnitude and significance over the next two periods, suggesting that a new equilibrium between television advertising and concentration change had not been reached by the mid-1960s.

Asch estimated a model quite similar to ours (he only omits S) for the sub-periods 1963-67 and 1967-72. The results for the two sub-periods directly oppose the findings given in Table 3. Asch found the effect of advertising to be mainly negative but rarely significant

(he does find advertising to be significant and negative in the 1967-72 period for a sample of 21 consumer durable products). When we used TA, rather than TVR and NOM, we found TA to be insignificant, but positive, in both the 1963-67 and 1967-72 periods. Thus, one reason for the differences in our findings and those of Asch (and Scherer) is the failure to separate the most powerful advertising medium for achieving product differentiation from the other forms of advertising. Furthermore, our TA variable was based on only eight measured media that are very consumer-oriented whereas Asch and Scherer used advertising data from the Department of Commerce's input-output tables. Those data are much more broadly defined, even including advertising directed at intermediate buyers who should be less sensitive to such appeals and thereby the advertising will likely have a higher informational context than is typically found in consumer advertising. Moreover, the input-output data have serious aggregation problems that prevents direct correspondence with Standard Industrial Classification industries. In addition, Rogers has shown there are substantial errors in the input-output advertising data that are likely to bias the advertising-concentration relationship to zero. Thus, these two differences, failure to isolate television advertising and the use of input-output advertising data, likely explain the differences between our findings and those of Asch and Scherer.

Asch also examined the full 1963-72 period, as did Scherer and Caves and Porter. Again, Asch and Scherer's failure to use an electronic media variable and their use of input-output advertising data likely were responsible for their conflicting results. Caves and Porter did not use any advertising variable in their model, which we feel is a

major weakness of their model. When we estimated our model for the 1963-72 period, TA proved insignificant, although positive, but TVR was positive and significant at the 5% level.[3] Again we see the weakest results are from periods that begin in 1963. Perhaps either a very short-run equilibrium between advertising and concentration change was reached around 1963 or, alternatively, the period has a few too many unpredicted concentration changes that prevent the results from reaching conventional significance levels.[4] In any event, the significant concentrating effect of advertising continued beyond 1963 with the 1967-77 period displaying values equal in magnitude to that for the 1958-67 period.

The final period analyzed was for 1972-77 (equation 7, Table 3). This was the only period for which all of the independent variables, including TVR and NOM, were fully lagged. The effect of TVR was positive and significant at the 5% level, suggesting that the concentrating effect of electronic media advertising had not reached a new equilibrium by 1977.

In sum, this paper resolves most, if not all, of the conflicting findings of researchers examining changes in concentration since 1963. The findings also strongly suggest that lagged models provide little, if any, added insight into the causes of changes in concentration. While structural influences must operate with a lag, there is no way of knowing the appropriate lag and researchers are constrained to use lag lengths that correspond to census years. Should these periods be too long, then one may be relating a true causal factor, when measured correctly, to an unrelated future event. For example, past industry growth affects the number of firms that enter the industry but at some

point an equilibrium will emerge and that past growth shall be unrelated to concentration change over the next period. While acknowledging that our simple model does not capture all of reality, we submit that a simple model that captures fundamental underlying causes of structural change is preferable to a more complex model that reveals little. In any event, using our model and data set unlagged and lagged models perform about the same in explaining changes in concentration.

FOOTNOTES

* University of Wisconsin-Madison and U.S. Department of Agriculture, respectively. The views expressed here are those of the authors and not necessarily of the U.S.D.A. This research was supported by the College of Agriculture and Life Sciences, University of Wisconsin and the U.S.D.A.

1. In his study of changes in concentration in food products, Rogers (1982) used advertising data for 1954, 1967 and 1972; his results did not differ significantly when advertising of various years were used.

2. It has been brought to our attention that one of our observations for 1963 may be in error. The 1963 4-digit CR_4 of SIC 3942, Dolls, was not reported by the Census Bureau for disclosure reasons. In this and previous studies we have used the Federal Trade Commission's (FTC) estimate of 41. Hence, CR_4 reportedly went from 12 in 1958 to 41 in 1963 and back to 19 in 1967. The FTC's estimate was made before the 1967 concentration ratios were available (Parker, 1967). If a trend line estimate between the 1958 and 1967 values is used to estimate the 1963 CR_4 for SIC 3942, the regression coefficients of TVR for the 1947-1963 period and the 1963-1977 period differ less than appears in equations 5b and 6b (the estimated coefficient is 1.45 in the 1947-1963 period and is 1.17 in the 1963-1977 period, with both being significant at the 1 percent level).

3. When the 1963 CR4 for SIC 3942 was re-estimated as in footnote 2, TA was still insignificant but TVR was positive and significant at the 1% level.

4. See footnote 2 for a possibly large error in an observation for 1963.

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