

A Reappraisal of Interpreting Rising Concentration: The Case of Beer*

I. Introduction

There has been a tremendous amount of change in the structure and conduct of the post-World War II brewing industry. Most important, concentration has risen, scale economies have increased, and advertising intensity, especially television advertising, has changed.¹ In a recent article in this *Journal* William J. Lynk (1984) attempted to determine empirically how changes in concentration and technology affected brewing industry performance between 1974 and 1980.² He found support for the "competition hypothesis" that cost reductions (due to cost superiority or the exploitation of scale economies) have dominated the possible market power effect of rising concentration and have caused output to increase and prices to fall. Thus the alternative, or the "exclusion hypothesis" that large brewers have squeezed smaller rivals out of

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1. For example, the number of firms declined from 386 to 37 and the five-firm concentration ratio increased from 23% to 71% between 1950 and 1978. See Elzinga (1973, 1982), Keithahn (1978), Ornstein (1981), and Greer (1971a, 1981) for excellent industry studies.

2. In this paper industry performance is evaluated from the consumer's point of view. For a given level of product quality, if structure and conduct changes are beneficial to consumers by causing the market price to fall, then industry performance has improved.

In contrast to the finding of William J. Lynk that rising concentration in the U.S. brewing industry caused industry output to expand (and by his presumption, prices to fall), the results of this study show that concentration had no significant direct impact on post-World War II beer prices. Estimates from a reduced-form price equation reveal that advertising and costs have had a significant positive effect on beer prices. These results provide evidence that the rising concentration, scale economies, and advertising expenditures in the U.S. brewing industry generated higher beer prices between 1950 and 1971.

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business in order to increase their market power and prices, was rejected. This led him to conclude "that concern over beer mergers . . . has been unwarranted."

This paper extends Lynk's analysis in a number of ways. First, the model developed in this paper includes a number of important variables, especially advertising, omitted from Lynk's analysis. This is important both because advertising affects demand and cost conditions and because consumer welfare may depend upon advertising as well as concentration.³ Furthermore, rising concentration may have caused advertising to increase and lower social welfare as suggested by Greer (1971a, 1981). In support of the competition hypothesis Lynk found that higher concentration caused an increase in beer output. He assumed this led to lower beer prices. However, since Lynk did not control for advertising, rising concentration in brewing may have caused increased advertising rivalry and higher rather than lower prices as Lynk assumes. Thus, concern over rising concentration in brewing may still be warranted even though rising concentration has had no direct effect on economic performance. Second, the process generating price, rather than output, is modeled so that the effects that concentration, costs, and advertising have on beer prices can be tested directly. Finally, in this study the structure of demand and cost functions are allowed to vary between national and regional producers, and the necessary autocorrelation and heteroscedasticity corrections are made.

The empirical results of this study indicate that advertising is an important variable in explaining beer prices and that escalating advertising kept beer prices from falling in spite of any cost reductions from 1950 to 1971. During this period consumers may not have benefited from the structure and conduct changes in the brewing industry. Greer argued that rising concentration led to growing advertising levels in brewing during this period. If this is true, then concentration may have been an issue of concern, since it appears that escalating advertising kept beer prices up even though costs declined.

The rest of this article proceeds as follows. The impact of advertising along with other methodological concerns with Lynk's work are discussed in Section II. In Section III an empirical model is developed to determine how changes in concentration, costs, and advertising have affected average beer prices. The empirical results are presented in Section IV, and a conclusion to this analysis is found in Section V.

II. A Critique of Lynk's Methodology

There are a number of concerns with Lynk's article. First, because of data limitations, a number of important variables were omitted from his

3. See Comanor and Wilson (1979) for a discussion of the welfare implications of advertising.

demand and supply reduced-form equation (his eq. [4]). Perhaps the most important omitted variable is advertising. Advertising increases firm costs and can affect firm demand by informing consumers of real differences, by increasing market power through the creation of entry barriers, and by creating an image most preferred by consumers. Thus advertising should be included in Lynk's analysis since it can influence market price and output. Other important variables excluded from his model might include: the prices of the product and its substitutes and complements, consumers' tastes and preferences, and the actual costs of production. Lynk, realizing this problem, used a linear time trend and state dummy variables in order to control for missing variables.⁴ However, if these proxy variables are incomplete in their control of missing variables, then the parameter estimates and hypothesis tests in Lynk's article would be biased.

The second problem concerns Lynk's estimation procedure. His use of ordinary least squares (OLS) implicitly assumes that the error structure in his reduced-form equation does not suffer from serial correlation or heteroscedasticity. He used a pooled data set which generally suffers from serial correlation because of its time-series component and from heteroscedasticity because of its cross-section component. Lynk did not test for the presence of either serial correlation or heteroscedasticity to ensure the validity of his procedure; therefore, the standard errors and hypothesis tests found in his study may be biased.

One final criticism of Lynk's model is that it ignored the fact that national and regional strategic groups appear to be present in the U.S. brewing industry.⁵ National and regional producers face different marketing constraints because only nationals are able to economically advertise on national television, which may cause systematic demand and cost differences. For example, Peles (1971) found the structure of demand to differ between national and regional producers; Hatten and Schendel (1977) found profits to differ between strategic groups in brewing; and Tremblay (1984, in press) found the structure of demand and costs to vary between national and regional beer producers. Lynk's model may therefore be misspecified since it does not control for potential asymmetries generated by national and regional strategic groups. This problem may also lead to parameter estimate bias.

4. Lynk also estimated his model in first-difference form. This procedure is designed to eliminate the problem of omitted variables for variables that remain constant over time. However, it is likely that most of the left out variables do vary over time. This procedure may also correct for a special type of serial correlation (see Pindyck and Rubinfeld 1981, p. 156), but there is no evidence or test to support the fact that the serial correlation in Lynk's model actually takes this form.

5. For a theoretical discussion of strategic groups see Caves and Porter (1977), Newman (1978), Porter (1979), and Hallagan and Joerding (1983).

III. An Alternative Methodology

An alternative procedure proposed in this paper uses a more complete data set and attempts to avoid the criticisms discussed above. A model of the process generating a firm's average annual profit-maximizing price is developed in order to test the effect that changes in concentration, advertising, and costs have had on beer prices between 1950 and 1977. Lynk correctly pointed out that there is a problem with modeling average price changes when quality is a strategic variable, but the problem is not completely avoided by modeling the output generation process designed by Lynk. By omitting the quality dimension, Lynk committed the sin of adding apples and oranges (premium and popular priced beer) and was unable to determine the effect advertising has had on beer prices.

To avoid this problem, a hedonic technique pioneered by Spady and Friedlaender (1978) is used. It models the quantity of "effective output" as a function of the quantity of physical output and of hedonic descriptors or attributes. Attribute differences are assumed to be adequately captured by the quantity of advertising messages per brand.⁶ This is justified since real differences are minimal among light pilsner beers marketed by the U.S. brewers in this sample. In blind taste tests most consumers cannot distinguish one brand from another.⁷ It appears that heavy advertising is predominantly used by beer producers to create perceived product images and increase market power. This specification is in keeping with the literature describing the structure of the brewing industry. For example, Greer (1971a, 1981) argued that the level of product differentiation and brand loyalty depend on the degree of advertising intensity in brewing.

Of considerable interest is the effect advertising has on beer prices. Advertising may be used to increase consumer information, or it may increase the demand for firms operating in the region of scale economies and result in lower prices, as found by Benham (1972). Alternatively, advertising may generate higher prices if it causes costs and market power to increase or improves the advertised product's image.⁸

6. This assumes the quality of advertising is constant across firms. Weighting the quantity of advertising by the number of brands controls for the fact that firm, not brand, data are used.

7. For example, Allison and Uhl (1964) conducted blind taste tests on various brands of beer and found that beer drinkers could not distinguish one brand from another and could not identify their favorite brands. In addition Ackoff and Emshoff conducted blind taste tests using the same brand of beer. They placed four different labels on the same product and presented them to their subjects as four different brands. They found that "all of the subjects believed that the brands were different and that they could tell the difference between them. Most [of the 250 subjects] felt that at least one of the four brands was not fit for human consumption" (Ackoff and Emshoff 1975, p. 12).

8. Unfortunately, if advertising generates higher prices, economic analysis without value judgments cannot determine how consumer welfare has changed. Advertising that

Since beer producers have market power, a simple oligopoly model is used to describe a firm's profit-maximizing price. Assume initially that brewery i 's inverse demand function can be represented as

$$P_i = P_i(\psi_i(q_i, A_i), \underline{\psi}_r(q_r, A_r), IM, POP, y), \quad (1)$$

where P_i equals firm i 's average revenue, ψ_i represents the quantity of firm i 's effective output, q_i is the quantity of firm i 's physical output, A_i is the quantity of firm i 's advertising per brand, $\underline{\psi}_r$ represents a vector of the effective output of firm i 's rivals, IM equals the quantity of U.S. beer imports, POP is the size of the primary drinking-age U.S. population (ages 20–44), and y equals the U.S. per capita income.⁹ Note that it is necessary to model a firm's aggregate output and average price (over all brands) since data are not available at the brand level.¹⁰ Thus a firm's representative brand is being modeled here.

A number of modifications must be made to this demand function. First, because of the presence of national and regional strategic groups in brewing, the impact of rival advertising and physical output are allowed to vary across groups but are assumed to remain symmetric within groups. The strategic group literature suggests that advertising from inside a firm's strategic group is expected to have a larger negative effect upon the firm's demand than advertising from outside the firm's own group. A national dummy variable, DN , is also added to the demand function to capture any additional demand asymmetries which may exist between national and regional producers.¹¹ Second, a conglomerate dummy variable, CO , is added to the demand function because price is measured by dividing total revenue by the quantity of physical output, and six of the 22 firms sampled are conglomerates with unobservable beer revenues. Thus CO controls for this measurement

increases costs and market power would unambiguously reduce consumer welfare. However, if advertising causes higher prices by creating an image that becomes tied to the product and is valued by some consumers, then consumer welfare may have increased. For a discussion of the differing views on the effect of advertising, see Comanor and Wilson (1979).

9. The strategic impact of rivals' behavior is modeled indirectly through output, rather than price, since the price charged by rivals suffers from the conglomerate measurement error described shortly and since a price index for imported beer is not available. Also the price of substitutes are ignored because most previous researchers have not found beer and other alcoholic beverages to be significant substitutes. See Tremblay (in press) for a more complete description of the variables used to describe the demand for beer at the firm level.

10. Hicks's Composite Commodity Theorem (Green 1976, p. 151) justifies this procedure if the relative prices of a firm's brands remain in fixed proportion.

11. This specification models the demand structure of the average national and regional producer by allowing the impact of strategic variables to differ between groups. It is maintained that the long-run firm behavior and the structure of demand is symmetric within groups. There are certain exceptions (Coors's unusual success in the 1960s and early 1970s and Schlitz's and Coors's failures in the late 1970s), but these firms are considered to be in disequilibrium rather than to be systematically different from the representative firm in their strategic group.

error. Finally, for simplicity it is assumed that q and A are separable in the $\psi(q, A)$ function. With these modifications firm i 's demand function can be written as

$$q_i = q_i[P_i(CO), A_i, IA, OA, Iq, Oq, IM, POP, y, DN]. \quad (2)$$

For simplicity, rival's output and advertising levels are defined in the following way. IA and Iq equal the quantity of advertising per brand and the quantity of physical output from the three dominant rivals inside firm i 's own strategic group, respectively, and OA and Oq equal the quantity of advertising per brand and the quantity of physical output from all rivals that are outside firm i 's own strategic group, respectively.

Assuming that the firm's goal is to maximize profit, the first order profit-maximizing condition, with respect to price, is

$$\frac{\delta \pi_i}{\delta P_i} = q_i[\cdot] + P_i \frac{\delta q_i}{\delta P_i} - MC_i \frac{\delta q_i}{\delta P_i} = 0, \quad (3)$$

where π_i equals firm i 's profit and MC_i is firm i 's marginal cost. Because brewing industry concentration has been rising since World War II, the effect of concentration must be incorporated into the model. Theory indicates that as concentration rises, competition may fall and cause firm demand curves to become less elastic. This implies that $\delta q_i / \delta P_i$ may be a positive function of concentration (CR). With this fact and equations (2) and (3), one can solve for firm i 's profit-maximizing price, P_i^* . Assuming it can be approximated by a linear function, a reduced-form price equation can be written as

$$P_i^* = b_0 + b_1 A_i + b_2 IA + b_3 OA + b_4 Iq + b_5 Oq + b_6 IM + b_7 POP + b_8 y + b_9 DN + b_{10} MC_i + b_{11} CR + b_{12} CO. \quad (4)$$

If equation (4) could be empirically estimated, then hypotheses concerning price effects due to changes in costs, concentration, and advertising could be tested. In this specification, if the actual changes in concentration, costs, and advertising cause the profit-maximizing price to fall over time, *ceteris paribus*, then consumers have benefited. The main problem with estimating such a function as equation (4) is that marginal cost is unobservable. Tremblay (1984) has estimated a translog cost function for the U.S. brewing industry; therefore, marginal cost will be approximated by the predicted marginal cost, $\overline{MC}$, from that estimated translog cost function.¹² In addition, a measure of con-

12. The translog cost specification is given below and follows Stevenson (1980). It was estimated with the same sample of firms that were used in this study.

$$\begin{aligned} \ln C = & \alpha_0 + \sum_i \alpha_i \ln W_i + \frac{1}{2} \sum_i \sum_j \alpha_{ij} \ln W_i W_j + \beta_1 \ln q + \frac{1}{2} \beta_2 \ln q^2 + \beta_3 \ln A \\ & + \frac{1}{2} \beta_4 \ln A^2 + \beta_5 \ln q \ln A + \sum_i \beta_{1i} \ln q \ln W_i + \sum_i \beta_{2i} \ln A \ln W_i + \alpha_1 DN + \alpha_2 DN \ln q. \end{aligned}$$

centration must be developed. The five-firm concentration ratio, $CR5$, is readily available, so it will be used. In order to be comparable with Lynk's work, the Herfindahl index, HI , is also used.¹³ Since the brewing market is national, or nearly so, and since Lynk found only national measures of concentration to be important, only national measures of $CR5$ and HI are applied.

Equation (4) becomes an empirical model by replacing MC with $\overline{MC}$, by using $CR5$ or HI in place of CR , and by adding a random-error term. The data set is pooled, consisting of 22 firms over the period 1950 to 1977. There are only 316 observations since some firms exited the industry before 1977. The sample, remaining variables, and data sources are described in the Appendix. Each regressor in the modified version of equation (4) is assumed to be predetermined; therefore, (4) should be estimated using OLS. The time-series component of this data set suggests that the presence of serial correlation is likely. An autocorrelation correction is made with a different correction for each strategic group.¹⁴ Since large brewers seem to face less variation in demand than smaller brewers, it is felt that heteroscedasticity might also be a problem. Heteroscedasticity is detected using a Goldfeld and Quandt (1965) test, and it is eliminated by using weighted least squares.¹⁵

IV. Empirical Results

Regression results are presented in table 1. Column 1 of the table gives the parameter estimates of equation (4) when concentration is mea-

$$\begin{aligned} & + \alpha_3 DN \ln A + \alpha_4 CO + \phi_1 T + \frac{1}{2} \phi_2 T^2 + \sum_i \psi_i T \ln W_i + \frac{1}{2} \sum_i \sum_j \psi_{ij} T \ln W_i W_j \\ & + \theta_1 T \ln q + \frac{1}{2} \theta_2 T \ln q^2 + \theta_3 T \ln A + \frac{1}{2} \theta_4 T \ln A^2 + \theta_5 T \ln q \ln A + \sum_i \theta_{1i} T \ln q \ln W_i \\ & + \sum_i \theta_{2i} T \ln A \ln W_i + \eta_1 TDN + \eta_2 TDN \ln q + \eta_3 TDN \ln A, \end{aligned}$$

where C equals total cost, W_i equals the price of input i (labor, capital, and materials), $\ln W_i W_j = \ln W_i \ln W_j$, and T is a time trend.

13. HI was measured as the sum of the squared market share (of barrels sold) for all firms with production levels exceeding one million barrels per year and the average squared market share of remaining firms times the number of remaining firms in the industry.

14. A technique described by Judge et al. (1981, p. 190) was used to test for a fourth-order autocorrelation process, $AR(4)$. This technique requires that the ρ 's are tested for significance using the following regression:

$$e_t = \rho_1 e_{t-1} + \rho_2 e_{t-2} + \rho_3 e_{t-3} + \rho_4 e_{t-4} + u$$

where e equals the predicted residuals from regression equation (5), t is the time period, and u is a random-error term. A separate regression was run on residuals for national (N) and regional (R) producers since the error structure is probably different for these two groups. The $CR5$ regression followed an $AR(1)$ process with ρ estimates equaling:

$$\rho_{1N} = .495442; \quad \rho_{1R} = .7793.$$

The HI regression followed an $AR(1)$ process with ρ estimates equaling:

$$\rho_{1N} = .649076; \quad \rho_{1R} = .725544.$$

15. The weight equaled the value of firm assets raised to the 0.4 power.

TABLE 1 Equation (5) Regression Results

Variable	Parameter	CR5		HI	
		Parameter Estimate	t-Ratio	Parameter Estimate	t-Ratio
Intercept	b_0	-4.2621340	-.156	-37.724114	-.987
A	b_1	.0041887	4.494*	.0039703	4.407*
IA	b_2	-.0000051	-1.675***	-.0000054	-1.828***
OA	b_3	.0001061	.581	.0002137	1.214
Iq	b_4	-.0008232	-2.838*	-.0006084	-1.922***
Oq	b_5	-.0001621	-.442	.0000818	.218
IM	b_6	-.0039368	-1.908***	-.0062652	-2.127**
POP	b_7	.0009292	1.728***	.0014395	1.965***
y	b_8	-.0070181	-2.939*	-.0059360	-2.527**
DN	b_9	3.5738950	.842	5.7653670	1.509
MC	b_{10}	.0052021	2.575*	.0076534	3.529*
CR5	b_{11}	-.0183640	-.813	...	...
HI	b_{12}	...	...	-1.4885070	-1.524
CO	b_{13}	2.1806260	1.641***	-.1200460	-.085

* Significant at 1%.

** Significant at 5%.

*** Significant at 10%.

sured by CR5, and column 2 gives the parameter estimates when concentration is measured by HI. The results from both columns 1 and 2 are quite similar and all significant parameters have expected signs.¹⁶ These results imply that firm advertising has a significant positive impact, concentration (whether measured by CR5 or HI) has an insignificant impact, and costs have a significant positive impact upon a firm's profit-maximizing price.

The impact of changes in concentration, advertising, and costs on beer prices between 1950 and 1977, with all other variables held constant, can be determined in the following way. A predicted mean price of beer is derived from equation (4), utilizing the parameter estimates in table 1. To generate this predicted price the concentration, advertising (both firm and rival), and marginal-cost explanatory variables are set equal to their actual observed values for each year. All remaining variables are held constant at their sample means, except for CO which is set equal to zero. The prices, predicted in this way, are designed to show the net effect of actual changes in concentration, advertising, and costs on beer prices over time, ceteris paribus. They are listed in table 2 and are defined as PCR5 and PHI when concentration is measured as CR5 and HI, respectively. In both cases these predicted beer prices rose from 1950 to 1964 and remained nearly constant from 1965 to 1971.

16. The positive and significant sign on the OA parameter supports the view that the brewing industry equilibrium may be polymorphic. See Hallagan and Joerding (1983) and Tremblay (in press).

TABLE 2 Predicted Average Beer Prices per Barrel in 1972 Dollars, 1950-77

Year	<i>PCR</i>	<i>PHI</i>
1950	24.704	27.203
1951	24.985	27.330
1952	25.212	27.358
1953	25.828	28.156
1954	27.631	30.396
1955	26.873	29.334
1956	27.775	30.383
1957	28.114	30.640
1958	28.068	30.451
1959	28.612	30.568
1960	28.958	30.905
1961	29.006	31.047
1962	29.850	31.828
1963	30.973	33.014
1964	31.727	33.881
1965	30.941	32.326
1966	30.872	31.924
1967	30.726	31.379
1968	31.309	31.351
1969	31.220	31.320
1970	32.337	31.665
1971	32.700	31.425
1972	31.746	29.515
1973	31.070	27.096
1974	30.635	25.038
1975	31.219	25.100
1976	30.286	24.751
1977	30.573	23.808

NOTE.—Concentration, advertising, and marginal costs are allowed to vary, and all other explanatory variables are held constant at their sample mean values.

Between 1950 and 1971 concentration and advertising expenditures rose and costs declined.¹⁷ Thus, even though rising concentration did not directly put upward pressure on prices, increases in advertising levels were sufficient to keep prices from falling in the wake of falling costs during this period. In support of Lynk's work which included data from 1974 to 1980, *PHI* began to fall after 1971; however, this is less evident in the *PCR5* index.

V. Conclusion

The purpose of this paper was to determine empirically how changes in both industry structure and firm conduct have affected brewing industry performance from 1950 to 1977. An attempt was made to develop a model which would avoid most of the methodological deficiencies

17. See Greer (1971a) for a discussion of the changes in concentration and advertising and Tremblay (1984) for a discussion of the changes in costs in brewing during this period.

found in Lynk's work. Lynk analyzed the effect that concentration had upon consumer welfare in the brewing industry, but the empirical results found in this research suggest that advertising, which was left out of Lynk's analysis, was also important. These results indicate that rising concentration has not had a significant impact upon beer prices, *ceteris paribus*. Perhaps the critical level of concentration has not yet been reached.¹⁸ In addition, the consequences of rising scale economies or large-firm cost superiority seem to have been sufficient to cause beer prices to fall only after 1971. Before then escalating advertising rivalry, which put upward pressure on prices, kept beer prices from falling.

Two implications result from this research. First, because of a number of weaknesses in Lynk's methodology, his model is incapable of testing the effect brewing industry structure and conduct changes have had on consumer welfare. However, in the overlapping time sequence of these two studies the results are quite similar. The net effect of concentration, advertising, and cost changes have caused beer prices to fall between 1972 and 1977. Second, the empirical results indicate that if Greer's contentions that rising concentration has led to greater advertising in brewing and that advertising has increased market power are true, then concern over rising concentration from 1950 to 1971 may have been warranted.¹⁹

Appendix

The Sample, Measurement of Variables, and Sources of Data

The number of firms available for this study was limited by the data availability for the output and advertising variables. *Advertising Age*, the source of these variables, only published brewery data when the firm's yearly output exceeded one million barrels (a barrel equals 31 gallons) of beer. A truncated sample exists when knowledge of variables is only available when output exceeds a certain level. If the usual least squares technique was used on such a sample, parameter estimates would have been biased. A number of relatively small breweries were contacted to see if the sample could be enlarged and made

18. See Geithman, Marvel, and Weiss (1981) for a discussion of critical concentration ratios.

19. Casual observation suggests that there is a quadratic relationship between advertising and concentration in brewing as hypothesized by Greer (1971b, 1981). Martin (1979a, 1979b) found support for this quadratic relationship in consumer-goods industries with a maximum advertising intensity occurring when the four-firm concentration ratio reached 45% to 50%. In brewing, maximum advertising occurred in the late 1960s when the four-firm concentration ratio approached 45%. If a quadratic relationship exists between concentration and advertising in brewing, and if mergers lead to a more rapid rise in concentration, then concern over rising concentration, especially in the 1960s, may have been warranted.

more representative. Two of these breweries agreed to provide data under the condition that their identities and data remain confidential.

It was maintained that the addition of these two smaller regionals eliminated the truncation problem. Brewers can be classified into groups of national, regional, and boutique brewers. Boutique brewers are not considered a part of the U.S. brewing industry since they offer expensive specialty products which compete mainly with imported brands. Thus the breweries of interest to this study include national and regional producers. With the addition of two small regionals, the sample becomes quite representative of the relevant U.S. brewers between 1950 and 1977.

The final sample included annual data from 22 brewing companies: three out of the four national producers, 17 large regional producers, and the two additional small regional brewers. Because data are not available for all 28 years between 1950 and 1977 for each company, the final sample included only 316 observations of pooled data. Data sources are listed below.

All prices were put in real terms by deflating them by the wholesale price index, taken from the U.S. Bureau of Labor Statistics. Physical output was measured in thousands of barrels of beer sold per year. These data were taken from *Advertising Age*. The price of a firm's representative product was defined as the average revenue of the firm. It was obtained by dividing total revenue (minus beer excise taxes) by the quantity of physical output. Revenue data were taken from *Moody's Industrial Manual* and *Moody's OTC Industrial Manual*.

A measure of advertising messages was developed in the following way. Firm advertising expenditures were taken from *Advertising Age*. They include firm expenditures on television, radio, and printed material; however, radio advertising expenditures were not available for 1950 through 1956, and newspaper advertising expenditures were not available for 1971. Advertising messages were obtained by dividing advertising expenditures by a price index for advertising. This variable was measured in thousands.

A number of steps were required to obtain a price index for advertising. Between 1950 and 1977 brewers typically used six media to advertise their products: national and spot television, national and spot radio, magazines, and newspapers. The price of advertising to a thousand media observers for each of these six media was taken from Schmalensee (1972) for 1950–1966 and Sterling and Haight (1978) for 1966–1977. A price index for each firm was developed by generating a weighted average price for all media for each year. The weights were defined as the ratio of advertising spending for a particular media to total advertising spending. Each firm may be an advertising price taker; nevertheless, this price index varied across firms since the price of advertising varied across media and each firm's media mix was unique. Measures of these weights were incomplete however because of a lack of data. Firm advertising expenditures by media were published by *National Advertising Investments*, but data were not available for 1950–1956, 1974, and 1976. Therefore, missing values for each firm were generated from predictions from the following regression. $ADM_{mt} = a_0 + a_1A_t + a_2q_t + a_3T_t + a_4T_t^2$ where ADM_{mt} equals the firm's advertising spending on media m in time period t , A_t equals the firm's total advertising spending in time period t , q_t equals the quantity of the firm's total physical output in time period t , and T equals a time trend. In order to obtain

the number of advertising messages per brand, the total number of brands sold by a firm was collected from *Moody's Industrial Manual* and *Moody's OTC Industrial Manual* and various firm reports.

Population was measured as the total U.S. population 20–44 years old and income was measured as per capita income. Both variables were measured in thousands and taken from the U.S. Bureau of the Census. Firm assets were measured in thousands of dollars and taken from *Moody's Industrial Manual* and *Moody's OTC Industrial Manual*.

A number of industry variables were used in this study. They included the five-firm concentration ratio taken from Ornstein (1981) and Greer (1971a), and the number of firms, industry output measured in thousands of barrels, and industry advertising expenditures measured in thousands of dollars, all of which were taken from *Brewers Almanac*.

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