# Entry Barriers, Concentration, and Profits*

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The conventional framework for cross-sectional studies of industrial organization focuses on the relations between market structure, firm conduct, and industry performance. Most research has emphasized investigation of the determinants of profitability, variously measured, as an index of industry performance. Although some attention has been given to the study of seller concentration (an endogenous structural element) and advertising intensity (conduct which may raise a barrier to entry), little attention has been paid to the problem of simultaneous causality among the three variables.[1]

We present below a discussion of the simultaneity problem, outlining a model within which advertising intensity, seller concentration, and profitability are considered endogenous. Earlier tests [14] of this model support the hypothesis that barriers to entry have no direct effect on profitability, but act indirectly, through concentration. We examine the robustness of this conclusion to the use of alternative measures of profitability.

## I. Advertising Intensity

According to the Dorfman-Steiner model of advertising intensity,[2] for any given level of the elasticity of demand with respect to advertising, advertising intensity will be greater the greater the price-cost margin:

$$ASR = ([P - MC]/P)\varepsilon_a \tag{1}$$

$ASR$ is the advertising sales ratio and $\varepsilon_a$ is the elasticity of demand with respect to advertising. Advertising intensity will thus be explained by profitability and, in a cross-sectional study, by variables describing the demand side of the market.

Advertising may also vary across industries with concentration. Firms in unconcentrated industries will advertise insofar as it is profitable for them to do so, along Dorfman-Steiner lines, where product is differentiated. Moderately concentrated industries may

* Useful comments from an anonymous referee are appreciated.

1. See Weiss [26;27] for surveys of the industrial organization literature; see Strickland and Weiss [23] and Martin [14] for treatments of the simultaneity problem.
2. See Martin [14] for an adaptation of the Dorfman-Steiner model to the Gaskins model discussed below.

exceed the joint profit maximizing level of advertising intensity, as oligopolistic discipline shackles price competition but not promotional rivalry. In highly concentrated industries, oligopoly coordination may be so great that advertising intensity will decline to the joint profit maximizing level [11; 23]. The expected relation between advertising and concentration is roughly quadratic: advertising intensity may rise as concentration reaches moderate levels, but decline thereafter.

Advertising will be explained, in general, by a relation of the form

$$ASR = f(PR, CR, D) \tag{2}$$

where $PR$ is some measure of profitability, $CR$ is seller concentration, and $D$ is a vector of variables describing the demand side of the market.

## II. Concentration

Concentration will vary across industries with the height of technical barriers to entry (minimum efficient scale, absolute capital requirements of a minimum efficient scale firm, cost disadvantage ratio) [2, 299; 16; 26, 384]. The more difficult entry into an industry, all else equal, the greater will be the concentration of sales.

To the extent that intensive advertising is associated with successful product differentiation, it will erect a barrier to entry, which should be conducive to greater concentration. On the other hand, advertising may serve as a tool of entry, or as an information disseminating device, which might ease entry conditions [3]. Concentration may be affected by advertising, but in principle the direction of the effect is uncertain.

Pashigian [19] asserts that in order to be useful, the limit price model must explain how and when entry occurs, given profit maximizing behavior of firms. Gaskins [10] develops a dynamic limit price model, which indicates [10, 317]

> . . . .growth of the product market not only raises the long-run price level . . . it also allows dominant firms with insignificant cost advantages to maintain a constant market share over the long haul.

In specifying a model for estimation,[3] suppose that there is a long-run market share for the dominant group, $CR^*$, which will vary across industries with the growth rate of sales and with the nature of barriers to entry. Suppose further that the current concentration ratio adapts partially to the long-run level in any period:

$$CR_t - CR_{t-1} = \lambda[CR^*(GR, BE) - CR_{t-1}] \tag{3}$$

Here $GR$ is the growth rate of industry sales, and BE is a vector of variables describing barriers to entry. The rate of adjustment parameter, $\lambda$, will vary across industries with the determinants of entry, which will include barriers to entry and historical profit margins: all else equal, greater past profitability will induce more rapid entry, reducing current concentration [17, 60]. Solving (3) for current concentration gives

$$CR_t = \lambda CR^*(GR, BE) + (1 - \lambda)CR_{t-1} \tag{4}$$

3. See Martin [14,9–10] for further discussion.

To capture variations in the rate of adjustment across industries, we specify in general

$$CR_t = g(GR,BE,PR_{t-1},CR_{t-1}) \tag{5}$$

**III. Profitability**

The static limit pricing model implies that the concentration-profit relation should depend on entry conditions [26, 376]:

> In the basic model rising concentration increases the ability of industry members to cooperate and to approach the maximum profit rates permitted by entry barriers. Thus profits should rise more rapidly with concentration, the higher the barriers to entry...

Research in the mainstream of empirical industrial organization studies, discussed by Weiss [26, 375-78], has tested this model. For our purposes, we specify

$$PR = h(CR,BE,D) \tag{6}$$

However, the independent role of barriers to entry is not universally accepted. High barriers to entry in the absence of concentration will not allow high profitability, since the competition of firms within the industry will yield competitive performance [1, 30]. On the other hand, the implication of the Gaskins model is that high concentration with low barriers to entry will allow high profitability, because entry occurs at a limited rate and does not eliminate the power of a dominant group to operate along a residual demand curve [10, 320]:

> The major substantive changes in the optimal pricing strategy resulting from growth of the product market are that the equilibrium price is raised above the limit price, and that dominant firms with no cost advantage no longer price themselves out of the market in the long-run.

Rhoades [20] has challenged the independent role of barriers to entry; Orr [18, 43] regards the expected relation between barriers to entry and profitability as ambiguous.

Following Martin [14], we specify as an alternative to (6)

$$PR = h(CR,D) \tag{7}$$

and propose to test the independent effect of barriers to entry on profitability.

Equations (2), (5) and (6) (alternatively (7)) constitute a simultaneous equations formulation of the structure-conduct-performance framework for industry analysis (illustrated in Figure 1).

Perhaps the most interesting question which can be addressed in the context of this model involves the existence of a direct effect of barriers to entry on profitability, independent of concentration. We may also examine the entry-inducing effect of historical profitability, and the dynamic adjustment of concentration over time.

Although the question of proper functional form for the estimating equations is of considerable interest [26, 376–78], we will specify linear forms (except as noted above for the quadratic relation of concentration to advertising).[4] The problems raised by nonlinear func-

4. A linear functional form will not impose the constraint that concentration range between 0 and 100 (percent), although the fitted values from the estimates presented below obey this constraint. Variations on the linear logit form can impose this constraint.

tional forms in a simultaneous causality model deserve separate treatment. Linear estimating equations may be regarded as approximations to more general functional forms.

## IV. Profit Measures

Four measures of profitability have been widely employed in empirical studies of industrial organization [25, 52–3; 27, 196–200].

Collins and Preston [5; 6] defend the use of a price-cost margin as "most closely related to the theoretical predictions" [5, 13]. The price-cost margin is constructed from Census of Manufactures data as (with occasional variations)

$$(VA - W - IR)/VS \tag{8}$$

where $VA$ is value added, $W$ is payroll, $IR$ is an imputed rental for capital services, and $VS$ is value of shipments. As noted by Weiss [27, 199] and others, this measure includes in the numerator taxes and expenditures on advertising, central office expense, research and development, and depreciation. Following Weiss [27, 227] we refine the price-cost margin by subtracting the advertising-sales ratio, described below. The first profit measure used in this study is

$$PR1 = (VA - W - IR)/VS - ASR \tag{9}$$

The price-cost margin is an empirical analogue of Lerner's degree of monopoly index, which is the price-marginal cost margin [5, 13]. With the qualifications noted above, $PR1$ is a price-average cost margin. Constructed from information referring to plants rather than firms, it avoids the problems associated with the classification of multi-industry firms in a single industry, inherent in Internal Revenue Service data. The price-cost margin is aggregated by value of shipments to correspond to IRS minor industries.

From the IRS Sourcebook of Statistics of Income, we compute

$$PR2 = PR/S \qquad PR3 = (PR - T)/S \tag{10}$$

The rate of profit ($PR$) on sales ($S$) is computed for firms with assets over \$500,000 (as are all variables derived from IRS data). $PR3$ is the after tax ($T$) rate of return on sales. Since the rate of return on sales is, like $PR1$, a price-average cost margin,[5] $PR1$ and $PR2$ in principle measure the same concept of profitability. Their comparison will serve to contrast the data sources from which they are derived.[6]

The case for rates of profit on stockholders's equity ($SE$)

$$PR4 = PR/SE \qquad PR5 = (PR - T)/SE \tag{11}$$

is put by Comanor and Wilson [7, 427]:

5. Since profit is the difference between revenue and cost, we may write in obvious notation

$$PR2 = \frac{PR}{S} = \frac{PQ - C(Q)}{PQ} = \frac{P - AC(Q)}{P}$$

so that the rate of return on sales is a price-average cost margin. Subject to the qualification in the text concerning the numerator of PR1, PR1 is also a price-average cost margin.

6. Weiss [27,199] regards the Census of Manufactures as the more reliable source.

> . . . firms presumably maximize profits, rather than the sum of profits plus interest payments. The rate of return on stockholders' equity will therefore be a more sensitive indicator of the extent of freedom from competitive constraints.[7]

In contrast, Stigler [22, 124] argues:

> If lenders correctly estimate future risks on average, therfore, we should expect them to demand a nominally higher rate when they are asked to assume larger risks. If the rate is higher only by the actuarial value of future risks, we would say there is no risk aversion. In this case we would expect the net realized rate of return to be independent of the relevant amounts of borrowed funds and entrepreneurial equity in an industry. . . . the essential symmetry in the theory of interindustry allocation of loan funds and equity funds supports the view that they should be combined in calculating the rate of return.

Thus the total return (profit plus interest payments) on all assets provides a measure of profitability which corrects for differences in leverage across industries. From IRS data, we compute

$$PR6 = (PR + I)/A \qquad PR7 = (PR + I - T)/A \tag{12}$$

where as before $PR$ is before tax profit, $I$ is interest payments, $T$ is tax payments, and $A$ is total assets.

We thus have seven measures of profitability, to be used within the framework (2), (5) and (6). This will allow testing the robustness of estimates comparing (6) and (7) to the use of alternative measures of profitability. Comparison of $PR1$ and $PR2$ will allow evaluation of the effect of classification of multiproduct firms within a single industry for IRS data. Comparison of results using $PR1$ with estimates obtained for the same model with less aggregated data will indicate the consequences of working with IRS minor industries.

The sample properties of the seven profit measures are described in Table I. $PR1$, based on plant data from the Census of Manufactures, is much less correlated with any of the variables based on IRS firm data than the IRS variables are correlated with each other. Although $PR1$ and $PR2$ are both price-average cost margins, they behave very differently. The larger mean for $PR1$ reflects the inclusion of certain items in the numerator (central office expense, research and development expense, depreciation) which ought in principle to be deducted and which are deducted for $PR2$. As ought to be expected, the profit rates on sales have lower means than the profit rates on either equity or assets.

If the theoretical symmetry in the theory of the interindustry allocation of loan and equity funds cited by Stigler were reflected in the data, we would expect $PR4$ and $PR6$ (or $PR5$ and $PR7$) to behave in essentially the same way. Although the pairs are highly correlated, the means are quite different; the higher mean rate of return on equity makes use of the rate of return on assets suspect.

## V. Other Variables

Besides the variables endogenous to the system (profitability, concentration, and advertising intensity), we require variables describing demand characteristics of different industries (see

7. See also Hall and Weiss [12,320].

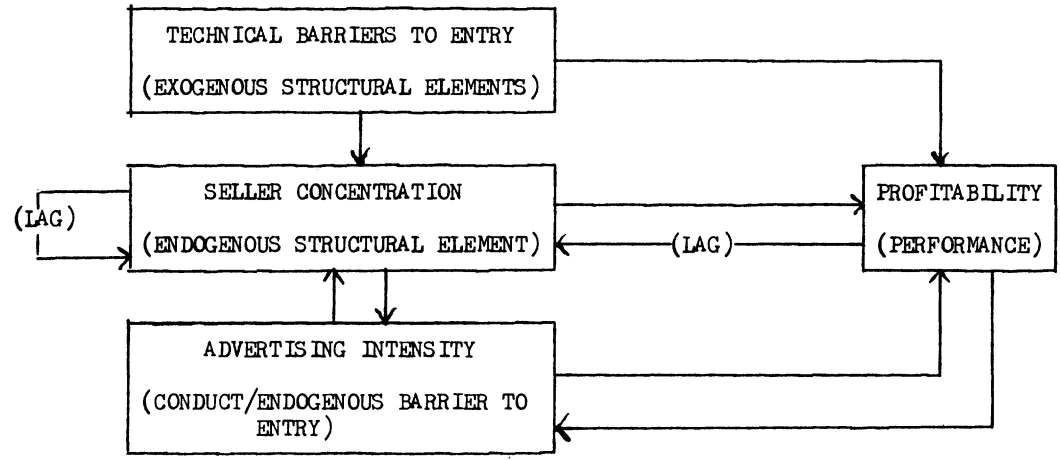


**Figure 1:** Structure-Conduct-Performance Framework

(2) and (6) or (7)) and variables quantifying the nature of barriers to entry across industries (see (5), (6)). A common characteristic of empirical studies of industrial organization is the use of relatively few such variables, selected according to the emphasis of different studies [14]. To the extent that relevant explanatory variables are omitted, estimates obtained will be inconsistent; we have thus collected as many of the exogenous variables included in previous studies as possible, subject to sample size and data quality limitations.

The four firm concentration ratio (*CR*4), originally reported in the Census of Manufactures, is taken from Ornstein [15]. It reports the percentage of industry value added accounted for by the largest four firms in an industry. Census of Manufactures data are aggregated by value of shipments to obtain weighted average concentration ratios for IRS minor industries.

Among barrier to entry variables we include minimum efficient scale (*MES*), absolute capital requirements (*ACR*), the cost disadvantage ratio (*CDR*) and the advertising-sales ratio (*ASR*).

We measure minimum efficient scale as the average sales per firm for firms in the midpoint size class,[8] as a percentage of industry sales.

The absolute capital requirements of a minimum efficient scale firm are calculated as the product of the industry capital-sales ratio and the sales of a minimum efficient scale firm. MES and ACR are thus functionally but not linearly related; their correlation coefficient in this sample is 0.47.

The cost disadvantage ratio was introduced by Caves, Khalilzaden-Shiraz, and Porter [4]. It is value added per worker in larger plants accounting for at least 50 percent of industry output, divided into value added per worker in remaining smaller plants. A larger cost disadvantage ratio thus indicates that smaller plants are more nearly on an equal footing with larger plants. The cost disadvantage ratio may be thought of as quantifying the slope of the average cost curve below minimum efficient scale output. Following Caves et al., we constrain the cost disadvantage ratio to be less than or equal to 100 (measured in percent). The cost disadvantage ratio is computed from Census of Manufactures data, and aggregated to the IRS minor industry level.

8. Half of industry shipments come from plants larger than the midpoint size plant; see Caves et al. [4,134–35] for a discussion of the estimation of MES from aggregate data.

Variables quantifying the demand characteristics of the different industries are the advertising-sales ratio (*ASR*), the buyer concentration ratio (*BCR*), the growth rate of sales (*GR*), the percentage of sales going to final consumer demand (*CDS*), a producer-consumer good industry dummy (*PCD*) and a durable-nondurable good industry dummy (*DUR*).

The buyer concentration ratio, approximately describing the share of industry output going to the largest four consumers, was computed by aggregating the data of Lustgarten [13]; the definition and details of construction are discussed there.

*GR* is the growth rate of industry sales between 1963 and 1967.

The percentage of sales going to final consumer demand is calculated by aggregating information provided for detailed industries in the input-output tables for the United States [24]. Use of this variable tests for continuous variation in dependent variables as more and more output goes to final consumption demand. To test for a discontinuous variation, a producer good dummy was set equal to one if the percentage of sales going to final consumption demand was less than 40 percent, and zero otherwise. 52 of the 72 IRS minor industries in the sample are producer good industries.

The classification of industries as producing durable or nondurable goods follows Ornstein [15]. *DUR* was set equal to one for the 20 industries in the sample classified as producing durable goods, and zero otherwise.

As noted by Weiss [27, 198–9], when either the rate of return on sales or the price-cost margin is used to measure profitability, some allowance must be made for the normal rate of return on capital. For comparability, we include in all tests the capital-sales ratio as an explanatory variable for profitability. *KSR* is, from IRS data, assets divided by sales for firms with assets not less than $500,000.

It is necessary to correct the national concentration ratio when the industry in question is regional in nature; for this purpose we employ a regional dummy (*REG*), set equal to one for the 19 industries in the sample which according to Schwartzman and Bodoff [21] are regional in nature.

Table II describes the sale properties of the data.

## VI. An Empirical Test

Table III gives the linear (except as noted for (13)) version of the system (2), (5) and (6) within which the seven alternative profit measures will be compared.

There are fourteen instrumental variables in the system, and no equation has more than twelve coefficients to be estimated. Order conditions for identification are satisfied for all equations.

*DUR* appears only in (13), *CR*463 and *PR*63 appear only in (14), and *KSR* appears only in (15). Rank conditions for identification are satisfied for all equations.[9]

In the concentration equation, we include *PR*63 times *PCD* as an explanatory variable, to allow for a possible differential entry effect for producer and consumer goods.

Consistent estimates for the structural equations were obtained using two-stage least squares.

9. The nonlinearity in (13) does not upset identification of the equations; see Fisher [9, 127–51]. The question of identification is far from trivial; the profitability equation of the Strickland-Weiss [23] model fails the rank condition and is not identified; see Martin [14].

**Table I.** Profit Measures

| | Correlation Coefficient | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PR1 | PR2 | PR3 | PR4 | PR5 | PR6 | PR7 | Mean | Standard Deviation |
| PR1 | 1.0000 | 0.5196 | 0.4846 | 0.2722 | 0.2423 | 0.3505 | 0.3037 | 25.3561 | 7.5148 |
| PR2 | | 1.0000 | 0.9867 | 0.7854 | 0.7676 | 0.7898 | 0.7519 | 7.4368 | 3.7244 |
| PR3 | | | 1.0000 | 0.7478 | 0.7621 | 0.7596 | 0.7448 | 4.0996 | 2.0173 |
| PR4 | | | | 1.0000 | 0.9743 | 0.8688 | 0.8316 | 17.5800 | 6.4767 |
| PR5 | | | | | 1.0000 | 0.8458 | 0.8426 | 9.6807 | 3.4453 |
| PR6 | | | | | | 1.0000 | 0.9844 | 11.6102 | 4.8356 |
| PR7 | | | | | | | 1.0000 | 6.9909 | 2.5444 |

(1) Profit variables defined in text.
(2) All profit variables measured in percent.
(3) PR1 is computed from Census of Manufactures data; all others are computed from IRS data, for firms with assets not less than $500,000.

**Table II.** Variables Other Than Profit

| | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|
| ASR | 0.2208 | 10.8961 | 1.8714 | 2.0692 |
| CR467 | 12 | 74 | 38.5139 | 16.1710 |
| CDS | 0 | 97 | 25.3056 | 31.2101 |
| BCR | 2.42 | 88.25 | 21.9219 | 18.8692 |
| GR | -20.3738 | 123.056 | 33.0222 | 27.6052 |
| MES | 0.0002 | 0.5691 | 0.0304 | 0.0733 |
| ACR | 0.0070 | 6.5170 | 0.5652 | 1.0419 |
| CDR | 49 | 100 | 89.4861 | 11.1268 |
| KSR | 20.2342 | 170.232 | 74.6476 | 25.0489 |
| DUR | 0 | 1 | 0.2778 | 0.4479 |
| REG | 0 | 1 | 0.2639 | 0.4407 |
| PCD | 0 | 1 | 0.7222 | 0.4479 |

(1) All variables are measured in percent, except ACR which is measured in million dollars, and the dummy variables.
(2) DUR = 1 if durable, 0 otherwise
REG = 1 if a regional industry, 0 otherwise
PCD = 1 if a producer good industry, 0 otherwise

### *Advertising*

Table IV shows estimates of the advertising equation for seven alternative profit measures.

It is apparent that producer goods are advertised significantly less than consumer goods; as the coefficient of CDS is never statistically significant, it would appear that the producer good dummy captures most of this effect.

Durable goods are advertised less than nondurable goods, although the coefficients are significant only for the rates of return on stockholders's equity.

All measures of profitability have coefficients which are highly significant. The estimated coefficient of $PR1$ is much smaller than those of the IRS measures; this reflects the larger magnitude of $PR1$.

The hypothesis of a quadratic relation between concentration and advertising is supported for this sample; the linear and quadratic concentration terms have statistically signifi-

**Table III.** Estimating Equations

$$(13)\quad \mathrm{ASR} = a_0 + \underset{(-)}{a_1\mathrm{PCD}} + \underset{(-)}{a_2\mathrm{DUR}} + \underset{(+)}{a_3\mathrm{PR67}} + \underset{(+)}{a_4\mathrm{CR467}} + \underset{(-)}{a_5\overline{\mathrm{CR467}}^2} + \underset{(+)}{a_6\mathrm{CDS}} + \underset{(-)}{a_7\mathrm{BCR}} + \underset{(+)}{a_8\mathrm{GR}}$$

$$(14)\quad \mathrm{CR467} = b_0 + \underset{(?)}{b_1\mathrm{PCD}} + \underset{(-)}{b_2\mathrm{REG}} + \underset{(-)}{b_3\mathrm{PR63}} + \underset{(?)}{b_4(\mathrm{PR63})(\mathrm{PCD})} + \underset{(+)}{b_5\mathrm{CR463}} + \underset{(?)}{b_6\mathrm{ASR}} + \underset{(-)}{b_7\mathrm{GR}}$$
$$+ \underset{(+)}{b_8\mathrm{MES}} + \underset{(+)}{b_9\mathrm{ACR}} + \underset{(-)}{b_{10}\mathrm{CDR}}$$

$$(15)\quad \mathrm{PR67} = c_0 + \underset{(?)}{c_1\mathrm{PCD}} + \underset{(+)}{c_2\mathrm{REG}} + \underset{(+)}{c_3\mathrm{CR467}} + \underset{(?)}{c_4\mathrm{ASR}} + \underset{(+)}{c_5\mathrm{CDS}} + \underset{(-)}{c_6\mathrm{BCR}} + \underset{(+)}{c_7\mathrm{GR}} + \underset{(+)}{c_8\mathrm{KSR}}$$
$$+ \underset{(+)}{c_9\mathrm{MES}} + \underset{(+)}{c_{10}\mathrm{ACR}} + \underset{(-)}{c_{11}\mathrm{CDR}}$$

(1) No-effect model: $c_9 = c_{10} = c_{11} = 0$.
(2) Marks in parentheses indicate expected sign of coefficient

**Table IV.** Advertising Equation Estimates

| | PR1 | PR2 | PR3 | PR4 | PR5 | PR6 | PR7 |
|---|---|---|---|---|---|---|---|
| C | -2.3097 (0.8658) | -1.0092 (0.4300) | -1.3492 (0.5623) | -2.2930 (0.9189) | -2.9422 (1.1182) | -1.9732 (0.7986) | -2.6477 (1.0091) |
| PCD | -2.1374** (1.6521) | -2.2839** (1.9328) | -2.1262** (1.7714) | -1.9990** (1.6757) | -1.7350* (1.4136) | -1.9378* (1.6299) | -1.7046 (1.3687) |
| DUR | -0.3551 (0.7968) | -0.3280 (0.8081) | -0.2811 (0.6767) | -0.6590* (1.5781) | -0.6748* (1.5612) | -0.2792 (0.6734) | -0.2551 (0.5856) |
| PR67 | 0.0953** (3.3045) | 0.2838** (4.1979) | 0.5427** (4.2298) | 0.1894** (4.2282) | 0.3788** (4.3580) | 0.2628** (4.7843) | 0.5417 (4.6359) |
| CR467 | 0.1635 (1.2614) | 0.1536* (1.4063) | 0.1543* (1.3937) | 0.1796* (1.5838) | 0.1843* (1.5762) | 0.1458 (1.2580) | 0.1289 (1.0785) |
| $\overline{CR467}^2$ | -0.001683 (1.1090) | -0.001708* (1.3230) | -0.001704* (1.3013) | -0.001936* (1.4406) | -0.001967* (1.4204) | -0.001513 (1.1089) | -0.001288 (0.9140) |
| CDS | 0.0076 (0.4051) | 0.0054 (0.3130) | 0.0082 (0.4662) | -0.0070 (0.3836) | -0.0048 (0.2588) | -0.0003 (0.0172) | 0.0020 (0.1083) |
| BCR | 0.0015 (0.1099) | -0.0052 (0.4483) | -0.0057 (0.4790) | -0.0138 (1.1558) | -0.0154 (1.2420) | -0.0064 (0.5372) | -0.0061 (0.4898) |
| GR | -0.0054 (0.7436) | -0.0135** (1.9060) | -0.0134** (1.8554) | -0.0181** (2.3511) | -0.0186** (2.3579) | -0.0169** (2.2794) | -0.0182** (2.3092) |
| SSR | 155.762 | 130.178 | 135.967 | 135.336 | 144.786 | 135.079 | 149.228 |
| $R^2$ | 0.4947 | 0.5777 | 0.5589 | 0.5610 | 0.5303 | 0.5618 | 0.5159 |
| DF | 63 | 63 | 63 | 63 | 63 | 63 | 63 |

t-statistics in parentheses
* Indicates coefficient significant at the .1 level
** Indicates coefficient significant at the .05 level

cant coefficients for four of the seven profitability measures. The critical concentration level, beyond which increasing concentration begins to reduce advertising, ranges from 45 to 50 percent, depending on the profitability measure used.

The coefficient of the growth rate of sales is statistically significant for all equations using profitability measures derived from IRS data.

In terms of sums of squared residuals, the before tax rate of profit on sales (*PR*2) generates estimates with the greatest explanatory power. In the rate of return on sale equations (*PR*2 and *PR*3), five of the nine coefficients are statistically significant; in the rate of return on stockholder's equity equations, six of the estimated coefficients are statistically significant.

## *Concentration*

Estimates of the concentration equation are shown in Table V.

The coefficient of lagged profitability measures the induced entry effect for consumer good industries; the coefficient is negative, as expected, but not statistically significant. The

**Table V.** Concentration Equation Estimates

| | PR1 | PR2 | PR3 | PR4 | PR5 | PR6 | PR7 |
|---|---|---|---|---|---|---|---|
| C | 19.3729** (2.4853) | 10.5032* (1.4308) | 9.6929 (1.2166) | 12.7490** (1.8113) | 12.5274** (1.7794) | 10.9021* (1.4982) | 11.2133* (1.5675) |
| PCD | -4.3384 (0.9561) | 3.0511 (0.9685) | 2.2663 (0.7315) | 3.1062 (0.5685) | 1.9146 (0.3589) | 4.4565 (0.9775) | 4.4877 (0.8897) |
| REG | 0.1105 (0.0673) | 0.9457 (0.5546) | 1.1791 (0.6584) | 0.7920 (0.4670) | 1.2928 (0.6751) | 1.1780 (0.6347) | 1.4962 (0.7755) |
| PR63 | -0.2226 (1.0814) | -0.1240 (0.1666) | -0.6634 (0.4034) | -0.1653 (0.3495) | -0.5345 (0.5362) | -0.3244 (0.5161) | -0.7216 (0.5681) |
| (PR63)(PCD) | 0.2024 (0.9251) | -0.3202 (0.4463) | -0.1842 (0.1167) | -0.1662 (0.3841) | -0.1248 (0.1363) | -0.2991 (0.5070) | -0.5425 (0.4552) |
| CR463 | 0.9116** (19.6712) | 0.9439** (19.8383) | 0.9455** (19.4415) | 0.9508** (19.8897) | 0.9594** (19.3330) | 0.9577** (20.2803) | 0.9617** (20.4143) |
| ASR | 0.4185 (0.5966) | 0.5751 (0.5620) | 0.7949 (0.6836) | 0.7330 (0.6320) | 0.8777 (0.6993) | 0.9992 (0.8373) | 0.9537 (0.8060) |
| GR | 0.0283 (1.1913) | 0.0403* (1.6338) | 0.0387* (1.5425) | 0.0394* (1.6021) | 0.0347* (1.4354) | 0.0387* (1.6447) | 0.0332* (1.4440) |
| MES | 2.5932 (0.2800) | 2.0853 (0.2268) | 2.1305 (0.2264) | 2.8298 (0.3077) | 2.9531 (0.3170) | 7.0049 (0.7626) | 12.0565 (0.2746) |
| ACR | 0.9730 (1.2769) | 0.4772 (0.7243) | 0.5299 (0.7856) | 0.3154 (0.4730) | 0.3450 (0.5201) | 0.2254 (0.3441) | 0.1576 (0.2421) |
| CDR | -0.1475** (2.2936) | -0.1207** (1.6997) | -0.1079* (1.3891) | -0.1306** (1.8205) | -0.1200* (1.5144) | -0.1171* (1.4595) | -0.1131* (1.3630) |
| SSR | 1408.45 | 1377.92 | 1429.00 | 1373.67 | 1387.56 | 1346.79 | 1313.61 |
| $R^2$ | 0.9252 | 0.9268 | 0.9241 | 0.9270 | 0.9263 | 0.9285 | 0.9302 |
| DF | 61 | 61 | 61 | 61 | 61 | 61 | 61 |

t-statistics in parentheses
* Indicates coefficient significant at the .1 level
** Indicates coefficient significant at the .05 level

sum of the two coefficients involving lagged profitability measures the induced entry effect for producer good industries; this sum is negative for all profitability measures, and highly significant for all measures derived from IRS data.[10]

The estimated coefficient of lagged concentration is always positive, highly significant, and less than one.[11] Regarding the coefficient of lagged concentration as a partial adjustment coefficient, averaged across industries, the indicated adjustment time to long-run concentra-

10. T-statistics under the hypothesis that the true value of the sum of the two coefficients is zero are: *PR*1 – 0.1955; *PR*2 – 2.2288; *PR*3 – 2.2048; *PR*4 – 2.4509; *PR*5 – 2.5097; *PR*6 – 3.2627; *PR*7 – 3.3304. The sum is thus significantly different from zero for all profitability measures except *PR*1.

11. T-statistics under the hypothesis that the true value of the coefficient is one are: *PR*1 – 1.9075; *PR*2 – 1.1796; *PR*3 – 1.1216; *PR*4 – 1.0301; *PR*5 – 0.8183; *PR*6 – 0.8958; *PR*7 – 0.8132.

tion levels is extremely long. In fact, of course, the rate of entry into any industry will vary with the barriers of entry into that industry.

The estimated coefficient of advertising is consistently positive, but never statistically significant. The coefficients of the growth rate of sales, statistically significant for profitability measures computed from IRS data, are not of the expected sign. The coefficients of the three barrier to entry variables are of expected sign, and the coefficient of the cost disadvantage ratio is significantly different from zero.

The explanatory power of the equations estimated using alternative profitability measures varies little; the after tax rate of return on assets (*PR*7) minimizes the sum of squared residuals. However, the estimated coefficients of *MES* are very much larger in the asset rate equations than when other rates represent profitability. Most of the explanatory power of the equations using rates of return on stockholder's equity and assets seems due to the lagged concentration term.

*Profitability*

Table VI presents estimates of the structural profitability equation, under the specification that there is no direct influence of barriers to entry on profitability; Table VII gives estimates when the possibility of such a role is admitted.

Comparing the equations for the different profitability measures in the two tables, it is evident that the model which specifies only an indirect influence of barriers to entry provides a much stronger explanation of variations in profitability (in terms of sums of squared residuals) than the direct effect model. Further, in Table VII, no coefficient of a barrier to entry variable is statistically significant and of correct sign for any measure of profitability. For this sample, there is no evidence of a direct effect of barriers to entry on profitability.

Examining the no-effect estimates, the price-average cost margin equations (*PR*1, *PR*2, and *PR*3) indicate that producer goods industries are more profitable than consumer good industries; only for the PR1 equation is the coefficient of *CD*/*S* statistically significant. The effect of concentration is positive for the price-average cost measures, negative otherwise, and in any event not statistically significant.

Advertising has a large effect on profitability, however measured, and an effect which is statistically significant for those variables derived from IRS data.

Among variables quantifying the demand side of the market, CDS and BCR are statistically significant only for *PR*1, while *GR* is statistically significant for all profitability measures except *PR*1.

For the three price-average cost margin variables (*PR*1, *PR*2, *PR*3), the capital-sales ratio (*KSR*) appears as an explanatory variable to allow for a normal rate of return on capital. The estimated coefficient is positive, but statistically significant only for *PR*1. The estimated coefficients of KSR for the remaining profitability measures are negative and statistically significant. This may be a mathematical artifact (since *K* appears in the numerator of *KSR* and as all or part of the denominator of *PR*4, *PR*5, *PR*6, and *PR*7) or it may reflect some other influence.

Since the dependent variables in Table VI differ from equation to equation, the sums of squared residuals cannot be used to compare explanatory power. Comparing $R^2$ across equations, the before tax rate of return on stockholders's equity (*PR*4) is best explained by the no-effect model. Across pairs of equations, the model is stronger for before than after tax rates

**Table VI.** No-effect Profitability Equation Estimates

| | PR1 | PR2 | PR3 | PR4 | PR5 | PR6 | PR7 |
|---|---|---|---|---|---|---|---|
| C | -8.3140<br>(0.9549) | -2.0041<br>(0.4598) | -1.0206<br>(0.4167) | 15.9374**<br>(2.1464) | 9.1213**<br>(2.2381) | 7.9629*<br>(1.3911) | 5.5072**<br>(1.7580) |
| PCD | 14.4871**<br>(2.8244) | 5.3825**<br>(2.0963) | 2.6766**<br>(1.8550) | 3.9417<br>(0.9011) | 1.4969<br>(0.6234) | 4.5123*<br>(1.3380) | 1.8889<br>(1.0235) |
| REG | 3.7364<br>(1.0907) | -0.1932<br>(0.1127) | 0.1210<br>(0.1256) | -2.3181<br>(0.7935) | -0.7635<br>(0.4761) | -0.6491<br>(0.2882) | -0.1653<br>(0.1341) |
| CR467 | 0.1937<br>(0.8838) | 0.0209<br>(0.1905) | 0.0219<br>(0.3557) | -0.1196<br>(0.6399) | -0.0470<br>(0.4580) | -0.0204<br>(0.1415) | -0.0001<br>(0.0013) |
| ASR | 1.7830<br>(1.1134) | 1.5828**<br>(1.9744) | 0.8233**<br>(1.8275) | 2.9750**<br>(2.1783) | 1.6355**<br>(2.1816) | 2.5747**<br>(2.4453) | 1.3220**<br>(2.2942) |
| CDS | 0.1350*<br>(1.5789) | 0.0087<br>(0.2023) | 0.0005<br>(0.0189) | 0.0002<br>(0.0024) | -0.0123<br>(0.3064) | -0.0233<br>(0.4152) | -0.0191<br>(0.6220) |
| BCR | -0.0934*<br>(1.3669) | -0.0040<br>(0.1171) | -0.0036<br>(0.1865) | 0.0427<br>(0.7323) | 0.0222<br>(0.6935) | -0.0163<br>(0.3638) | -0.0122<br>(0.4947) |
| GR | 0.0110<br>(0.2964) | 0.0440**<br>(2.3651) | 0.0211**<br>(2.0185) | 0.1113**<br>(3.5149) | 0.0555**<br>(3.1930) | 0.0640**<br>(2.6225) | 0.0320**<br>(2.3930) |
| KSR | 0.1298**<br>(3.3514) | 0.0034<br>(0.1754) | 0.0019<br>(0.1725) | -0.0826**<br>(2.5015) | -0.0480**<br>(2.6448) | -0.0621**<br>(2.4404) | -0.0350**<br>(2.5111) |
| SSR | 2464.97 | 617.679 | 195.060 | 1792.73 | 540.119 | 1065.50 | 319.110 |
| $R^2$ | 0.3938 | 0.3815 | 0.3343 | 0.4064 | 0.3680 | 0.3671 | 0.3154 |
| DF | 63 | 63 | 63 | 63 | 63 | 63 | 63 |

t-statistics in parentheses
* Indicates coefficient significant at the .1 level
** Indicates coefficient significant at the .05 level

of return. The price-cost margin, *PR*1, has the greatest number of estimated coefficients which are both statistically significant and of expected sign.

*Robustness of Results*

The primary results of the tests made with this sample seem invariant to the use of alternative profitability measures.

Concentration bears a quadratic relation to advertising intensity, and profitability is a significant explanatory variable, no matter which profitability measure is used in the advertising equation.

In the concentration equation, all measures of profitability show an induced entry effect, accompanied by slow adjustment of concentration to long-run levels which are determined most significantly by the growth rate of sales and the cost disadvantage ratio.

No one of the profitability measures indicates an independent influence of barriers to entry on profitability. All measures of profitability are explained by advertising intensity or one of the demand-characteristic variables (*CDS*, *BCR*, or *GR*) in a significant way.

**Table VII. Direct-Effect Profitability Equation Estimates**

| | PR1 | PR2 | PR3 | PR4 | PR5 | PR6 | PR7 |
|---|---|---|---|---|---|---|---|
| C | -34.7346 | -20.7378* | -10.0595 | -6.1836 | 0.6640 | -1.4100 | 3.3109 |
| | (1.0442) | (1.3130) | (1.1819) | (0.4128) | (0.0823) | (0.1208) | (0.5634) |
| PCD | 23.7759** | 10.0859** | 5.0548* | 8.3749* | 3.2903 | 6.7063* | 2.5189 |
| | (1.9412) | (1.7423) | (1.6144) | (1.4258) | (1.0326) | (1.4572) | (1.0853) |
| REG | 2.3683 | 0.6882 | 0.3715 | 0.5490 | 0.3014 | -0.0569 | -0.2101 |
| | (0.4969) | (0.3042) | (0.3027) | (0.2297) | (0.2315) | (0.0302) | (0.2211) |
| CR467 | -0.1439 | -0.0046 | -0.0070 | 0.0299 | 0.0049 | -0.0158 | -0.0162 |
| | (0.9547) | (0.0651) | (0.1836) | (0.4022) | (0.1216) | (0.2718) | (0.5517) |
| ASR | 8.8549** | 4.4237** | 2.3441** | 4.8833** | 2.4845** | 3.8068** | 1.7755** |
| | (2.6526) | (2.8427) | (2.8270) | (4.1172) | (4.0197) | (4.2915) | (4.0221) |
| CDS | 0.0130 | -0.0334 | -0.0230 | -0.0229 | -0.0244 | -0.0402 | -0.0267 |
| | (0.0739) | (0.4015) | (0.5097) | (0.2624) | (0.5157) | (0.5880) | (0.7740) |
| BCR | -0.0424 | -0.0092 | -0.0032 | 0.0037 | 0.0081 | -0.0222 | -0.0107 |
| | (0.3663) | (0.1684) | (0.1085) | (0.0626) | (0.2554) | (0.4820) | (0.4579) |
| GR | 0.1018* | 0.0718** | 0.0370** | 0.1145** | 0.0573** | 0.0751** | 0.0371** |
| | (1.3832) | (2.0770) | (1.9832) | (3.2640) | (3.0146) | (2.7371) | (2.6820) |
| KSR | 0.0399 | -0.0440 | -0.0222 | -0.1304** | -0.0679** | -0.0842** | -0.0416** |
| | (0.4316) | (1.0083) | (0.9416) | (3.0782) | (2.9691) | (2.5497) | (2.5015) |
| MES | 4.7773 | 1.9534 | 0.4874 | 3.3083 | 0.8078 | 1.0795 | -0.4231 |
| | (0.1818) | (0.1572) | (0.0723) | (0.2495) | (0.1118) | (0.1034) | (0.0803) |
| ACR | 1.3033 | 0.1450 | 0.1384 | -0.5193 | -0.1741 | 0.0069 | 0.0749 |
| | (0.6785) | (0.1600) | (0.2813) | (0.5373) | (0.3307) | (0.0091) | (0.1950) |
| CDR | 0.2754 | 0.1612* | 0.0814 | 0.1556* | 0.0605 | 0.0777 | 0.0221 |
| | (1.0626) | (1.3146) | (1.2340) | (1.3828) | (1.0016) | (0.8910) | (0.5048) |
| SSR | 10857.3 | 2426.79 | 714.884 | 2769.05 | 822.414 | 1716.18 | 437.567 |
| $R^2$ | -1.6703 | -1.4299 | -1.4399 | 0.0832 | 0.0377 | -0.0194 | 0.0613 |
| DF | 60 | 60 | 60 | 60 | 60 | 60 | 60 |

t-statistics in parentheses
* Indicates coefficient significant at the .1 level
** Indicates coefficient significant at the .05 level

What differences consistently appear seem to be between *PR*1, which is computed from Census of Manufactures's data, and the remaining profitability measures, which are calculated from Internal Revenue sources.

## *Aggregation*

Table VIII gives estimates obtained when the three equation system is estimated for a sample of 209 input-output tables industries, corresponding roughly to 4-digit SIC industries. The sample is described in detail in Martin [14]. All variable definitions correspond to

**Table VIII.** Input-Output Industry Sample

| | ASR | CR467 | PR167 | PR167 |
|---|---|---|---|---|
| C | -0.1613 | 7.3485 | 2.8836 | -21.7731* |
| | (0.1123) | (1.2511) | (0.8195) | (1.6321) |
| PCD | -1.9856** | 8.1099 | 10.2831** | 14.6842** |
| | (1.7495) | (1.2788) | (3.4713) | (2.3111) |
| DUR | -0.2168 | | | |
| | (0.5653) | | | |
| REG | | -1.6648* | 2.2469** | 5.4137 |
| | | (1.4311) | (1.6928) | (1.8608) |
| PR167 | 0.0701** | | | |
| | (2.6261) | | | |
| PR163 | | 0.4428** | | |
| | | (1.6767) | | |
| (PR163)(PCD) | | -0.5007* | | |
| | | (1.5558) | | |
| CR467 | 0.0720** | | 0.0864** | 0.0144 |
| | (2.1393) | | (3.3145) | (0.2057) |
| $\overline{CR467}^2$ | -0.000666** | | | |
| | (1.8810) | | | |
| CR463 | | 0.9128** | | |
| | | (36.7654) | | |
| ASR | | -0.9642* | 0.8352* | 5.5367** |
| | | (1.4222) | (1.3702) | (3.9540) |
| CDS | 0.0139 | | 0.1013** | 0.0022 |
| | (0.8469) | | (2.2275) | (0.0223) |
| BCR | -0.0124 | | -0.0669** | 0.0394 |
| | (1.1434) | | (2.1414) | (0.5717) |
| GR | 0.0010 | -0.0118 | 0.1044** | 0.1047** |
| | (0.1238) | (0.6961) | (5.2113) | (2.4004) |
| MES | | 0.0651 | | 0.1108 |
| | | (0.5973) | | (0.4473) |
| ACR | | 0.0075 | | -0.0221 |
| | | (0.5226) | | (0.6051) |
| CDR | | -0.1049** | | 0.1647** |
| | | (2.4361) | | (1.6278) |
| KSR | | | 0.1023** | 0.1327** |
| | | | (5.9809) | (3.4688) |
| SSR | 1093.65 | 5931.71 | 7726.64 | 34675.1 |
| $R^2$ | 0.2899 | 0.9325 | 0.3299 | -2.0072 |
| DF | 200 | 198 | 200 | 197 |

t-statistics in parentheses
* Indicates coefficient significant at the .1 level
** Indicates coefficient significant at the .05 level

those used for the IRS sample employed above. There is considerable, but not complete, correspondence between the industries in the two samples.[12]

The profitability measure used with this less aggregated sample is the price-cost margin; hence the results in Table 8 should be compared with the results for *PR*1 for the IRS sample.

The advertising equation seems to yield a better fit for the more aggregated sample, although the precision of the coefficients of the concentration terms is greater for the less aggregated sample.

The concentration equations for the two samples are similar. In the less aggregated sample, there is an induced entry effect for producer good industries only.[13] The estimated coefficient of lagged concentration is significantly different from both zero and one.[14] The coefficient of advertising is both significant and negative. The coefficient is positive when consumer and producer good industries are tested separately [14]. As in Table V, the coefficient of the cost disadvantage ratio is statistically significant.

When the alternative profitability equations are estimated for the less aggregated sample, it is clear that the equation which specifies no direct effect of barrier to entry variables on profitability dominates. The no-effect model provides a better fit, in terms of sums of squared residuals, and no one of the barrier to entry variables is significant and of expected sign.

The explanatory power of the no-effect equation is somewhat greater in the more aggregated sample, but the precision of the estimates is greater with the less aggregated sample: every coefficient except the constant term is statistically significant. The most important difference is with concentration, which has a positive and statistically significant influence in the less aggregated sample. In the more aggregated sample, the estimated coefficient of concentration is positive only for the price-average cost margin measures, and is never statistically significant.

Aggregation, of course, reduces the size of the sample, so it is not surprising that the precision of estimates is less in the more aggregated sample. The comparison made here seems consistent with the results of Esposito and Esposito [8].

## VII. Conclusion

Cross-sectional studies of industrial organization have typically employed one of four measures of profitability: the price-cost margin, the rate of return on sales, the rate of return on stockholders's equity, and the rate of return on assets.

We have outlined a simultaneous causality model of industrial organization, and examined the robustness of empirical results to the use of alternative measures of profitability. Those results, which indicate that barrier to entry variables influence profitability only through their influence on concentration, appear no matter which measure of profitability is employed.

12. 167 of the 209 input-output table detailed industries are included among industries aggregated to form the IRS minor industry sample.

13. The t-statistic under the hypothesis that the sum of the lagged profit terms has a true value of zero is 0.6144.

14. The t-statistic under the hypothesis that the true value of the lagged concentration coefficient is one is 3.5109; hence the estimated coefficient is significantly less than one.

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