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MARKET SHARE AND PROFITABILITY:

A NEW APPROACH

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INTRODUCTION

This paper attempts to further investigate the relationship between market share and profitability. The new approach normalizes the firm's market share with the four-firm concentration ratio to define a relative-market-share variable that can measure the size-dependent efficiency advantage of a firm in a market. This eliminates the possibility of the market share variable measuring a tacit collusion among a group of efficient firms. Thus, the relative-share variable will minimize the potential for confusing the efficiency and collusion effects in a share/profitability model.

The first section presents a brief survey of the relevant literature and discusses the interpretation of market share in a profitability equation. Then the relative-market-share/profitability model is summarized, and the data set based on Economic Information System, Compustat, and Census data is discussed. Next the model is estimated and the initial results are discussed. This is followed by specialized models to investigate a nonlinear relative-share relationship, the effect of changing the dependent variable, a more general specification of the collusion hypothesis, an ordinary market-share model and a simultaneous-equations formulation of the model. Finally, the results of the analysis are summarized in a brief conclusion.

THE FIRM PROFITABILITY MODEL, MARKET SHARE VS. CONCENTRATION

A number of empirical studies have attempted to explain a firm's rate of return with either a collusion hypothesis (collusion leads to high profits in concentrated industries) or an efficiency hypothesis (efficiency leads to high profits for firms with a high share). Aggregate industry data were initially used to support the collusion hypothesis because firm data were difficult to obtain. The weight of the evidence implied concentration had a significant effect on the profitability of a firm [32]. But all of these studies lacked the market-share data necessary to test the efficiency hypothesis, so the results were not conclusive.

Two pioneering studies managed to acquire market-share data for agricultural processing industries [15, 27]. Both papers used the data to calculate a relative-market-share variable for each firm in the sample. The Federal Trade Commission (FTC) study noted successful product differentiation or economies of scale could cause relative share to have a significant impact on profitability [27, p. 10]. In the second paper, Imel and Helmberger reported relative share was included "because of its statistical significance in the FTC study rather than on strong theoretical grounds" [15, p. 622]. Thus, neither paper interpreted the relative-share variable as a pure test of the efficiency hypothesis. The econometric results indicated that both relative market share and concentration had significant positive effects on profitability.[1] These empirical conclusions tend to confirm both the efficiency and the collusion hypotheses but their general applicability is limited due to the specialized nature of their data sample.

Two additional papers have used data for firms in a broad spectrum of industries to study profitability [10, 22]. Shepherd found market share was significant in explaining profitability, but his concentration proxy was usually insignificant [22]. Weiss dismisses this result, because Shepherd "stacks the deck" against the concentration effect by measuring it with the difference between the concentration ratio and the firm's market share [32, p. 226]. Gale used a different data set to derive similar results [10]. He found either market share or a share-concentration interaction variable was significant, while a concentration dummy variable was insignificant. These general studies raise some serious doubts about the significance of concentration once the model is specified to include a share variable.

Recent line-of-business evidence casts further doubt on the general relationship between concentration and profitability. Gale and Branch reported that market share was significant and concentration was insignificant in explaining the return on

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1 Another study with the same data found both market share and concentration were significant in explaining profitability [28, p. 16].

investment for a sample of business units in the PIMS data base [12]. Also, Ravenscraft found similar results using the FTC line-of-business data [20]. Concentration even had a significant negative effect on return on sales, while the market-share parameter was positive and significant in the basic model.[2] Both concentration and share are insignificant in a more general model that includes various market-share interaction variables. Thus, no support exists for the concentration-collusion hypothesis when the analysis is done at the line-of-business level.

The overall weight of the evidence suggests that concentration is not related to profitability when market share is incorporated in the model.[3] Thus, the simple collusion hypothesis must be rejected. But more complex versions of the collusion hypothesis can still be considered. The relationship between concentration and collusion is not necessarily linear, since a requisite level of concentration may be required for collusion. Dalton and Penn [7] found a critical concentration ratio of 45 for their sample of agricultural processing firms. A previous study [28], with the same data set, also supported the linear concentration relationship, so the nonlinear specification did

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2 Ravenscraft also noted the concentration effect was positive and significant in 2 of 20 two-digit industries [20, p. 24].

3 A varient of the collusion hypothesis links price and concentration [19]. Most of the evidence is in regulated markets and fails to incorporate a share variable. Also quality differences can explain the higher prices. Thus, this version of the collusion hypothesis is not well established.

not uncover new evidence for the collusion hypothesis. A second hypothesis considers the possibility of an interaction between concentration and market share being related to profitability. Large firms in concentrated industries may be able to capture most of the returns to collusion, so concentration may not be directly linked to high profitability. Gale [10] found the interaction effect had a significant effect on profitability, but this relationship could be caused by the omission of the market-share variable. Thus, there is no strong support for the interaction between share and concentration. Finally, some type of interaction between concentration and a proxy for entry barriers could lead to higher profits. Comanor and Wilson [6] found an interaction between concentration and a high-entry-barrier dummy variable had a positive impact on industry profitability, while the ordinary concentration ratio had no impact on industry returns. The validity of this collusion effect is in doubt because the model did not include an efficiency variable. Thus, none of the more complicated studies offer strong support for the collusion hypothesis, but they do leave enough unanswered questions to merit further investigation.

The significant market-share variable implies that there is a positive relationship between share and profitability. This relationship can be explained with either a market-power or an efficiency theory [10]. The traditional market-power theory suggests that a group of firms can earn monopoly profits by limiting output. This theory can only be applied to a very-high-share firm in isolation, because the single firm must unilaterally restrict output to force up price. Product differentiation can also allow a firm to earn monopoly profits if the firm can create and protect a relatively inelastic demand for its output. But the differentiated market segment is not guaranteed to be large, so differentiation will not necessarily cause a relationship between share and profitability. Finally, brand loyalty may lead to higher firm profits if customers discover a given firm has a low-risk product. Market position can become a proxy for low risk, so large firms would be more profitable. This can be considered an efficiency advantage since large firms actually provide a better product. Thus, none of the market-power interpretations of the share/profitability relationships are convincing.

The efficiency theory suggests that large firms in a market are more profitable than fringe firms due to size-related economies. These economies allow large firms to produce either a given product at a lower cost or a superior product at the same cost as their smaller competitors. Gale and Branch note their study supports this theory and conclude, "a strong market position is associated with greater efficiency [12, p. 30]." Although this general efficiency theory seems reasonable, it suffers from one serious theoretical fault: it cannot explain why prices do not fall with costs and leave the large efficient firms with normal returns. For example, why should 5 firms, each with a 20-percent share, be more profitable than 20 firms, each with a 5-percent share? In either case, price should fall until each firm only earns a normal return. The only explanation for the maintenance of high profits is some type of collusion in industries dominated by a few high-share firms. Thus, the large firms are profitable because they are efficient and they avoid competing away the return to their efficiency. This implies the efficiency interpretation of the market-share model fails to completely separate the efficiency from the market-power effect.

A relative-market-share variant of the profitability model should be able to separate the two effects, because relative share is defined in comparison to the firm's major competitors.[4] Thus, relative share will not measure an ability to collude.[5] Rather it will act as a measure of relative size and a proxy for efficiency-related profits. This formulation of the efficiency model appears in the business planning literature, where it is suggested that the dominant firm in an industry will have the lowest costs and earn the highest returns [4]. The efficiency advantage can be caused by a combination of scale economies and exogenous cost advantages [8]. Scale economies offer the leading firm an advantage because the first firm can build an optimal sized plant without considering its competitors responses. Also an exogenous cost advantage, by its very nature, would be

4 Relative market share will be defined as market share divided by the four-firm concentration ratio.

5 In our sample, the correlation between relative share and concentration is only .13559.

impossible to match. Thus, a superior cost position would be difficult to imitate so smaller firms can not duplicate the success of the leading firm. The low cost position of the firm with the highest share implies that relative market share is related to profitability.[6] For example, a firm with a 40-percent share should be more profitable than three competitors, each with a 20-percent share, because it has the lower costs. But all the firms can be profitable if they do not vigorously compete. Thus, the concentration ratio is still of interest as a proxy for collusion. This version of the profitability model should allow a clear test of both the efficiency and collusion theories, but it has never been estimated for a broad group of firms.

THE SPECIFICATION OF THE RELATIVE-MARKET-SHARE/PROFITABILITY MODEL

A detailed profitability model is specified, to test the efficiency and collusion hypotheses.[7] The key explanatory variables in the model are relative market share and concentration. Relative share should have a significant positive effect on

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[6] Gale and Branch note that relative market share should be used to measure the advantage of the leading firm over its direct competitors [11]. But they also suggest that market share is related to profitability. This relationship fails to consider the potential for prices to fall and eliminate any excess profits from high market share.

[7] Data limitations make it impossible to estimate the model at the line-of-business level. Therefore, we follow most of the previous firm-profit studies and define the key explanatory variables (relative share and concentration) as weighted averages of the individual line-of-business observations. Then the model is tested with the average firm data.

profitability if the efficiencies are continuously related to size. An insignificant sign would indicate any efficiencies that exist in an industry are comparable for all major firms. The concentration variable should have a positive sign if it proxies the ability of the firms in an industry to engage in any form of collusion. Lack of significance could suggest that the existence of a few large firms does not make it easier for the firms in an industry to collude. A geographic-dispersion index was also incorporated in the basic model, to control for the possible bias in the measurement of the efficiency and market power variables with national data.

The model incorporates a set of six control variables to account for differences in the characteristics of each firm.[8] First, the Herfindahl diversification index is included to test for synergy from diversification [3]. A significant positive sign would indicate that diversified firms are more profitable than single-product firms. A firm-size variable, the inverse of the logarithm of net assets, is used to check for the residual effect of absolute size on profitability. Shepherd notes size can lead to either higher or lower returns, so the net effect on profitability is indeterminate [22]. An advertising-to-sales variable and a research-and-development-to-sales measure are incorporated in the model, to account for the variables' effect on

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[8] A minimum efficient scale variable is omitted because it would pick up the some effect as the relative-market-share variable.

profitability. We cannot offer a strong theoretical explanation for the effect of either variable, but the previous empirical research suggests that both coefficients will be positive [5, 15]. A measure of industry growth is included to allow increases in output to affect industry profitability. The sign of this variable is indeterminate, because growth in demand tends to raise profitability, while growth in supply tends to reduce profitability. But the previous studies suggest that a positive sign will be found [15, 27]. Finally, the capital-to-sales ratio must be included in the model, to account for interindustry variations in capital intensity if a return-on-sales measure is used for profitability. The ratio should have a positive sign, since the firm's return on sales is not adjusted to reflect the firm's capital stock.

The estimated form of the model is

$$P = a_1 + a_2\ RMS + a_3\ CONC + a_4\ DIV + a_5\ 1/LOG\ A$$
$$+ A_6\ AD/S + A_7\ RD/S + a_8\ G + a_9\ K/S + a_{10}\ GEOG$$

where:

P = the after-tax return on sales (including interest expense),

RMS = the average of the firm's relative market share in each of its business units,

C4 = the average of the four-firm concentration ratios associated with the firm's business units,

DIV = the diversification index for the firm ($1 - \Sigma s_i^2$, where s_i is the share of the firm's sales in the i'th four-digit SIC industry),

1/LOG A = the inverse of the logarithm (base 10) of the firm's net assets,

AD/S = the advertising-to-sales ratio,

RD/S = the research-and-development-to-sales ratio,

G = the average of the industry growth rates associated with the firm's business units,

K/S = the capital-to-sales ratio, and

GEOG = an average of the geographic-dispersion indexes associated with the firm's business units.

THE ESTIMATION OF THE MODEL

The data sample consisted of 123 large firms for which analogous data were available from the EIS Marketing Information System (EIS) and the Compustat tape.[9] The EIS data set contributed the market shares of all the firm's business units and the percentage of the firm's sales in each unit. The Compustat file provided information on after-tax profit, interest payments, sales, assets, equity, advertising, research-and-development

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[9] This requirement eliminated all firms with substantial foreign sales. Also a few firms that primarily participated in local markets were eliminated because the efficiency and market-power variables could only be measured for national markets.

expense, and total costs.[10] Overall values for these variables were calculated by averaging the 1976, 1977, and 1978 data.

The firm-specific information was supplemented with industry data from a variety of sources. The 1977 Census was used to define the concentration ratio and the value of shipments for each four-digit SIC industry. Concentration was then used to calculate relative market share from the EIS share variable, and the value-of-shipments data for 1972 and 1977 were used to compute the industry growth rate. Kwoka's data set contributed a geographic-dispersion index [16]. This index was defined as the sum of the absolute values of the differences between the percentages of an industry's value-added and all-manufacturing value added for all four Census regions of the country [16, p. 11].[11] Thus, a low value of the index would indicate that the firm participates in a few local markets and the efficiency and market-power variables are slightly understated. The final variable was taken from a 1967 FTC classification of consumer- and producer-goods industries

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10 Advertising and research-and-development data were not available for all the firms on the Compustat tape. Using the line-of-business data, we constructed estimates of the advertising and the research-and-development intensities for most of the industries [29]. This information was supplemented with additional data to define values for each four-digit SIC industry [25, 31]. Then firm-level advertising and research and development variables were estimated. The available Compustat variables were modeled with the estimates and the relationships were used to project the missing data.

11 A value of zero was assigned to the geographic-dispersion index for the miscellaneous industries.

[26]. Each consumer-goods industry was assigned the value of one, and each producer-goods industry was given the value of zero. Some adjustments were necessary to incorporate the changes in the SIC code from 1967 to 1977. The industry data associated with each business unit of the firm, were averaged to generate a firm-level observation for each industry variable. The share of the firm's sales in each business unit provided a simple weighting scheme to compute the necessary data. Firm-level values for relative market share, concentration, growth, the geographic-dispersion index and the consumer/producer variable were all calculated in this manner. Finally, the diversification index was computed directly from the sales-share data.

The profitability model was estimated with both ordinary least squares (OLS) and generalized least squares (GLS), and the results are presented in table 1. The GLS equation used the fourth root of assets as a correction factor for the heteroscedastic residuals [27].[12] The parameter estimates for the OLS and GLS equations are identical in sign and significance except for the geographic-dispersion index, which switches from an insignificant negative effect to an insignificant positive effect. Thus, either

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[12] Hall and Weiss [14], Shepherd [22], and Winn [33] have used slightly different factors, but all the correlations of the correction factors for the data set range from .95 to .99. Although this will not guarentee similar results, it strongly suggests that the results will be robust with respect to the correction factor.

Table 1.--Linear version of the relative-market-share model (t-statistics in parentheses)

	Return on sales (OLS)	Return on sales (GLS)
RMS	.0555 (2.98)	.0623 (3.56)
C4	-.0000622 (-.51)	-.000111 (-.92)
DIV	.000249 (3.23)	.000328 (4.44)
1/Log A	.163 (2.89)	.182 (3.44)
AD/S	.395 (3.19)	.452 (3.87)
RD/S	.411 (3.12)	.412 (3.27)
G	.0159 (2.84)	.0189 (3.17)
K/S	.0712 (10.5)	.0713 (12.3)
GEOG	-.00122 (-.16)	.00602 (.78)
Constant	-.0918 (-3.32)	-.109 (-4.36)
R^2 *	.6166	.6077
F-statistic	20.19	195.85

* The R^2 in the GLS equation is the correlation between the dependent variable and the predicted values of the dependent variable. This formula will give the standard R^2 in an OLS model.

the OLS or GLS estimates of the parameters of the model can be evaluated.

The parameters of the regression models offer some initial support for the efficiency theory. Relative market share has a significant positive effect in both the equations. In addition, concentration fails to affect the profitability of the firm and the geographic-dispersion index is not significantly related to return. These results are consistent with the hypothesis of a continuous relationship between size and efficiency but do not support the collusion theory. Thus, a relatively large firm should be profitable, but the initial evidence does not suggest a group of large firms will be able to collude well enough to generate monopoly profits.

The coefficients on the control variables are also of interest. The diversification measure has a significant positive effect on the profitability of the firm. This implies that diversified firms are more profitable than single-business firms, so some type of synergy must enhance the profitability of a multiunit business. Both the advertising and the research-and-development variables have strong positive impacts on the profitability measure. As Block [2] has noted, this effect could be caused by measurement error in profitability due to the expensing of advertising (or research and development). Thus, the coefficients could represent a return to intangible advertising and research capital or an excess profit from product-differentiation barriers to entry. The size variable has a significant effect on the firm's return. This suggests that overall size has a negative effect on profitability after controlling for diversification and efficiency advantages.[13] The weighted industry growth rate also significantly raises the firm's profitability. This implies that growth increases the ability of a firm to earn disequilibrium profits in an industry. Finally, the capital-to-sales variable has the expected positive effect. All of these results are consistent with previous profitability studies.

The initial specification of the model could be too simple to fully evaluate the relative-market-share hypothesis. Thus, additional regressions were estimated to consider possible problems with the initial model. A total of five varients of the basic model were analysed. They include tests of the linearity of the relative share relationship, the robustness of the results with respect to the dependent variable, the general lack of support for the collusion hypothesis, the explanatory power of the ordinary market share variable and the possible estimation bias involved in using ordinary least squares instead of two-stage least squares. A regression model will be estimated and evaluated for each of these possibilities to complete the analysis of the relative-market-share hypothesis.

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13 Shepherd [22] found the same effect in his study.

First, it is theoretically possible for the relationship between relative market share and profitability to be nonlinear. If a threshold minimum efficient scale existed, profits would increase with relative share up to the threshold and then tend to level off. This relationship could be approximated by estimating the model with a quadratic or cubic function of relative market share. The cubic relationship has been previously estimated [27], with some significant and some insignificant results, so this specification was used for the nonlinear test.

Table 2 presents both the OLS and the GLS estimates of the cubic model. The coefficients of the control variables are all similar to the linear relative-market-share model. But an F-test fails to reject the null hypothesis that the coefficients of both the quadratic and cubic terms are zero. Thus, there is no strong evidence to support a nonlinear relationship between relative share and profitability.

Next, the results of the model may be dependent on the measure of profitability. The basic model uses a return-on-sales measure comparable to the dependent variable used in the Ravenscraft line-of-business study [20]. But return on equity, return on assets, and price/cost margin have certain advantages over return on sales. To cover all the possibilities, we estimated the model with each of these dependent variables. Weiss noted that the weighting scheme used to aggregate business-unit-based variables to a firm average should be consistent with the

Table 2.--Cubic version of the relative-market-share model (t-statistics in parentheses)

	Return on sales (OLS)	Return on sales (GLS)
RMS	.224 (1.88)	.157 (1.40)
C4	-.0000185 (-.15)	-.0000828 (-.69)
DIV	.000244 (3.18)	.000342 (4.62)
1/Log A	.174 (3.03)	.179 (3.34)
AD/S	.382 (3.05)	.452 (3.83)
RD/S	.412 (3.12)	.413 (3.28)
G	.0166 (2.86)	.0176 (2.89)
K/S	.0715 (10.55)	.0715 (12.40)
GEOG	-.00279 (-.37)	.00410 (.53)
$(RMS)^2$	-.849 (-1.61)	-.556 (-1.21)
$(RMS)^3$	1.14 (1.70)	.818 (1.49)
Constant	-.105 (-3.50)	-.112 (-4.10)
R^2	.6266	.6168
F-statistic	16.93	165.77

measure of profitability used in the model [32, p. 167]. This implies that the independent variables can differ slightly for the various dependent variables.

The price/cost-margin equation can use the same sales-share weighting scheme as the return-on-sales equation because both profit measures are based on sales. But the return-on-assets and return-on-equity dependent variables require different weights for the independent variables. Since it is impossible to measure the equity of a business unit, both the adjusted equations used weights based on the assets of a unit. The two-digit industry capital/output ratio was used to transform the sales-share data into a capital-share weight.[14] This weight was then used to calculate the independent variables for the return-on-assets and return-on-equity equations.

Table 3 gives the results of the model for the three different dependent variables. In all the equations, relative market share retains its significant positive effect and concentration never attains a positive sign. Thus, the results of the model seem to be robust with respect to the choice of the dependent variable.

As we have noted earlier, a number of more complex formulations of the collusion hypothesis are possible. They include the critical concentration ratio, the interaction between some measure of barriers and concentration, and the interaction between share

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14 The necessary data were taken from tables A-1 and A-2 [28].

Table 3.--Various measures of the dependent variable (t-statistics in parentheses)

	Return on assets (OLS)	Return on equity (OLS)	Price-cost margin (OLS)
RMS	.0830 (2.87)	.116 (2.22)	.225 (3.07)
C4	.0000671 (.35)	.000176 (.50)	-.00103 (-2.12)
DIV	.000370 (3.08)	.000797 (3.66)	.000759 (2.52)
1/Log A	.302 (3.85)	.414 (2.92)	.615 (2.77)
AD/S	.451 (2.31)	.806 (2.28)	3.82 (7.85)
RD/S	.452 (2.18)	.842 (2.24)	3.05 (5.89)
G	.0164 (1.90)	.0319 (2.03)	.0420 (1.90)
K/S	--	--	.122 (4.57)
GEOG	-.00341 (-.29)	-.0143 (-.67)	-.0206 (-.708)
Constant	-.0816 (-2.22)	-.131 (-1.96)	-.213 (-1.96)
R^2	.2399	.2292	.5750
F-statistic	4.50	4.24	16.99

and concentration. Thus, additional models were estimated to fully evaluate the collusion hypothesis.

The choice of a critical concentration ratio is basically arbitrary, so we decided to follow Dalton and Penn [7] and chose a four-firm ratio of 45.[15] This ratio proxied the mean of the concentration variable in the sample so that half the firms have average ratios above and half, below the critical level. To incorporate the critical concentration ratio in the model, two variables were added to the regression. The first was a standard dummy variable (D45) with a value of one for firms with concentration ratios above 45. The second variable (D45C) was defined by multiplying the dummy varible (D45) by the concentration ratio. Thus, both the intercept and the slope of the concentration effect could change at the critical point. To define the barriers-concentration interaction variable, it was necessary to specify a measure of barriers. The most important types of entry barriers are related to either product differentiation or efficiency. Since the effect of the efficiency barriers should be captured in the relative-share term, we concentrated on product-differentiation barriers. Our operational measure of product differentiation was the degree to which the firm specializes in

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15 The choice of a critical concentration ratio is difficult because the use of the data to determine the ratio biases the standard errors of the estimated parameters. Thus, the theoretical support for Dalton and Penn's figure is weak but the use of one specific figure in our model generates estimates with the appropriate standard errors.

consumer-goods industries (i.e., the consumer/producer-goods variable). This measure was multiplied by the high-concentration variable (D45C) to define the appropriate independent variable (D45CCP). Finally the relative-share/concentration variable was difficult to define because the product of the two variables is the firm's market share. Use of the ordinary share variable did not seem to be appropriate, so we used the interaction of relative share and the high-concentration dummy (D45) to specify the relevant variable (D45RMS).

The models were estimated and the results are given in table 4. The critical-concentration-ratio model weakly suggests that profits will increase with concentration above the critical level, but the results are not significant at any standard critical level. Also, the overall effect of concentration is still negative, due to the large negative coefficients on the initial concentration variable (C4) and dummy variable (D45). The barrier-concentration variable has a positive coefficient, suggesting that concentrated consumer-goods industries are more profitable than concentrated producer-goods industries, but again this result is not statistically significant. Finally, the relative-share/concentration variable was insignificant in the third equation. This suggests that relative dominance in a market does not allow a firm to earn collusive returns. In conclusion, the results in table 4 offer little support for the complex formulations of the collusion hypothesis.

Table 4.--General specifications of the collusion hypothesis (t-statistics in parentheses)

	Return on sales (OLS)	Return on sales (OLS)	Return on sales (OLS)
RMS	.0536 (2.75)	.0565 (2.89)	.0425 (1.38)
C4	-.000403 (-1.29)	-.000399 (-1.28)	-.000434 (-1.35)
DIV	.000263 (3.32)	.000271 (3.42)	.000261 (3.27)
1/Log A	.159 (2.78)	.161 (2.82)	.154 (2.65)
AD/S	.387 (3.09)	.326 (2.44)	.387 (3.07)
RD/S	.433 (3.24)	.433 (3.25)	.437 (3.25)
G	.0152 (2.69)	.0155 (2.75)	.0147 (2.54)
K/S	.0714 (10.47)	.0737 (10.49)	.0715 (10.44)
GEOG	-.00328 (-.43)	-.00381 (-.50)	-.00319 (-.42)
D45	-.0210 (-1.15)	-.00982 (-.49)	-.0246 (-1.24)
D45C	.000506 (1.28)	.000254 (.58)	.000538 (1.33)
D45CCP	--	.000198 (1.30)	--
D45RMS	--	--	.0163 (.47)
CONSTANT	-.0780 (-2.54)	-.0806 (-2.63)	-.0735 (-2.28)
R^2	.6223	.6280	.6231
F-statistic	16.63	15.48	15.15

In another model, we replaced relative share with market share to determine whether the more traditional model could explain the firm's profitability better than the relative-share specification. It is interesting to note that the market-share formulation can be theoretically derived from the relative-share model by taking a Taylor expansion of the relative-share variable. The Taylor expansion implies that market share will have a positive impact and concentration will have a negative impact on the firm's profitability. Thus, a significant negative sign for the concentration variable would tend to suggest that the relative-market-share specification is more appropriate. Also, we included an advertising-share interaction variable in both the ordinary-market-share and relative-market-share models. Ravenscraft's findings suggest that the market share variable will lose its significance in the more complex model.[16] This result may not be replicated if relative market share is a better proxy for the efficiency advantage. Thus, a significant relative-share variable would imply that the relative-market-share specification is superior.

The results for the three regressions are presented in table 5, with the first two columns containing models with market share and the third column, a model with relative share. In the first regression, market share has a significant positive effect on

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[16] Ravenscraft used a number of other interaction variables, but multicollinearity prevented the estimation of the more complex model.

Table 5.--Market-share version of the model
(t-statistics in parentheses)

	Return on sales (market share)	Return on sales (market share)	Return on sales (relative share)
MS/RMS	.000773 (2.45)	.000693 (1.52)	.0650 (2.23)
C4	-.000219 (-1.67)	-.000223 (-1.68)	-.0000558 (-.45)
DIV	.000224 (2.93)	.000224 (2.92)	.000248 (3.23)
1/Log A	.132 (2.45)	.131 (2.40)	.166 (2.91)
AD/S	.391 (3.11)	.343 (1.48)	.538 (1.49)
RD/S	.416 (3.11)	.421 (3.10)	.405 (3.03)
G	.0151 (2.66)	.0151 (2.65)	.0159 (2.83)
K/S	.0699 (10.22)	.0700 (10.18)	.0711 (10.42)
GEOG	.000333 (.05)	.0000736 (.01)	-.000942 (-.13)
RMSxADV	--	--	-.844 (-.42)
MSxADV	--	.00608 (.24)	--
CONSTANT	-.0689 (-2.74)	-.0676 (-2.62)	-.0946 (-3.31)
R^2	.6073	.6075	.6172
F-statistic	19.42	17.34	18.06

profitability, and most of the coefficients on the control variables are similar to the relative-share regression. But concentration has a marginal negative effect on profitability, which offers some support for the relative-share formulation. Also the summary statistics imply that the relative-share specification offers a slightly better fit. The advertising-share interaction variable is not significant in either of the final two equations. In addition, market share loses its significance in the second equation, while relative share retains its significance. These results tend to support the relative-share specification.

Finally, an argument can be made that the profitability equation is part of a simultaneous system of equations, so the ordinary-least-squares procedure could bias the parameter estimates. In particular, Ferguson [9] noted that given profits entering the optimal advertising decision, higher returns due to exogenous factors will lead to higher advertising-to-sales ratios. Thus, advertising and profitability are simultaneously determined. An analogous argument can be applied to research-and-development expenditures, so a simultaneous model was specified for profitability, advertising, and research intensity. A simultaneous relationship between advertising and concentration has also been discussed in the literature [13]. This problem is difficult to handle at the firm level because an individual firm's decisions cannot be directly linked to the industry concentration ratio. Thus, we treated concentration as an exogenous variable in the simultaneous-equations model.

The actual specification of the model was difficult because firm-level simultaneous models are rare. But Greer [13], Strickland and Weiss [24], Martin [17], and Pagoulatos and Sorensen [18] have all specified simultaneous models at the industry level, so some general guidance was available. The formulation of the profitability equation was identical to the specification in table 1. The advertising equation used the consumer/producer-goods variable (C-P) to account for the fact that consumer goods are advertised more intensely than producer goods. Also, the profitability measure was included in the equation, to allow advertising intensity to increase with profitability. Finally, a quadratic formulation of the concentration effect was used, to be compatible with Greer [13]. The research-and-development equation was the most difficult to specify, because good data on the technological opportunity facing the various firms were not available [23]. The growth variable was incorporated in the model as a rough measure of technical opportunity. Also, profitability and firm-size measures were included to allow research intensity to increase with these variables. Finally, quadratic forms for both concentration and diversification were entered in the equation, to allow these variables to have a nonlinear effect on research intensity.

The model was estimated with two-stage least squares (TSLS), and the parameter estimates are presented in table 6.[17] The profitability equation is basically analogous to the OLS version, with higher coefficients for the advertising and research variables (but the research parameter is insignificant). Again the advertising and research coefficients can be interpreted as a return to intangible capital or excess profit due to barriers to entry. But the important result is the equivalence of the relative-market-share effects in both the OLS and the TSLS models.

The advertising equation confirms the hypotheses that consumer goods are advertised more intensely and profits induce additional advertising. Also, Greer's result of a quadratic relationship between concentration and advertising is confirmed. The coefficients imply advertising intensity increases with concentration up to a maximum and then declines. This result is compatible with the concepts that it is hard to develop brand recognition in unconcentrated industries and not necessary to advertise for brand recognition in concentrated industries. Thus, advertising seems to be less profitable in both unconcentrated and highly concentrated industries than it is in moderately concentrated industries.

The research equation offers weak support for a relationship between growth and research intensity but does not identify a

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[17] A four-equation model (with concentration endogenous) was also estimated, and similar results were generated.

Table 6.--Simultaneous-equations model
(t-statistics in parentheses)

	Return on sales (Return)	Advertising to sales (AD/S)	Research to sales (RD/S)
RMS	.0548 (2.84)	--	--
C4	-.0000694 (-.55)	.000714 (2.15)	.000572 (1.41)
DIV	.000256 (2.94)	--	-.000531 (-1.99)
1/Log A	.166 (2.25)	--	-.576 (-1.84)
AD/S	.575 (3.00)	--	--
RD/S	.524 (.81)	--	--
G	.0160 (2.42)	--	.00595 (1.46)
K/S	.0707 (10.25)	--	--
GEOG	-.00188 (-.24)	--	--
$(C4)^2$	--	-.00000784 (-2.36)	-.00000534 (-1.34)
$(DIV)^2$	--	--	.00000394 (1.76)
C-P	--	.0290 (9.24)	--
Return	--	.120 (2.78)	.0110 (.18)
Constant	-.0961 (-2.61)	-.0155 (-1.84)	.0302 (1.72)
F-statistic	18.37	23.05	1.92

significant relationship between profits and research. Also research intensity tends to increase with the size of the firm. The concentration effect is analogous to the one in the advertising equation, with high concentration reducing research intensity. But this result was not very significant. Diversification tends to reduce research intensity initially and then causes the intensity to increase. This result could indicate that slightly diversified firms can share research expenses and reduce their research-and-development-to-sales ratio. On the other hand, well-diversified firms can have a higher incentive to undertake research because they have more opportunities to apply it. In conclusion, the simultaneous model serves to confirm the initial parameter estimates of the OLS profitability model, and restrictions on the available data limit the interpretation of the advertising and research equations.

CONCLUSION

The significance of the relative-market-share variable offers strong support for a continuous-efficiency hypothesis. The relative-share variable retains its significance for various measures of the dependent profitability variable and a simultaneous formulation of the model. Also, the analysis tends to support a linear relative-share formulation in comparison to an ordinary market-share model or a nonlinear relative-market-share specification. All of the evidence suggests that dominant firms should earn supernormal returns in their industries. The general insignificance of the concentration variable implies it is difficult for large firms to collude well enough to generate substantial profits. This conclusion does not change when more complicated versions of the collusion hypothesis are considered. These results suggest that competition for the number-one spot in an industry makes it very difficult for the firms to collude. Thus, the pursuit of the potential efficiencies in an industry can act to drive the competitive process and minimize the potential problem from concentration in the economy. This implies antitrust policy should be focused on preventing explicit agreements to interfere with the functioning of the marketplace.

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