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A NEW VIEW OF THE MARKET STRUCTURE—PERFORMANCE DEBATE*

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I. INTRODUCTION

Because economics is a non-experimental science, the data that economists work with are generated by measurement of uncontrolled systems. In order to make use of such data it is necessary to have some basis for placing restrictions on the models which generate the observations. This is the role of deductive reasoning in economics. Theories about the behavior of individuals, markets, firms, and even sectors of the macroeconomy place restrictions on the data that are observed, and statistical methods are used in lieu of experimental controls in testing these restrictions. While there is often debate about the validity of the deductive foundations and the credibility of the implied restrictions (e.g., Sims [40]) such foundations provide at least a framework within which meaningful debate can take place. Occasionally, however, the foundations are virtually non-existent or at best very weak and yet statistical work proceeds, often on a very large scale, in the hope that statistical regularities will appear in the data that either confirm or refute informal conjectures. This paper is concerned with one area of economics in which this latter practice has been widespread, namely the debate about the relationship between market structure and performance.

While the relationship between competition and market performance on the one hand and pure monopoly and performance on the other have been well established in the literature since the 18th century, the vast middle ground has remained relatively unsusceptible to theoretical analysis. Nevertheless, there has developed over the past thirty years an area of research based initially on the following two conjectures. The first is that the more concentrated an industry is, that is the more it is dominated by a few firms, the easier it is for firms to coordinate their policies. Firms operating in more concentrated industries thus find it easier to collude either explicitly or implicitly than do firms operating in less concentrated industries, and successful collusion should lead to higher profits. The second conjecture is that measurable characteristics of market structure are exogenous with respect to measures of profitability. These two conjectures form the basis of the widely

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influential work of Bain [1], which searched for statistical regularities in the relationship between profitability and concentration over a cross section of U.S. manufacturing industries. Over time, Bain's original work inspired a vast proliferation of empirical studies of the relationship between various measures of market structure or firm characteristics and economic performance.

Obviously, the original Bain conjecture has great intuitive appeal. Successful collusion need not be overt since firms which deviate from the accepted market norms do so in the face of likely retaliation by other firms with at best uncertain consequences. At the same time, the prisoners' dilemma argument is equally compelling on *a priori* grounds because the gains from acting individually can be great and policing of the collusive arrangement may be difficult or costly (Stigler [41]). The variations on the static oligopoly model are numerous. The existence of asymmetric information, non-homogeneous products, non-contiguous markets and differences in technology all influence whether the equilibrium solution to the oligopoly problem in a given industry is more likely to be competitive, monopolistic or a Nash-Cournot equilibrium. The result is that there is no real consensus about what generalities are likely to emerge in the study of the relationship between market structure and performance.[1]

While there is no consensus about the foundations of the market structure—performance paradigm, there are clearly many who believe in the basic Bain conjectures. The many studies which have been conducted in the Bain tradition have mostly been attempts to unveil the particular generality conjectured by Bain—a positive correlation between measures of profitability and measures of concentration for a cross section of industries or firms. This search for empirical generalities marked a significant departure from the earlier tradition in industrial organization. This approach was originated by Mason [28], who argued that the relationship between industry characteristics and performance could best be understood by conducting detailed case studies of industries in the hope that useful generalizations would emerge. Thus, in the case study approach, the search for generalities is a secondary objective conditioned on the richly detailed information about the industry. In the Bain approach the conditioning information set is quite limited, although as the tradition evolved, new entrants have expanded the information set by examining the correlation between concentration and profits conditional on additional characteristics of firms that are measurable for cross sections of firms.

By now the Bain tradition is quite well developed. In a recent survey, Weiss [44] discusses some fifty-four empirical studies of the relationship between concentration and profits and there undoubtedly have been many more since.

[1] The fact that some industries are dominated by a few large firms can be quite consistent with competitive equilibrium in a world with adjustment costs, or a skewed distribution of managerial talent (Lucas [23], [24]).

There are three basic controversies that are involved in discussions of this research: (1) The exogeneity of measures of market structure or firm characteristics with respect to profitability; (2) The appropriate selection of data to test the Bain conjecture; (3) The role of specification uncertainty and prior beliefs in the interpretation of the results. This paper addresses only the last of these issues, not because we think the others are unimportant, but because we believe the latter problem has been the most neglected in the literature and is probably the most important source of scepticism about the results.[2]

Given the vast number of market structure—performance studies, it is unlikely that any new empirical results will alter significantly the beliefs of those who are interested in this line of research. All of the empirical evidence is based on projections of the data that are heavily conditioned by the prior beliefs of the researcher. If the results are not robust over alternative projections, then there is little reason to accept the evidence as reflecting the information content of the data rather than the prior beliefs of the researcher. In this paper we analyze the relationship between profitability and market structure using methods which make explicit the role of prior beliefs and specification uncertainty. This methodology is based on the work of Chamberlain and Leamer [8] and Leamer [20].

In the next section of the paper, we identify several prominent classes of alternative prior beliefs that have appeared in the literature. The third section presents a brief discussion of the methodology used in this paper. The following two sections discuss the data and the results. The major conclusion that emerges from our analysis is that specification uncertainty plays a critical role in market structure—performance studies. When this uncertainty is accounted for, the data appear to be largely uninformative about the relationship between concentration and profits. This is in contrast to the claim of Weiss [44, p. 363] that, ". . . the fairly simple econometric techniques applied in the field over the past 10 to 15 years have yielded a set of conclusions that, to my mind, surpass in concreteness and certainty those attained by the preceeding case studies." For some classes of prior belief, the data do appear to be informative. Thus, the positive correlations between market share and profitability and advertising and profitability do not appear terribly sensitive to specification uncertainty. However, it is by now well established that the causal direction of these correlations is at least questionable and that there is no obvious connection between these and the Bain hypothesis.

The results presented here suggest to us that, at the level of theoretical abstraction typically considered in market structure—performance studies, data on cross sections of firms or industries are unlikely to be sufficiently

[2] The question of data selection has been discussed fairly thoroughly by Weiss [44] and Demsetz [15] among others, although there appears to be little agreement on the direction of bias in the most commonly used samples. The question of exogeneity has been less thoroughly discussed, although in specific instances (e.g., Schmalensee [37], Martin [27]) it has been dealt with explicitly.

informative to make such empirical analysis useful. It may, therefore, be more productive to return to industry specific analysis. There will undoubtedly be some who are unconvinced by this argument and for them we offer the observation that further empirical studies based on weak deductive foundations are likely to be convincing only to the extent that they account explicitly for the role of prior beliefs and specification uncertainty.

II. DETERMINANTS OF PROFITABILITY

The conventional market structure—conduct—performance paradigm has guided vast amounts of empirical research in the field of industrial organization for the past three decades. Like empirical research in other areas of economics, the maintained hypotheses that are considered reflect to a large extent the prior beliefs of the researchers. The result is that there is always a suspicion that what is being engaged in is more advocacy than objective empirical analysis.

In the market structure—performance literature, the most important, alternative prior beliefs (maintained hypotheses) appear to fall into six categories which we characterize as follows:

1. Seller concentration explains profits. High rates of return are thought to be caused by monopoly power conferred by high degrees of seller concentration. This is the basic collusion specification of Bain [1].
2. Seller concentration and entry barriers explain profits. High rates of return are thought to reflect monopoly power resulting from both high seller concentration and high barriers to entry. This prior comes from the traditional market structure—performance paradigm of industrial organization and accounts for the peristence of collusive gains. It is prevalent in the work of Mann [26], Weiss [45, 46], Comanor and Wilson [11], Qualls [34], [35] and many other researchers.
3. Absolute or relative firm size explain profits. This prior reflects the Demsetz [14], [15] and Peltzman [33] notion that high rates of return result from superior firm efficiency or innovativeness, and not from oligopolistic collusion and joint profit maximization. This prior has also been adopted by others (e.g., Shepherd [39], Gale [17]) who assume that high market shares indicate high barriers to entry.
4. Risk differentials explain profitability differences. This reflects the notion that high rates of return reflect neither monopoly power nor superior efficiency, but the payment of positive risk premiums to risk averse investors. It underlies much of the work of Stigler [41], Fisher and Hall [16], Cootner and Holland [13], and many others. There are, however, considerable differences in beliefs about which measure of risk—variability of return over time, financial leverage, or nondiversifiable risk—is relevant.

5. Advertising intensity explains profits. This reflects the notion of Bloch [4] and others that differences in reported accounting profit rates result from differences in the amounts of omitted, intangible capital resulting from advertising expenditures. Because advertising is assumed by some to be a source of product differentiation, this prior also may reflect the belief that the extent of product differentiation is a major determinant of profitability (Comanor [10], Schmalensee [37]).
6. Growth explains profits. This reflects Brozen's [6], [7] disequilibrium hypothesis that profitability differences result not from monopoly power, but from adjustments in capacity lagging behind changes in demand.

Given a particular maintained hypothesis about the most important determinant of profitability, there remains uncertainty about the rest of the specification of the model. If the results are not robust with respect to uncertainty about the conditioning set of variables then it cannot be concluded that the data are very informative about the hypothesis in question. The next section discusses the methodology used to determine whether the results are robust to such specification uncertainty.

III. SPECIFICATION UNCERTAINTY

The hypotheses discussed in the previous section all specify the primary determinants of profitability. In each case, however, the investigator must have in mind a set of possible conditioning variables that may or may not belong in the regression. Although uncertainty about the inclusion or exclusion of such variables is not often explicitly acknowledged, it is an inevitable and important aspect of virtually all empirical investigations. The primary concern for the problem at hand is the extent to which this specification uncertainty leads to uncertainty in the estimated parameters of primary interest.

Consider the regression model

$$(1) \qquad y_i = \beta x_i + \sum_{j=1}^{k} \gamma_j z_{ji} + u_i$$

where the maintained hypothesis is that y_i is related to x_i, the focus variable, and β is the parameter of primary interest. The z_i represent the uncertain conditioning set whose inclusion in the regression is regarded as doubtful. When there are k uncertain variables, there are 2^k possible regressions that are defined by the inclusion or exclusion of some or all of the variables that are uncertain. If k is at all large, only a subset of the possible regressions can be examined. What is finally reported is usually a still smaller subset, generally those that are confirmatory of the non-explicit prior beliefs of the researcher. If it were possible to specify doubts about the role of possible conditioning variables explicitly in terms of a well defined prior distribution, with the prior location and covariance matrix specified, then there would be no particular problem since integration of such a distribution with a sample likelihood function would lead to a well defined posterior distribution on the parameters of interest.[3] But, while what is usually meant by doubt about a variable's inclusion is a prior location of zero, it is generally difficult to specify the covariance matrix of the prior distribution. The approach adopted in this paper is based on results of Chamberlain and Leamer [8] and Leamer [20] which show that specification of the prior location and the sample covariance matrix is sufficient to constrain the posterior means to lie within a particular ellipsoid. Thus it is possible to consider how the parameters of interest vary over all possible prior covariance specifications.

To illustrate this, consider the special case of equation (1) in which there are two doubtful variables:

$$y_i = \beta x_i + \gamma_1 z_{1i} + \gamma_2 z_{2i} + u_i . \tag{2}$$

We can define a composite variable,

$$w_i(\theta) = z_{1i} + \theta z_{2i}, \tag{3}$$

and rewrite this equation as

$$y_i = \beta x_i + w_i(\theta)\Gamma + u_i . \tag{4}$$

where $\Gamma = \begin{pmatrix} \gamma_1 \\ \gamma_2 \end{pmatrix}$.

For suitably defined θ this regression will yield any of the four regressions defined by including both doubtful variables, deleting one or the other or both. These four points are noted in Figure 1.[4] There is no obvious reason to restrict our attention only to these four points, however, since they are only a subset of the regressions which incorporate general linear restrictions among the doubtful variables. Each value of θ in equation (4) will define a different regression and yield a different estimate of the parameter of interest $\hat{\beta}(\theta)$. Varying θ over the real line yields the ellipse of constrained estimates shown in Figure 1. This ellipse contains all possible posterior means that can result from integration of the prior distribution centered at the origin with the sample likelihood function.

One measure of the effect of specification uncertainty on the uncertainty about the parameter of interest is to simply consider the extreme values of $\hat{\beta}(\theta)$ over this ellipse. Alternatively, since extreme values of the ellipse of constrained estimates may occur at locations in the parameter space which are unlikely given the sample, it is possible to consider extreme values over this ellipse that are constrained to fall within any given likelihood ellipse. For

[3] A compendium of Bayesian terminology is in Appendix I.

[4] The four values of θ and their corresponding points are: $\theta = 0$, $(\hat{\gamma}_1, 0)$; $\theta = \infty$, $(0, \hat{\gamma}_2)$; $\theta = b_{yz_2 \cdot xz_1}/b_{yz_1 \cdot xz_2}$, $(\hat{\gamma}_1, \hat{\gamma}_2)$; and $\theta = -b_{z_1y \cdot x}/b_{z_2y \cdot x}$, $(0, 0)$ where $b_{cd,e}$ is the least squares estimated coefficient of d as an explanatory influence of c in a model that also has e.

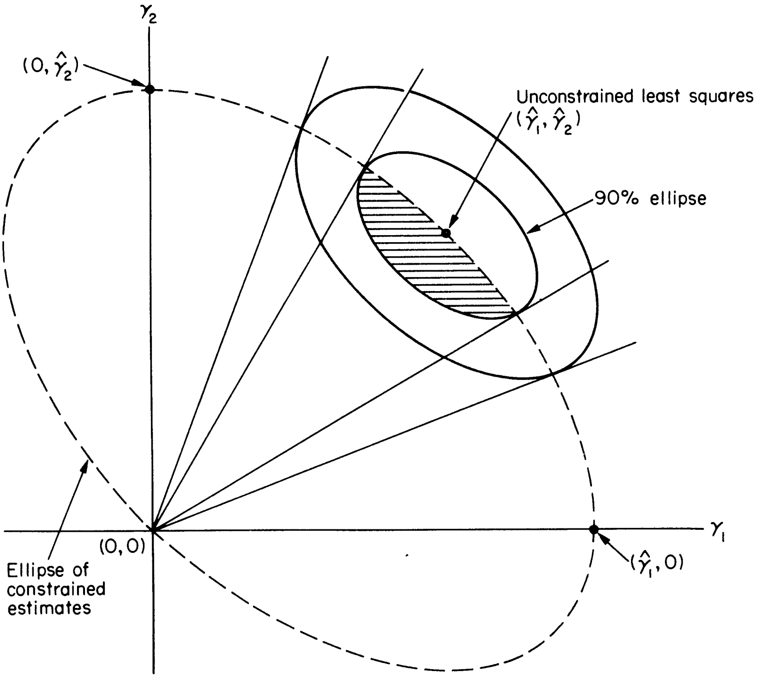

FIGURE 1
Ellipsoids of Constrained Estimates

example, these extreme values would be defined within the set indicated by the shaded region in Figure 1 for the 90 percent likelihood ellipse, which is generated in the usual way under the assumption that all doubtful variables enter the regression. By examining the extreme values of the parameter of interest over a sequence of likelihood ellipsoids (representing various values of the data confidence), we can examine how specification uncertainty varies for different possible relative weights on the sampling and prior distributions.

In Section V we present the upper and lower bounds on the parameter of interest for various values of the data confidence. In addition we perform this analysis for prior distributions which isolate different parameters as being of primary interest in accord with the scheme discussed at the end of the previous section. This analytical procedure has the advantage that consumers, even those with strong prior convictions, can judge how informative the data are about various hypotheses in the face of specification uncertainty.

IV. THE DATA SET

For the purpose of this analysis, it is important to have a data set roughly comparable to those used in previous empirical studies of the concentration—

profits relationship. Most of the studies contained in Weiss' [44] extensive review of this literature use cross section data on large U.S. manufacturing firms or industries over periods of several years during the 1950s or the 1960s. The estimation procedure almost always involves a single equation, ordinary least squares regression of some measure of profitability on a measure of seller concentration. Major differences among specifications result primarily from differences in the number and type or other explanatory variables included in the various models.

The present study uses a sample of 156 large U.S. manufacturing firms over the period 1960–67. These firms are a subset of the 231 firm sample used by Shepherd [39] and are taken primarily from the *Fortune Directory* of the 500 largest U.S. industrial corporations. In compiling his sample, Shepherd excluded firms which he considered were either experiencing a major disequilibrium or merger during the 1960s, operating subject to regulatory constraints, or highly diversified, and for which, in his opinion, adequate market structure data were not available. In order to capture the full variety of different specifications appearing in the literature, it was necessary to have data on measures of firm and industry attributes not considered by Shepherd. The additional data constraints we encountered account entirely for the reduced sample size. The resulting 156 firm subsample is approximately the same as the 158 subset of Shepherd's sample subsequently used by Bothwell and Keeler [5].

Profitability Measures

Prior studies have used several different measures of profitability. Most, based on the general economic principle that rates of return on investment will tend, in the long run, toward equality under competition, use either the rate of return on equity or the rate of return on total assets (for firms or industries) averaged over periods of several years. Some researchers (see Hall and Weiss [18]) have preferred the former measure on the basis that it corresponds to what entrepreneurs, or managers acting in the best interest of owners, should seek to maximize. Capital structure is viewed as an element of input mix, with the optimal amount of debt varying among firms or industries because of differences in such factors as stability and growth. As a result, they argue that although rates of return on equity will tend toward equality under competition, rates of return on assets will differ among firms or industries even in a perfectly competitive long run equilibrium.

Stigler [41], however, has argued that lenders also seek to maximize the present value of their future income streams and differ from entrepreneurs only in placing a higher value on security relative to earnings. To the extent that lenders are risk averse, he thought that the realized rate of return on assets should be expected to be larger the greater the proportion of debt in the capital structure, but with a partially offsetting reduction in the risk premium demanded by equity holders. Stigler, however, preferred to leave open all questions concerning the effect of interfirm or interindustry differences in capital structure on realized rates of return by considering total assets as the investment basis and the sum of interest payments, dividends and undistributed profits net of income taxes as the return on this capital.[5]

Regardless of which of these measures is used, both are subject to several well known problems stemming from the lack of correspondence between accounting and economic profits. First, depreciation practices vary considerably among firms and industries and do not adjust asset valuations for changes in price levels. Accounting rates of return are thus affected by interfirm and interindustry differences in accounting conventions and the age and durability of capital assets. Second, advertising and research and development expenditures are treated as current expenses rather than as investment in depreciable, intangible capital stocks. Third, executive salaries and emoluments may, to varying degrees, contain a portion of economic profits as well as a payment for labor services. Fourth, economic profit is net of all opportunity costs, including the opportunity cost of invested capital, while accounting profit is not.

Because of this continuing disagreement over what the appropriate rate of return to use is, and the fact that different measures of profitability have significantly affected the results of several prior empirical studies, we use both the after tax rate of return to stockholders' equity (RE) and the after tax rate of return to total assets (RA) as alternative dependent variables. Each of these is derived from individual firm, annual accounting data taken from the Compustat tape and averaged over the period 1960–67.

Explanatory Variables

The various specifications and priors discussed in Section II imply that profitability can be related to a large number of firm specific and industry specific attributes. Since it would be impractical to collect data on all of the diverse measures appearing in prior empirical studies, we focus on the principal ones. Specifically, the full set of explanatory variables considered in this study includes the following:[6]

Seller Concentration (SC)

By far the most frequently used measure is the ubiquitous four firm concentration ratio for three or four digit Standard Industrial Code (SIC) industries.

[5] If accounting rates of return are reflective of market rates, this approach is consistent with the capital structure irrelevance theorem of Modigliani-Miller which suggests that while the rate of return on equity is positively related to the ratio of debt to equity, the rate of return on assets will be unaffected by the degree of financial leverage.

[6] A data appendix listing the firms in the sample, their primary industry classification, and the basic market structure data are available on request, for a reasonable length of time, from the authors.

Since many of these industry definitions do not correspond closely with the product and geographical bounds of theoretically meaningful markets, many researchers adjust the raw concentration data supplied by the Census of Manufacturers for over- or under-inclusion. In addition, because of firm diversification, weighted average concentration ratios are often computed on an individual firm basis with the weights based on either product line sales data or plant employment statistics. Shepherd followed both of these procedures in calculating firm specific, weighted averages of four firm concentration ratios based on adjusted SIC concentration ratios. These estimates were available to us and are used here without alteration.

Advertising Intensity (*ADVS*)

The conventional measure used by Comanor and Wilson [11], Shepherd [39] and others is the ratio of advertising outlays to industry sales revenues. Data are from the 1965 *Internal Revenue Service Corporation Source Book of Statistics of Income* for IRS "minor industries", which are roughly comparable to 3-digit SIC industry groups. This measure, as well as all other measures of industry-specific attributes used except seller concentration, is determined for each firm on the basis of the most important industry in which that firm produced.[7]

Economies of Scale in Production (*SCALE*)

We use the same measure of economies of scale in production relative to market size as that first developed and used by Comanor and Wilson [11]. Following their procedure, it is calculated by dividing the average plant size among the largest establishments accounting for half of industry output by total output. Data on the size and output of establishments within four digit SIC industries are from the 1963 *Census of Manufacturers* and the 1963 *Census of Mineral Industries*.

Absolute Capital Requirements (*LOGCAP*)

The amount of capital necessary for a single efficient plant. This measure is also computed by following the procedure used by Comanor and Wilson [11] and multiplying the average output level of plants at estimated minimum efficient scale by the ratio of total assets to gross sales for the industry. The variable is expressed in logarithmic form. Data on industry assets and sales are from the 1963 *IRS Statistics of Income: Corporation Income Tax Returns*, which is also the source of correspondence between IRS and census defined industries.

[7] Firms were assigned to primary 3-digit industries according to the classification appearing in *Mergers and Super Concentration* [42].

Leverage (*AEIC*)

Leverage has been used as a measure of risk in several empirical studies, including Hall and Weiss [18], Gale [17], Baker [3] and Hurdle [19]. The usual supposition is that a leveraged firm with relatively more borrowed capital represents a greater financial risk to equity holders than a firm with relatively less debt. Gale, however, argues that firms have low debt because they operate in industries with high degrees of business risk and thus expects a negative leverage-return relationship if owners are risk averse. We use annual accounting data on each firm's financial structure taken from the Compustat tapes to measure leverage inversely as the ratio of common equity to total invested capital, averaged for the period 1960–67.

Profit Variability (*STD*)

Another frequently used measure of risk reflects the amount of variation in rates of return over time. Following Fisher and Hall [16] and Shepherd [39], we use the standard error of a trend line fitted to each firm's annual rate of return on equity for the period 1960–67. Annual accounting data are from the Compustat tapes.

Non-Diversifiable Risk (*BETA*)

Recently, a measure of risk based on the capital asset pricing model of Sharpe [38] and Lintner [21] has been incorporated into a market structure-profitability model by Bothwell and Keeler [5]. The basic supposition is that risk averse investors will seek to reduce risk by holding diversified portfolios. If so, the only measure of risk that should matter for any given investment is that which cannot be eliminated through diversification, and the cost of equity capital to a firm, i.e., the expected return required by investors in order for them to continue to hold that firm's stock in their portfolios, becomes a function of the degree of non-diversifiable systematic risk associated with the return on the firm's stock. This risk measure, the well known "beta coefficient", is estimated by regressing the actual monthly rate of return on the stock of each firm on the monthly return of an index representing a market portfolio for the period 1960–67. The necessary stock market data are from the data tapes supplied by the Center for Research in Security Prices of the University of Chicago School of Business. (For a more detailed discussion of the estimation procedure see Bothwell and Keeler [5, p. 76]).

Firm Growth (*GD*)

Measured as the percentage change in each firm's sales revenue over the period, 1960–67. Prior studies have used either this measure, or one based on the growth of physical output. (See, for example, Hall and Weiss [18], Shepherd [39]). Sales data are from the Compustat tapes.

Firm Size (*CLOGA*)

We use a common measure of firm size, the logarithm of total year end assets (in millions of dollars) averaged over the period of the analysis (e.g., Hall and Weiss [18], Shepherd [39]). The data are again taken from the Compustat tapes.

Market Share (*MS*)

Shepherd [39] calculated weighted average market shares in 1961 and 1968 for each of the 231 firms in his sample. We use the average of these estimates for our 156 firm subsample.

V. RESULTS OF THE ANALYSIS

Table I presents the results of the ordinary least squares estimates of the basic equations including all of the possible explanatory variables for both measures of profitability. The least squares estimates of most of the coefficients appear to be reasonable and the degree of explanatory power is acceptable for cross sectional data. The sample confidence intervals for some of the coefficients are quite wide and the effect of seller concentration (SC) is obviously poorly defined.

Our primary concern is to analyze the effect of specification uncertainty on these results for a variety of priors. Each of the priors defines a focus variable or variables whose coefficient(s) are of primary interest and assigns a prior distribution that is uninformative about those variables. The remaining vari-

TABLE I
ORDINARY LEAST SQUARES ESTIMATES
STANDARD ERRORS IN PARENTHESIS

$$(1)\quad RE = \underset{(0.0337)}{-0.003597} + \underset{(0.0235)}{0.01874}\ SC + \underset{(0.119)}{0.5680}\ ADVS + \underset{(0.00267)}{0.00197}\ LOGCAP$$

$$+ \underset{(0.106)}{0.01779}\ SCALE + \underset{(0.0264)}{0.07752}\ AEIC + \underset{(0.237)}{0.1619}\ STD - \underset{(0.0131)}{0.01186}\ BETA$$

$$+ \underset{(0.00479)}{0.01944}\ GD + \underset{(0.0306)}{0.1653}\ MS - \underset{(0.00717)}{0.00759}\ CLOGA$$

$$R^2 = 0.5656 \qquad SEE = 0.0370$$

$$(2)\quad RA = \underset{(0.0213)}{-0.00609} + \underset{(0.0149)}{0.02028}\ SC + \underset{(0.0755)}{0.2641}\ ADVS + \underset{(0.00169)}{0.00163}\ LOGCAP$$

$$\underset{(0.0673)}{-0.07513}\ SCALE + \underset{(0.0167)}{0.0896}\ AEIC + \underset{(0.150)}{0.003061}\ STD - \underset{(0.00830)}{0.0106}\ BETA$$

$$+ \underset{(0.00303)}{0.00866}\ GD + \underset{(0.0194)}{0.09871}\ MS - \underset{(0.00454)}{0.00862}\ CLOGA$$

$$R^2 = 0.5914 \qquad SEE = 0.0234$$

ables in each equation are treated as doubtful and the prior distribution assigns them a location of zero. The upper and lower extreme bounds (denoted U and L) on the coefficient(s) of primary interest are reported for various values of data confidence in Tables II and III for each of the measures of profitability.

The first prior considered is the basic collusion hypothesis of Bain. The focus variable is seller concentration (SC) and all other variables are regarded as doubtful. The extreme bounds are presented in the first row of Tables II and III. The extreme bounds over the entire ellipsoid of constrained estimates is extremely wide (0.237 to −0.026) when rate of return on equity is the dependent variable (Table II). While the upper bound of this coefficient is quite large at the prior, its lower bound is negative and remains negative for values of data confidence that give much more weight to the data. Since larger values of the data confidence mean less weight to the data, the uncertainty in this coefficient that is due to specification uncertainty is very large indeed and is everywhere larger than the sampling uncertainty in the coefficient. This result is obtained for both of the measures of profitability considered. Since the upper bounds of the interval are always positive, it is clear that there are some specifications which will yield a positive conditional correlation between concentration and profits. It is nevertheless clear that such a finding would be a property of the researcher's prior, not of the data.

The second prior considered treats both seller concentration and two common measures of barriers to entry, the extent of scale economies (SCALE) and capital requirements (LOGCAP), as focus variables. All other variables are regarded as doubtful. The second row of Tables II and III shows the extreme bounds on the coefficient of SC for this barriers to entry prior. The third row shows the extreme bounds on the sum of the coefficients of the barriers to entry measures for the same prior. The results in row 2 suggest that inclusion of some measure of barriers to entry as a focus variable is sufficient to bound the conditional correlation of concentration and the rate of return on equity or assets above zero. This may appear to lend support to the barriers to entry hypothesis, but it should be noted that the lower bound is still very close to zero and the uncertainty in the coefficient of SC due to specification uncertainty is quite large and is greater than the sampling uncertainty for all values of the data confidence. Moreover, the extreme bounds on the sum of the coefficients of the barriers to entry measures (SCALE and LOGCAP) are quite wide with a negative lower bound for most values of the data confidence. Thus, the data do not seem terribly informative about the conditional correlation of these two barriers to entry measures and profitability. On the whole, these results suggest to us that the support for the barriers to entry hypothesis is at best very weak.

The third prior considered treats only firm size (CLOGA) as a focus variable with all other variables treated as doubtful. This is a prior that seems implicit in much of the work of Demsetz. The results presented in row 4 of

TABLE II
EXTREME BOUNDS WHEN RETURN ON EQUITY (RE) IS THE DEPENDENT VARIABLE

	Prior Focus Variables	Bounds on Coeff. of	Bounds	Data confidence						
				0.0	0.250	0.500	0.750	0.900	0.990	1.00
1	SC	SC	U	0.0187	0.0823	0.0931	0.150	0.116	0.136	0.237
			L	0.0187	−0.0169	−0.0205	−0.0235	−0.0253	−0.026	−0.026
2	SC, SCALE,	SC	U	0.0187	0.0748	0.0844	0.0946	0.104	0.122	0.228
	LOGCAP		L	0.0187	0.00069	0.00011	0.00010	0.00010	0.00010	0.00010
3	SC, SCALE,	SCALE &	U	0.0198	0.114	0.129	0.146	0.162	0.191	0.564
	LOGCAP	LOGCAP	L	0.0198	−0.0438	−0.0539	−0.0641	−0.0732	−0.0884	−0.129
4	CLOGA	CLOGA	U	−0.00759	0.0132	0.0166	0.0202	0.0237	0.0300	0.0820
			L	−0.00759	−0.0225	−0.0249	−0.0274	−0.0296	−0.0332	−0.0420
5	MS	MS	U	0.165	0.238	0.252	0.266	0.280	0.305	0.527
			L	0.165	0.125	0.122	0.120	0.118	0.118	0.118
6	ADVS	ADVS	U	0.568	0.803	0.843	0.887	0.928	1.00	2.93
			L	0.568	0.482	0.471	0.461	0.453	0.441	0.432
7	GD	GD	U	0.0194	0.0303	0.0321	0.0341	0.0360	0.0395	0.109
			L	0.0194	0.0144	0.0137	0.0131	0.0126	0.0118	0.0108
8	AEIC	AEIC	U	0.0775	0.144	0.156	0.168	0.180	0.200	0.257
	BETA		L	0.0775	0.0194	0.0111	0.0029	−.0041	−0.0148	−0.0249
9	AEIC	BETA	U	−0.0118	0.0139	0.0182	0.0266	0.0266	0.0335	0.0489
	BETA		L	−0.0118	−0.0362	−0.0400	−0.0438	−0.0471	−0.0526	−0.0606
10	STD	STD	U	0.162	0.722	0.815	0.913	1.01	1.18	5.23
			L	0.162	−0.171	−0.226	−0.283	−0.334	−0.442	−0.788

TABLE III
EXTREME BOUNDS WHEN RETURN ON ASSETS (RA) IS THE DEPENDENT VARIABLE

Prior #	focus Variables	Bounds on Coeff. of	Bounds	Data confidence P.O	0.250	0.500	0.750	0.900	0.990	1.00
1	SC	SC	U	0.0203	0.0610	0.0678	0.0751	0.0821	0.0950	0.165
			L	0.0203	−0.0022	−0.0048	−0.0070	−0.0085	−0.0096	−0.0096
2	SC, SCALE, LOGCAP	SC	U	0.0203	0.0563	0.0623	0.0688	0.0749	0.0862	0.159
			L	0.0203	0.00814	0.00739	0.00714	0.00714	0.00714	0.00714
3	SC, SCALE, LOGCAP	SCALE & LOGCAP	U	−0.0735	−0.0127	−0.0029	0.00759	0.0176	0.0360	0.294
			L	−0.0735	−0.114	−0.121	−0.128	−0.134	−0.145	−0.183
4	CLOGA	CLOGA	U	−0.0086	0.00493	0.00706	0.00933	0.0115	0.0155	0.0550
			L	−0.0086	−0.0173	−0.0188	−0.0203	−0.0216	−0.0239	−0.0299
5	MS	MS	U	0.0987	0.143	0.151	0.160	0.169	0.185	0.362
			L	0.0987	0.0733	0.0714	0.0699	0.0691	0.0688	0.0688
6	ADVS	ADVS	U	0.264	0.413	0.438	0.465	0.491	0.539	1.98
			L	0.264	0.208	0.200	0.193	0.187	0.177	0.163
7	GD	GD	U	0.00866	0.0154	0.0166	0.0179	0.0191	0.0213	0.0748
			L	0.00866	0.00516	0.00467	0.00418	0.00375	0.00305	0.00153
8	AEIC BETA	AEIC	U	0.0896	0.132	0.139	0.146	0.153	0.164	0.184
			L	0.0896	0.0516	0.0462	0.0408	0.0363	0.0297	0.0249
9	AEIC BETA	BETA	U	−0.0106	0.0053	0.0078	0.0103	0.0126	0.0162	0.0207
			L	−0.0106	−0.0264	−0.0289	−0.0313	−0.0335	−0.0370	−0.0413
10	STD	STD	U	0.00306	0.372	0.430	0.492	0.551	0.660	3.61
			L	0.00306	−0.188	−0.222	−0.258	−0.291	−0.347	−0.619

Tables II and III lend little support to this hypothesis. The value of the coefficient at the data is negative for both of the profitability measures and the extreme bounds span zero for all values of the data confidence.

The next prior considered focuses on market share (MS) as the primary determinant of profitability; all other variables are regarded as doubtful. The results presented in row 5 of Tables II and III show that, although the specification uncertainty leads to substantial uncertainty in the coefficient, the existence of a strong positive correlation between market share and profitability is fairly robust to specification uncertainty. A similar result is obtained when the advertising-sales ratio (ADVS) is treated as the focus variable. Those results, presented in row 6, show strong positive correlation between advertising intensity and profitability. Thus, both of these hypotheses show some sensitivity (in terms of the magnitude of the effect) to uncertainty in the specification, but the direction of the effect is supported by the data. This does not, of course, imply anything about the causal direction of the relationship.

The notion that disequilibrium in an industry, as measured by the growth in demand (GD), is the primary factor affecting profitability is represented by a prior which focuses on GD as the primary variable of interest. These results are presented in row 7 of Tables II and III. Again, while there is substantial uncertainty in the coefficient due to the uncertain specification, the data seem to support a positive correlation between growth and profitability.

The final priors consider measures of risk as the primary determinant of profitability. The first regards both non-diversifiable risk (BETA) and leverage (AEIC) as focus variables. These results are presented in rows 8 and 9 of Tables II and III. The extreme bounds are presented for the coefficients of the two focus variables. The last prior considered focuses on business risk as measured by the variability of a firm's rate of return on equity over time (STD) as the primary determinant of profits. The results presented in row 10 of Tables II and III suggest that there is no support for this hypothesis in the data.

Theory would predict that the sign of the coefficient of BETA should be positive (assuming the measure of profitability is correct) while the coefficient of AEIC should be negative if it is a measure of financial risk and positive if it is a measure of business risk. There is, thus, little interpretation that can be placed on the results for AEIC except to note that the effect of specification uncertainty on the uncertainty in this coefficient is very large. When the effect of the specification uncertainty is accounted for, the data appear uninformative about the coefficient of BETA.

VIII. CONCLUDING REMARKS

The presence of specification uncertainty in studies of the relationship between market structure and performance must be acknowledged. That uncertainty can be accounted for in a way that makes explicit both the maintained hypothesis of the researcher and the incomplete specification of prior uncertainty about the set of conditioning variables. The results of the previous section suggest that when these factors are accounted for, the data examined in this paper do not support the basic collusion hypothesis of Bain. Neither do they lend any convincing support to the barriers to entry hypothesis (i.e., the extended Bain "monopoly power" hypothesis), the absolute firm size hypothesis, or the various "risk premium" hypotheses.

The data offer the strongest support for the hypotheses that advertising and profits are positively correlated and market share (relative firm size) and profits are positively correlated. There are some who would interpret the former finding as evidence in favor of the Bain hypothesis, because they interpret advertising intensity as indicating product differentiation barriers to entry. Alternative, quite different interpretations are offered by Nagle [32]. The robust positive correlation between market share and profits is also subject to two interpretations, one due to Demsetz and Peltzman that firm size is an indication of efficiencies, and the other that large firm size indicates a large capital requirements barrier to entry. The latter would seem to be suspect in this context where capital requirements are used as an additional variable, but the possibility of multiple interpretations itself suggests the limitations of the basic hypothesis considered at this level of abstraction.

There are some who believe that an inductive research program still holds promise (e.g., Scherer [36, p. 295]). Our own view is that stronger theoretical restrictions on the data than are typically offered in market structure—performance studies will make it easier to interpret the conditional correlations that emerge. Whatever course one pursues, it seems clear that the substantial role played by specification uncertainty at the very least counsels caution in the acceptance of empirical results from regressions such as those considered here, particularly if the results of such studies are used to support or advocate changes in public policy. Finally, however, it seems to us that the best way to lend credibility to studies of market structure and performance is to ground them more firmly in economic theory.

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APPENDIX I

Compendium of Bayesian Terminology

Doubtful variables: The explanatory variables that the researcher is uncertain whether to include or exclude from the regression.

Ellipse of constrained estimates: the set of all estimated values of the coefficients of the doubtful variables resulting from estimation of the regression under all possible linear constraints among the doubtful variables. Each point on this ellipse corresponds to a different estimate of the coefficient of the focus variable.

Likelihood ellipse: the ellipse summarizing the sample information, centered around the unconstrained least squares point (the values of all estimated coefficients when all of the doubtful variables are included in the regression). The ellipse traces out the set of all possible values for the estimated coefficients of the doubtful variables (which implies corresponding values of the coefficients of the focus variables) for a constant sum of squared residuals and a certain probability (data confidence). The larger the probability is, the larger the ellipse is. This corresponds to the classical F test.

Posterior distribution: the estimates resulting from the combination of the prior distribution with the sample likelihood function. These Bayesian posterior estimates will reflect the researcher's prior beliefs about the parameter's values. In pure classical statistics, estimates are formed solely from the sample information—prior information is not explicitly acknowledged.

Prior distribution: the prior location (mean) and prior covariance matrix which summarize the state of ignorance or knowledge about a parameter before the sample data are analyzed.

Prior location: the mean of the prior distribution. Since the researcher is uncertain about including the doubtful variable in the regression, this uncertainty is expressed by setting the prior location of the coefficient of the doubtful variable equal to zero. If the researcher strongly believes that a variable belongs in the regression, then the prior location is unspecified.

Specification uncertainty: the uncertainty of the researcher about what explanatory variables to include in a regression. The effects of specification uncertainty are that every time a regression is estimated with a different set of explanatory variables, the coefficient of the variable of interest (focus variable) will be different.

Upper (Lower) bound: the highest (lowest) value of the coefficient of a focus variable that corresponds to coefficients of the doubtful variables laying within both the ellipse of constrained estimates and a certain confidence ellipse. The data confidence corresponding to each set of extreme bounds indicates the relevant confidence ellipse. The specification uncertainty at each level of data confidence is measured by the distance between the corresponding upper and lower bounds.

APPENDIX II

Summary Characteristics of the Data

Variable	*Mean*	*Standard Deviation*	*Minimum Value*	*Maximum Value*
BETA	0.88837	0.27020	0.31184	1.65872
SC	0.64622	0.17144	0.25000	0.96000
RA	0.08805	0.03549	0.01680	0.22450
RE	0.12582	0.05432	0.02560	0.35740
ADVS	0.02236	0.02814	0.00100	0.11780
CLOGA	2.57779	0.53190	1.32250	4.09120
AEIC	0.81556	0.13395	0.36510	1.00000
GD	0.86853	0.66688	−0.26400	3.97700
MS	0.22551	0.12640	0.04000	0.75000
STD	0.01710	0.01462	0.00141	0.11384
SCALE	0.02444	0.02999	0.00020	0.15570
LOGCAP	3.49367	1.42383	−0.66165	5.92693

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