

Relative Market Power versus Concentration as Measure of Market Dominance: Property and Liability Insurance

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Abstract: This paper utilizes a rank-size function to investigate market concentration in lieu of well-known measures. For comparison, two measures were chosen: Theil's entropy and the Herfindahl. The empirical results are based on premiums written for twelve lines of property and liability insurance. While the two concentration measures rank the lines for the level of concentration in almost complete unanimity, the empirical results indicate that the ranking breaks down for the rank-size function. This important finding gives substantial strength to advocates of the market share as measure of market power as opposed to the market concentration measure. [Key words: market power, market share, p-1 insurance, Theil's entropy.]

INTRODUCTION

According to Round (2002), in most industrialized countries there is the recognition that, in general, markets work best when operating under competitive conditions. It is also recognized that when markets are left to their own devices, a failure may occur because of personal advantages sought by entrepreneurs, as well as because of diverse market conditions. In the United States, the Sherman Act in 1890 was enacted as an antitrust law to enhance competition. Dozens of countries, copying the United

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States, also developed antitrust legislation to prevent monopolistic practices.

Anti-trust cases spawned a body of economic research in industrial organization, starting with the publication of Mason in 1939. The framework is known as the structure-performance relationship which early empirical research, according to Amato and Wilder (1995), revealed generally as a positive relationship between seller profitability and concentration. Amato and Wilder cite a collection of articles that play down the relationship between seller concentration and profitability and another collection of articles that contend that individual firm market share is a more relevant explanation of profitability than is concentration.

Nissan and Caveny (2001) reviewed the regulation of the insurance industry, pointing to the enactment of the McCarran-Ferguson Act of 1945, which gives priority of regulation to the states unless effective enforcement is lacking at the state level. Nissan and Caveny also pointed to recent calls to repeal the act by citing numerous studies that observe a prevailing view among the public that some lines of property and liability insurance earn excessive profits. In order to detect which lines are the most concentrated, they made comparisons of concentration between twelve lines and various other industries using data on the largest fifty companies. They employed the broad view that if concentration as measured by the Herfindahl index (discussed in the sequel) in the insurance lines exceed or are comparable to other industries that are subject to federal regulation, then perhaps considerations for regulation of the property and liability insurance should be returned to the federal authorities.

Rhoades (1985) provides strong arguments in favor of market share rather than concentration as a source of monopoly power, with important implications for both microeconomic theory and antitrust policy. Industries with low concentration may in actuality have a market power problem, in the sense that—as, for instance, in conglomerate mergers—a large firm seeking to expand into a new market acquires one of the market leaders. Antitrust enforcement would be better served to make decisions based on market share measures rather than concentration measures. For the identification of market power, Rhoades suggests that firm market rank should be taken seriously. The concern of Rhoades was voiced much earlier by Ijiri and Simon (1971), who have challenged the prevalent view that mergers noticeably increase concentration as measured by conventional concentration indexes.

This paper builds on the work laid out by Nissan and Caveny (2001), entailing a comparison between two well-known measures of concentration—the Theil's Entropy and the Herfindahl—and a rank function. The rank function may be utilized as an alternative for measuring concentration

when the shares of the leading firms are given special attention. This way, it may happen that industries that display minor levels of concentration by the conventional measures may in fact have a market power problem. The data used, as was done by Nissan and Caveny (2001), are the leading fifty firms of twelve lines of property and liability insurance. This makes comparisons possible.

The structure of the paper is divided into four sections. The first provides a review of the literature, with the second section describing the methodology and data. The third discusses empirical results and is followed by a summary and conclusions section.

REVIEW OF LITERATURE

The debate about the importance of market share rather than concentration as a criterion of market power virtually started with Shepherd (1972) leading Rhoades (1997) to coin the phrase "relative market power." Shepherd laid out the pro and con arguments relating higher market shares with profitability by invoking the neoclassical expectation that a higher market share results in a higher profitability on one hand, and by invoking the Cournot model, which gives a zero relationship, on the other hand. Shepherd employed a regression model with market share, leading-firm group (size), advertising intensity, and growth as variables to explain profitability employing the *Fortune* directory of the largest 500 firms as the source of data. Shepherd found that market-share association with profitability is positive and highly significant, while the size coefficient is negative but small. Both advertising intensity and growth were positive and significant.

Other notable contributors are Gale (1972), Dalton and Levin (1977), Porter (1979), Ravenscraft (1983), and Rhoades (1985, 1995). These contributors follow Shepherd's procedure employing regression models relating collections of variables to profitability. Gale (p. 422) concludes that "high market share is associated with high rates of return and that the effect of share on profitability depends on other firm and industry characteristics." Dalton and Levin (p. 33) conclude: "Market shares and profit rates are directly related only in the high concentration subgroups. When concentration is low, market share and rates of return are not related." Porter also shows that profits are related to market power, while Ravenscraft, using the line of business (LB) levels as a source of data, concludes (p. 29) that "Concentration's effect on profit is negative in the LB regression and in some cases significantly negative, when the positive effect of market share is taken into account."

Berger (1995) comes to the conclusion that market power does not necessarily increase profitability in the banking industry. Similarly, in their study of determinants of bank growth, Cyree, Wansley, and Boehm (2000) conclude that the Herfindahl index as a measure of concentration does not predict market power. Rhoades (1985), using the banking industry as a case study, comes to the important conclusion (p. 360) that "with respect to policy, it appears that the antitrust authorities and banking authorities should devote attention to the market share of firms to be acquired, regardless of market concentration." Rhoades (1995) tackles the issue again by using four types of estimating techniques to detect the role of size of the largest firms.

These cited articles have in common interaction of concentration and market share with other variables such as advertising, mobility barriers, oligopolistic rivalry, and economies of scale, among others, as explanations for profitability. Complicating the issues relating size and profitability are arguments that reverse the direction from market size leading to profitability to one that advocates that low-cost, highly profitable firms gain big shares of the market because of their superior performance (Demsetz, 1973; Brozen, 1982). In the particular case of the property and liability insurance industry, Sigalla (2002) explains that the market experiences "soft" and "hard" cycles. In the former case, the level of capital grows and premium prices come down, while in the latter case, capital dwindles, contributing to rises in price of premium. Sigalla points out that the 1990s insurance market may be characterized as soft, leading insurance firms to seek increase in market share. The year 2000 ushered in a hard market, in which insurers faced growing claims resulting in difficulties offsetting operating losses. Furthermore, returns on investment income, a major source, considerably declined because of lower interest rates and lower stock earnings. These considerations make association of profit to market power in the property and liability industry a bit problematic and, perhaps, statistically unreliable when concentration is used as an explanatory variable in an econometric relationship to profit in an insurance setting.

METHODOLOGY

The present paper attempts to show that two well-known measures of concentration differ in their assessment of the magnitude of monopolization from a measure based on ranking of shares. The two well-known measures of concentration are the Theil's Entropy Index and the Herfindahl Index. A rank function is introduced as an alternative. The three indexes

incorporate the relative size (market share) of all the firms in the sample. By letting S_i equal market share of firm i , then $\sum S_i = 1.00$.

Premiums written by the fifty largest firms in twelve lines of property and liability insurance are the source of data obtained from the National Association of Insurance Commissioners (NAIC, 1998). The NAIC data are provided in a disaggregated form covering some forty different lines of insurance. This research chose the well-known twelve lines that are used as the data base for this research. The choice of the largest firms as a basis of analysis provides an equalized sample. The rationale is to eliminate distortions resulting from differences in sample size. The largest 50 in the chosen lines control a large segment of the business, with 82 percent being the norm. Table 1 provides descriptive statistics showing the premium written of the total dollar amounts of the twelve lines. Also shown are the total dollar amounts of the top 100 and top 50 firms, as well as their ratios to total. The last column of Table 1 presents the ratios of the top 50 as compared to the top 100. An important conclusion of Table 1 is the relative sizes of the premium written by the top 100 and the top 50, which gives justification to using the top 50 as a basis of analysis.

The Theil's Entropy Index E

$$E = -\sum S_i \log S_i, \quad 0 \leq E \leq \log n. \quad (1)$$

When all firms have an equal share, $E = \log n$. When one firm controls all shares, $E = 0$. The Theil's Entropy is derived from the notion of entropy in information theory (Theil, 1967, pp. 24–48). Jenkins (1991) explains that if a particular event is very rare, then the information value of its occurrence is valuable. Thus, in terms of its use as a measure of business concentration, higher weights are given to smaller firms. Note also that decreasing values of E indicate increasing levels of concentration.

The Herfindahl Index H

$$H = \sum S_i^2, \quad 1/n \leq H \leq 1.00. \quad (2)$$

Scherer and Ross (1990) indicate that by squaring market shares, the H index gives heavier weights to larger firms than to small firms, unlike the case for E . They also indicate that if shares of small firms were ignored, the resulting errors will not be large. Note that increasing values of H indicate increasing levels of concentration, an opposite direction as compared to E . Note also that both E and H agree on whether concentration

Table 1. Dollar Magnitudes of Premium Written of Total and Top 100 and Top 50 Firms and Their Proportion of Total

Line	Total		Top 100		Top 50		Ratio
	\$ million	\$ million	Ratio	\$ million	Ratio	Top 50/Top 100	
Private passenger auto liability	59,932	54,312	0.91	49,126	0.82	0.89	
Private passenger auto physical damage	37,435	33,635	0.90	30,424	0.81	0.90	
Workers' compensation	34,139	26,326	0.77	23,694	0.69	0.90	
Homeowner's multiple peril	25,846	23,412	0.91	21,428	0.83	0.92	
General liability	22,512	20,476	0.91	18,881	0.84	0.92	
Commercial auto liability	13,163	11,848	0.90	10,221	0.78	0.86	
Commercial multiple peril	11,176	10,115	0.91	9,220	0.83	0.91	
Commercial multiple peril (liability)	9,777	8,494	0.92	8,205	0.84	0.92	
Medical malpractice	6,164	3,560	0.58	3,552	0.57	0.99	
Fire	5,350	4,402	0.82	3,900	0.73	0.89	
Commercial auto physical damage	4,750	4,233	0.89	3,649	0.77	0.86	
Allied	3,734	3,338	0.89	2,916	0.78	0.87	

Source: NAIC (1998).

rises or falls, though they may disagree about how much. According to Rhoades (1993), H as a statistical measure of concentration has achieved considerable visibility because of its use by the Department of Justice and the Federal Reserve when deciding on the competitive effects of mergers. According to Pepall, Richards, and Norman (2002), the Department of Justice would not challenge horizontal mergers if H is less than 0.10. A merger also would not be challenged if $0.10 < H < 0.18$ and if the merger did not raise H by more than 0.01. If $H > 0.18$, any merger that raises the index is likely to be challenged.

The Rank-Size Function S

As Rhoades (1995) points out, there are many measures, such as Gibrat's law of proportionate growth (for a comprehensive understanding

of this law, see Sutton, 1997), to measure the sheer inequality of market shares, which may have implications for strategic behavior. The rank-size procedure adopted in this paper was developed by many scholars using Gibrat's insights into the structure of industries. Kwoka (1982), who studied the rank distribution of the top ten shares of 300 four-digit U.S. industries, explains that the origin of the rank-function was concerned with the skewed size distribution of firms as envisioned by Gibrat's law, which claims that the percentage change in a firm's size is independent of its initial size. Such process produces a log-normal size distribution of firms. Kwoka (1982) indicates that after some regularity conditions, a Yule distribution results. The upper tail of the Yule distribution resembles a Pareto distribution, which describes that relation between size S of a firm and its rank order R by its size "1" being the rank of the largest firm. The rank-size function takes the form (Ijiri and Simon, 1971)

$$SR^B = A. \quad (3)$$

Equation (3), where B and A are constants, implies that the larger the B , the greater the difference in size between two firms with a given ratio of their ranks. Alternatively, equation (3) can be written as

$$S = AR^{-B}$$

which in logarithmic form (any base) is

$$\log S = \log A - B \log R$$

estimated by regression using natural logarithms base (Malecki, 1980) as

$$\ln S_i = \ln a - b \ln R_i. \quad (4)$$

Kwoka (1982) explains that the coefficient "b," because of its ability to capture the decline pattern in the firm size distribution, is used as a summary concentration statistic. The assumption regarding the rank function is that the observed distribution is a sample from a Pareto curve. The task is to estimate, by means of regression, the population parameters. Hart (1982) makes the point that some economists prefer measures of concentration without theoretical distribution assumptions, as, for instance, the two measures E and H . In other words, E and H are definitional, while the third measure involves estimation through regression of distribution parameters.

Note that data for S_i may be entered as dollar size of premium written for firm i or entered as shares in terms of percentages or proportions. In all such cases, the slope b in equation (4) is the same. However, the parameter a (the intercept) reflects the units of S_i . In applying equation (4) for the concentration in property and liability insurance, the natural logarithms of premium written S_i by firm i is related to the natural logarithms of the firm's rank R_i ordered from largest to smallest. The parameter b is the logarithmic estimate of the slope coefficient of the ranks.

It is well known in the economic literature that b in equation (4) measures the elasticity of the logarithmic rank-size. Therefore, b is an estimator of the percentage rate of change of premium written associated with a percentage rate of change in rank. By using Danta's (1987) explanations, the implication when $b = -1$ is that the premiums written, on average, are distributed evenly among the various sized firms. When $-\infty < b < -1$, the indication is that a greater proportion of premiums are written by the largest firms. For values of $-1 < b < 0$, the implication is a system whereby smaller firms control relatively larger shares of premiums written under rank-size conditions. In other words, when b approaches negative infinity, it corresponds to perfect concentration where one firm controls the whole market. When it approaches zero, the implication is an equal share among the firms. Thus, a more negative value implies a greater level of concentration and a less negative value, a lower level of concentration.

The rank-size function, which has recently been used in connection with income inequality (Fan and Casetti, 1994), describes the relationship between the size and rank of observations arranged in descending order. Fan (1992) explains that an important usage of the function is in the investigations of relationships between city size and rank. When all cities of a region are ranked in decreasing order of population size, the size of a city of a given rank among the sample is related to the size of the largest city.

RESULTS

Table 2 presents estimated values obtained from equation (1) for Theil's Entropy E , from equation (2) for the Herfindahl H , and from equation (4) for slope b of the rank-size function S . In each case, the pertinent values of the estimators for concentration were provided along with their ranks for each of the twelve lines of property and liability insurance under consideration.

The table reveals that in the ranking between E and H , there is almost complete unanimity among the twelve lines of insurance. The Spearman rank correlation is 0.99. Not so when the ranking is made according to the slope b of the rank-size function (equation 4), where it gives, for instance,

Table 2. Herfindahl, Theil, and Rank-Size Indexes of Concentration for Property and Liability Insurance

Line	Theil		Herfindahl		Rank-Size	
	E	k	H	k	b	k
Private passenger auto liability	1.3143	3	0.1019	3	-1.0961	3
Private passenger auto physical damage	1.2855	1	0.1152	1	-1.0499	5
Workers' compensation	1.5182	8	0.0431	8	-0.8834	9
Homeowners multiple peril	1.2872	2	0.1144	2	-1.0948	4
General liability	1.3596	4	0.0857	4	-1.1348	2
Commercial auto liability	1.5926	11	0.0323	11	-0.7128	11
Commercial multiple peril	1.5379	9	0.0381	10	-0.9407	7
Commercial multiple peril (liability)	1.5064	7	0.0452	7	-0.9749	6
Medical malpractice	1.5394	5	0.0577	5	-1.3818	1
Fire	1.4969	6	0.0525	6	-0.8833	10
Commercial auto physical damage	1.6098	12	0.0301	12	-0.6575	12
Allied	1.5394	10	0.0385	9	-0.8973	8

Note: E, H, and b are calculated from equations (1), (2), and (4), respectively; k is the rank.

rank 1 to medical malpractice in contrast to rank 5 for both E and H. The Spearman rank correlation between E and b is 0.76 and between H and b is 0.77. Correlations $r_{Eb} = 0.76$ and $r_{Hb} = 0.77$, though seemingly respectable, are nowhere near the respectability of $r_{EH} = 0.99$, which is expected among the various concentration measures in common use (Scherer and Ross, 1990). Kwoka (1977) makes the point that relative usefulness of the measures on concentration is not their high correlation, but their individual explanatory power with respect to industry performance. The rank-size function specifically takes into account, unlike E and H, the skewness of market share distribution. E, on the other hand, gives higher weights to the smaller firms, while H gives higher weights to larger firms.

A way to look at these differences is by means of Pearson correlation, which takes into account the levels of concentration of the twelve lines rather than their ranks. Here Pearson correlations between E and H, between E and b, and between H and b are, respectively, -0.96 , 0.72 , and -0.57 . The negative signs reflect the opposite direction of increase in concentration and decrease in values for E and b. Of special interest here is the correlation between H and b (-0.57) where both measures give larger weights to larger shares. However, b gives top ranks to top firms, and that distinguishes it from H, corroborating Rhoades (1985), discussed in the Introduction.

In terms of the H index and in terms of the guidelines of the Department of Justice, where $H = 0.10$ is a threshold for challenge in mergers and acquisitions, the lines of insurance that are poised for scrutiny are private passenger auto liability, private passenger auto physical damage, and homeowners multiple peril. On the other hand, the rank-function adds two more lines, general liability and medical malpractice, as having market power problems.

CONCLUSIONS

This work was triggered by the claims of Rhoades (1985, 1995), who made it clear that large inequality of shares among firms in a market plays an exceedingly important role in the dominance of leading firms, at times independent of measures of concentration such as the Herfindahl. This debate started with Shepherd (1972), with many scholars following suit, as indicated in the second section. As Rhoades (1995) explained, distributions of market shares about a mean have little economic meaning because the measures do not capture market share differences. Distributions that may be evenly distributed about the mean may yet have market share inequality to provide implications for strategic behavior.

The gist of the research of these scholars was to relate market shares along with other interacting variables with profitability as explanatory variables. Such interactions, at times, produce difficulties in the regression models employed because of econometric problems of multicollinearity and the like. This research, unlike the regression procedure connecting shares or concentration to profitability, followed a different path. The path was merely to compare well-known concentration measures with a measure that stresses the role of rank of size. The paper has shown that, indeed, while the two well-known measures of concentration employed (Theil's and Herfindahl's) give consistent results, a measure of dominance of large firms gives different results as applied to twelve lines of property and

liability insurance, giving further credence to the concerns of Shepherd and Rhoades.

The implications of the results as related to the advisability of the repeal of the McCarran-Ferguson Act may be summarized as follows: (1) Lines of insurance displaying low levels of concentration may indeed have market power problems. Thus, decisions regarding monopoly power using the Herfindahl index alone may not be appropriate. (2) The five lines that display high levels of market power ($b < -1.00$) need not be subjected to extra scrutiny for monopolistic power. All that is needed is to watch out for the behavior of the few largest companies, or maybe even the largest, as is done, for instance, in Korea, as pointed out by Shin (2002). Hart (1982) adds the example of Britain, where, for instance, the Census of Production statisticians allocates the greatest portion of its resources by giving attention to the larger enterprises rather than spending excessive time on small enterprises, which contribute little to economic activity. (3) The defense that the ease of entry and large number of firms may not prevent the acquisition of market power by the leading few companies or even the top company may not be credible. As Grossack (1965) explained, if the large firms (market shares are substantially above the average) are very much larger than small firms, small firms may not be able to increase output or may find the increase in output very costly. Further, small firms may find that matching price increases of the largest firms is more profitable than expanding output. Furthermore, Kwoka (1982) found for the consumer goods industries that a leading firm's position is difficult to overtake, and (4) high concentration levels may indicate that companies with superior management have lower costs, which leads to their capturing larger shares of the market.

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