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Concentration in American Property-Casualty Companies

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Concentration in American Property-Casualty Companies

Edward Nissan*

Abstract†

A Theil's entropy index utilizing premiums written as units is employed to measure trends in concentration of the largest 200 property-casualty companies in the United States between 1985 and 1993 based on Best's Insurance Report data. Each of the indexes confirms that concentration trends experienced no increase for the whole period for all 200 firms, the top 20, and subsets of lower ranked companies. Significant differences are observed, however, between groups of companies for the same period.

Key words and phrases: mergers and acquisitions, Theil's entropy, insurance

1 Introduction

Throughout its history the United States economy has experienced cycles of mergers and acquisitions. The most recent cycle, according to Shleifer and Vishny (1991) and Sikora (1995), occurred during the 1980s. Significant factors contributing to mergers and acquisitions in the 1980s included laxity in antitrust enforcement policies and improvements in takeover technology (such as leveraged buyouts and junk bonds).

The property and casualty insurance industry was not exempt from this merger wave. Farinella (1996) reports that between 1985 and 1995

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some 660 corporate retirements, acquisitions, and mergers occurred in response to what Gart (1994) describes as tremendous changes within the insurance industry. Increasing competition drives the change and forces more company mergers, creating conglomerates of multiple function companies. Multiple functions allow a company to take advantage of the opportunities in the emerging financial services field. Such activities may lead insurance companies to engage in anticompetitive practices, resulting in allegations of collusion, restriction of output, and favorable terms from consumers. Anticompetitive practice may cause the repeal of the McCarran-Ferguson Act which exempts insurance companies from federal antitrust enforcements.

Roughly 3,000 companies constitute the property-liability insurance industry. Due to numerous affiliations, however, there are really only 800 independent decision-making units or groups. In 1993, according to Huebner, Black, and Webb (1996), the net premiums written, the combined admitted assets, and policyholders' surplus totaled $253.8 billion, $571.5 billion, and $182.3 billion, respectively. Policyholders' surplus serves as a cushion so that larger-than-expected losses can be paid. The abundance of cash, access to cheap capital, and low interest rates helped boost the recent trend in mergers and acquisitions (Farinella 1996).

There are two major conflicting arguments regarding mergers. One, according to Gilbert (1989), is that mergers enhance efficiency by promoting consumer welfare through a superior allocation of productive, financial, and managerial resources. Potential competition serves as a control on monopoly power. Salop (1987) and Adams and Brock (1996) note that the rationale for this argument is provided by economists at the University of Chicago. Simply stated, this theory focuses on consumer welfare as the sole concern. The other argument, supported by economists at Harvard University, is that mergers damage the overall working of the economy, lessen competition, and increase concentration of sales and thereby create monopoly power in a given industry. The process of concentration is defined as the increase in the extent economic activity is controlled by large firms.

Clarke (1985) distinguishes market and aggregate concentration and absolute and relative concentration. Market concentration concerns a specific industry under the control of a few large firms which may lead to the exercise of monopoly power. Aggregate concentration occurs when a few large firms control broad segments of the economy (such as manufacturing, financial, and insurance sectors) or when the power of conglomerates extend beyond a particular industry. Changes in aggregate concentration may signal a change in the distribution of economic,
political, or social power. Another distinction is between relative and absolute concentration. If all firms grow the same proportion, concentration increases absolutely but relatively remains the same. Relative concentration is concerned with the share of output held by large firms among a fixed number of firms. Accordingly, various indexes are proposed to measure such concentrations.

The most widely used indexes are the $k$-firms concentration ratio, whereby the share of sales of the $k$ largest firms (out of a total of $n$ firms) are combined; the Herfindahl, defined as the sum of the squares of all $n$ firms with the share of each firm weighted by itself; the Gini, which measures the extent to which firms in the industry are unequal in size; the coefficient of variation, which is the ratio of the standard deviation to the mean; and the Theil's entropy, which is used in physics as a measure of disorder. Hannah and Kay (1977) find Theil's entropy to be one of the most satisfactory indexes. As a result, Theil's entropy is used throughout this paper as the measure of concentration.

2 Past Studies

In the two decades spanning 1973 to 1991 three studies provide excellent information on the structure of the property insurance industry. The common denominator of these articles is an assessment of market concentration by product line category or by ownership category. Joskow (1973) informs us that the 1206 property-liability insurance firms as a whole in 1971 held assets of $68$ billion and premiums of $35$ billion. Over half of the latter was written by the top 20 firms, resulting in a slight increase in concentration since 1961. Joskow also examines concentration within two individual lines, automobile and fire. Again, the top 20 firms accounted for concentration levels of approximately 56 percent in each line, increasing from 45 percent for automobile and from 49 percent for fire in 1954. Joskow believes that as a result of effective competition, consumers moved their business from high cost firms to low cost firms and thereby caused concentration to increase.

1 Entropy in used in information theory a measure of disorder. In the field of economics, entropy is conveniently translated as a measure of the concentration of firms in an industry. Sawyer (1981, pp. 29) explains that this use of entropy in economics is justified along the lines that an industry will be more competitive the greater the uncertainty as to which of a given number of firms will secure the business of a buyer chosen at random, and entropy is a measure of this uncertainty. Note that a rise in entropy indicates an increase in competitiveness and hence a decrease in concentration. Brockett (1991), Brockett and Song (1995), and references therein provide examples of other applications of information theory to actuarial science.
Mayers and Smith (1988) use geographical concentration, line-of-business concentration, and specialization as indicators of success for the ownership type structure (Lloyds, common stock, mutual, reciprocal) of the insurance companies. Mayers and Smith find stock companies are less concentrated geographically than the other three forms of ownership. When not controlling for size, mutual companies were the least concentrated by line of business. When controlling for size, however, reciprocals were the most concentrated.

The third significant paper, by Cummins and Weiss (1991), assesses concentration for the personal and commercial categories for four, ten, and 50 largest firms. They discover that for the personal lines in 1989 the top four firms controlled 43.2 percent and 41.8 percent of private passenger auto liability and private passenger auto physical damage, respectively. For homeowners, 39.5 percent was controlled by the top four firms. On the commercial side, 26.7 percent of workers' compensation was controlled by the top four firms. Cummins and Weiss echo the assessment of Joskow that concentration in some insurance lines results from the efficiency advantage some companies have in dealing with clients and from gains in market share that accompany lower prices for insureds.

3 Aim and Purpose

Most studies on concentration of property insurance have been based on a product line category or on ownership category, the two important classifications according to Gart (1984). Due to the two interrelated categories, the noticeable reorganization of the insurance industry where there is increased interest in financial services, and general corporate mergers, many insurance companies operate on many lines and thus have become conglomerates. Specifically, mergers among competing firms, who already occupy substantial positions as pointed out by Manne (1965), are viewed with suspicion.

Utton (1970) explains that where overall (aggregate) concentration exists, it is most likely that some individual markets will be highly concentrated. There are also arguments that stress the significance of aggregate concentration. Among these arguments is the notion that when a large proportion of economic activity is held by a relatively few firms, it constitutes a threat to democratic government directly through pressure groups and indirectly through advertising. A follow-up to this notion is the concern that basic policy decisions such as future investment, price, and product policies (which are functions associated with
entrepreneurship) are made by a small number of individuals, perhaps one or two members of the board of directors. Furthermore, large diversified firms can affect the market conduct even though their relative shares do not constitute a monopoly. If one large firm has a stronger position in a specific product line and another firm has a stronger position in another line, it is unlikely that any of the firms compete in the market where it has the advantage for fear of retaliation in the market where its position is not strongly established. The focus of attention, therefore, is the overall concentration of economic power controlled by a small number of large firms, typically the largest 100 or 200 enterprises.

The purpose of this paper is to quantify the effects of reorganization and mergers of recent years on aggregate concentration. Such an assessment will add further insight into the structure of the property-casualty insurance industry with data from Best's Insurance Reports on the largest 200 American property casualty companies. Similar studies concerned with aggregate concentration in the industrial sector have been conducted using the Fortune 500, a popular source of data for such studies. Notable among these are the works by Hexter and Snow (1970), Nissan and Caveny (1985, 1988), Attaran and Saghafi (1988), Saghafi and Attaran (1990), and Deutsch and Silber (1995). The data supplied by Best's Insurance Reports since 1985, whereby the 200 largest American property-casualty companies are ranked, provide a similar opportunity for measuring aggregate concentration for the insurance industry.

4 Measurement

Using the data on shares of premiums reported in Best's Insurance Reports for the largest 200 firms or groups in 1985, 1989, and 1993, Theil's entropy is used to quantify the degree of concentration. The three periods 1985, 1989, and 1993 are spaced in time to show if any significant changes occurred. Between 1985 and 1989 approximately 250 mergers and acquisitions occurred. Between 1990 and 1993 approximately 300 occurred. The question is whether these mergers have resulted in an increase in concentration.

Theil's (1967) entropy, $E$, is defined as

$$E = - \sum_{i=1}^{n} p_i \log p_i, \quad 0 \leq E \leq \log n$$

(1)

where $p_i \geq 0$ is the $i$-th firm's proportional share of premiums; $n$ is the number of firms, and $\sum_i p_i = 1$. 
If all \( n \) firms have an equal share, then \( E = \log n \), and concentration is at a minimum, in contrast to \( E = 0 \) when one firm controls all shares. Therefore, a decline in \( E \) corresponds to an increase in concentration. For a given level of entropy \( E^* \), the numbers equivalent, \( (n^*) \), is the number of equally sized firms it would take to produce the same level of entropy \( E^* \), i.e.,

\[
    n^* = e^{E^*}.
\]

5 Empirical Results

The largest 200 property-casualty insurance companies or groups of companies accounted in 1993 for 73 percent of net premiums written ($189 billion of $259 billion), 78 percent of admitted assets ($527 billion of $672 billion), and 84 percent of holders' surplus ($153 billion of $182 billion). These huge sums indicate that this comparably small number of firms held a significant control of the market.

The three panels of Table 1 report for 1985, 1989, and 1993 the total net premiums, the mean, the standard deviation, the minimum, the maximum, and the coefficient of variation. The information in Table 1 is supplied for the largest 200 companies as well as by smaller sets of four groups of companies 001-020; 021-050; 051-100; 101-200. Total net premiums written by the 200 companies increased from approximately $117 billion in 1985 to $189 billion in 1993, an increase of 62 percent. The largest 20 companies accounted on average for 50 percent of total premiums written throughout the period, followed by the next 30 companies of lesser rank accounting for approximately 20 percent. The lesser ranked sets of 50 companies and 100 companies, ranked 51 to 100 and 101 to 200, accounted for approximately 16 percent and 15 percent, respectively.

In 1993 the average net premiums written for all the 200 companies reached almost $1 billion, with the largest 20 companies writing on average $4.7 billion. The smallest company among the 200 in 1993 wrote $200 million worth of premiums, while the largest wrote well over $22 billion. For all 200 companies the coefficient of variation shows an increase from 1.81 in 1985 to 2.01 in 1989 to 2.18 in 1993. For the respective three periods the most noticeable increase in the coefficient of variation occurred for the top 20 companies, moving from 0.80 to 0.94 to 1.12. The coefficient of variation for the other groups remained virtually the same throughout the three periods.

Table 2 shows the results for the computation of the concentration index, the Theil's entropy \( E \) of equation (1). There are slight changes
Table 1
Summary Information of Net Premiums Written of Largest Property-Casualty Companies

<table>
<thead>
<tr>
<th>Companies</th>
<th>Total</th>
<th>Percent</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: 1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 200</td>
<td>117,103</td>
<td>100</td>
<td>586</td>
<td>1,058</td>
<td>114</td>
<td>10,331</td>
<td>1.81</td>
</tr>
<tr>
<td>001-020</td>
<td>56,840</td>
<td>49</td>
<td>2,842</td>
<td>2,281</td>
<td>1,228</td>
<td>10,331</td>
<td>0.80</td>
</tr>
<tr>
<td>021-050</td>
<td>23,460</td>
<td>20</td>
<td>782</td>
<td>183</td>
<td>547</td>
<td>1,201</td>
<td>0.23</td>
</tr>
<tr>
<td>051-100</td>
<td>19,005</td>
<td>16</td>
<td>380</td>
<td>79</td>
<td>265</td>
<td>540</td>
<td>0.21</td>
</tr>
<tr>
<td>101-200</td>
<td>17,798</td>
<td>15</td>
<td>178</td>
<td>46</td>
<td>114</td>
<td>264</td>
<td>0.26</td>
</tr>
<tr>
<td>Panel B: 1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 200</td>
<td>166,645</td>
<td>100</td>
<td>833</td>
<td>1,677</td>
<td>148</td>
<td>16,873</td>
<td>2.01</td>
</tr>
<tr>
<td>001-020</td>
<td>83,380</td>
<td>50</td>
<td>4,169</td>
<td>3,920</td>
<td>1,664</td>
<td>16,873</td>
<td>0.94</td>
</tr>
<tr>
<td>021-050</td>
<td>32,706</td>
<td>20</td>
<td>1,090</td>
<td>272</td>
<td>770</td>
<td>1,657</td>
<td>0.25</td>
</tr>
<tr>
<td>051-100</td>
<td>27,010</td>
<td>16</td>
<td>540</td>
<td>118</td>
<td>350</td>
<td>757</td>
<td>0.22</td>
</tr>
<tr>
<td>101-200</td>
<td>23,549</td>
<td>14</td>
<td>236</td>
<td>54</td>
<td>148</td>
<td>348</td>
<td>0.23</td>
</tr>
<tr>
<td>Panel C: 1993</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 200</td>
<td>189,030</td>
<td>100</td>
<td>945</td>
<td>2,060</td>
<td>200</td>
<td>22,226</td>
<td>2.18</td>
</tr>
<tr>
<td>001-020</td>
<td>93,100</td>
<td>49</td>
<td>4,655</td>
<td>5,202</td>
<td>1,982</td>
<td>22,226</td>
<td>1.12</td>
</tr>
<tr>
<td>021-050</td>
<td>36,735</td>
<td>20</td>
<td>1,225</td>
<td>264</td>
<td>879</td>
<td>1,882</td>
<td>0.22</td>
</tr>
<tr>
<td>051-100</td>
<td>30,730</td>
<td>16</td>
<td>615</td>
<td>139</td>
<td>425</td>
<td>853</td>
<td>0.23</td>
</tr>
<tr>
<td>101-200</td>
<td>28,465</td>
<td>15</td>
<td>285</td>
<td>60</td>
<td>200</td>
<td>423</td>
<td>0.21</td>
</tr>
</tbody>
</table>


in the magnitudes of $E$ over time among the 200 companies, as well as the smaller subsets of 20, 30, 50, and 100 companies. This is also obvious from the numbers equivalent $n^*$ of equation (2). The numbers equivalent for all the 200 firms was reduced from 99 in 1985 to 92 in 1989 to 91 in 1993. For the top 20 the sequence is 16, 15, 14. Hardly any change is visible for the lower ranked companies.

Next we need to ascertain whether these apparent differences in entropy over time are statistically significant. Let $E_{ij}$ denote the entropy associated with the proportion of premiums ($p_{ij}$) written for firm $i$ in time period $j$, be denoted by

$$E_{ij} = -p_{ij} \log p_{ij}$$  \hspace{1cm} (3)
Table 2
Concentration of Premiums Written of Largest Property-Casualty Companies

<table>
<thead>
<tr>
<th>Companies</th>
<th>Theil’s Entropy (E)</th>
<th>Standard Deviation</th>
<th>Equivalent Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: 1985</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 200</td>
<td>1.9976</td>
<td>.0112</td>
<td>99</td>
</tr>
<tr>
<td>001-020</td>
<td>1.2022</td>
<td>.0265</td>
<td>16</td>
</tr>
<tr>
<td>021-050</td>
<td>1.4661</td>
<td>.0079</td>
<td>29</td>
</tr>
<tr>
<td>051-100</td>
<td>1.6901</td>
<td>.0052</td>
<td>49</td>
</tr>
<tr>
<td>101-200</td>
<td>1.9859</td>
<td>.0040</td>
<td>97</td>
</tr>
<tr>
<td>Panel B: 1989</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 200</td>
<td>1.9661</td>
<td>.0119</td>
<td>92</td>
</tr>
<tr>
<td>001-020</td>
<td>1.1720</td>
<td>.0293</td>
<td>15</td>
</tr>
<tr>
<td>021-050</td>
<td>1.4646</td>
<td>.0084</td>
<td>29</td>
</tr>
<tr>
<td>051-100</td>
<td>1.6890</td>
<td>.0055</td>
<td>49</td>
</tr>
<tr>
<td>101-200</td>
<td>1.9887</td>
<td>.0036</td>
<td>97</td>
</tr>
<tr>
<td>Panel C: 1993</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 200</td>
<td>1.9594</td>
<td>.0119</td>
<td>91</td>
</tr>
<tr>
<td>001-020</td>
<td>1.1333</td>
<td>.0317</td>
<td>14</td>
</tr>
<tr>
<td>021-050</td>
<td>1.4678</td>
<td>.0073</td>
<td>29</td>
</tr>
<tr>
<td>051-100</td>
<td>1.6881</td>
<td>.0057</td>
<td>49</td>
</tr>
<tr>
<td>101-200</td>
<td>1.9908</td>
<td>.0033</td>
<td>98</td>
</tr>
</tbody>
</table>

Source: Best’s Insurance Reports: Property-Casualty United States (Oldwick, New Jersey: A.M. Best Company, 1985, 1989, and 1993) and calculations from equation (1).

for \( i = 1, 2, \ldots, n \), \( j = 1985, 1986, \ldots, 1993 \) and \( \sum_{i=1}^{n} p_{ij} = 1 \). From equation (1), it is obvious that

\[
E_j = \sum_{i=1}^{n} E_{ij} = nE_j.
\]

To test the hypothesis of equality of a pair of total entropies \( E_j \) and \( E_k \), for \( j, k = 1985, 1989 \) and 1993, the appropriate test statistic (assuming that a large sample approximation is appropriate) is

\[
Z = \frac{E_j - E_k}{\sqrt{n(S_j^2 + S_k^2)}}
\]

where

\[
S_j^2 = \frac{\sum_i E_{ij}^2 - \bar{E}_j^2}{n - 1}.
\]
Under the null hypothesis, the statistic $Z$ has a standard normal distribution.

The results indicate that differences in total entropy are not statistically significant at $\alpha = 0.05$, in which case $|Z| < 1.96$. None of the computed $|Z|$ values for the groups of companies 20, 30, 50, and 100 exceeds 1.96. The important conclusion from these results is that the levels of concentration among these groups remained virtually the same throughout the period 1985-1993. In other words, no substantial shares of premiums written were transferred from one company to another.

The picture looks a bit different when the comparisons are made between the groups at each period. Note in Table 1 that $E$ increases in magnitude, indicating a decrease in concentration as one moves down the hierarchy from the top 20 companies to the bottom 100 companies for every period, thus pointing to the existence of larger concentration among the top 20 than among the next 30. In turn, there is more concentration among this group of 30 than among the smaller group of 50 companies, which has higher concentration than the next group of the smaller 100 companies. The patterns, however, remain the same for every period. Concentration does exist, especially among the largest firms, yet the level of concentration has remained stable.

The reorganization and mergers of recent years have not resulted in a perceptible increase in concentration in the property-liability insurance industry, unlike what has happened in other services such as retail trade, electric and utilities, and the transportation sectors, as shown by O'Neill (1996). These services experienced large increases in concentration in recent years.

6 Summary

This paper focuses on measuring aggregate concentration using as units net premiums written of the 200 largest property casualty companies, an important sector in the U.S. economy. Theil's entropy index is employed for the period 1985 to 1993. The index is not sensitive to measuring an increase in concentration among the 200 companies or by groups of 20, 30, 50, and 100 companies. Concentration between these groups of companies remained stable for every period under consideration. During the period under consideration which was marked by a substantial activity of mergers and takeovers the property-liability insurance industry cannot be accused of increasing its overall economic power in spite of the large number of mergers.
The findings that no perceptible increase is detected in aggregate concentration in the property-liability insurance industry do not preclude the possibility that some lines of insurance have become concentrated as a result of recent mergers and acquisitions. Tests at the aggregate level may mask increasing trends in concentration on a by-line basis. Past studies were conducted using data prior to 1990. Because mergers and acquisitions have been relatively high in the past five years, documenting changes in by-line concentration since 1989 would be useful.

The debate whether industry concentration is due to growth of efficient firms that manage to maintain low cost operations through economies of scale or whether concentration is due to collusion and suppression of competition continues. In the mean time, efforts must be made to provide empirical evidence as to whether concentration exists and, if so, whether it is increasing or decreasing over time.

References


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