

## ***STRUCTURE OF AMERICAN BUSINESS: GOODS VERSUS SERVICES***

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### **ABSTRACT**

The Fortune 500, beginning in 1995, includes services in addition to manufacturing in the list of the largest corporations. This article examines the level of concentration for the twenty-year period between 1985 and 2004 divided into two equal parts of 10 years each. The findings indicate that the levels of concentration as measured by the Hirschman-Herfindahl (HHI) index as well as the 4-firm (CR4) and 8-firm (CR8) ratios somewhat changed for assets but not for sales.

### **INTRODUCTION**

*Fortune* magazine's early listings of the largest U.S. corporations until 1995 were for industrial enterprises. Directory listings from 1995 and later added corporations that provide services, thus changing the title from "The Largest Industrial Corporations" to simply "The Largest Corporations." For example, in the *Fortune* 1996 edition the new entrant, Wal-Mart Stores, is ranked fourth with \$93.6 billion in sales, trailing General Motors, Ford Motor and Exxon, who ranked in the first three spots with respective sales in billions of \$169, \$137 and \$110. In the 2004 *Fortune* edition, Wal-Mart Stores moved into the first slot with sales of \$259 billion, leaving General Motors, Exxon and Ford behind with respective sales in billions of \$213, \$196 and \$164 in respective ranks of second, third and fourth. By comparison, Microsoft ranked at 46.

In fact, Head (2004) attributes the growth of U.S. productivity (output per worker) during the years of the new economy exemplified by the high-tech bubble on Wall Street between 1995 to 2000 to two sectors of the economy. The two sectors, which account for over half of growth in productivity, are retail and wholesale. Wal-Mart, in the opinion of Head, directly or indirectly was responsible for the greatest share of the acceleration in productivity. Wal-Mart's lead in productivity over its rivals was 44 percent in 1987 and 48 percent in 1995. Even though competitors have responded by following its strategy, Wal-Mart's lead remained at 41 percent in 1999. Also, with 1.4 million employees all over the world, Wal-Mart's workforce in 2004 was larger than General Motors, General Electric, Ford and IBM combined.

The report by the Federal Reserve Bank of Dallas (2004) provides an illuminating picture of the re-organization in the American economy of the last few years, giving credit to productivity. Accordingly, the power of productivity made America prosper by building capital stock such as more machinery, factories, offices and research facilities; by upgrading workers' skills through formal schooling or on-the-job experience or retraining; and by introducing new technologies to improve efficiency and lower costs for increased output. Added to these factors is open

market trade. In summary, productivity moved upward between 1979 and 2003, posting an increase of 67 percent. Most recently, according to Preciphs (2005), the gain in non-farm business productivity surged at 4.1 percent seasonally adjusted annual rate. The robust productivity growth helps drive labor costs down, which is helpful in raising wages without fueling inflation. The rise in productivity in the 1980s and continuing to the present is in contrast to slowdowns of the earlier decade as reported by Griliches (1988), Jorgenson (1988) and Olson (1988), who blame it in part on the rise in energy prices and the resulting macro consequences during the 1970s.

The inclusion of service industries with industrial businesses from 1995 and beyond reflects the radical change in the industrial output mix since the 1950s. The effect of such an industrial shift was brought to light on a regional level by Beeson and Tannery (2004), who document the loss of net jobs in the industrial sectors, due to shrinking manufacturing sectors as exemplified by the steel industry in Pennsylvania. Employment in durable manufacturing and especially the steel-dominated primary metals experienced drastic losses. For employment in durable goods, for instance, a total of 250,000 jobs in 1979 was reduced to 91,400 by the end of 1987. The industrial restructuring experienced in Pennsylvania is amplified throughout the country, affecting the distribution of earnings as a consequence.

Smith and Miller (2001) document the structural shift of the national economy from primary to secondary to tertiary sectors. The primary sector composed of agriculture, forestry, fishing and mining gave way to the secondary sector composed of manufacturing, construction and utilities, and this sector in turn is giving way to the tertiary sector composed of a wide range of service industries. Thus, through the course of economic development, there is this sequential shift of employment from agriculture and other extractive industries to manufacturing to services. The shift from manufacturing to services is deemed a reflection of economic progress, which, according to Aizenman (2001), was a consequence of the catching up of emerging economies with high-income economies. De-industrialization in the high-income economies would have occurred without the presence of emerging markets, but the process was speeded up.

The growth of a company, according to Greer (1992), can be accomplished either internally because of its efficiency in a given market or externally through mergers. In either case, there is a potential for business concentration, which may lead to monopolization. A practical way to gauge the level of business concentration in the United States is to view the pattern of growth of the largest companies for which sales and assets data is provided by *Fortune* magazine's publication of the Fortune 500. In 2004, the companies included in the list accounted for \$8.0 trillion in revenues, \$21 trillion in assets and \$445.6 billion in profits.

The purpose of this paper is to provide an assessment of industrial concentration of the largest U.S. companies between 1985 and 2004, as provided annually by *Fortune* magazine. A particular purpose is to find out whether the inclusion of service industries changed the sales and assets levels of concentration. A further insight is possible in determining the change in the dollar magnitudes of sales and assets. For the purpose of comparisons, the twenty-year period between 1985 and 2004 is divided into two ten-year periods, 1985-1994 and 1995-2004. This division allows analysis based on two equal periods with the rationale of eliminating distortions due to differences in sample size. The computational models used in the sequel depend on the sample size. Therefore, the inclusion of services in the Fortune

500 list, which spans a period of 10 years, 1995-2004, made it advisable on a technical basis to use Fortune 500 data of the prior ten-year period 1985-1994.

A question may arise concerning using the Fortune 500 list instead of, for instance, the standard S&P 500 list as a data basis. Aside from the use of Fortune 500 in many similar studies, such as Attaran and Saghafi (1988), Attaran and Zwick (1987), Saghafi and Attaran (1990) and many others as a source of data for industrial structure research, the intention of this paper is specifically to investigate the change in concentration due to the inclusion of the service industry with manufacturing in the Fortune 500 list in recent years. To the best of the author's knowledge, this is the first study to quantify this result.

### **LITERATURE SURVEY**

Merger mania at the turn of the last century, according to Adams and Brock (2004), marked the initial consolidations in corporate America. The second round, occurring between World War I and the beginning of the Great Depression, was followed by a third wave in the 1960s, which peaked in 1969 and diminished during the 1970s. Resumption occurred through the "leveraged buyout/junk bond/hostile takeover" activity in the 1980s but crashed through bankruptcies in the late 1980s and early 1990s. In the mid 1990s, a fourth wave exploded to new heights. Adams and Brock provide a sense of the magnitudes by pointing out that announced mergers and acquisitions of \$130 billion in 1991 skyrocketed to \$1.7 trillion in 1999. During the Clinton administration alone, they say, some 70,000 mergers took place with a combined value of \$6 trillion, which is equivalent to the U.S. gross domestic product in 1992.

Crook (1996) traces the peaks in aggregate merger activity in the United States, occurring in 1920, 1929, 1968, 1986 and 1992. Crook documents his evidence through eleven scholarly studies, each of which provides an economic reasoning for the occurrence of these peaks. Taking these together, he summarizes the economic variables that induced the merger peaks. The variables appear to suggest that such activities were related to Tobin's Q, an index computed as a function of share prices, fuel prices, unemployment, real expenditures on housing, business failure rate and credit rationing. The first two variables are positively related to Tobin's Q, while the other four are negatively related. Two other variables included in the index – bond yields and industrial production – had ambiguous relationships.

Shleifer and Vishny (1991) and Sikora (1995) blame the administering of antitrust laws as the strongest single cause in the increase in mergers and acquisitions as witnessed in the 1980s as compared to the 1960s. They say lax policies of the 1980s made it possible to divest and acquire assets and to resell peripheral divisions to companies who could manage them better. Adams and Brock (2004) also note the role merger policies played in increasing the levels and numbers of mergers during the Reagan and Bush administrations through the merger guidelines of 1982, 1984, 1988 and 1992. These guidelines view mergers and takeovers as valuable instruments to force management to heed stockholder-owner interests. Restraints to takeovers would be counterproductive by protecting inefficient managers from the discipline of the merger market. Ip (2004) also notes the role of the Federal Reserve's opposition to government-imposed limits on mergers, especially in the financial sector in recent years.

Amoto (1995) explains the dichotomy of scholarly opinions related to the so-called structure-performance model of industrial organization, a model that hypothesizes a strong correlation between concentration as a consequence of business organic growth and/or mergers for profit. The other side of the dichotomy discredits the structure-performance model, suggesting that individual firm efficiency explains profits. The revisionist view, initially introduced by Demsetz (1973) and supported by Ravenscroft (1983), Branch (1980) and Gale and Branch (1982), hypothesizes that concentration is found to have a negative impact on profits. More recently, Bhuyan (2002), in his study of the relationship between vertical mergers and profitability, has shown that the relationship is negative.

Grone and Spikes (2004), commenting on the recent \$58 billion merger of J.P Morgan Chase & Co. with Bank One Corp., and Bank of America Corp.'s agreement to acquire Fleet Boston Financial Corp for \$49 billion, say a major benefit of such mergers is the provision of larger access to the U.S. retail market. The retail market, according to Langley, Pacelle and Sapsford (2004) includes services to consumers, such as lending and credit cards. Yet, Hamel (2004) questions the wisdom of such mergers, contending that his research on twenty industries suggests no correlation between size and profitability. He goes on to say that the cost of integration far exceeds the benefit of anticipated economies. A major acquisition is simply a way to compensate for organic growth, which, when free of accounting trickery, is of course desirable.

Paul (2003) provides an exception to this view by concluding that the U.S. beef packing industry consolidation of recent years resulted in significant scale economies substantiating cost-efficiency benefits outweighing pecuniary diseconomies associated with market power. Bley and Madura (2003), on assessing conglomerate mergers due to the removal of cross-border barriers and the adoption of a single currency in the European Union, claim that diversification is the motivating factor. Conglomerates can gain financial benefits in improving their negotiation posture with banks, thus reducing the cost of capital. Focarelli and Panetta (2003) provide evidence that though consolidation in the banking industry may adversely affect price changes to consumers in the short run, gains in efficiency dominate over the market power effect of consolidation. Favorable prices for consumers are the end result.

The above review of literature provides a brief look at the question of mergers and their consequences on the increase in business concentration. For this, Gallo et al (2000) investigates the number of antitrust enforcement cases undertaken by the Department of Justice (DOJ), including those involving the largest 500 enterprises as reported by *Fortune*. Between 1955 and 1997, according to their calculations, 454 out of 1,248 (34 percent) of the cases involved the Fortune 500.

## **THE COMPUTATIONAL MODELS**

Hannah and Kay (1977) provide a list of the most commonly used mix of concentration measures. The list includes the coefficient of variation (CV) obtained by dividing the standard deviation by the mean. Two popular measures are the k firm concentration ratio where k indicates how many leading firms are taken into account to define concentration (usually k=4 or k=8) denoted by CR4 and CR8, and the Hirschman-Herfindahl Index (HHI) obtained by squaring and summing the companies' share in a sample. Another measure, the Gini concentration coefficient

(G), plots cumulative percentages of shares against the cumulative percentages of firms (Sherman 1974).

Two other measures, less often used, are the Theil's entropy (1967) derived from the notion of entropy in information theory according to Sen (1973), and the variance of logarithms. According to Creedy (1985), variance of logarithms describes a process known as the Gibrat's law of proportionate effect, whereby if the growth of firms follows the lognormal distribution, the variance of this distribution will increase steadily. Each of the measures outlined possesses some inherent weaknesses and strengths, according to Caswell (1987). However, they are expected to correlate well, according to Sherman (1974), plausibly because of consistency and validity of time trends inherent in each of the measures.

This paper uses three indexes, the Hirschman-Herfindahl (HHI), the four-firm ratio (CR4) and the eight-firm ratio (CR8). Where  $n$  is the number of firms and  $P_i$  is the market share (based on sales or assets) so that  $\sum P_i = 1.0$ , the first index of concentration employed in this study, the Hirschman-Herfindahl Index HHI, is obtained by summing the square of firm shares in the sample. That is,

$$HHI = \sum P_i^2, \quad i=1, \dots, n. \quad (1)$$

When one firm holds all shares,  $HHI=1.00$ ; when shares are held equally,  $H=1/n$ . Note that HHI gives larger weights to larger firms, making it a favorite in the Department of Justice–Federal Trade Commission's merger guidelines.

It can be shown (Clarke 1985) that the coefficient of variation,

$$CV = S / \bar{P} \quad (2)$$

where

$$\bar{P} = 1/n \quad (3)$$

and

$$S = [\sum (P_i - \bar{P})^2 / n]^{1/2} \quad (4)$$

and where  $\bar{P}$  and  $S$  are the mean and the standard deviation is related to  $H$  by the relationship

$$(CV)^2 = nH - 1. \quad (5)$$

After some algebraic manipulation (see Clarke 1985 for further detail), it can be shown that the "numbers equivalent" corresponding to a given  $H$  is

$$m = 1/H. \quad (6)$$

The nature of the measure of concentration can be understood more clearly by the concept, "numbers equivalent," which is the number of equal-size firms with the same

value of the concentration index. In other words, as if the “n” firms under consideration dwindle to “m” firms by equation (6) for a given H.

The second and third measures of concentration, CR4 and CR8, are obtained as sales or assets of the leading four or eight firms as ratios of totals. That is the ratio of the largest four or eight firms of total n=500 of the Fortune 500 for sales or assets comprise the concentration indexes CR4 and CR8, respectively.

### EMPIRICAL RESULTS

The disruption in the Fortune 500 listing described earlier is shown in Table 1.

**TABLE 1.**  
**PERCENT DISTRIBUTION OF SALES AND ASSETS OF FORTUNE**  
**500 FIRMS, IN GROUPS OF 100**

Year	Group 1		Group 2		Group 3		Group 4		Group 5	
	Sales	Assets	Sales	Assets	Sales	Assets	Sales	Assets	Sales	Assets
1985	69.5	69.9	14.9	15.0	7.9	8.1	4.6	4.5	3.0	2.5
1986	70.0	70.4	14.7	14.8	7.8	7.5	4.6	4.7	2.9	2.6
1987	69.7	71.4	15.2	14.2	7.6	7.1	4.6	4.9	2.8	2.4
1988	69.6	72.5	15.3	14.5	7.6	7.0	4.7	4.0	2.9	2.0
1989	69.7	75.5	15.1	13.4	7.7	6.2	4.6	3.3	3.0	1.6
1990	70.1	76.2	14.8	12.9	7.6	6.0	4.5	3.3	3.0	1.6
1991	71.6	77.0	14.2	12.6	7.1	5.7	4.3	3.1	2.8	1.5
1992	71.5	77.4	14.3	12.2	7.1	5.7	4.2	3.1	2.9	1.5
1993	71.1	76.9	14.4	12.4	7.2	5.9	4.4	3.3	2.9	1.6
1994	70.7	77.2	14.5	12.0	7.4	5.7	4.5	3.3	3.0	1.7
1985-1994										
<i>Mean</i>	70.35	74.44	14.74	13.40	7.50	6.49	4.50	3.75	2.92	1.90
<i>std dev</i>	0.81	3.04	0.39	1.14	0.29	0.87	0.16	0.71	0.08	0.44
1995	57.0	74.0	18.5	14.9	11.0	6.4	7.6	3.2	5.9	1.5
1996	56.1	73.9	19.0	15.1	11.4	6.5	7.6	3.1	5.9	1.4
1997	55.7	74.4	19.2	14.6	11.4	6.3	7.7	3.2	5.9	1.5
1998	55.7	75.8	19.1	13.6	11.6	5.9	7.8	3.3	5.8	1.5
1999	55.3	76.9	19.4	13.0	11.7	5.7	7.8	3.1	5.7	1.4
2000	57.0	77.6	19.0	12.3	11.2	5.8	7.3	3.0	5.5	1.3
2001	58.6	77.5	18.8	12.6	10.5	5.8	7.0	2.9	5.1	1.2
2002	59.6	78.3	18.7	12.3	10.4	5.5	6.6	2.7	4.8	1.1
2003	59.0	67.4	18.6	16.5	10.7	8.4	6.8	4.9	5.0	2.8
2004	60.1	63.7	17.8	17.4	10.4	9.5	6.7	5.5	4.9	3.9
1995-2004										
<i>Mean</i>	57.4	74.0	18.8	14.2	11.0	6.6	7.3	3.5	5.4	1.8
<i>std dev</i>	1.78	4.77	0.44	1.78	0.50	1.31	0.48	0.93	0.45	0.88
<i>t test</i>	-20.9	-0.3	21.9	1.2	19.5	0.2	17.6	-0.7	17.4	-0.5

Source: Based on data published annually by *Fortune*

This table presents the percent distribution of sales and assets of the 500 firms in five equal groups of 100. Table 1 and subsequent tables list the results between 1985 and 2004. Table 1 shows that prior to 1995 the top 100 companies increased their share of sales from 69.5 percent of the total in 1985 to 70.7 percent in 1994. The share of

sales of this group between 1995 and 2004, however, is reduced to much smaller levels, ranging for this period between 57 percent to 60 percent. This reduction in the share of sales of the top 100 at the break date 1995 is translated into increases in shares of sales for the lower groups. On average, the changes in percent sales between the two periods for the five groups of 100 companies were 70.4, 14.8, 7.5, 4.5 and 3.0 to 57.4, 18.8, 11.0, 7.3 and 5.4. For assets in Table 1, the disruption in the Fortune 500 listing for the five groups resulted in virtually no change in distribution. On average, the shares of assets of the five groups changed little in percentages between the two periods from 74.4, 13.4, 6.5, 3.8 and 1.9 to 74.0, 14.2, 6.6, 3.5 and 1.8. The t-test at significance level  $\alpha = .05$  for differences between two means indicates that the reduction in average sales for the top 100 and the increase in sales of the four lower ranked firms between the two periods are highly significant with corresponding t-values of -20.9, 21.9, 19.5, 17.6 and 17.4. None of the changes in mean assets of the five sets was significant.

A further look at Table 1 provides partial answers as to why the shares of assets remained virtually the same during the two periods for the five groups of 100 while the share of sales decreased for the top 100 and increased for the lower 400. A partial answer could be supplied by checking the ratios of assets/sales of some prominent service companies representing banking, finance and insurance as follows.

	Assets (\$million)	Sales (\$million)	Ratio Assets/Sales
<b>CitiGroup</b>	1,264,032	44,713	13.35
<b>Fannie Mae</b>	1,009,568	53,766	18.78
<b>Bank of America Corp.</b>	736,445	48,065	15.32
<b>JP Morgan Chase</b>	770,912	44,363	17.38
<b>MetLife</b>	326,841	36,261	9.01

The display indicates that the inclusion of services in the Fortune 500 impacted mostly the highest ranked companies in the top 100 predominated by banks, finance and insurance with levels of assets far exceeding those of sales. Following is an example of large industrial firms in \$million.

	Assets (\$million)	Sales (\$million)	Ratio Assets/Sales
<b>Exxon</b>	174,278	213,199	0.81
<b>General Motors</b>	448,507	195,645	2.29
<b>Ford Motor</b>	312,564	164,496	1.90
<b>Chevron</b>	81,470	112,937	0.72

By contrast, the largest industrial corporations have smaller Assets/Sales ratios as compared to services. This anomaly perhaps explains the change in the distribution observed in Table 1.

Table 2 provides the results of using both sales and assets as bases in computing concentration. The first two columns of Table 2 contain total sales and assets for the 500 firms.

Mean sales for 1985-1994 is approximately \$2.1 trillion, jumping to \$6.1 trillion for 1995-2004. A more remarkable jump is for assets from \$2.1 trillion to \$15.3 trillion, changing the average ratio (sales/assets) shown in column (3) from 1.024 to 0.406, where the difference in means with  $t = -15.091$  is highly significant. The dramatic change in the ratio (sales/assets) can be explained by the inclusion of

businesses engaged in finance and banking, such as Citigroup, Fannie Mae, Bank of America Corp and J.P Morgan Chase where their assets exceed in proportion to sales in much larger magnitudes than the industrial corporations. The effect of disruption in listings on the coefficient of variation (CV), as a measure of concentration in its own right, is a considerable reduction for sales as compared to assets, though both are statistically significant with corresponding values of  $t=-31.014$  and  $t=-2.767$  for significance level  $\alpha = .05$ .

**TABLE 2**  
**TOTAL SALES AND ASSETS AND COEFFICIENT OF VARIATION**

Year	Total		CV		
	Sales	Assets	Sales/Assets	Sales	Assets
1985	1753129	1406266	1.247	2.269	2.204
1986	1807800	1521463	1.188	2.303	2.259
1987	1712292	1560828	1.097	2.279	2.270
1988	1878912	1704149	1.103	2.234	2.290
1989	2022595	2078840	0.973	2.341	3.024
1990	2164348	2287122	0.946	2.338	3.021
1991	2312352	2416175	0.957	2.364	3.093
1992	2262652	2457653	0.921	2.337	3.133
1993	2364700	2551452	0.927	2.347	3.179
1994	2370164	2676140	0.886	2.336	3.382
1985-1994					
<i>mean</i>	2064895	2066009	1.024	2.315	2.785
<i>std dev</i>	261897	477367	0.125	0.042	0.467
1995	4267399	9561923	0.446	1.559	1.893
1996	4690324	10491271	0.447	1.521	1.895
1997	5077370	11546466	0.440	1.484	1.971
1998	5518510	12881427	0.428	1.433	2.100
1999	5740596	14288321	0.402	1.368	2.354
2000	6324961	16026617	0.395	1.466	2.339
2001	7180880	17706748	0.406	1.501	2.460
2002	7420326	19075689	0.389	1.501	2.558
2003	6955711	19933936	0.349	1.560	2.652
2004	7641200	21030831	0.363	1.623	2.718
1995-2004					
<i>mean</i>	6081728	15254323	0.406	1.502	2.294
<i>std dev</i>	1198381	4108021	0.034	0.072	0.312
t-test	-15.09	-31.01	-2.76		

Note: Sales and assets (\$million).

Source: Based on data published annually by *Fortune*

The first four columns of Table 3 provide the HHI scores for both sales and assets by equation (1) with corresponding numbers equivalent by equation (6), followed similarly by two columns for CR4 and again by two columns for CR8. The remarkable finding here is that the three indexes are almost mirror images of each other. Concentration, according to the three indexes, decreased between Period I (1985-94) and Period II (1995-04) for sales. The means of HHI for sales were reduced between the two periods from 0.01274 to 0.00651. For CR4, the means for sales were reduced from 0.16803 to 0.10610. A similar finding was true for CR8, where the corresponding reduction was from 0.25588 to 0.16463. For assets, HHI was also in complete conformity with CR4 and CR8 where the mean levels of concentration for assets were reduced, respectively, from 0.01817 to 0.01270 for HHI



and from 0.21029 to 0.14008 for CR4. For CR8, the reductions were from 0.30172 to 0.23603. It seems overall that HHI is in conformity with CR4 and CR8 on both counts, sales and assets.

**TABLE 3.  
HHI, 4-FIRM AND 8-FIRM CONCENTRATION OF SALES AND ASSETS OF  
FORTUNE 500 FIRMS**

Year	HHI		4-Firm Ratio		8-Firm Ratio		Sales	Assets
	Sales	m	Assets	m	Sales	Assets		
1985	0.01242	80.5	0.01184	84.5	0.16152	0.14226	0.25413	0.24282
1986	0.01259	79.5	0.01219	82.0	0.16140	0.14945	0.25710	0.24716
1987	0.01260	79.4	0.01251	80.0	0.16742	0.15332	0.25255	0.24708
1988	0.01199	83.4	0.01262	79.3	0.16183	0.15850	0.24619	0.24825
1989	0.01294	77.3	0.02070	48.3	0.17441	0.23695	0.25680	0.33190
1990	0.01291	77.4	0.02067	48.4	0.17280	0.23862	0.25664	0.32886
1991	0.01316	76.0	0.02161	46.3	0.17264	0.24646	0.26032	0.33841
1992	0.01290	77.5	0.02208	45.3	0.16829	0.25206	0.25813	0.34166
1993	0.01299	77.0	0.02249	44.5	0.17009	0.25520	0.25779	0.33996
1994	0.01289	77.6	0.02498	40.0	0.16990	0.27009	0.25918	0.35107
<i>1985-1994</i>								
<i>Mean</i>	<i>0.01274</i>	<i>78.5</i>	<i>0.01817</i>	<i>55.0</i>	<i>0.16803</i>	<i>0.21029</i>	<i>0.25588</i>	<i>0.30172</i>
<i>STD</i>	<i>0.00034</i>	<i>2.2</i>	<i>0.00520</i>	<i>18.8</i>	<i>0.00492</i>	<i>0.05209</i>	<i>0.00409</i>	<i>0.04805</i>
1995	0.00685	145.9	0.00915	109.3	0.10973	0.10017	0.17147	0.18151
1996	0.00662	151.1	0.00928	107.8	0.10865	0.10000	0.17012	0.18126
1997	0.00640	156.3	0.00979	102.1	0.10654	0.10744	0.16600	0.19039
1998	0.00610	163.9	0.01080	92.6	0.10392	0.11293	0.15656	0.20439
1999	0.00573	174.4	0.01306	76.6	0.09505	0.14958	0.15016	0.24019
2000	0.00629	159.0	0.01292	77.4	0.10788	0.14543	0.16220	0.23821
2001	0.00650	153.9	0.01408	71.0	0.10708	0.16575	0.16708	0.26347
2002	0.00650	153.9	0.01509	66.3	0.10122	0.16592	0.16541	0.27538
2003	0.00686	145.8	0.01604	62.4	0.11205	0.17382	0.17066	0.29052
2004	0.00726	137.7	0.01675	59.7	0.10889	0.17978	0.16664	0.29494
<i>1995-2004</i>								
<i>Mean</i>	<i>0.00651</i>	<i>153.6</i>	<i>0.01270</i>	<i>78.8</i>	<i>0.10610</i>	<i>0.14008</i>	<i>0.16463</i>	<i>0.23603</i>
<i>STD</i>	<i>0.00043</i>	<i>10.3</i>	<i>0.00282</i>	<i>18.9</i>	<i>0.00492</i>	<i>0.03191</i>	<i>0.00672</i>	<i>0.04450</i>
<i>1985-2004</i>								
<i>Mean</i>	<i>0.00962</i>	<i>103.9</i>	<i>0.01543</i>	<i>64.8</i>	<i>0.13706</i>	<i>0.17519</i>	<i>0.21026</i>	<i>0.26887</i>
<i>STD</i>	<i>0.00322</i>	<i>39.5</i>	<i>0.00495</i>	<i>21.7</i>	<i>0.03213</i>	<i>0.05536</i>	<i>0.04712</i>	<i>0.05628</i>
t-test	-35.85	22.60	-2.92	2.81	-28.15	-3.63	-36.70	-3.17

Note: HHI is the Hirschman-Hirfindahl index by equation (10) and m is the numbers equivalent by equation (6).

Source: Based on data published annually by *Fortune*.

It is of interest here to find out whether these observed differences in means of the three indexes between Period II and Period I differ significantly by utilizing a t-test of two independent samples. The critical points of the test for a five percent significance level is  $t = \pm 2.101$ . The t-test results shown in Table 3 for Sales are: HHI=-35.845, CR4=-28.150, and CR8=-36.702. Similarly for Assets, the t-tests are: HHI=-2.924, CR4=-3.634, and CR8=-3.172. Thus, for sales, all three measures indicate a greater statistically significant decrease in concentration as compared to assets. A better way to judge the comparative relative performances of the three indexes is to evaluate their correlations. For both sales and assets, the correlation coefficient is approximately 0.99, which gives an indication of high correlation

among the sundry concentration indexes. The findings here substantiate to a great extent the comments reported earlier that in general the concentration indexes correlate highly.

A final observation of note regarding the levels of concentration in table 3 is to deal with the numbers equivalent  $m$  by equation (6), which are associated with HHI. For both sales and assets,  $m$  increased in magnitudes during Period II (1995-2004) as compared to Period I (1985-94). For Period I, the average for sales was  $m=78.5$ , while for Period II,  $m=153.6$ . For assets, the corresponding numbers are  $m=55$  and  $m=78.8$ . Thus, as an alternative measure of concentration, the indication obtained from observing  $m$  is that concentration of assets is relatively higher for assets as compared to sales for both periods and that there was a decrease in levels of concentration for both sales and assets during Period II as compared to Period I.

To test whether the changes in HHI for both sales and assets between Period I and Period II are statistically significant, the device connecting HHI of equation (1) with  $(CV)^2$  of equation (5) is of help. This is done by testing for equality of variances by the F-distribution and by implication the equality of  $(CV)^2$ . This is so because with a fixed number companies ( $n=500$ ) in the *Fortune* directory year in and year out, testing for  $(CV)^2$  is identical to simply testing for the variance  $S^2$  because the mean  $\bar{P}$  by equation (3) cancels out. This leads to an implied test statistic for equality of H for pairs of years  $j$  and  $k$  by the F-distribution

$$F^* = S_j^2 / S_k^2. \quad (7)$$

The test statistic  $F^*$  is compared for significance with a tabular  $F(\alpha, n_j-1, n_k-1)$  when  $F^* > 1$ , and  $1/F(\alpha, n_k-1, n_j-1)$  when  $F^* < 1$ . Since  $n_j$  and  $n_k$  are the same at 500, the critical  $F$  at  $\alpha=0.05$  is  $F=1.00$ . Thus, for values of  $F^* > 1.0$  or  $F^* < 1.0$ , the indication is statistical significance between the two years. The results of this exercise for sales concentration is shown in Table 4 and for assets concentration is shown in Table 5. Numbers in both tables greater than 1.0 indicate concentration in year  $j$  is higher as compared to year  $k$ . The reverse is true when the numbers are less than 1.00. From the looks of both tables, the break year 1995 separated the  $F^*$  values into two groups. Take as an example concentration of sales for the year 2004 (Table 4). The  $F^*$  values up to 1994 are greater than 1.0, indicating that concentration in 2004 is larger than in the earlier years. From 1994 and earlier years,  $F^* < 1.00$ , indicating that concentration in 2004 is lower than in the corresponding year used for comparison. Overall, the findings of Tables 4 and 5 substantiate, at a different level of detail, the discussion obtained through the use of HHI, CR8 and CR4 in Table 3.

A further form of analysis is to determine whether the trends in concentration indexes differ over the two periods 1985-1994 and 1995-2004, referred to as Periods I and II. A simple way to do this is to apply the suggestion by Lapin (1993) that time series covering a small number of years may be fitted by a straight line of the form

$$Y_t = a + b t, \quad (8)$$

where  $Y_t$  is the computed value of the dependent variable and  $t$  is a code for time serving as the independent variable. Thus for Periods I (1985-1994) and II (1985-2004),  $t = 1, 2, \dots, 10$ . The slope "b" measures the annual increase or decrease in the time series, and "a" is the intercept. The test statistic for significance of  $b$  is

$$t = b / S_b, \quad (9)$$

where  $S_b$  is the standard error of the slope  $b$ .

**TABLE 4**  
**F\* FOR TESTING EQUALITY OF HERFINDAHL (SALES)**

Sales	CV <sup>2</sup>	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1988	
2004	2.64	1.00	1.08	1.17	1.17	1.23	1.41	1.28	1.20	1.14	1.08	0.48	0.48	0.48	0.47	0.48	0.48	0.53	0.51	0.50	0.51	5.15
2003	2.43	1.00	1.00	1.08	1.08	1.13	1.30	1.19	1.11	1.05	1.00	0.45	0.44	0.45	0.44	0.45	0.44	0.49	0.47	0.46	0.47	5.15
2002	2.25	1.00	1.00	1.00	1.00	1.05	1.21	1.10	1.02	0.97	0.93	0.41	0.41	0.41	0.40	0.41	0.41	0.45	0.43	0.43	0.44	5.15
2001	2.25	1.00	1.00	1.00	1.00	1.05	1.20	1.10	1.02	0.97	0.93	0.41	0.41	0.41	0.40	0.41	0.41	0.45	0.43	0.42	0.44	5.15
2000	2.15	1.00	1.00	1.00	1.00	1.00	1.15	1.05	0.98	0.93	0.88	0.39	0.39	0.39	0.38	0.39	0.39	0.43	0.41	0.41	0.42	5.15
1999	1.87	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.85	0.81	0.77	0.34	0.34	0.34	0.33	0.34	0.34	0.37	0.36	0.35	0.36	5.15
1998	2.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.89	0.84	0.38	0.37	0.38	0.37	0.38	0.37	0.41	0.40	0.39	0.40	5.15
1997	2.20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.91	0.40	0.40	0.40	0.39	0.40	0.40	0.44	0.42	0.42	0.43	5.15
1996	2.31	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.42	0.42	0.42	0.41	0.42	0.42	0.46	0.45	0.44	0.45	5.15
1995	2.43	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.45	0.44	0.45	0.43	0.44	0.44	0.49	0.47	0.46	0.47	5.15
1994	5.46	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.98	1.00	1.00	1.09	1.05	1.03	1.06	5.15
1993	5.51	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	0.99	1.01	1.00	1.10	1.06	1.04	1.07	5.15
1992	5.46	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.09	1.05	1.03	1.06	5.15
1991	5.59	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.02	1.02	1.12	1.08	1.05	1.09	5.15
1990	5.47	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.05	1.03	1.06	5.15
1989	5.48	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.05	1.03	1.06	5.15
1988	4.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.94	0.97	5.15
1987	5.20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.01	5.15
1986	5.30	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	5.15
1985	5.15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.15

Note: Calculations by equation (7) Source: Based on data published annually by *Fortune*.

TABLE 5  
F\* FOR TESTING EQUALITY OF HERFINDAHL (ASSETS)

Asset	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	
	CV <sup>2</sup>	7.39	7.03	6.54	6.05	5.47	5.54	4.41	3.88	3.59	3.58	11.44	10.11	9.81	9.56	9.13	9.14	5.24	5.15	5.10	4.86
2004	7.39	1.00	1.05	1.13	1.22	1.35	1.33	1.68	1.90	2.06	2.06	0.85	0.73	0.75	0.81	0.81	1.41	1.43	1.45	1.45	1.52
2003	7.03	1.00	1.07	1.16	1.28	1.27	1.59	1.81	1.96	1.96	1.96	0.61	0.70	0.72	0.74	0.77	1.34	1.37	1.38	1.38	1.45
2002	6.54	1.00	1.00	1.08	1.20	1.18	1.48	1.68	1.82	1.83	1.83	0.57	0.85	0.87	0.88	0.72	1.25	1.27	1.28	1.28	1.35
2001	6.05	1.00	1.00	1.11	1.09	1.09	1.37	1.56	1.69	1.69	1.69	0.53	0.60	0.62	0.63	0.66	1.15	1.18	1.19	1.19	1.25
2000	5.47	1.00	1.00	1.00	0.99	0.99	1.24	1.41	1.52	1.53	1.53	0.48	0.54	0.56	0.60	0.60	1.04	1.06	1.07	1.07	1.13
1999	5.54	1.00	1.00	1.00	1.00	1.00	1.26	1.43	1.54	1.55	1.55	0.48	0.55	0.56	0.61	0.61	1.06	1.08	1.09	1.09	1.14
1998	4.41	1.00	1.00	1.00	1.00	1.00	1.00	1.14	1.23	1.23	1.23	0.39	0.44	0.45	0.48	0.48	0.84	0.86	0.86	0.86	0.91
1997	3.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.08	1.08	1.08	0.34	0.38	0.40	0.43	0.42	0.74	0.75	0.76	0.76	0.80
1996	3.59	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.31	0.36	0.37	0.38	0.39	0.68	0.70	0.70	0.70	0.74
1995	3.58	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.31	0.35	0.37	0.37	0.39	0.68	0.70	0.70	0.70	0.74
1994	11.44	1.00	1.00	1.00	1.00	1.00	1.00	1.13	1.17	1.20	1.25	1.00	1.13	1.20	1.25	1.25	2.18	2.22	2.24	2.24	2.35
1993	10.11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.06	1.11	1.00	1.03	1.06	1.11	1.11	1.93	1.96	1.98	1.98	2.08
1992	9.81	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.08	1.00	1.03	1.03	1.08	1.07	1.87	1.91	1.92	1.92	2.02
1991	9.56	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.05	1.00	1.00	1.00	1.05	1.05	1.82	1.86	1.87	1.87	1.97
1990	9.13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.74	1.77	1.79	1.79	1.88
1989	9.14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.74	1.77	1.79	1.79	1.88
1988	5.24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.02	1.03	1.03	1.08
1987	5.15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.06
1986	5.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.05
1985	4.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Note: Calculations by equation (7). Source: Based on data published annually by *Fortune*.

Equation (8) is applied to HHI, m, CR4, and CR8 based on sales and assets (displayed in columns 1-8 of Table 3). In each case, the hypothesis of equality of trends for Periods I and II will be tested in accordance with the suggestion of Bailey (1985) by the test statistic

$$t^* = (b_1 - b_2) / [s^2_{b_1} + s^2_{b_2}]^{1/2}, \quad (10)$$

where  $b_1$  and  $b_2$  are the slope coefficients for Period I and II and  $s^2_{b_1}$  and  $s^2_{b_2}$  are their squared standard errors.

The results of these time series trends are shown in Table 6. The columns labeled “ $b_1$ ” and “ $b_2$ ” in Table 6 present the slope values for the two periods. For each slope, a test of the hypothesis of no trend is accomplished with the t-test given in equation (9). With the exception of CR8 (sales), all the slopes are significant in Period I, as indicated by the P-values. For Period II, the bag is mixed in that only slopes associated with assets are significant. Of special interest in this table is the trend of m (assets) for the two periods in which  $m=-5.67$  and  $m=-6.10$  whereby the 500 companies are shrinking by as many as six companies on average per year due to consolidation and increase in concentration.

**TABLE 6  
TRENDS IN CONCENTRATION FOR PERIODS I AND II.**

	Period I		Period II		t*-test
	$b_1$	P-value	$b_2$	P-value	$b_2-b_1$
<b>HHI (sales)</b>	0.0000728	0.046	0.00004620	0.356	-0.471
<b>m (sales)</b>	-0.4557600	0.049	-1.02000000	0.399	-0.486
<b>HHI (assets)</b>	0.0016700	0.000	0.00092100	0.000	-3.106
<b>m (assets)</b>	-5.6690900	0.000	0.01042400	0.000	-2.432
<b>CR4 (sales)</b>	0.0010390	0.046	0.00007240	0.903	-1.335
<b>CR4 (assets)</b>	0.0160600	0.000	0.01018100	0.000	-2.468
<b>CR8 (sales)</b>	0.0007300	0.107	0.00000582	0.994	-0.821
<b>CR8 (assets)</b>	0.0143280	0.000	0.01446000	0.000	0.051

Note: Calculations by equations (8-10). Source: Table 3, based on data published annually by *Fortune*.

In comparing the slopes across the two periods, as shown by  $t^*$  in Table 6 calculated from equation (10), in only two cases did the test statistics reject equality of trends between the two periods, namely HHI (assets) and CR4 (assets) where statistically significant differences were found with corresponding t-values of  $-3.106$  and  $-2.468$  as compared to critical values for a two-sided test at  $\alpha=5\%=\pm 2.306$ . Overall, the results in Table 6 indicate that the trends in concentration of sales did not change significantly between the two periods as a result of the change in composition of the Fortune 500 listing. Only two (HHI, CR4) of eight tests, both for assets, showed statistically significant results.

## SUMMARY AND CONCLUSIONS

The interest in concentration of business is a key element in industrial organization theory and an important guide when dealing with merger and acquisition issues, according to Scheffman and Coleman (2002). This paper, through the use of Fortune 500 data, provided a survey of concentration in big business for both sales and assets. The measures of choice for concentration were the Hirschman-Herfindahl

(HHI) index and the four-firm and eight-firm concentration ratios CR4 and CR8, respectively. The time period under consideration was 1985-2004.

The list of 500 U.S. companies identified by *Fortune* has changed in composition from strictly industrial firms to include, beginning in 1995, service companies as well. This paper, through the use of the three measures of concentration, also investigated whether the change in composition of the *Fortune* list has considerably impacted the levels of concentration. For this reason, the research dealt with sub-periods 1985-1994, denoted as Period I, and 1995-2004, denoted as Period II. The choice of the sub-periods is directed by the desire to use an equalized and symmetric number of observations at the 1995 divide of the *Fortune* reporting. The findings, through the use of statistical analysis, attest, with minor exceptions, to a general agreement among the three measures in that:

- (1) all three measures are highly correlated,
- (2) differences in mean sales and assets concentration between Period I and Period II were negative and statistically significant, implying a decrease in sales and assets concentration during Period II, and
- (3) trends in concentration for sales and assets (exception CR8) during Period I were statistically significant, implying an increase in concentration. For Period II, none of the four measures detected any statistically significant change in sales concentration. However, all agreed that there was an increase in concentration trends when assets were used as the basis.

This paper demonstrates the effect of including services with industrial in the Fortune 500 listing, in the sense that while the changes in sales were relatively moderate, the changes in assets were dramatic, giving rise to relatively small changes in concentration for sales and relatively larger concentration for assets. Thus, the inclusion of the services sector plays different roles in asset concentration and sales concentration.

Because the list of Fortune 500 is consistently used as a guide of level of concentration in business and because the previous scholarly work in this area of research contended that the use of sales or assets as bases of measurement provide similar results, an important contribution of this paper is to provide warnings in the use of data for time series analysis prior to or after the break date 1995. In other words, when the historic Fortune 500 list is used, researchers should be aware that the inclusion of services in the list changes the picture of the make-up of the list. This aspect was made clear whether looking at the distribution of shares and assets among the sets of 100 companies (Table 1) or looking at concentration levels (Tables 2 and 3).

There are many economic and financial factors that affect structural changes. The factors include global competition, changes in technology and infrastructure, access to financial resources, tax policies and consolidation due to business failure. A hypothesis regarding consolidation is that reaction of the concentration levels differ in years of high or low rates of business failure. While these economic factors are essential in explaining the increase or decrease in the levels of concentration on a yearly basis, they are beyond the scope of this research.

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