STRUCTURE, CONDUCT, PERFORMANCE

The measure of monopoly power is the difference between price and cost. Monopolies set price above average and marginal cost. Competition drives price down toward minimum average cost.

The ability of the firms in an industry to succeed in implementing a collusive agreement and setting price above cost is expected to be inversely related to the number of firms.

The question is to what extent can we infer from the structure of an industry, that is, the number and size of the firms, the kind of conduct they will engage in, and thereby, the performance of the industry in comparison to competition.

A convenient measure of industry structure is the Herfindahl-Hirschman Index (HHI).[1] This index is sum of squared market shares of the firms operating in an industry. For instance, in the long distance telephone industry there are around six firms: AT&T, MCI, Sprint, and three small players. Their shares are 60%, 20%, 9%, and 4%, 4%, 3%, respectively. The HHI is computed by squaring the percentage shares treated as whole numbers. For the LD market this gives:

$$3600+400+81+16+16+9=4122$$

This number can be compared across industries. Generally speaking as the number gets smaller, the industry is more competitive. In the limit, the number approaches zero as the market share of each firm becomes trivially small. Consider what the number would look like if there were 1000 firms each with an equal share of the market. The market share of each would be .1%. The Herfindahl-Hirschman index in this situation would be the sum of .1% squared over the thousand firms in the industry, or

$$1000 \bullet (.1)^2 = 10$$

A more intuitive way of thinking about the HHI is to divide it into the upper boundary value, 10,000. This inverse HHI is a number that can be interpreted as the number of firms in the industry *assuming that all firms are the same size*.

When the firms are of unequal size, as is the case in the LD industry, the interpretation becomes more interesting. In the LD market the Herfindahl is 4122 as shown above. This value divided into 10,000 gives 2.4. Our interpretation of this number, 2.4, is that the LD market structure is like there are two and one-half, equally sized firms. Even though the industry actually has six firms, since on of them is very large compared to the rest, the market looks much more like an oligopoly than it would if there were six equally sized firms.

The following table gives a list of HHI across industries. Of the industries listed, the one with the highest HHI is breakfast cereals at around 2200. In the following section there is a discussion of the treatment and use of the HHI by antitrust officials. This was taken from some testimony that I gave before the Mississippi Public Service Commission in the matter of electricity deregulation.

As the Herfindahl index increases, we say that the market becomes more *concentrated.*

---

[1] Other measures are discussed in your text. These include 4 and 8 firm concentration ratios, which are simply the share of the market served by the four or eight biggest firms.

Selected Concentration Ratios in Manufacturing (Based on Value of Shipments)

SIC Industry	1947		1967		1987		HHI
	4 firm	8 firm	4 firm	8 firm	4 firm	8 firm	
Meat Packing (2011)	41	54	26	38	32	50	403
Fluid milk (2026)			22	30	21	32	195
Cereal breakfast foods (2043)	79	91	88	97	87	99	2207
Distilled liquor, except brandy (2085)	75	86	54	71	53	75	883
Roasted coffee (2095)			53	71	66	78	1589
Cigarettes (2111)	90	99	81	100	92		
Men's and boys' suits and coats (2311)	9	15	17	27	34	47	506
Women's and misses' dresses (2335)			7	9	6	10	24
Logging camps and contractors (2411)			14	22	18	24	150
Mobil homes (2451)					30	44	351
Pulp mills (2611)			45	70	44	69	743
Book publishing (2731)	18	29	20	32	24	38	259
Cellulosic man-made fibers (2823)			86	99+		100	
Pharmaceutical preparations (2843)	28	44	24	40	22	36	273
Petroleum refining (2911)	37	59	33	57	32	52	435
Flat glass (3211)			94	98	82		1968
Ready-mixed concrete (3273)			6	9	8	11	25
Blast fumaces and steel mills (3312)	50	66	48	66	44	63	607
Metal cans (3411)	78	86	73	84	54	70	1076
Electric lamps (3641)	92	96	91	95	91	94	
Radio and TV receiving sets (3651)			49	69	39	59	559
Motor vehicles and car bodies (3711)			92	98	90	95	
Jewelry, precious metals (3911)	13	20	23	28	12	18	68
Pens and mechanical pencils (3951)			46	60	49	65	772

Herfindahl-Hirschman index for the 50 largest companies. Not available prior to 1982.

Source: US Department of Commerce, Bureau of the Census, 1987 Census of Manufactures: Concentration Ratios in Manufacturing (Washington, DC: U.S. Government Printing Office, 1992), pp. 4-43, table 4.

CALCULATION OF MARKET CONCENTRATION

      Ever since the U.S. Department of Justice issued revised merger guidelines in 1982, market concentration has been gauged by calculating the Herfindahl-Hirschman Index (HHI).[2] The index is the sum of the squares of the market shares of the sellers included within the boundaries of the relevant product and geographic market. A monopolist, by definition, accounts for 100 percent of all of the units sold in its market, and so in this extreme case $HHI = 100^2 = 10,000$. A market served by two equally sized firms generates an HHI of 5,000, which is $50^2 + 50^2$. A market served by ten equally sized firms generates a HHI of 1000 ($=10^2 + 10^2 + 10^2 +10^2 +10^2 +10^2 +10^2 +10^2 +10^2 +10^2$). As the number of equally sized firms becomes very large, HHI approaches its lower limit of zero.

---

    [2] The guidelines were first promulgated in 1968, at which time the market concentration measure of choice was the four-firm concentration ratio (CR_4), calculated by summing the market shares of the four largest firms. CR_4 weights the markets shares of the leading firms equally, whereas HHI includes the shares of all of the firms in the market and gives greater weight to firms with larger market shares.

For public policy purposes, the critical value of HHI is between 1,800 and 2,500.[3] The lower end of this range has been accepted as the threshold for merger cases. That is, antitrust authorities are likely to challenge mergers where the HHI is 1800 or higher. Other things being the same, a merger that would raise concentration by 50 points in markets where the HHI is 1,800 is likely to be challenged by the antitrust authorities because such a merger would "substantially lessen competition or tend to create a monopoly".[4]

The upper end of this range, 2500, has been applied by the Department of Justice in determining whether oil pipeline markets are competitive enough to allow market-based pricing to displace regulated pricing. In particular, the Justice Department has recommended that the Federal Energy Regulatory Commission "consider concentration in the relevant market below this level as sufficient to create a rebuttable presumption that a pipeline does not possess significant market power".[5] This same rule has been proposed for electric power generation.[6]

CONDUCT

Of course, the 64 thousand dollar question[7] is, how does concentration translate into performance?

The measurement of performance offers its own set of problems. First, we define performance, as noted above, in terms of price and cost. However, it is often times hard to measure price and quite often nearly impossible to measure cost.

Alternatively, we can measure profits directly. This too has pitfalls. Profits are measured as the difference between revenues and costs. If the costs capture the value of the monopoly profits, then measured profits will not depict the monopoly that in fact exists. For instance, suppose that an entrepreneur invents a new product, applies for and receives a patent, and then licenses the production of the good among several competitive manufacturers. The market will be monopolized by definition. The product is patented, and the patent holder will limit production in order to raise price to the monopoly level. However, the income statements of the manufacturers will not show the profits because their costs will include the license fee.

Or consider the case of U.S. Steel when it merged together the lion's share of the steel industry in the late 19th century. As U.S. Steel was buying up steel manufacturers these firms were selling out at a price that included the expectation of USS achieving a monopoly and raising price. The small firms that were joining together under the umbrella of USS knew that their assets were more valuable than they had been. The price at which they sold out to USS captured their share of the monopoly that was to be. As a consequence, the book value of USS was inflated. The book value of the facilities owned by USS when it reached the zenith of its control of the industry included some of the monopoly value caused by the higher prices it was able to set by controlling the market. The same was true of Standard Oil.

An alternative measure of monopoly power is the stock market reflection of the value of

---

[3] An HHI of 1,800 is the level of concentration that would be observed in a market served by five to six equally sized firms; a market served by four equally sized firms would produce an HHI of 2,500.

[4] Clayton Act, section 7.

[5] Judith B. Cardell, Carrie Cullen Hitt, and William W. Hogan, "Market Power and Strategic Interaction in Electricity Networks", *Resource and Energy Economics* 19 (1997), p. 112.

[6] Werden, "Identifying Market Power", p. 20, citing Paul L. Joskow, *Horizontal Market Power in Wholesale Power Markets, Appendix A to Initial Comments of Edison Electric Institute*, FERC Dkt Nos. RM94-7-001 and RM95-8-000, August 1995.

[7] This expression comes from an old TV game show that was the center of controversy in the '60s because it was rigged.

the firms operating in an industry. Stock market measurements are even more expectationally driven than book values.

In order to use the stock market to detect the presence of monopoly, one has to look at the stock market reaction—the stock price fluctuation—at the time investors recognized that a monopoly was going to be created or at the time they recognized that a monopoly was going to be purged. I have investigated two such events. First, monopoly creation

In 1970 the federal government passed the Clean Air Act. This was the first federal legislation that imposed specific clean up standards on firms nation-wide. The standards were process oriented. That is, the standards mandated pollution control machine by machine in the work place. In this sense they were industry standards.

Interestingly, the standards were two-tiered. One level of pollution control was mandated for existing facilities. Another for facilities constructed after the Act. The *new-source* standards were substantially more strict than the *retrofit* requirements. Partly this was because retrofit technology was more costly. But partly the theory was that we had to move toward a cleaner environment and new production facilities had to lead the charge.

The effect of the new-source-old-source bias in the mandated level of pollution control was to raise price and at the same time create a barrier to entry. Market price increased because old facilities had to reduce pollution. In part this meant reducing output; the market price of output was driven up. However, new firms that might otherwise have entered in order to compete away the profits associated with this higher price were thwarted by the more restrictive new-source standards.

One industry that was particular affected by this was copper smelting. When the EPA standards for copper smelting were proposed, analysts forecast that there would never be a new smelter built in this country. McCormick and I looked at the stock market reaction to the announcements of the proposed pollution abatement rule making. As predicted by a theory of government controlled barriers to entry, the stock prices of the firms in the copper industry actually went up when the pollution control rules were promulgated.

In the second case, the stock market reaction to competitive entry into the local telecommunications industry was examined. From 1911 until 1984, AT&T had a government regulated monopoly in telephone. In 1984, this monopoly was broken into two pieces, long distance and local service (called local loop). AT&T was spun off from the Bell Operating Companies that provided local loop service. As time passed, LD service became fairly competitive while entry into the local loop service was restricted by a labyrinth of rules at both the local and federal level, such as the prohibition of cable companies from selling telephone services.

Technological advances began chipping away at these. Cellular telephony has become highly sophisticated and increasingly effective. While cellular service alone may not compete strongly against regular local service, cellular service linked with long distance may. On November 4, 1992, AT&T announced its intention to acquire McCaw Cellular the largest cellular provider in the country. This announcement sent shock wave throughout the telecommunications industry. Most notably, the announcement was received by stock market investors as an indication that profits for AT&T were going to go up, while profits for the Bell companies were going to fall. The stock price of AT&T went up and the prices of the Bell companies fell.

In a similar move, on January 4, 1994, MCI announced that it was directly entering the local loop market place. This announcement caused the stock prices of the Bell's to fall

dramatically. The stock prices of AT&T and the other LD suppliers also fell. The implication is that analysts and investors think that monopoly power in local telephone services is being eroded.

CORPORATE CONCENTRATION

The question is whether the increased consolidation of corporate America causes it to be more monopolized. We need to find a way to measure monopolization. Generally the approach has been to measure profits and then to determine if increased concentration has led to increased profits.

The first measure of profits is called the Lerner Index. The common parlance labels this Price-Cost Margins. PCM is a very bad measure of monopoly profits.

Another measure is Tobin's q. This is a good index, but very difficult to measure. Tobin's q is the ratio of the market value of the firm to the replacement cost of the firm's productive capacity. Tobin's q should be equal to 1 for competitive firms. If it is greater than 1, it means that the market value of the assets (market value of stock plus the face value of bonds) is greater than the amount necessary to replicate the productive capacity. This means that the firm is either real lucky or it has monopoly power. Tobin's q can bounce around 1 in the short run, but can only be greater than 1 in the longer term if there are monopoly restrictions on entry of firms into the business. However, the problem with Tobin's q is that it is nearly impossible to measure the replacement cost of assets. Often the replacement cost of assets is substituted for by the book value of assets.

The measure of profit that is normally used is Return on Assets (ROA). This called the Bain Index in your book. It is just operating income less taxes divided by the book value of assets (usually the depreciated value of assets). ROA is a flow value that measures much the same thing as the stock concept in the bastard version of Tobin's q.

The empirical fact to confront is that there is a high correlation between ROA and concentration. Bain was the first to present this result. It has stood up to different measurement.

Brozen and then Peltzman argued that the correlation between concentration and profits was not necessarily causal. That is, efficiency could be causing both concentration and profits such that the relationship between them was not the result of monopolization. Peltzman's empirical work seems to confirm this.

Demsetz went one step further. He argued that if profits were the result of concentration that allowed for monopoly, then there should be no relationship between profits and firm size. That is, if monopoly, which resulted from concentration, were driving profits, the small firms in the industry should benefit as well as the big firms, indeed, maybe more. On the other hand, if efficiency drives concentration and profits, then the efficient firms are the ones that get big, profitable, and leave the little guys behind. This is latter his what he found.

ANALYSIS OF THE BEER INDUSTRY

Micha Gisser[8] on the Beer Industry(excerpts)

I have chosen the brewing industry as a case study. This industry, which was basically unconcentrated in the late 1940s, is today one of the most concentrated manufacturing industries in the United States. The real price of beer has been falling almost steadily since the mid 1950s and its Herfindahl index has been rising, very slowly, from the

---

[8] Department of Economics, University of New Mexico.

mid 1940s to the mid 1960s, and very rapidly since the sixties. In what follows I utilize historical evidence and econometric analysis relating to the brewing industry in support of the theory of dynamic gains to consumers.

History of the Brewing Industry
According to Charles G. Burck [1972], there were 735 beermakers in the United States just after the repeal of prohibition. Table I offers some revealing summary statistics relating to the history of the beer industry from the mid-1940s to date. From 1947 to 1982 the number of beermakers decreased from 404 to 67 but started to increase toward the end of the 1990s. The Convenience ratio is defined as beer shipments in non-returnable bottles and cans divided by total shipments. As I explain later, the process of replacing the one-way glass containers by convenience packages has played the key role in changing the technology of beer production in the United States. This ratio increased steadily from 9.43 percent in 1947 to 80.76 percent in 1987. During this period, as shown by column (3), real prices of beer increased up to the mid-1950s, but then fell 24 percent. (The real price per barrel fell from $82.54 in 1954 to $65.89 in 1987 and $62.67 in 1989). The four-firm concentration ratio, C-4, was 21 percent in 1947, consistent with a competitive but non-atomistic market structure. The geographic scope of the beer market has grown since the 1950s. National concentration ratios probably do not accurately reflect the state of competition in the 1940s and the early 1950s because the market for beer was geographically fragmented. Nevertheless, by 1958 Anheuser-Busch, Schlitz and Pabst were established as national breweries. In 1987 the C-4 ratio rose to 87 percent indicating that the beer industry is currently heavily concentrated. The Herfindahl index (times 10,000) in column (5), has risen from 135 in 1947 to 2,516 in 1987.
Most of the innovation involving changes in aluminum cans and packaging equipment was purchased from firms outside the industry--e.g. aluminum producers. If the beer companies bore heavy development costs of the new canning lines, then high profits would be needed to help them reap the benefits of their fixed cost of innovation. The pioneers who took the first step, by either indigenously investing in new technology or, alternatively, purchasing it outside the industry, were able to lower their marginal costs of delivering beer to consumes. Historically, they initially reaped only Ricardian rents, and later, following the increase in concentration, they also reaped oligopolistic profits. The mergers that occurred in the wake of new technologies accelerated the course of falling prices, they did not cause them.
The early technological innovation introduced by breweries starting in the mid-1870s involved the building of refrigerated rail car systems. Breweries later developed coordinated regional systems of railside ice houses to support their fleet of refrigerated cars. In the early 1870s brewers also adopted Pasteur's discovery. Pasteurization prevented spoilage and extended the scope of the market. Steel cans appeared in the 1930s, and the first six-pack cartons appeared in the late 1950s. The moderate increase in concentration before the 1960s lends limited support to the hypothesis that most of the industry was innovating at the same time. Indeed, the increase in concentration before the 1960s resulted from replication of existing, relatively labor-intensive plants. In those days, some advantages of large scale originated from utilities, such as water processing and refrigeration equipment. The early 1960s ushered in the first aluminum beer cans with the variety of tab and pull tops. The aluminum industry developed new methods of manufacturing cans using smaller amounts of higher-priced metal to be competitive with steel. Later they invented new alloys of aluminum and manganese that permitted a reduction in container wall thickness and led to increasingly cheaper containers. According to Burck [1972] technological changes in the late 1960s and the early 1970s significantly increased the rate of operation of closing lines:

> In 1965 a typical high-speed canning line filled 800 cans per minute and a good bottling line ran at a rate of just 500 per minute. Today, using the same number of people, efficient canning lines run at 1,200 cans a minute, and the fastest bottling lines are pushing 900. [Page 104].

According to Keithahn [1978] it was not until the early 1960s that technological changes induced an increase in concentration:

> The first reason behind the increase in the minimum efficient size of plant is the fact that there have been significant technological improvements in the packaging of beer. The improvements have been in the form of faster canning and bottling machinery. Modern canning lines are capable of running at a rate 1,500 twelve-ounce cans per minute, whereas 12 years ago a typical high-speed canning line filled just 750 cans per minute. [Page 34].

Keithahn also mentions the introduction of automation into brewhouses as a labor saving measure, and the development by Schlitz of a special fermentation method, which shortened the aging time of beer, as a capital-saving measure.

Some evidence is supporting the existence of a coincidence between large-scale *demand* shifts and technological innovation. Conversations with experts in the industry indicate that the markets in periods 1947-63, 1963-73, 1973-80 and 1980-90 were "poor," "excellent," "good" and "poor," respectively. I estimated the demand shifts for beer for these four periods by calculating the percentage growth in the adult population plus 0.4 times the GNP-per-capita percentage growth, at 1.87, 2.68, 2.47 and 2.04 percent, respectively.[9] The multiplier 0.4 is the income elasticity for beer estimated by Hogarty and Elzinga [1972]. Thus, during the 1963-73 period the beer industry probably achieved the largest scale demand shifts as compared with any of the other three periods. As I later show, during this period cost curves shifted downwards and simultaneously the zone of increasing returns to scale grew ever larger. As noted earlier, replacement of returnable bottles and draught by convenience packages (metal cans and nonreturnable bottles) may be used as an index of technological innovation. According to R.S. Weinberg [1992], beer shipments in convenience packages increased from 9.43 percent in 1947 to 82.24 percent in 1990 of total shipments, and from 1963 to 1973--the era of potential large scale economies--from 43.48 to 70.97 percent. Although technological change has been a continuous process, its impact was the greatest during the decade extending from 1963 to 1973. Frank J. Sellinger, in a statement before a Senate subcommittee of environmental pollution [1974], explains in detail why the process of replacing the returnable bottles by one-way glass containers and cans has played the key role in creating more efficient production and large-scale distribution systems. Production lines for convenience packages opened the door to automation and costly high-speed equipment that could be justified only by building larger capacity breweries. One observation by Sellinger is particularly enlightening:

> Production lines for one-way containers justified the required automation and potential of high speed and high efficiency. High cost required high utilization. High use required large capacity breweries. Large capacity breweries justified sophisticated instrument control investment that reduces labor and results in lower production costs. Higher speed equipment requires containers manufactured with uniform specification and quality. The newer equipment requires a jam-proof environment to operate efficiently. Example: At the former low speed of 120 to 250 bottles per minute, if a returnable bottle broke and jammed a conveyor, an operator had time leisurely to walk over, clear the jam, and return to his station without sacrificing production. At today's speed of 1,000 per minute for one-way bottles and 1,500 cans, no matter how fast an operator reacts, production is immediately jeopardized. [Page 27].

---

[9] These are the data used in calculating the annual demand shifts:

Period (1)	Percentage Growth of Adult Population (2)	Percentage Growth of Real GNP Per Capita (3)	Demand Shift (2)+0.4(3) (4)
1947-63	1.14	1.38	1.87
1963-73	1.59	2.72	2.68
1973-80	2.02	1.12	2.47*
1980-90	1.38	1.64	2.04

*The period 1973-80 corresponds roughly to a period in which the drinking age was lowered to 18 in most states. Thus 2.47 percent understates the true demand increase during this period. Note: The data source is the Economic Report of the President. Adults are people 20 years of age and over. The multiplier 0.4 is Hogarty and Elzinga's [1972] estimate for the beer income elasticity.

The evidence provided by Burck [1972], Keithahn [1978] and Sellinger [1974], implies that the most impressive technological change in the beer industry occurred in the late 1960s and the 1970s, and resulted in dramatic price drops in the 1970s.

Is horizontal merger associated with efficiency increases? To answer the question I looked at historical data on shipment of brewers who have had at least one million barrels during any year from 1947 to 1990. The data were compiled by Robert Weinberg [July 15, 1991]. From 1947 to 1959 five firms were acquired and one failed; from 1960 to 1969 six firms were acquired; from 1970 to 1979 one firm was split up, nine firms were acquired and two merged; between 1980 and 1990 six firms were acquired. Not surprisingly, the most intensive process of merger and acquisition occurred between 1970 and 1979, coinciding with two periods of dramatic price drops (1971-3, and 1977-81). If so, merger is a low-cost method of increasing market share in the wake of technological innovations.

In 1969 Phillip Morris acquired 53 percent of the Miller Brewing Company stock. On August 1, 1970, Phillip Morris owned the entire Miller stock. Immediately thereafter, Miller launched bold capacity expansions and introduced to the market a new product--Miller Lite. Although the big price decrease cannot be attributed to that vertical-merger episode, the new product probably contributed to the impressive increase in the demand for beer.

Some success of the national brewers is attributed to multi-plant economies of scale. The emerging national oligopolies had to pursue a multi-plant strategy to reduce transportation costs. These transportation-costs reductions, per se, could not favor the national producers over the regional breweries. However, due to the proliferation of television there were advantages from advertising on a national scale.[10]

---

[10] It seems, however, that the advantage from economies of scale in advertising may be somwhat offset by the disadvantage of the resulting less elastic demand curve. The demand curve which is perceived by the large firm becomes less elastic as its market share increases. If the demand curve facing the entire industry is inelastic, when the share of the large firm exceeds a critical level it reduces its level of advertising. For detail see Gisser [1991].

TABLE I
Summary Statistics
The Beer Industry: 1947-1987

Year	Companies (number)	Convenience Ratio	Real Beer Price per Barrel 1982-84 =100	C-4 Index (percent)	Herfindahl Index times 10,000
	(1)	(2)	(3)	(4)	(5)
1947	404	9.43	74.18*	21	135
1954	263	29.12	82.54	27	234
1958	211	35.60	80.71	28	293
1963	171	43.48	80.07	34	418
1967	125	54.66	81.00	40	580
1972	108	68.46	72.58	52	854
1977	81	75.78	68.86	64	1,194
1982	67	79.20	64.62	77	1,902
1987	101	80.76	65.89	87	2,516

*For 1949.

Data Sources: Columns (1) and (4); U.S. Department of Commerce, Bureau of the Census, 1987 Census of Manufactures, *Concentration Ratios in Manufacturing*, Washington D.C.

　　Columns (2) and (5); Robert S. Weinberg and Associates, Mimeo 1992. Convenience packages include metal cans and non-returnable bottles. The convenience ratio equals beer shipments in convenience packages divided by total shipment. The Herfindahl index is not truncated.

　　Column (3); Real value of shipment divided by production. The source for the real value of shipments is the Beer Institute compiled from various issues of the Census of Manufactures. The source for production is Robert S. Weinberg and Associates [mimeos, July 15, 1991 and May 10, 1995].