Food Marketing Policy Center

When is Concentration Beneficial?

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Preface

This paper separates market power and efficiency effects of concentration in a sample of 255 U.S. manufacturing industries and computes welfare changes from rises in concentration. The empirical findings reveal that in nearly two-third of the cases, consumers lose as efficiency gains are generally pocketed by the industries. From an aggregate welfare standpoint, concentration is found to be beneficial in nearly 70% of the cases, mostly for low and moderate levels of concentration being particularly against the public interest in highly concentrated markets. Overall, the results support the existing U.S. Federal Trade Commission guidelines for approval of mergers.

Key words: concentration, marked power, efficiency, manufacturing

1. Introduction

Traditionally, the existence of excessive price-cost margins has justified antitrust action without regard to the level of prices and costs separately. With ongoing dramatic increases in industrial concentration and globalization of markets, this conventional wisdom has been challenged more recently (Blair and Harrison, 1999; Berger and Hannan, 1998). However, concentration changes induce both price and cost changes. While price variations raise questions regarding consumer welfare, cost variations do the same regarding technical efficiency.

In the last two decades the U.S. manufacturing sector has experienced dramatic changes in market concentration. Most manufacturing industries have experienced rises in market concentration, particularly those classified as "highly concentrated" by the U.S. Department of Justice and the Federal Trade Commission (1992). Although many studies have found that market concentration affects both prices and production cost (e.g., Allen, 1983; Chappell and Cottle, 1985 and Martin, 1988), none of these studies established a structural link between costs and concentration (Berger, 1995). Furthermore, beyond the empirical measures and testing of the market power effects of concentration, studies covering the welfare effects of market power *and* efficiency effects for a wide range of industries are lacking.

The thrust of this study is to investigate under what circumstances market concentration leads to social welfare enhancement. The welfare calculations include both oligopoly power and efficiency effects. The underlying econometric model is a variation of the oligopsony study by Azzam (1997). The empirical findings indicate that concentration is more likely to be beneficial when the degree of concentration is low and the price elasticity of demand high. For highly concentrated industries (Herfindahl index greater than 1800), any benefits of efficiency gains are generally outweighed by market power increases. These findings support the current Department of Justice guidelines for scrutinizing merger activity in highly concentrated industries. Further results show that consumers generally lose with concentration as efficiency gains are generally pocketed by the industries.

2. Empirical Model

The econometric model draws on the work of Clarke and Davis (1982) and Azzam (1997). Consider an oligopolistic industry with a market demand function $Q=f(P,z)$ and n number of firms producing a homogenous product. Q is the total industry output, P is the output price and z is a vector of demand shifters.

Each firm is assumed to choose its output level in order to maximize profits:

$$\Pi_i = P(Q,z)q_i - C_i(q_i,w,t)\,, \tag{1}$$

where q_i = firm i's output,

$$Q\,(=\sum_i q_i;\ \text{i=1,…n}).$$

The firm's dual cost function is represented by $C_i(q_i,w,t)$ in which w is a non-negative vector of exogenous input prices and t represents the state of technology.

The first-order condition of (1) w.r.t. q_i yields:

$$P = \frac{mc_i(q_i,w,t)}{1-\left(\frac{(1+\phi_i)S_i}{\eta}\right)}\ , \tag{2}$$

where $\phi_i = \frac{\partial \sum q_j}{\partial q_i}$ is firm i's conjecture with respect to the reaction of rivals $(j \neq i)$,

$S_i = \frac{q_i}{Q}$ is the firm's market share,

$\eta = -\left(\frac{\partial Q}{\partial P}\right)\left(\frac{P}{Q}\right)$ is the price elasticity of demand,

mc_i = the firm's marginal cost.

The cost function is assumed to take the restricted Generalized Leontief form:

$$C_i(q_i,w,t_i) = q_i\sum_j^m\sum_k^m \gamma_{jk}(w_j w_k)^{.5} + q_i t\sum_j^m \gamma_{jt} w_j + q_i^2\sum_j^m \beta_j w_j. \tag{3}$$

Summing (3) across firms in the industry, using the market shares as weights the derived input demand functions and the supply relation for a particular industry can be obtained:

$$\frac{X_j}{Q} = \sum_j^m \sum_k^m \gamma_{jk} \left(\frac{w_k}{w_j} \right)^{.5} + \gamma_{tj} t + HQ\beta_j \,, \qquad (4)$$

$$P = \frac{\sum_j^m \sum_k^m \gamma_{jk} (w_j w_k)^{.5} + t \sum_j^m \gamma_{tj} w_j + 2HQ \sum_j^m \beta_j w_j}{1 - \left(\frac{\alpha + (1-\alpha)H}{\eta} \right)} \,, \qquad (5)$$

where X_j = the total industry employment of the j^{th} input,

$H = \sum_i^n S_i^2$ = the Herfindahl Index,

α is the weighted conjectural variation,

η is the price elasticity of demand.

Let the weighted marginal cost (the numerator of (5)) be expressed by $mc = \beta_0 + 2QH\beta_1$.

where $\beta_0 = \sum_j^m \sum_k^m \gamma_{jk} (w_j w_k)^{.5} + t \sum_j^m \gamma_{tj} w_j =$ the intercept,

$\beta_1 = \sum_j^m \beta_j w_j$ = its slope in quantity space.

Thus, β_1 equals zero, a negative or a positive value for constant, increasing and decreasing economies of size, respectively

Let the market demand function take logarithmic the form:

$$\ln Q = \delta_0 + \eta \ln\left(\frac{P}{d} \right) + \delta_1 \ln\left(\frac{y}{d} \right) + \delta_2 t \,, \qquad (6)$$

where d is a price deflator,

y stands for the U.S. national income, and

t captures changes in taste and preference.

Market equilibrium in a particular industry is reached when P and Q fulfill equations for the supply relation and demand function simultaneously. Consequently, the elasticity of price with respect to the Herfindahl index ($\varepsilon_{P,H}$) is obtained by applying the implicit-function theorem to equations (5) and (6):

$$\varepsilon_{P,H} = \left[\frac{[1-\alpha]PH}{(mc)\eta} + \frac{2QH\beta_1}{mc} \right] * \frac{mc}{mc + 2HQ\beta_1 \eta} \,, \qquad (7)$$
$$= (\varepsilon_{L,H} + \varepsilon_{c,H}) * \lambda \,,$$

where $\varepsilon_{P,H}$ is the elasticity of price with respect to the Herfindahl index, which is the sum of the market-power elasticity $\varepsilon_{L,H}$ and the efficiency elasticity $\varepsilon_{c,H}$, multiplied by the price-quantity adjustment λ.. While the market power elasticity is always positive, the sign of the efficiency elasticity and the strength of the price-quantity adjustment will depend on the sign of β_1. For instance, if $\beta_1 < 0$, the efficiency elasticity is negative and the price-quantity adjustment is greater than 1.

Next consider the impacts of concentration on welfare. A rise in concentration will lead to price, quantity and cost variations. The former two affect both consumer and producer surpluses and the latter affects only producer surplus. The changes in consumer surplus (dCS), producer surplus (dPS), and net social welfare (dSW) from an increase in concentration from H_0 to H_1 are given by:

$$dCS = \int_{Q_1}^{Q_0} \left(\frac{z^d}{Q} \right)^{1/\eta} dQ - P_1(Q_1 - Q_0) + Q_0(P_0 - P_1) \,, \qquad (8)$$

$$dPS = (Q_1 - Q_0)P_1 - (P_0 - P_1)Q_0$$
$$+ \int_0^{Q_0} \left(2Q\beta_1 (H_0 - H_1) \right) dQ \qquad (9)$$
$$- \int_{Q_1}^{Q_0} (\beta_0 + 2QH_1\beta_1) dQ,$$

$$dSW = dCS + dPS \,, \qquad (10)$$

where (P_0Q_0) and (P_1Q_1) are the equilibrium prices and quantities, given H_0 and H_1, respectively.

As an illustration, consider the equilibrium depicted in Figure 1 representing the case of a rise in concentration from H_0 to H_1 with economies of size and a net price decline. The change in consumer surplus is (A+B), where A is a pure transfer and B is a deadweight loss. The change in producer surplus is given by (C+D+E-A). In this particular example, there is an increase in social welfare given by (B+C+D+E) where both consumers and producers are winners.

3. Empirical Implementation

A model consisting of five structural equations is estimated. The sample consists of annual data for the period 1972-1992 for 255 U.S. manufacturing industries at the four-digit SIC level. The inputs are divided into three categories: capital (K), labor (L) and material (M). The full model of industry equilibrium consists of a set of three derived input demand equations a pricing equation and a market demand equation. The endogenous variables are Q,,P, X_K , X_L , and X_M . The exogenous variables consist of W_K ,W_L ,W_M , y,d, *and* H..

The non-linear 3SLS estimation procedure was implemented using the SHAZAM 7.0 software. The equilibrium P and Q before and after a 1% increase in the Herfindahl index (at mean values) are determined simultaneously by solving equations (5) and (6) with the MATLAB 4.0 software. The same software was used to compute the ensuing welfare changes for each of the 255 U.S. manufacturing industries.

The main data sources for prices and quantities of outputs and inputs was the online National Bureau of Economic Research database of Bartelsman and Gray (1996) on U.S. manufacturing industries. Due to lack of data on the price of capital at the 4-digit SIC level, all industries are assumed to face the same rental prices but each to have a different level of capital stock. Therefore, the rental price of capital was computed by dividing the cost of capital services (provided electronically by the Bureau of Labor Statistics) divided by total capital assets at the 2-digit SIC level. Also due to data limitations, we use maximum entropy with market shares derived from concentration ratios (Golan, Judge, and Perloff, 1996) and extrapolate an instrumental variable for the Herfindahl index.

4. Empirical Results

Table 1 shows the number of the industries in the sample (255 in total) that experienced net welfare increases and decreases after a one-percent rise in the Herfindahl index. Following the U.S. Federal Trade Commission (1992) guidelines, the industries were classified into three categories: low (H < 1000), medium (1000≤ H<1800), and high (1800 ≤ H ≤ 10,000 upper limit) concentration levels.

The results summarized in Table 1 indicate that increases in concentration lead to increases in social welfare in approximately 69.4% (177 out of 255) of the industries analyzed. Note however, that 81% of these industries (143) are in the low concentration category, which is, of course, in part due to the fact that approximately 77% of the industries are classified as low concentration. Nonetheless, concentration would be socially beneficial in approximately 72.6% (143 out of 197) of the low-concentration industries. For the moderate-concentration industries, increases in concentration lead to social welfare improvement in approximately two-thirds of the cases (30 out of 45). On the other hand, only 31% of the highly concentrated industries show an improvement in social welfare as these industries further concentrate. These results lend support to the guidelines used by the Federal Trade Commission that closely scrutinizes mergers of highly concentrated industries but generally allows mergers in low-concentration industries.

From the aggregate welfare changes it seems that concentration is mostly desirable in low and moderately concentrated industries. An important issue is how concentration affects consumers; that is, whether any efficiency gains are passed on to the consumers or are simply pocketed by the oligopolistic industries. In nearly 64% of the cases (163 out of 255), concentration leads to consumer losses; that is, it leads to price declines in only approximately 36% (92) of the cases. In the 163 industries where consumers lose, concentration leads to significant efficiency gains that outweigh the consumer losses in 85 additional industries leading to a total of 177 (85+92) where concentration is beneficial from an aggregate welfare standpoint.

To obtain further insight into the pattern of concentration impacts on social, we estimated the following regression model:

$$dSW = g_0 + g_1 H + g_2 HD_1 + g_3 HD_2 + g_4 |h| + g_5 DS + v, \quad (11)$$

where dSW is the social welfare change;

H is the Herfindahl index at mean values for each industry;

HD_1 and HD_2 are dummy variables that take the value of 1 for moderate- and highly-concentrated industries,

η is the absolute value of the price elasticity of demand,

DS is a dummy variable that takes the value of 1 for significant economies of size (below 0.7),

v is an error term, and the ã's are parameters to be estimated. The results are presented in Table 2.

These regression results strengthen the previous conclusions with respect to the impact of concentration on social welfare. Concentration is beneficial for low levels of concentration, still beneficial for moderate levels ($\tilde{a}_1+\tilde{a}_2$=4.963), and detrimental in highly concentrated industries ($\tilde{a}_1+\tilde{a}_3$=-3.912). Note, however, that the coefficients for the Herfindahl index and the slope shifter for the highly concentrated industries are significant at the 1% level and that the one for the moderate concentration is significant only at the 10% level.

Note also that the elasticity of demand plays an important role in determining the impact of concentration on social welfare. The more elastic the demand for the output, the more likely concentration will have a beneficial impact on social welfare. This is consistent with the fact that a more elastic demand restricts market power and mitigates the impact of oligopolistic quantity restrictions on price. Finally, the economies of size dummy failed to show a discernible effect in shaping the impact of concentration on social welfare. This may not be surprising since the Herfindahl index may be partially capturing economies of size and efficiency effects.

5. Conclusions

A key motivation of this paper is that ongoing changes in concentration have to be evaluated not only for their effects on market power, which are generally detrimental to consumers and result in deadweight losses, but also in light of efficiency effects that may actually lead to beneficial aggregate welfare changes and even lower consumer prices.

This paper examines social welfare effects of rises in concentration for 255 U.S. manufacturing industries taking into account both market power and efficiency effects. Concentration is mostly beneficial for industries in low- and moderately- concentrated markets but is detrimental in highly concentrated markets, even if efficiencies are strong. Overall, concentration is found to be socially beneficial (from an aggregate welfare standpoint) in nearly 71% of the cases.

The distributional consequences are quite stark: in nearly two-thirds of the cases, consumers lose, arising from the fact that efficiency gains are mostly pocketed by the oligopolistic industries. Finally, the results generally support the current merger guidelines of the U.S. Federal Trade Commission in which industries with high levels of concentration are scrutinized not only for their impact on net social welfare but also on consumer welfare. In sum, although concentration generally increases aggregate welfare, it generally benefits corporate welfare and hurts consumer welfare.

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Figure 1. Illustration of a Possible Increase in Welfare from Concentration.

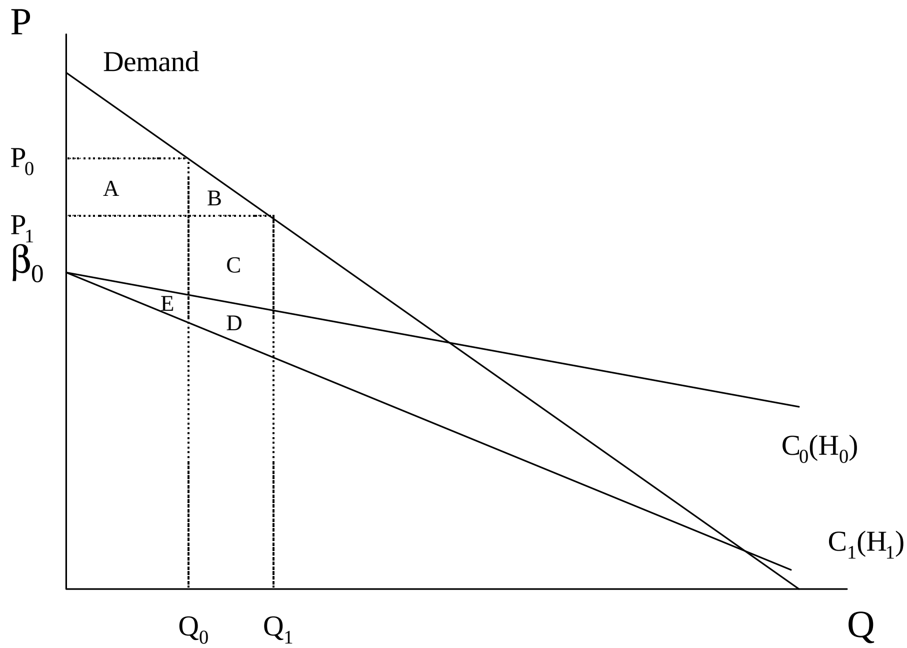

Figure1

Table 1: Welfare Changes from a Rise in Concentration, U.S. Manufacturing Industries, 1972-1992.

	Low Concentration	Moderate Concentration	High Concentration	Total
Social Welfare:				
Decline	54 (27.4%)	16 (33.3%)	8 80%)	78 (30.6%)
Increase	143 (72.6%)	32 (66.7%)	2 (20%)	177 (69.4%)
Total	197	48	10	255
Consumer Welfare:				
Decline	122 (61.9%)	33 (68.8%)	8 (80%)	163 (63.93%)
Increase	75 (38.1%)	15 (31.2%)	2 (20%)	92 (36.07%)
Total	197	48	10	255

Table 2: Regression Results Explaining Social Welfare Changes

Table 2: Regression Results Explaining Social Welfare Changes

Variable	Parameter	Estimate	t-statistic
H	g_1	13.233***	2.594
HD_1	g_2	-8.270*	-1.93
HD_2	g_3	-17.145***	-3.43
$\lvert h \rvert$	g_4	1.420***	4.120
DS	g_5	3.025	1.210
Constant	g_0	0.89863***	4.092

Notes: The levels 10%, 5% and 1% of significance are represented by *, ** and ***, respectively. The dependent variable is dSW. The regression was corrected for dependent-variable heteroskedasticity.

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