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WHEN IS CONCENTRATION BENEFICIAL? EVIDENCE FROM U.S. MANUFACTURING

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Abstract

This article estimates the impact of industrial concentration on market power and cost and then links the ensuing welfare changes to market structure characteristics using a sample of 232 U.S. manufacturing industries. Empirical results indicate that further increases in concentration would enhance welfare in 70% of the industries due to widespread efficiency gains, although these would generally not be passed on to consumers. From a social standpoint, further concentration is more likely to be beneficial in industries with economies of size, high export intensity, which are engaged in consumer-oriented goods, face larger markets, and have low or moderate levels of initial concentration.

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When is Concentration Beneficial? Evidence from U.S. Manufacturing

Rigoberto A. López, Elena López and Carmen Liron-Espana*

1. Introduction.

The conventional view that high levels of concentration yield excessive price-cost margins and, therefore, welfare losses, was challenged in the late 1960s by Williamson (1968) and more recently by Dickson and He (1997), Berger and Hannan (1998), Blair and Harrison (1999), Bian and McFetridge (2000), Feltovich (2001), and Focarrelli and Panetta (2003), among others. By considering both the price *and* cost changes resulting from industrial concentration, these authors raised the possibility that concentration could give rise to welfare gains. However, their studies are limited by specific market structure or conduct assumptions and do not establish a broader structural link between concentration and welfare consequences.

In this article we estimate an oligopsony model that allows for price and cost changes from further concentration for each of 232 U.S. manufacturing industries, compute changes in welfare and then link them to market structure characteristics in order to assess when is further concentration beneficial. We find that although concentration enhances aggregate welfare in nearly 70% of the industries due to widespread efficiency gains, consumers lose in 64% while producers gain in 82% of the cases, as efficiency gains accrue mostly to the industries themselves. Further findings show that increases in concentration augment social welfare in industries which are large, have economies of size, inelastic demand functions, high export intensities, and have low or moderate levels of initial concentration.

2. Empirical Model

The econometric model draws from the work by Azzam (1997) and Lopez, Azzam, and Lirón-España (2002). Consider n firms, each producing a homogeneous product q_i, so that $Q = \sum_i q_i$ is total industry output, and assume that their cost function takes a restricted Generalized Leontief form and that each firm chooses the output level which maximizes its profit function. Taking the derivative of the cost function with respect to the firm's output and inputs, one obtains the firm's marginal cost and input demand equations. Summing up these expressions across firms in the industry, using the market shares as weights, one obtains a supply relation given by

$$P = \frac{MC}{1-L} \quad , \tag{1}$$

where P is the output price; MC denotes the share-weighted marginal cost, given by

$$MC = \sum_j^m \sum_k^m \gamma_{jk} (w_j w_k)^5 + t \sum_j^m \gamma_{tj} w_j + 2HQ \sum_j^m \beta_j w_j, \quad \text{where} \quad w_i \text{ are exogenous input}$$

prices, t denotes the state of technology, and $H = \sum_i^n S_i^2$ is the Herfindahl Index of industrial concentration where S_i is the market share. Note that the last term equals zero, a negative, or a positive value for constant, increasing, and decreasing economies of size, respectively, and thus determines the nature of the efficiency impacts of concentration. In the denominator of [1], $L = (\alpha + (1-\alpha)H)/\eta$ is the industry-level Lerner index of oligopoly, where α is Clarke and Davies' (1982) collusion parameter, and $\eta = -\partial \ln Q / \partial \ln P$ is the price elasticity

of demand in absolute value. β_j, γtj and γjk $(j, k = 1...m)$ are fixed parameters to be estimated.

Assume that the industry faces an output demand function which takes the logarithmic form:

$$\ln Q = \delta_0 - \eta \ln(P/d) + \sum_{l=1}^{r} \delta_l \ln Z_l, \qquad [2]$$

where d is a price deflator, Z_l denotes exogenous demand shifters, and δ_0, δ_l and η are fixed parameters.

Market equilibrium in a particular industry is reached when P and Q fulfill equations [1] and [2] simultaneously. Consequently, the total elasticity of price (with respect to the Herfindahl index ($\varepsilon_{P,H}$) can be expressed as

$$\varepsilon_{P,H} = \lambda[\varepsilon_{L,H} + \varepsilon_{MC,H}], \qquad [3]$$

which is the sum of the Lerner index elasticity $\varepsilon_{L,H} (= [1-\alpha]PH/MC\eta)$ and the marginal cost elasticity $\varepsilon_{MC,H}(= 2QH\sum_{j}^{m} \beta_j w_{j_1}/MC)$ multiplied by an equilibrium adjustment factor $\lambda = (1+\eta\varepsilon_{MC,H}]^{-1})$.[1] While the Lerner index elasticity is always non-negative, the marginal cost elasticity is positive only if there are diseconomies of size. Moreover, if there are

economies of size, the adjustment factor is greater than 1 and industry output tends to expand with further concentration.

Whether a rise in concentration enhances or impairs welfare depends on market power and cost efficiency effects. Three relevant scenarios are: (1) price decrease with cost efficiency gain; (2) price increase with cost efficiency gain, and (3) price increase with cost efficiency loss.

A total welfare standard assumes that society as a whole can potentially benefit from rises in concentration as long as the sum of the changes in consumer surplus and producer surplus is positive, as shown in Figure 1 for a rise in *H* from *H0* to *H1*. The market power effect is represented by a downward shift in the perceived marginal revenue from *MR0* to *MR1*, resulting, by itself, in a higher price. On the other hand, the increase in efficiency effect is represented by a downward shift in the marginal cost curve from *MC0* to *MC1*. The change in consumer surplus is given by $T + G$, where *T* is a pure transfer and *G* is a net welfare gain. The change in producer surplus is given by *F+E-T*, where *F* is a change in net revenue from changes in output and *E* is the cost saving at the *ex-ante* level of output. The change in social welfare (*dSW*) is thus given by *G+F+E*. Scenarios 2 and 3 can be represented similarly with the corresponding changes in perceived marginal revenue and marginal cost curves.

3. Empirical Procedures

The econometric model of industry equilibrium consists of the supply relation in equation [1] and the output demand function in equation [2]. In addition, three input demand equations (capital, labor and materials) are estimated to help identify the parameters in the marginal cost

function, as in Lopez, Azzam, and Lirón-España (2002). Income and time are used as demand shifters. The five-equation system was estimated using a non-linear, three-stage least squares procedure. The sample consists of annual data for the period 1972-1992 for 232 U.S. manufacturing industries at the 4-digit SIC level. The model was estimated separately for each industry in the sample and based upon these estimates, we calculated equilibrium values of P and Q before and after a one-percent increase in the Herfindahl index and computed the ensuing welfare changes at mean values of 1972–1992.

The next task is to empirically test the relationship between the impact of increased concentration on social welfare, *dSW*, and *Z*, a vector of exogenous variables which denote market structure, economies of size, and the price elasticity of demand. Since some of the same variables may influence more than one of these elements, we estimate the reduced form equation of the net impacts of *Z* on social welfare via regression analysis. We begin by identifying the key elements to be included as explanatory variables in Z.

The first element is the level of concentration (*H*) which is the focus of this article. Ever since the seminal paper by Cowling and Waterson (1976) there has been a well-established positive relation between industrial concentration and market power that yields higher prices under the assumption of constant marginal cost. However, increased concentration also affects social welfare through its impact on costs, reducing them when the industry faces economies of size and increasing them when the industry faces diseconomies of size. The interrelation of these elements renders unpredictable the *a priori* outcome of an increase in concentration on social welfare.

The 1992 merger guidelines of the U.S. Federal Trade Commission (FTC) imply that the initial level of concentration could have a crucial impact on the balance of cost and market power effects. Accordingly, we expect further concentration from already high initial levels to have a negative impact on social welfare, while increased concentration beginning at lower levels is more likely to be beneficial. Thus, the Herfindahl index, H, is included as a regressor in the determinants of dSW in interaction with three dummy variables which replicate the FTC guidelines for low levels of concentration (Dlo for $H<0.1$), medium levels (Dme for $0.1<H<0.18$), and high levels of concentration (Dhi for $H>0.18$).

The next element is the role of economies of size. To capture their impact, a dummy variable (Des) that takes the value of 1 for those industries with economies of size is included in Z. This variable is expected to have a positive effect on dSW as we anticipate concentration to foster cost efficiency in industries with economies of size. However, as shown by Harris (1988), economies of size can also act as entry barriers, thus amplifying the market power effects that could reduce welfare.

Another element involves the determinants of the price elasticity of demand. An increase in the level of concentration increases market power, yielding higher prices and lower output which leads to welfare transfers from consumers to producers and consumption-related deadweight losses. At the same time, this also leads to higher producer surpluses. The lower the price elasticity of demand, however, the smaller the consumption-related deadweight losses and the more likely that further concentration will result in a net welfare gain. Therefore, we expect the social welfare effect of increased concentration to be positive the more price inelastic the demand function is.

The work of Pagoulatos and Sorensen (1986) indicates that industry concentration, the stage of production (consumer vs. industrial outlets), and the extent of new product introduction are key determinants of the variation of the own-price elasticity of demand across industries. Since concentration was already accounted for, an explanatory variable is added to the model: the percentage of products shipped to consumer outlets (*CONS)*. Due to lack of data, the extent of new-product introduction is not included. Since consumer goods tend to have a lower price elasticity of demand, we expect *CONS* to have a positive impact on *dSW*.

Another element involves the role of trade in mitigating or enhancing market power and cost effects underlying welfare changes from concentration. As the works of Stahlhammer (1991) and Lopez and Lopez (2003) show, imports have a disciplining effect on domestic industries. One can thus expect the market power effect of concentration to be mitigated in industries facing import competition. For this reason import intensity (*IMP,* the ratio of imports to total sales) is expected to be positively related to *dSW.*

Exporting offers firms a means of expanding the available market. Although exports are likely to have little impact on domestic market power (Pugel, 1980; Marvel, 1980), they can importantly affect the scale of operation, which could have an important impact on efficiency. Consistent with this argument are the conclusions of Lopez and Lopez (2003) who found that export intensity has a negative effect on the domestic Lerner index, possibly due to greater efficiency in capacity utilization that enhances cost efficiency rather than lower domestic market power per se. Since this would imply a positive effect of export intensity on domestic welfare changes, export intensity (the f.o.b. value of exports over domestic sales) is expected to have a positive effect on *dSW.*

Likewise, the size of the market matters. Previous work has found that in general, the larger the industry, the lower the markups (i.e. market power effect), but the higher the propensity to exploit economies of scale and to export (Holmes and Stevens, 2005; Melitz and Ottaviano, 2005; Weder, 2003). Thus, we expect a positive relationship between the domestic value of sales (*VS*) and *dSW*.

In sum, *Z= (H, Dlo, Dme, Dhi, Des, CONS, IMP, EXP, VS)* is the vector of exogenous variables to be used in assessing the factors shaping the question whether or not further concentration is beneficial in U.S. manufacturing industries. Using a linear function of this relationship, the following regression equation is to be estimated across industries:

$$
\begin{aligned}
dSW_i = {} & \varphi_0 + H_i(\varphi_1 Dlo_i + \varphi_2 Dme_i + \varphi_3 Dhi_i) + \varphi_4\,Des_i \\
& + \varphi_5\,CONS_i + \varphi_6 IMP_i + \varphi_7 EXP_i + \varphi_8 VS_i + v_i
\end{aligned}
\tag{4}
$$

where *v* is a random error, the φ's are parameters to be estimated, and dSW_i is the social welfare change derived from a one-percent increase in concentration in industry i as a percentage of sales. Other variables are as defined above. To gain additional insight, two additional regressions are performed on the components of *dSW* using the same explanatory variables: one for changes in consumer surplus as a percentage of sales (*dCS*) and another one for the changes in producer surplus as a percentage of sales (*dPS*). The equations are estimated correcting for dependent-variable heteroskedasticity. All estimations are conducted with Shazam. The results are presented in the following section.

4. Empirical Results

Table 1 presents a summary of the results obtained from the estimations of market equilibrium for each industry. Detailed results for each industry along with information on how the data series were constructed are available from the authors upon request. The Lerner Index of U.S. manufacturing industries obtained an average value of 0.291, with a standard deviation of 0.10, which indicates that the exertion of oligopolistic power is an extended practice throughout the industries in the sample. In terms of economies of size, 78% of the industries have cost elasticities less than one, indicating a widespread prevalence of economies of size that would translate into lower unit cost with higher concentration. The average value of the estimated own price elasticities is approximately -0.64, and almost 82 percent of the industries in the sample are price-inelastic.

Table 2 indicates that although a one-percent rise in concentration in all industries would increase aggregate welfare in nearly 70% of the industries, consumers would lose in 64% of the cases due to higher output prices. On the other hand, producer surplus would increase in 82% of the industries, mainly due to transfers from consumers caused by price increases (69%) while cost savings account for the remaining 31% of producer gains.

Table 3 presents the estimates of the determinants of welfare changes from increased concentration. These results suggest that whether or not this process is beneficial depends strongly on the initial level of concentration. More specifically, greater concentration is beneficial for industries with initially low or moderate values of the Herfindahl index ($H<0.18$), possibly due to cost savings and improved allocative efficiencies in industries with weak or non-existing market power effects. However, further concentration in already highly

concentrated industries (*H>0.18*) leads to aggregate welfare losses, possibly due to allocative efficiency losses from enhanced market power effects that offset any welfare gains from cost efficiency. These results are consistent with the simulation results of Dickson and Yu (1989) that state that social welfare gains tend to be smaller the higher the degree of market power.

Table 3 also shows that, regardless of the level of concentration, when industries with economies of size concentrate, there are social welfare gains, in accordance to the simulations of Dickson and Yu (1989). The results for CONS also confirm our initial expectation that welfare gains tend to occur in industries with more inelastic demand functions since inelastic demands generate smaller consumer deadweight losses. Table 3 moreover reveals that increases in concentration also tend to be beneficial in industries with high export intensity, which lends support to the hypothesis that further concentration enhances cost-efficiency in export-oriented industries. However, the coefficient of the variable import intensity is not significantly different from zero, which weakens support for the hypothesis that imports discipline prices to the benefit of consumers in the face of further concentration. Finally, the coefficient of value of shipments indicates that concentration is likely to have a beneficial impact in larger industries rather than smaller ones, in consistency with previous findings that show that larger industries tend to charge smaller unit price-cost margins and that they are better able to exploit economics of size.

Finally, the results in Table 3 show the impact of the explanatory variables on the changes in consumer and producer surpluses. It is interesting to point out that industrial concentration tends to be beneficial to both consumers and producers at low levels of concentration. For medium levels, further concentration harms consumers but benefits producers in a way that producers gain more than they offset consumer losses, which results

in a positive impact on social welfare. For high levels of concentration, however, consumer losses more than offset any producer gains resulting in a social welfare loss.

The coefficients for the economies of size dummy and the percentage of consumer shipments are both positive for changes in consumer surplus and negative for changes in producer surplus. Given that economies of size implies output expansion with concentration, any expansion in output that derives from concentration will cause prices and revenues (or consumer expenditures) to drop, benefiting consumers but hurting industries. Most industries in the sample fall in this case (Table 2). However, the final effect on producer surplus will also be mitigated by any cost savings and other explanatory variables.

It is also interesting to note that import intensity has a beneficial impact on consumer welfare and a detrimental one on producer welfare as industries concentrate and that producer losses practically cancel any consumer gains, leading to a neutral impact of concentration on social welfare changes through import intensity. Export intensity has the opposite effect on welfare changes from concentration: it hurts consumers as industries concentrate since products are removed from domestic markets, but it is beneficial to producers since they can better exploit economies of size. Finally, the size of the market, as measured by domestic sales, follows a similar pattern as that of exports.

5. Conclusions

When is concentration beneficial? Our results, based on a full model of industry equilibrium for a sample of 232 U.S. manufacturing industries, show that a one-percent across-the-board increase in the Herfindahl index would lead to welfare gains in 70% of the industries. More

specifically, social welfare gains occur mostly in industries with economies of size, inelastic demand, high export intensity, large size and low or moderate levels of initial concentration. Moreover, the impact of the explanatory variables on consumer surplus changes is generally in the opposite direction of the ensuing producer surplus changes from concentration, implying a trade-off, except for industries with low levels of concentration where further concentration benefits both consumers and producers.

The results of this study thus lend support to the U.S. Federal Trade Commission guidelines (1992) that closely scrutinize mergers of highly-concentrated industries but generally allow mergers in low-concentration industries. Moreover, the Commission's concern not only for the overall impact on net social welfare but also for the consequences of mergers for consumer welfare in particular is justified, because as this study shows, while concentration generally increases aggregate welfare, it also leads to higher prices as cost savings are usually not passed on to consumers.

Figure 1. Scenario 1: Output Price Decrease with Efficiency Gains
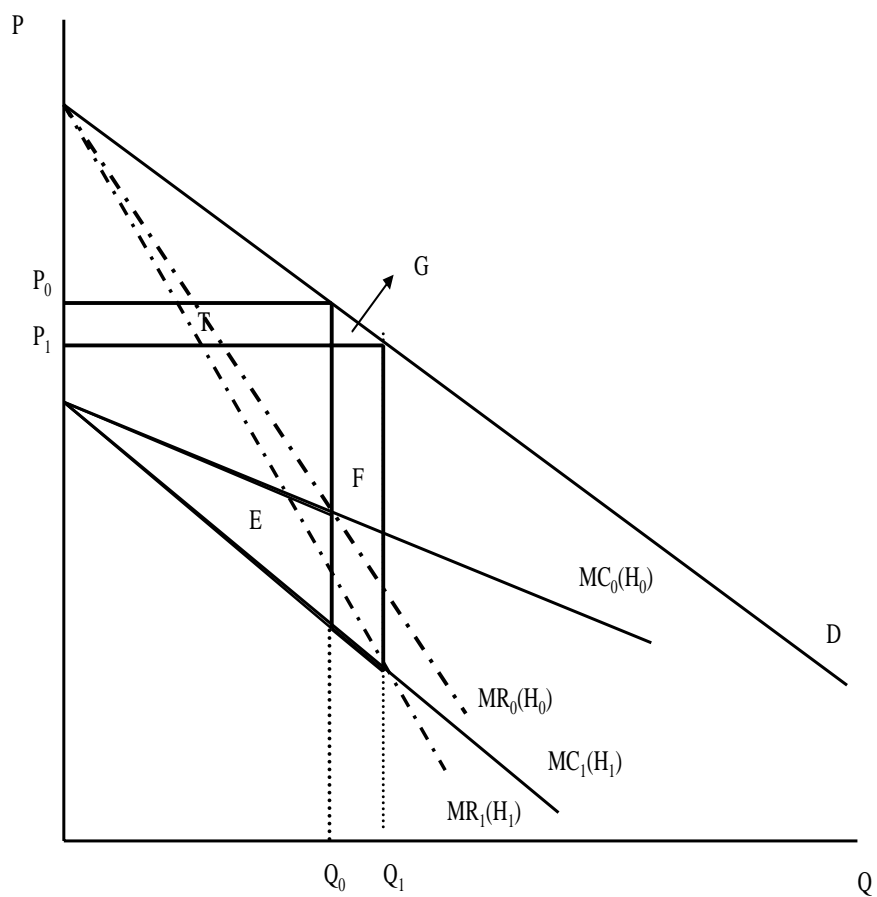
Endnotes

[1] Recall that quantity is a function of price (via the demand function) and therefore of *H* via the pricing equation. Thus, differentiating (1), one obtains

$$\frac{\partial P}{\partial H} = \frac{1}{1-L}\left[\frac{(1-\alpha)P}{\eta} + 2P\sum_{j=1}^{m} \beta_j W_j Q\right],$$

where L is the Lerner index. Multiplying both sides by *H/P* one obtains equation (3):

$$\varepsilon_{P,H} = \frac{MC}{MC + 2\beta H\eta Q}(\varepsilon_{LH} + \varepsilon_{C,H}),$$ where $\varepsilon_{L,H}$ and $\varepsilon_{C,H}$ are as defined in the text.

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***Table 1:* Summary of Estimates of Pricing Conduct and Economics of Size**

Number of Industries:		232
Lerner Index	Mean Value	0.291
	Standard Deviation	0.1
Economies of Size	Mean Value	0.94
	Positive	78%
	Negative	22%
Price Elasticity of Demand	Mean Value	-0.64
	Inelastic	81.6%
	Elastic	19.4%

Table 2: Welfare Effects of a 1% increase in the Herfindahl index

Changes in:	1992 $ Value (millions)	Positive impact		Negative impact	
		Number of industries	%	Number of industries	%
Aggregate Welfare	463.4	162	70%	70	30%
Consumer Surplus	-986.2	83	36%	149	64%
Producer Surplus	1499.9	191	82%	41	18%
Changes in welfare as % of Total Value of Shipments		Mean Value	St. Deviation	Lower Bound	Upper Bound
Change in Aggregate Welfare		0.05	0.10	-0.26	0.52
Change in Consumer Surplus		-0.05	0.24	-1.09	0.99
Change in Producer Surplus		0.10	0.18	-0.50	1.07

Table 3. Determinants of Welfare Changes from Concentration

	Aggregate welfare	Change in: Consumer Surplus	Producer Surplus
	(Standard Errors in parenthesis)		
Constant	-0.17*** (-0.01)	-0.22*** (-0.01)	0.12*** (0.008)
H x Low Concentration Dummy	1.06*** (0.16)	0.53*** (0.03)	0.18*** (0.03)
H x Medium Concentration Dummy	0.66*** (0.08)	-0.44*** (0.03)	0.97*** (0.11)
H x High Concentration Dummy	-0.15*** (-0.03)	-0.62*** (-0.12)	0.60*** (0.16)
Economies of Size Dummy	0.20*** (0.009)	0.18*** (0.006)	-0.04*** (0.006)
Consumer Shipments	0.0003*** (0.0001)	0.001*** (0.00006)	-0.0011*** (0.00007)
Import Intensity	0.00005 (0.0001)	0.0002*** (0.00004)	-0.0002*** (0.00002)
Export Intensity	0.0006* (0.0003)	-0.0009*** (0.00009)	0.001*** (0.0002)
Domestic Sales	0.0002*** (0.00003)	-0.0003*** (0.00002)	0.0004*** (0.00004)

Notes: The levels of statistical significance 10%, 5% and 1% are represented by *, **, and ***, respectively. The regressions were corrected for heteroskedasticity.

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