

IS PRICING ABOVE MARGINAL COST AN INDICATION OF MARKET POWER IN THE U.S. MEATPACKING INDUSTRY?

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Abstract: There have been concerns about the increasing concentration in the meat packing industry. But this increased concentration may be due to various types of cost economies. In this paper we prove the existence of scale economies that might justify the increased consolidation in the industry.

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1.1 Statement of the Problem

Many times we have heard the expression “extraction of market power” or “oligopolistic conditions” for a specific industry. This means that firms in that market price above marginal cost of production. Figure 1 below shows what is happening in the specific industry.

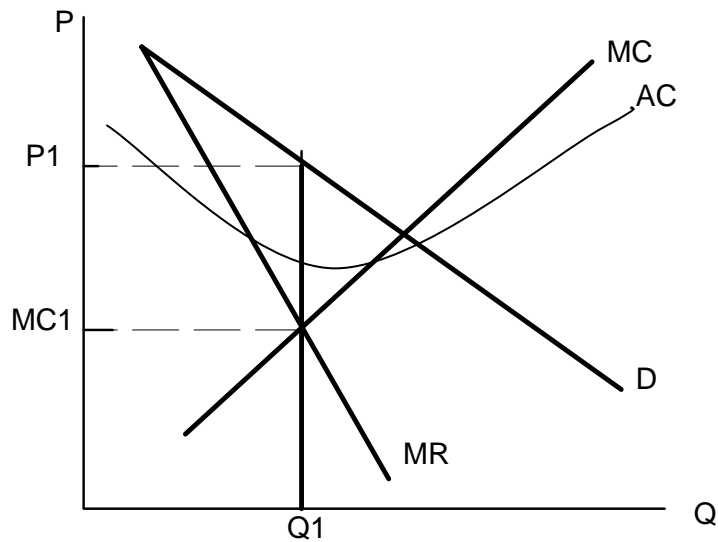


Figure 1

But is it really pricing above marginal cost an indication of exercising market power or is it the result of cost economies under which firms operate

in this industry? In this case Figure 2 represents what is happening for a representative firm in the industry.

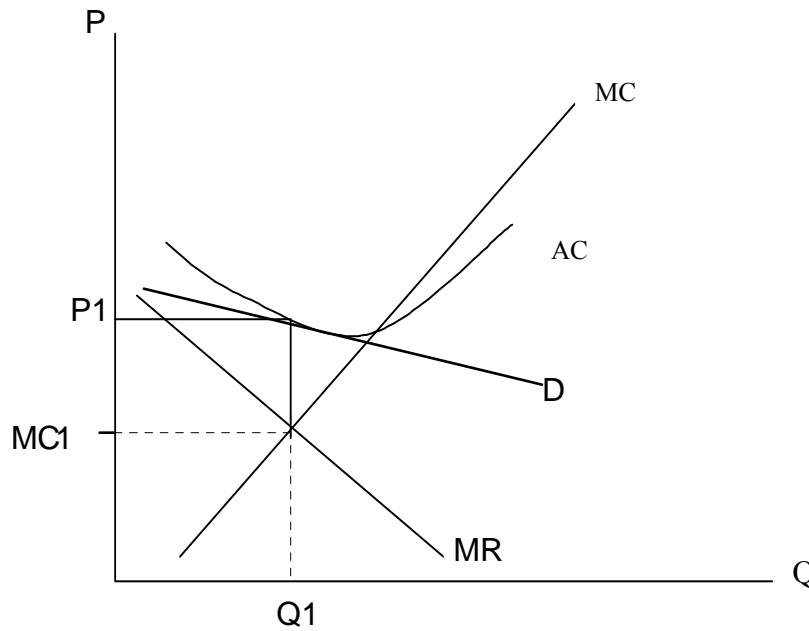


Figure 2

As we can see from figure 2, the price in this industry is above marginal cost, but there is no exertion of market power. The industry in order to avoid losses, prices its product above marginal cost where price equals average cost and consequently economic profits equal zero.

Thus, before we make rush judgments about the degree of competitiveness of an industry as concentration increases, we should take into account any cost economies that might exist. By cost economies we mean

short-run (utilization), long-run (scale), scope (output jointness) and multi-plant (information and risk-sharing) may provide incentives for expanding output, size, diversification, and plant numbers.

In this paper we are going to find out what is really happening in the U.S. meatpacking industry. Is it really the case that firms exercise market power in this market, or the situation described in figure 2 characterizes the specific industry?

1.2 Literature Review

Paul Cathy Morrison in her paper: "Market and Cost Structure in the U.S. Beef Packing Industry: A Plant Level Analysis." *American Journal of Agricultural Economics* 83(1) (February 2001), pp.64-76, comments that increasing size of plants and firms in the beef-packing industry could also be indicative of the efficiency potential from scale, scope, multi-plant, and other types of cost economies, which could allow larger and more diverse or specialized plants or firms to increase their cost effectiveness. Modeling and measuring the market power and technological structure in this industry to explore these questions involves appropriate representation of both the oligopsony/poly nature of the industry, and the production/cost structure. Characterization of market power depends on the cost structure, because it

involves comparing the average prices of an output or input to its associated marginal valuation – the marginal shadow value for the input, or the marginal cost for the output. Careful representation of costs, with recognition of scale, size, utilization, and scope economies, is therefore important to the construction of the market power. Her results indicated little if any existence of market power in the beef-packing industry, and significant cost economies in this industry.

Paul Cathy Morrison in her paper: “Cost Economies and Market power: The case of the U.S. Meat Packing Industry.” The review of Economics and statistics 83(3) (August 2001), pp.531-540, by utilizing a dynamic model based on a restricted Generalized -Leontief cost function finds out significant but declining market power and cost economies in the U.S. meat packing industry. Analysis of the cost structure, suggests utilization issues and long-run scale economies being the main forces driving expansion in the scale of production.

This paper differs from the above mentioned papers in the sense that we have no input fixities. We test our model within a long-run framework, where everything is flexible.

Finally this paper is related to the master’s thesis of D. Panagiotou: “Cointegration, Error Correction and the Measurement of Oligopsony

Conduct in the U.S. Cattle Market”, 2002, University of Nebraska-Lincoln, because it moves downstream in the marketing channel. That paper used an error correction model to find out if beef packers (which can be considered a category of meatpackers) exert oligopsony power when they purchase their primary input: cattle. The assumption there was that the packers are price takers when they sell their product. The results indicated no market power in the short-run as well as in the long-run. In this paper we assume that packers are price takers when they purchase cattle, but they might exert market power when they sell their output.

2. Theoretical framework

We make use of the framework that E. Appelbaum uses in his paper: “The Estimation of the Degree of Oligopoly Power.” (*Journal of Econometrics* 9(1979), pp.287-299). We consider a possible non-competitive industry, in which j firms produce a homogeneous (in the eyes of the consumer) output Q (meat), with each firm producing q_j . Each firm uses m inputs X_1, \dots, X_m , in order to produce the desirable output.

Let the inverse market demand curve facing the industry be given by $P = P(Q)$. Then the Profit function for each firm can be written as:

$$\Pi_j = P(Q) q_j - C(q_j)$$

From the first order conditions we get:

$$\frac{\partial \Pi_j}{\partial q_j} = P(Q) + q_j \frac{\partial P}{\partial Q} \frac{\partial Q}{\partial q_j} - \frac{\partial C(q_j)}{\partial q_j} = 0$$

$$P(Q) + q_j \frac{\partial P}{\partial Q} \frac{\partial Q}{\partial q_j} \frac{Q}{P} - MC(q_j) = 0 \quad (1)$$

In equation (1), the second term of the summation includes the inverse of the demand elasticity of the industry,

$$\frac{\partial P}{\partial Q} \frac{Q}{P} = \frac{1}{\eta}$$

and the conjecture for each firm:

$$\theta_j = \frac{\partial Q}{\partial q_j}$$

Thus, equation (1) can be written:

$$P(Q) + P(Q) \frac{\theta_j}{\eta} - MC(q_j) = 0$$

If we aggregate across the firms of the industry, and at the same time multiply each term by $\frac{q_j}{Q}$ we are going to get:

$$\sum_{j=1}^k P(Q) \frac{q_j}{Q} + \sum_{j=1}^k \frac{q_j}{Q} \frac{\theta_j}{\eta} P - \sum_{j=1}^k MC(q_j) \frac{q_j}{Q} = 0 \quad (2)$$

In equation (2) the relation $\sum_{j=1}^k \frac{q_j}{Q} \theta_j$ represents the weighted average of the conjecture for each firm, and can be replaced by θ ; where θ is an average conjecture for the industry. Thus, equation (2) transforms to:

$$P \left(1 - \frac{\theta}{\eta} \right) - \sum_{j=1}^k MC(q_j) \frac{q_j}{Q} = 0$$

where with the ratio $\frac{\theta}{\eta} = \varphi$ we represent the market power that firms exercise in this industry:

$$P(1 - \varphi) - \sum_{j=1}^k MC(q_j) \frac{q_j}{Q} = 0 \quad (3)$$

Under the assumption that firms have identical marginal costs (access to same technology), we can write equation (3) as:

$$P(1 - \varphi) - MC(q) = 0 \quad (3a)$$

Equation (3a) is the first equation that we should keep in mind because is going to be relevant in the econometric analysis.

Now we are going to look at the cost structure of the industry, in order to use it for the derivation and estimation of the marginal cost, the average cost. We are doing this because it is going to be very helpful in our analysis for the cost economies that might exist in this industry.

If we let the cost function to be represented by a Generalized-Leontief function, then the total cost for each firm can be written as:

$$C(q_j) = h(q_j) \sum_{i=1}^n \sum_{m=1}^n d_{im} (w_i w_m)^{0.5} + g(q_j) \sum_{i=1}^n b_i w_i; \forall i, j = 1, \dots, n$$

and the marginal cost can be derived as:

$$\frac{\partial C(q_j)}{\partial q_j} = h_q(q_j) \sum_{i=1}^n \sum_{m=1}^n d_{im} (w_i w_m)^{0.5} + g_q(q_j) \sum_{i=1}^n b_i w_i; \forall i, j = 1, \dots, n$$

In this paper we are going to use the following specifications:

$$h(q_j) = q_j \text{ and } g(q_j) = q_j^2.$$

These are specifications that Olson and Shien (1989) and Baffles and Vasavada (1989) first introduced (see references for their papers):

Thus, the marginal cost takes the form:

$$\frac{\partial C(q_j)}{\partial q_j} = \sum_{i=1}^n \sum_{m=1}^n d_{im} (w_i w_m)^{0.5} + 2q_j \sum_{i=1}^n b_i w_i \quad (4)$$

If we additionally assume that the firms use m inputs, then for the Generalized- Leontief cost function, the optimal input demand functions are going to be given by:

$$X_i \equiv \frac{\partial C(q_j)}{\partial w_i} = q_j \sum_{m=1}^n d_{im} (w_m / w_i)^{0.5} + q_j^2 b_i$$

and dividing by q_j we get:

$$X_i / q_j \equiv \sum_{m=1}^n d_{im} (w_m / w_i)^{0.5} + q_j b_i \quad \forall i = 1, \dots, m \quad (5)$$

Combining equations (3) and (5) we are going to get a system of equations, with the help of which we can estimate the parameters of the cost function as well as the index of market power φ .

From our function specification for the cost we use in this paper we already derived the marginal cost in equation (4). The average cost for the Generalized- Leontief cost function we use in this paper is:

$$AC = \frac{C}{q} = \sum_{i=1}^n \sum_{m=1}^n d_{im} (w_i w_m)^{0.5} + q \sum_{i=1}^n b_i w_i \quad (6)$$

Dividing equation (4) with equation (6) we get:

$$\frac{MC}{AC} = \left[\sum_{i=1}^n \sum_{m=1}^n d_{im} (w_i w_m)^{0.5} + 2q \sum_{i=1}^n b_i w_i \right] / \left[\sum_{i=1}^n \sum_{m=1}^n d_{im} (w_i w_m)^{0.5} + q \sum_{i=1}^n b_i w_i \right] \quad (7)$$

As we can observe in equation (7), if $\sum_{i=1}^n b_i w_i$ is negative, then MC is less than AC and we have cost economies, which in our case is going to be scale economies (size increase), since we examine the industry in a long-run framework. So in this case figure 2 is going to give us the best picture about what is happening in the industry.

If $\sum_{i=1}^n b_i w_i$ is positive, then MC is greater than AC then there is no indication about cost economies, and figure 1 is relevant in our analysis for this case.

If $\sum_{i=1}^n b_i w_i$ is not statistically different than zero, then MC is equal to AC and we have constant returns to scale, and firms are making zero economic profits.

If $\varphi = 0$ then price equals marginal cost from equation (3a), and in the long-run we are going to have an equilibrium where price equals marginal cost and both of them equal the long average cost, and that's the case where we have zero economic profits and exertion of market power in the specific industry.

3. Econometric application

3.1 Data

We use data from 1958 to 1996 for the U.S meatpacking industry, obtained from the National Bureau of Economic Research. The data include observations on the slaughtering of cattle, hogs, sheep, lambs, and calves for meat to be sold or to be used in canning, cooking, curing, and freezing, and in making sausage, lard, and other products.

We have four competitively priced inputs, labor (X_L), capital (X_K), materials (X_M), and energy (X_E) whose prices are W_L , W_K , W_M , W_E respectively and Q is the quantity produced and p is the price of the product. In the appendix there is a description of the data:

3.2 Empirical results

The Generalized-Leontief cost function in equation (4) takes the form:

$$C(q) = q \sum_{i=1}^4 \sum_{m=1}^4 d_{im} (w_i w_m)^{0.5} + q^2 \sum_{i=1}^4 b_i w_i,$$

and we are going to have four equations, one for each input, of the form:

$$X_i / q \equiv \sum_{m=1}^4 d_{im} (w_m / w_i)^{0.5} + q b_i$$

For empirical implementation the model has to be estimated within a stochastic framework. To do this, we assume that equations are stochastic due to errors in optimization.

Although the equation by equation OLS estimation might appear attractive, since the equations are linear in the parameters, these demand equations have cross-equation symmetry constraints, and the OLS method is not going to impose the symmetry condition. In our study we use the Zellner's seemingly unrelated estimator (ZEF) in order to obtain efficient parameter estimates.

We define the additive disturbance term in the i^{th} equation at the time t as $e_i(t)$, $t=1, \dots, T$. We also define the column vector of disturbances at the time t as e_t . We also assume that the vector of disturbances is jointly normally distributed with mean vector zero and non-singular covariance matrix Ω ,

$$\begin{aligned} E[e_j(s)e_j'(t)] &= \Omega & \text{if } t = s, \\ &= 0 & \text{if } t \neq s. \end{aligned}$$

Estimating the system of the four equations along with equation (3a), we get the following results:

Nonlinear SUR Parameter Estimates

Approx Parameter	Estimate	Approx Std Err	t Value	Pr > t
ϕ	0.156827	0.0270	5.81	<.0001
DKK	-0.05816	0.0204	-2.85	0.0074
DKL	0.003408	0.000711	4.79	<.0001
DKE	-0.00374	0.00546	-0.69	0.4977
DKM	-0.02564	0.0180	-1.42	0.1633
DLL	0.000468	0.000599	0.78	0.4402
DLE	0.000504	0.000268	1.88	0.0679
DLM	0.001068	0.00188	0.57	0.5734
DEE	-0.00128	0.00522	-0.25	0.8076
DEM	0.000948	0.00535	0.18	0.8603
DMM	1.073771	0.0387	27.71	<.0001
bk	1.738E-6	2.165E-7	8.02	<.0001
bL	-3.18E-9	8.383E-9	-0.38	0.7072
bM	-3.32E-6	5.965E-7	-5.57	<.0001
bE	1.666E-7	9.658E-8	1.73	0.0936

Covariances of Parameter Estimates

	F	DKK	DKL	DKE	DKM
F	0.0007285	0.0000344	-.0000010	0.0000051	0.0000064
DKK	0.0000344	0.0004162	0.0000018	-.0000108	-.0002771
DKL	-.0000010	0.0000018	0.0000005	0.0000013	-.0000086
DKE	0.0000051	-.0000108	0.0000013	0.0000299	-.0000259
DKM	0.0000064	-.0002771	-.0000086	-.0000259	0.0003242
DLL	-.0000078	-.0000007	0.0000000	-.0000000	0.0000000
DLE	0.0000001	0.0000003	0.0000000	0.0000001	-.0000006
DLM	-.0000197	-.0000043	-.0000003	-.0000018	0.0000083
DEE	-.0000038	0.0000174	-.0000001	-.0000085	-.0000050
DEM	-.0000034	-.0000043	-.0000011	-.0000185	0.0000275
DMM	0.0007129	0.0001874	0.0000135	0.0000554	-.0003628
bk	-.0000000	-.0000000	0.0000000	0.0000000	0.0000000
bL	0.0000000	0.0000000	-.0000000	0.0000000	-.0000000
bM	-.0000000	0.0000000	-.0000000	-.0000000	-.0000000
bE	0.0000000	-.0000000	-.0000000	-.0000000	0.0000000

	DLL	DLE	DLM	DEE	DEM
F	-7.81E-6	1.4294E-7	-.0000197	-.0000038	-.0000034
DKK	-7.325E-7	2.8444E-7	-.0000043	0.0000174	-.0000043
DKL	1.8818E-8	2.9803E-8	-.0000003	-.0000001	-.0000011
DKE	-3.859E-8	8.8369E-8	-.0000018	-.0000085	-.0000185
DKM	4.605E-10	-5.525E-7	0.0000083	-.0000050	0.0000275
DLL	3.5909E-7	-1.522E-9	0.0000004	0.0000002	-.0000000
DLE	-1.522E-9	7.1594E-8	-.0000001	-.0000002	-.0000010
DLM	3.5419E-7	-1.126E-7	0.0000035	0.0000008	0.0000026
DEE	2.2289E-7	-1.761E-7	0.0000008	0.0000273	-.0000017
DEM	-9.37E-9	-9.941E-7	0.0000026	-.0000017	0.0000286
DMM	-8.599E-6	3.139E-6	-.0000497	-.0000231	-.0000761
bk	1.575E-11	3.606E-13	-.0000000	-.0000000	0.0000000
bL	-4.76E-12	1.439E-13	-.0000000	-.0000000	-.0000000
bM	1.594E-10	-2.34E-11	0.0000000	0.0000000	0.0000000
bE	-3.51E-12	1.593E-11	-.0000000	-.0000000	-.0000000

	DMM	bk	bL	bM	bE
F	0.0007129	-9.62E-10	9.845E-11	-1.402E-8	2.413E-11
DKK	0.0001874	-2.841E-9	4.137E-12	2.4087E-9	-7.2E-11
DKL	0.0000135	6.329E-11	-2.06E-13	-4.76E-11	-4.08E-12
DKE	0.0000554	2.917E-11	1.028E-12	-6.45E-11	-6.43E-11
DKM	-.0003628	3.522E-10	-7.34E-13	-5.06E-10	1.261E-10
DLL	-.0000086	1.575E-11	-4.76E-12	1.594E-10	-3.51E-12
DLE	0.0000031	3.606E-13	1.439E-13	-2.34E-11	1.593E-11
DLM	-.0000497	-8.21E-12	-7.92E-12	3.93E-10	-2.22E-11
DEE	-.0000231	-6.46E-11	-5.22E-12	5.719E-10	-3.49E-10
DEM	-.0000761	4.735E-12	-1.48E-12	1.818E-10	-8.74E-11
DMM	0.0015013	1.2435E-9	1.486E-10	-1.752E-8	6.438E-10
bk	0.0000000	4.689E-14	-7.59E-17	-3.43E-14	5.899E-16
bL	0.0000000	-7.59E-17	7.027E-17	-2.29E-15	1.095E-16
bM	-.0000000	-3.43E-14	-2.29E-15	3.558E-13	-1.26E-14
bE	0.0000000	5.899E-16	1.095E-16	-1.26E-14	9.328E-15

As we can observe there is indication of market power, since φ equals to 0.1568, and is quite significant. But, as we stated in the theoretical

framework we have to check if $\sum_{i=1}^n b_i w_i$ is significantly less than zero:

$$\sum_{i=1}^n b_i w_i = b_K \bar{w}_K + b_L \bar{w}_L + b_m \bar{w}_M + b_E \bar{w}_E \quad (8)$$

where the prices of the factors of production are estimated at the means.

From our estimation of the sum of equation (8) we get:

$$\sum_{i=1}^n b_i w_i = b_K \bar{w}_K + b_L \bar{w}_L + b_m \bar{w}_M + b_E \bar{w}_E = \mathbf{-1.13E-06}$$

and the estimated variance of the sum is found by the multiplication of the matrices below:

$$\text{Var} \left(\sum_{i=1}^n b_i w_i \right) =$$

$$= [0.6577 \quad 22.5 \quad 0.7 \quad 0.64] \begin{bmatrix} 4.7E-14 & -7.6E-17 & -3.43E-14 & 5.9E-16 \\ -7.6E-17 & 7.03E-17 & -2.3E-15 & 1.1E-16 \\ -3.43E-14 & -2.3E-15 & 3.56E-13 & -1.3E-14 \\ 5.9E-16 & 1.1E-16 & -1.26E-14 & 9.33E-15 \end{bmatrix} \begin{bmatrix} 0.6577 \\ 22.5 \\ 0.7 \\ 0.64 \end{bmatrix} = \mathbf{1.19003E-13}$$

The table below summarizes the results:

Sum	-1.13E-06
Var	1.19003E-13
Se	3.44968E-07
t-stat	-3.28

Thus, as we can see the summation $\sum_{i=1}^n b_i w_i$ is negative, and significantly different than zero. So, in our case the ratio MC/AC is less than zero, indicating scale economies in the industry.

4. Conclusion

The purpose of this paper is to examine if in the U.S. meatpacking industry the indication of pricing above marginal cost is a sign of existence of market power or Figure 2 describes what is happening in the industry. By utilizing a Generalized-Leontief cost function, we found out that the estimated parameter φ for the market power is statistically significant, and the ratio of (MC/AC) is significantly less than one. Hence figure 2 describes what is happening in the specific industry. Thus, we have low Marginal Cost as compared to Average Cost, and even though the price mark up is significant, it is supported by scale economies which are just high enough to allow average costs to be covered. We use the world scale economies to describe the case of cost efficiencies (or economies) we have here, because our model examines the industry within a long-run framework.

The above analysis is relevant for antitrust authorities and policies that try to force downsizing in an industry like the one we analyzed in this paper. The results indicate that an increase in concentration in the industry might be welfare enhancing for consumers because it can lead to lower prices because of the economies of scale. Thus, in this case, increased concentration in an industry might be socially optimal.

Appendix:

1) Description of the Data

The SAS System

The MEANS Procedure

Variable	Label	N	Mean	Std Dev	Minimum
Q	Q	39	42580.34	5161.22	29654.34
piship	piship	39	0.7305897	0.2986963	0.3350000
wm	wm	39	0.6957436	0.2980598	0.3070000
wk	wk	39	0.6576923	0.3674194	0.2460000
we	we	39	0.6407179	0.4043910	0.2040000
wl	wl	39	22.5246080	6.0746394	13.3351186
XK	XK	39	356.9177167	72.3127443	243.1208054
XL	XL	39	250.4230769	34.5653802	197.6000000
XM	XM	39	38879.45	4241.61	29825.36
XE	XE	39	284.4098174	40.3584273	224.8826291

Variable	Label	Maximum
Q	Q	48917.45
piship	piship	1.1990000
wm	wm	1.1580000
wk	wk	1.2800000
we	we	1.1740000
wl	wl	29.0935484
XK	XK	500.8064516
XL	XL	312.7000000
XM	XM	46014.80
XE	XE	367.4757282

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