Survey of Empirical Studies of Market Power in Food Industries

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1. Introduction

Applying the approaches developed in the New Empirical Industrial Organization (NEIO) literature to estimate the degree of market power in agricultural and food markets has become increasingly important in analyzing competitive relationships between producers, processors and retailers. Usually empirical studies of market power are based on some maintained assumptions, which only rarely are subjected to statistical tests. Thus, there is rarely a justification for functional forms, for the choice of econometric methods for estimating model parameters, and even for assumptions concerning market structure (e.g. oligopoly versus monopoly) as reflected in the model equations.

2. Objectives

Our study has two objectives: First, to compare some of the recently published studies of market power on agricultural and food markets with respect to their choice of model structure, functional forms, estimation methods and results concerning coefficients of market power. Second, to check for the suitability of some of the usual assumptions in a market structure model of oligopsony power for the Ukrainian milk processing industry. The model is estimated in four distinct model specifications, using three different estimation methods. Comparison of the results gives some indication of the appropriateness of the different assumptions.

3. Overview of selected empirical studies of market power

Author(s)	Journal/Year	Country	DA[a)]	DF[b)]	Period	Industry/Market	Function forms for[c)]: P/C/R/PF	D	S	Ne[d)]	Method	Model[f)]	Market power
Lopez	JAE/1984	Canada	N	A	1965-79	Food process.	GLC	SL	-	6	FIML	θ	0.192
Schroeter	RES/1988	USA	N	A	1951-83	Beef &Cattle	GLC	DL	DL	4	FIML	θ/φ	0.0176
Azzam & Pagoulatos	JAE/1990	USA	N	A	1959-82	Meat Livestock	TLPF	-	-	5	I3SLS	θ φ	0.223 0.178
Schroeter & Azzam	AE/1990	USA	N	Q	1976-86	Beef Pork	GLC	-	-	4	I3SLS	θ/φ θ/φ	0.0475 0.0558
Buschena & Perloff	AJAE/1991	USA	N	A	1959-87	Coconut Oil	-	LIT	LIN	3	N3SLS	$\theta^{\dagger}$	0.578
Lopez & You	JDE/1993	Haiti	N	A	1954-84	Coffee export	-	SL	DL	2	FIML	φ	0.027
Deodhar & Sheldon	JFDR/1995	Germany	N	A	1966-93	Banana imports	-	LIT	-	2	2SLS	$\theta^{\dagger}$	0.29
Liu, Sun & Kaiser	JARE/1995	USA	N	Q	1975-92	Manuf. proces. Fluid processor	-	DL	-	2	SUR	θ θ	0.1 0.176
Bhuyan & Lopez	JAE/1998	USA	N	A	1972-87	Cereal Break Pet Food Ind.	TLC	DL	-	6	N3SLS	θ θ	0.55 0.014
Hyde & Perloff	AE/1998	Australia	N	Q	1970-88	Meat retailing	-	AIDS	-	5	N3SLS	$\theta^{\dagger}$	≈0
Millán	ERAE/1999	Spain	N	A	1978-92	Oils and fats	TLC	DL	-	5	ILS	θ	0.68
Morrison Paul	AJAE/2001	USA	F	M	1958-91	Beef packing	GLC	-	-	6	N3SLS	θ/φ	-0.0083
Chidmi, Lopez & Cotterill	A/2005	USA	R	W	1996-00	Retail milk	-	DL	-	2	SUR	θ	0.1663
Hockmann & Vöneki	AO/2009	Hungary	N	M	1998-06	Raw milk	TLR	-	TL	3	N3SLS	φ	0.05
Mérel	ERAE/2009	France	N	Q	1985-05	Comté cheese	-	LIT DL	-	2	GMM	θ θ	0.001 0.002
Zheng & Vukina	AJAE/2009	USA	N	D	2001-07	Hogs & Pork	-	DL	DL	1	GMM	$\theta/\varphi^{\dagger}$	0.3198
Bakucs, Fertö, Hockmann & Perekhozhuk	EEE/2010	Hungary	N	M	1995-04	Hogs	TLPF	-	TL	3	N3SLS	φ	0.0284

Notes: Journal: A=Agribusiness; AE=Applied Economics; AJAE=American Journal of Agricultural Economics; EEE=Eastern European Economics; ERAE=European Review of Agricultural Economics; JAE=Journal of Agricultural Economics; JARE=Journal of Agricultural and Resource Economics; JDE=Journal of Development Economics; JFDR=Journal of Food Distribution Research; OA=Outlook on Agriculture; RES=The Review of Economics and Statistics; [a)]Data Aggregation (DA): F = Firm, N = National, R = Regional. [b)]Data Frequency (DF): A = Annual, Q = Quarterly, M = Monthly, W=Weekly and D = Daily. [c)] Functional forms for Profit (P), Cost (C), Revenue (R), Production (PF), Demand (D) and Supply (S) functions. [d)]NE=number of equations. [f)]The degree of market power is represented by testing the parameter of conjectural elasticity or by the conjectural variation ([†]) in the output market (θ= oligopoly) and/or input market (φ= oligopsony), as well as by the joint estimation of market power (θ/φ).

4. Methodology: A model for the milk processing industry

(1) Production function of the milk processing industry: $Y=f(M, L, K, E, T)$

(2) Supply function for raw milk: $M=g(W_M, W_D, W_B, W_F, C, T)$

(3) First order condition for the optimal raw milk demand: $W_M = P\frac{\partial Y}{\partial M}\Big/\left(1+\frac{\varphi}{\varepsilon}\right)$

5. Data description

Symbol	Description of variables	Mean	Min	Max
Y	Aggregate output of the milk processing industry, in milk equivalent (tons/month)	354695.2	229568.3	602323.1
M	Quantity of milk delivered to the milk processing industry (metric tons)	298663.8	167459.2	530249.2
L	Number of workers	78685.6	70300.4	99471.9
K	Capital (thousand UAH/month)*	760.3	491.2	2223.4
E	Energy (thousand kWh/month)	1929405.7	1240678.6	3235724.5
P	Output price index of the milk processing industry**	182.1	95.5	264.1
T	Time trend	48.5	1	96
W_M	Price for milk delivered to the milk processing industry (UAH/metric ton)*	452.4	159.6	803.6
W_D	Price for milk sold by 'direct marketing' (UAH/metric ton)*	439.8	145.9	723
W_B	Beef cattle price index**	241.5	100.6	402.5
W_F	Mixed forage price index**	263.2	100.9	427.3
C	Number of milking cows (thousand heads)	5717.9	4483.7	7667.9

Note: *UAH = Ukrainian currency Hryvnia. ** January 1996 = 100. Source: State Committee of Statistics of Ukraine.

6. Empirical findings

Coefficient	General identification approach (Eq. 2 & 3)						Theoretic-production approach (Eq.1, 2 & 3)					
	Model 1 TTLS & FOC			Model 2 TLS & FOC			Model 3 TTLS, TLPF & FOC			Model 4 TLS, TLPF & FOC		
	N3SLS	*IT3SLS*	*GMM*	*N3SLS*	*IT3SLS*	*GMM*	*N3SLS*	*IT3SLS*	*GMM*	*N3SLS*	*IT3SLS*	*GMM*
ε	0.504**	0.321**	0.530***	0.360***	0.373***	0.317***	0.409***	0.644***	0.293***	0.351***	0.257***	0.374***
φ	0.033	0.070*	0.010	0.014	0.015	0.012**	0.148**	0.298***	0.086***	0.011	0.001*	0.008
$\boldsymbol{L}$	0.065	0.218***	0.018	0.039	0.039	0.037***	0.361***	0.464***	0.293***	0.031	0.038**	0.022**
$\overline{R^2}$: ln M	0.897	0.884	0.895	0.917	0.916	0.915	0.891	0.746	0.893	0.912	0.871	0.897
ln Y							0.975	0.978	0.972	0.941	0.923	0.944
w_M	0.978	0.981	0.978	0.971	0.972	0.974	0.981	0.972	0.982	0.975	0.970	0.978
DW : ln M	1.233	1.073	1.203	1.520	1.516	1.463	1.157	0.536	1.207	1.465	1.126	1.438
ln Y							1.695	1.556	1.877	1.695	1.251	1.898
w_M	0.771	0.637	0.820	1.268	1.247	1.161	0.518	0.375	0.582	1.153	1.157	0.940
Obj. Value	1.733	1.742	0.375	1.339	1.349	0.388	2.525	2.595	0.474	2.118	2.111	0.418

Note: TTLS = Truncated translog supply, FOC = First Order Condition, TLS = Translog supply, TLPF = translog production function. N3SLS = Nonlinear Three-Stage Least Squares, I3SLS = Iterative Three-Stage Least Squares and GMM = Generalized Method of Moments. φ = the conjectural elasticity in the input market (oligopsony power), $\boldsymbol{L}$= the Lerner-Index. Subscripts range ***, **,* denotes significance at the 1%, 5%, and 10% level, respectively.

7. Conclusions

1) To measure the degree of market power, the majority of empirical studies use the theoretic-production approach (including the production or cost function) pioneered by Appelbaum (1982) and the general identification approach (based only on supply and demand relationships) developed by Bresnahan (1982).

2) For the estimation of cost, production, profit, or revenue functions only two functional forms were used in the literature surveyed, i.e. the transcendental logarithmic (translog) and the generalized Leontief functions. Although for the estimation of supply and demand functions, more than nine different functional forms can be found in the literature, the most frequently used functional forms are the double logarithmic and linear functions.

3) The N3SLS is the most frequently used estimator. The FIML and the IT3LSL are rarely utilized. However, there are no empirical studies on market power which use several estimation methods for comparison.

4) Using time-series data of the Ukrainian milk processing industry we use the production approach to test for the exercise of oligopsony power and to check for the appropriateness of structural assumptions, functional forms and estimation methods.

5) The results of our analysis show that, irrespective of the estimation method, the estimated parameters of oligopsony power (φ and $\boldsymbol{L}$) are significantly different from zero in Model 3 based on a system of three simultaneous equations (supply function, first order condition, and production function), but, depending on the estimation method, the parameter varies in size. On the other hand, estimation of the two-equation market structure models (Models 1 and 2) did not produce any evidence suggesting the exercise of market power by the milk processing industry. A comparison of Models 3 and 4 shows that estimation results are sensitive to the choice of the functional form for the supply function.

6) In conclusion, our survey of empirical studies shows that market structure models designed to test for market power vary considerable with respect to model structure, functional forms and estimation methods. Our own study suggests that estimated parameters of market power are particularly sensitive to choice of model structure and choice of functional form for the supply function. Moreover, the size of the parameters can vary substantially with the choice of the estimation method. Obviously, more research is needed for a better understanding of possible fallacies in NEIO-approaches for the analysis of market power.

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