Market Power in Direct Marketing of Fresh Produce: Community Supported Agriculture Farms

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Abstract

CSA farms establish a loyal customer base and, potentially, market power. Two new empirical industrial organization (NEIO) approaches and survey data from Northeast CSA farms are used to determine the presence and extent of market power. Results suggest CSA farms exert only about 3.5 percent of their potential monopoly power.

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Introduction

Community Supported Agriculture (CSA) is a marketing approach that connects consumers with farmers through direct purchase of shares of farm product. To become a shareholder, consumers agree to purchase a share of the farm's produce prior to the season, usually during the winter or early spring. The farmer then produces the crop and provides a weekly bundle of produce to the consumers throughout the growing season, typically from May through October. Some CSA farms provide winter shares as well. Having sold shares prior to the season, the farmer can then focus on production throughout the growing season. The CSA principle is simple: by purchasing shares prior to the season, the consumers share the risks of farming as well as the rewards (Stern, 1992; Karr, 1993).

The CSA concept brings together consumers and farmers with similar ideologies. CSA shareholders are typically consumers who are interested in where their food comes from and how it is produced (Cooley and Lass, 1998). By focusing on product and market diversification, reducing chemical inputs, introducing new food products and applying innovative marketing techniques, farmers are trying to maintain their economic viability in response to various detrimental effects such as rising land prices, competing land uses and low prices for their product. Viability of the farm may still be a problem for those farmers practicing organic agricultural production. The costs of production may not be covered due to fluctuating market prices and organic agriculture is perceived to be more susceptible to pests due to inability to intervene with fertilizer and biocide applications. Perception of this higher degree of risk has led some producers to seek a new social and economic basis for agriculture, namely CSA (Lamb 1996; Padel and Lampkin 1994). Through CSA, the shareholders develop a stronger appreciation for

farms and for the linkages between farms and the environment (Van En, 1988; Lamb, 1996). The CSA operator, writes Karr (1993), has a desire for the farm to be self-sufficient, vital, and a healthy part of the community. If there is a demand for fresh, locally grown, organic food in the community, CSA operators can encourage reliance on locally produced food rather than a dependence upon imported produce.

If CSA farms successfully capture a loyal customer base, then they may behave in an imperfectly competitive manner by exercising, at least to a degree, monopoly power. In this study, we investigate the presence and extent of market power exercised by CSA farms in their supply decisions. Two new empirical industrial organization (NEIO) methods are applied: estimation of a linear reduced-form equation to evaluate the presence of market power, and nonlinear estimation of a structural model to measure the extent of departure from competition through estimation of a market power parameter.

Conceptual Model

Assume that a typical CSA farm maximizes profit and has the ability to exercise monopoly power in selling shares. CSA farms can be considered monopolies because of their geographic isolation from other farms (few farms in each region have such an operation). Moreover, the nature of their products, i.e., fresh organic vegetables produced from a known source, is such that consumer loyalty and "brand" recognition make consumers captive to a given farm. In fact, from the consumer's perspective, purchasing a share buys more than fresh produce during the season, it also makes a statement about supporting local agriculture and sharing the risks and rewards of farming. In addition, many CSA farms have additional events for their shareholders during the season and

many offer low-income programs as well. As such, produce purchased at the grocery store is a poor substitute for the produce provided in a CSA share.

Assume that a CSA farm seeks to solve the following maximization problem:

$$\max_{q} p = p(q, Y)\, q - C(r, q, E);$$

where $p(q,Y)$ is the inverse demand facing the farm. It is a function of q, the number of shares sold, q, and Y, a vector of exogenous demand shifting variables. $C(r,q,E)$ is the total cost of producing the agricultural goods sold, where r is a vector of input prices and E is a vector of exogenous factors that affect farm production. Shares are sold during the winter and each share allows a consumer to pick-up one bag of fresh produce each week through the summer. Having sold shares prior to planting, the farmer can plan production accordingly.

Obtaining first-order conditions for the profit maximization problem and solving for the share price allows determination of the supply relation:

$$p = -\frac{\partial p(q, Y)}{\partial q}\, l\, q + \frac{\partial C(r, q, E)}{\partial q}; \tag{1}$$

where the parameter λ is an index of departure from perfect competition and varies between 0 (perfect competition) and 1 (monopoly). Although we assume each farm is in position to exercise monopoly power, we estimate λ to examine the extent to which farms exercise market power. If the farmer has altruistic feelings towards her shareholders, she may seek to forgo some or all of her monopoly rents in the interests of her shareholders.

The market power parameter is estimated by estimating simultaneously the supply relationship and the demand equation. There are two methods to identify the parameter λ: the first method is a production theoretic approach following the work of Appelbaum

(1982) where the demand equation and supply relation are estimated together with factor demand equations. The second method identifies the market power parameter through rotation of the demand curve (for market power in selling) (Bresnahan, 1982). Sexton and Lavoie (2001), Sheldon and Sperling (2003) and Bresnahan (1989) provide overviews of these two approaches. According to Sexton and Lavoie (2001), the choice of the identification principle depends on the specific application and the types of data available. The demand rotation method requires the presence of an exogenous variable that interacts with price to determine demand. For example, changing socio-economic characteristics of the market faced by a CSA will cause the demand curve to shift allowing identification of both demand and marginal cost parameters (Sheldon and Sperling, 2003).

Assume that the demand equation takes the following linear functional form:

$$q = a_0 + a_1 p + a_2 p^* Y_1 + a_3 Y_2 + e_d . \quad (2)$$

Interaction between the exogenous variable Y_1 and p is required so that λ can be identified; rotation of the demand curve is necessary to identify λ.

Assume that marginal costs of production for CSA shares also take a linear form:

$$MC = b_0 + b_1 q + b_2 r_1 + b_3 r_2 + b_4 E_1 + b_5 E_2 ; \quad (3)$$

where r1, r2 and E1, E2 represent elements of the input price vector and other exogenous factors that affect share production. Using equations (2) and (3), the supply relationship can be re-written as:

$$p = l q^* + b_0 + b_1 q + b_2 r_1 + b_3 r_2 + b_4 E_1 + b_5 E_2 + e_s , \quad (4)$$

where, $q^* = -\dfrac{q}{a_1 + a_2 Y_1}$.

Equations (2) and (4) form a system of equations that can be estimated simultaneously. Inclusion of the exogenous factor that shifts demand, Y_1, allows identification of both the demand and cost parameters, and, therefore, λ.

The model can be estimated as a reduced form model. Substituting for the jointly endogenous variable q in equation (4) and solving price yields a general linear form:

$$p = p(Y_1, Y_2; r_1, r_2, E_1, E_2) + e$$

While the market power parameter, λ, can not be identified, a test can be conducted to determine whether demand factors are important to CSA pricing decisions.

Data

Survey data were obtained by mail from Northeastern CSA farms during 1995, 1996 and 1997. There were a total of 82 respondents during the three-year period; some farms participated in all three years of the survey. Detailed data were obtained on farm and farmer characteristics, revenue from CSA shares, other sources of income, and CSA costs.

Table 1 presents summary characteristics of the CSA farms that responded. These are small farms by conventional measures. The average amount of cropland was between 18.7 (1997) and 23.2 acres (1996). The amount of cropland used for the CSA operation was typically about half the total available. The different share types offered by the CSA farms that responded are also listed in Table 1. The predominant type of share was the full non-working share, a share that typically fed 3-4 individuals with no CSA farm work commitment required of the shareholder.[1] A standard measure of output was determined

[1] On many CSA farms, shareholders can obtain reductions in the price of a share by working on the farm.

Table 1. Farm Characteristics for the average CSA operation in 1995, 1996 and 1997

	1995	1996	1997
Total Cropland (acres)	22.20	23.19	18.72
CSA Cropland (acres)	11.96	10.79	7.59
CSA Share Prices	Avg.($) / Share	Avg. ($) / Share	Avg. ($) / Share
Non-working Shares:			
Full	416.32	412.88	352.98
Individual	326.00	298.29	270.56
Half	243.75	247.00	273.35
Working Shares:			
Full	260.67	248.89	246.39
Individual	0.00	205.00	136.25
Half	135.00	131.67	132.50
Other (Senior, Institutional)	307.50	358.33	266.43
Number of *Full Share Equivalents*	75.09	77.29	92.04
Pounds of Product per Full Share	374.17	329.85	324.20

for all farms by transforming the seven types of shares into equivalent numbers of full shares. Each type of working share was weighted by its price relative to the price of a full working share. Similarly, non-working shares were weighted by their share prices relative to the price of a full non-working share. These weighted shares were then summed to determine the total number of *full share equivalents*, which we use as a unit of output. An average of 75 full shares were produced in 1995 weighing about 374 pounds. In 1996, 77 shares averaging about 330 pounds were sold. In the final survey year, 92 shares were sold with an average weight of about 324 pounds.

A summary of CSA farm revenues, costs and net income appears in Table 2. Revenues were calculated based on sales of CSA shares. Many farms sold produce through other outlets such as farmers' markets. CSA respondents were asked to list

Table 2. Costs and Revenue for the CSA Operations.

	Average $ - 1995		Average $ - 1996		Average $ - 1997	
	per Farm	*per Share*	*per Farm*	*per Share*	*per Farm*	*per Share*
Reported Revenue	$33,398	$444.77	$35,568	$460.18	$32,182	$349.65
Reported Costs	$30,674	$408.50	$28,254	$365.56	$23,362	$253.82
Net Income	$ 2,724	$ 36.27	$ 7,313	$ 94.62	$ 8,820	$ 95.83

specific costs associated with farm production and the percent of expenses that should be allocated to the CSA operation. In each of the three survey years, average net income was positive ranging from $2,724 in 1995 to $8,820 in 1997. On a per-share basis, the CSA farms surveyed earned about $36 per share in 1995 and about $95 per share in 1996 and 1997.

Estimation and Results

Estimation of the demand function required socio-economic characteristics of the markets served by each CSA farm. We defined each market as the community in which the CSA farm was located. Community characteristics were measured using 1990 U.S. Census data for minor civil divisions (MCD) where available. If MCD data were not available for a specific farm location, Census designed place data were used. The data collected included population density, percent rural/urban, median household income, and percentages of high school graduates and percentages of college graduates. The cross-sectional nature of these data implies a common demand and cost structure across markets and farms respectively. Thus, the estimated parameters represent the parameters of common demand and cost functions for all CSA farms.

Initially, a reduced form model of the supply relationship was estimated using pooled time-series and cross-sectional data. All revenue and cost data were deflated to 1995 using the consumer price index; tests conducted using the reduced form model supported pooling all observations. Estimation corrected for heteroskedastic disturbances. Estimated parameters for the reduced form model are presented in Table 3. If exogenous variables from the demand equation explain a statistically significant portion of the reduced form supply relationship, then CSA farms may be exerting monopoly power. The chi-square statistic for this test of zero-restrictions was 19.53 (5 degrees of freedom), which was statistically different from zero at the one percent level of significance. We reject the hypothesis that demand factors do not affect CSA supply decisions.

Reduced form estimation suggests the presence of market power, but does not evaluate the degree of departure from competition. Estimation of a structural model (demand and supply relationships) allows estimation of the degree to which CSA farms exert monopoly power. Identification was obtained by interacting share price and median income in the demand equation. Estimation of the demand and supply relationship system was done using a two-step procedure. The demand relationship was estimated and the parameters were used to create the variable q^* (see equation (4)). This variable and quantity (q) were included in the final supply relationship. Both q^* and q are endogenous; two-stage least squares was used to estimate the final supply relationship. Estimates for the demand and supply relationship are presented in Table 3. Consistent with the results of the reduced form model, CSA farms do appear to exert market power, albeit very little. The estimated market power parameter was 0.035. While the estimated market power

parameter was statistically different from zero, it suggests CSA farms exert very little market power, only about 3.5 percent of that of a monopolist.

Summary and Conclusions

CSA is an alternative form of marketing. Most CSA farms are small vegetable farms that provide shareholders fresh organic produce through the growing season. CSAs strive to develop a loyal and stable customer base (shareholders) that will reduce (or ideally eliminate) the need to market their product each year. CSAs thus try to capture a share of the local market for fresh produce and set the price of a share each year. Using a pooled cross-section time-series data set of Northeast CSA farms, we found that CSA supply decisions are affected by local demand characteristics and that CSA farms appear to exert a small degree of monopoly power. However, CSA farms only exert about 3.5 percent of their potential monopoly power. While the estimated market power parameter was statistically different from zero, we might question whether the magnitude is economically significant. However, a limited degree of market power exerted makes sense for CSA farms. CSA farms use sustainable production methods and are committed to building a relationship with the community in which they operate. Pricing decisions by CSA farms, while dependent upon demand factors, are likely affected by altruistic feelings of the farmer towards shareholders. Our results suggest that CSA farms may have the power to price above marginal costs, but for a variety of reasons, they choose to exert very little of that power.

Table 3: Estimated parameters for the reduced form and demand/supply relationships.

Variable	*Reduced Form*	*Quantity*	*Price*
Constant	39.06* (3.43)	164.29* (1.85)	321.38* (4.05)
Market Power	--	--	0.04* (1.73)
Quantity	--	--	-0.618 (-1.15)
Price	--	-0.090 (-0.53)	--
Median Income	0.007* (3.43)	-0.001 (-0.61)	--
Price ´ Median Income	--	1.31×10^{-6} (0.35)	--
% High School Grads	553.523* (2.04)	-238.732* (-2.14)	--
% College Grads	-1078.122* (-3.04)	101.608 (0.62)	--
Density	-0.006 (-0.24)	0.033* (3.00)	--
Rural	-30.633 (-0.47)	15.223 (0.54)	--
Acres	1.717* (1.41)	--	1.762* (1.37)
Education	-34.420 (-0.70)	--	5.207 (0.10)
All Farm Experience	-4.741* (-1.30)	--	-6.838* (-1.76)
Current Farm Experience	3.702 (0.83)	--	7.097* (1.49)
Core Group	119.366* (2.91)	104.212* (5.82)	140.891* (3.27)
Year 1996	47.139 (1.04)	7.715 (0.38)	22.984 (0.46)
Year 1997	-41.216 (-0.94)	12.326 (0.69)	-60.973 (-1.27)
R^2	0.372	0.489	0.259
F	3.41*	6.79*	2.79*

t-statistics are presented in parentheses below the estimated parameters.
* Statistically different from zero at the 10% level of significance or better.

References

Appelbaum, E. "The Estimation of the Degree of Oligopoly Power." *Journal of Econometrics* 19(1982): 287-99.

Azzam, A. and T. A. Park "Testing for Switching Market Conduct." *Applied Economics* 25(1993): 795-800.

Bresnahan, T.F. "The Oligopoly Solution Concept is Identified." *Economics Letters* 10(1982): 87-92.

Bresnahan, T.F. "Empirical Studies of Industries with Market Power." *Handbook of Industrial Organization.* R.Schmalensee and R.D.Willig, eds., 1012-55. 1989.

Buschena, D.E. and J. M. Perloff "The Creation of Dominant Firm Market Power in the Coconut Oil Export Market." *American Journal of Agricultural Economics* 73(1991): 1000-8.

Cooley, Jack and Daniel Lass. 1998. AConsumer Benefits from Community Supported Agriculture Membership.@ *Review of Agricultural Economics* 20(1).

Karr, Paul. 1993. AThe Last Best Hope for Family Farms.@ *Sanctuary, Journal of the Massachusetts Audubon Society* 32(July/Aug):5-9.

Lamb, Gary. 1996. ACommunity Supported Agriculture: Can It Become the Basis for a New Associative Economy?@ In: *1996 CSA Farm Network*. Edited by Steve Gilman. Northeast Organic Farming Association, Stillwater, NY.

Lau, L.J. "On Identifying the Degree of Competitiveness From Industry Price and Output Data." *Economics Letters* 10(1982): 93-9.

Love, H.A. and E. Murniningtyas "Measuring the Degree of Market Power Exerted by Government Trade Agencies." *American Journal of Agricultural Economics* 74(1992): 546-55.

Padel, Susanne and Nicolas H. Lampkin. 1994. AFarm-level Performance of Organic Farming Systems: An Overview.@ In: *The Economics of Organic Farming: An International Perspective,* Edited by N. H. Lampkin and S. Padel. Wallingford: CAB International.

Sexton, R.J. and N. Lavoie "Food Processing and Distribution: An I.O. Approach." *Handbook of Agricultural Economics.* B.Gardner and G.C.Rausser, eds., 864-921. 2001.

Stern, Preston. 1992. ASubscription Squash, and celery, and spinach, etc.@ *In Context*. No.31.

Van En, Robyn. 1988. ABasic Formula to Create Community Supported Agriculture.@ CSA Indian Line Farm, RR 3, Box 85, Great Barrington, MA 01230.