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"Estimating the Extent of Imperfect Competition in the Food Industry: What have we learned?" *

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Abstract:

Since the late-1980s, empirical analysis has typically analyzed the extent of market power in the food industry using structural econometric models drawing on an approach commonly termed the new empirical industrial organization (NEIO). In this paper, we examine what has been learned from use of this methodology, and consider whether it has relevance for empirical analysis of market power in food retailing, and the nature of vertical contractual arrangements between food manufacturers and retailers.

Keywords: Market power, food industry

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Introduction

In the mid-1980s, studies of the UK food industry by Burns, McInerney, and Swinbank (1983), and the US food manufacturing industries by Connor *et al*. (1985) became standard texts in undergraduate food marketing courses. Much of the focus in these studies was on analyzing the impact of increased market concentration in food manufacturing and retailing, the analysis drawing explicitly on the structure-conduct-performance paradigm (SCPP). The SCPP posits a one-way causal relationship from market structure to conduct to performance. Market structure usually refers to industry concentration, the extent of product differentiation, and the ease with which new firms can enter an industry. Market structure determines firm or industry conduct, notably pricing policy. Conduct, in turn, determines economic performance, which typically is measured by profits or price-cost margins.

While early SCPP research took the form of industry case-studies, it was Bain (1951) who pioneered the use of statistical methods in SCPP research, using data from a large sample of industries to examine whether and how much structure and conduct variables affected profits or price-cost margins.[1] A typical SCPP model was written as:

$$\Pi_i = \alpha_i + \beta S_i \qquad (1)$$

where Π_i measures average accounting profits in the *i*th industry, S_i is industry concentration, and α_i represents all other factors affecting industry profitability (Geroski, 1988). Typically, β exceeded zero, taken to mean that higher industry concentration facilitates collusion, which, in turn, leads to higher industry profits in the long run.

[1] Analysis of the UK food industry based on the SCPP has typically been descriptive, while analysis of the US food manufacturing industries drew more on the statistical methods of Bain (*op. cit*.).

The SCPP has been subject to a variety of criticisms.[2] Demsetz (1973) provided an early critique of the view that high profits in concentrated industries reflect collusive behavior. If the collusive hypothesis is correct, then there should be no difference between the profitability of large and small firms in a given industry since collusion benefits firms of all sizes. Alternatively, differential profitability among firms in an industry may reflect differential efficiency.

SCPP studies have also been criticized for their reliance on accounting measures of profitability to infer market power. Fisher and McGowan (1983) demonstrated that the accounting rate of return bears little or no resemblance to its economic counterpart. For a given combination of the economic rate of return and corporate tax rate, Fisher and McGowan (*op. cit.*) showed that the corresponding accounting rate of return varies widely under different assumptions about firm growth rates, depreciation methods, and time shapes of net revenues. Consequently, SCPP inferences of market power, which rely on accounting data, may be incorrect.

Perhaps the most serious problem with the SCPP stems from the fact that all variables in a typical model are logically endogenous. In order to demonstrate this, first consider Cowling and Waterson (1976), who sought to give SCPP models a sound theoretical underpinning. They showed that a static oligopoly model implies a positive relationship between the Lerner index and the Herfindahl index of industry concentration. In its most familiar form, the Lerner index equals the difference between price and marginal cost as a proportion of price, which, for a monopolist, is given by:

$$\frac{P-c}{P} = -\frac{1}{\eta},$$

[2] See Schmalensee (1989) for a detailed critique of empirical research based on the SCPP.

where P is price, c equals marginal cost, and η is the price elasticity of demand. Under the assumptions that firms maximize profits and have constant marginal cost equal to average variable cost, Cowling and Waterson derived the industry average equilibrium condition as:

$$\frac{\Pi + F}{R} = -\frac{H}{\eta}(1+\mu), \tag{2}$$

where Π equals industry profit, F is fixed cost, R is total revenue, H is the Herfindahl index, and μ is a weighted conjectural variations term that reflects the degree of industry competitiveness. For given values of η and μ, (2) is interpreted as showing that the Lerner index is positively related to the Herfindahl index.[3]

Clarke and Davies (1982) extended this model to allow for a range of (tacitly) collusive behavior. In so doing, they cast serious doubt on the entire SCPP literature by showing that the Lerner and Herfindahl indices are logically endogenous. In their model the analogue of equation (2) is:

$$\frac{\Pi + F}{R} = \frac{H(1-\alpha)}{\eta} + \frac{\alpha}{\eta}, \tag{3}$$

where α indexes the degree of tacit collusion and takes values between zero and one, equaling zero under Cournot behavior and one under perfect collusion. The key insight of Clarke and Davies follows from the expression they derive for H:

$$H = \frac{1}{N} + \left\{1 - N\frac{(\eta-\alpha)}{(1-\alpha)}\right\}^2 \frac{v_c^2}{N}, \tag{4}$$

where v_2^c measures the coefficient of variation of industry marginal costs and N equals the number of firms. Clearly, H is endogenous since it depends on all structural parameters of the

[3] Note that the left-hand side of (2) can be interpreted as the Lerner index given that marginal cost is assumed equal to average variable cost.

model. Substituting (4) into (3), we see that the Lerner index is also endogenous, since it too depends on all structural parameters of the model. Consequently, the Lerner and Herfindahl indices are simultaneously determined, making it impossible to infer the direction of causality between market structure and performance.

Dissatisfaction with the SCPP as a means of analyzing market power motivated the so-called new empirical industrial organization (NEIO). This approach draws on game theoretic models of imperfectly competitive, profit maximizing firms to guide specification, estimation, and testing of structural econometric time series models of industry behavior (Bresnahan, 1989).[4] Although game theory has revolutionized industrial organization, it poses something of a problem for the applied researcher. Specifically, multiple models that are capable of explaining observed behavior, and multiple equilibria within a given model, raise questions about the types of behavior game theoretic models can exclude. Studies in the NEIO attempt to resolve this problem by limiting analysis to single or related industries. This strategy allows the analyst to use detailed industry knowledge to restrict the class of admissible specifications. In contrast, SCPP studies typically studied a large number of disparate industries, in which case it becomes difficult to capture inter-industry differences within a single model (Sutton, 1990).[5]

Since the late-1980s, application of the NEIO approach to estimating the extent of market power has become very common in analysis of the food processing and manufacturing industries, most notably in the US. In light of the increased use of this methodology, it is useful to consider what we have learned from its use, and whether it can contribute to analysis of market power in food retailing, and the types of vertical contractual arrangements that

[4] The use of time series data in NEIO models avoids the potential bias associated with SCPP studies that results from using data for a single time period.

[5] See Sutton (1991) for a book-length treatment of an alternative approach that seeks to reconcile NEIO models with the SCPP.

characterize both the US and UK food manufacturing and retailing sectors. The paper is divided into three sections: first, the basic NEIO methodology is laid out, along with an outline of some key issues that have been identified in the use of the methodology. Second, the relevance of the methodology to analyzing food retailing and vertical contractual arrangements is considered, with specific focus on the use of retail slotting allowances. Finally, the paper is summarized in the third section, and some conclusions are drawn.

1. The NEIO Methodology

Oligopoly Specification

In order to illustrate the basic methodology, we first consider the basic specification of an NEIO oligopoly model.[6] In standard theory, a supply curve represents a unique one-to-one functional relationship between price and quantity supplied of the form $P = MC(Q)$, where P is price, Q is quantity, and MC is marginal cost. For a perfectly competitive firm, the supply curve coincides with that portion of the marginal cost curve above average variable cost. Outside the perfectly competitive model, firms do not have supply curves. Instead, firms have more general supply relations, that is, the locus of points that result from equating marginal revenue and marginal cost. Mathematically, the supply relation represents the equality of perceived marginal revenue and marginal cost. For an n-firm, homogeneous-goods, quantity setting oligopoly, the general form of the i^{th} firm's supply relation is:

$$P(Q,\mathbf{z}) = \frac{\partial C(q_i,\mathbf{w})}{\partial q_i} - \lambda_i \frac{\partial P(Q,\mathbf{z})}{\partial Q} q_i, \tag{5}$$

[6] While we stick to analysis of oligopoly, the methodology is readily adapted to analyzing oligopsony.

where P(Q,**z**) is inverse industry demand, q_i is the firm's output, $Q = \sum_{i=1}^{n} q_i$ is industry output, **z** is a vector of exogenous demand-shift variables, $\partial C/\partial q_i$ is firm-specific marginal cost, **w** is a vector of exogenous cost-shift variables, λ_i is a parameter to be determined, and $\partial P/\partial Q$ is the slope of inverse industry demand. The appearance of marginal cost in the supply relation seemingly leaves the NEIO vulnerable to the same criticisms leveled at SCPP studies associated with the use of accounting data to measure economic variables. However, in contrast to the SCPP, the NEIO assumes that economic cost cannot be directly observed. The approach taken in NEIO research is to estimate marginal cost as part of a complete structural econometric model.

The key parameter in (5) is λ_i, whose value lies in the range 0 to 1, equaling 0 under competition, $1/n$ for an n-firm Cournot oligopoly, and 1 for a monopolist or cartel. In any given application, the particular form of the supply relation, and hence, the value of λ_i, depends on the modeling approach. One approach takes the specification of the supply relation from a single oligopoly theory. A related approach specifies several supply relations, each one corresponding to a particular oligopoly theory, and uses non-nested statistical tests to distinguish among the various specifications (Gasmi *et al*., 1992; Carter and MacLaren, 1997).[7] Another approach remains silent on the exact nature of the game that firms play, instead estimating λ_i as a continuously valued parameter. In this regard, λ_i can have two possible interpretations: it measures the equilibrium wedge between price and marginal cost; alternatively, λ_i can be given a conjectural variations interpretation (Bresnahan, 1989). This follows from the fact that $\lambda_i = dQ/dq_i$, which, as Deodhar and Sheldon (1995; 1997) have demonstrated, can also be expressed as $1 + v_i$, where v_i equals the conjectural variation of the i^{th} firm. However, because there is no underlying

[7] Nevo (2001)also estimates price-cost margins for the US breakfast cereal industry, based on three industry structures, but does not conduct a non-nested statistical test of these different structures.

theoretical structure to the model, it is not clear that λ_i can measure a firm's conjectural variations outside the specific market structures mentioned above. For this reason, it has become common to follow the more general interpretation of λ_i as the wedge between price and marginal cost (Perloff, 1992).

A typical NEIO oligopoly model consists of equations for a demand curve and a supply relation. The simultaneous determination of demand and supply raises an important issue: namely, whether and how the structural parameters of the model are identified. Consider once more the supply relation in (5). The reduced-form coefficient on q_i, call it π, is a composite of the conduct parameter, λ_i, and the slope of inverse industry demand, $\partial P/\partial Q$. Thus, the question arises as to whether λ_i can be distinguished from π. Clearly, the demand equation yields the slope of the demand curve, call it γ, which equals $\partial Q/\partial P$. If marginal cost is constant with respect to output, then $\lambda_i = \gamma\pi$ (Deodhar and Sheldon, 1995).

Following Carlton and Perloff (1994), this simple identification principle is illustrated in figure 1. Let D_1 and MR_1 denote the demand and associated marginal revenue curves, and assume that marginal cost (MC) is constant at some unknown level. The initial equilibrium point E^* corresponds to a quantity of Q^* and a price of P^*. This equilibrium is consistent with perfect competition, where D_1 intersects MC_c, and monopoly, where MR_1 intersects MC_m. Consequently, it is impossible to determine the price-cost margin, and, therefore, λ_i. Now suppose that an exogenous shock causes a parallel shift in the demand and marginal revenue curves from D_1 and MR_1 to D_2 and MR_2. If the market is perfectly competitive, the equilibrium point moves from E^* to E_c; quantity increases from Q^* to Q_c, but price remains constant at $P_c = P^*$. If, on the other hand, the market is characterized by imperfect competition, the equilibrium point moves from E^* to E_m; quantity increases, albeit by a smaller amount than under competition, from Q^* to Q_m, as does price, rising from P^* to P_m. Thus, as long as marginal cost is constant, a parallel shift in demand identifies λ_i: price remains constant if the market is perfectly competitive, but changes (increasing in this case) if the market is imperfectly competitive.

For the most part, lack of publicly available firm-level data means that supply relations of individual firms cannot be estimated. Instead, industry data must be used, in which case (5) becomes:

$$P(Q,\mathbf{z}) = \frac{\partial C(Q,\mathbf{w})}{\partial Q} - \lambda \frac{\partial P(Q,\mathbf{z})}{\partial Q} Q, \quad (6)$$

where $\partial C/\partial Q$ is industry marginal cost. Existence of an industry marginal cost function implies restrictions on the functional form that an individual firm's cost function may take. Furthermore, interpretation of the industry supply relation may be clouded when firms have market power. For now we simply note that it is best to interpret equation (6) as some sort of industry average (Bresnahan, 1989).

At this point, it useful to consider an alternative interpretation of the conduct parameter λ: subtracting $\partial C/\partial Q$ from both sides of equation (6) and dividing the resulting expression by P allows us to write the industry average supply relation as:

$$\lambda = -L\varepsilon, \quad (7)$$

where $\varepsilon < 0$ is the industry price elasticity of demand, and L is the Lerner index. Since $0 \leq \lambda \leq 1$, it follows that $0 \leq L \leq -1/\varepsilon$.[8] Thus, equation (7) shows that λ can be interpreted as an elasticity-adjusted Lerner index. In contrast to the Lerner index, λ accounts for (a) "markets that have high margins because demand is inelastic" and (b) "markets that have high margins because they are less competitive or perhaps collusive" (Corts, 1999). However, in order to distinguish between

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[8] $L = -1/\varepsilon$ only for a monopolist. More generally, if $\lambda < 1$, then $0 \leq L \leq 1$ (Appelbaum, 1982).

these two possibilities, information is also needed on at least one of the other parameters in (7). Since economic cost and, hence, the Lerner index cannot be directly observed, attention centers on estimates of the conduct parameter and the industry price elasticity of demand.

NEIO Studies of Market Power

In order to keep the analysis manageable, we now focus on the two standard, static approaches to estimating industry measures of conduct and market power: the *production theoretic* approach pioneered by Applebaum (1982); and the *general identification* method developed by Bresnahan (1982).

(a) Production Theoretic Approach: Appelbaum (*op. cit.*) exploited the duality between cost and production functions to derive industry measures of conduct and the price-cost markup in an *s*-firm, homogeneous-good, quantity-setting oligopoly. Let the industry demand curve be:

$$y = J\left(p, \mathbf{z}\right), \tag{8}$$

where $y = \sum_{j=1}^{s} y^j$ is industry output, p is the price of output, and $\mathbf{z}$ is a vector of exogenous demand-shift variables. Starting with a firm-level model, Appelbaum assumed that firms have general cost functions of the form $C^j\left(y^j, \mathbf{w}\right) = \min_{\mathbf{x}^j \geq 0}\left\{\mathbf{w} \cdot \mathbf{x}^j : \mathbf{x}^j \in V\left(y^j\right)\right\}$, where $\mathbf{w}$ is an n-dimensional vector of competitively determined factor prices, $\mathbf{x}^j$ is an n-dimensional vector of inputs used by the firm, and $V(y^j)$ is the firm's input requirement set (those combinations of inputs that are capable of producing output level y^j).[9] Applying Shephard's Lemma to C^j yields the firm's n-dimensional vector of cost-minimizing input demands:

$$\mathbf{x}^j = \partial C^j\left(y^j, \mathbf{w}\right) \big/ \partial \mathbf{w}. \tag{9}$$

[9] See Chambers (1988) and Diewert (1971) for a discussion of the properties of the cost function.

The typical firm's profit maximization problem is given by:[10]

$$\Pi^j(p,\mathbf{w}) = \max_{y^j}\left[py^j - C^j(y^j,\mathbf{w}) : y = J(p,\mathbf{z})\right]. \tag{10}$$

The solution to equation (10) yields the firm's supply relation:[11]

$$p\left(1-\theta^j/\varepsilon\right) = \partial C^j(y^j,\mathbf{w})\big/\partial y^j\,, \tag{11}$$

where θ^j is the firm's conjectural elasticity of industry output, and ε is the magnitude of the price elasticity of demand.[12] Since the conjectural elasticity is a continuously valued parameter that takes values between zero (perfect competition) and one (monopoly), it provides a basis for testing various hypotheses about market structure. In particular, the null hypothesis of competition, H_0: $\theta^j = 0$, can be tested against various alternatives under which firms have monopoly power.

The complete model consists of equations (8), (9), and (11). Econometric estimation of this model requires the availability of a time series data set for each firm in the industry. Lacking such data, Appelbaum examined the conditions under which the model can be treated at the industry level. Summing equation (9) over all firms yields the industry input demand vector:

$$\mathbf{x} = \sum\nolimits_j \mathbf{x}^j = \sum_{j=1}^{s} \partial C^j(y^j,\mathbf{w})\big/\partial \mathbf{w}. \tag{12}$$

Clearly, the functional form of **x** depends on the functional form of C^j. Appelbaum assumed that firms have cost functions of the Gorman polar form:

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[10] Equation (10) resembles the long-run profit-maximization problem facing a competitive firm, except that in this case the firm is not a price-taker. Nevertheless, in equilibrium, the firm behaves "as if " it maximizes profits subject to a given output price equal to the firm's perceived marginal revenue. Thus, by replacing the competitive price with its shadow price or marginal revenue, Appelbaum was able to use duality theory to estimate oligopoly-pricing distortions.

[11] If the cost function satisfies certain regularity properties, then the profit function also will be "well behaved", such that the maximum in (10) exists. See Hazilla (1991) and the references cited therein. See also Chambers (*op. cit.*) for a discussion of the profit function.

[12] The conjectural elasticity equals the product of the price-cost wedge λ^j and the firm's market share.

$$C^j\left(y^j,\mathbf{w}\right)=y^jC\left(\mathbf{w}\right)+G^j\left(\mathbf{w}\right), \tag{13}$$

where $C(\mathbf{w})$ and $G^j(\mathbf{w})$ are linearly homogeneous functions.[13] Choosing this form for the cost function allows different firms to have different linear cost curves, but restricts marginal cost to be constant and equal (to $C(\mathbf{w})$ in this case) across firms. Given equation (13), the industry input demand vector in equation (12) becomes:

$$\mathbf{x}=y\left[dC\left(\mathbf{w}\right)/d\mathbf{w}\right]+\sum_j dG^j\left(\mathbf{w}\right)/d\mathbf{w}. \tag{14}$$

The main advantage of the Gorman polar cost function is that if industry output is the un-weighted sum of each firm's output, then $C(\mathbf{w})$ also equals industry marginal cost (Chambers, 1988). This also implies that each firm's perceived marginal revenue must be equal in equilibrium, or that $\theta^j = \theta$ for all $j = 1,\ldots,$ s. This result enabled Appelbaum to write the industry supply relation as:

$$p(1-\theta/\varepsilon)=C(\mathbf{w})\,. \tag{15}$$

From (15), the Lerner index is:

$$\frac{p-C\left(\mathbf{w}\right)}{p}=-\frac{\theta}{\varepsilon},$$

which can also be written as, $L = -\theta/\varepsilon$.[14] Note that, when using industry data, it is best to interpret θ as the industry average equilibrium price-cost wedge and L as the industry average markup (Bresnahan, 1989).[15]

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[13] This cost function is dual to a quasi-homothetic technology and allows for consistent linear aggregation over firms. See the discussions in Chambers (*op. cit.*) and Hazilla (*op. cit.*).

[14] Note the similarity between this expression and expression (2) derived by Cowling and Waterson (*op.cit.*).

[15] The method for identifying θ in this model is similar to that of Bresnahan (1982) for the case of constant marginal costs, the only difference being that it requires estimation of three parameters. In addition, the cross-equation restrictions between the factor demand equations and the supply relation means that the parameters, and, hence, θ, are estimated more precisely.

Using annual data over the period 1947-71, Appelbaum estimated the complete model, which consisted of the expressions given by (8), (14), and (15), for a series of US industries, including textiles and tobacco, using full information maximum likelihood (FIML) methods. To obtain an estimate of ε, the industry demand function was assumed to be of double-log form.[16] The industry cost function was approximated by a generalized Leontief cost function of Gorman polar form.[17] From this, Applebaum derived the industry marginal cost function as well as the industry input demand functions for labor, capital, and intermediate inputs were derived. From equation (15), θ was modeled parametrically as a function of exogenous input prices.

(b) <u>General Identification Method</u>: Identification of market power in the Appelbaum-type model is straightforward since marginal cost (value marginal product) is assumed to be constant. However, identification of market power becomes more complicated when marginal cost slopes upward (value marginal product slopes downward). In these circumstances a more general identification method is needed. This method was developed in papers by Just and Chern (1980), Bresnahan (1982), and Lau (1982), where it was shown how an index of market power could be identified by the comparative statics of profit maximization using industry data on prices, quantities, and exogenous demand and supply variables. Essentially, the response of equilibrium price and quantity to an exogenous shock to the competitive side of the market reveals the degree of market power. The value of this method lies in the fact that market power can be identified even if neither cost nor profit data are available.

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[16] As an alternative, Appelbaum could have used an exogenous estimate of ε (see Roberts, 1984).

[17] The generalized Leontief cost function, one of the so-called flexible functional forms, satisfies all of the standard regularity properties with the exception of concavity in input prices. Local concavity is satisfied if the parameters of the cost function are positive. However, because Appelbaum did not report these coefficient estimates, it is not possible to determine whether the estimated cost function satisfies the curvature property. See the discussions in Diewert (1971; 1987).

Bresnahan (1982) has presented a clear exposition of the issues involved and has outlined a simple econometric solution to the identification problem in the context of an oligopoly model. Let price taking buyers have a demand curve given by $Q = D(P,Y,\alpha) + \varepsilon$, where Q is quantity, P is price, Y is an exogenous demand variable, α is a vector of demand parameters, and ε is an econometric error term. Industry marginal cost is $c(Q,W,\beta)$ where W is an exogenous supply variable and β is a vector of supply parameters. Profit maximization implies an industry supply relation of the form:

$$P = c\left(Q,W,\beta\right) - \lambda \cdot h\left(Q,Y,\alpha\right) + \eta, \tag{16}$$

where λ is the oligopoly conduct parameter, $P + \lambda h$ equals industry marginal revenue, and η is an econometric error term. Suppose the demand curve takes the linear form:

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \varepsilon. \tag{17}$$

Let industry marginal cost also have a linear form given by:

$$MC = \beta_0 + \beta_1 Q + \beta_2 W.$$

Expression (16) then implies that the industry supply relation is

$$P = \lambda\left(-Q/\alpha_1\right) + \beta_0 + \beta_1 Q + \beta_2 W + \eta. \tag{18}$$

A check of the order and rank conditions for identification reveals that equations (17) and (18) are identified. Identification of λ presents more of a problem as can be seen by rewriting equation (18) as:

$$P = \beta_0 + \gamma Q + \beta_2 W + \eta, \tag{19}$$

where $\gamma = \beta_1 - \lambda/\alpha_1$. Solving this expression for λ shows that its identification requires estimates of β_1, α_1, and γ. However, because equations (17) and (19) only provide estimates of α_1 and γ, λ cannot be identified.

This identification problem is illustrated in figure 2. The initial equilibrium occurs at point 'a'. Clearly, this outcome is consistent with perfect competition where D_1 intersects MC_c and monopoly or oligopoly where MR_1 intersects MC_m. Now suppose a change in Y results in a parallel shift of the demand curve from D_1 to D_2. Although the equilibrium moves from 'a' to 'b', competition remains indistinguishable from monopoly or oligopoly. Consequently, a vertical shift in the demand curve cannot identify λ. Bresnahan (1982) solved this problem by adding a new exogenous variable, Z, which enters interactively with P in equation (17).[18] With the addition of Z, the demand equation becomes

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \alpha_3 PZ + \alpha_4 Z + \varepsilon., \tag{20}$$

which can be re-written as:

$$Q = \underbrace{\left(\alpha_0 + \alpha_2 Y + \alpha_4 Z\right)}_{\text{Vertical Intercept}} + \underbrace{\left(\alpha_1 + \alpha_3 Z\right)}_{\text{Slope}} P + \varepsilon. \tag{20′}$$

Expression (20′) shows that changes in Z combine elements of both vertical shift and rotation of the demand curve. This rotation of demand is both necessary and sufficient for identification of λ. Given (20), the supply relation becomes:

$$P = \lambda Q^* + \beta_0 + \beta_1 Q + \beta_2 W + \eta, \tag{19′}$$

where $Q^* = -Q/(\alpha_1 + \alpha_3 Z)$. Since equation (20) yields estimates of α_1 and α_3, λ is now identified as the coefficient of Q^*. The foregoing argument is illustrated in figure 3. The initial equilibrium occurs at point 'a', which is consistent with perfect competition and monopoly or oligopoly.

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[18] Bresnahan (1982) remarks that Z might be best interpreted as the price of a substitute good.

Now suppose that a change in *Z* causes the demand curve to shift and rotate from D_1 to D_2. Under perfect competition the equilibrium moves from 'a' to 'b', tracing out the supply curve MC_c. In contrast, under monopoly or oligopoly the equilibrium moves from 'a' to 'c', tracing out the supply relation S_m. Thus, rotation of the demand curve identifies the nature of industry competition, and the vertical shift in demand traces out the corresponding supply relation.[19] The typical empirical approach to using this methodology has been to estimate (19′) and (20′) as a simultaneous equations system using non-linear three stage-stage least squares, based on annual data. It should be noted, however, that use of this method is dependent on a once-and-for-all shock identifying market power. For example, Just and Chern (*op.cit.*) were especially fortunate in that they had a natural experiment, introduction of the mechanical tomato harvester, which rotated the tomato supply curve, allowing them to identify oligopsony power of tomato processors.[20]

Market Power Estimation in the Food and Related Industries

The seminal articles by Appelbaum, and Bresnahan (1982), have had a profound and lasting effect on the way in which economists approach the estimation of market power. Importantly, both of the methodologies outlined have been frequently applied to estimation of market power in the food and related industries. For example, Schroeter (1988) extended Applebaum's model to allow measurement of both oligopoly and oligopsony power in the US beef packing industry, while Azzam and Pagoulatos (1990) generalized Schroeter's model by using a primal production function approach that allowed for more general forms of market conduct and input substitution. Buschena and Perloff (1991) generalized Bresnahan's (1982) model, allowing the parameter, λ, to vary over time with changes in the market, and using a

[19] Lau (*op.cit*.) provides a formal proof of Bresnahan's (1982) result.
[20] A similar principle of identification can be used if one allows for increasing returns to scale, e.g., see Bhuyan and Lopez (1997).

dominant firm and competitive fringe model to estimate oligopoly power in the Philippine coconut oil export industry. Deodhar and Sheldon (1997) also used the Bresnahan (1982) model to estimate market power in the world market for soy meal exports, accounting for entry of Argentinian firms into the export market using a technique similar to Buschena and Perloff.

Some estimates of the market power parameter, along with the computed Lerner index are listed in table 1 for various food and related industries. Albeit selective, several comments can be made concerning these results: first, the majority of the listed studies, and for that matter many of the studies not included, concern the US food and related industries; second, estimates of both market power and the Lerner index vary quite widely across industries, and it is clear that the value of the Lerner index depends not only on the value of the market power parameter, but also the price elasticity of demand; third, as Sexton (2000) has pointed out, the US meat marketing system, notably beef, has been subject to most analysis, the studies listed in the table only representing a portion of the NEIO literature on this particular industry.[21] Sexton suggests that this interest has been due in large part to the very large increase in seller concentration in the US beef packing sector, which has resulted in both academic, industry, and political interest in whether market power has been/is being exercised in this particular sector; fourth, analysis of food retailing has received no attention in terms of this methodology, the one exception being the recent study of French food retailing by Gohin and Guyomard (2000). In summary, if one accepts that the methodology for estimating market power is robust, we have learned a moderate amount about the exercise of market power, most notably in the US food-manufacturing sector, meat marketing in particular.

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[21] Other studies not listed include Azzam (1992; 1997), Koontz and Garcia (1997), and Morrison Paul (1999a)

Discussion of Static NEIO Models

Since static NEIO methods are still widely used, it is important to note some key issues that arise with use and interpretation of these methods.[22] First, there is the issue of how the conjectural elasticity θ relates to the equilibrium price-cost wedge λ. The decision by Appelbaum to refer to θ as the conjectural elasticity is rather unfortunate because it once again confuses the issue as to whether θ measures the price-cost wedge or the conjectural variations of either a firm or an industry. An explicit derivation of the conjectural elasticity helps to clarify the confusion. The profit maximization problem facing a typical firm in an n-firm homogeneous product oligopoly is given by:

$$\Pi^j(p,\mathbf{w}) = \max_{y^j}\left[py^j - C^j\left(y^j,\mathbf{w}\right)\right], \tag{21}$$

where p is price, y^j is the firm's output, $\mathbf{w}$ is a vector of input prices, and C^j is the firm's cost function. Differentiating (21) with respect to y^j yields:

$$\frac{d\Pi^j}{dy^j} = p + \frac{dp}{dy}\frac{dy}{dy^j}y^j - \frac{\partial C^j}{\partial y^j} = 0. \tag{22}$$

Equation (22) can be simplified as follows:

$$p\left(1 + \frac{dp}{dy}\frac{dy}{dy^j}\frac{1}{p}y^j\right) = \frac{\partial C^j}{\partial y^j}. \tag{23}$$

Multiplying (23) by y/y yields:

$$p\left(1 + \frac{dy}{dy^j}\frac{y^j}{y}\frac{dp}{dy}\frac{y}{p}\right) = \frac{\partial C^j}{\partial y^j}, \tag{24}$$

which can be written as:

[22] Note that this is not a comprehensive discussion of all of the issues relating to use of the NEIO methodology, a more thorough discussion can be found in Sexton (*op. cit.*), and Sexton and Lavoie.

$$p\left(1+\theta^{j}/\varepsilon\right)=\frac{\partial C^{j}}{\partial y^{j}}. \qquad (25)$$

It should be clear from comparing equations (24) and (25) that $\theta^{j}=\frac{dy}{dy^{j}}\frac{y^{j}}{y}$. Notice also that in the expression for θ^{j}, $dy/dy^{j}=\lambda^{j}$. These results allow us to write the conjectural elasticity as:

$$\theta^{j}=\lambda^{j}\frac{y^{j}}{y}. \qquad (26)$$

Clearly, $\theta\in[0,1]$ since both λ and y^{j}/y lie in the same range. Expression (26) shows that the conjectural elasticity is nothing more than a weighted λ, where the weight is the firm's output market share. Thus, both λ and θ have the interpretation of an equilibrium price-cost wedge. Of course, this does not address the general criticism many theorists have of the concept of conjectural variations (Friedman, 1983).

A second issue concerns whether to model production technology as one of either fixed or variable-proportions. Sexton (*op.cit.*) has pointed out that some critics have attacked findings of market power in the US beef packing industry as a failure to allow for input substitution in production, e.g., Muth and Wohlgenant (1999a; 1999b). Studies appealing to a variable-proportions technology, however, typically use very aggregate data, where substitution relates to allocation of an input among several end uses, and, Sexton questions whether this is actually a very relevant way to define both product markets and technology.[23] This suggests that the real problem with many studies in the NEIO literature is not so much that that inappropriate specifications of production technology are used, but instead that researchers often use very poorly defined product markets in their empirical analysis.

[23] See, for example, Goodwin and Brester (1995).

A third issue is that, with the exception of Karp and Perloff (1989), and Deodhar and Sheldon (1996), all of the NEIO studies listed in table 1 are static models of oligopsony/oligopoly. A general criticism of these, and other studies in the field, is that they attempt to model dynamic interactions between agents, namely, reactions to each other's quantity or price strategies in a static framework, using the concept of conjectural variations.[24] This is surprising in light of the fact that perhaps the most important advance made in the field of industrial organization has been the ability to analyze multi-period games that have oligopolistic equilibria. In particular, it has been shown that non-cooperative collusive equilibria can be obtained in repeated games (Fudenberg and Tirole, 1989). This is reinforced by a recent survey of the empirical industrial organization literature by Slade (1995), suggesting that static one-shot Nash games in either quantities or prices are nearly always rejected by the data.

In contrast to static models, dynamic models attempt to capture the underlying strategic behavior of market participants. A characteristic of dynamic models that has limited their use is the fact that they can be very difficult to solve, and usually require firm-level data. For the sake of tractability, most dynamic models have restricted attention to linear-quadratic games. The term linear-quadratic comes from optimal control theory and refers to a problem where the objective function is quadratic and the constraints are linear.[25] The linear-quadratic approach has frequently been used in theoretical models of oligopoly (Fershtman and Kamien, 1987; Reynolds, 1987; Dockner, 1992; and Karp and Perloff, 1993a), and has received some limited application in analysis of the food industries (Karp and Perloff, 1989, 1993c; and Deodhar and

[24] An additional criticism of this methodology has recently been put forward by Corts (*op. cit.*). He shows that with high seasonality in demand, it may be incorrect to make inferences about market power based on a static conjectural variations approach. Typically, most NEIO studies have treated the market power parameter as a constant. If, however, it is treated as variable, it is likely correlated with the instruments used to identify it, and is, therefore, a biased estimate of the mean level of market power. Corts' point is that an average level of market power cannot be estimated independently of any dynamic model of oligopolistic behavior.

[25] In these games the profit function is quadratic in the state and control variables and the equations of motion that describe the evolution of the state are linear in these same variables.

Sheldon, 1996). A particular advantage of using this approach is that closed-form solutions can be found for the equilibria of differential games and, therefore, it is possible to solve analytically for a market conduct parameter (Dockner, *op.cit.*; Karp and Perloff, 1993a, 1993b; Slade, *op.cit.*).

Notwithstanding this, most researchers continue to use static models to obtain estimates of market power. In this regard, some critics, notably Friedman (*op.cit.*), have attacked this approach by pointing out that static measures of market power do not contain any information about the dynamics of market interaction. Recent theoretical work, however, has blunted this criticism somewhat. Specifically, Dockner (*op.cit.*), Cabral (1995), and Pfaffermayr (1997) have shown that static measures of market power are sufficient statistics for an underlying dynamic game.

Finally, there are some key econometric issues relating to the methodology.[26] As Sexton has pointed out, most NEIO studies are based on specific *ex ante* choices of functional forms and explanatory variables for the demand function, supply relation, and processing technology. Consequently, the NEIO researcher is always testing a joint hypothesis, i.e., a test of whether a market is competitive or not, along with a test of the maintained hypotheses concerning functional forms for demand and cost. Sexton suggests that this problem is perhaps not too serious in terms of processing technology where researchers have commonly used flexible functional forms, but may be a problem with respect to demand specification, where usually very simple functional forms have been utilized. Genovese and Mullin (1998) have noted that if strong assumptions are made about the functional form of demand, this also imposes restrictions on the relation between price and marginal cost.

[26] There are other practical econometric issues that NEIO research faces, but they are not particularly unique to this line of research.

Genesove and Mullin (*op. cit.*), and Bettendorf and Verboven (2000) have both explicitly examined how sensitive estimates of market power are to the functional form of demand. In the former study, focused on historical data for US sugar processing, estimates of market power were found to be very similar across linear, log-linear, quadratic, and exponential specifications for demand.[27] In the latter study, which analyzed the Dutch coffee roasting sector, it was found that the estimate of the conjectural elasticity was quite sensitive to whether a logarithmic as opposed to either a linear or quadratic specification was used. This suggests that NEIO researchers should take more care in examining how robust their estimates of market power are to the underlying demand specification.

In addition, notwithstanding Sexton's view that researchers have used more flexible functional forms in the case of processing technology, it is also the case that most NEIO studies of the food industry have failed to account for the possibility of economies of scale by assuming constant marginal costs. Bhuyan and Lopez (1997), in their analysis of oligopoly power in forty US, 4-digit SIC food industries over the period 1972-87, were able to reject the hypothesis of constant returns to scale in thirty-three cases, finding instead that twenty industries in the sample exhibited increasing returns to scale. Morrison Paul (1999b) has further developed analysis of how mark-ups of price over marginal cost are affected by both scale effects and market power. Importantly, she has analyzed both short and long run changes in costs internal to firms, as well as external factors that shift cost functions. Using data for the US food and fiber industries over the period 1961-91, Morrison Paul (1999b) found scale economies and mark-ups were larger for textile compared to the food industry, and that scale economies underlay the mark-up behavior of

[27] Genoseve and Mullin were also able to estimate an elasticity-adjusted Lerner index directly using price and cost data. They found that their econometric estimate of the market power parameter was very close to the econometric estimate.

both industries. This type of analysis also sheds light on the Demsetz (*op. cit.*) critique of the SCPP, and the Williamson (1968) notion of a trade-off between market power and scale economies.[28]

3. Relevance of the NEIO Methodology to Competition in Food Retailing

As noted in the previous section, virtually all of the empirical work applying the NEIO to the food and related industries has occurred in the US, with only a few applications to the food industry in Europe. Sexton (*op.cit.*) has suggested that much of the stimulus for this type of research in the US has been the significant increase in observed seller concentration in a wide range of industries, notably meat packing. Recent evidence suggests that the UK food manufacturing industry also exhibits high levels of seller concentration (Strak and Morgan, 1995), yet, to the authors' knowledge, there have been virtually no published NEIO-type studies of this sector, an exception being the study of the UK bread manufacturing industry by Wilson (1997)

While there may be many possible reasons for this lack of application of the NEIO methodology to the UK food-manufacturing sector, researchers and policymakers in the UK have mainly been concerned with the extent, and economic consequences of increased concentration in the food-retailing sector, this having been the focus of the recent Competition Commission (2000) inquiry. Dobson and Waterson (1999) have noted that food retailing is highly concentrated in the UK as compared to the US, and they indicate that a standard food basket in the US costs only 69 percent of what it would cost in the UK. They suggest that, because UK food retailers seem to have both buying and selling power, this may explain why

[28] Azzam (1997) has explicitly tested this trade-off in the case of US beef packing, finding over the period 1970-92 that cost-efficiency effects on the price-cost margin outweigh oligopsony effects.

UK food retailers are more profitable than their European counterparts. On the face of it, the types of technique outlined in the previous section seem well suited to evaluating the degree to which UK food retailers exert both selling and buying power. In addition, as McCorriston and Sheldon (1997) have discussed, the types of contractual arrangements that exist between food manufacturers and retailers, may, in theory, have either a beneficial or detrimental effect on economic welfare, yet we have little empirical evidence to support the predictions of models in the literature on vertical restraints.

Interestingly, only Gohin and Guyomard's (2000) paper on French-food retailing has used the NEIO methodology to measure the extent to which firms are able to exert oligopsony/oligopoly power. They motivated their research with the observation that seller concentration increased markedly in French food retailing over the period 1969-1991. Their paper is strongly based in the production theoretic tradition of Appelbaum, and also draws on the multi-output approach developed by Schroeter and Azzam (1990), and Wann and Sexton (1992). As noted in table 1, their results suggest that, on average, 20, 17, and 12 percent of the unit margin for dairy, meat, and other food products respectively can be explained by the oligopsony/oligopoly power of French food retailers.

Irrespective of the overall merits of the technique, the Gohin and Guyomard (*op.cit.*) study does highlight the type of problem faced by researchers wishing to apply the NEIO to food retailing. First, while a multi-output model is applied, the analysis is still highly aggregated both in terms of products and the fact that it is at the industry level. By the authors' own admission, other food products is a very broad sector, and one has to wonder how meaningful it is to calculate market power for such an aggregate, especially given the wide range of products such a category covers. In addition, given the increasing importance of a small number of large food retailers, it would seem more appropriate to estimate the model with firm-level data. Of course this study, and most NEIO studies, are hampered by a lack of disaggregated product and firm-level data, which raises the question of how useful such analysis would be for food retailing.

Second, as the authors' themselves have recognized, the model is estimated not only at the industry level, but also the national level. While many food retailers operate at the national level, it is likely that market power in retailing is often exerted at the regional or local level. This suggests some sort of spatial analysis would be more appropriate. For example, one could adapt the type of modeling framework used in Mathewson and Winter (1984), and Rogers and Sexton (1994), drawing on spatial concepts such as Loschian and Hotelling/Smithies conjectures.[29] Yet again lack of relevant data is a constraint in this respect, but it raises the question as to how useful national, industry level analysis of food retailing would be.

Third, Gohin and Guyomard have assumed retailing firms' compete in quantities selling homogeneous goods. Typically in the current literature on vertical restraints, retailers are assumed to compete in price, selling differentiated products. In particular, food retailers compete not just in terms of products, but also store characteristics such as size, location, convenience, shelf space, and product range (Shaffer, 1991a; 1991b). This suggests that considerably more thought needs to be given to how retailers interact strategically.

Finally, due to the assumption of fixed proportions in the food retailing production function, the conjectural elasticities are constrained to be identical in both the input and output markets. This is not necessarily a robust assumption if one believes that food retailers exert buying power over food manufacturers but are somewhat more competitive in selling to consumers. In addition, retailer-buying power is modeled as a straightforward oligopsony

[29] Loschian conjectures imply each retailer assumes its market area is invariant to changes in its price, while Hotelling/Smithies conjectures imply each retailer assumes its rival retailers' prices are invariant to its price changes.

problem. While this may give the researcher some feel for the degree to which food retailers can exert bargaining power over food manufacturers, it does not really capture the richness of vertical contractual arrangements that may characterize the interaction of manufacturers and retailers.

It is worth expanding on the latter point by considering a vertical contractual arrangement that is a common practice in both the US and UK food systems: retail slotting allowances. There are of course many other types of vertical restraint, but slotting allowances provide an interesting test of whether the NEIO methodology might be a useful tool for analysis. Retail slotting allowances are lump-sum payments that food manufacturers pay for the “right” to slot food products on food retailers’ shelves. In the case of new products, Lariviere and Padmanabhan (1997) report estimates that retail slotting allowances currently account for 16 percent of food product introduction costs in the US. The Competition Commission (*op.cit.*) also noted the use of slotting allowances in the UK, indicating that they may be against the public interest. While there has been very little theoretical analysis of such allowances, essentially, much like the broader literature on vertical restraints, the available results suggest that slotting allowances can be either anti-competitive or pro-competitive compared to situations without slotting allowances.

The only paper in the literature that clearly articulates and proves why slotting allowances might be anti-competitive is that by Shaffer (1991a). Using a structure similar to others in the vertical restraints literature[30] Shaffer (1991a) has shown that in a Bertrand game between differentiated retailers, slotting allowances are, a “facilitating” practice, which allows retailers to credibly raise prices above the Nash equilibrium level. Basically, each manufacturer raises the wholesale price, and then pays a negative franchise fee to the retailer. Accepting an

[30] See Bonanno and Vickers (1988).

increase in the wholesale price is rational, as the slotting allowance recompenses the retailer for lost revenue from raising the wholesale price. The key result then is that both retail and wholesale prices increase in equilibrium, i.e., slotting fees are credible compensation for higher wholesale prices, and hence, the game is a perfect equilibrium. Essentially, vertical chain rents increase, the retailer grabbing the increase in rents, while the manufacturer is no worse off. The Shaffer (1991a) rationale is that scarce shelf-space allows the retailer to grab the rents.

In terms of the other theories concerning slotting allowances, these break down into risk-sharing and signaling/screening stories when there is asymmetric information over the likelihood of success of new products, manufacturers knowing whether they are selling a high-demand or a low-demand product, as compared to retailers who do not have this information. Sullivan (1997) explicitly assumed that retailers and manufacturers are competitive, and the role of slotting allowances is to provide insurance to the retailer, successful products subsidizing unsuccessful products. Papers by Chu (1992), and Lariviere and Padmanabhan (*op.cit.*) have laid out the signaling/screening arguments. Chu has assumed that if retailers can move first, then slotting allowances will be used by them as a screening device, manufacturers producing high demand products self-selecting to pay the allowance. Chu has shown that wholesale and retail prices are lower as compared to the case where manufacturers move first and attempt to signal through a high wholesale price and dissipative advertising.

Lariviere and Padmanabhan have argued that retailer first-mover advantage is not necessary for slotting allowances to occur. They have shown that, when retailer, fixed stocking costs are not too high, the high-demand manufacturer can credibly signal through a high wholesale price. When retailer-stocking costs are high, a lower wholesale price is offered along with a slotting allowance. Essentially the manufacturer takes on the burden of part of the retailer's stocking costs, and provides an incentive for retailer effort through the lower wholesale price. In either equilibrium, retailers simply break even, so consumers are unaffected by slotting allowances. The key point in all of these stories is that slotting allowances result in neither higher wholesale nor retail prices, and the slotting allowance provides an incentive to retailers to stock new products. In addition, except in Chu's model, there is no presumption that retailers have the balance of bargaining power in the food system.

Azzam (2001) notes recently that the various models of slotting allowances have not actually been tested, and wonders how they might be discriminated between. He suggests a reduced form approach that is essentially based on the NEIO methodology. Azzam (*op.cit.*) assumes a retailer i operating in competition against N_j other retailers in region j. Given the retail technology is assumed to be fixed proportions, Azzam derives an expression for the price-cost margin of the retailer including slotting allowances:

$$\frac{\pi_{ij}}{P_j q_{ij}} = \beta_1 \frac{S_{ij}^r}{\eta_j} + \beta_2 \frac{S_{ij}^n}{\varepsilon} R_{ij} + \beta_3 \frac{A_{ij}}{P_j q_{ij}}, \qquad (27)$$

where the left-hand term can be interpreted as the Lerner index, which is a function of: (a) the ratio of the market share of the i^{th} retailer in the j^{th} retail market, S_{ij}^r, to the regional elasticity of demand, η_j, weighted by $\beta_1 = 1 + \lambda_{ij}$, where λ_{ij} is the i^{th} retailer's conjectural variation in the j^{th} retail market; (b) ratio of the market share of the retailer in the national wholesale market, S_{ij}^n, to the national elasticity of wholesale supply, ϵ, weighted by $\beta_2 = 1 + \theta_{ij}$, where θ_{ij} is the i^{th} retailer's conjectural variation in the national wholesale market, and R_{ij} is the wholesale-retail price ratio; and (c) the ratio of the retail slotting allowance for the i^{th} retailer in the j^{th} retail market, A_{ij}, to retailer sales revenue in the j^{th} retail market, $P_j q_{ij}$. Obviously, the first two terms capture the familiar effects of oligopolistic power and oligopsonistic power on retail price-cost margins, while the last term captures the effects of slotting allowances. Azzam suggests that if β_3 = 1, then the retail price-cost margin is the same with or without slotting allowances. Alternatively, if there is no evidence of oligopoly power, and $\beta_3 = 0$, the retailer earns normal rents, which would be consistent with the risk-sharing/signaling/screening stories of Sullivan, Chu, and, Lariviere and Padmanabhan. In addition, while the model is not a differentiated goods, Nash in prices story, Azzam suggests that retailer exertion of market power in the presence of slotting allowances would be consistent with Shaffer's (1991a) prediction. Retail slotting allowances may also be consistent with no retailer oligopsony power, $\beta_2 = 0$, or retailer oligopsony power, $\beta_2 > 0$.

Apart from the fact that implementing such analysis empirically would be very data intensive, with numbers on firm-level slotting allowances being very hard to come by, Azzam suggests that the model would only give indirect evidence of the competing hypotheses of the effects of slotting allowances. This would likely also be the case if one were to apply such a methodology to analyzing other types of vertical restraint such as exclusive dealing and territories, and resale price maintenance. In many ways this is a fundamental problem with the whole NEIO methodology: empirical estimates of conjectural variation parameters/price-cost margins may give some sense of whether market power is being exerted in a market, but little sense of the exact nature of the game firms are playing.

3. Summary and Conclusions

Since the late-1980s, empirical analysis has typically analyzed the extent of market power in the food industry using structural econometric models drawing on an approach commonly termed the new empirical industrial organization (NEIO). In this paper, we have examined what has been learned from use of this methodology, and considered whether it has relevance for empirical analysis of market power in food retailing and the nature of vertical contractual arrangements made with food manufacturers.

Two basic methodologies have commonly been applied to studies of market power in the food industry: the production theoretic approach pioneered by Appelbaum, and the general identification method of Bresnahan (1982). The majority of studies using NEIO methodologies have concerned the US food and related industries. Estimates of the Lerner index vary quite widely over the sample of industries, and, as Sexton suggests, estimated departures from perfect competition, as measured by conjectural variations parameters, have often been quite small. Unfortunately, we know very little about the extent of market power outside of the US food manufacturing sector, and virtually nothing about food retailing.

So what have we learned? Bresnahan (1989) asked this very same question in his survey of empirical studies using the NEIO methodology, and it is worth re-visiting two of his conclusions. His first conclusion was that there is a great deal of market power, as measured by the Lerner index, in some concentrated industries. This conclusion would also seem to hold for the sample of studies in table 1. In particular, these studies have typically focused on industries where there are high levels of seller concentration, and so it is perhaps not surprising that some evidence for market power is found. This raises an interesting question: was it necessary to apply a relatively complex methodology to establish the existence of market power when a thorough case study would likely have come to the same conclusion for a highly concentrated industry? A possible test of the usefulness of these types of study would be whether they are actually used by the antitrust authorities.

A second conclusion drawn by Bresnahan (1989) was that little has been learned from the NEIO methods about the relationship between market power and market structure. Bresnahan (1989) made this comment partly because the industries examined are typically concentrated, and also because NEIO studies have not really addressed the issue of what causes market power. Geroski (*op.cit.*) reinforces this point by suggesting that future analysis should focus less on where market power exists, but rather on why it persists over time. For example, most studies in the literature have failed to model entry. In addition, the discussion in the previous section would suggest that NEIO models of food retailing and vertical contractual arrangements probably need to be more sophisticated than current models, although data constraints would likely limit the researcher's ability to actually apply such models. [31] We conclude by citing Geroski:

> "Detecting collusion is a lot like searching for skeletons in closets. Over the years industrial economists have learned much about which closet doors to try opening, and about how to recognize what they can only imperfectly observe within." (Geroski, 1988, p.119)

[31] See Smith (1999) for an example of how a model of supermarket competition might be developed.

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Figure 1: Identifying monopoly power of a firm

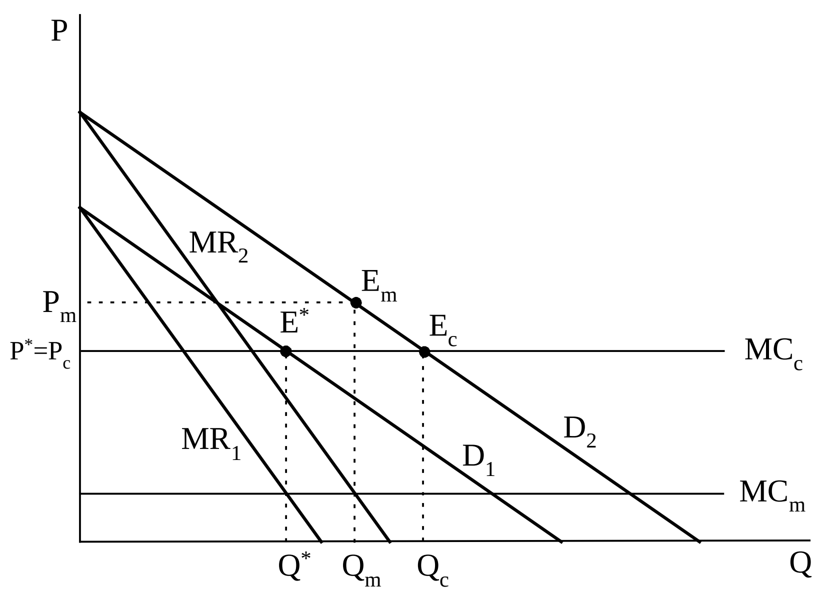

Figure 2: Monopoly power not identified

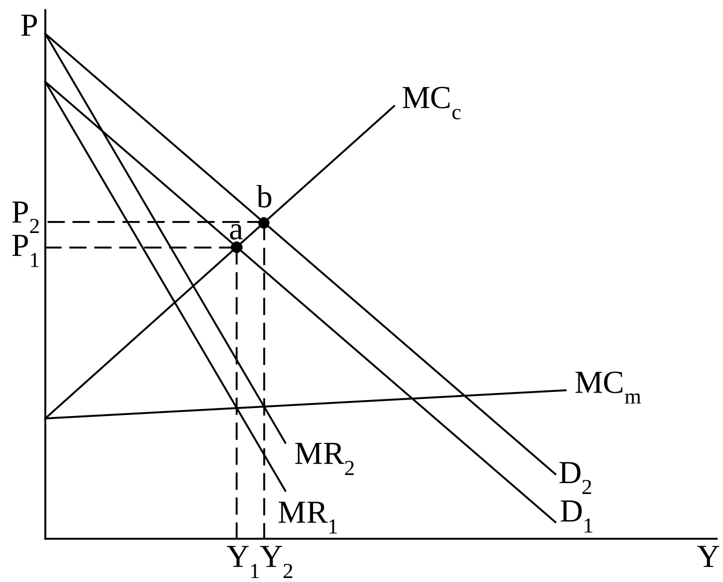

Figure 3: Identification of monopoly power and the industry supply relation

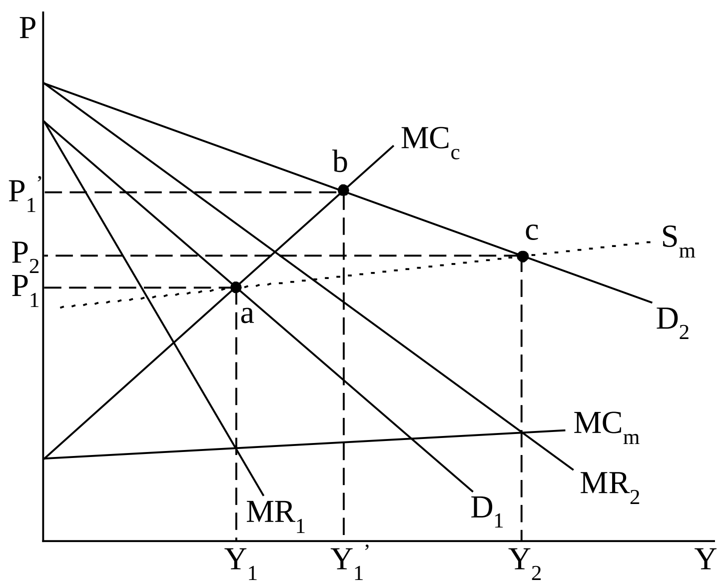

Table 1: Estimated Market Power and Lerner Indices [a]

Study	Industry	Market Power	Lerner Index
Appelbaum (1982)	US textiles	0.05*	0.07
	US tobacco	0.40*	0.65
Lopez (1984)	Canadian food processing	0.19*	0.50
Schroeter (1988)	US beef-packing:	0.22*	
	- oligopsony		0.01
	- oligopoly		0.04
Karp and Perloff (1989)	Rice export	0.68† [d]	0.11
Azzam and Pagoulatos (1990)	US meat (oligopoly)	0.22*	0.46
	US livestock (oligopsony)	0.18*	1.10
	US composite meat processing		0.74
Schroeter and Azzam (1990)	US beef [b]	0.05*	0.55
	US pork [b]	0.06*	0.47
Buschena and Perloff (1991)	Philippines coconut oil	0.58†	0.89
Wann and Sexton (1992)	US grade pack pears [b]	0.08*	0.15
	US fruit cocktail [b]	0.48*	1.41
Deodhar and Sheldon (1995)	German bananas	0.29†	0.26
Deodhar and Sheldon (1996)	German bananas	0.20† [d]	0.18
Bhuyan and Lopez (1997)	US food industries [c]	0.18*	0.33
	US tobacco industries	0.18*	0.33
Wilson (1997)	UK bread manufacturing	0.31	0.84
Genoseve and Mullin (1998)	US sugar industry	0.04†	0.05
Steen and Salvanes (1999)	French fresh salmon	0.02-0.05† [e]	0.12-0.04
Bettendorf and Verboven (2000)	Dutch coffee roasting	0.02-0.17* [f]	0.07-0.54
Gohin and Guyomard (2000)	French food retailing:		
	- dairy products [b]	-0.02*	0.20
	- meat products [b]	-0.03*	0.17
	- other food products [b]	0.01*	0.12

[a] Acknowledgements to Jeff Perloff (UC Berkeley) for providing some of the data in this table
[b] Estimates based on joint oligopsony/oligopoly power
[c] Bhuyan and Lopez also calculated Lerner indices for 40 4-digit SIC food industries, ranging from 0.72 for cereal preparation to 0.08 for dried fruit and vegetables
[d] Estimate based on a closed loop dynamic model
[e] Static and dynamic estimate
[f] Quadratic and logarithmic demand estimates
* Conjectural elasticity
† Conjectural variation