ON IDENTIFYING THE DEGREE OF COMPETITIVENESS FROM INDUSTRY, PRICE AND OUTPUT DATA: A DISEQUILIBRIUM APPROACH

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I. INTRODUCTION

For many years now, identifying econometrically the extent of market power in a concentrated industry, has been an issue extensively debated on industrial organization.

In early empirical studies[1] economists measured the degree of market power implicitly. In such cases researchers used primarily profit or cost data. Recently, Bresnahan (1982) and Lau (1982) pointed out why an implicit determination suffers from a fundamental deficiency.

Furthermore, they exhibited how, rather than identifying implicitly an index of competitiveness, one can use a specific explicit approach, a system of demand and supply functions, and identify the degree of market power with great accuracy.

The appealing argument, proved theoretically by Lau, states that if the inverse demand function $P = f(Q, z)$ is not separable on z, then standard econometric techniques and information on price, output and other demand or supply exogenous variables, are sufficient to measure the degree of market power.

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1) For references see (2).

The purpose of this paper is to demonstrate how we can identify the degree of market power explicitly even if the demand function is linear i.e. separable on z.

The analysis proceeds in the context of an estimation technique used for models of markets in disequilibrium. What distinguishes these models from the equilibrium ones, is the extra information available, thereby permitting us to discriminate between periods of excess supply and excess demand.

Since we now have available information as to which of the two possible regimes is currently in, we have in effect not one, as in Bresnahan's model, but two «observations» in each period, namely :

i. the value Qt of transacted quantities,

ii. a variable indicating whether or not we are currently in excess demand or excess supply.

The primary result which easily emerges from this analysis is the following : Under fairly plausible assumptions, we can identify the degree of market power if we utilize the additional information which is inherent in most disequilibrium models. Evidently this approach allows us to overcome Lau's restriction for non - separable inverse demand function.

II. THE MODEL

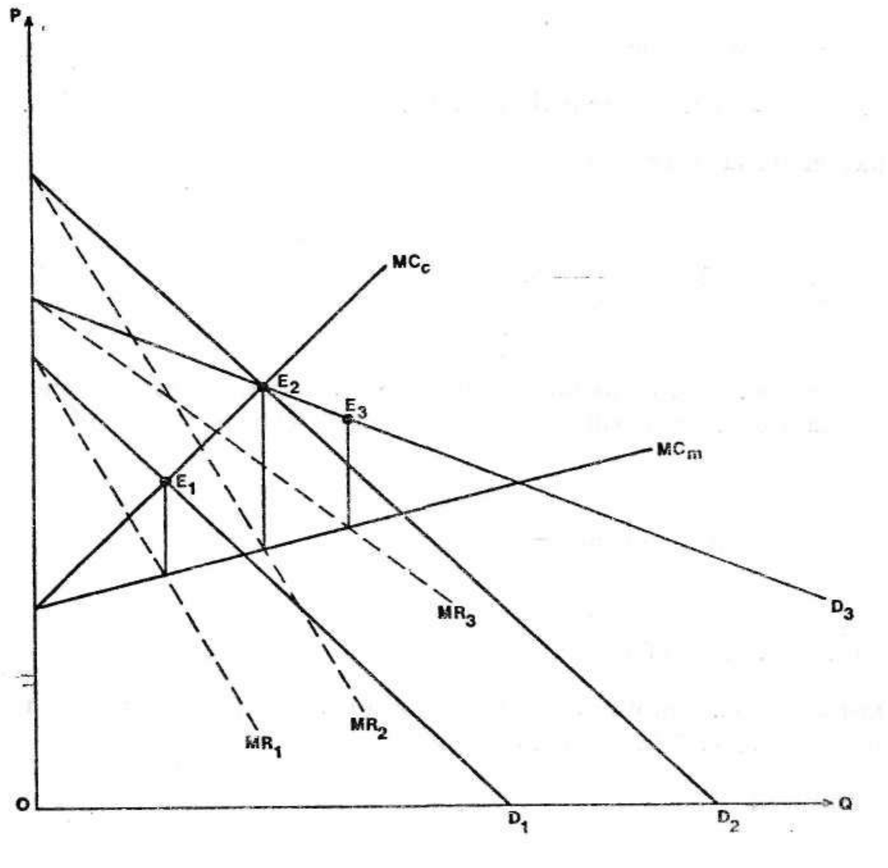
Bresnahan's basic idea is illustrated in figure I. We start with an original demand function D_1, and two marginal cost functions, one for competitive MC_c and the other for monopolistic market conditions MC_m. By construction equilibrium point for either one of the two markets turns out to be the same E_1. Assuming linear inverse demand functions a change in one of the exogenous variables results to :

(i) a parallel shift in D_1(such as D_2 position),

(ii) a new equilibrium point E_2 again the same for both monopoly and competition.

Evidently the degree of market power is not identified. In order to solve this problem Bresnahan introduced internactively with P i.e. the price of the product, another independent variable which combines elements of both rotation and vertical shifts for the demand function. From figure I we observe that if the new position for the demand is D^3, the equilibrium point for competition remains the same E_2, but for the monopolistic market we have a new equilibrium point, which is E_3. Clearly, now the degree of market power is identified.

In this paper we want to argue that the above methodology is feasible when the identification problem is approached from a market equilibrium perspective i.e. Qt = Dt = St- However following a disequilibrium approach we can relax the restriction imposed by Lau's theorem on the inverse demand function i.e. non separable on exogenous variables, improving substantially the flexibility of the model.



Following Bresnahan we define the demand function as :

$$D_t = \alpha_o + \alpha_1 P_t + \alpha_2 Yt + \varepsilon_t \qquad (1)$$

where : D_t = quantity demanded in period t.

P_t = price asked on the transaction of D.

Y_t = income, and

ε_t = a random element.

To keep the model simple we assume that marginal cost function is linear :

$$MC = \beta_o + \beta_1 S_t + \beta_2 W_t \qquad (2)$$

where : W = wage rate

and S_t = quantity supplied in period t.

Since marginal revenue is :

$$MR_t = Pt + \frac{1}{\alpha_1} St \qquad (3)$$

easily we can modify this function in order to consider cases with firms acting as price setters. The modified marginal revenue function is :

$$MR_t^M = P + \lambda \left[\frac{S_t}{\alpha_1} \right] \qquad (4)$$

and λ is an index of market power.

Obviously from a profit maximazation condition we derive a supply relation similar to equation (5) in Bresnahan's paper :

Thus, when :

$$MC = MR_t^M \qquad (5)$$

then :

$$P = \beta_0 + (\beta_1 - \frac{\lambda}{\alpha_1}) S_t + \beta_2 W_t + n_t \qquad (6)$$

including a random element (n_t) and O $\lambda <$ 1[2]

Equations (1) and (6) form a simultaneous market equilibrium model in terms Qt, D_t, St, and P_t as follows :

$$Dt = \alpha_o + \alpha_1 P_t + \alpha_2 Y_t + \varepsilon_t \quad (7)$$

$$S_t = \theta_9 + \theta_1 P_t + \theta_2 W_t + \mu_t \quad (8)$$

$$Qt = D_t = S_t$$

$$\theta_0 = \frac{\alpha_1 \beta_o}{\beta_1 \alpha_1 - \lambda} \quad (9)$$

$$\theta_1 = \frac{\alpha_1}{\beta_1 \alpha_1 - \lambda} \quad (10)$$

$$\theta_2 = - \frac{\alpha_1 \beta_2}{\beta_1 \alpha_1 - \lambda} \quad (11)$$

$$\alpha_1$$

$$\beta_1 \alpha_1 - \lambda$$

The same equations form a simultaneous disequilibrium model called by Laffont and Garcia (1977) the «Fair - Jaffee» (F - J) model.

$$D_t = \alpha_0 + o_1 P_t + a_2 Y_t + \varepsilon_t$$

$$S_t = \theta_0 + \theta_1 P_t + \theta_2 + \mu_t \qquad (Y_t, W_t \text{ exogenous})$$

$$Q_t = \min (D_t, S_t) \quad (12)$$

2) When $\lambda = 1$ we observe a case of cartel, and then it becomes almost impossible to determine a supply relation.

$$P_t - P_{t-1} = \delta_1 (D_t - S_t) \quad \text{if } D_t - S_t \; 0 \qquad (13)$$

$$= \delta_2 (Dt - St) \quad \text{if } Dt - St < 0$$

with $\delta_1 \pm \delta_2$.

In the (F - J) specification Dt and St react simultaneously to form Pt which is consequently interpreted as the price during period t rather than being located at the end of the period. Let k_1 (resp. k_2) be the set of points attributed to the demand (resp. supply) function. The difference $Pt - Pt_{-1}$ provides a simple switch between periods of excess demand and excess supply. P_t is considered as endogenous and Pt_{-1} predetermined[3].

A straightforward reformulation for the (F - J) model results to the following simultaneous specification :

$$Qt = \alpha_0 + \alpha_1 P_t + \alpha_2 Yt - \frac{1}{\delta_1}(Pt - P_{t-1}) \; R \; (Pt - P_{t-1})\varepsilon_t \qquad (14)$$

$$Qt = \theta_0 + \theta_1 P_t + \theta W_t - \frac{1}{\delta_2}(P_t - P_{t-1}) \; (1 - R(Pt-Pt-1)) + \mu_1 \qquad (15)$$

where R is a (0,1) - ramp function defined by :

$$R(x) = \begin{cases} 1 \text{ if } x \geqslant 0 \\ 0 \text{ otherwise} \end{cases}$$

$$\text{with} \quad x_t = D_t - S_t$$

The system of reduced form equations for the original Bresnahan's equilibrium specification is :

$$Q_t = \left[\alpha_0 + \alpha_1 \left(\frac{\theta_0 - \alpha_1}{\alpha_1 - \theta_1}\right)\right] - \frac{\alpha_2 \theta_1}{\alpha_1 - \theta_1} Y_t + \frac{\alpha_1 \theta_2}{\alpha_1 - \theta_1} W_t + \Phi_t \qquad (16)$$

3) See T. Amemiya (1974) and Laffont and Garcia (1977).

$$\mathrm{Pt} = \frac{\theta_0 - \alpha_1}{\alpha_1 - \theta_1} - \frac{\alpha_2}{\alpha_1 - \theta_1} \mathrm{Y}_t + \frac{\theta_2}{\alpha_1 - \theta_1} \mathrm{W}_t + \omega_t \tag{17}$$

and

$$\Phi_t = \left[\varepsilon_t + \frac{\alpha_1}{\alpha_1 - \theta_1} (\mu_t - \varepsilon_t) \right] \quad \omega_t = \frac{1}{\alpha_1 - \theta_1} (\mu_t - \varepsilon_t).$$

Given that (16) and (17) are all in terms of as and 0's the model is id enti fied, as it has been argued convincingly by Bresnahan. However the degree o market power λ is not identified endogenously from the model, because knowing as and 0's from (9), (10) and (11) we determine β's if we specify λ.

The system of reduced form equations for the disequilibrium specification (excess supply conditions) has as follows :

$$\mathrm{Q}_t = \alpha_0 + \frac{(\alpha_0 - \theta_0)\alpha_1\delta_2}{\delta} + \frac{\alpha_1\alpha_2\delta_2}{\delta} \mathrm{Y}_t - \frac{\alpha_1\theta_2\delta_2}{\delta} \mathrm{W}_t + \frac{\alpha_1}{\delta} \mathrm{P}_{t-1} + \frac{\alpha_1\delta_2}{\delta} (\varepsilon_t - \mu_t) \tag{18}$$

$$\mathrm{Pt} = \frac{(\alpha_0 - \theta_0)\delta_2}{\delta} + \frac{\alpha_1\delta_2}{\delta} \mathrm{Y}_t - \frac{\theta_2\delta_2}{\delta} \mathrm{W}_t - \frac{1}{\delta} \mathrm{P}_{t-1} + \frac{\delta_2}{\delta} (\varepsilon_t - \mu_t) \tag{19}$$

and $\delta = 1 + (\theta_1 - \alpha_1)\,\delta_2$. **(20)**

However and contrary to the result obtained from the equilibrium model, λ and the equation coefficients are all identified.

This is true because the estimated coefficient from equation (18) and (19) and equation (20) form a system of nine equations with nine unknowns (α's, 0's and λ, δ, δ_2). Thus, in principle the system has a solution for all the unknown variables, including the undetermined, from the equilibrium model, degree of monopoly power λ.

III. CONCLUSION

In the introduction of this paper we argued that an econometric determination of the degree of monopoly power from price - output data is feasible, even if the inverse demand function is linear. To support this argument with a paradigm, we use a simple disequilibrium model, the «Fair - Jaffee» model, proposed by J.J. Laffont and R. Garcia. Modifying the equilibrium hypothesis on Bresnahan's model with the disequilibrium assumption, we claimed that this stands as a counterargument for the impossibility theorem proved by Lau for an equi librium specification.

However, it is reasonable to accept two limitations imposed to the researchers by this approach. First, the profound inconvenience that always exists when we use a disequilibrium versus an equilibrium econometric model. Second, there is no Maximum Likelihood algorithm available to solve the problem. Obviously the one proposed by Laffont and Garcia is not operational in this case, because originally it has not been constrained for the values of the coefficients. Thus it is probable, using the same algorithm to evaluate different λ's as we estimate the two regimes (excess supply- excess demand) separately applying the short-side technique (k_1, k_2 sets of points).

REFERENCES

1. AmemiyaT. : «A note on a Fair and Jaffee model». Econometria Vol.42 (1974) pp. 759 - 762.
2. Bresnahan Timothy F. : «The Oligopoly solution concept is identitied». Economics Letters 10 (1982) pp. 87-92.
3. R.C. Fair and D.M. Jaffee : «Methods of Estimation for Markets io Disequilibrium». EcconometricaVol. 40 (1972) pp. 492 - 514.
4. J.J. Laffont and R. Garcia : «Disequilibrium Econometrics for Business Loans». Econometrica Vol. 45 (1977) pp. 1187-1204.
5. Lau Lawrence J. : «On identifying the Degree of Competitiveness from Industry Price and Output Data». Economics Letters 10 (1982) pp. 93-99.