Main Idea!

Conduct Parameter

Empirical Studies of Pricing: Homogenous Goods

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Empirical Studies of Pricing

You want to infer from data the "competitivenes" of an industry/market. How would you go about it?

Empirical Studies of Pricing

- The Structure Conduct Performance Paradigm (SCPP)
- "Reduced Form" tests of market power
- NEIO – The question of identification

The Structure Conduct Performance Paradigm (SCPP)

- Question: How does concentration affect conduct?
- "Theory":

  Basic conditions (supply:tech, unions, volume/weight, legal; demand: pref., growth, seasonality) $\rightarrow$ **Market Structure** (# of sellers/buyers, vertical integration, product diff) $\rightarrow$ **Conduct** (pricing, advertising, investment) $\rightarrow$ **Performance** (equil outcome, welfare)
- The ideal experiment: randomly assign market structure and see how performance is affected
- The actual procedure: look at profitability as a function of concentration

The Structure Conduct Performance Paradigm (SCPP)

For example: in Cournot equilibrium $\frac{p-mc}{p} = \frac{HHI}{\eta}$; used to loosely motivate the regression

$$ln(PCM_j) = \alpha_0 + \alpha_1 * C4_j + \alpha_2 ln\eta + \epsilon_j$$

or

$$ln(PCM_j) = \beta_0 + \beta_1 * C4_j + \epsilon_j$$

where $PCM = \frac{p-mc}{p}$, $C4$ is share of top 4 firms, $j = 1, ..., J$ − cross section of firms.

The second is the "plain vanilla" version of a SCPP regression;

Problems

- Data:
  i) Dependent variable: accounting profits/returns on assets, PCM from Census of Mnfr;
  None of these are true economic margins, which is what we want.
  ii) Additional variables: elas of demand, BTE, product differentiation;
  Rarely observed $\rightarrow$ cannot control for differences across mkts/industries.
  iii) Market definition: needed to define concentration

Problems (cont)

- "Experiment"/Simultaneity issues:

  Comparison across industries – do we think that concentration is exogenous? Especially since there is little control for industry characteristics.

- Interpretation:

  Positive correlation between C4 and profits can be due to cost advantage (good performance) or high markups (bad performance)

Where does this leave us?

1) Not all is lost – Example, Salinger (1990) uses panel data to introduce industry fixed effects (to "deal") with simultaneity problem) and additional regressions (to "address" interpretation issues);
2) Can't answer original question, all we can hope for are empirical regularities (Schmalensee, HIO)

Where does this leave us?

3) "New Empirical IO"

   (i) PCM are not assumed to be observed, rather mc are estimated.

      Deals with the main data problem.

   (ii) Study a specific industry, using time series or a cross section of geographical mkts.

      Deals with the simultaneity problem.

   (iii) Conduct is viewed as a parameter to be estimated.

      Ties more directly to theory (not always) and deals with interpretation.

“Reduced Form” Tests of Market Power

– Motivated by the concerns with the SCPP an early literature tried to use “reduced form” approaches to study market power

– Note the “reduced form” refers to a different style than what one might see in various labor papers: still derived from theory as apposed to being a purely a-theoretical approach – The general

lesson from these approaches: one needs to specify a more complete model to interpret the results

– Some of these approaches have made a come back

Sumner (JPE, 81), Measurement of Monopoly Behavior: An Application to the Cigarette Industry

- Proposes to measure monopoly power by looking at pass through rates
- Data: panel (state-year) in the cigarette industry
  - Observes prices (p_{it}) and per-pack taxes (τ_{it})
  - Large variation in τ_{it} due to regulation
  - τ_{it} is mc, since per pack

Model

- If firms are "price takers" (and there are CRS in production) then
$$p_{it} = mc_{it} + tau_{it}$$
and pass-through is 1. Thus
$$H_0 : \frac{dp_{it}}{d\tau_{it}} = 1$$

- If firms have market power then, w/ constant (and identical over i and t) elas of demand, $\eta > 1$ then (using the firm FOC):
$$MR_{it} = p_{it}(1 - \frac{1}{\eta}) = mc_{it} + \tau_{it}$$
Thus
$$H_1 : \frac{dp_{it}}{d\tau_{it}} = \frac{1}{(1 - \frac{1}{\eta})} > 1$$

Estimation

- The paper proposes to estimate

$$p_{it} = \alpha_i + \beta_t + \gamma \tau_{it} + u_{it}$$

- If $\hat{\gamma} > 1$ reject H_0
- What do you think of this?

Comments

1) Correct specification on H_1 depends on the demand curve (Bulow and Pfleiderer, JPE 83)
   - The above critically relies on the constant elasticity assumption
   - In general pass through depends on the curvature of the demand curve and can be greater/less/equal to 1
   - If inverse demand curve is $p = \alpha - \beta q^{\delta}$ then $dp/d\tau = 1/(1+\delta) < 1$ (=0.5 if demand is linear)
   - If inverse demand curve is $p = \alpha - \beta ln(q)$ then $dp/d\tau = 1$

Comments

2) Similar issue with H_0
   - The above critically relies on the CRS assumption
   - If the supply curve is upward sloping then

$$H_0 : \frac{dp_{it}}{d\tau_{it}} < 1$$

   - Standard result in PF re the "incidence" of a tax.
3) Could get $\hat{\gamma} > 1$ even in "competitive" market if we have entry or switching to more expensive brands (some form of product differentiation) when a tax is introduced

Additional papers

- Panzar and Rosse (JIE, 1987)
    - Look at comparative statics in the revenue function ($\psi =$ the sum of the factor price elasticities of revenue)
        - show $\psi = 1$ for PC, $\psi < 0$ for M and $\psi <= 1$ for monopolistic competition
    - Find that for newspapers $0 < \hat{\psi} < 1$
    - Pros: more theoretically sound; uses easier to get data
    - Cons: empirical challenges (requires all relevant factor prices, factors must be exogenous, etc.)
- Ashenfelter and Sullivan (JIE, 1987): go back to cigarettes and derive "local" conditions for monopoly behavior

- The main conclusion form this literature is that one needs to impose more structure in order to interpret the RF results
- Recently we have seen some resurgence of these ideas
  - Weyl and various co-authors (e.g., Weyl and Fabinger, JPE 2013 re-examine incidence under imperfect competition
  - Cabral, Geruso and Mahoney (AER, 2018, Do Larger Health Insurance Subsidies Benefit Patients or Producers? Evidence from Medicare Advantage)
    - Using diff-in-diff to show incomplete pass through of subsidies
    - Find higher pass through rates in more "competitive markets

NEIO — The question of identification

(based on Bresnahan, Economic Letters, 1982)

Question: Can conduct be identified (jointly with cost and demand parameters) from equilibrium price and quantity data from different markets (time periods)?

A non-identification result

Demand: $$Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 Y_t + \epsilon_t$$

where:

$$Q_t = \text{Quantity in period } t$$

$$P_t = \text{Price in } t$$

$$Y_t = \text{exogenous demand shifter}$$

Marginal Cost: $$MC_t = \beta_0 + \beta_1 Q_t + \beta_2 W_t + \eta_t$$

where: W_t = exogenous cost shifter

NEIO — A non-identification result

Supply: $$P_t = \theta(-Q_t/\alpha_1) + \beta_0 + \beta_1 Q_t + \beta_2 W_t + \eta_t$$

θ is a (conduct) parameter that indexes different models of pricing. Later we will talk where it comes from. For now note that $\theta = 1$ is monopoly pricing and $\theta = 0$ is marginal cost pricing.

- Using the exogenous variables Y_t and W_t we can identify $\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_2$ and $\beta_1 + \theta/\alpha_1$
- But we cannot separate the conduct parameters from economics of scale

We can also see this graphically.

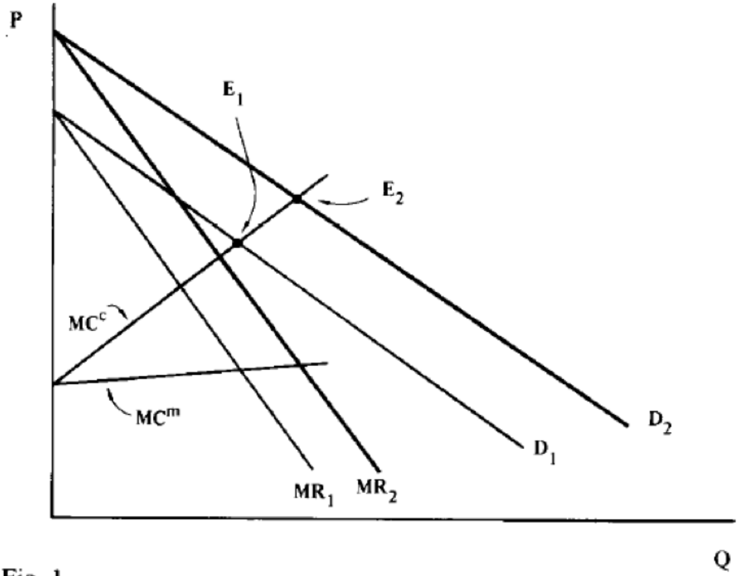


Fig. 1.

Identification through rotation of demand

Suppose we alter the model by adding a variable that exogenously rotates the demand curve.

Demand: $Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 Y_t + \alpha_3 P_t Z_t + \epsilon_t$

where: $Z_t =$ exogenous variable;

The supply relation now becomes

Supply: $P_t = \theta(-Q_t/\alpha_1 + \alpha_t Z_t) + \beta_0 + \beta_1 Q_t + \beta_2 W_t + \eta_t$

The demand parameters are identified; treat them as known; define $Q_t^* = -Q_t/(\alpha_1 + \alpha_2 Z_t)$; supply can be written as:'

$$P_t = \beta_0 + \beta_1 Q_t + \beta_2 W_t + \theta Q_t^* + \eta_t$$

Now all the parameters are identified

Graphically:

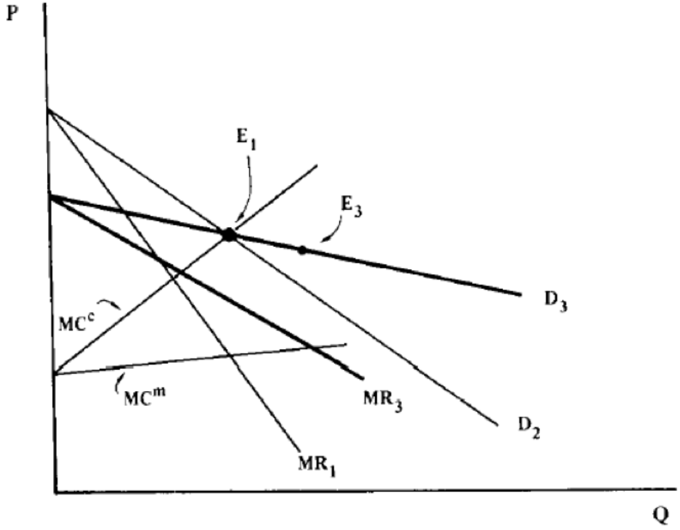


Fig. 2.

Comments:

1) The above can be generalized beyond linear demand and supply curves (see Lau, Economic Letters, 82).
2) There are alternative assumptions we could make to get identification. For example:
   - fixed marginal cost
     $\Rightarrow P_t = \theta(-Q_t/\alpha_1) + \beta_0 + \beta_2 W_t + \eta_t$
   - (lack of) supply shocks (Porter, 83);
   - comparative statics in cost;
   - direct measures of cost;
3) How should we think of the parameter θ?

   Note: a key point in the above analysis is that θ is constant over time, as we will see below this is important for the interpretation.

Porter, 1983, A Study of Cartel Stability: the JEC 1880-1886

Q: We observe price (and quantity) shifts over time. Are they due to (exogenous) shifts in the demand and cost functions? Or are they due to price wars?

Background: The JEC was a cartel that controlled the eastbound railway grain shipment. It preceded the Sherman Act and therefore was explicit.

The cartel used an internal enforcement mechanism similar to the trigger strategy.

Theory (Green-Porter, 84)

- Firms compete in prices
- (Aggregate) Demand uncertainty
- Firms collude: set price between Bertrand and monopoly
- Firms observe demand, which is a noisy signal of competitors behavior. (low demand could be due to a deviation in collusion or aggregate low demand)
- If the (firm-level) demand falls below a threshold (trigger) then firms switch to Bertrand pricing for T periods, i.e., there is a price war

Prediction: along the equilibrium path price wars occur.
(Other predictions: timing of price wars (triggers) and no cheating in equilibrium).

Model

– Demand: $log(Q_t) = \alpha_0 + \alpha_1 log(P_t) + \alpha_2 L_t + U_{1t}$

where $L_t = 1$ if Lakes were open, 0 otherwise;

– N symmetric firms with costs $C_i(q_{it}) = a_i Q_{it}^{\delta} + F_i$

where δ is a constant greater than 1.

– Homogenous product so the firm-level supply for different behavioral models can be summarized by

$$P_t(1 + \theta_{it}/\alpha_1) = mc_i(q_{it}) \quad i = 1, ..., N$$

Model (cont)

The estimation uses aggregate data so this is aggregated to market level supply. Let $\theta_t = \sum_{i=1}^{N} \theta_{it} S_{it}$, where $S_{it} = q_{it} / Q_t$, and

$$P_t(1 + \theta_t / \alpha_1) = \sum_{i=1}^{N} S_{it} mc_i(q_{it}) = DQ_t^{\delta - 1}$$

where $D = \delta(\sum_i a_i^{1/(1-\delta)})^{1-\delta}$

Taking logs

$$log(P_t) = -log(1 + \theta_t / \alpha_i) + log(D) + (\delta - 1) log(Q_t)$$

Model (cont)

For the estimation the supply equation will be

$$log(P_t) = \beta_0 + \beta_1 log(Q_t) + \beta_2 S_t + \beta_3 I_t + U_{2t}$$

where $I_t = 1$ if industry is in collusive state at time t; S_t is a vector of structural dummy variables that reflect entry and acquisitions.

If during non-collusive states the industry plays Bertrand then $\beta_0 = log(D)$ and $\beta_1 = \delta - 1$. If during collusive states firms max joint profits then $\beta_3 = log(\alpha_1/(1+\alpha_1))$.

Identification and Estimation

– U_{1t} and U_{2t} are assumed to be distributed joint normal
– If the sequence $\{I_1, ..., I_T\}$ is known the model can be estimated using 2SLS
– If instead I_t is unknown and assumed to be distributed

$$I_t = \begin{cases} 1 & \text{with probability } \lambda \\ 0 & \text{with probability } 1 - \lambda \end{cases}$$

then the model becomes a "switching model" and can be estimated by ML (either directly or using an E-M algorithm).

– The key identifying assumption is that there are no systematic supply shocks missing from the supply equation. Or that U_{2t} does not have a bi-modal distribution.

Results

TABLE 1	List of Variables*
GR	grain rate, in dollars per 100 lbs.
TQG	total quantity of grain shipped, in tons.
LAKES	dummy variable; =1 if Great Lakes were open to navigation; =0 otherwise.
PO	cheating dummy variable; =1 if colluding reported by *Railway Review*; =0 otherwise.
PN	estimated cheating dummy variable.
DM1	=1 from week 28 in 1880 to week 10 in 1883; =0 otherwise; reflecting entry by the Grand Trunk Railway.
DM2	=1 from week 11 to week 25 in 1883; =0 otherwise; reflecting an addition to New York Central.
DM3	=1 from week 26 in 1883 to week 11 in 1886; =0 otherwise; reflecting entry by the Chicago and Atlantic.
DM4	=1 from week 12 to week 16 in 1886; =0 otherwise; reflecting departure of the Chicago and Atlantic from the JEC.

* The sample is from week 1 in 1880 to week 16 in 1886.

Results

TABLE 2 **Summary Statistics**

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
GR	.2465	.06653	.125	.40
TQG	25384	11632	4810	76407
LAKES	.5732	.4954	0	1
PO	.6189	.4864	0	1

TABLE 3 **Estimation Results***

Variable	Two Stage Least Squares (Employing *PO*) Demand	Supply	Maximum Likelihood (Yielding *PN*)** Demand	Supply
C	9.169	−3.944	9.090	−2.416
	(.184)	(1.760)	(.149)	(.710)
LAKES	−.437		−.430	
	(.120)		(.120)	
GR	−.742		−.800	
	(.121)		(.091)	
DM1		−.201		−.165
		(.055)		(.024)
DM2		−.172		−.209
		(.080)		(.036)
DM3		−.322		−.284
		(.064)		(.027)
DM4		−.208		−.298
		(.170)		(.073)
PO/PN		.382		.545
		(.059)		(.032)
TQG		.251		.090
		(.171)		(.068)
R^2	.312	.320	.307	.863
s	.398	.243	.399	.109

* Monthly dummy variables are employed. To economize on space, their estimated coefficients are not reported. Estimated standard errors are in parentheses.

** *PN* is the regime classification series $(\hat{I}, \ldots, \hat{I}_T)$. The coefficient attributed to *PN* is the estimate of β_3.

TABLE 4 **Price, Quantity, and Total Revenue for Different Values of *LAKES* and *PN****

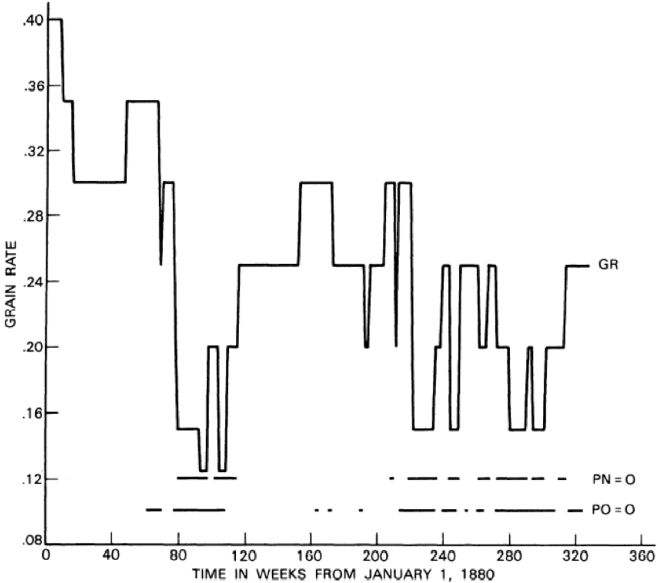
Price	LAKES 0	LAKES 1
PN 0	.1673	.1612
1	.2780	.2679
Quantity		
PN 0	38680	25904
1	25775	17261
Total Revenue**		
PN 0	129423	83514
1	143309	92484

* Computed from the reduced form of the maximum likelihood estimates of Table 3, with all other explanatory variables set at their sample means.

** Total Revenue = 20 (Price × Quantity), to yield dollars per week.

FIGURE 1

PLOT OF GR, PO, PN AS A FUNCTION OF TIME



Comments:

- The paper documents the existence of price wars (subject to the identifying assumption and the functional forms).
- Note the different use of θ relative to Bresnahan:
  1) θ varies over time according to a theory of repeated interaction
  2) No attempt to measure which equilibrium is being played in each period just document that there are 2 different states (the assumption is that the equilibrium being played is constant within a regime)

Extensions:

- Ellison (*Rand, 94*) re-examines the model, generalizing it in several ways. He also looks at Rotemberg-Saloner theory, looks for triggers and looks for evidence of secret price cuts.
- Other papers have looked for evidence supporting other predictions of the model.

Comments on Conduct Parameters (θ)

– Suppose we observe prices and quantities of (single product) firms $i = 1, ..., I$ at time (market) $t = 1, ..., T$. Write

$$P_{it} = mc_{it} + \theta_{it} \frac{Q_{it}}{\partial Q_{it} / \partial p_{it}}$$

– Note:

- Since the conduct parameter varies over observations (and can take on any value) this is not restrictive
- We do not need error to fully explain data
- The same is true even if we impose a functional form on costs
- The restrictions (and any objections) come when we impose restrictions over observations and on values of θ.

– We will see that some have objected to the conduct parameter approach: these objections have to come from the restrictions one imposes on th above.

Where do the Conduct Parameters (θ) come from?

1) Specific theory (or a small # of theories). (e.g., static theories, Bertrand , Cournot, etc. or models of repeated interactions, like the Porter paper)
   θ are often used as shorthand;
   θ were written as a varying parameter but significant structure was imposed on it in the empirical work.

Where do the Conduct Parameters (θ) come from?

2) Conjectural Variations approach.

- θ is treated as a continuous-valued parameter to be estimated
- The θ parameters are sometimes described in terms of firms conjectures (or expectations) about the reactions of other firms to their actions;
- This has been widely criticized for many reasons including:
  - lack of theoretical consistency;
  - difficult interpretation;
  - "as if" parameter/structural interpretation;
  - identification (see below);

Where do the Conduct Parameters (θ) come from?

3) Specification test: estimate θ as a continuous parameter but use it only as a specification test (i.e., can you reject some specific theory).

Final Comments on CPM

1) Empirical findings

The empirical work tends to find that θ is different from 0 and 1. In other words, both perfect competition ($p = mc$) and monopoly pricing are rejected (see survey in Bresnahan's Handbook chapter).

Maybe not surprising but coming from a Chicago-School view of the world this is useful.

Final Comments on CPM (cont)

2) The Corts criticism (Corts, *Journal of Econometrics*, 98)

   Criticizes the as-if interpretation of the continuous conduct parameter. The as-if interpretation says that the firms could be thought of as behaving as if they were using conjectural variations (even if they are not). The as-if conduct parameter measures an elasticity weighed pricecost margin. Corts claims

   (i) That the estimated conduct parameter measures the average slope of the supply relation;

   (ii) In general this will not equal the elasticity weighted price-cost margin;

   (iii) In Monte Carlo studies he shows that not only are the two not equal, but they are not always positively correlated.

   (iv) Calls for a structural model in order to infer conduct;

Note: as we saw, if θ varies with each observation it imposes no restrictions. So what Corts objects to are the equality restrictions over observations, which are often imposed without a clear model.

Final Comments on CPM (cont)

3) Direct Evidence of Performance
   Wolfram (*AER*, 99) and Genesove and Mullin (*RAND*, 98) compare estimates from CPM to direct measures of market power and find that the two are similar.

Final Comments on CPM (cont)

4) Can we allow θ the vary over observations (and still point identify cost parameters)? Answer is generally no. But we might be able to set identify the parameters.

   Rosen (2005): (1) assumes that θ is between 0 and 1 and (2) uses it to set identify the cost parameters. Interestingly he can then go back and ask what is the range of θ that is consistent with the range of cost parameters and the observed price and quantity (because of the parametric cost function the range for θ will not equal [0 1]).

   Because θ varies over time this avoids the Corts critique.