FALL 2022

Problem Set 2: Estimating Markups

Instructions: You may work in groups. However, you should create, comment, and run your own code after discussions with classmates, and turn in an individual write-up.

1. *Theory of how equilibria change with demand and cost parameters.* Suppose that price is determined by

$$P = a_0 - a_1 Q + \nu \tag{1}$$

and total costs are given by

$$C = F + (b_0 - \eta)Q, \tag{2}$$

where F is an entry cost that must be borne prior to production.

(a) How does the elasticity of demand change with Q and ν?

(b) Solve for the Cournot equilibrium for fixed F and N.

(c) Calculate the industry Lerner index L_I, Herfindahl index H, and demand elasticity for fixed N as a function of the other parameters.

(d) If firms enter up to the point where it is no longer profitable, what is the equilibrium number of firms, the Lerner index, and HHI? (Do not worry about integer constraints.)

(e) Suppose now that firms collude perfectly and split the profits, but firms choose to enter if it is profitable (anticipating collusive conduct). Calculate the equilibrium number of firms, Lerner index L_I, Herfindahl index H, and demand elasticity as a function of the other parameters. How do they differ from the results of (d)?

2. *SCP regression analysis: exogenous market structure, Cournot competition.*

(a) Suppose that there are 1000 different cities in the population, and the number of firms per city is uniformly distributed on {1,2,...,10} (i.e., assign probability 1/10 to each number). In 500 cities, the antitrust authority is inactive, and firms collude perfectly when the number of firms is less than or equal to 8. Otherwise, firms play Cournot.

(b) For the demand function, assume that $a_0 = 3$, $a_1 = .1$ and $v = 0$; .for the cost function, assume that $F = 1$, $b_0 = 1$, $b_1 = 0, \eta = 0$. Construct a dataset that simulates these 1000 cities, and for each city determine the equilibrium Lerner index, Herfindahl index, and demand elasticity as a function of the other parameters. Suppose there is measurement error on the Lerner index, so what is observed is $\ln(L_I) + \varepsilon$, where $\varepsilon \sim U[-.05, -.05]$. You can do this in Stata. Initial code would read:

```
set obs 1000;
gen unif = uniform();
```

```
gen unif2 = uniform();
gen Num = int(unif*10+1);
gen collude = 0;
replace collude = 1 if _n <=500 & Num <=8; /* first 500 markets collude if Number firms <=8
*/
gen F = 1;
gen a0 = 3;
gen a1 = 1
gen b0 = 1;
gen z = 0;
gen h = 0;
gen LernerCN = {insert formula as function of a0, b0, etc.}; /* Eqm Lerner index for Num firms
playing Cournot*/
gen LernerM = {insert formula as function of a0, b0, etc.}; /* Eqm Lerner index for Monopoly*/
gen Herf = 1/Num; /* Herfindahl for symmetric firms with fixed N*/
gen Lerner = collude * LernerM + (1-collude)*LernerCN; /* Lerner index depends on conduct
*/
gen lnLernerObs = ln(Lerner) + .1*(unif2 - .5);
```

In Matlab, the (uncommented) code would read:

```
J = 1000;
unif = rand(J,1);
unif2 = rand(J,1);
Num = ceil(10*unif);
collude = [(Num(1:500)>=8); zeros(500,1)];
F = 1;
a0 = 3;
a1 = 1;
b0 = 1;
z = 0;
h = 0;
LernerCN = {insert}
LernerM = {insert};
Herf = 1./Num;
Lerner = collude.*LernerM + (1-collude).*LernerCN;
lnLernerobs = log(Lerner) + .1*(unif2-.5);
```

(c) Run the structure-conduct-performance paradigm regression:

$$\ln(ObservedLerner_t) = \beta_0 + \beta_1 \ln(ObservedHHI_t) + \varepsilon_t$$

where t indexes the city. Do this separately for the 500 cities where collusion is possible, and the 500 cities where it is not, as well as for the pooled sample. Interpret your estimates of β_1? Should we expect this coefficient to be equal to 1?

3. *SCP regression analysis: endogenous market structure, Cournot competition.*

For this question, suppose that, in every city, firms compete a la Cournot and enter until profits are zero (ignoring integer constraints). Assume that $a_0 = 5$, $a_1 = 1$, $F = 1$, and $b_0 = 1$. Suppose there are 1000 cities in the population.

(a) Assume that, for each city, the demand parameter v is distributed $U[-1, 1]$ and $\eta = 0$. For each city, simulate a value of v and compute the equilibrium number of firms, Lerner index, and Herfindahl index. As above, there is measurement error on the Lerner index so that what is observed is $\ln(L_I) + \varepsilon$, where $\varepsilon \sim U[-.05, .05]$. Run a regression of the (natural) log of the observed Lerner index on the (natural) log of the observed Herfindhal Index.

(b) Repeat part (a) but where the cost parameter η is distributed $U[-1, 1]$ and $v = 0$.

(c) Interpret your results carefully in light of the theory you derived above. In particular, what are the effects of v and η on the equilibrium Lerner Index and Herfindahl Index?