OLIGOPOLY – PART 1

Industry consists of small number of firms - autos, airlines, radio/TV stations in small city, ...
Again depends on industry definition, also changes in time, e.g. emergence of cable TV
Key features: Structural interaction - choice of each affects profits of others
Strategic interaction - all are aware of this interdependence, and this influences their choices

Common idea to all market structures: each firm's choice
  each chooses the variables under its control to maximize its profit
Difference is - given what environment (things outside its control, or constraints on its choices) ?
  Perfect competition - given market price. Monopoly - given demand curve.
  Oligopoly - given the choices of other firms
Question - What are the choice variables of a firm? Two basic possibilities and examples
  Quantity (Cournot) - Boats fish at night, unload catch in morning market
  Price (Bertrand) - Mail order firms simultaneously print catalogs and commit to those prices
In reality some industries may be close to one or the other, but again
  must think of the theories as organizing principles flexibly, not literally
Other dimensions in which oligopolists compete: product design, advertising, R&D, ...
  Different time spans - production capacity may change slowly, prices faster
  Different relationships among products - substitutes or complements ...
In reality, firms often interact repeatedly through time
  Then action at one time must consider future repercussions; affects collusion possibilities
General concept or theory for the outcome of such choices:
   Nash equilibrium - each firm’s choices maximize its profit given the choices of all other firms

But if firms make their choices simultaneously, how can one of them take the other’s choice as given and respond?
Answer – each tries to figure out or guess what the other is choosing and makes its own best choice or best response to this guess
Nash equilibrium is where everyone’s guess about the others is correct
   Similar to concept of rational expectations in macro

Sometimes we will consider situations where firms move sequentially
   Then the second-mover does know what the first has chosen and chooses its own best response
The first one looks ahead to this development, and its choice is best for itself taking into account how the second will react
This is called “rollback” or “subgame perfect” equilibrium

When firms have repeated interaction, need simultaneous / sequential combination

Terminology:
   Cournot – firms choose quantities simultaneously
   Bertrand – firms choose prices simultaneously
   Stackelberg – firms choose sequentially; quantity and price separate subcases
We will illustrate some of these using simple special examples;
   much more theory, policy implications, ... in ECO 321: Industrial Organization next term
COURNOT (QUANTITY) – HOMOGENEOUS PRODUCTS (P-R pp. 443-7)

Price $P$, total quantity $Q = Q_1 + Q_2$, 
inverse demand $P = 200 - Q$

Firm 1 has constant marginal cost $MC_1 = 100$.
If firm 1 thinks firm 2 is choosing $Q_2 = 0$, 
firm 1 has whole inverse demand: $P = 200 - Q_1$
$MR_1 = 200 - 2 Q_1$. To maximize firm 1 profit
$MR_1 = MC_1$, so $200 - 2 Q_1 = 100,
Q_1 = (200 - 100)/2 = 50$

If firm 1 thinks firm 2 is choosing $Q_2 = 40$, 
firm 1’s "residual" inverse demand $RD_1$: 
$P = 200 - 40 - Q_1$
"residual" marginal revenue: $RMR_1 = 160 - 2 Q_1$.
To maximize firm 1 profit, $RMR_1 = MC_1$, 
so $160 - 2 Q_1 = 100, Q_1 = (160 - 100)/2 = 30$

General: If firm 1 thinks firm 2 is choosing $Q_2$, 
firm 1 has residual inverse demand: $P = 200 - Q_2 - Q_1$
$RMR_1 = 200 - Q_2 - 2 Q_1$. To maximize firm 1 profit,
$RMR_1 = MC_1$, so $200 - Q_2 - 2 Q_1 = 100,$
"Reaction curve" $Q_1 = (200 - 100 - Q_2)/2 = 50 - \frac{1}{2} Q_2$

These numbers replicate P-R Fig. 12.4 p. 444

Firm1’s residual demand when $Q_2 = 40$:

See also P-R Fig. 12.3 p. 443
Firm 2’s $MC_2 = 100 - \frac{2}{3} Q_2$

Its profit-max $RMR_2 = MC_2$ given $Q_1$

$200 - Q_1 - 2Q_2 = 100 - \frac{2}{3} Q_2$

$Q_2 = \frac{2}{4} (100 - Q_1) = 75 - \frac{4}{3} Q_1$

Note: $RMR_2$ declines faster than $MC_2$

Cournot equilibrium at point where two firms’ reaction curves intersect

Solving $Q_1 = 50 - \frac{1}{2} Q_2$, $Q_2 = 75 - \frac{3}{4} Q_1$

yields $Q_1 = 20$, $Q_2 = 60$

Then $P = 200 - 20 - 60 = 120$

Profits $\Pi_1 = (120 - 100)20 = 400$

And $AC_2 = 100 - \frac{1}{3} 60 = 80$, so $\Pi_2 = (120 - 80)60 = 2400$

Stability argument:

No matter what firm 2 thinks firm 1 is doing, $Q_2 > 75$ is never its best response

Firm 1 knows this, so it should never produce less than $Q_1 = 50 - \frac{1}{2} 75 = 12.5$

[$Q_2 \leq 75$ implies $50 - \frac{1}{2} Q_2 \geq 50 - \frac{1}{2} 75$]

Firm 2 knows this, so it should never produce more than $Q_2 = 75 - \frac{3}{4} 12.5 = 65.625$

Continuing these steps, and similarly from the other side, $Q_1 \to 20$, $Q_2 \to 60$

$Q = 20 + 60 = 80$, $P = 200 - 80 = 120$

$P > MC_1$, $MC_2$, but less than price under monopoly of either firm.
BERTRAND (PRICE) – HOMOGENEOUS PRODUCTS (P-R pp. 449-50)

If price-setting with homogeneous products, cross-price elasticities are infinite.
One firm can get all demand by undercutting other’s price by just a little.
This fierce price competition leads to Bertrand equilibrium of following kinds:

[1] If $MC_1 = MC_2 = \text{constant}$, $P = MC_1 = MC_2$

[2] If $MC_1 < MC_2$, each constant, then firm 1 sets $P$ just under $MC_2$

[3] If $MC_1$, $MC_2$ rising sufficiently, can have $P = MC_1 = MC_2$ and $Q_1 = Q_2 > 0$

BERTRAND (PRICE) – DIFFERENTIATED PRODUCTS (P-R pp. 450-3)

Locational model of differentiation
Range of neck sizes in inches, distributed uniformly from 13 to 19, a million per inch
Everyone buys exactly one shirt
If no scale economies, fit everyone perfectly
If substantial scale economies, suppose only two sizes are produced: 15 and 17
Each producer sets price, $P_1$, $P_2$ resp.
Person at $15 \pm L$ buying 15 pays $P_1$ to firm, but “effective cost” $P_1 + L$
counting utility cost of wearing bad fit
Will buy the size that has lower effective cost

Indifferent customer at $15 + x$ where $P_1 + x = P_2 + (2 - x)$, $x = 1 + (P_2 - P_1)/2$
Firm 1 sells $Q_1 = 2 + x = 3 + (P_2 - P_1)/2$
Firm 2 sells $Q_2 = 2 + (2 - x) = 3 - (P_2 - P_1)/2$
Each firm’s fixed cost $10 million, marginal cost of each shirt constant and $10

Firm 1’s profit:

$$\Pi_1 = (P_1 - 10) Q_1 - 10 = (P_1 - 10)(3 + \frac{1}{2} P_2 - \frac{1}{2} P_1) - 10$$

Taking $P_2$ as outside its control, this firm chooses $P_1$ to maximize $\Pi_1$

$$\frac{\partial \Pi_1}{\partial P_1} = 1 \times (3 + \frac{1}{2} P_2 - \frac{1}{2} P_1) + (P_1 - 10) \times (-\frac{1}{2}) = 8 + \frac{1}{2} P_2 - P_1$$

Setting this $= 0$, we get firm 1’s reaction curve: $P_1 = 8 + \frac{1}{2} P_2$; upward-sloping

Similarly firm 2’s reaction curve $P_2 = 8 + \frac{1}{2} P_1$.

Solving the two equations together, Bertrand equilibrium has $P_1 = P_2 = 16$

Then $Q_1 = Q_2 = 3$, $\Pi_1 = \Pi_2 = 18 - 10 = 8$

Possible problem – limit to effective price consumers are willing to pay

Those at 13 and 19 are paying $16 + 2 = 18$.

If max willingness (“reservation price”) is say 17,
then setting $P = 16$ will lose the firms some “extreme” consumers

Taking this into account, equilibrium prices will be lower

Extension: choice of location (size to produce), entry of new firms, ...

Also some other cases where equilibrium may fail to exist ...

Similar Downs’ model of politics: parties/candidates locate along left-right ideology spectrum
Equivalent of price is non-ideological economic benefits promised
Swing voters will trade off some ideological misfit for some economic benefit
But extreme voters may get disillusioned and not vote if ideology too centrist
So parties/candidates’ tradeoff – appealing to swing voters versus to extremist core supporters