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 $MC_1 = 100$.

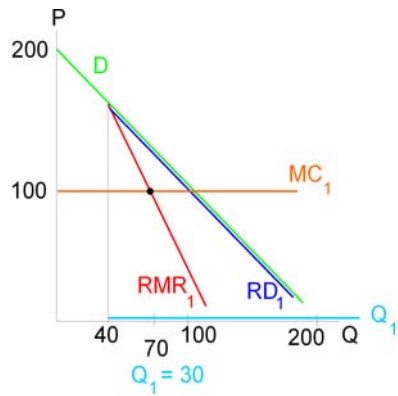
If firm 1 thinks firm 2 is choosing $Q_2 = 0$,
firm 1 has whole inverse demand: $P = 200 - Q_1$
$MR_1 = 200 - 2\,Q_1$. To maximize firm 1 profit
$MR_1 = MC_1$, so $200 - 2\,Q_1 = 100$,
$Q_1 = (200 - 100)/2 = 50$

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 $Q_2 = 40$:



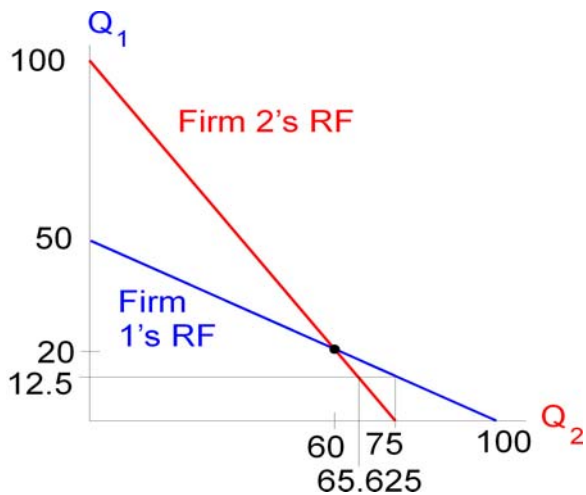
See also P-R Fig. 12.3 p. 443

Firm 2's $MC_2 = 100 - \frac{2}{3}\, Q_2$
Its profit-max $RMR_2 = MC_2$ given Q_1
$200 - Q_1 - 2\, Q_2 = 100 - \frac{2}{3}\, Q_2$
$Q_2 = \frac{3}{4}\,(100 - Q_1) = 75 - \frac{3}{4}\, Q_1$
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, $Q_1 \to 20$, $Q_2 \to 60$

Cournot equilibrium



Replicates P-R Fig. 12.4 p. 444

$Q = 20 + 60 = 80$, $P = 200 - 80 = 120$
$P > MC_1$, 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 $MC_1 = MC_2 =$ 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

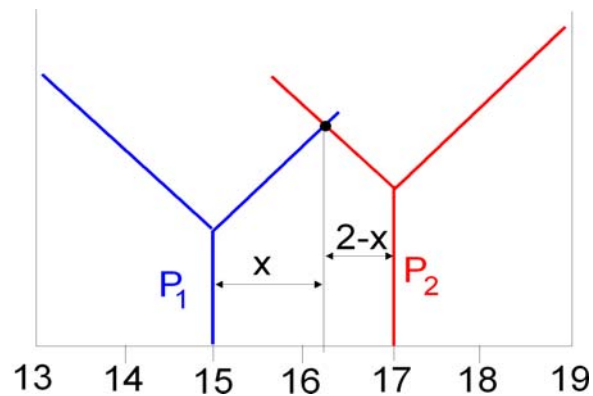
If substantial scale economies, suppose only two sizes are produced: 15 and 17

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

(More general theory needs [1] non-uniform neck-size distribution, [2] nonlinear and asymmetric cost of wearing bad fit)



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:

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

Taking P_2 as outside its control, this firm chooses P_1 to maximize Π_1

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

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