Overview: Market Power

• Competitive Equilibrium
• Profit Maximization
• Monopoly
  – Output and Price Analytics
• Coordination of Multiple Plants
• Pricing with Learning Effects and Network Externalities
Competitive Equilibrium

• Mechanism of Competitive Equilibrium
  – Demand Growth
    • Higher prices stimulate more supply from existing firms
    • Emergence of profits causes entry/expansion of capacity
  – Demand shortfall
    • Lower prices cause cutbacks in supply from existing firms
    • Losses (negative profits) cause exit/contraction of capacity
  – Processes continue until economic profits return to 0
Market Power

- Ability to raise price above costs and make sustainable profits
  - *Economic* costs and *economic* profits

- Requires that the mechanism of competition fails to operate
  - Barriers to entry
  - Sufficient product differentiation (that cannot be copied)
  - Secret technology - No information on profitability
  - Market too small relative to efficient production scale

Profit Maximization

How do you maximize profit

\[ \Pi = R - C \]

(drum roll)

Pick Q such that \[ MR = MC \]
Monopoly: Price and Output Analytics

• Focus on monopoly, the simplest case of market power

• Suppose we have

  Demand: \( Q = 100 - P \)
  Costs: \( MC = AC = 10 \)

Direct Monopoly Solution

Demand: \( Q = 100 - P \) implies that
Revenue: \( R = PQ = (100 - Q) Q \)

\( MC = AC = 10 \) implies that costs are \( C = 10 Q \)

Profit: \( \Pi = R - C \)
  \( = (100 - Q) Q - 10 Q \)
  \( = (100Q - Q^2) - 10Q \)

Want to find \( Q \) (or \( P \)) that maximizes \( \Pi \).
Direct Monopoly Solution

Profit: $\Pi = (100Q - Q^2) - 10Q$

Take derivative:

\[ \frac{d\Pi}{dQ} = (100 - 2Q) - 10 \]

( = MR – MC )

Profits are maximized where $\frac{d\Pi}{dQ} = 0$

\[ 0 = (100 - 2Q) - 10 \ (= MR – MC) \]

Q = 45

With price

\[ P = 100 - Q = 55 \]
MR in Detail

Approximate MR as $\Delta R$ from selling one more unit
i.e., compare selling $Q_0$ at $P_0$ with selling $Q_1 = (Q_0 + 1)$ at $P_1$ [with $P_1 \leq P_0$]

$MR = R_1 - R_0 = P_1 Q_1 - P_0 Q_0$

$= P_1(Q_1 - Q_0) + Q_0(P_1 - P_0)$

$= P_1 + Q_0 \Delta P$

MR in Pictures
MR, Calculus Version

\[ R = P(Q)Q \]

\[ MR = \frac{dR}{dQ} = P + Q \frac{dP}{dQ} \]

(Compare to \( MR = P_1 + Q_0 \Delta P \))
The Monopoly Picture

![Graph showing monopoly and competitive solutions]

The Mark-Up Formula

\[ MR = P + Q \frac{dP}{dQ} = P \left( 1 + \frac{Q}{P} \frac{dP}{dQ} \right) = P \left( 1 + \frac{1}{\varepsilon} \right) \]

At a maximum of profits, we have MR = MC, so

\[ MC = P \left( 1 + \frac{1}{\varepsilon} \right) \]

Or, rearranging terms,

\[ \frac{P - MC}{P} = - \frac{1}{\varepsilon} \]

\( \varepsilon \) is the price elasticity of demand
Example: Supermarkets and Convenience Stores

- Supermarkets: $\varepsilon \approx -10$
  \[(\text{P-MC)/P = .1}, \ 10\% \text{ markup}\]
- Small convenience stores: $\varepsilon \approx -5$
  \[(\text{P-MC)/P = .2}, \ 20\% \text{ markup}\]

- Which do you expect to show higher profits?

Example: Drug pricing

- Elasticity estimates often are near -1.0

- If elasticity is -1.1, then
  \[(\text{P–MC)/P = .9}; \ 90\% \text{ markup}\]

- e.g. Tagamet monopoly, elasticity is -1.7
  \[(\text{P-MC)/P = .58}; \ 58\% \text{ markup}\]
Multi-plant Firms

Plant H:
Cost $C_H(Q_H)$

Distribution and Sale:
Revenue $R(Q_H + Q_L)$

Plant L:
Cost $C_L(Q_L)$

- Max profit $\Pi = R(Q_H + Q_L) - C_H(Q_H) - C_L(Q_L)$, by
- $MC_H(Q_H) = MC_L(Q_L) = MR(Q_H + Q_L)$

Multi-Plant Firm: Graphical Setup
Overall MC Curve is the *Horizontal* Sum of Individual Plant MC Curves

Costs with Multiple Plants

Pricing and Allocation of Production in a Multi-Plant Firm
Algebra of Constructing MC Curve

Plant “H”: $MC_H = 5 + Q/10$
Plant “L”: $MC_L = 4 + Q/20$

• Up to $Q=20$, all production is at “L” and the cost curve is equal to the single plant supply curve (since $MC_L(20) = MC_H(0) = 5$)
• Above $Q=20$, some production occurs at “H”

Algebra of Overall MC

• To sum horizontally, must solve for $Q$ to add
  $Q_H = -50 + 10 MC$
  $Q_L = -80 + 20 MC$
• So for $Q_T < 20$
  $Q_T = Q_L = -80 + 20 MC$ or
  $MC = 4 + Q_T/20$
• And for $Q_T > 20$, $Q_T = Q_L + Q_H$
  $Q_T = -130 + 30 MC$ or
  $MC = 13/3 + Q_T/30$
Adjustments to Current MR and MC

• When current production has future implications, the overall profit-maximizing output is typically not given by (current period) \( MC_0 = MR_0 \)

• Learning: Additional production \( Q_0 \) gives \( MR_0 \) plus lower future costs \( C_1 \).

• Network Externalities: Additional production \( Q_0 \) gives \( MR_0 \) plus larger future revenue \( R_1 \).

• Produce more and lower price. How much depends on size of learning/network effects.
Take Away Points

• Nearly any firm has some degree of market power

• \( MR = MC \); \( MR = MC \); \( MR = MC \) (say 100 times)

• \( MR = MC \) has a number of implications
  – The mark-up formula summarizes optimal pricing
  – With multiplant firms, \( MR = MC_H = MC_L \)