Lecture 5
Competition, Monopoly, Monopolistic Competition and Oligopoly
Overview

- Firm supply decisions in a perfectly competitive market
  - Short run supply
  - Long run supply
- Competitive equilibrium
- Monopoly
  - Supply decisions
  - Barriers to entry/sources of monopoly power
- Monopolistic Competition
Overview

- Oligopoly
  - Rivals reactions
  - Nash equilibrium
  - Prisoners’ Dilemma

- Measuring market structure
Market structure

Start by looking at extreme cases

- Competitive market
  - Many firms
  - Commodity market obvious example

- Monopoly markets
  - Single seller
  - Firm with patent, government protection or access to scarce resource
Market structure

Intermediate Cases

- Monopolistic competition
  - Many firms
  - Firms sell differentiated products
  - Some market power

- Oligopolistic markets
  - Few sellers
  - Barriers to entry

- Take into account rivals response to your actions
A taxonomy of market structures
Competitive or Commodity Markets

- Characteristics of a Commodity Market

1. Price taking
2. Product homogeneity
3. Free entry and exit
4. Perfect Information
Commodity Markets

- **Price Taking**
  - The individual firm sells a very small share of the total market output
    - Cannot influence market price
    - Firm’s demand curve is perfectly elastic
  - The individual consumer buys too small a share of industry output to have any impact on market price.
Commodity Markets

Many sellers, each one small relative to the market

- https://www.tripadvisor.com/Restaurants-g189400-Athens_Attica.html
Commodity Markets

Product Homogeneity

- The products of all firms are perfect substitutes
- Small differences in quality
- Examples
  - Agricultural products, oil, copper, iron, lumber, coal
Characteristics of Substitutes

Two products tend to be close substitutes when

– They have similar performance characteristics
– They have similar occasion for use and
– They are sold in the same geographic area
Commodity Markets

➢ Free Entry and Exit

- Buyers can easily switch from one supplier to another
- Suppliers can easily enter or exit a market
- All factors of production are perfectly mobile in the long-run
Commodity Markets

- **Perfect Information**
  - Every consumer knows about all goods being produced and their prices
  - All producers have well defined production functions
  - Can relax these assumptions
Commodity Markets

- Do we believe these assumptions hold all the time?
  - Seem to hold in commodity markets
  - Other markets have characteristics similar to commodity markets

- Even if all the conditions do not hold, competition can still be fierce if at least two hold
  - Predictions of basic model will still hold
Perfectly Competitive Markets

- Need to be aware of the assumptions so that we know whether the assumptions are violated in such a way that the model is no longer valid.
- We will talk about other market structures where some of these assumptions don’t hold.
Can I actually farm these things?
Short-run production decision of a perfectly competitive firm

- Imagine that you are a commodity market analyst for a major fashion house.
  http://gattonweb.uky.edu/faculty/troske/teaching/eco411/articles/Alligator Farm 3 WSJ 18-03-06.pdf
- The CEO comes to you and asks where you think alligator skin prices are going, because she wants to add a line of alligator handbags, luggage, and cowboy boots.
  http://www.ralphlauren.com/product/index.jsp?productId=54367636&pkwid=Brand_G_Brand_Ricky+Bag_General_Exact_ricky+bag&utm_source=PaidSearch&gclid=EAlalQobChMlyP_ow93r1QIVW7XACH0AZgLkEAAYASAAEgK1YPD_BwE&parentPage=family#tab-emailus
- You say let me do some research and get back to you on that.
- What analytical framework do you use to figure out what is going on now in the alligator market and where things are headed?
Modeling the firm’s supply decision

- To understand how price and output get determined in both the short run and long run in a competitive industry, let’s ask and answer a series of questions:

  - How is the price of alligators determined?
  - What does the demand curve facing each individual alligator farmer look like?
  - What output will maximize profit for the farmer in the short run?
  - What happens to the farmer’s optimal output as market price changes?
  - What does the farmer’s short-run supply curve look like?
  - What does the short-run market supply curve for alligators look like, given information on individual farmers’ supply curves?
How is the price of alligators determined?

Market demand and supply. Market demand represents the collective decisions of all alligator buyers. We are building towards understanding how market supply is determined.

What is P* in 1987 in the market for alligators?

http://gattonweb.uky.edu/faculty/troske/teaching/eco411/articles/AlligatorFarm_1_WSJ_02-08-89.pdf
Profit Maximizing Choice of Output

Determining the profit maximizing level of output

- Profit ($\pi$) = Total Revenue - Total Cost
- Total Revenue ($R$) = $Pq$
- Total Cost ($C$) = $Cq$
- Therefore:

$$\pi(q) = R(q) - C(q)$$
Profit Maximizing Choice of Output

- Cost, Revenue, Profit (€s per year)
- Total Revenue
- Slope of $R(q) = MR$
- Output (units per year)
Profit Maximizing Choice of Output

Cost, Revenue, Profit (€s per year)

Output (units per year)

Total Cost

Slope of $C(q) = MC$

Profit Maximizing Choice of Output

Cost, Revenue, Profit (€s per year)

Output (units per year)

Total Cost

Slope of $C(q) = MC$
Profit Maximizing Choice of Output

Cost, Revenue, Profit (€s per year)

Output (units per year)

Distance between the two curves is $\pi$. 

$q^*$
Profits are maximized when \( MC = MR \).

- This is the point where the two curves are farthest apart.

- This is true regardless of the type of market in which the firm operates.
Marginal Revenue, Marginal Cost, and Profit Maximization

\[ \pi = R - C \]

\[ MR = \frac{\Delta R}{\Delta q} \]

\[ MC = \frac{\Delta C}{\Delta q} \]
Marginal Revenue, Marginal Cost, and Profit Maximization

Profits are maximized when:

\[
\frac{\Delta \pi}{\Delta q} = \frac{\Delta R}{\Delta q} - \frac{\Delta C}{\Delta q} = 0 \quad \text{or}
\]

\[
MR - MC = 0 \quad \text{so that}
\]

\[
MR(q) = MC(q)
\]
Consider the case for a firm operating in a commodity market.

- The firm is a price taker.
- Revenue is given by: \( R(q) = P \times q \).
- \( MR = P \) and \( MR(q) \) is a horizontal line.

Call market output \((Q)\), and firm output \((q)\). market demand \((D)\) and firm demand \((d)\).
What does the demand curve facing each individual alligator farmer look like?

- If each producer is small relative to the market, what impact will any one producer’s output decision have on market price?
- What is the relevant range of output for an individual alligator farmer?
- What is industry output?
- What happens to market price if an individual alligator farmer withholds all his gators from the market in a given year?
- What happens to market price if that farmer produces and sells as many as he can in a given year?
- We say that a firm in a perfectly competitive industry is a **Price Taker**, because the firm’s demand curve is perfectly elastic at the market price.
Demand and Marginal Revenue Faced by a Competitive Firm

<table>
<thead>
<tr>
<th>Price (€ per bushel)</th>
<th>Output (bushels)</th>
<th>Industry Demand (D)</th>
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</thead>
<tbody>
<tr>
<td>$4</td>
<td>100</td>
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<tr>
<td>200</td>
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The Competitive Firm’s Demand

- Profit Maximization occurs where: $MC(q) = MR = P$.

- Let’s combine production and cost analysis to see again why this is the profit maximizing (or cost minimizing) point for the firm to produce.
A Competitive Firm Making a Positive Profit

At $q^*$: $MR = MC$ and $P > ATC$

$$\pi = (P - AC) \times q^*$$
or $ABCD$
A Competitive Firm Making a Positive Profit

- The way I have drawn these curves $P > AVC$ and $P > ATC$.
- Firm is making an economic profit.
- However, in the short-run firm will produce as long as $P > AVC$, even if $P < AFC$.
- Why?
- Let’s see why.
A Competitive Firm Incurring Losses

At \( q^* \): \( MR = MC \) and \( P < ATC \)
Losses = \( (P - AC) \times q^* \) or ABCD

If firm produced 0 then losses=CBFE or amount of fixed costs
What does the firm’s short-run supply curve look like?

- As market price varies from zero to $200 per four-foot gator, what output will maximize profits (minimize losses) at each possible price?
- If $P_{\text{Mkt}} < \text{min AVC}$, then $q^* = 0$, where $q^*$ is the firm’s profit-maximizing output.
- If $P_{\text{Mkt}} > \text{min AVC}$, then producing $q^*$ where $P_{\text{Mkt}} = MC$ will maximize short-run profits (minimize short-run losses) for the firm.
- Does the firm’s short-run supply curve obey the Law of Supply?
- What is the logic of the economic behavior suggested by the firm’s short-run supply curve that we have just derived?
A Firm’s Short-Run Supply Curve

S = MC above AVC

Price (€ per unit)

P = AVC

P = AVC

P₁

P₂

MC

ATC

AVC

Output

q₁

q₂

Shut-down
What does the market supply curve look like?

Suppose we have information on the supply behavior of all the producers currently in the market, i.e. we know the individual firms’ supply curves.

How do we derive the market supply curve?

The market supply curve is the aggregation of the supply curves of all firms in the market.

Thus we sum the quantities supplied by all firms at each possible price to get the market supply curve, i.e. we sum the firm supply curves horizontally (since we are aggregating quantities).

Does the short-run market supply curve for a perfectly competitive industry obey the Law of Supply? Why?
Market supply

\[ S = s_1 + s_2 \]

\( q \) (firm output) vs. \( Q \) (industry output)
Predicting the future: 1987

- Suppose it is 1987 and the market price of a 4-foot alligator is $180. Alligator farmers are doing great, earning significant economic profits. [refer to diagrams on board].
- What do you think will happen as time passes? What does it mean that firms in the industry are earning positive economic profits?
- As entry occurs, what will happen to the market supply curve?
- What will happen to market price?
- After enough time passes for all adjustments to occur, what do you predict market price will be? How long will that take?
In the long run, a firm can alter all its inputs, including the amount of machinery and the size of the plant.

Firms can also enter and exit the industry at no cost.
Choosing Output in the Long Run

- Firms continue to use the same rule when choosing output; $P = MC$.
- However, now the relevant marginal cost is long-run marginal cost.
- Firms produce output as long as $P \geq LRAC$.
Choosing Output in the Long Run

- Recall that we have assumed that firms can enter the industry at no cost and begin producing output.
- What will firms do if they see an industry where firms are earning a positive profit?
  - Note, this is above the opportunity cost for all of the resources being employed.
- Firms will enter the industry until long-run profits are zero.
Choosing Output in the Long Run

Question: Where are long-run profits zero?
Long-Run Competitive Equilibrium

• Profit attracts firms
• Supply increases until profit = 0

Firm

Industry

$30

$40

P1

P2

Q1

Q2

Output

$q_2$

Output

$q_2$

$P_1$

$P_2$

$S_1$

$S_2$

$D$

LAC

LMC

€ per unit of output

€ per unit of output

Profit attracts firms
Supply increases until profit = 0
Choosing Output in the Long Run

- Long-Run Competitive Equilibrium

1) $MC = MR$

2) $P = LAC$
   - No incentive to leave or enter
   - Profit = 0

3) Equilibrium Market Price—quantity demanded equals quantity supplied.
Suppose it is 1997 and the market price of a 4-foot alligator is $80. Alligator farmers are struggling, suffering significant economic losses. http://gattonweb.uky.edu/faculty/troske/teaching/eco411/articles/Alligator Farm 2 WSJ 12-11-97.pdf

[refer to diagrams on board].
What do you think will happen as time passes? What does it mean that firms in the industry are earning negative economic profits?

As exit occurs, what will happen to the market supply curve?
What will happen to market price?
After enough time passes for all adjustments to occur, what do you predict market price will be? How long will that take?
A competitive market is in long-run equilibrium when:

- Market price $P^*$ clears the market, i.e. market quantity demanded equals quantity supplied, i.e. $Q_D = Q_S$.
- Each firm maximizes profit, producing $q_i^*$ where $P^* = mc_i$.
- Market quantity supplied equals the aggregation of each firm’s profit maximization decision: $Q_S = \sum_{i=1}^{n} q_i^*$
- At $P^*$ firms earn a normal economic return, i.e. zero economic profit.
- $P^* = \text{min LRAC}$, i.e. firms produce the product as cheaply as is possible, given input prices and technology.
A taxonomy of market structures
Definition of Monopoly

• Monopoly: the only producer of a product for which there are no close substitutes
• Examples?
Standard Oil Company (1911)

- Esso
  - Standard Oil of New Jersey
    - Exxon (renamed in 1973)
    - ExxonMobil (merged in 1999)
  - Standard Oil of New York
    - Mobil (renamed in 1963)
    - Chevron
      - Began Using Chevron Name in 1930
      - Acquired by Chevron in 1950
  - Standard Oil of California
    - Amoco
      - Acquired by BP (1998)
  - Standard Oil of Kentucky
    - BP
      - Acquired by BP (1987)
  - Standard Oil of Indiana
    - Marathon Oil (renamed in 1930)
    - Marathon Petroleum (spun-off from Marathon Oil in 2011)
  - The Ohio Oil Company

Monopoly

- The monopolist is the supply-side of the market and has complete control over the amount offered for sale.
- Profits will be maximized at the level of output where marginal revenue equals marginal cost.
- One seller of a product with no close substitutes

http://www.scientificamerican.com/article/we-now-have-the-cure-for-hepatitis-c-but-can-we-afford-it/
“for which there are no close substitutes”

- Cable TV monopoly? [https://www.windstream.com/KineticLaunch/](https://www.windstream.com/KineticLaunch/)
- Google’s market dominance? [https://www.bing.com/](https://www.bing.com/)
- Mickey Mouse? [https://disneyworld.disney.go.com/](https://disneyworld.disney.go.com/)
- Cancer treatment? [https://www.ibrance.com/](https://www.ibrance.com/)
- The Parthenon?
Supply side of a competitive market: many small independent firms

Supply side of a monopoly market: one firm

Demand curve facing a competitive firm: perfectly elastic at the market price

Demand curve facing a monopolist: Market demand, since the supply side of the market consists of one firm—the monopolist

[refer to diagram on board—demand for Parthenon visits]

Result is that in order to sell more of the product a monopoly must reduce its price, so it is a price searcher—it must determine which price and output combination maximize profit.
What output will maximize profit in the short run for the only miniature golf course in town?

- First decision: produce $Q = 0$ or produce $Q > 0$ in the short run?
- What does producing $Q = 0$ in the short run [i.e. shut down] look like?
- How to decide whether to shut down or produce a positive output?

\[ \pi = TR - TC = TR - TVC - TFC \]

- If $Q = 0$, then $TR = 0$ and $TVC = 0$, so $\pi = -TFC$; i.e. your losses equal your fixed costs
- If $Q > 0$, then $\pi = TR - TVC - TFC$

So, if $[TR - TVC] > 0$, you are better off producing $Q > 0$. If $TR < TVC$, you are better off shutting down in the short run.

- Alternatively, if $TR/Q < TVC/Q$, i.e. if $P < AVC$, then shut down in the short run.
If \( P > AVC \), what output will maximize profit in the short run for the only miniature golf course in town?

- If \( P > \text{min } AVC \) such that producing a \( Q > 0 \) is optimal, what \( Q \) will maximize profit for the monopolist in the short run?
- Expand output as long as producing and selling another unit adds more to total revenue than it does to total cost.
- In other words, expand output up to point where \( MR = MC \).
- [Refer to diagram drawn on board for monopolist, with AVC and MC diagrams included.]
- What is marginal revenue for a monopolist? \( MR = \frac{\Delta TR}{\Delta Q} \).
- As the firm expands output, does it have to lower price to sell more output? Yes, since the market demand curve is the firm’s demand curve.
Maximizing Profit When Marginal Revenue Equals Marginal Cost

\[ D = AR \]

\[ MC \]

\[ P^* \]

\[ P_1 \]

\[ P_2 \]

\[ \text{Lost profit} \]

\[ Q_1 \]

\[ Q^* \]

\[ Q_2 \]

\[ \text{Lost profit} \]

\[ \text{€ per unit of output} \]
Monopoly

The Monopolist’s Output Decision

An Example

\[ \text{Cost} = C(Q) = 50 + Q^2 \]

\[ MC = \frac{\Delta C}{\Delta Q} = 2Q \]
Monopoly

The Monopolist’s Output Decision

An Example

Demand: $P(Q) = 40 - Q$

Revenue: $R(Q) = P(Q)Q = 40Q - Q^2$

Marginal Revenue: $MR = \frac{\Delta R}{\Delta Q} = 40 - 2Q$
The Monopolist’s Output Decision

An Example

\[ MR = MC \text{ or } 40 - 2Q = 2Q \]

\[ Q = 10 \]

When \( Q = 10 \), \( P = 30 \)
An Example

- By setting marginal revenue equal to marginal cost, it can be verified that profit is maximized at $P = $30 and $Q = 10$. 
Example of Profit Maximization

Observations

- Profit = (P - AC) x Q = ($30 - $15)(10) = $150
Sources of Market Power

- A firm’s monopoly power is determined by the firm’s elasticity of demand.
  - More sensitive demand is to changes in price the closer we are to the competitive outcome (P=MC).
Monopoly

A Rule of Thumb for Pricing

- We want to translate the condition that marginal revenue should equal marginal cost into a rule of thumb that can be more easily applied in practice.
A Rule of Thumb for Pricing

Can show that optimal price is:

\[ P = \frac{MC}{1 + \left(\frac{1}{E_D^*}\right)} \]

Where \( E_D^* \) is the elasticity of demand at the optimal level of output.

– When demand is perfectly elastic \( P=MC \).
More generally, a monopolist earning positive short-run economic profits:
Long-run adjustments in monopoly markets

- In the short run, a monopolist may make positive, zero, or negative economic profits.
- What sort of adjustments do you expect to occur over time if the monopolist is suffering short-run economic losses?
- Enjoying short-run economic profits?
Barriers to Entry and Monopoly Power

- In a competitive market, when existing sellers are earning an above-normal return, we predict that new firms will enter the market and compete away those profits.
- If a monopolist is earning short-run economic profits, will entry occur and the monopolist’s profits disappear?
- Not if there are significant barriers to entry.
- **Monopoly Power**: the ability of a firm to earn positive long-run economic profits
- Only if there are barriers to entry can a firm expect to earn an above-normal return that persists over time.
Sources of Monopoly Power

- Some of the things that limit substitutes are:

1. Control over a unique input or special knowledge—Specific Assets

2. The government
   - Governments frequently limit entry into markets through the use of licenses and other devices.
Sources of Monopoly Power

3. Patents
   - Other firms are prevented from competing with the firm holding the patent for a given number of years.

4. Scale Economics

5. Learning Curves

6. Brand Advantages
The Social Costs of Monopoly Power

- Monopoly power results in higher prices and lower quantities.
- However, does monopoly power make consumers and producers in the aggregate better or worse off?
Deadweight Loss from Monopoly Power

Because of the higher price, consumers lose $A+B$ and producer gains $A-C$. 

![Graph showing Deadweight Loss from Monopoly Power]

- **AP**: Average Price
- **MC**: Marginal Cost
- **AR**: Average Revenue
- **MC**: Marginal Cost
- **MR**: Marginal Revenue
- **Q_m**: Quantity at Monopoly Price
- **Q_c**: Quantity at Competitive Price
- **€/Q**: Euros per Unit

The graph illustrates the concept of deadweight loss, showing the area $A$ representing the lost consumer surplus and the area $C$ representing the producer gains.
The Social Costs of Monopoly Power

Rent Seeking
- Firms may spend to gain monopoly power
  - Lobbying
  - Advertising
  - Building excess capacity

Also spend money to defend their monopoly, “How a Fight Over a Board Game Monopolized an Economist’s Life,” WSJ, 10/20/09.

http://gattonweb.uky.edu/faculty/troske/teaching/eco411/articles/Fight_Monopoly_WSJ_20-10-09.pdf
Other possible problems

- Monopoly power may affect quality and/or cause firms to become complacent

http://gattonweb.uky.edu/faculty/troske/teaching/eco411/articles/Plastic Cork WSJ 05-01-10.pdf
A taxonomy of market structures
Monopolistic Competition

- How would you characterize MacDonald’s and its signature product, the Big Mac?

- Monopoly? Perfectly competitive? A blend of the two?
- MacDonald’s has a monopoly on Big Macs. But there are many substitutes for Big Macs, so MacDonald’s monopoly is a bit different from DeBeers.
Characteristics of monopolistic competition

- Many small independent sellers
- Many small independent buyers
- Differentiated product
- Insignificant entry barriers
- Examples?

http://www.lexingtonburgerweek.com/#!burgers/cfvg
Monopolistic Competition

- Market structure that combines monopoly and competition—Monopolistic Competition.
  - Where there are many buyers buying slightly different products.
  - Where there are just a few sellers.
- Examples of these types of markets are
  - Automobiles
  - Soft drinks
  - Hotels/restaurants
Monopolistic Competition

- Our models for these markets will combine some aspects of the competitive model and some aspects of the monopoly model.
Monopolistic Competition

➢ Characteristics

1) Many firms

2) Free entry and exit
   • 1) and 2) ensure competition in the long run

3) Differentiated product
   • Means firms have some monopoly power.
Monopolistic Competition

-The amount of monopoly power depends on the degree of differentiation.

-Automobile
  - Ferrari and monopoly power
    - Consumers can have a preference for Ferrari—performance, handling, style
    - The greater the preference (differentiation) in consumers’ minds the higher the price.
Monopolistic Competition

The Makings of Monopolistic Competition

- Two important characteristics
  - Differentiated but highly substitutable products
  - Free entry and exit
Monopolistic Competition

- How do firms differentiate their products?
  - Presumably through advertising.
  - This is actually the origin of this model, trying to explain advertising.

- Why do firms want to do this?
Short-run profit maximization by a monopolistically competitive firm

- Firm’s demand curve is downward sloping, because other attributes of the product besides price matter to consumers.
- Firm must lower price to sell more of the product.
- Customer responsiveness to changes in price (own price elasticity of demand) depends on “closeness” of substitutes.
- Shut down decision?
- How much to produce? What price to charge?
- Short-run economic profits? Losses?
- [refer to diagram drawn on board]
Long-run adjustments in a monopolistically competitive market

- Suppose firms in the industry are earning positive economic profits.
- What changes do you predict, given enough time for firms to adjust?
  - Entry of new competitors.
- How will that affect existing producers?
  - Fewer customers. Incumbent producers will see their demand curves shift inward.
- Where does it end? When is the market in long-run equilibrium?
  - Zero economic profits. When enough new competitors have entered the market such that sellers are earning a normal return, there is no incentive for additional entry.
A Monopolistically Competitive Firm in the Short and Long Run

Short Run

$P_{SR}$

$Q_{SR}$

$P_{SR}$

$D_{SR}$

$M_{SR}$

$AC$

$MC$

Long Run

$P_{LR}$

$Q_{LR}$

$D_{LR}$

$M_{LR}$

$AC$

$MC$
A Monopolistically Competitive Firm in the Short and Long Run

Observations (short-run)
- Downward sloping demand--differentiated product
- Demand is relatively elastic--good substitutes
- $\text{MR} < \text{P}$
- Profits are maximized when $\text{MR} = \text{MC}$
- This firm is making economic profits
A Monopolistically Competitive Firm in the Short and Long Run

Observations (long-run)
- Profits will attract new firms to the industry (no barriers to entry)
- The old firm’s demand will decrease to $D_{LR}$
- Firm’s output and price will fall
- Industry output will rise
- No economic profit ($P = AC$)
- $P > MC$ -- some monopoly power
Comparison of Monopolistically Competitive Equilibrium and Perfectly Competitive Equilibrium

**Perfect Competition**

- $P_C$ (Price in Perfect Competition)
- $Q_C$ (Quantity in Perfect Competition)
- $D = MR$ (Demand = Marginal Revenue)

**Monopolistic Competition**

- $Q_{MC}$ (Quantity in Monopolistic Competition)
- $P$ (Price)
- $MC$ (Marginal Cost)
- $AC$ (Average Cost)
- $D_{LR}$ (Demand curve in Long Run)
- $MR_{LR}$ (Marginal Revenue in Long Run)
- **Deadweight loss**

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Monopolistic Competition

- **Monopolistic Competition and Economic Efficiency**
  - The monopoly power (differentiation) yields a higher price than perfect competition. If price was lowered to the point where $MC = D$, total surplus would increase by the yellow triangle.
Monopolistic Competition

Monopolistic Competition and Economic Efficiency

- Although there are no economic profits in the long run, the firm is still not producing at minimum AC and excess capacity exists.
Monopolistic Competition Versus Perfect Competition

➢ Monopolistic competition is similar to perfect competition.
   – Each firm acts independently, without regard to the responses of its competitors.
   – Free entry guarantees that firms earn zero economic profits in the long-run.
Monopolistic Competition Versus Perfect Competition

- Monopolistic competition differs from perfect competition.
  - Monopolistic competitors are not price takers.
  - The firm's equilibrium price exceeds its marginal cost.
  - Firms have excess capacity in long-run equilibrium.

How might you differentiate your product?
Nonprice Competition

- Firms in monopolistic competition sometimes engage in nonprice competition.
  - Provide better-quality products.
  - Product characteristics are designed to match the preferences of specific groups of consumers.
  - May involve location.
- Firms making high quality, expensive products are not necessarily more profitable.
Profit-Maximizing Product Differentiation

Type of Car

- Slower/better gas mileage
- Faster/Poor gas mileage

Type of Car Sold by the Other Firm

Type of Car that Your Firm Should Sell to Maximize Profit

People who like better gas mileage cars buy from you.

People who like faster cars buy from the other firm.
Oligopoly

- Oligopoly: a market with a small number of sellers
- Characteristics of oligopoly
  - Homogeneous or differentiated product
  - Often times significant barriers to entry (perhaps because of economies of scale)
  - Recognized mutual interdependence, i.e. firms have identifiable rivals
- It is this **recognized mutual interdependence** that sets the analysis of oligopoly apart. We do not have a neat deterministic abstract model that we can apply to oligopoly markets. Instead, the outcome in an oligopoly market depends on how much or how little firms compete vigorously with one another, which can be idiosyncratic to the particular industry being studied.
Real-world oligopolists
### Ten Most Concentrated Industries

Percentage of Value of Shipments Accounted for by the Largest Firms in High-Concentration Industries, 1992

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<tr>
<th>SIC NO.</th>
<th>INDUSTRY DESIGNATION</th>
<th>FOUR LARGEST FIRMS</th>
<th>EIGHT LARGEST FIRMS</th>
<th>NUMBER OF FIRMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2823</td>
<td>Cellulosic man-made fiber</td>
<td>98</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>3331</td>
<td>Primary copper</td>
<td>98</td>
<td>99</td>
<td>11</td>
</tr>
<tr>
<td>3633</td>
<td>Household laundry equipment</td>
<td>94</td>
<td>99</td>
<td>10</td>
</tr>
<tr>
<td>2111</td>
<td>Cigarettes</td>
<td>93</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>2082</td>
<td>Malt beverages (beer)</td>
<td>90</td>
<td>98</td>
<td>160</td>
</tr>
<tr>
<td>3641</td>
<td>Electric lamp bulbs</td>
<td>86</td>
<td>94</td>
<td>76</td>
</tr>
<tr>
<td>2043</td>
<td>Cereal breakfast foods</td>
<td>85</td>
<td>98</td>
<td>42</td>
</tr>
<tr>
<td>3711</td>
<td>Motor vehicles</td>
<td>84</td>
<td>91</td>
<td>398</td>
</tr>
<tr>
<td>3482</td>
<td>Small arms ammunition</td>
<td>84</td>
<td>95</td>
<td>55</td>
</tr>
<tr>
<td>3632</td>
<td>Household refrigerators and freezers</td>
<td>82</td>
<td>98</td>
<td>52</td>
</tr>
</tbody>
</table>
How would you decide on the price of a new life-saving drug?


➤ What about the price of a new phone:
Modeling Oligopoly

- Imagine a market with two firms supplying a homogeneous product to a large number of small, independent buyers.
- If these two firms compete vigorously with one another, what do you predict market price and output will be?
- If these two firms cooperate totally and behave as one, what do you predict market price and output will be?
- What will total profits of the two firms be if they behave competitively?
- What will total profits of the two firms be if they collude and behave as a monopolist?
- What will price, output, and profits be if they are only partially successful in suppressing competition?
Oligopoly

What are some barriers to entry?

- Natural
  - Scale economies
  - Patents
  - Technology
  - Name recognition/branding
Oligopoly

What are some barriers to entry?

– Strategic action
  • Flooding the market
  • Controlling an essential input
Oligopoly

- Management Challenges
  - Strategic actions
  - Rival behavior

- Question
  - What are the possible rival responses to a 10% price cut by Ford?
Equilibrium in an Oligopolistic Market

- In perfect competition, monopoly, and monopolistic competition producers did not have to consider a rival’s response when choosing output and price.
- In oligopoly producers must consider the response of competitors when choosing output and price.
Equilibrium in an Oligopolistic Market
  - Defining Equilibrium
    • Firms do the best they can and have no incentive to change their output or price
    • All firms assume competitors are taking rival decisions into account.
Oligopoly

Nash Equilibrium

- Each firm is doing the best it can given what its competitors are doing.
Oligopoly

➢ The Cournot Model
  – Duopoly
    • Two firms competing with each other. They choose output independently.
    • Homogenous good
    • The output of the other firm is assumed to be fixed
    • Barriers to new entry
If Firm 1 thinks Firm 2 will produce 75 units, its demand curve is shifted to the left by this amount.

Firm 1’s Output Decision

What is the output of Firm 1 if Firm 2 produces 100 units?
The Reaction Curve

- A firm’s profit-maximizing output is a decreasing function of the expected output of Firm 2.
Firm 2’s Reaction Curve $Q_2^*(Q_1)$

Firm 2’s reaction curve shows how much it will produce as a function of how much it thinks Firm 1 will produce. The x’s correspond to the previous example.

Firm 1’s Reaction Curve $Q_1^*(Q_2)$

Firm 1’s reaction curve shows how much it will produce as a function of how much it thinks Firm 2 will produce. The x’s correspond to the previous example.

Cournot Equilibrium

In Cournot equilibrium, each firm correctly assumes how much its competitors will produce and thereby maximizes its own profits.
Oligopoly

The Linear Demand Curve

An Example of the Cournot Equilibrium

- Duopoly
  - Market demand is $P = 30 - Q$ where $Q = Q_1 + Q_2$
  - $MC_1 = MC_2 = 0$
Oligopoly

The Linear Demand Curve

An Example of the Cournot Equilibrium
- Firm 1’s Reaction Curve

Total Revenue, \( R_1 = P Q_1 = (30 - Q)Q_1 \)

\[ = 30Q_1 - (Q_1 + Q_2)Q_1 \]

\[ = 30Q_1 - Q_1^2 - Q_2Q_1 \]
Oligopoly

The Linear Demand Curve

An Example of the Cournot Equilibrium

\[ MR_1 = \frac{\Delta R_1}{\Delta Q_1} = 30 - 2Q_1 - Q_2 \]
\[ MR_1 = 0 = MC_1 \]
Firm 1's Reaction Curve
\[ Q_1 = 15 - \frac{1}{2}Q_2 \]
Firm 2's Reaction Curve
\[ Q_2 = 15 - \frac{1}{2}Q_1 \]
Oligopoly

The Linear Demand Curve

An Example of the Cournot Equilibrium

Cournot Equilibrium: \( Q_1 = Q_2 \)

\[
Q_1 = 15 - 1/2(15 - 1/2Q_1) = Q_1 = 10 = Q_2
\]

\[
Q = Q_1 + Q_2 = 20
\]

\[
P = 30 - Q = 10
\]
Duopoly Example

The demand curve is $P = 30 - Q$ and both firms have 0 marginal cost.

Firm 1’s Reaction Curve

Firm 2’s Reaction Curve

Cournot Equilibrium
Oligopoly

Profit Maximization with Collusion

\[ R = PQ = (30 - Q)Q = 30Q - Q^2 \]

\[ MR = \Delta R/\Delta Q = 30 - 2Q \]

\[ MR = 0 \text{ when } Q = 15 \text{ and } MR = MC \]
Oligopoly

Profit Maximization with Collusion

Contract Curve

- $Q_1 + Q_2 = 15$
  - Shows all pairs of output $Q_1$ and $Q_2$ that maximizes total profits
- $Q_1 = Q_2 = 7.5$
  - Less output and higher profits than the Cournot equilibrium
Duopoly Example

For the firm, collusion is the best outcome followed by the Cournot Equilibrium and then the competitive equilibrium.
Cournot Model

- Equilibrium lies between competitive equilibrium and monopoly equilibrium.
- In general in the Cournot model where n is the number of firms in the industry.
- When n=1 we have the monopoly outcome, when n gets big we have the competitive outcome.

\[ Q = \frac{n}{(n + 1)} \times \frac{a}{b} \]
First Mover Advantage-- The Stackelberg Model

Assumptions

- One firm can set output first
- MC = 0
- Market demand is \( P = 30 - Q \) where \( Q = \) total output
- Firm 1 sets output first and Firm 2 then makes an output decision
First Mover Advantage-- The Stackelberg Model

➢ Firm 1
  – Must consider the reaction of Firm 2

➢ Firm 2
  – Takes Firm 1’s output as fixed and therefore determines output with the Cournot reaction curve: $Q_2 = 15 - 1/2Q_1$
First Mover Advantage--The Stackelberg Model

Firm 1

– Choose $Q_1$ so that:

$$MR = MC, \quad MC = 0 \text{ therefore } MR = 0$$

$$R_1 = P Q_1 = 30 Q_1 - Q_1^2 - Q_2 Q_1$$
First Mover Advantage--The Stackelberg Model

Substituting Firm 2’s Reaction Curve for $Q_2$:

$$R_1 = 30Q_1 - Q_1^2 - Q_1(15 - 1/2Q_1)$$
$$= 15Q_1 - 1/2 Q_1^2$$

$$MR_1 = \Delta R_1 / \Delta Q_1 = 15 - Q_1$$

$$MR = 0 : Q_1 = 15 \text{ and } Q_2 = 7.5$$
First Mover Advantage--The Stackelberg Model

➤ Conclusion
- Firm 1’s output is twice as large as firm 2’s
- Firm 1’s profit is twice as large as firm 2’s

➤ Questions
- Why is it more profitable to be the first mover?
- Which model (Cournot or Stackelberg) is more appropriate?
The Stackelberg Model

- Consider the case where demand is given by:
  \[ P = a - bQ \]
  where \( MC_1 = MC_2 = 0 \).

- You can show that:
  \[ Q_1 = \frac{a}{2b} \]
  \[ Q_2 = \frac{a}{4b} \]
  \[ Q = \frac{3a}{4b} \]
  \[ P = \frac{a}{4} \]

(You should work this out yourself)

- Total output is higher than in the Cournot model and price is lower.
Price Competition

- Competition in an oligopolistic industry may occur with price instead of output.

- The Bertrand Model is used to illustrate price competition in an oligopolistic industry with homogenous goods.
Price Competition

**Assumptions**
- Homogenous good
- Market demand is \( P = 30 - Q \) where \( Q = Q_1 + Q_2 \)
- \( MC = $3 \) for both firms and \( MC_1 = MC_2 = $3 \)
Price Competition

Bertrand Model

Assumptions

- The Cournot equilibrium:
  
  $P = $12 \quad Q_1 = Q_2 = 9

  $\pi$ for both firms = $81$

- Now, assume the firms compete with price, not quantity.
How will consumers respond to a price differential? (Hint: Consider homogeneity)

- The Nash equilibrium:
  - $P = MC; \ P_1 = P_2 = $3$
  - $Q = 27; \ Q_1 \ & \ Q_2 = 13.5$
  - $\pi = 0$
Price Competition

Bertrand Model

- Why not charge a higher price to raise profits?

- How does the Bertrand outcome compare to the Cournot outcome?

- The Bertrand model demonstrates the importance of the strategic variable (price versus output).
Outcome for different Oligopoly models

<table>
<thead>
<tr>
<th>Model</th>
<th>$Q_1$</th>
<th>$Q_2$</th>
<th>$Q$</th>
<th>$P$</th>
<th>$\Pi_1$</th>
<th>$\Pi_2$</th>
<th>$\Pi_1 + \Pi_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collusion</td>
<td>$a/4b$</td>
<td>$a/4b$</td>
<td>$a/2b$</td>
<td>$a/2$</td>
<td>$a^2/8b$</td>
<td>$a^2/8b$</td>
<td>$a^2/4b$</td>
</tr>
<tr>
<td>Cournot</td>
<td>$a/3b$</td>
<td>$a/3b$</td>
<td>$2a/3b$</td>
<td>$a/3$</td>
<td>$a^2/9b$</td>
<td>$a^2/9b$</td>
<td>$2a^2/9b$</td>
</tr>
<tr>
<td>Bertrand</td>
<td>$a/2b$</td>
<td>$a/2b$</td>
<td>$a/b$</td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
</tr>
<tr>
<td>Stackelberg</td>
<td>$a/2b$</td>
<td>$a/4b$</td>
<td>$3a/4b$</td>
<td>$a/4$</td>
<td>$a^2/8b$</td>
<td>$a^2/16b$</td>
<td>$3a^2/16b$</td>
</tr>
<tr>
<td>Perfect Competition</td>
<td>$a/2b$</td>
<td>$a/2b$</td>
<td>$a/b$</td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
</tr>
</tbody>
</table>

Where demand is given by: $P = a - bQ$, where $Q = Q_1 + Q_2$ and where $MC_1 = MC_2 = 0$. 


Other possible ways to interact with a dominant firm?


➢ “Winds of Change for Boeing, Airbus,” WSJ, 3/16/10.
  http://gattonweb.uky.edu/faculty/troske/teaching/eco411/articles/Boeing_Airbus_WSJ_3-16-10.pdf.
Competition Versus Collusion: The Prisoners’ Dilemma

- Each firms profits are highest when they collude

- Why wouldn’t each firm set the collusion price independently and earn the higher profits that occur with explicit collusion?
Assume:

\[ FC = $20 \text{ and } VC = $0 \]

Firm 1's demand: \[ Q = 12 - 2P_1 + P_2 \]

Firm 2's demand: \[ Q = 12 - 2P_2 + P_1 \]

Nash Equilibrium: \[ P = $4 \quad \pi = $12 \]

Collusion: \[ P = $6 \quad \pi = $16 \]
Possible Pricing Outcomes:

- If both charge $6, \pi = $16

- If \( P_1 = $6 \) and \( P_2 = $4 \)
  
  then \( \pi_2 = P_2Q_2 - 20 \)
  
  \[ \begin{align*}
  &= (4)[12 - (2)(4) + 6] - 20 = $20 \\
  \pi_1 &= P_1Q_1 - 20 \\
  &= (6)[12 - (2)(6) + 4] - 20 = $4
  \end{align*} \]
Payoff Matrix for Pricing Game

Firm 2

<table>
<thead>
<tr>
<th>Firm 1</th>
<th>Charge $4</th>
<th>Charge $6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge $4</td>
<td>$12, $12</td>
<td>$20, $4</td>
</tr>
<tr>
<td>Charge $6</td>
<td>$4, $20</td>
<td>$16, $16</td>
</tr>
</tbody>
</table>
These two firms are playing a noncooperative game.

- Each firm independently does the best it can taking its competitor into account.

Question

- Why will both firms both choose $4 when $6 will yield higher profits?
Cartels

Characteristics

1) Explicit agreements to set output and price

2) May not include all firms
Cartels

➤ Characteristics

3) Most often international

- Examples of successful cartels
  - OPEC
  - International Bauxite Association
  - Mercurio Europeo

- Examples of unsuccessful cartels
  - Copper
  - Tin
  - Coffee
  - Tea
  - Cocoa
Suppose all the alligator farmers in the U.S. form an agricultural cooperative and name it the AAA (American Alligator Association). They hire you as a business consultant to advise them on setting market price and output so as to maximize industry profits.

You are asked to present your recommendations at their annual meeting in Natchitoches. Use the following diagram to explain how to set market output and individual farmer outputs, what the resulting market price of alligators will be, and how much economic profit each farmer will earn.

What incentive do these farmers have to go along with your plan?
Cartels

- Conditions that make forming a cartel easier.
  - Potential for monopoly power—inelastic demand.
  - A concentrated industry.
  - Firms compete primarily on price.
Cartel Theory: incentive to cheat

- Suppose all members go along with the plan and abide by their production quotas, so that market price rises from $P_C$ to $P_M$.
- Do you see any problems down the road keeping this cartel functioning as designed?
- If you are an alligator farmer and market price is $P_C$, what output would you like to produce and what would be your profits be if you were the only cartel member to cheat on your production quota?
- What happens if one member cheats? What happens if several members cheat?
- Do you think that the number of alligator farmers will stay the same over time?
Coordinating oligopolistic activity

Why don’t producers just get together with their lawyers and draw up a contract agreeing to collude?

Sherman Antitrust Act (1890):

Section 1:
"Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal."

Section 2:
"Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a felony [. . . ]"
Coordinating oligopolistic activity

- In the EU the prohibition against collusion is referred to as Article 101. [https://en.wikipedia.org/wiki/Article_101_of_the_Treaty_on_the_Functioning_of_the_European_Union](https://en.wikipedia.org/wiki/Article_101_of_the_Treaty_on_the_Functioning_of_the_European_Union)

- Overt vs. Tacit Collusion—what’s the difference?

- Legal cartels? NCAA, UAW, Sunkist . . .
Factors facilitating or impeding oligopolistic coordination among producers in an industry

- Number and size distribution of sellers
- Number and size distribution of buyers
- Extent of product differentiation
- Own-price elasticity of demand
- Similar or dissimilar costs
- Availability of information
- Frequency of interaction in the market
- Barriers to entry
Cartels

Why cartels fail
- Firm’s have strong incentive to cheat
- Difficult to all agree on the appropriate policy
- Profits of the cartel encourage entry
- Often illegal

Who is going to blink first?
Market Structure

Markets are often described by the degree of concentration

- Common measure is N-firm concentration ratio = combined market share of the largest N firms (such as 4 or 20)
- Another is Herfindahl index, the sum of squared market shares

\[ H_i = \sum_i (S_i)^2 \]

Where \( S_i \) is firm \( i \)'s share of output
Measuring Market Structure

- Monopoly is one extreme with the highest concentration - one seller
- Perfect competition is the other extreme with many, many sellers
## Four Classes of Market Structure

<table>
<thead>
<tr>
<th>Nature of Competition</th>
<th>Range of Herfindahls</th>
<th>Price Competition Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect competition</td>
<td>&lt; 0.2 usually</td>
<td>VERY intense</td>
</tr>
<tr>
<td>Monopolistic competition</td>
<td>&lt; 0.2 usually</td>
<td>Depends on product differentiation</td>
</tr>
<tr>
<td>Oligopoly</td>
<td>0.2 to 0.6</td>
<td>Depends on interfirm rivalry</td>
</tr>
<tr>
<td>Monopoly</td>
<td>0.6 to 1</td>
<td>Usually light, except when threat of entry</td>
</tr>
</tbody>
</table>
Competition Level Varies within Market Structure

- A monopoly market may produce the same outcomes as a competitive market
- A market with as few as two firms can lead to fierce competition
- With monopolistic competition, level of product differentiation determines the intensity of price competition
- Do not rely solely on Herfindahl index!!!
Summary

➢ We assume that all firms try and maximize profits.

➢ A competitive firm makes its output choice under the assumption that the demand for its own output is horizontal.
Summary

- In the short run, a competitive firm maximizes its profit by choosing an output at which price is equal to (short-run) marginal cost.

- In the long-run, profit-maximizing competitive firms choose the output at which price is equal to long-run marginal cost.
Summary

- Market power is the ability of sellers or buyers to affect the price of a good.
- Monopoly power is determined in part by the number of firms competing in the market.
- Market power can impose costs on society.
- In a monopolistically competitive market, firms compete by selling differentiated products, which are highly substitutable.
Summary

- In an oligopolistic market, only a few firms account for most or all of production.

- In the Cournot model of oligopoly, firms make their output decisions at the same time, each taking the other’s output as fixed.

- In the Stackelberg model, one firm sets its output first.
Summary

- The Nash equilibrium concept can also be applied to markets in which firms produce substitute goods and compete by setting price.

- In a cartel, producers explicitly collude in setting prices and output levels.

- Firms would earn higher profits by collusively agreeing to raise prices, but the antitrust laws usually prohibit this.