

Topics

- Topics in Demand and Supply Analysis
- The firm and Market Structures

Topics in Demand and Supply Analysis

Curve elasticity 弧弹性

- $E = \frac{\% \Delta Q}{\% \Delta P} = \frac{\Delta Q/Q}{\Delta P/P} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{(P_1 + P_2)/2}{(Q_1 + Q_2)/2}$ (average price or quantity)

Own-Price Elasticity 自身价格弹性

- **Elastic**
 - The effect of percent change in price to the percent change in quantity
 - $E = \frac{\% \Delta Q}{\% \Delta P} = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$
- Non-positive 非正
 - $E \leq 0$, increase in price decrease quantity
- Classification
 - Perfect elastic 完全弹性
 - $E = +\infty$
 - Elastic 富有弹性
 - $|E| > 1$
 - Unit elastic 单位弹性
 - $|E| = 1$, revenue $P \times Q$ is maximized
 - Inelastic 缺乏弹性
 - $|E| < 1$
 - Perfect inelastic 无弹性
 - $E=0$
- Factors
 - Available of substitutes
 - Income Spent
 - More income spends (i.e., housing rental), more elastic
 - Time
 - Short time, cannot adjust demand quickly (i.e., gas price)
 - Longer time, more elastic because advances in technology

Income Elasticity 收入弹性

- **Elastic**
 - $E = \frac{\% \Delta Q}{\% \Delta I} = \frac{\Delta Q}{\Delta I} \times \frac{I}{Q}$
- Classification
 - Normal goods 正常品
 - $E > 0$
 - 细分
 - Necessities 必需品 $0 < E < 1$
 - Luxury 奢侈品 $E > 1$
 - Inferior goods 劣质品

- $E < 0$

Cross-Price Elasticity 交叉价格弹性

- **Elastic**
 - $E = \frac{\% \Delta Q_x}{\% \Delta P_y} = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_x}$, effect of a change in another product's price
- **Classification**
 - Substitute goods 替代品
 - $E > 0$
 - Complement goods 互补品
 - $E < 0$

Substitution and Income Effects 替代和收入效应

- When price of a product decrease, it's quantity
 - Substitution effects: consume more, usually positive
 - Income effects: falling prices mean more income, can be positive or negative
- **Outcomes**
 - Substitution: positive, Income: positive -> increase
 - Substitution: positive, Income: negative (less than substitution) -> increase
 - 一般劣质品
 - Substitution: positive, Income: negative (larger than substitution) -> negative
 - Giffen 吉芬物品

Giffen and Veblen

- **Normal and Inferior**
 - A good can be **normal** for some income ranges and **inferior** for some income ranges
- **Giffen** 吉芬物品
 - **Negative Income** effect outweighs **positive substitution** effect when price fall
 - 价格下降, 需求下降
 - Could have positively sloping demand
- **Veblen** 韦伯伦物品 (违反了消费原理)
 - Higher price makes the good more desirable
 - High status
 - 价格越高, 需求越大
 - Not an inferior goods
- **Giffen and Veblen**
 - Similar
 - Both positively sloping demand
 - Difference
 - Giffen are inferior goods, Veblen is not
 - Giffen is supported by customer theory, Veblen is not
 - Income increase, Veblen increase, but Giffen decrease

Demand

- 价格放在纵轴，横轴是数量。
- Demand Function 需求函数
 - $Q_x = f(P_x, I, P_y)$
- Demand Curve 需求曲线
 - $P_x = f(Q_x, I, P_y)$
 - Inverse demand function
- Movement
 - 量增加，向右移动；量减少，向左移动
- 弹性大，曲线平坦 (flat)
- 收益
 - 缺乏弹性时，增加价格，增加收益
 - 富有弹性时，减少价格，增加收益
- Supply Function 供给函数
- Supply Curve 供给曲线

Demand & Supply Equilibrium

- Equal the supply and demand function

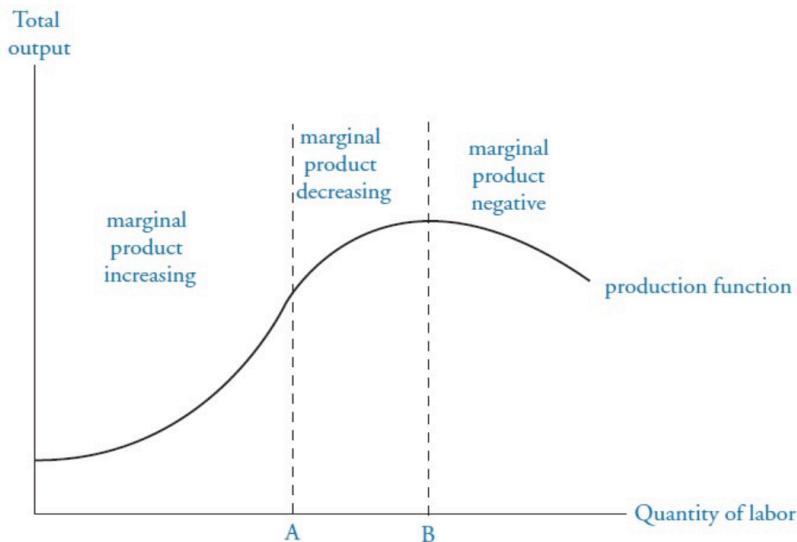
Consumer Surplus

- Consumer Surplus 消费者剩余
 - The upper triangle in the demand curve
 - $S = \frac{1}{2} \times Q \times (P_{max} - P)$
 - $P_{max} = f(0, I, P_y)$, by setting quantity to zero to find maximum price
 - Keep the same quantity, charge each player different price, the revenue is the triangle.

Product Factors

- Four factors
 - Land 土地
 - Labor 劳动
 - Capital 固定资产 (设备、厂房)
 - Material 材料
- Production Function 生产函数
 - only consider two factors: labor and capital
- Marginal Productivity 边际生产效率
- Fix capital, increase labor
 - Positive
 - Marginal productivity increasing
 - Marginal productivity decreasing
 - Marginal productivity negative

Figure 4: Production Function—Capital Fixed, Labor Variable

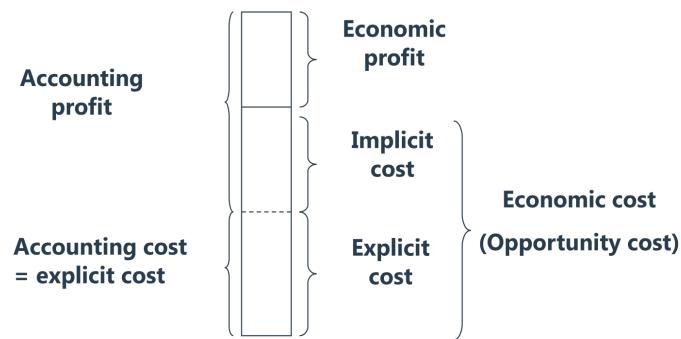


Short and Long Run

- **Short run 短期**
 - Assume the **capital** is fixed in the short run
 - 至少有一个固定不变
 - Usually raw material and labor can be changed, but capital and land are not
- **Long run 长期**
 - In the long run, all factors are variable
 - 所有都可以变

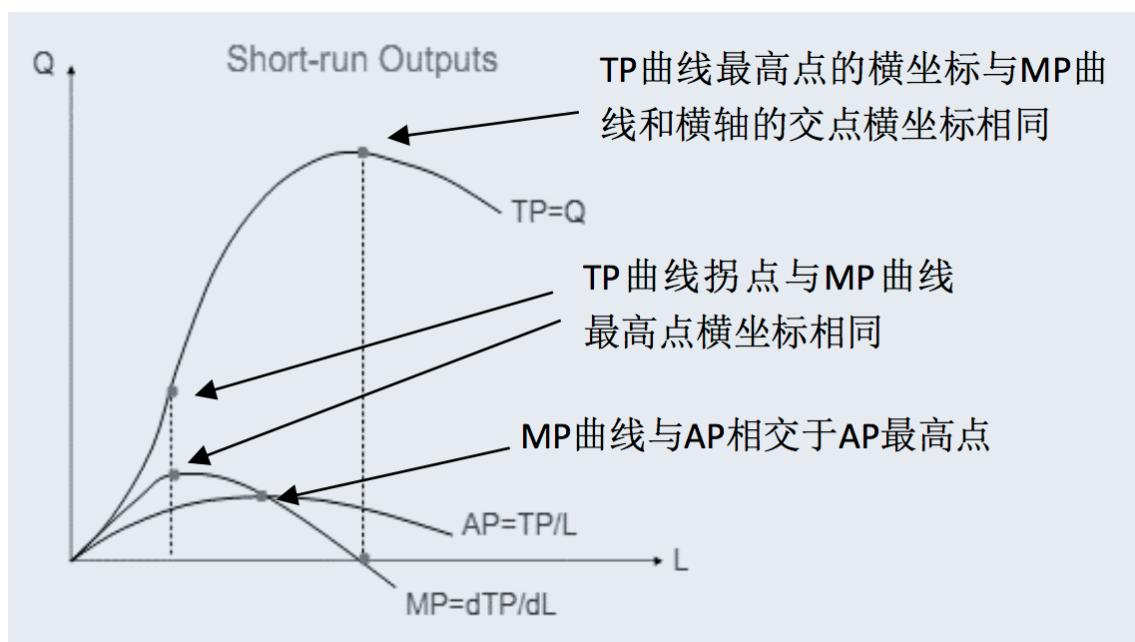
Accounting Profit and Economic Profit

- Accounting profit 会计利润
 - Economic cost=abnormal profit
 - Implicit cost=normal profit
- Accounting cost 会计成本
 - Explicit cost 显性成本
- Economic cost
 - Implicit profit (opportunity costs)
 - Explicit cost
- Implicit cost/opportunity cost/Normal profit 隐性成本/机会成本 = 正常收益
 - **Opportunity** cost of resources supplied to the firm by its owners
 - Private firms
 - Cost of time
 - Cost of owner-supplied capital
 - Entrepreneurial ability of owner's
 - Public firms
 - Opportunity cost of equity owner's investment
 - The accounting that make economic profit equal to **zero**
 - Normal profit is implicit cost



Product

- **Total product (TP)**
 - Total output Q using labor L
- **Average product (AP)**
 - Total output divided by labor $\frac{Q}{L}$
- **Marginal product (MP)**
 - Adding one more unit of labor L is $\frac{\Delta Q}{\Delta L}$
 - First derivative
 - Increase and then decrease
- **MP and TP**
 - $MP > 0 \Rightarrow TP$ increase
 - $MP = 0 \Rightarrow TP$ is maximized
 - $MP < 0 \Rightarrow TP$ decrease
- **MP and AP**
 - $MP > AP \Rightarrow AP$ increase
 - **$MP = AP \Rightarrow AP$ is maximized**
 - $MP < AP \Rightarrow AP$ decrease



Revenue

- **Total Revenue (TR)**
 - Total revenue $TR = \sum P_i \times Q_i = P \times Q$
 - A firm charges a single price to all customers
- **Average Revenue (AR)**
 - Total revenue divided quantity $AR = \frac{TR}{Q} = P$
- **Marginal Revenue (MR)**
 - Revenue from selling one more quantity $MR = \frac{\Delta TR}{\Delta Q}$
 - First derivative
 - Increase and then decrease
- **Perfect Competition**
 - A firm is price **taker**
 - Take the market price as given
 - perfectly elastic, horizontal demand curve
 - Price = AR = MR demand horizontal line
- **Imperfect Competition**
 - A firm is price **searcher**
 - Negatively sloped demand curve
 - $MR = 0 \Rightarrow AR$ is maximized
 - $MR = P(1 + 1/E)$, where E is negative

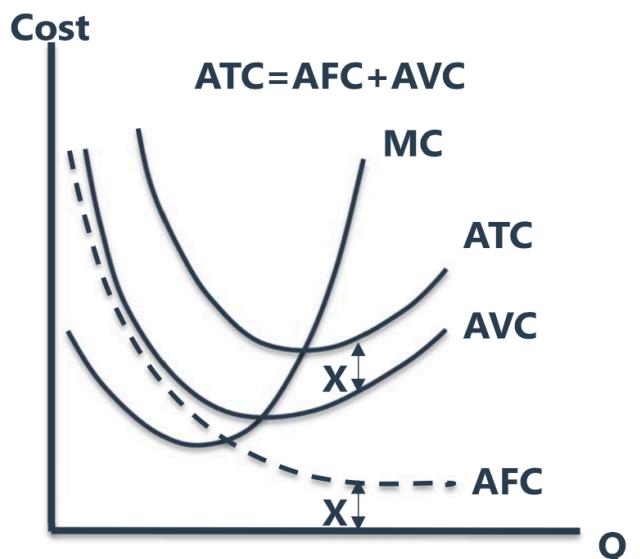
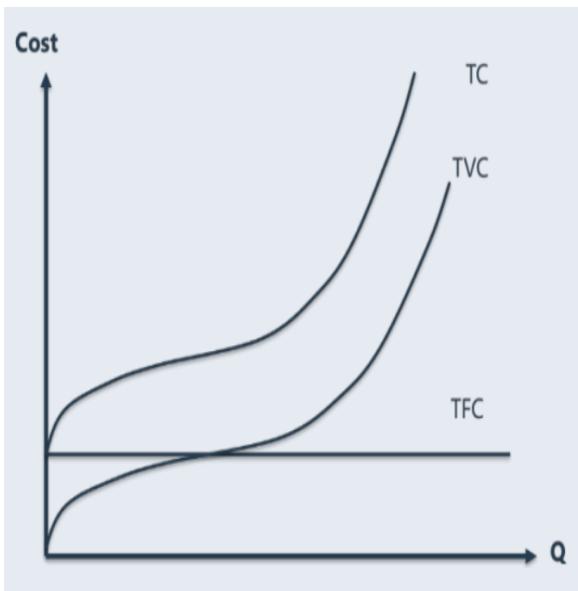
Margin Revenue and Elastic

- Revenue $R(Q) = P(Q) \times Q$, where price is a function of quantity
- Margin Revenue $MR = \frac{\Delta R(Q)}{\Delta Q}$
- Derivative $\frac{\Delta R(Q)}{\Delta Q} = P(Q) + \frac{\Delta P(Q)}{\Delta Q} \times Q = P(Q) + P(Q) \frac{\Delta P(Q)}{\Delta Q} \times \frac{Q}{P(Q)} = P(1 + 1/E(Q))$
- Simplified $MR = P(1 + \frac{1}{E})$, where E is usually less than 0
 - If demand is inelastic ($-1 < E < 0$), $MR < 0$
 - $-1 < E < 0 \Rightarrow \frac{1}{E} < -1 \Rightarrow 1 + \frac{1}{E} < 0$
 - If demand is elastic ($E < -1$), $MR > 0$ and $MR < P$
 - $E < -1 \Rightarrow -1 < \frac{1}{E} < 0 \Rightarrow 0 < 1 + \frac{1}{E} < 1$
- Example
 - If a company can sell 10 units at \$20 each or 11 units at \$19 each, then the marginal revenue from the eleventh unit is $(11 \times 19) - (10 \times 20) = \9 .

Cost

- Cost Types
 - Variable cost 可变成本
 - Fixed cost 固定成本
 - Total cost 总成本
 - $\text{Total cost} = \text{fixed cost} + \text{variable cost}$
- Total
 - Total variable cost TVC
 - Total fixed cost TFC is **constant**
 - Total cost TC = TVC + TFC

- Average cost (U型平均成本)
 - average variable cost $AVC = TVC/Q$
 - average fixed cost $AFC = \frac{TFC}{Q}$ is decreasing
 - average total cost $ATC = TC/Q$
- Marginal (MC) (近似上升边际成本)
 - Marginal variable cost $MVC = \frac{\Delta TVC}{\Delta Q}$
 - Marginal fixed cost $MFC = \frac{\Delta TFC}{\Delta Q} = 0$
 - Marginal total cost $MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q} = MVC$
- Conclusion
 - AFC slopes downward
 - MC declines initially, then increase
 - MC intersects AVC and ATC at their minimal points



Profit Maximum 利润最大化

- Total Profit
 - Total Profit = $TR - TC$
- Margin Profit
 - $MP = \frac{\Delta \text{Profit}}{\Delta Q} = \frac{\Delta TR}{\Delta Q} - \frac{\Delta TC}{\Delta Q} = MR - RC$
- Maximum profit Condition
 - $MR = MC$
 - 边际收益等于边际成本

Perfect Competition 完全竞争

- Everyone is price taker 价格接受者
 - Price = marginal revenue = average revenue
- Shutdown Shot run 短期停业：收入 < 可变成本
 - average revenue < average variable cost
 - 多余的至少能覆盖一些固定成本

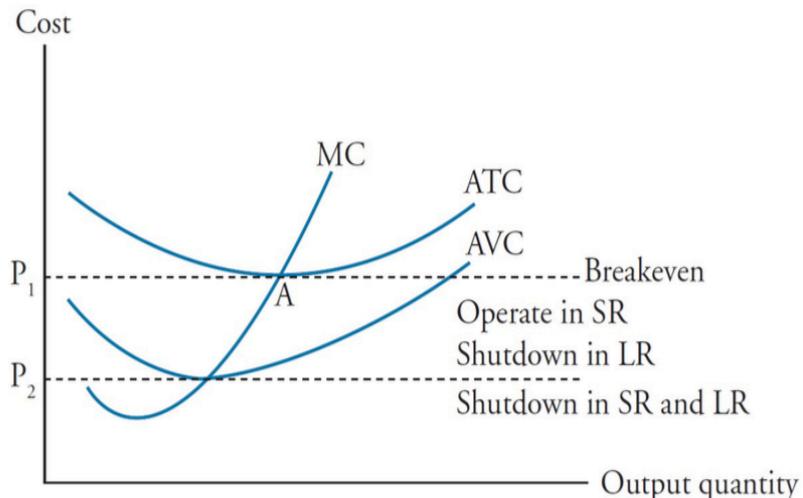
- Shutdown Long run 长期停业 : 收入 < 总成本
 - average revenue < average total cost
- Breakeven point 盈亏平衡点
 - Average revenue = average total cost

Perfect Competition

Revenue-Cost Relationship	Short-Run Decision	Long-Run Decision
AR > ATC	Stay in the market	Stay in the market
AR = ATC		Breakeven point 盈亏平衡点
AVC < AR < ATC	Stay in the market	Exit market
AR = AVC		Shutdown point 停止营业点
AR < AVC	Shutdown	Exit market

For imperfect competition, change average cost to **total cost**

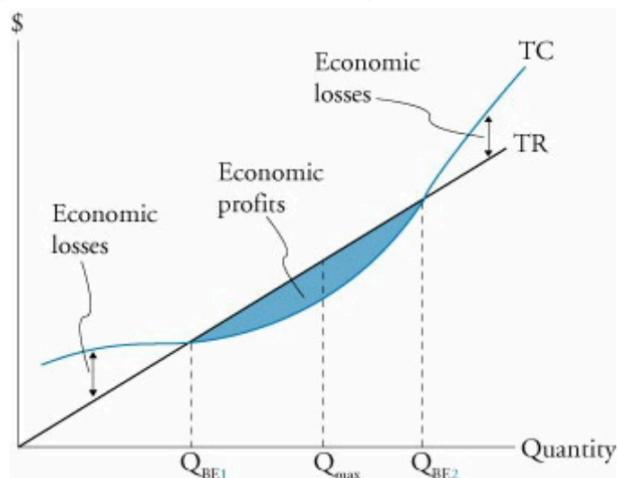
Figure 5: Shutdown and Breakeven



Imperfect Competition 非完全竞争

- Price searcher 价格寻找者、觅价者
 - price ! = margin revenue
- Breakeven points $TR = TC$
 - QBE_{low} 低收支平衡点
 - QBE_{high} 高收支平衡点
- Maximum Revenue
 - Maximum $TR - TC$
- $TVC < TR < TVC$: operate in the short run but shut down in the long run
- $TR < TVC$: shut down in short and long run

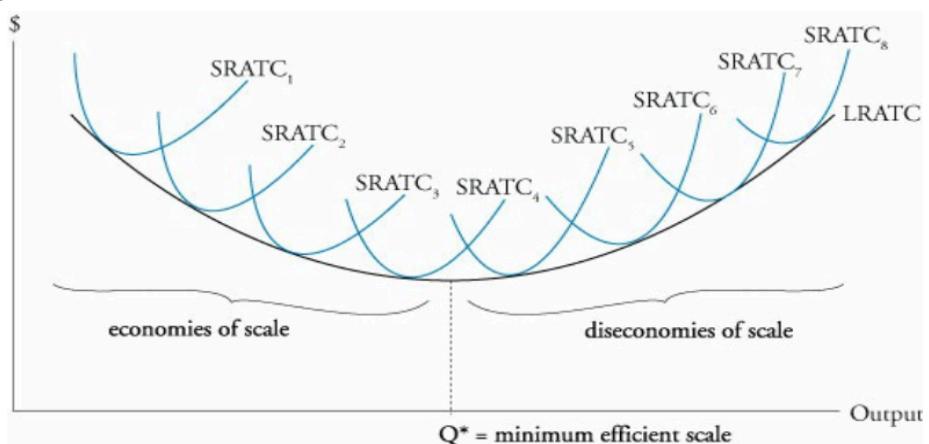
Figure 6: Breakeven Point Using the Total Revenue/Total Cost Approach



Economies of Scale and Diseconomies of Scale

- SRATC: short-run average total cost
- LRATC: long-run average total cost
 - Each point is a minimal ATC for a given scale SRATC
 - U-shaped: decrease and then increase
- Minimum efficient scale 最小规模效应
 - Lowest point on LRATC
- **Economies of Scale** 规模经济
 - Labor specialization
 - Mass production
 - Investment in efficient equipment and technology
 - Negotiate lower price
 - Average cost falls as output increases
- **Diseconomies of Scale** 规模不经济
 - Increasing Bureaucracy
 - Problems motivating a larger workforce
 - Greater barriers to innovation
 - Increase output increases long-run average cost

Figure 7: Economies and Diseconomies of Scale



The firm and Market Structures

Market Structure

- Perfect Competition 完全竞争
 - May company, identical product
- Monopolistic competition 垄断竞争
 - Many sellers, differentiated product
- Oligopoly 寡头
 - Few firms that compete in a variety of ways
- Monopoly 垄断
 - One firm

Market Structure

Type	Perfect Competition	Monopolistic Competition	Oligopoly	Monopoly
Number of Sellers↓	Many	Many	Few	Single
Product Substitute↓	Very good	Good substitutes but differentiated	Very good substitutes or differentiated	NO
Competition	Price	Price, marketing innovation, advertising, branding	Price, marketing	Advertising
Elastic↓	Perfect elastic	Elastic ($E < 1$)	Less elastic	
Dependency	independent	independent	Interdependent	None
Product Difference	Identical	Differentiated (quality, brand, features, market)	Some	None
Entry Barrier ↑	Very low	Low	High (economy of scale, market share)	Very high (copyrights, patents, government)
Pricing Power ↑	None	Some	Some to significant	Significant
Supply Function	Sum all of them	Not clear	Not clear	Not clear
Pricing Strategy	MR=Price	MR<Price	MR<Price Depend on assumption	MR<Price maximize profit single-price price discrimination

1) For all cases: $MR=MC \rightarrow$ Quantity

2) For most cases: Demand curve \rightarrow Price (Oligopoly is unclear that depend on assumption)

Perfect Competition

- Firm elasticity - Perfect elasticity
 - Demand = market price = MR
- Market elasticity: large than zero but **not perfect** elasticity
- Revenue

- $MR = AR$
- Short-Run equilibrium 短期平衡 (边际成本 -> **economic profit**)
 - $MR = MC$ to get **economic profit**
 - **MR = P**
- Long-run equilibrium output 长期平衡 (最小平均成本 -> **normal profit**)
 - $MR = MC = \text{minimum ATC}$ minimum average total cost
 - The exist of economic profit will attract more companies
 - Economic profit is **zero** and a normal return is realized
- **Long-run equilibrium - Permanent increase in demand**
 - In the short run
 - Demand curve shift to right, the price increase and quantity increase
 - More companies enter, increase supply (quantity)
 - The increase in quantity decreases price to the original price
 - Overall, the quantity increases and price stable
- Changes in demand, entry and exit, plant size

Monopolistic competition 垄断竞争

- Properties
 - A large number of **independent** sellers
 - Each have a small share and no **pricing** power
 - Pay attention to the average market **price** not the price of competitors
 - **Slightly** different product from its competitors
 - **Quality** is a significant feature
 - **Marketing** is a must
 - Can set **price** and output and a strong correlation between quality and price
- Elasticity
 - **High** elastic 富有弹性 because of substitutes
 - **Downward-sloping** demand curve, price searchers
- Profit
 - Short-term, can earn economic profit
 - Long-term, can only earn normal profit
- Production Innovation
 - Innovation is necessary to **pursue** economic profits
 - Face a less **elastic** demand curve, enable them to charge **higher** price to earn economic profit
 - Need to **continuously** innovate because close substitutes
 - Optimal innovation: margin cost equals to margin revenue of innovation
- Advertising
 - **High** advertising fee than those in perfect competition and monopolies
 - Increase average total cost, it decreases as output increases
- Brand names
 - Signals about the **quality** of the product
 - Can create economic profit
- Short-Run equilibrium 短期平衡 (边际成本 -> **economic profit**)
 - $MR = MC$ to get **economic profit**
 - $P^* > ATC^*$ → **economic profit**

- Long-run equilibrium output 长期平衡 (最小平均成本 -> **normal profit**)
 - $MR = MC > \text{minimum ATC}$ minimum average total cost
 - $P^* = ATC^*$ → **no economic profit**

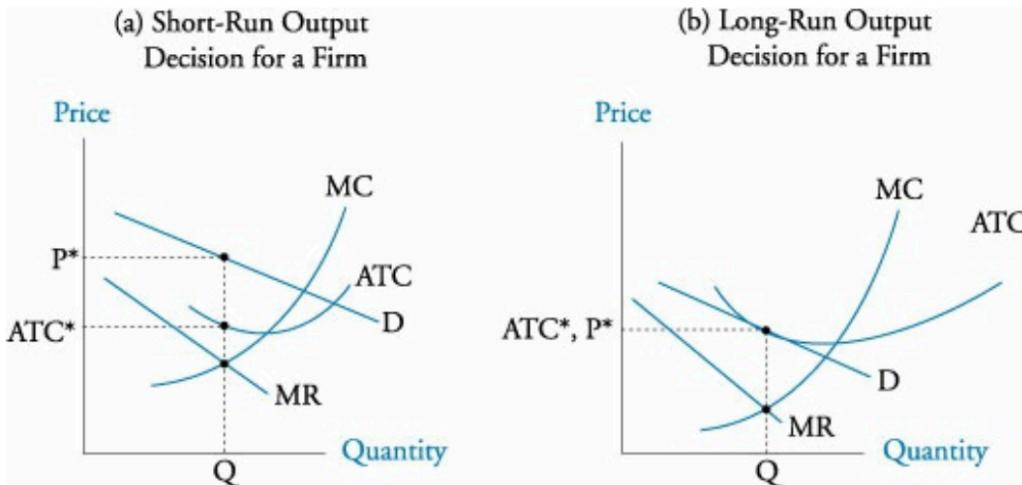
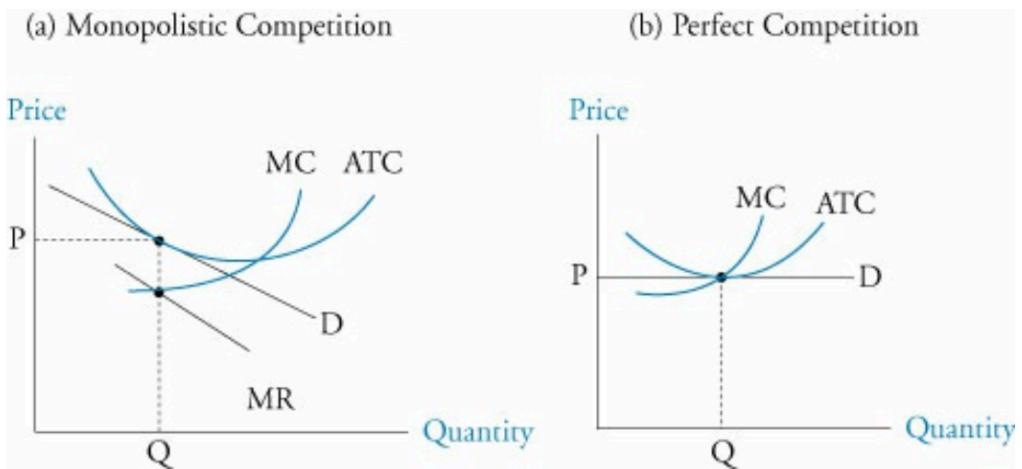


Figure 11: Firm Output Under Monopolistic and Perfect Competition



Oligopoly 寡头

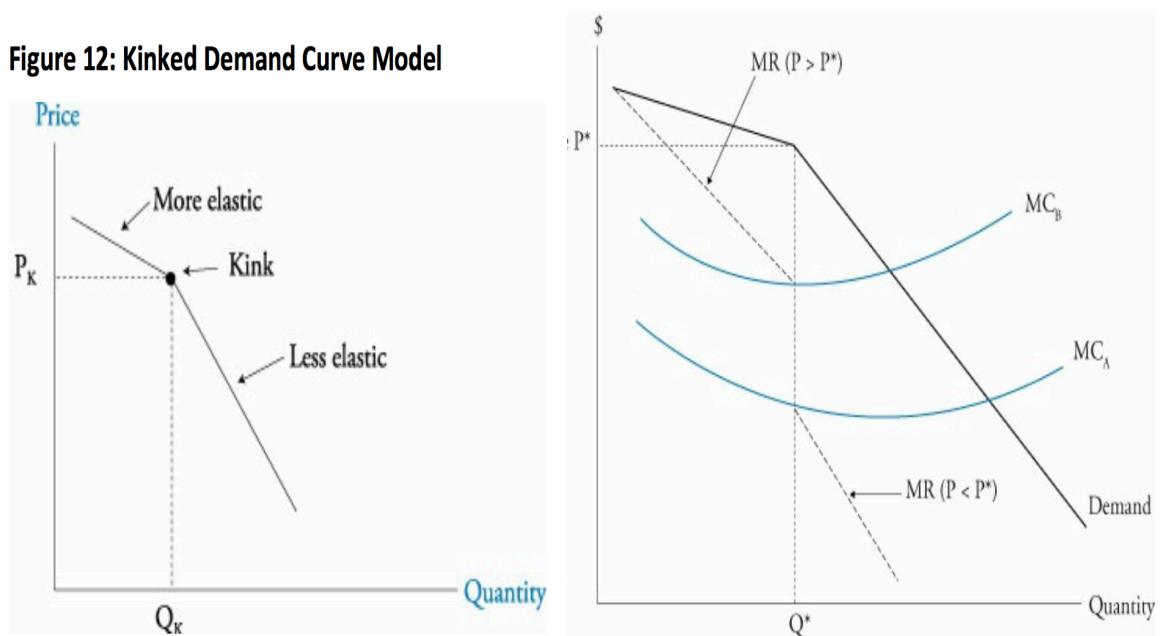
- Firms are **interdependent**
- **Fewer** firms and **higher** barriers to enter
- Focus on competitors

Kinked Demand Curve Model

- Assumption 跟跌不跟涨
 - Increase in price will be not followed by other firms
 - Decrease in price will be followed
- **Kink Point**
 - a more **elastic** curve when price is higher (left side)
 - increase price, demand decrease a **lot**
 - a less elastic curve when price is lower (right side)
 - decrease price, demand increase **little**

- the point is the **profit-maximizing** level of output
- Limitation
 - The model cannot decide the kind point

Figure 12: Kinked Demand Curve Model



Cournot Duopoly Model 双寡头/数量一致

- Core idea: adjust the **quantity** until they are the same
- Assumptions
 - Two firms with identical and constant **margin cost**
 - Each firm knows the quantity of the other
 - Subtract this and construct its own demand and marginal revenue curve
- Equilibrium
 - Both select the **same** quantity
 - Price is **higher than marginal cost**
- Early version of strategic games, decisions depend on actions of others

Nash Equilibrium Model

- Nash equilibrium 无法变得更好
 - It is reached when **choices** of all firms are such that there are **no** other choices that makes any firm better off (increase profits or decrease losses)
 - Not the best choice
- Game: prisoner's dilemma: both to confess
- Cheat in Collusion agreement: both charge lower
- **Collusion Agreement** more successful 越相似越容易成功
 - Fewer firms
 - Similar products
 - Cost structures are similar
 - Purchases are relatively small and frequent
 - Retaliation for cheating is certain and severe
 - Less actual or potential competition from firms outside the cartel

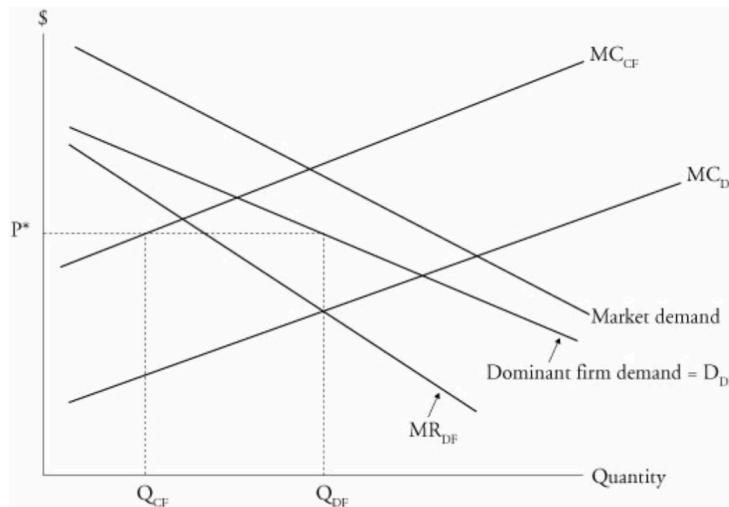
Figure 16: Nash Equilibrium

	<i>Firm B Honors</i>	<i>Firm B Cheats</i>
<i>Firm A Honors</i>	A earns 150 B earns 150	A earns 50 B earns 200
<i>Firm A Cheats</i>	A earns 200 B earns 50	A earns 100 B earns 100

Stackelberg Dominant Firm Model

- 主导公司根据自己情况设置价格，其余公司接受
- Assumption
 - One dominant firm (DF) + many competitive firms (CF)
 - DF: monopoly, CF: perfect competition**
 - DF: greater scale, lower cost structure, set the price
 - $MC=MR \Rightarrow Q^* \Rightarrow P^*$
 - DF: price setter, CF: take prices as given
 - $MC = P^*$ (set by the DF)
- Situation 1 - CF decrease price
 - Decrease CF market share (exit)
 - Increase market share of DF
- Situation 2 – overtime
 - DF market share will decrease because new competitors enters

Figure 17: Dominant Firm Oligopoly



Terms

- Monopsony, when there is only a single buyer in a market.
- Monopoly, only one company
- Duopoly, a special case of an oligopoly with two firms.
- Oligopsony, a market where many sellers can be present but meet only a few buyers

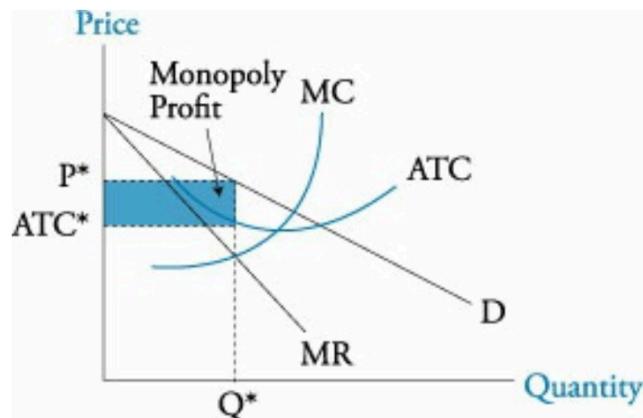
Monopoly 垄断

- One player
- Decide the price and output combination to **maximize profit**
- Pricing strategies: **single-price and price discrimination**
- Price searchers and **imperfect** information about market demand

Single-price

- Maximum profit
 - $MR = MC < ATC$, so there is economic profit
 - Profit: $(P^* - ATC^*) \times Q^*$
- Long-run: can have economic profit

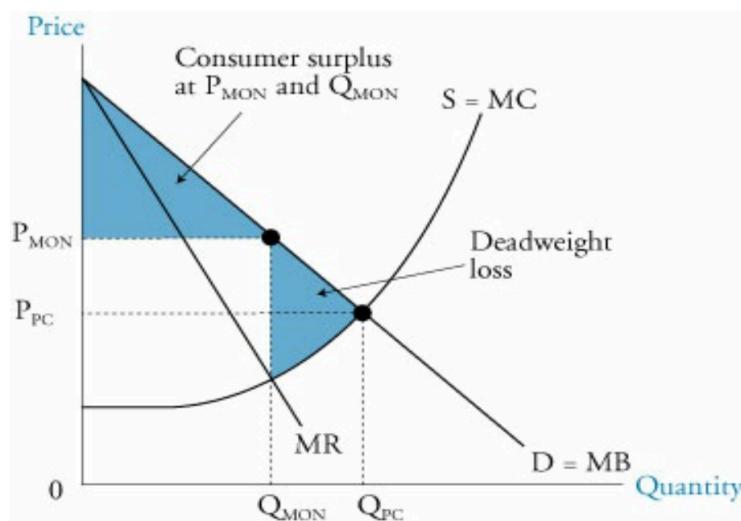
Figure 19: Monopoly Short-Run Costs and Revenues



Price Discrimination

- Motivation
 - Capture more **consumer surplus**
- Condition
 - Downward-sloping demand curve
 - At least two groups with different price **elasticities** of demand
 - Prevent buying at a lower price from **reselling**
- **Deadweight loss (DWL)**
 - Reduce the sum of consumer and producer surplus by an amount

Figure 21: Perfect Competition vs. Monopoly



Price Discrimination Levels

- first-degree (**highest price**) 最高价
 - Charge each customer the highest price they can accept
 - **Perfect** price discrimination
 - Customer surplus is **eliminated**
- Second-degree (**quantity-based** pricing) 基于数量
 - Use the **quantity** purchased as the basis for the pricing of a particular good.
 - Can be based on **quality**
- Third-degree (segmentation) 基于特征
 - segregating customers by demographic or other traits.

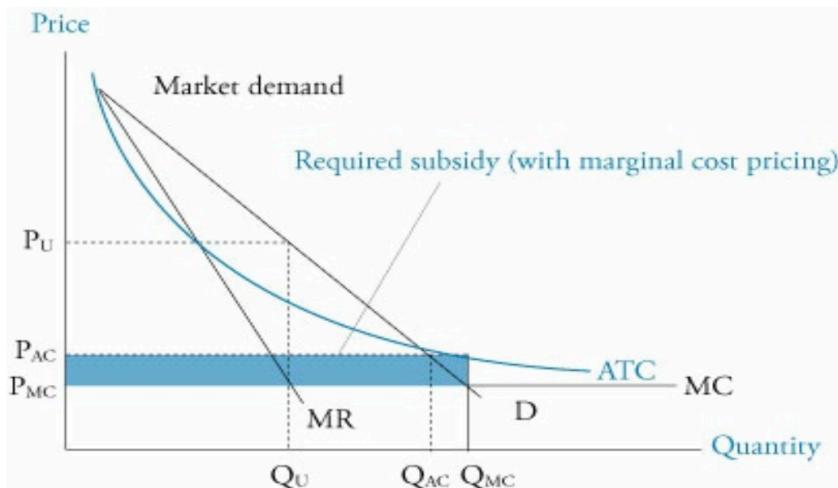
Natural Monopoly (平均价格曲线下降)

- Natural monopoly: **the average cost** of production for a firm is falling
- **Large economies of scales**
 - The average cost curve is **declining**
 - present significant barriers to entry
- **Examples: electric utility**

Monopoly Regulation

- **Unregulated**
 - $MC = MR = P \times \left(1 - \frac{1}{|E|}\right) \rightarrow \text{economic profit}$
- **Average Cost Pricing (most common)**
 - $\text{Demand} = \text{average total cost (ATC)} \rightarrow \text{normal profit}$
 - Increase output and decrease price
 - Increase social welfare (allocative efficiency)
- **Marginal Cost Pricing (efficient regulation)**
 - Efficient regulation
 - $\text{Demand} = MC < ATC \rightarrow \text{economic loss}$
 - government subsidy to maintain normal profit and prevent it from leaving
- **Monopoly Right (long-run average cost)**
 - Sell the right to the highest bidder
 - The winner bidder will be an **efficient** supplier
 - The bid value = expected economic profit
 - Price = long-run average cost

Figure 22: Natural Monopoly—Average Cost and Marginal Cost Pricing



u: unregulated, AC: average cost, MC: marginal cost

Supply Function

- **Perfect Competition**
 - Marginal cost curve above its average **variable** cost curve
 - Short-run supply curve
 - **sum the quantities supplied at each price across all firms**
- Monopolistic Competition, Oligopoly, Monopoly
 - **No** well-defined supply functions
 - Downward-sloping demand curves
- Pricing
 - *step 1: $MR = MC \rightarrow$ quantity*
 - *step 2: quantity & demand curve \rightarrow price*

Pricing Strategy

- **Overall**
 - $MC=MR$
 - $MR = \text{price}$ for Perfect Competition and $MR < \text{Price}$ for others
- **Perfect Competition**
 - $MC = MR$
 - **MR = Price (horizontal curve)**
 - Zero economic in equilibrium
- **Monopolistic Competition**
 - $MC= MR$
 - **$MR < \text{Price}$ (downward sloping)**
 - Zero economic in the **long-run** equilibrium
- **Oligopoly**
 - Interdependence, depend on the assumption of reactions
 - May have **positive** economic profit in the long-run equilibrium, but moves toward zero economic over time
 - Kinked demand curve
 - Competitors match a price decrease but not a price increase

- MC=MR, Margin revenue curve is **discontinuous** (a gap)
- Collusion
 - all producers must agree to share the market -> similar to monopoly
 - MC=MR, price based on the demand curve
- Dominant Firm
 - One firm has lowest cost structure and a large market share
 - DF: MC=MR and price based on its **firm** demand curve
 - CF: MC=price (perfect competition), firms are price takers
- Game Theory
 - Long-run outcome is **indeterminate**
 - Price between **monopoly** price and **perfect competition** price (MR)
- Monopoly
 - MC= MR < **Price** (downward sloping)
 - May have **positive** economic profit in the long-run equilibrium

Concentration Measures

- Hard to measure **demand elasticity**
- **N-firm concentration ratio**
 - Ratio = $\sum_i^n P_i$ sum of the top N largest firm's market share
 - Insensitive to **M&A**
- **Herfindahl-Hirschman Index (HHX)**
 - Ratio = $\sum_{i=1}^n P_i^2$ sum of the squared market share of the top N largest firm's
- **Limitation**
 - neither measures **market power** directly
 - **high** market share does not mean **high pricing power**
 - Fail to consider **entry barriers**
 - If entry barrier is low, there is a potential competition, and **elastic** is **high**

Figure 23: Characteristics of Market Structures

	<i>Perfect Competition</i>	<i>Monopolistic Competition</i>	<i>Oligopoly</i>	<i>Monopoly</i>
Number of sellers	Many firms	Many firms	Few firms	Single firm
Barriers to entry	Very low	Low	High	Very high
Nature of substitute products	Very good substitutes	Good substitutes but differentiated	Very good substitutes or differentiated	No good substitutes
Nature of competition	Price only	Price, marketing, features	Price, marketing, features	Advertising
Pricing power	None	Some	Some to significant	Significant