**MGEC02**

Intermediate Microeconomics II

# Lecture Notes

documented by Eric Wu

**Instructor(s):** **Prof. Ata Mazaheri**
**Email:** ata.mazaheri@utoronto.ca
**Office:** IC288
**Textbook:** Pindyck and Rubinfeld, ”Microeconomics”, 9th Edition, Pearson Prentice Hall, 2018.

# 1 Monopoly and Monopsony

## 1.1 Monopoly and Monopsony

**Definition 1.1.1** (Monopoly)**.** *Monopoly* is a market environment where there is only one seller.

**Definition 1.1.2** (Monopsony)**.** *Monopsony* is a market environment where there is only one buyer.

**Definition 1.1.3** (Market power)**.** *Market power* refers to the ability of a seller or buyer to affect the price of a good.

**Proposition 1.1.3.1** (profit maximization)**.** Monopoly maximizes profit when $MR = MC$. As

$$\begin{aligned} \pi &= TR - TC \\ &\implies \pi_{\max} \iff \frac{\partial \pi}{\partial Q} = 0 = MR - MC \iff MR = MC. \end{aligned}$$

**Proposition 1.1.3.2** (Pricing Power)**.** Setting $MR = MC$ allows us to further develop that

$$\begin{aligned} TR &= PQ \\ &\implies MR = \frac{\Delta P}{\Delta Q} Q + P = \frac{\Delta P}{\Delta Q}\frac{Q}{P} \cdot P + P = P + P\frac{1}{E_d} = MC \\ &\implies P = \frac{MC}{1 + \frac{1}{E_d}} \\ &\implies \frac{P - MC}{P} = -\frac{1}{E_d} = L \text{ s.t. } L \in [0, 1) \\ &\qquad \text{where } L \text{ is the \textit{Lerner Index of Monopoly Power}} \\ &\implies |E_d| \in (1, \infty) \qquad \text{do not produce at inelastic region.} \end{aligned}$$

**Proposition 1.1.3.3** (Multiplant Firm)**.** Given that

$$\pi = PQ_T - C_1(Q_1) - \cdots - C_k(Q_k),$$

We can set

$$\frac{\Delta\pi}{\Delta Q_1} = \frac{\Delta(PQ_T)}{\Delta Q_1} - \frac{\Delta C_1}{\Delta Q_1} = 0$$
$$\vdots$$
$$\frac{\Delta\pi}{\Delta Q_k} = \frac{\Delta(PQ_T)}{\Delta Q_k} - \frac{\Delta C_k}{\Delta Q_k} = 0$$

And optimize through lagrange. Else perform horizontal summation, i.e.,

$$Q_1 + \cdots + Q_k = Q_T = \text{with all } MC_i = MCT$$

**Definition 1.1.4** (Monopsony Power)**.** The Lerner Index of Monopoly Power is given by

$$L^{\text{monopsony}} = \frac{MV - P^s}{P^s} = \frac{1}{E_s} \in (0, \infty).$$

Of which, if we standardize, yields

$$L^{\text{standardized}} = \frac{MV - P}{MV} = \frac{1}{E_s} \cdot \frac{P}{MV} \in (0, 1).$$

# 2 Discrimination

## 2.1 Price Discrimination and Quality Discrimination

**Definition 2.1.1** (First Degree PD)**.** First-degree price discrimination firms price at the *reservation price* of each customer.

**Definition 2.1.2** (Variable Profit)**.** *Variable Profit* is defined as the sum of profits on each incremental unit produced by a firm:

$$V\Pi = TR - TVC$$

**Remarks 2.1.2.0.1** (Difference of Variable Profit)**.** Consider Monopoly vs first-degree.

$$\boxed{\text{Variable Profit}_{\text{Monopoly}} = \int_0^Q [MR(q) - MC(q)]\ dq}$$

As $MR = D = AR$ for perfect price discrimination,

$$\boxed{\text{Variable Profit}_{\text{1st-degree}} = \int_0^Q [D(q) - MC(q)]\ dq}$$

In particular,

$$\text{Variable Profit}_{\text{1st-degree}} > \text{Variable Profit}_{\text{Monopoly}}$$

However, price discrimination is hypothetical as consumer will not reveal true information regarding their reservation price.

**Definition 2.1.3** (Perfect vs Imperfect PD)**.** We have Perfect Price Discrimination,
if *the additional profit from producing and selling an incremental unit is now the difference between demand and marginal cost*
However Imperfect PD is more realistic where pricing is not continuous therefore some consumer surplus is shared.

**Definition 2.1.4** (Second Degree Price Discrimination)**.** $2^{nd}$ PD is the practice of charging different prices per unit for different quantities of the same good or service.

**Definition 2.1.5** (Block Pricing)**.** The second degree PD practice of charging different prices for different quantities or *blocks* of a good. Suppose the $i^{th}$ block prices at $P = P_i$ s.t. $Q(P_0) = 0$ for $n$ total blocks, then

$$V\Pi = \sum_{i=1}^{n}(P_i - MC)\left[Q(P_i) - Q(P_{i-1})\right], \quad \text{where } Q \text{ is a function of } P_i$$

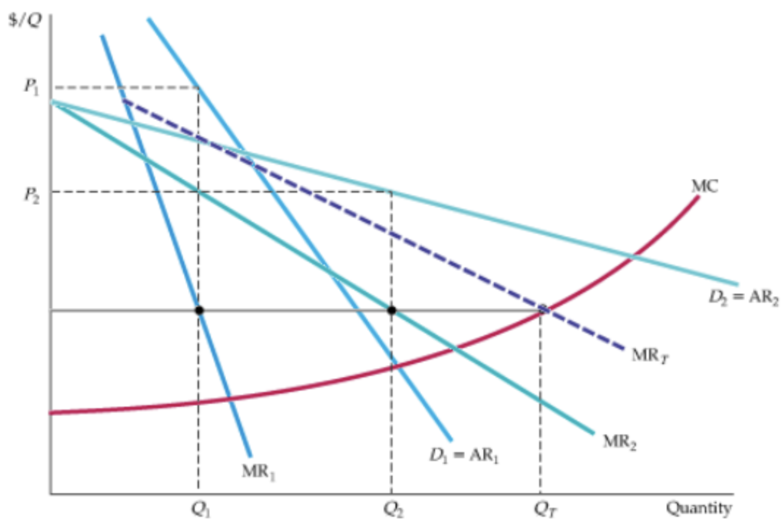
From which it follows that

$$CS = \sum_{i=1}^{n} CS_i \text{ s.t. } CS_i = \frac{Q(P_i) - Q(P_{i-1}) \times (P(Q_{i-1}) - P(Q_i))}{2}$$

**Definition 2.1.6** (Third Degree PD)**.** Third Degree PD is a practice of dividing consumers into two or more groups with separate demand curves and charging different prices to each group.

*Theory Set Up.* Given $MR = MC$,

$$MC = \begin{matrix} MR_1 \\ \vdots \\ MR_k \end{matrix} \text{ s.t. } MR_i = MR_j, \forall i, j.$$




□

*Procedure.*

1. Find $MRT$ by finding $MR_i$, express in inverse as a function $Q_i$ of $MR_i$ get $MRT = \sum_i Q_i$.
2. $MRT = MC \to Q_T$
3. $Q_T \to MC = MR_i \to Q_i \to P_i$

□

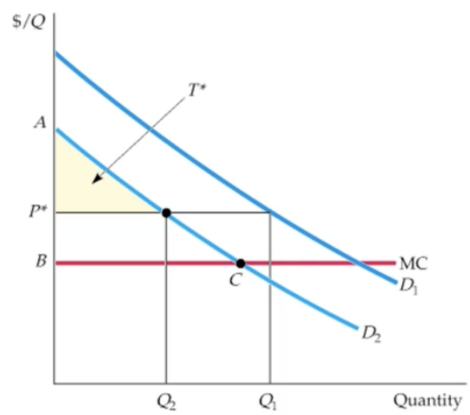
**Remarks 2.1.6.0.1.** It is possible for increasing marginal cost firms to neglect the low demand group that is not willing to pay much (as it is unprofitable).

**Definition 2.1.7** (Two "Types" of Third Degree PD)**.** Peak Load, Intertemporal differs from Third Degree in that third degree price discrimination requires simultaneous optimization ($MR_i = MC$) whereas the other two require not.

1. Intertemporal PD: practice of separating consumers with different demand functions into different groups by charging different price at different points in time (constant marginal cost).

2. Peak-Load: Practice of charging higher prices during peak periods when capacity constraints cause marginal costs to be high (non-constant marginal cost)

**Definition 2.1.8** (Two Part Tariff)**.** *Two Part Tarriff* is a practice that charges the consumer both an entry and a usage fee.
**Example.** Say we have a single consumer. Then, we can charge the entry fee, $T = CSandP = MC$ at competitive outcome thereby extracting all the CS + Usage Fee.
**Example.** Suppose we have two consumers.




In this case, marginal cost price pricing wont necessarily maximizes profit. Note, in this case marginal cost pricing yields

$$V\Pi = ABC \times 2 = 2T.$$

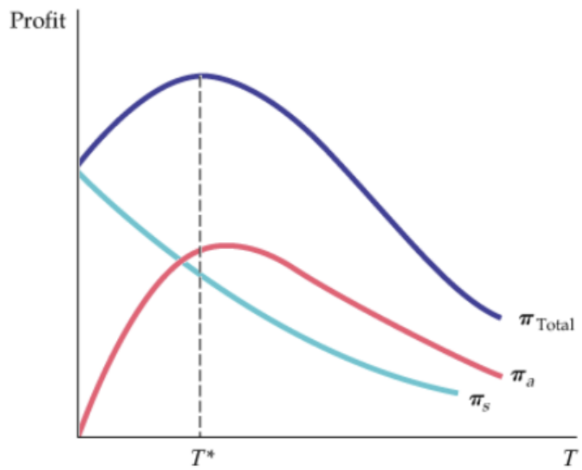
Whereas we can alternatively have

$$V\Pi = 2 \cdot T^* + PFBG + PIBH = 2T^*(P^* - MC)(Q_1 + Q_2).$$

**Proposition 2.1.8.1** (Two Parts tarrif with many consumer)**.** Let $\Pi$ be the total profit such that it is the sum of entry fee $\pi_e$, and profit from sales, $\pi_s$. Then,

$$\Pi = \pi_a + \pi_s = n_\tau(T) + (P - MC)Q_{n_\tau},$$

where $n_\tau$ is the number of entrants and is dependent on $T$ and $Q_{n_\tau}$ is the total sales.




**Theorem 2.1.8.2** (General Solutions to $n$ consumer two parts tarriff question)**.** Consider $k$ number of demand curves.
Let the reservation price of each demand curve be $r_i$ s.t. $i \in [1, k] \cap \mathbb{N}$. Then, by **Proposition 1.2.8.1.** we have

$$\begin{aligned}
\Pi &= kT + (P^* - MC)(\sum_i Q_i) \text{ s.t. } T = \frac{(\min_{i\in[1,k]} r_i - P) \min_{i\in[1,k]} Q_i}{2} \\
&= k\frac{(\min_{i\in[1,k]} r_i - P) \min_{i\in[1,k]} Q_i}{2} + (P - MC)(Q_p^T) \quad \text{where } Q_p^T \text{ is } \textstyle\sum_i Q_i \text{ expressed in } p \\
&\implies \frac{\partial \Pi}{\partial P}\text{max} = 0 = \frac{\partial}{\partial P}\left[k\frac{(\min_{i\in[1,k]} r_i - P) \min_{i\in[1,k]} Q_i}{2}\right] \\
&\implies P_{\text{solved}} \xrightarrow{\text{sub}} Q_i \to T \to \Pi.
\end{aligned}$$

Note that we must check if $MC$ pricing yeilds better result by neglecting low demand.

**Definition 2.1.9** (Menu Cost Pricing)**.** Menu Cost Pricing differs from Two-Tariff in that, instead of having both entry and usage fee, now the firm offers only one menu fee that combines the CS and the Variable Cost. Intuitively, price at total utility.

**Proposition 2.1.9.1** (Interplay Between High vs Low Demand)**.** The high type has incentive to pretend as the low type why their total utility of being low type is greater than the menu cost of lower type. To counter, firms should set discount price

$$P_{discount} = P_{menu-high} - \left[U_{high}(Q_{low}) - P_{menu-low}\right].$$

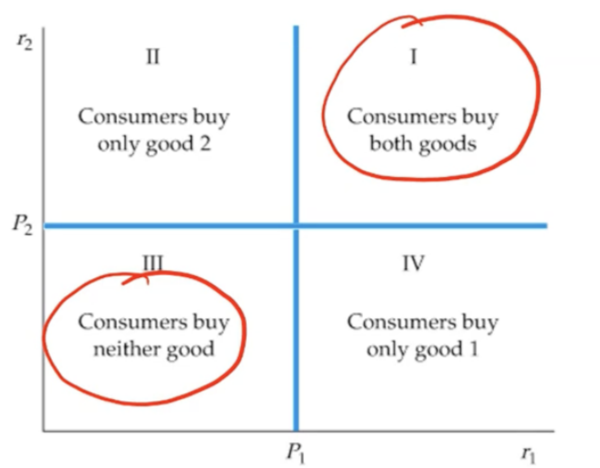
**Definition 2.1.10** (Bundling)**.** Bundling is the practice of selling two or more products as a package.
**Example** (Relative Valuations). Suppose there are two movie theaters and their reservation prices for two films are

| | Film 1 | Film 2 |
|---|---|---|
| Theater A | 12000 | 3000 |
| Theater B | 10000 | 4000 |

Note that as there is an *inverse relation* to the willingness to pay – here, A likes Film 1 better whereas B likes Film 2 better. Thus, we can bundleing the two films at 14000 will earn us a profit of 28000. This is called *Relative Valuations*

**Proposition 2.1.10.1** (Identifying Practice-third degree)**.** Suppose some grocery stores are offering coupons. Such practice is considered third degree as it attempts to scale up the known demand of low-demand consumers.

**Proposition 2.1.10.2** (Consumption Decisions when Products are sold separately)**.**



**Example.** Consider

| | Shampoo | Conditioner |
|---|---|---|
| I | \$7 | \$a |
| II | \$6 | \$8 |

where $a > 0$ with $N$ number of consumers half of which is type I and else type II. Suppose the salon cannot price discriminate. Compute the salon's profit under separate pricing.

*Solution.* As $6 < 7$, pricing \$6 for Shampoo will yield $6N$ profit. Now consider possible $a$

| $a$ | $\Pi$ |
|---|---|
| $a < 4$ | $8 \times N/2$ |
| $4 < a < 8$ | $a \times N$ |
| $8 < a < 16$ | $8 \times N$ |
| $16 < a$ | $a \times N/2$ |

Now consider bundling. We have

| I | II |
|---|---|
| 7 + a | 14 |

Thus, consider

| $a$ | $\Pi$ |
|---|---|
| $a < 7$ | $(7 + a)N$ |
| $7 < a < 21$ | $(14)N$ |
| $21 < a$ | $(7 + a)N/2$ |

Consider

| | good 1 | good 2 | bundle |
|---|---|---|---|
| I | 5 | a | 5+a |
| II | 10 | 5 | 15 |

Then,

| $a$ | $\Pi$ |
|---|---|
| $0 < a < 2.5$ | $15 \times N/2$ |
| $2.5 < a < 10$ | $(5 + a)N$ |
| $10 < a < 25$ | $15 \times N$ |
| $25 < a$ | $(5 + a)N/2.$ |

■

**Proposition 2.1.10.3** (Mixed Bundling vs Bundling)**.** One might be interested in asking whether mixed bundling can beat bundling. Suppose we have two goods, I and II, with $n$ customers. Let the bundle price of maximum profit be $\beta$. Let the marginal cost be $MC$. We set the price of goods $I$ and $II$ respectively with index as

$$P_i^{original} - (\beta_{highest} - \beta) = P_i^{discount}$$

From which it follows that

$$\Pi_v = \alpha_0(\beta - 2MC) + \sum_i (P_i^{discount} - MC),$$

where $\alpha_0$ is number of people accepting bundle price. This will force group with higher demand to purchase at single price and beat the bundling.

**Definition 2.1.11** (Advertisement)**.** Let $AR, MR$ be average revenue and marginal revenue; $AC, MC$ be average and marginal cost; $A$ be the cost of advertisement. As

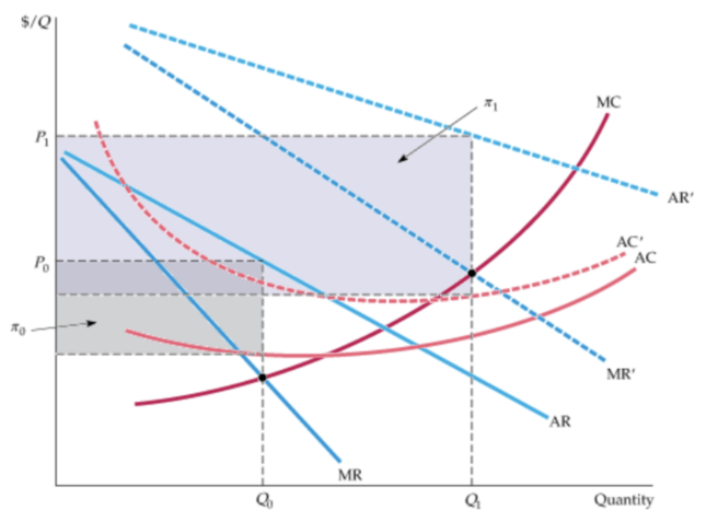
$$TR = P_q Q \implies AR = P_q,$$

$AR$ is the demand curve. Now let $AC', AR', MR'$, be respective outcomes of advertisement. Then,

$$\Pi_A > \Pi_0$$

where

$$\Pi_A = PQ_{P,A} - C(Q) - A.$$



**Proposition 2.1.11.1** (Three Effects of Advertisement)**.** Note that after advertisement,

$$TC_A = C(Q) + A.$$

Thus,

$$MC_A = \frac{\partial TC_A}{\partial A} = (\frac{\partial}{\partial A} C(Q)) + 1 = \frac{\partial C}{\partial Q}\frac{\partial Q}{\partial A} + 1 \overset{\text{at equilibrium}}{=} MR_A = P \cdot \frac{\partial Q}{\partial A}.$$

From which it follows that

$$(P - MC)\frac{\partial Q}{\partial A} = 1.$$

Multiplying both sides by $\frac{A}{PQ}$ gives

$$\frac{P - MC}{P}\left[\frac{A}{Q}\frac{\partial Q}{\partial A}\right] = \frac{A}{PQ}$$

**advertising-to-sales ratio.**

Let

$$\frac{A}{Q}\frac{\partial Q}{\partial A} := E_A, \text{i.e., advertising elasticity of demand}$$

And so,

$$\frac{A}{PQ} = -\frac{E_A}{E_p},$$

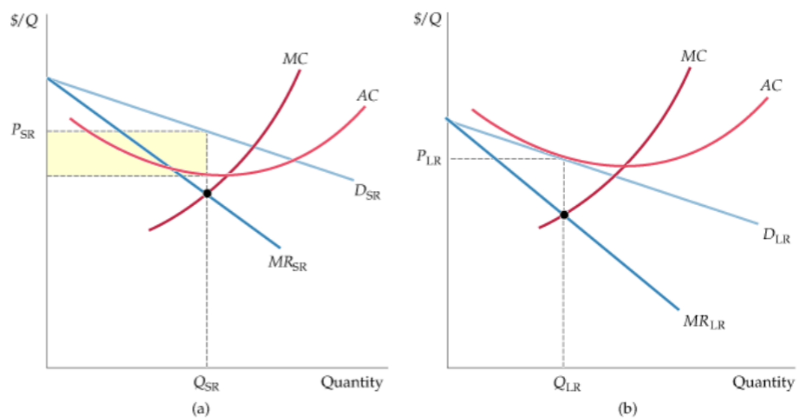
**Proposition 2.1.11.2** (Effects of Advertisement)**.** Two things determine the effects of advertisement, $E_A$ and $E_p$. Advertisement is more effective when

1. $E_p$ is low, i.e., inelastic.
2. $E_A$ is high, i.e., elastic.

# 3 Monopolistic/Oligopoly

## 3.1 Monopolistic Competition

**Definition 3.1.1** (Monopolistic Competition)**.** Market in which firms can enter freely, each producing its own brand or version of a differentiated product.

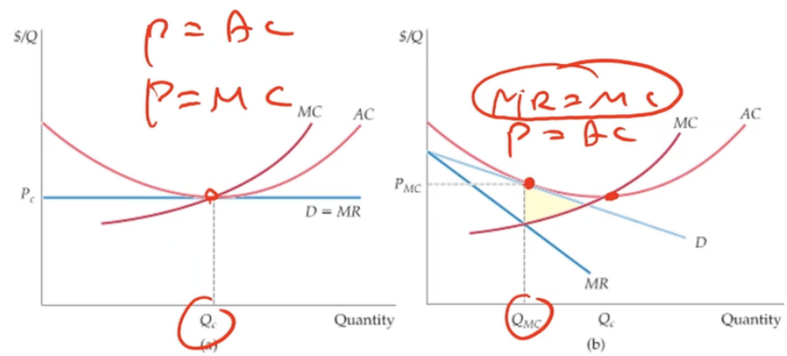



Where in the SR, $\Pi$ is extractable; whereas in the LR, $AC = P \iff \Pi = 0$.

**Remarks 3.1.1.0.1.** $\Pi = 0$ with *free exit-entry.* In particular,

1. Firms compete by selling *differentiated and substitutable* products (not perfect substitutes), i.e., the *cross-prices elasticities of demand* are large but not infinite.
2. *free entry and exit.*

**Proposition 3.1.1.1** (Monopolistic Competition and Economic Efficiency)**.** Monopolistic Competition is inefficient. Consider on the left a perfect competition pricing where $P = MC$ and on the right a monopolistic competition pricing where $MR = MC \xrightarrow{Q_{equi}} P = AC$

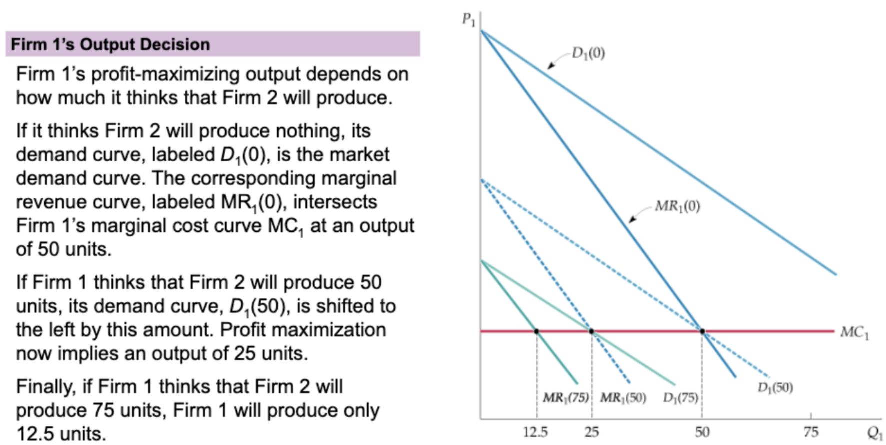


## 3.2 Oligopoly

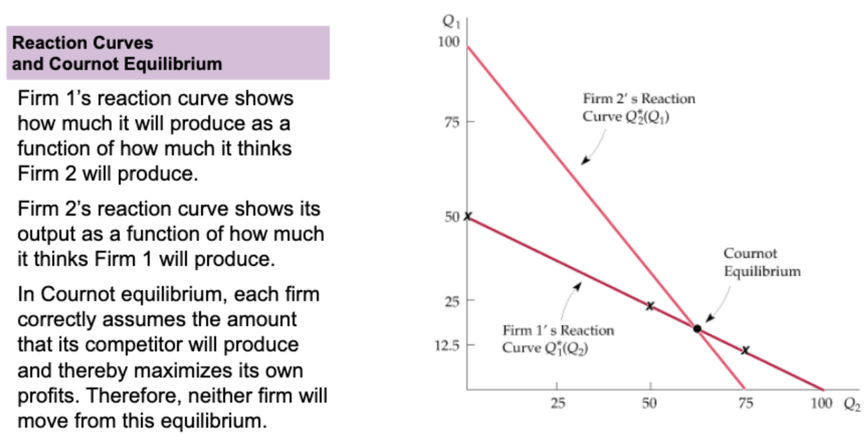
**Definition 3.2.1** (Oligopoly)**.** Market in which only a few firms compete with one another, and entry by new firms is *impeded.*

**Remarks 3.2.1.0.1.** $\Pi > 0$ with *high fixed cost.* In particular, Oligopolistic Equilibrium are *Nash.*

**Definition 3.2.2** (Cournot Model)**.** Oligopoly Model in which firms produce a homogeneous good, each firm treats the output of its competitors as fixed, and all firms decide simultaneously how much to produce.




**Definition 3.2.3** (Reaction Curve)**.** Relationship between a firm's profit-maximizing output and the amount it thinks its competitor will produce.




**Definition 3.2.4** (Cournot Equilibrium)**.** Equilibrium in the Cournot model, in which each firm correctly assumes how much its competitor will produce and sets its own production level accordingly.

**Theorem 3.2.4.1** (Cournot Generalization for equal $MC$)**.** Assume a linear demand curve $P = a - bQ$ with $n$ firms and $MC = c$. Then,

$$q_i = \frac{c-a}{(n+1)b}, \quad n \to \infty \implies p = c, q_i \approx 0$$

*Proof.*

$$\begin{aligned}
TR_i &= Pq_i - Cq_i \\
&= \left[ a - b(\sum_{i=1}^{n} q_i) \right] q_i - cq_i \\
&\overset{\max}{\implies} \frac{\partial TR_i}{\partial q_i} = 0 = a - b(q_1 + \cdots + 2q_i + q_n) - c \\
&\implies q_i = \frac{a-c}{(n+1)b} \qquad\qquad \text{as } MC = C, \forall i \iff q_i = q_j, \forall i, j \\
&\implies \lim_{n\to\infty} p = \lim_{n\to\infty} a - bn\left(\frac{a-c}{(n+1)b}\right) = c
\end{aligned}$$

□

**Definition 3.2.5** (Stackelberg Model)**.** Oligopoly model in which one firm sets its output before other firms do.

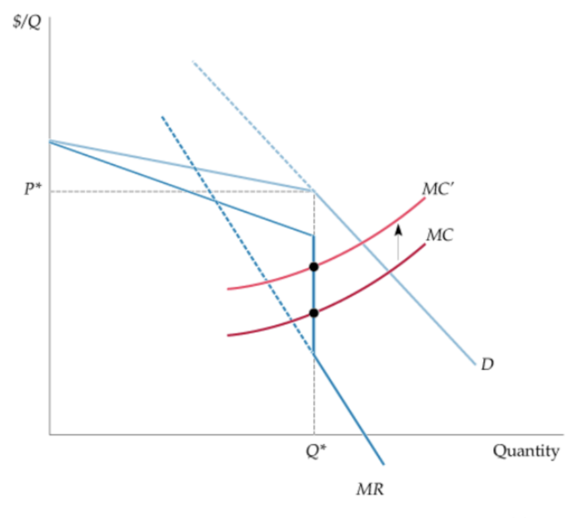
**Definition 3.2.6** (Bertrand Model)**.** Oligopoly model in which firms produce a homogeneous good, each firm treats the price of its competitors as fixed, and all firms decide simultaneously what price to charge.

## 3.3 Implications of the Prisoner's Dilemma For Oligopolistic Pricing

**Definition 3.3.1** (Price Rigidity)**.** Characteristic of oligopolistic markets by which firms are reluctant to change prices even if costs or demands change

**Definition 3.3.2** (Kinked Demand Curve Model)**.** Oligopoly model in which each firm faces a demand curve kinked at the currently prevailing price: at higher prices demand is very elastic, whereas as lower prices it is inelastic.

**Proposition 3.3.2.1.** Oligopolistic participants view demand to be kinked.




**Definition 3.3.3** (Price Signaling)**.** Form of implicit collusion in which a firm announces a price increase in the hope that other firms will follow suit.

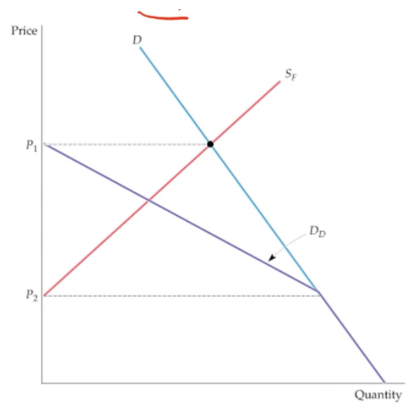
**Definition 3.3.4** (Price Leadership)**.** Pattern of pricing in which one firm regularly announces price changes that other firms then match.

## 3.4 Cartel

**Definition 3.4.1** (Cartel)**.** Market in which some or all firms explicitly collude, coordinating prices and output levels to maximize joint profits.

**Definition 3.4.2** (Dominant Demand Curve)**.** Let $S_F$ be the aggregate supply curve of the *fringe* firms with $D$ being the market demand. We define the dominant demand, $D_D \equiv Q_R$ s.t.

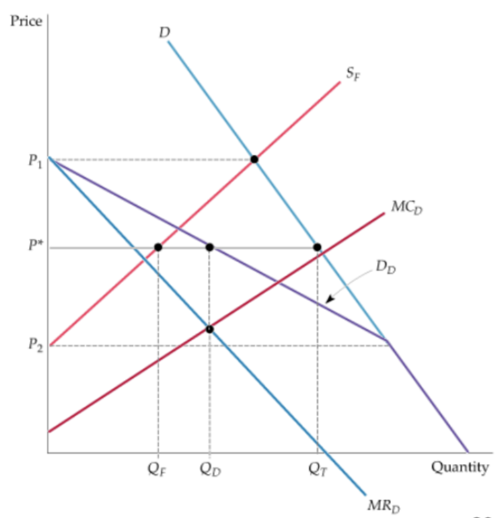
$$D_D := D - SF.$$




**Definition 3.4.3** (Dominant Pricing)**.** Dominant firm produces quantity $Q_D$ at the point where

$$MR_D = MC_D$$

at which point $P = P^*$ fringe sells $Q_F$ and total sales $= Q_T = Q_D + Q_F$



# 4 Game Theory

## 4.1 Gaming and Strategic Decisions

**Definition 4.1.1** (Game)**.** Situation in which players make strategic decisions that take into account each other's actions and responses.

**Definition 4.1.2** (Payoff)**.** Value associated with possible outcome.

**Definition 4.1.3** (Strategy)**.** Rule or plan of action for playing a game.

**Definition 4.1.4** (Optimal Strategy)**.** Strategy that maximizes a player's *expected payoff*.

**Definition 4.1.5** (Cooperative Game)**.** Game in which participants *can negotiate* binding contracts that allow them to plan joint strategies.

**Definition 4.1.6** (Noncooperative Game)**.** Game in which negotiation and enforcement of binding contracts are not possible.

**Remarks 4.1.6.0.1.** Rationality is assumed in neoclassical front. In 2017, Richard Thaler won the noble prize in economics in the field of behavioral economics that investigates the alternative of rationality as an assumption.

**Definition 4.1.7** (Dominant Strategies)**.** Optimal strategy that is indifferent to opponent's action.

**Definition 4.1.8** (Weak Dominant Strategies)**.** A strategy that cannot do worse.

**Definition 4.1.9** (Equilibrium in Dominant Strategy)**.** Outcome of a game in which each firm is doing the best it can regardless of what its competitors are doing

**Definition 4.1.10** (Nash Equilibrium)**.** I'm doing the best I can given what you are doing. You're doing the best you can given what I am doing. Intuitively, we optimize given the opponent's action.

**Definition 4.1.11** (Prisoner's Dilemma)**.** Game theory example in which two prisoners must decide separately whether to confess to a crime; if a prisoner confesses, he will receive a lighter sentence and his accomplice will receive a heavier one, but if neither confesses, sentences will be lighter than if both confess.

**Definition 4.1.12** (Maximin Strategy)**.** Strategy that maximizes the minimum gain that can be earned.

**Definition 4.1.13** (Pure Strategy - mixed strategy)**.** Strategy in which a player makes a specific choice or takes a specific action.

## 4.2 Repeated Games

**Definition 4.2.1** (Repeated Games)**.** Game in which actions are taken and payoffs received over and over again.

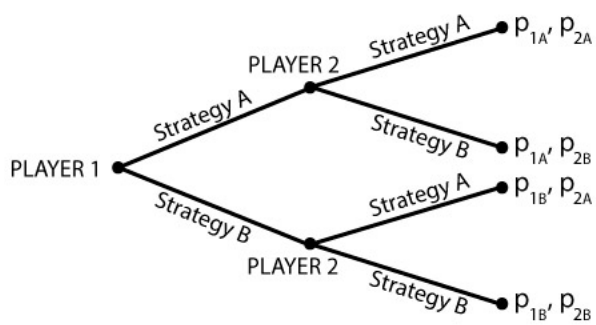
**Definition 4.2.2** (Tit-For-Tat)**.** Repeated-game strategy in which a player responds in kind to an opponent's previous play, cooperating with cooperative opponents and retaliating against uncooperative ones.

**Definition 4.2.3** (Infinitely Repeated Game)**.** Suppose the game is infinitely repeated. In other words, my competitor and I repeatedly set prices month after month, forever. With infinite repetition of the game, the expected gains from cooperation will outweigh those from undercutting.

## 4.3 Sequential Games

**Definition 4.3.1** (Sequential Game)**.** Game in which players move in turn, responding to each other's actions and reactions.

**Definition 4.3.2** (Extensive Form of a Game)**.** Representation of possible moves in a game in the form of a decision tree.



## 4.4 Threats, Commitment, Credibility

**Definition 4.4.1** (Empty Threats)**.** Threats that do not better off the player threatening others–therefore empty. Such threats are ignored.

**Remarks 4.4.1.0.1** (Commitment and Credibility)**.** Developing the right kind of reputation can also give one a strategic advantage. Suppose that the managers of Far Out Engines develop a reputation for being irrational—perhaps downright crazy. They threaten to produce big engines no matter what Race Car Motors does. Now the threat might be credible without any further action; after all, you can't be sure that an irrational manager will always make a profit- maximizing decision. In gaming situations, the party that is known (or thought) to be a little crazy can have a significant advantage.

**Definition 4.4.2** (Bargaining Strategy)**.** Our discussion of commitment and credibility also applies to bargaining problems. The outcome of a bargaining situation can depend on the ability of either side to take an action that alters its relative bargaining position.

**Remarks 4.4.2.0.1** (Entry Deterrence)**.** To deter entry, the incumbent firm must convince any potential competitor that entry will be unprofitable.

**Proposition 4.4.2.1** (Irrevocable Commitment)**.** But what if you can make an irrevocable commitment that will alter your incentives once entry occurs—a commitment that will give you little choice but to charge a low price if entry occurs? # yet finished

## 4.5 Auctions

**Definition 4.5.1** (Auction Formats)**.**

1. English (or oral) auction Auction in which a seller actively solicits progressively higher bids from a group of potential buyers.
2. Dutch auction Auction in which a seller begins by offering an item at a relatively high price, then reduces it by fixed amounts until the item is sold
3. sealed-bid auction Auction in which all bids are made simultaneously in sealed envelopes, the winning bidder being the individual who has submitted the highest bid.
   (a) first-price auction Auction in which the sales price is equal to the highest bid.
   (b) second-price auction Auction in which the sales price is equal to the second-highest bid.

**Definition 4.5.2** (Private-value Auction)**.** Auction in which each bidder knows his or her individual valuation of the object up for bid, with valuations differing from bidder to bidder.

**Definition 4.5.3** (Common-value Auction)**.** Auction in which the item has the same value to all bidders, but bidders do not know that value precisely and their estimates of it vary.

**Remarks 4.5.3.0.1.** Whatever the auction format, each bidder must choose his or her bidding strategy. For an open English auction, this strategy is a choice of a price at which to stop bidding. For a Dutch auction, the strategy is the price at which the individual expects to make his or her only bid. For a sealed-bid auction, the strategy is the choice of bid to place in a sealed envelope.

**Remarks 4.5.3.0.2** (Common Value Auction; who wins?)**.** Suppose that you and four other people participate in an oral auction to purchase a large jar of pennies, which will go to the winning bidder at a price equal to the highest bid. Once you have estimated the number of pennies in the jar, what is your optimal bidding strategy?

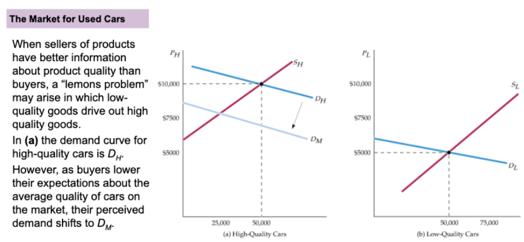
**Definition 4.5.4** (The Winner's Curse)**.** Situation in which the winner of a common-value auction is worse off as a consequence of overestimating the value of the item and thereby overbidding.

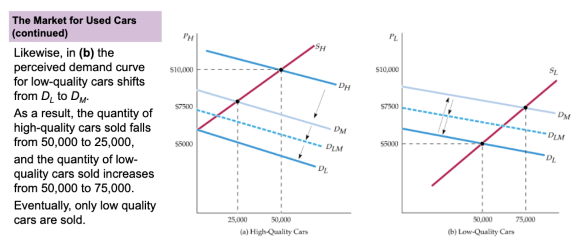
# 5 Asymmetric Information

## 5.1 Adverse Selection

**Remarks 5.1.0.0.1.** George Arthur Akerlof (1940) observes that the used car market is dominated by bad quality cars: as information is not symmetric, good quality car buyers are skeptical and therefore have a lower demand than they should have been–until all good cars are casted out of the market.

**Definition 5.1.1** (Asymmetric Information)**.** When buyers and sellers possess different information about a transaction.




**Definition 5.1.2** (The Lemons Problem)**.** With asymmetric information, low-quality goods can drive high-quality goods out of the market.

**Definition 5.1.3** (Adverse Selection)**.** Form of market failure resulting when products of different qualities are sold at a single price because of asymmetric information, so that too much of the low-quality product and too little of the high-quality product are sold.

**Proposition 5.1.3.1** (Solutions?)**.**

1. Sellers can offer money back guarantees: does not solve the asymmetric information problem, but treats the downside risk of asymmetric information

2. Buyers can take to a garage for an inspection: can solve some of the asymmetric information problem

**Proposition 5.1.3.2** (Implications of Asymmetric Information)**.**

1. The Market for Credit: credit card companies/Banks use computerized credit histories (often share with one another) to distinguish low-quality from high-quality borrowers. A practice not liked by consumers

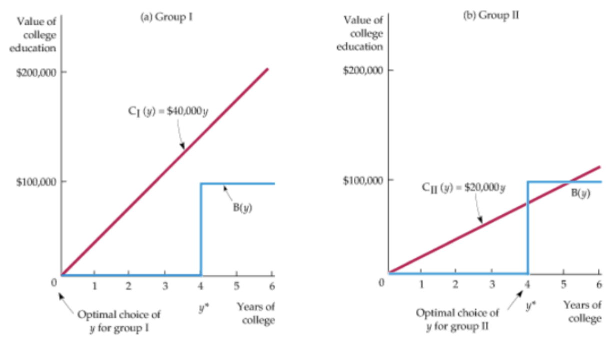
2. The Market for Insurance: Buyers of insurance know much more about their general health than any insurance company, even if it insists on a medical examination. As a result, adverse selection arises, much as it does in the market for used cars.

**Definition 5.1.4** (Market Signaling)**.** Process by which sellers send signals to buyers conveying information about product quality. To be strong, a signal must be easier for high-productivity people to give than for low-productivity people to give, so that high-productivity people are more likely to give it.

**Example.** Firms that produce a higher-quality, more dependable product must make consumers aware of this difference. But how can they do it in a convincing way? The answer is guarantees and warranties. Guarantees and warranties effectively signal product quality because an extensive warranty is more costly for the producer of a low-quality item than for the producer of a high-quality item.

In **(a)**, the low-productivity group will choose an education level of $y = 0$ because the cost of education is greater than the increased earnings resulting from education.

However, in **(b)**, the high-productivity group will choose an education level of $y^* = 4$ because the gain in earnings is greater than the cost.




**Remarks 5.1.4.0.1** (Cost–Benefit Comparison)**.** In deciding how much education to obtain, people compare the benefit of education with the cost. People in each group make the following cost-benefit calculation: Obtain the education level y* if the benefit (i.e., the increase in earnings) is at least as large as the cost of this education.

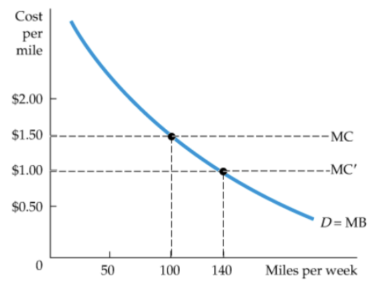
## 5.2 Moral Hazard

**Definition 5.2.1** (Moral Hazard)**.** When a party whose actions are unobserved can affect the probability or magnitude of a payment associated with an event.

Moral hazard alters the ability of markets to allocate resources efficiently. *D* gives the demand for automobile driving.

With no moral hazard, the marginal cost of transportation MC is $1.50 per mile; the driver drives 100 miles, which is the efficient amount.

With moral hazard, the driver perceives the cost per miles to be MC = $1.00 and drives 140 miles.




**Definition 5.2.2** (Agent)**.** Individual employed by a principal to achieve the principal's objective

**Definition 5.2.3** (Principal)**.** Individual who employs one or more agents to achieve an objective.

**Proposition 5.2.3.1** (Principal–agent problem)**.** Problem arising when agents (e.g., a firm's managers) pursue their own goals rather than the goals of principals (e.g., the firm's owners).

**Incentives in the Principal–Agent Framework**

| | Bad luck | Good luck |
|---|---|---|
| Low effort (e=0) | $10,000 | $20,000 |
| High effort (e=1) | $20,000 | $40,000 |

The cost of effort is 10,000e.
Suppose, for example, that the owners (principal) offer the following payment scheme:

If $R$ = $10,000 or $20,000, $w = 0$
If $R$ = $40,000, $w$ = $24,000

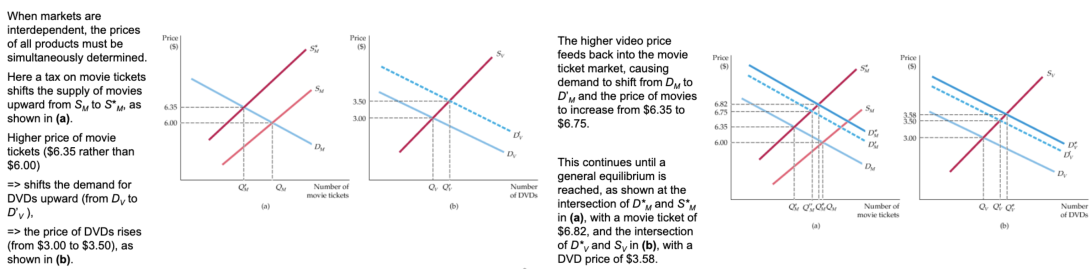
Under this system, the repairperson will choose to make a high level of effort.

# 6 General Equilibrium

## 6.1 General Equilibrium Analysis

**Definition 6.1.1** (Partial Equilibrium Analysis)**.** Determination of equilibrium prices and quantities in a market independent of effects from other markets.

**Definition 6.1.2** (General Equilibrium System)**.** Simultaneous determination of the prices and quantities in all relevant markets, taking feedback effects into account.




### Reaching General Equilibrium:

1. To find the general equilibrium prices (and quantities) in practice, we must simultaneously find two prices that equate quantity demanded and quantity supplied in all related markets.

2. For our two markets, we need to find the solution to four equations (supply of movie tickets, demand for movie tickets, supply of DVDs, and demand for DVDs).

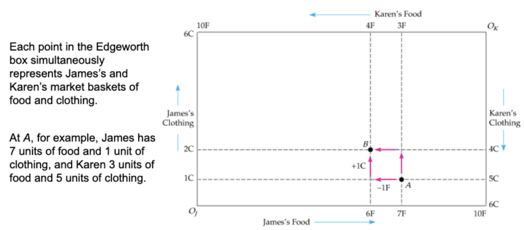
3. Movies and DVDs are substitute goods. If the goods in question are complements, a partial equilibrium analysis will overstate the impact of a tax.

**Definition 6.1.3** (Exchange Economy)**.** Market in which two or more consumers trade two goods among themselves.

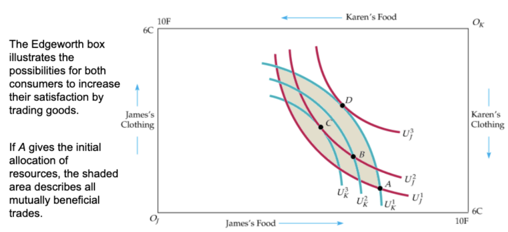
**Definition 6.1.4** (Pareto Efficient Allocation)**.** Allocation of goods in which no one can be made better off unless someone else is made worse off.

## 6.2 Efficiency in Exchange

**Definition 6.2.1** (Edgeworth Box)**.** Diagram showing all possible allocations of either two goods between two people or of two inputs between two production processes.



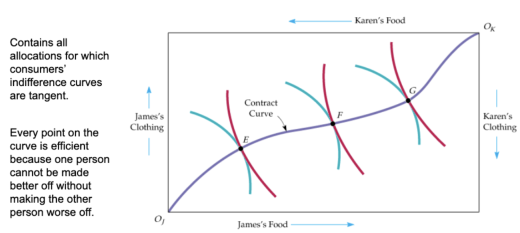

**Definition 6.2.2** (Efficient Allocation)**.** The Edgeworth box illustrates the possibilities for both consumers to increase their satisfaction by trading goods. If A gives the initial allocation of resources, the shaded area describes all mutually beneficial trades.



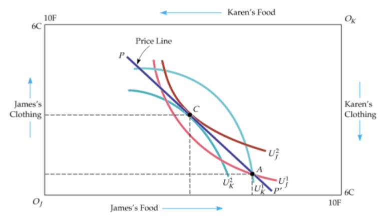

where

$$MRS_j = MRS_k$$

**Definition 6.2.3** (Contract Cruve)**.** Curve showing all efficient allocations of goods between two consumers, or of two inputs between two production functions.



**Definition 6.2.4** (Consumer Equilibrium in a Competitive Market)**.** In a competitive market the prices of the two goods determine the terms of exchange among consumers. If A is the initial allocation of goods and the price line PP represents the ratio of prices, the competitive market will lead to an equilibrium at C - the point of tangency of both indifference curves $\implies$ The competitive equilibrium is Pareto efficient.




Let $E$ be endowment. Then, we must satisfy:

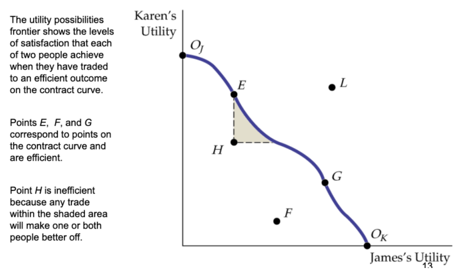
1. $MRS_A = \frac{P_x}{P_y}$
2. $MRS_B = \frac{P_x}{P_y}$
3. $x_A + x_B = E$ and $y_A + y_B = E$

**Definition 6.2.5** (Welfare Economics)**.** Welfare economics is the normative evaluation of markets and economic policy: if everyone trades in the competitive marketplace, all mutually beneficial trades will be completed and the resulting equilibrium allocation of resources will be economically efficient. In a competitive equilibrium from the consumer's perspective:
1. Because the indifference curves are tangent, all marginal rates of substitution between consumers are equal.
2. Because each indifference curve is tangent to the price line, each person's MRS of clothing for food is equal to the ratio of the prices of the two goods.

$$MRS^j_{FC} = P_F/P_C = MRS^k_{FC}.$$

## 6.3 Equity and Efficiency

**Definition 6.3.1** (Utility Possibilities Frontier Curve)**.** The Utility Possibilities Frontier Curve showing all efficient allocations of resources measured in terms of the utility levels of two individuals.




Note that by definition $H$ and $F$ are inefficient and $L$ is impossible.

**Definition 6.3.2** (Social Welfare Functions)**.** social welfare function Measure describing the well-being of society as a whole in terms of the utilities of individual members.

1. Egalitarian—all members of society receive equal amounts of goods
2. Rawlsian—maximize the utility of the least-well-off person
3. Utilitarian—maximize the total utility of all members of society
4. Market-oriented—the market outcome is the most equitable

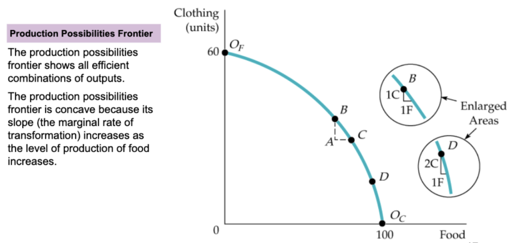
**Definition 6.3.3** (Equity and Perfect Competition)**.** If individual preferences are convex, then every efficient allocation (every point on the contract curve) is a competitive equilibrium for some initial allocation of goods. Any equilibrium deemed to be equitable can be achieved by a suitable distribution of resources among individuals and that such a distribution need not in itself generate inefficiencies. But, all programs that redistribute income in our society are economically costly $\implies$ tradeoff between efficiency and equity.

## 6.4 Input Efficiency

**Definition 6.4.1** (Technical Efficiency)**.** *Technical Efficiency refers to* Condition under which firms combine inputs to produce a given output as inexpensively as possible.
If producers of food and clothing minimize production costs, they will use combinations of labor and capital so that the ratio of the marginal products of the two inputs is equal to the ratio of the input prices:

$$MP_L/MP_K = MRTS_{LK} = w/r.$$

**Definition 6.4.2** (Production Possibilities Frontier). *Production Possibilities Frontier Curve* shows the combinations of two goods that can be produced with fixed quantities of inputs.

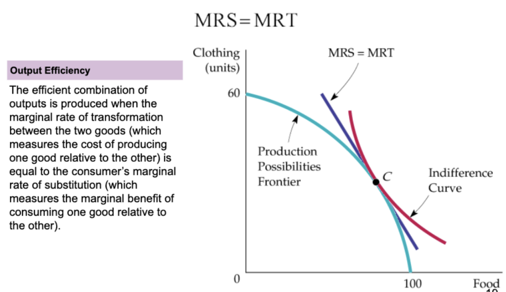



**Definition 6.4.3** (Marginal Rate of Transformation). Amount of one good that must be given up to produce one additional unit of a second good. At any point on PPF,

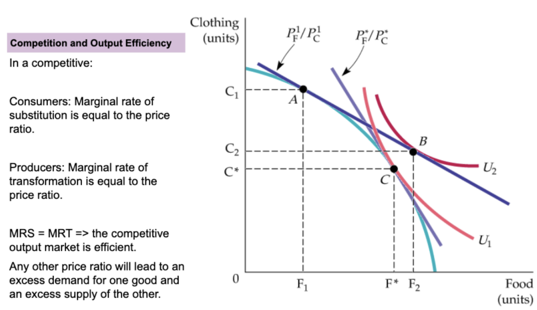
$$MRT = MC_F/MC_C = \frac{P_F}{P_C}.$$

**Proposition 6.4.3.1** (Output Efficiency). An efficient economy produces its output only if for each consumer

$$MRS = MC_F/MC_C = P_F/P_C = MRT.$$




**Definition 6.4.4** (Efficiency in Output Market).

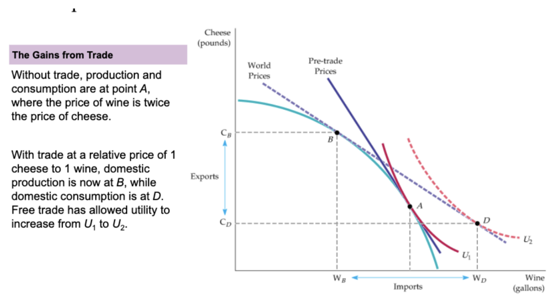


## 6.5 Free Trade

**Definition 6.5.1** (Comparative Advantage)**.** Situation in which Country 1 has an advantage over Country 2 in producing a good because the cost of producing the good in 1, relative to the cost of producing other goods in 1, is lower than the cost of producing the good in 2, relative to the cost of producing other goods in 2.

**Definition 6.5.2** (Absolute Advantage)**.** Situation in which Country 1 has an advantage over Country 2 in producing a good because the cost of producing the good in 1 is lower than the cost of producing it in 2.

**Definition 6.5.3** (Expanded Production Possibilities Frontier)**.**



# 7 Market Failure

## 7.1 Why Market Fall

**Proposition 7.1.0.1** (Market Power)**.** Suppose that unions gave workers market power over the supply of their labor in the production of food. Then,

1. Too little labor would then be supplied to the food industry at too high a wage and too much labor to the clothing industry at too low a wage.
2. In the clothing industry, the input efficiency conditions would be satisfied. In the food industry, the wage paid would be greater than the wage paid in the clothing industry.
3. The result is input inefficiency because efficiency requires that the marginal rates of technical substitution be equal in the production of all goods. • Market Power

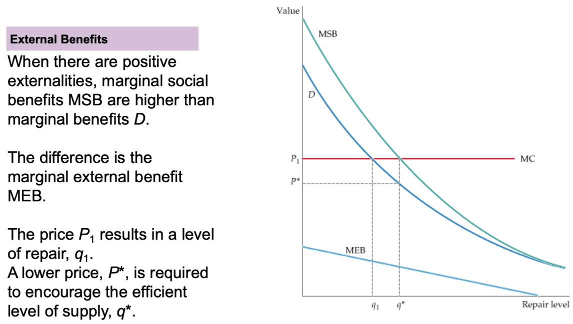
**Proposition 7.1.0.2** (Incomplete Information)**.** If consumers do not have accurate information about market prices or If product quality is not maintained, the market system will not operate efficiently. This lack of information may give producers an incentive to supply too much of some products and too little of others. In other cases, while some consumers may not buy a product even though they would benefit from doing so, others buy products that leave them worse off.

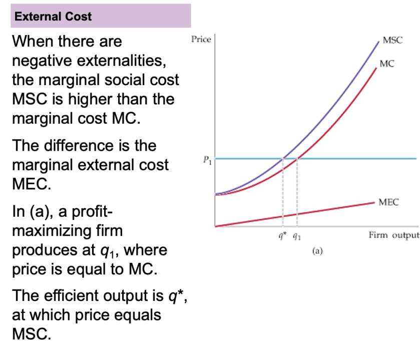
**Proposition 7.1.0.3** (Externalities)**.** Sometimes, however, market prices do not reflect the activities of either producers or consumers.There is an externality when a consumption or production activity has an indirect effect on other consumption or production activities that is not reflected directly in market prices. In particular, we define externalities as *action by either a producer or a consumer which affects other producers or consumers, but is not accounted for in the market price.* There are two types of negative externalities:

1. *marginal external cost*: increase in cost imposed externally as one or more firms increase output by one unit.
2. *marginal social cost*: sum of the marginal cost of production and the marginal external cost.

In contrast to

1. *marginal external benefit*: Increased benefit that accrues to other parties as a firm increases output by one unit.
2. *marginal social benefit*: Sum of the marginal private benefit plus the marginal external benefit.

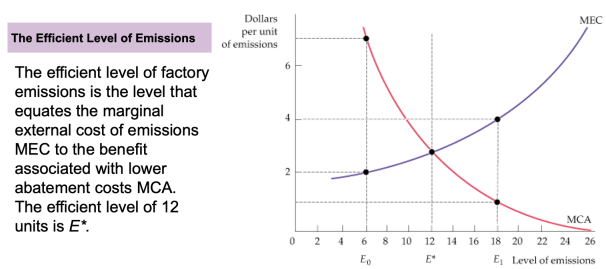



**Proposition 7.1.0.4** (Public Goods)**.** Market failure arises when the market fails to supply goods that many consumers value. We define public goods as *the nonexclusive, nonrival good that can be made available cheaply but which, once available, is difficult to prevent others from consuming.*

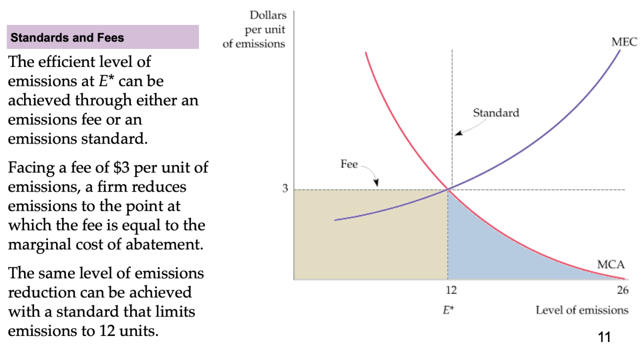
## 7.2 Ways of Correction

**Proposition 7.2.0.1** (Emissions?)**.** Let $MEC = MSC$ and $MPC = 0$ for the cost of emission. Now correspondingly define $MCA$ as the cost of abatement, i.e., the cost of removing emission; thus it is downward sloping. Then, the optimal level of pollution occurs at $E^*$

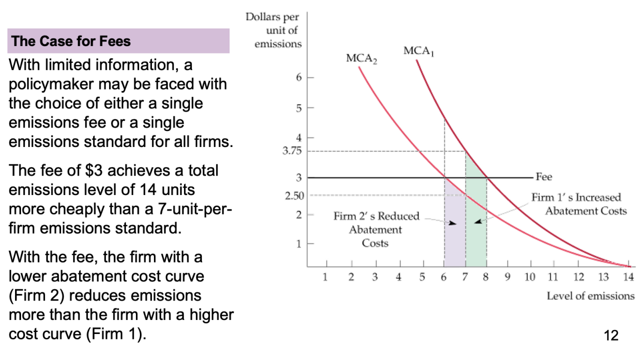


**Definition 7.2.1** (Emissions Standard)**.** Legal limit on the amount of pollutant that a firm can emit; think of it analogously as quota

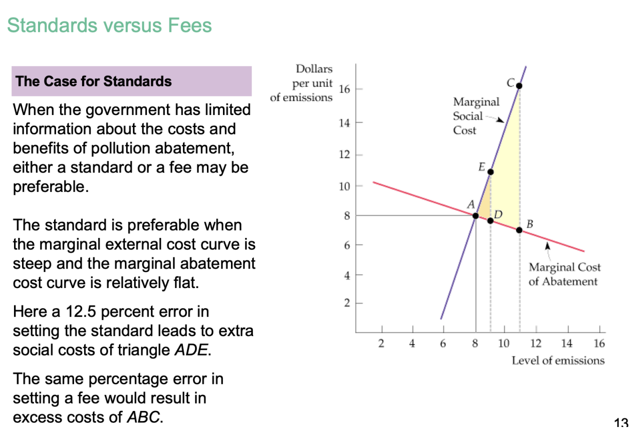
**Definition 7.2.2** (Emission Fee)**.** Charge levied on each unit of a firm's emissions




**Definition 7.2.3** (The case for fees)**.**

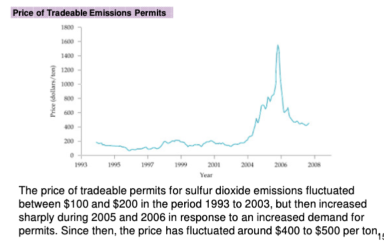



**Proposition 7.2.3.1** (Standard v.s. Fee)**.** It is highly likely for the policy to be set with inaccuracy. In particular, a miss on the standard often results in less deadweight loss than that of a miss on the fee.

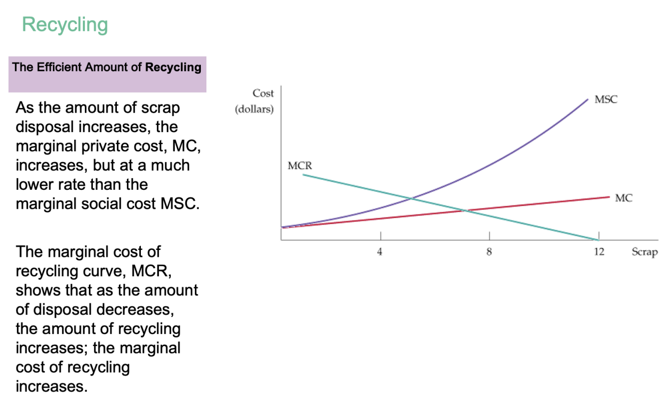


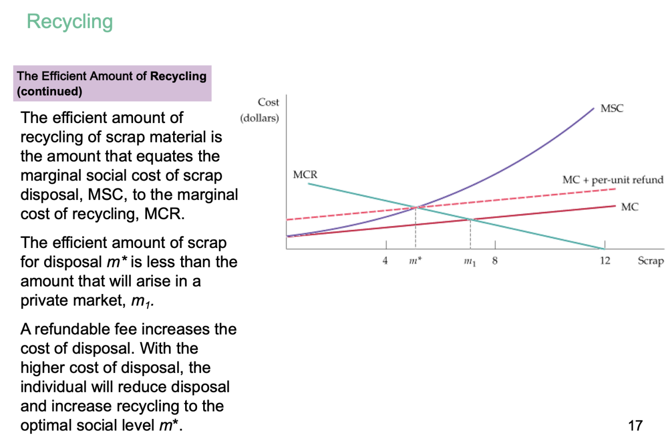
This gives rise to the combination of two approach, i.e.,

**Definition 7.2.4** (Tradeable Emission Permits)**.** A system of marketable permits, allocated among firms, specifying the maximum level of emissions that can be generated. Marketable emissions permits create a market for externalities. This market approach is appealing because it combines some of the advantageous features of a system of standards with the cost advantages of a fee system.

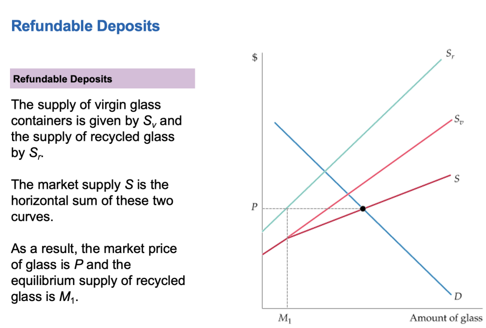


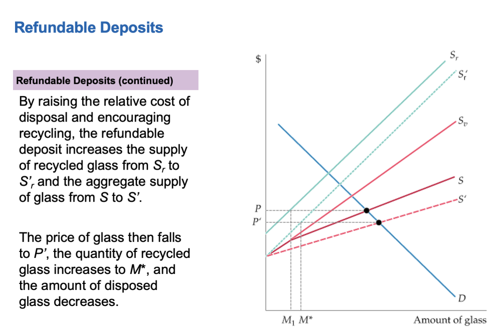

**Proposition 7.2.4.1** (Recycling)**.** We can similarly develop for recycling with per unit refund:




**Proposition 7.2.4.2** (Refundable Deposits)**.**



**Theorem 7.2.4.3** (General Solution)**.** We typically talk about a negative supply externality (when supply too much) and a positive demand externality (whem consuming too little). In short, a general solution can be found by the followings. We have by definitions

$$MSC = MPC + MEC, \quad MSB = MPB + MEB.$$

We can obtain the competitive $q^c$ by setting

$$MPC = MB \text{ or } MPB = MC.$$

Then, the social optimal output $q^e$ obtained by

$$MSC = MB \text{ and } MSB = MC.$$

From which suitable tax or subsidy can be obtained by

$$MPC(q^e) + T = MSC(q^e) \text{ and } MPB(q^e) + S = MSB(q^e).$$

Where we can then compute the deadwight loss by

$$DWL_s = (q^c - q^e)\left(MSC(q^c) - MPC(q^c)\right)/2; DWL_d = (q^e - q^c)\left(MSB(q^c) - MPB(q^c)\right)/2.$$

## 7.3 Stock Externalities

**Definition 7.3.1** (Stock Externality)**.** Accumulated result of action by a producer or consumer which, though not accounted for in the market price, affects other producers or consumers. Let the total stock of pollutant at a time $t$ be $S_t$. Let $E_t$ be pollution at time $t$. in general, the nature cleans itself. Let $\delta$ be dissipated rate. And so the non-diissipated stock from the previous year will be $(1-\delta)\,S_{t-1}$. We can then define the total stock of pollutant recursively. Let

$$S_1 = E_1.$$

Then,

$$S_2 = (1-\delta)\,S_1 + E_2.$$

Thus,

$$\begin{aligned} S_t &= E_t + (1-\delta)\,S_{t-1} \\ \implies S_N &= \left[\sum_{n=0}^{\infty} E\,(1-\delta)^n\right] = \frac{E}{\delta} \qquad \text{sps } E_t \text{ annually is constant, then after } N \text{ years.} \end{aligned}$$

**Definition 7.3.2** (Social Rate of Discount)**.** Opportunity cost to society as a whole of receiving an economic benefit in the future rather than the present. In principle, the social rate of discount depends on three factors: (1) the expected rate of real economic growth; (2) the extent of risk aversion for society as a whole; and (3) the "rate of pure time preference" for society as a whole.

$$\text{NPV} = (-1.5 + .1) + \frac{(-1.5 + .198)}{1 + R} + \frac{(-1.5 + .296)}{(1 + R)^2} + \cdots + \frac{(-1.5 + 4.337)}{(1 + R)^{99}}$$

**TABLE 18.2 NPV of "Zero Emissions" Policy**

| | | Discount Rate, $R$ | | | | |
|---|---|---|---|---|---|---|
| | | .01 | .02 | .04 | .06 | .08 |
| Dissipation Rate, $\delta$ | .01 | 108.81 | 54.07 | 12.20 | -0.03 | -4.08 |
| | .02 | 65.93 | 31.20 | 4.49 | -3.25 | -5.69 |
| | .04 | 15.48 | 3.26 | -5.70 | -7.82 | -8.11 |

Note: Entries in table are NPVs in $billions. Entries for $\delta$ = .02 correspond to net benefit numbers in Table 18.1.

The Table shows the NPV as a function of the discount rate. It also shows how the NPV of a "zero emissions" policy depends on the dissipation rate, $\delta$. If $\delta$ is lower, the accumulated stock of pollutant will reach higher levels and cause more economic damage, so the future benefits of reducing emissions will be greater.

## 7.4 Property Rights

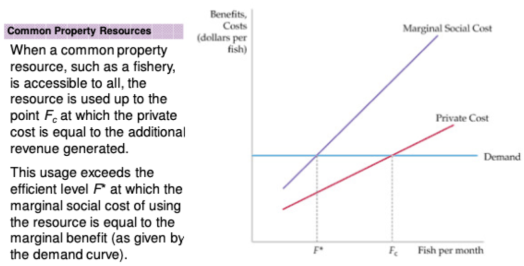
**Definition 7.4.1** (Property Rights)**.** Legal Rules stating what people or firms may do with their property.

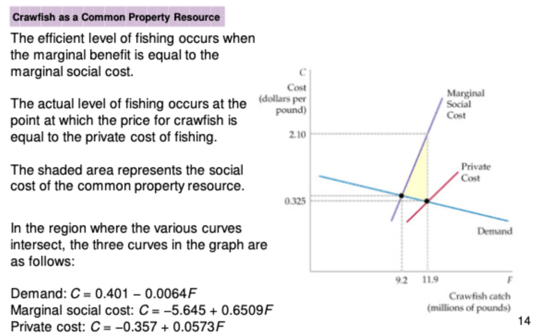
**Theorem 7.4.1.1** (Coase Theorem)**.** Principle that when parties can bargain without cost and to their mutual advantage, the resulting outcome will be efficient regardless of how property rights are specified. If property rights are well-defined and transaction costs are zero, private parties can bargain to reach an efficient allocation of resources regardless of the initial assignment of rights. Where,

1. *Well-defined property rights*: Everyone knows who owns what.
2. *Zero (or negligible) transaction costs*: No costs for bargaining, enforcement, or information– usually not too many parties.
3. *Voluntary negotiation*: Parties can freely negotiate without coercion.
4. *Efficiency*: The final allocation maximizes total economic surplus.

## 7.5 Public Goods

**Definition 7.5.1** (Common Property Resoures)**.** Resource to which anyone has free access.

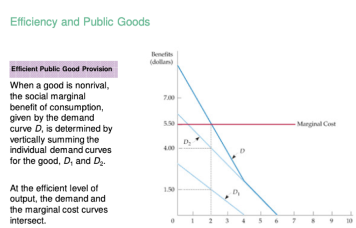


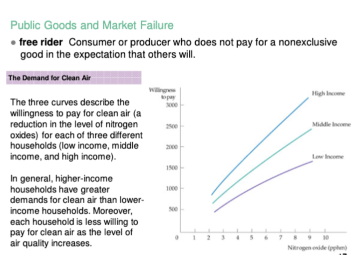

**Definition 7.5.2** (Nonrival Good)**.** Good for which the marginal cost of its provision to an additional consumer is zero.

**Definition 7.5.3** (Nonexclusive good)**.** Good that people cannot be excluded from consuming, so that it is difficult or impossible to charge for its use.

**Definition 7.5.4** (Public Goods)**.** *Nonexclusive* and *nonrival* good: the marginal cost of provision to an additional consumer is zero and people cannot be excluded from consuming it.




**Definition 7.5.5** (Free Rider)**.** Consumer or producer who does not pay for a nonexclusive good in the expectation that others will.



**Definition 7.5.6** (Proportion to Benefits)**.** Let the total surplus of benefits for $A$ and $B$ respectively be $S_A$ and $S_B$. Let $S = S_A + S_B$. Then, the propertion to benifits of each individual is

$$S_A/S, \quad S_B/S,$$

which should be the proportion of tax imposed on each individual.