$MR = MC$
$P = f(Q)$

Current Price of Investments:

$$PV_1 = \frac{FV}{(1+i)^n}$$

If it generates a value at the end of each year:

$$PV_{stream} = \sum_{t=1}^{n} \frac{FV_t}{(1+i)^t}$$

$$PV_{net} = \sum_{t=1}^{n} \frac{FV_t}{(1+i)^t} - C_0 \text{ -where } C_0 \text{ is the current investment}$$

Current value of a firm before paying

$$PV_{firm} = \pi_0 \frac{i+1}{i-g}$$

Current value of a firm after paying

$$PV_{firm} = \pi_0 \frac{i+1}{i-g} - \pi_0 = \frac{\pi_0(1+g)}{i-g}$$

$$PV_{perpetuity} = \frac{CF}{i}$$

Full Economic Price: Amount consumers would be willing to pay if the supply was the amount being sold under a price ceiling.
Deadweight loss when surplus is triangle on the right of intersection.
Deadweight loss when shortage is triangle on the left of intersection.
Deadweight loss when govt. pays is **M** shaped.

Least squares regression: $y = \hat{a} + \hat{b}x$
CI: $\hat{a} \pm 2\sigma_{\hat{a}}, \hat{b} \pm 2\sigma_{\hat{b}}$ where σ are standard errors.
The t-stat is: $t_{\hat{x}} = \frac{\hat{x}}{\sigma_{\hat{x}}}$ where $x = a, b$

$$Marginal_{revenue} = Price \left(\frac{1 + Elasticity}{Elasticity} \right)$$

$$Elasticity = \frac{\delta Q_x^d}{\delta P} \frac{P}{Q_x} \text{ (or M if income)} = \left| \frac{\frac{Q_2 - Q_1}{(Q_2+Q_1)}}{\frac{P_2-P_1}{(P_2+P_1)}} \right|$$

Demand is elastic if the revenue increases by decreasing the price, that is $|E > 1|$.
Own demand elasticity is affected by substitute availability, time of purchase horizon, expenditure of consumer budgets.
In cross-product, if $E < 0$, products are complements. In income, if $E < 0$, product is inferior.
If Q function is logarithmic, coefficients are elasticities.
Marginal rate of substitution $= |\frac{d}{dQ_x} Q_y|$
If a firms revenues are derived from the sales of two products, y and x:

$$\Delta Revenue = [Rev_x(1 + E_{xx}) + Rev_y E_{yx}] \times \%\Delta P_x$$

For producer:

$$Market_{subs_{rate}}(x, y) = -\frac{P_x}{P_y} \text{ otherwise, equilibrium is not achieved}$$

For consumer:

$$Marginal_{rate_{subs}}(x, y) = MRS_{x,y} = \frac{P_x}{P_y} \text{ otherwise,equilibrium consumption bundle is not achieved}$$

$$MRTS_{KL} = \frac{MP_L}{MP_K} (= \frac{\mathbf{w}age}{\mathbf{r}ent} \text{ for cost minimization} = tangent(isoquant = isocost))$$

$$\text{remember that } K \uparrow \implies MP_K \downarrow$$

$$Value_{Marginal_{Product}} = VMP_x = P_{rice} \times MP_x (= w \text{ if } x = L_{abor}, \text{ fixed } K_{apital})$$

$$C(Q_1,0)+C(0,Q_2)>C(Q_1,Q_2) \implies \text{Economy of Scope}$$
$$\frac{\Delta MC_1(Q_1,Q_2)}{\Delta Q_2}=\frac{\delta}{\delta Q_2}(\frac{\delta}{\delta Q_1}C(Q_1,Q_2))<0 \implies \text{Cost Complementarity}$$

$$\frac{d}{dQ}AVG_{TOT_{cost}}<0 \implies \text{economy of scale}$$

- Contract - well defined and measurable and highly specialized with optimal length $L^* = L(MB = MC)$
- Specialized Investment - exchange that cannot be recovered, relationship specific (site, physical asset, dedicated assets, human capital). Leads to costly bargaining, underinvestment, opportunism and hold up.
- Spot exchange - modest number,standardized,many sellers,opportunism not problem,underinvestment $\implies$ bad quality
- Vertical integration - buying internally, or from subsidiaries, less costs and opportunism, more work.
- hold-up problem - losses from contract breach
- principal-agent problem - agent/principal goals don't align (conflict of interest), solved using %profits or spot checks

$$NewContractValue=(\sum SunkCosts)(-1?)$$

$$4FirmConcentrationRatio=\frac{F1+F2+F3+F4}{TotalMarket}$$

$$HHI=10000\times\sum_i\left(\frac{F_i}{TotalMarket}\right)^2$$

block if merger makes $HHI_n > 2500$ or $\Delta HHI > 200$

$$RothschildIndex=\frac{OwnElaticity}{DemandElasticity}$$

$$P=\frac{1}{1-LernerIndex}\times MC$$
$$MarkUpFactor=\frac{P}{MC}$$

Perfect Competition:

- Many buyers and sellers
- homogenous products
- perfect information in buyers and sellers
- free entry and exit

Market Parameters

- Monopoly: Rothschild = 1, HHI=10000, C4=1
- Oligopoly: Rothschild = large, HHI = large, C4 =1
- Monopolistic Competition: Rothschild = small >> 0, HHI = small, C4 = small
- Perfect Competition: Rothschild = very small, HHI = very small, C4 = very small

A firm should shut down if $profit < fixed_{cost}$ or $P < AVC$.
Entry to a market occurs until economic profits shrink to 0.
Profit Maximizing Price is: P_{demand} at $Q_{MR=MC}$
Revenue Maximizing Price is: P_{demand} at $Q_{MR=0}$

Let $P = b - mQ$:
$MR = \frac{d}{dQ}PQ = b - 2mQ = b - 2m(Q_1 + Q_2) = P\left(\frac{1+E}{E}\right)$
For a multiple source monopoly: $MR(Q_1, Q_2) = MC_1(Q_1)$ and $MR(Q_1, Q_2) = MC_2(Q_2)$

Slope in oligopoly where opposing firm does not match changes is more horizontal.
Range of marginal cost to keep price: $[MR(D_1(P)), MR(D_2(P))]$

In a Sweezy oligopoly: Few firms, many customers, differentiated products, rivals will cut in response to cut, but not increase in response to increase.
In a Cournot duopoly: Few firms, many customers, any kind of product, rival holds constant output in response to changes.

$$P = a - b(Q_1 + Q_2)$$
$$\implies MR_1(Q_1, Q2) = a - bQ_2 - 2bQ_1, MR_2(Q_1, Q2) = a - bQ_1 - 2bQ_2$$
$$\implies Q_1 = r_1(Q_2) = \frac{a - c_1}{2b} - \frac{1}{2}Q_2, Q_2 = r_2(Q_1) = \frac{a - c_2}{2b} - \frac{1}{2}Q_1$$

In a Stackelberg duopoly: few firms, many customers, any kind of product, one leader defines price before, all others follow

$$P = a - b(Q_L + Q_F)$$
$$\implies Q_L = \frac{a + c_F - 2c_L}{2b}, Q_F = \frac{a - c_F}{2b} - \frac{1}{2}Q_L$$

In a Bertrand oligopoly: few firms, many customers, identical products, constant MC, price comepetition, perfect info, no transaction cost

$$P = a - bQ, P_{eq} = MC$$
$$Q = \frac{a - MC}{b}$$
$$\pi = 0$$

In Collusive Environments, which behave like monopolies:

$$MR = MC \implies Q = \frac{a - MC}{2b}$$

Contestable market if: same tech, consumer quick price change response, firms slow price change response, no sunk cost.

In a one-shot game: the strategy is the one with the best payout for each of the other player's choices.
In a game where the one-shot Nash equilibrium points at nonideal payout, **near-infinite** plays are necessary to earn more. If it is an infinite game with interest, higher payoff is possible if:

$$\frac{\pi_{cheat} - \pi_{cooperation}}{\pi_{cooperation} - \pi_{Nash}} \leq \frac{1}{i}$$

If there is a probability θ for the game to end, no reason to cheat if: $\Pi_A^{Cheat} \leq \frac{\pi_A^{coop}}{\theta} = \Pi_A^{coop}$
if it is a multistage game, make a choice tree.
In a Monopoly/Mon Comp: $P = \left(\frac{E_F}{1+E_F}\right) MC = K \times MC$ where K is the profit-maximizing markup factor
In a Cournot Oligopoly: $P = \left(\frac{NE_M}{1+NE_M}\right) MC = \left(\frac{E_F}{1+E_F}\right) MC$

In Price Discrimination:

- First Degree: Price sticks to demand curve. $P = D$, $\pi = \int D - MC$
- Second Degree: Change price after certain amount is consumed.
- Third Degree: $P_1\left(\frac{1+E_1}{E_1}\right) = MC, P_2\left(\frac{1+E_2}{E_2}\right) = MC$, $Markup = \frac{E}{E+1}$, needs no resale, different E
- Two-Part Pricing: $Fixed_{Fee} + PerUnit_{Fee}$ where $Fixed_{Fee} = \pi = \int D - MC$ and $PerUnit_{Fee} = MC$
- Block Pricing: Sell total quantity as one. $P = \int_0^Q D$, $\pi = \int D - MC$, $Q = Q_{uantity}(D = MC)$
- Commodity Bundling: Sell multiple different products as a single bundle. Customer will buy if price of bundle is less than sum of individual MB.
- Peak-load pricing: higher prices during peak hours
- Cross-subsidy: if two products are related through cost, sell one cheaper, the other more expensive
- Transfer pricing: internal pricing - upstream set price for lowstream avoiding double marginalization.
$NRM_D = MR_D - MC_D = MC_U$
- Double marginalization: when both upstream and attempt to maximize division profits, instead of overall profits.
- Price matching, brand loyalty, randomized pricing are other strategies

Random Outcome Probability: $Variance = (Stdev)^2 = \sum P(x)(x-\mu)^2$, $\mu = Expected_{Value} = \sum x * P(x)$, big stdev is risky

- Risk Neutral: indifferent to probability vs for sure
- Risk Averse: prefers for sure, *this type of customers leads to chain stores, online reviews, insurance*
- Risk loving: prefers a probability of higher

Reservation Price is the price at which $Expected_{benefit} = Search_{Cost}$
Diversification: reduce risks by investing in multiple projects
Auction:

- Independent Private Values:
  - First Price, seal:
    $$b = value - \frac{value - lowest_{valuation}}{num_{bidders}}$$
  - Dutch: let lower until
    $$b = value - \frac{value - lowest_{valuation}}{num_{bidders}}$$
  - Second Price, seal: $b = v$
  - English: active until $b = v$

  Expected Revenues for auctioneer: $English = Second - price = first - price = Dutch$
- Correlated Values Auctions: avoid winner's curse, which is the fact that the winner values it more than all others. Expected revenue for auctioneer: $English > Second - price > first - price = Dutch$

Assymetric information leads to:

- Hidden Actions are morally hazardous, and can be avoided by incentive contracts, signaling or screening.
- Hidden Characteristics lead to adverse selection, and can be avoided through screening and sorting.