

Lecture 1 Nature of Economics

Biwei Chen

Outline

- Origin and Evolution
- Definition and Nature
- General Classification
- Analytical Statements

I. Origin and Evolution

1. Ancient Greek: “household management” or “management of the state”
2. Two pivotal schools of economic thought: Mercantilism and Physiocracy
3. Classical political economy: Adam Smith (1776) *The Wealth of Nations*
4. Neoclassical economics: Alfred Marshall (1890) *Principle of Economics*
5. Keynesian economics: John Maynard Keynes (1936) *The General Theory*

II. Economics and Careers

1. Economics is the study of choice under scarcity.
2. Benefits: 1) improve yourself; 2) improve the society
3. Costs: 1) time; 2) money; 3) every action has a cost.
4. Roles of economists: 1) economic analysis (applied to business/finance/law/behavioral studies); 2) public policy evaluation and design; 3) education; 4) research; 5) consulting
5. Careers: 1) private business; 2) public institutions; 3) academia; 4) inter-government & NGO
6. Economics as a pre-requisite: 1) business/law schools; 2) public policy/health/education/social work schools; 3) professional certifications: CFA, CPA, CMA, PMP, FRM.

III. Scientific Nature

1. Economics is a social science. (The only social science that a Nobel prize award.)
2. Science: intellectual inquiry into the universe. Social vs natural science: society vs nature.

IV. General Classification

1. Microeconomics (individual units) vs Macroeconomics (overall economy)
2. Finance: asset allocation and pricing. E is the king of SS. F is the crown of the king.
3. Econometrics: economics + statistics. For estimation, forecasting, and causal inferences.
4. Behavioral Economics: accounting for cognitive bias and seemingly irrational behaviors.

V. Positive and Normative

1. Positive statements: descriptive and explanatory (what, when, where, how, and why)
2. Normative statements: subjective and prescriptive (involve moral and value judgement)

Lecture 2 Scientific Methodology

I. Definition and Characteristic

1. Science is human being's intellectual inquiry into the universe.
2. Scientists develop and organize knowledge systematically.
3. Distinguishing characteristic: testable explanations and predictions
4. Examples of scientific inquiries
 - 1) Develop a theory: Newton's law of gravitation
 - 2) Reject a theory: Galileo's thought experiment
 - 3) Predict the unknown: Mendeleev's periodic table

II. Nature

1. Science discovers underlying patterns, explains cause and effect, and changes the world.
2. Science is not truth (Karl Popper's empirical falsification). What is the ultimate truth then?
3. Art, science, and religion are not mutually exclusive. Human beings can be exclusive.

III. Principles

1. General: 1) Natural laws exist; 2) Human beings can understand; 3) Theory explains facts
2. Examples: 1) the law of gravitation; 2) sunrise and sunset theory; 3) Einstein's relativity theory.
3. Validity: General theory (tautology) vs specific theory (ad hoc). Example: "I like it!"

IV. Components of Scientific Theory

1. Postulate: starting point of a scientific discipline. " $1+1=2$ "
2. Assumption: statements or conditions used to construct a theory.
3. Model: a theoretical description of the phenomenon in abstract forms
4. Testable implications: logical statements derived from the theory and designed for empirical tests

V. Basic Steps in Scientific Inquiry

1. Start from realistic observations
2. Develop or apply a theory or hypotheses
3. Derive testable implications/conditions
4. Collect data and design experiments
5. Reject or fail to reject the theory

VI. Scientific Methods for Economists

1. Real life is economists' lab and data sources; economists design experiments.
2. Postulate of economics: Rationality. Implication: decision optimization.
3. Economic theory and model: Simplified description. Examples: circular flow; PPF; market
4. Test a theory: $(x, y, z) \rightarrow P$. Hypothesis: If A, then B. Test: If Not B, then Not A.
 - 1) Example: if Coronavirus mutates and persists, the markets and economy will contract.
 - 2) Example: if college tuition is flat, students will tend to take more courses and graduate early.

Lecture 3 Scarcity and Competition

Economics is the study of choice under **scarcity**. How does scarcity affect our life?

I. Fundamental Aspect of Life

1. Economics arises from scarcity.
2. Scarcity: More is preferred to less. Is anything not scarce? Air and water?
3. Competition: com + pet (seek or strive for in Latin) +ition
4. Scarcity implies competition and vice versa.

II. Competition: Forms and Criteria

1. Why do we have to compete on earth? Answer: In nature or by design.
2. How do we compete? Answer: In various forms and based on certain criteria.
3. Forms: 1) Jungle's law; 2) Hierarchy; 3) Violence; 3) Exchange.

III. Social Experiment: Super Bowl Tickets

1. How do you distribute 100 tickets without selling them? One word.
2. Which way is fair (not discriminatory)? Why? Random is most unbiased.
3. Which way is better or the best? Why? Answer: To whom? Random isn't.
4. Golden standard in policy debates: equity ("fairness") and efficiency ("best").
5. Equity is defined as "the state, quality or ideal of being just, impartial and fair."
6. The concept of equity is synonymous with fairness and justice. Opportunity or outcome?
7. Efficiency describes the relation between the means and the end. How costly to get there?

IV. Competitive Criteria and Rules of the Game

1. Question: in most college courses, about 10% of students on average earn an A. Fair?
2. Question: how do professors evaluate student performance? Answer: Based on grades.
3. Question: how to ensure fairness of the academic competition? Answer: Academic honesty.
4. Competitive criterion (CC): the standards being used in competition to allocate resources.
5. What does society choose various competitive criteria? → Determines winners and losers.
6. Rules of the game (ROG): certain rules and laws people must obey in the competition.
7. Why does society impose rules of the game? Answer: For fairness and effectiveness.
8. What kind of people would thrive under different criteria? Think about ticket allocation.
9. Among various forms of competition, which form/criterion is fair? Which is best or efficient?
10. What is the relation between cc and rog? CC and ROG govern people's competitive behavior.

Equity involves trying to understand and give people what they need to enjoy full, healthy lives. Equality, in contrast, aims to ensure that everyone gets the same things in order to enjoy full, healthy lives. Like equity, equality aims to promote fairness and justice, but it can only work if everyone starts from the same place and needs the same things. www.aecf.org/blog/racial-justice-definitions

Lecture 4 The Opportunity Cost

Economics is the study of **choice** under scarcity. How can we make better decisions?

I. The Economic Postulate

1. Rationality/Economic Man/Self-interest
2. Three implications from the postulate
 - 1) Individuals know how to make decision
 - 2) How? To maximize benefit at a minimum cost.
 - 3) Rational decision → economic efficiency

II. Opportunity Cost

1. Definition: highest-valued option forgone
 - 1) O.C of choice $i = \max\{\text{value}(j)\}$ for j not equal to i .
 - 2) O.C. of *an event* is the *highest-valued option forsaken*
 - 3) Examples: time allocation and job choice
2. Highlights for thought
 - 1) Cost is tied to an action. No choice, no cost.
 - 2) Historical cost is not a cost. History is not relevant for decision-making now.
 - 3) Forward-looking: let bygones be bygones. Expected future cost is what matters.
 - 4) Investment examples: stamps and stocks. Cost minimization = income maximization.

III. The PPF Model

1. Definition: max production capacity an economy can achieve with its limited resources.
2. Model assumptions: one factor and two products with constant productivities.
3. PPF equation: 1) X intercept; 2) Y intercept; 3) slope is Y intercept over X intercept
4. PPF and opportunity cost: the slope is the o.c. of one X in terms of Y. what is one over slope?
5. **Production efficiency**: 1) within PPF→inefficient; 2) on PPF→efficient; 3) outside PPF
6. Why efficient on PPF but inefficient within PPF? Answer: Max benefit at min cost.
7. PPF movements: 1) working hours → parallel shift; 2) productivity changes → rotation
8. PPF applications: 1) population growth/migration; 2) natural/human disaster; 3) technology
9. PPF shapes: 1) linear→constant o.c.; 2) hump→increasing o.c.; 3) bowl→decreasing o.c.
10. Why does PPF display different shapes? Which shape of PPF is a better description of reality?
 - 1) Answer: O.C. of production is not always constant (resource transformation has “friction”)
 - 2) Reality: humped PPF because of rising opportunity cost when more of the good is produced
 - 3) Intuition I: it takes more time (cost) to improve from 90% to 100% than from 70% to 80%.
 - 4) Intuition II: first two hours of study is usually more productive than the second two hours of study, in terms of their measurable outcomes.
 - 5) Lesson: to make the most out of your effort, it is more efficient to get the easiest part first

Lecture 5 World Trade Facts and Models

I. World Trade Data and Facts

1. Rank international trade countries: US, CH, EU
2. Historical development: a rapidly rising trend
3. Trade and nation's prosperity: positive correlation
4. Why trade? Why US and CH? Economic reasons.

II. Classical Trade Model

1. Assumptions: 1) 2-2-1; 2) average preference; 3) no transportation and transaction costs
2. PPF model setup: productivity and production cost table.
3. Autarky equilibrium: closed economy under the condition consumption=production
4. Would they trade? What are the associated benefits and costs? #1 Economic Principle.
5. What are the trade possibilities (1a:1b)? Consumption possibilities frontiers (CPF) \geq PPF
6. Pure exchange equilibrium: consumption=production & import value=export value
7. Can they do better? Cost-minimization principle applies in social division of labor
8. Specialization in production: division of labor according to productivity advantage
9. Trade equilibrium after specialization: consumption=production & import value=export value
10. Summary table:
 - 1) From efficient to impossible: pure exchange CPF \geq autarky PPF
 - 2) Efficiency uplifting: specialization and trade TPF $>$ pure exchange CPF
 - 3) Specialization and trade is most efficient among all states of life: TPF $>$ CPF $>$ PPF
 - 4) Is free trade fair? who gains more from trade? Can it cause domestic inequality?

III. Classical Trade Theories

1. Mercantilism: trade surplus is beneficial because it accumulates wealth
2. Adam Smith: absolute advantage principle (productivity measure)
3. David Ricardo: comparative advantage (opportunity cost measure)

*IV. Limitation of the Classical Trade Theory (optional not required for exams)

It is naïve to think of the world functioning as the model suggests. Classical theory implies maximum efficiency as a result of specialization and trade whereas trade wars and protectionism have been the norm in reality. What went wrong? What are the limitations of the theory and model?

1. Zero transaction cost: political groups of interest vote for protectionist policies
2. Specialization can potentially lead to work monotonicity and national insecurity.
3. One production factor with full specialization will imply damaging unemployment effects when disadvantaged inefficient sector closed down and advantaged sector expanded, leading to higher level of overall efficiency but resulting in greater social inequality. PPF rules out equity issues.
4. Trade equilibrium does not account for trade imbalances which cannot happen with bartering
5. Currency and debt financing of trade deficits make the trade system chronicle and unsustainable
6. Labor market disruption. <https://www.aeaweb.org/research/deaths-despair-trade-liberalization-china>

Lecture 6 Value and Exchange

Biwei Chen

I. Sources of Wealth

1. Mercantilism: precious metals constitute wealth, in the form of gold and silver
2. Physiocrats: land is the only source of all wealth
3. Adam Smith: labor brings wealth and trade promotes prosperity
The wealth of nations <https://www.adamsmith.org/the-wealth-of-nations>
4. What is wealth? How to measure wealth?
 - 1) Wealth is all belongings human beings value
 - 2) Mercantilism vs Physiocrats vs Adam Smith (labor hours)
 - 3) All in one: opportunity cost

II. What is Value? Why a Paradox?

1. Smith: Value in use UV (utility) and value in exchange EV (purchasing power)
2. Diamond-water paradox: 1) $UV_{\text{water}} > UV_{\text{diamond}}$ & 2) $EV_{\text{water}} < EV_{\text{diamond}}$
3. Solve the paradox: 1) $UV_{\text{water}} > UV_{\text{diamond}}$ for whom? & 2) $EV_{\text{diamond}} > EV_{\text{water}}$ no exception?
4. What went wrong with Smith's argument?
 - 1) He never married and did not appreciate the UV of a diamond for couples truly in love
 - 2) He never risked running out of water supplies in his daily life as opposed to in the desert

III. Modeling Market Exchange

1. Use value UV: max subjective value derived from its consumption (in the eye of the user).
2. Exchange value EV: actual value resulted from mutually agreed exchange (in the market).
3. Use value is not observable whereas exchange value equals transaction price.
4. For any individual, the max price to pay (UV) is equal to the min price to sell.
5. Exchange condition and (net) gains from exchange
 - 1) The O.C. of holding is seller's $UV_S \leq EV = P^* \leq UV_B$ is buyer's O.C. of selling
 - 2) $UV \geq EV$ for the buyer, the opportunity cost of selling is the buyer's use value
 - 3) $EV \geq UV$ for the seller, the opportunity cost of holding is the seller's use value
 - 4) Buyer's net gain = $UV_B - EV$. In market welfare analysis, it is defined as consumer surplus.
 - 5) Seller's net gain = $EV - UV_S$. In market welfare analysis, it is defined as producer surplus
6. Example: A Bitcoin exchange between Biwei and Alex.
 - 1) $UV_{\text{Biwei}} = \$11,000$ and $UV_{\text{Alex}} = \$10,000$
 - 2) Who is likely to buy and who sell?
 - 3) What are the possible prices in exchange?
 - 4) What are the net gains to Biwei and Alex?
 - 5) What happen if Sonia's use value of a Bitcoin is \$11,111?

Lecture 7 Utility and Preference

I. Utilitarianism and Utility

1. Bentham and Mill: utility is a measure of happiness, pleasure, or satisfaction. According to utilitarianism, the goal in our life is to maximize utility, individually as well as collectively.
2. Utility measurements: 1) ordinal (rank); 2) cardinal (numbers); 3) hot dog example.
3. The Law of diminishing marginal utility (DMU: $Q \uparrow \rightarrow MU \downarrow$)
 - 1) The utility from an extra unit of consumption is diminishing (less than the previous unit)
 - 2) Graph: relationship between total utility (TU) and marginal utility (MU) as a function of Q
 - 3) Two stages of utility function: $MU > 0 \rightarrow TU \uparrow$ (negative slope); $MU < 0 \rightarrow TU \downarrow$ (negative MU).
 - 4) Decision equation: $dMU/dQ < 0$ & $dTU/dQ > 0$, where d indicates the change of a variable.
4. Utility functions and limitations
 - 1) $U = F(Q)$: from consumption quantity Q to total utility U
 - 2) Example: $U = \sqrt{Q}$ where Q is the quantity of consumption
 - 3) Is utility comparable among individuals? (culture or tradition)
 - 4) Is utility additive over different goods? (complements and substitutes)
 - 5) Is utility stable over time across space? (kids, adults, seniors; weather and climate)
 - 6) All in all: is it representative enough of all individuals? does a social utility function exist?

II. Aggregate utility and social welfare

- 1) Political economy: how to design public policy to improve social welfare?
- 2) To start, how to aggregate individual utility into a social utility function?
- 3) Four views regarding social equity/justice, embodied in the social welfare function
 - a. Egalitarian: $U = U_1 = U_2 = \dots = U_N$
 - b. Utilitarian: $U_S = U_1 + U_2 + \dots + U_N$
 - c. Rawlsian: $U_S = \min\{U_1, U_2, \dots, U_N\}$
 - d. Market is fair \rightarrow No need to derive $U_S \rightarrow$ No public policy necessary in the markets
- 4) Arrow impossibility theorem (Kenneth Arrow): social utility function does not exist.

III. Optimal Decision Principles

1. Rationality Postulate: $\text{Benefit} \geq \text{Cost}$, a decision is made whenever $B \geq C$
2. Opportunity cost: $OC(i) = \max\{j\}$ where i and j represent different goods
3. Exchange condition: $UV \geq EV = P$, a decision is made whenever $UV \geq EV$
4. Benefit-cost comparison $TB - TC$, a decision is made whenever $\text{net benefit} \geq 0$
5. Marginal equalization $MB \geq MC$, a decision is made whenever $MC \geq MB$
6. Optimality condition: 1) $MB = MC$ (necessary) & 2) $\text{Max}\{TB - TC\}$ (sufficient)

IV. Axioms in Utility Theory

Axiom of Comparison; Axiom of Transitivity; Axiom of Insatiateness

$\uparrow \downarrow$

Lecture 8 Utility Maximization

I. The Indifference Curve

1. How to measure and model consumer's preference for different bundles of goods?
2. Indifference curve (IC): consumption bundles that yield the same level of utility $U = F(X, Y)$
3. Four properties of the indifference curve: negative-slope; higher better; no contact; convexity
4. The law of diminishing marginal rate of substitution MRS
 - 1) MRS: the quantity of Y in exchange for one unit of X, given the same level of utility
 - 2) The law of diminishing MRS: holding U constant, as X increases, extra Y sacrificed falls
 - 3) Calculation: the slope of the indifference curve, dY/dX is the MRS of X in terms of Y
 - 4) As having more X, the use value of X in terms of Y is falling (the law of DMU)
 - 5) As having more X, the opportunity cost of X consumption in terms of Y is falling
 - 6) Examples: $XY=4$ (or $Y=4/X$), $XY=9$ (or $Y=9/X$), $XY=16$ (or $Y=16/X$). Or C-D form.
5. Special cases of indifference curve
 - 1) Perfect substitutes: linear IC. Example: Pepsi and Coca (truly indifferent)
 - 2) Perfect complements: rectangular IC. Example: Coffee and milk (truly different)

II. Consumer Budget Constraint (CBC)

1. Definition: the max combination of goods a consumer is able to afford given a budget
2. Equation: $P_X X + P_Y Y = I$, where I is income or consumer's budget constraint (CBC)
3. Graph: a negative-sloping line with a slope $(-P_X/P_Y)$ and an intercept on $Y=I/P_Y$
4. Intercepts $X=I/P_X$ and $Y=I/P_Y$: max amount of each good affordable by the budget
5. Slope: $-P_X/P_Y$, the relative price of x to y or **the opportunity cost** of one x in terms of y
6. The slope of the CBC is the opportunity cost of x in terms of y in the market exchange
7. Change in income: parallel shift of CBC vs Change in prices: the slope rotation of CBC

III. Utility Maximization Model

1. In a model, how do consumers choose among various combinations of goods?
2. Utility function $U=XY$, subject to consumer budget constrain $P_X \cdot X + P_Y \cdot Y = I$
3. Given the income budget and market prices, what bundle of goods is optimal?
4. Rationality (Benefit-cost principle): max benefit at a minimum cost
 - 1) benefit: utility from consumption; 2) cost: total expenditure on two goods
5. Efficiency principle (the relationship between the means and the end)
 - 1) allocate budget on spending; 2) increase consumption satisfaction
6. The budget is fixed and the choice is the combination of two goods. (P_X/P_Y)
7. **Graphical solution:** a combination where B.C. "haircuts" I.C. $(P_X/P_Y = MRS_{XY})$
8. **Intuition:** the consume spends relatively less on the relatively more expensive good.
9. What happens to the new optimum if income budget increases? Relative price rises or falls?

*Lecture 9 Utility and Demand (Skip)

Lecture 10 The First Law of Demand

I. The Law of Demand

1. The Law: all else equal (ceteris paribus), $P \uparrow \rightarrow Q_D \downarrow$ and $P \downarrow \rightarrow Q_D \uparrow$
2. Quantity demanded: max quantity a consumer is willing and able to buy at a given price
3. Demand: all possible combinations of price and quantity demanded. Demand schedule.
4. Difference: Q_D is a point for a given price on the entire D demand curve.
5. Graph: downward-sloping line or curve showing the causal effect of P on Q.
6. Equation: $P = aQ_D + b$, for $a < 0$ and $b > 0$. Linearity is simple. The world is nonlinear.
7. Slope: $a < 0$ measures how sensitive is a consumer's quantity demanded to a price change.
8. Intercept: $b > 0$ measures the cutoff price the discourages consumption ($P = b$ such that $Q_D = 0$). It is also the marginal use value of the initial unit of consumption. The "demand choke off" price.
9. Individual demand curve reveals information about the consumer's marginal use value.
10. Price elasticity of demand: $E_p = (P/Q) * (dQ/dP)$, measures the sensitivity of Q respond to P.
Example: $P = -Q + 5$, what is the E at $Q = 1$? at $Q = 4$? Which point is more elastic?

II. Demand Factors

1. The assumption behind the law: ceteris paribus
2. What if something else changes? Answer: D will shift in parallel and b will change the intercept.
3. Example: Biwei's daily demand for apply 1) $P = -0.5Q + 1.5$; 2) $P = -0.5Q + 3$ when income doubles.
4. Demand factors: other variables that affect Q_D , such as income, price of related goods, etc.
 - 1) Income: normal good ($I \uparrow \rightarrow D +$) vs inferior good ($I \uparrow \rightarrow D -$)
 - 2) Price of related goods: complements ($P \uparrow \rightarrow Q_D \downarrow \rightarrow D -$) vs substitutes ($P \uparrow \rightarrow Q_D \uparrow \rightarrow D +$)
 - 3) Weather and climate: seasonality patterns
 - 4) Public policy: tax, subsidy, welfares, loans
 - 5) Expectation: speed up the realization

III. Derive Market Demand

1. Given Alex's demand and Biwei's demand schedule, how to derive the market demand curve?
2. Market demand is the horizontal sum of individual demands (the slope of D_M is flatter than D_I).
 - 1) Assume linearity in Alex and Biwei demand schedules
 - 2) At $P = P_1$, market $Q_1 = Q_{Alex} + Q_{Biwei}$
 - 3) At $P = P_2$, market $Q_2 = Q_{Alex} + Q_{Biwei}$
 - 4) Connect the dots (Q_1, P_1) and (Q_2, P_2)

IV. Individual and Society

1. Society is a place where more than two individuals live.
2. Individual prosperity contributes to the social welfare.
3. Microeconomics is the foundation of macroeconomics.

Lecture 11 The Second Law of Demand

I. Shape of the Demand Curve

1. Equation: $P=aQ+b$ for $a<0$ and $b>0$
2. Slope $a<0$: causal effect between P and Q
3. Steep a : Q responds a little to change in P
4. Flat a : Q responds a lot to a change in P
5. Vertical D ($a=+\infty$): Q is independent of P
6. Horizontal D ($a=0$): Q is infinitely-sensitive to P

II. Measuring Price Sensitivity

1. The price elasticity of demand E_P
 - 1) How responsive is the consumer's Q_D to a price change?
 - 2) Definition: percentage change in Q over percentage change in P .
 - 3) Formula: $E_P = (\Delta Q/Q)/(\Delta P/P) = (\Delta Q/\Delta P) \cdot (P/Q)$ where Δ is the change
 - 4) Purpose: apply a unit-free measurement across types over time in comparison
 - 5) Numbers: E_P measures, for every 1% change in P , what is the % change in Q_D ?
2. Linear demand curve D and price elasticity E_P
 - 1) Same slope but different $P/Q \rightarrow E \downarrow$ as $P/Q \downarrow$ (P down, Q up, or both)
 - 2) Different ranges of price elasticity along the demand linear curve
 - 3) $P \downarrow \rightarrow D$ goes from elastic to inelastic with unit elasticity in the middle
3. Range of E : Applications
 - 1) Business revenue $TR=PQ$
 - a. Graphical example. Easy for linear D if $(\Delta Q/\Delta P=1/a)$. How to maximize sales revenue?
 - b. $|E|>1$ elastic, $TR \uparrow$ as $P \downarrow$ (change of price effect dominates change of quantity effect)
 - c. $|E|<1$ inelastic, $TR \downarrow$ as $P \downarrow$ (change of quantity effect dominates change of price effect)
 - d. $|E|=1$, TR is maximized (unit price elasticity of demand leads to maximum revenue)
 - 2) Taxation policy ($T \uparrow$)
 - a. Goal: discourage bad consumption. Which market more effective? Why? (elastic)
 - b. Goal: raise government tax revenue. Which market more effective? Why? (inelastic)

III. The Second Law of Demand

1. The 2nd Law: Q_d and D are more responsive to price change in the long run than in the short run.
2. Intuition: It takes time to adjust consumption. Decision-makers try to lower their costs and look for alternatives and substitutes because as time goes by, information/substitution costs go down.
3. The 1st Law: As $P \uparrow$, $Q \downarrow$; If all $Q \downarrow$, market $D \downarrow$. Longer time elapses, greater substitution.
4. Graph: Flatter demand curve in the long run than in the short run.
5. Example: 1980s oil crises in the short run (oil price spikes & long lines) vs in the long run.
6. Policy implication: higher prices or taxes imposed on necessity goods and inelastic markets will render the policy less effective or ineffective in the long run.

Lecture 12 Production Theory: Output

Biwei Chen

Production is the source of economic life. This lecture introduces basic production models and laws.

I. Production: From PPF to PF to C-D PF

1. PPF: one economy, two goods/outputs, one production input/factor. Decompose PPF to PF.
2. Production function PF: a math relationship between production input and output.
3. Production factors or inputs: 1) labor; 2) land; 3) capital.
4. Derive PF from PPF: apple $Q=4L$ and banana $Q=6L$.
5. PF Models: $Q=F(X)$, where $X=L$. Trinity: TP, AP, MP.
 - 1) Linear $Q=4L$, $TP=Q$, $AP=Q/L=4$, $MP=\Delta Q/\Delta L=4$.
 - 2) Nonlinear $Q=\sqrt{L}$, $TP=Q$, $AP=1/\sqrt{L}$, $MP=\Delta Q/\Delta L$
 - 3) Nonlinear $Q=L^2$, $TP=Q$, $AP=L$, $MP=\Delta Q/\Delta L$
6. PF synthesis: three stages of production in real life.
 - 1) First stage: $MPL>0$ & $MPL\uparrow \rightarrow TP\uparrow$ at an increasing rate
 - 2) Second stage: $MPL>0$ & $MPL\downarrow \rightarrow TP\uparrow$ at a decreasing rate. ($MPL=0 \rightarrow \max TP$)
 - 3) Third stage: $MPL<0 \rightarrow TP\downarrow$ (redundant labor does more harm than good, negative value)
 - 4) AP and MP are both productivity measures: slope from the origin vs slope on the curve.
 - 5) $MPL>APL \rightarrow APL\uparrow$; $MPL<APL \rightarrow APL\downarrow$; $MPL=APL \rightarrow TPL$ is linear (constant slope)
7. The law of production (the law of diminishing marginal product)
 - 1) When capital is fixed, as labor increases, MPL will decline after a threshold
 - 2) Life wisdom: all work and no play makes Jack a dull boy. Watch the video for evidence.
Does vacation make you more productive? <https://www.youtube.com/watch?v=Io08RFTu2Wc>
 - 3) Why do we observe such a pattern? Proof by contradiction. Optimal K/L (factor intensity).
 - 4) What if K increases? What would happen to MPK and MPL? [Hint: apple trees and farmers]
8. Production function with two inputs
 - 1) Model: $Q=F(K, L)$, where K is capital and L is labor, both measured in standardized units.
 - 2) Cobb-Douglas PF: $Q = AK^\alpha L^\beta$, where α -capital share, β -labor share, and A-tech coefficient.
 - 3) Example: $Q = AK^{0.5}L^{0.5}$. When $K=4$, what is Q? Compute TP, AP, MP in a table.
 - 4) Graphs: TP, AP, MP. Does the production follow the law of diminishing MP?
 - 5) Short-run (K fixed) vs long run production (all factors are variable)

II. Down to Business Video: Tesla Giga-factory <https://www.youtube.com/watch?v=vv1mFAMz0PE>

1. In Tesla Giga-factory production, how do you character its production function?
 - 1) What are the three key production factors? Which factor is most intensively employed?
 - 2) Which factor is fixed in the short run? Which factors are variable?
 - 3) Compare with traditional auto manufacturers, what are the special features in Tesla's employment of K and L? Compare Tesla's MPK and MPL with others.
 - 4) In order to increase its Q more efficiently, should Tesla employ more K or L in its production? What is the most important constrain in Tesla's K/L ratio?

Lecture 13 Production Theory: Technology

In the era of AI, how do we better understand the role of technology in production? How to measure different technology factors? How to analyze the technology effects in the economy? How to compete with robots and machines? How to survive the AI revolution? History and theory provide lessons.

Background Video: Four Industrial Revolutions https://www.youtube.com/watch?v=yMBE_EBDnKE

I. Malthus: Population Crisis

1. Malthusian prediction: world population cannot go unchecked because food growth (arithmetic) cannot sustain population growth (geometric) after a certain point [$GR_{\text{food}} < GR_{\text{pop}}$]
2. Facts since 1820s: population, food production and consumption all rise, labor share in agricultural sector falls, land use~. Malthus only considered labor in his reasoning and underestimated MPL.
3. The enhanced law of production: $K \uparrow \rightarrow MPL \uparrow$. Graph: Higher MPL and TPL (S24).
4. Agricultural production function: $Q = Q(F, L, K)$, where K-tech, L-land, F-farmer.
 - 1) Farmer $\uparrow \rightarrow MPF \downarrow$ & $APF \downarrow$, all else equal; (Malthus' focus and mistake)
 - 2) Land $\uparrow \rightarrow MPF \uparrow$ & $MPK \uparrow$, all else equal; (Malthus' dismiss)
 - 3) Capital $\uparrow \rightarrow MPL \uparrow$ & $MPF \uparrow$, all else equal; (Malthus' dismiss)
 - 4) Malthus is wrong because $Q \uparrow \uparrow > P \uparrow$ and $Q \uparrow \uparrow$ because $MPF \uparrow$ & $MPL \uparrow \uparrow$ as $K \uparrow$ & $F \downarrow$ (S17).
 - 5) The agricultural revolution. Capital is production knowledge and agricultural technology.

II. Modeling Production Technology (S23-27)

1. Isoquant: all combinations of inputs that produce the same output. $Q = Q_C(K, L)$.
2. Graph: $Q_1 < Q_2 < Q_3$, more inputs \rightarrow more output (proportionality)
3. Factor intensity: the ratio of capital over labor in the production $FI = K/L$
4. For $Q_1 = 55$, A (1, 3) and D (3, 1) are on the same isoquant $Q_A = Q_D$
5. For $Q_1 = 55$, $(K/L)_A > (K/L)_D$, A is more capital intensive than D
6. For $L = 3$, $Q_D < Q_C$, why? What happen to MPL from D to C?
7. For $K = 3$, $Q_A < Q_B < Q_C$, why? What happen to MPK from A to C?
8. Marginal rate of technology substitution (MRTS): for a given Q, how many units of K is required to substitute one unit of L? Formula: $MRTS = (\Delta K / \Delta L) = MPL / MPK$.
9. As $L \uparrow$ (or $K \downarrow$), down the isoquant, $MPL \downarrow$ but $MPK \uparrow$, both follow the laws of production.
10. For any given Q, what determines the factor combination in efficient production? (optimal ratio)

III. Production Technology and Return to Scale: WHICH RTS FITS REALITY?

1. CRS: $aF(L) = F(aL) = aQ$. Double input, double output. $AP = MP$. (Copy and Paste)
2. DRS: $F(aL) < aF(L) = aQ$. Double input, less than double output.
3. IRS: $F(aL) > aF(L) = aQ$. Double input, more than double output.
4. Examples: 1) $Q = L$; 2) $Q = \sqrt{L}$; 3) $Q = L^2$. (Scale refers to the adoption of inputs)

IV. Down to Challenges: Machines, Robots, and AI Revolution. What is AI revolution? How to characterize AI in production technology and function? Are workers losing their jobs to robots?

Lecture 14 Production Theory: Cost

Caution! This lecture is very challenging because of the concepts derived from the opportunity cost.

I. Production Cost in Depth

1. Production cost is the opportunity cost arising from production decisions.
2. Example: Apple orchard. Answers: 1) $20 \times 8 \times 10 = \1600 ; 2) No, as long as apple harvest continues; 3) Yes, because the orchard farmer can sell his apple trees; 4) No. Apple saplings were paid 5 years ago but workers are hired during the harvest. The orchard farmer cannot change the decision he made in the past but can decide how many workers to hire today.
3. Historical cost is not cost. Accounting cost is not cost. Production cost is forward-looking.
4. Cost is tied to every action and decision. No choice, no cost. More choice, lower cost.

II. From Output to Cost Function

1. Cost function: $C=C(Q)$ describes the relation between product Q and production cost C .
2. Models: $C=C(Q)$ and $Q=Q(L) \rightarrow C=C(Q(L))$
 - 1) Linear: $Q=40L$, $TC=wL$. Draw the TC , AC , MC as a function of Q . (S7)
 - 2) Quadratic: $Q=\sqrt{L}$, $TC?$ Draw TC , AC , MC as a function of Q . (S9)
 - 3) Given any form of MC , derive TC and AC as a function of Q . (S10)
3. Relationship between MC , TC , AC : graphs
4. Relationship between output and cost function (S11-15)
 - 1) $MP \uparrow \rightarrow MC \downarrow$ (first stage) and $MP \downarrow \rightarrow MC \uparrow$ (second stage)
 - 2) Economics of scale: $Q \uparrow \rightarrow MC \downarrow$ & $AC \downarrow$ (first stage)
 - 3) Example: Tesla's Gigafactory in Nevada, Berlin, and Shanghai

III. Production Costs: Classification (S16-24)

1. Fixed vs variable costs: 1) fixed cost is independent of Q ; 2) variable cost is related to Q .
2. Example: Daily $TC=FC+VC=100+10Q$, $FC=100$, $VC=10Q$, $AFC=100/Q$, $AVC=Q$, $MC=?$
3. Factor costs: 1) labor (wage); 2) capital (interest or dividend); 3) land or property (rent)
4. Capital costs: 1) debt (interest); 2) equity (dividend); 3) capital gains (risk premium)
5. Short-run vs long-run cost: all costs are decision costs; no decision, no cost; if adjusting capital is a decision in the long-run, hence capital cost. $LTC=wL+rK$, where r is the rate of return to K .

IV. Optimal Production Decision (constrained optimization: S26-28)

1. Isoquant $Q=F(K, L)$ and isocost $C=wL+rK$. Examples. Graphs. Slopes.
2. Maximum output given cost constraint: fixed C , push Q up to haircut C . $MRTS=w/r$
3. Minimum cost given output constraint: fixed Q , push C down to haircut Q . $MRTS=w/r$

V. Down to Biz: 1. What strategy did Tesla adopt to lower AC ? Vertical integration or internalization.
 2. Why is it more efficient to factory in US? Benefits of nimble production > lower labor cost elsewhere.
 First Video: Elon Musk's Basic Economics 10:21 <https://www.youtube.com/watch?v=h97fXhDN5qE>

Lecture 15 Production Theory: Profit

Profit is the hallmark of capitalism and the ultimate goal in the world of business. This lecture distinguishes economic profit from business profit and derives a model for profit maximization firms.

I. Marx on Capitalist Profit

1. According to Marx, why were the capitalist society so evil? Where was the profit from?
2. Marx's labor theory of value = necessity value (labor wage) + surplus value (profit)
3. The source of all profit: surplus value. Hence, the surplus value theory of profit.
4. Was Karl Marx right? Video https://www.youtube.com/watch?v=TMmDebW_OBI

II. Accounting Profit vs Economic Profit

1. Business revenue: $TR=PQ$. Examples and graphs: TR, AR, MR.
2. Business costs: explicit cost, implicit cost, and overhead cost
 - 1) Explicit cost (EC): historical cost on the accounting book (accounting costs or direct costs)
 - 2) Explicit cost includes labor cost, rental cost, capital cost (depreciation, debt or equity cost).
 - 3) Implicit cost (IC): part of opportunity cost of staying in business (accountants might miss)
 - 4) Implicit cost is not an opportunity cost in the short run because it's "fixed" (not strictly)
 - 5) Direct costs (staying in business) vs overhead cost (selling the business outright, liquidation)
 - 6) Overhead cost, realized only if the business owner sells out the business, equals market cap.
Overhead cost is not a cost and irrelevant in the short run as long as the business operates.
 - 7) Why liquidation? The owner expects higher return from alternative future investment.
3. Accounting profit ($TR-EC$) vs economic profit ($TR-TC=TR-EC-IC$)

III. Profit Maximization: Model and Rule

1. Business end (goal): maximum profit.
2. Business means (tools): decide Q and P
3. Efficiency principle: 1) $\max\{TR(Q)-TC(Q)\}$ and 2) $MR \geq MC$
4. Numerical example (S16): $TR=PQ$, $TC=\sum\{MC\}$, $\text{Profit}=TR-TC$. $MR \geq MC$.
5. Graph: choose the optimal Q so that the gap between TR and TC is maximized.
6. Sources of profit: 1) $TR=P*Q$; 2) $TC=EC+IC=AC*Q=(AEC+AIC)*Q$; 3) Lower AEC
7. Nature of profit: return to investor and business owner, compensating for their time and money tied up in the business. Profit is part of the opportunity costs of doing business. No free lunch and no easy money. Winning the lottery is a windfall, totally unexpected and unreproducible.

V. Down to Biz: Does profit still matter? | CNBC 5:04 <https://www.youtube.com/watch?v=PDA6nF-fxdo>

1. What do Uber, Tesla and Spotify have in common by industry and by profitability?
2. They are unprofitable, but still attract huge investments. Why? Don't they really look for profits?
3. What do venture capitalists care most about these companies' performance in the short run and in the long run? What is the Chinese counterpart of these companies that failed to balance its short-run rapid growth and long-run profitability?

Lecture 16 Market Structure & Business Decision

I. Evolution of Cellphone and PC Industry

1. Product: over time, lower price, higher quality, more varieties, tremendous growth
2. Industry: one trumps the market (M) → multiple companies dominates (N S A H)
3. Why such patterns? Market competition and monopoly models provide an answer.

II. Modeling Firm's Decision

1. Revenue ($TR=PQ$) and demand
 - 1) Price taker: horizontal demand curve facing the firm → perfect competition → $P=AR=MR$
 - 2) Price setter: downward-sloping demand curve → market power → $P=AR>MR$
 - 3) Price maker: downward-sloping D + information advantage → market power
2. Cost $C=C(Q)$ and supply
 - 1) Constant MC (constant MP): flat supply curve
 - 2) Falling MC (>0) (rising MP): downward-sloping supply curve
 - 3) Rising MC (>0) (falling MP): upward-sloping supply curve
 - 4) Marginal cost curve is the firm's supply curve $MC(Q)=S(Q)=MR(Q)$. Why?
3. Firm's decision: choose Q (and P) to maximize its profit
 - 1) Profit maximization principle: $\max\{TR(Q)-TC(Q)\}$ and $MR(Q) \geq MC(Q)$.
 - 2) Short-run decision (operate or shutdown) vs long-run decision (stay or leave)
 - 3) Short-run operation: Accounting Profit $=PQ-EC > 0 \rightarrow P > AEC$. Graph (assume rising MC).
 - 4) Short-run shutdown: Accounting Profit $=PQ-EC < 0 \rightarrow P < AEC$. Graph (assume rising MC).
 - 5) Long-run exit or liquidation: Economic profit $=PQ-TC < 0 \rightarrow P < ATC=AEC+AIC$. Graph.

III. Market Structure: Perfect Competition

1. Perfect competition: free entry + price taking firms (zero economic profit theorem)
 - 1) Q_c is identical and P_c is determined by the market (all firms are price takers)
 - 2) Market equilibrium analysis: optimal level market output and price
 - a. Downward-sloping D_M and upward-sloping S_M (rising marginal cost)
 - b. Downward-sloping D_M and identical constant marginal cost ($MC_A=MC_B$)
 - c. Downward-sloping D_M and different constant marginal costs (higher MC die first)
 - 3) Positive profit will attract competitors, lowering P , Q , TR , and profit for existing firms.
 - 4) Negative profit will drive out weak firms, increasing P , Q , TR , and profit for existing firms.
 - 5) Zero-profit theorem: a competitive market with no entry barriers will drive all economic profit to zero in the long run. (Market-level profit is also zero because loss cancels out profit.)
 - 6) Market welfare under perfect competition: net total benefits to all market participants
 - a. Consumer surplus CS : net gain to consumers ($UV-EV$), the area below D above P
 - b. Producer surplus PS : net gain to producers ($EV-UV$), the area below P and above S
 - c. Example: demand curve ($P=10-Q$) and supply curve ($S=Q$), what are the CS , PS , MW ?
 - d. Example: demand curve ($P=10-Q$) and supply curve ($MC=5$), what are the CS , PS , MW ?

IV. Market Structure: Monopoly

1. Monopoly: A single firm that dominates the market with significant market power
 - 1) Examples: Google; Tesla; Microsoft; IBM; AT&T; American Tobacco; Standard Oil.
 - 2) Decisions: setting both P and Q (downward-sloping D_M) to maximize its profit
 - 3) Principle: $\max\{TR(Q)-TC(Q)\}$ and $MR \geq MC$
 - 4) Model 1: Downward-sloping market demand D_M and constant MC
 - 5) Numerical example: $D_M (P=AR=10-Q, MR=10-2Q)$ and $S_M (MC=AC=5)$
 - 6) Solution: $MR=MC \rightarrow E_M (P_M, Q_M) \rightarrow$ monopoly profit? $TR(Q_M)-TC(Q_M)$
 - 7) Graph: Monopoly profit (single pricing) = $P_M Q_M - AC * Q_M = (P_M - AC) * Q_M$
 - 8) Model 2: D_M and upward-sloping S_M (solution $P_M > P_C$ and $Q_M < Q_C$)
 - 9) Numerical example: $D_M (P=AR=10-Q, MR=10-2Q)$ and $S_M (MC=Q, AC=0.5Q)$
2. Monopoly market welfare: equity and efficiency evaluation (assume constant MC)
 - 1) Example: $P=AR=10-Q, MR=10-2Q$ and $MC=5$, what are CS, PS, MW?
 - 2) Market welfare ($MW=CS+PS$) under monopoly: $CS=? PS=? MW=?$
 - 3) Evaluation: equity (how to distribute the pie?) and efficiency (how big is the pie?)
 - 4) Equity: monopoly usually benefits the company more than the consumers because consumer surplus is maximized under perfect competition ($CS_C > CS_M$ & $PS_M > PS_C=0$)
 - 5) Efficiency: perfect competition is more efficient than monopoly ($MW_C > MW_M$)
 - 6) Monopoly deadweight loss (inefficiency) is the deviation from perfect competition MW
 - 7) **Deadweight loss (DWL)** results from monopoly pricing ($P_M > P_C$) and lower output $Q_M < Q_C$
 - 8) Perfect competition leads to maximum MW (“a bigger pie” only shared by consumers)
 - 9) Monopoly with single pricing results in DWL & less MW (“a smaller pie” shared by both)
3. Monopoly efficiency improvement: remove deadweight loss via strategic pricing
 - 1) Price discrimination: charge consumers different prices close to their marginal use values at the same time. Effective when consumers cannot arbitrage (buying low and selling high).
 - 2) Purpose: remove DWL, extract all consumer surpluses and turn it into monopoly profit
 - 3) Efficiency: less DWL (more outputs) and more efficient (MW) than a single price
 - 4) Equity: more PS_M ($PS_M=CS_C$) and less CS_M ($CS_M=0$) compared to a single price
 - 5) Other strategies: block pricing, membership pricing, all-or-nothing pricing, bundling, etc.
4. Causes of monopoly market power: entry barriers and transaction costs (new technology, new business model, product uniqueness, first-mover advantage, government-granted business privilege and license, natural monopoly with falling AC, and government monopoly)
5. Natural monopoly: a monopoly firm with falling average cost. Due to a significant start-up cost (investment in capitals), a natural monopoly’s production can display economies of scale. Regulation ($P=MC$) on public utility companies can incur a loss ($P < AC$) and gov subsidy.
6. Duopoly (two), oligopoly (multiple), monopolistic competition (a large number), and more.

Based on the perfect competition model and monopoly model, how do you explain the evolution of the cellphone and PC industries in the introduction of the lecture? (Hint: focus on P, Q, CS, PS, MW.)

Note: Producer surplus is similar but not the same as profit. PS is calculated as the area above supply curve (marginal cost) and below price line. Profit is calculated as the total revenue minus total cost (average cost times quantity).

Summary: Production and Business Decision

Biwei Chen

The goal of business is to maximize profit. Production and business decisions consider output function, cost function, revenue function, and profit function.

Given any two-factor production function $Q=Q(K, L)$

The first law of production: when capital is fixed, marginal product of labor will fall as labor increases.

The second law of production: when capital rises, marginal product of labor will rise, and vice versa.

- Input (production factor) \rightarrow capital K and labor L
- Output (production quantity) \rightarrow Production function $Q=Q(K, L)$
- Cost (production cost) \rightarrow Cost function $C=C(Q)$
- Revenue (business income) \rightarrow Revenue $=PQ=R(Q)$
- Profit (return to business owner) \rightarrow Profit $=R(Q)-C(Q)$

Profit maximization principle: $\max\{TR(Q)-TC(Q)\}$ and $MR(Q) \geq MC(Q)$

Decision Variable	Total Variable	Average Variable	Marginal Variable	Special Notes
Output	$TP=Q(L)$	$AP=TP/L$	$MP=\Delta TP/\Delta L$	Real income
Cost	$TC=C(Q)$	$AC=TC/Q$	$MC=\Delta TC/\Delta Q$	MFC=0
Revenue	$TR=PQ=R(Q)$	$AR=TR/Q$	$MR=\Delta TR/\Delta Q$	AR=Price
Profit	$TF=TR-TC$	$AF=TF/Q$	$MF=\Delta TF/\Delta Q$	“Zero Profit”

Note: all variables measured in monetary value are nominal variables.

Short-run decision: 1) change variable production factors (fixed capital); 2) operate or shutdown

Long-run decision: stay in or leave the business (sell all the capitals)

Short-run total cost: variable costs + fixed costs (implicit cost is irrelevant in the short run, why?)

Long-run total cost: variable costs + fixed costs + overhead cost (liquidation)

Overhead cost is the opportunity cost of staying in business, compensating investors and business owners for tying up their time and money with the business.

Accounting profit: total revenue minus accounting cost (explicit)

Economic profit: total revenue minus opportunity cost (explicit + implicit)

Economic profit it is part of the opportunity cost of doing the business. Winning a lottery is pure luck; windfall is not profit. In a competitive market with free entry, economic profit (rent) is zero.

Lecture 17 Market Equilibrium & Welfare

Biwei Chen

This lecture explains how price is determined in the market and how economists measure social welfare. As a popular concept, equilibrium in Physics is not as equilibrium in Economics: Equilibrium in Physics is a fact but in Economics it is the solution of a model. In reality, without access to transaction data, no economists can see and know exactly where the market equilibrium is, not to mention market welfare.

I. The Demand and Supply Model $P(Q_D) = P(Q_S) = P^*$

1. The law of demand: quantity demanded goes down when price goes up, ceteris paribus.
2. Demand factors: income, prices of related goods, population, weather, policies, expectation.
3. The law of supply: quantity supplied goes up when price goes up, ceteris paribus.
4. Supply factors: technology, input costs, weather conditions, entry barriers, policies.
5. Market equilibrium: when D meets S, the market is said to be in equilibrium $E(P, Q)$
6. Mathematical model: 1) D curve: $P = a + bQ_D$; 2) S curve: $P = c + dQ_S$; 3) E: $P^* = P(Q_D) = P(Q_S)$
7. Graphical solution: the intersection of demand curve and supply curve is the equilibrium.
8. Market factors and new equilibrium
 - 1) $D+ \rightarrow P\uparrow \& Q\uparrow$; $D- \rightarrow P\downarrow \& Q\downarrow$
 - 2) $S+ \rightarrow P\downarrow \& Q\uparrow$; $S- \rightarrow P\uparrow \& Q\downarrow$
 - 3) $D \& S+ \rightarrow Q\uparrow \& P(?)$; $D \& S- \rightarrow Q\downarrow \& P(?)$
 - 4) $D+ \& S- \rightarrow P\uparrow \& Q(?)$; $D- \& S+ \rightarrow P\downarrow \& Q(?)$
9. Equilibrium analysis step by step:
 - 1) Characterize the initial equilibrium
 - 2) Identify the demand or/and supply factors
 - 3) Analyze the nature of the event, positive or negative
 - 4) Decide the direction and the size of the curve movement
 - 5) Characterize the new equilibrium and compare with the initial
10. Case study: global oil market <https://www.eia.gov/finance/markets/crudeoil/>

II. Market Welfare Analysis (Equity and Efficiency Principle)

1. Consumer surplus CS: net gain from transaction = use value - exchange value (UV - EV)
2. Calculation CS: the area below the demand curve and above price ("upper triangle")
3. Producer surplus PS: net gain from transaction = exchange value - use value (EV - UV)
4. Calculation PS: the area below the price and above supply curve ("lower triangle")
5. Market welfare MW: the total welfare of all market participations. $MW = CS + PS$. ("pie")
6. Deadweight loss DWL (inefficiency): deviation from competitive market equilibrium ("wedge")

III. Applications: Taxation and Subsidy Analysis

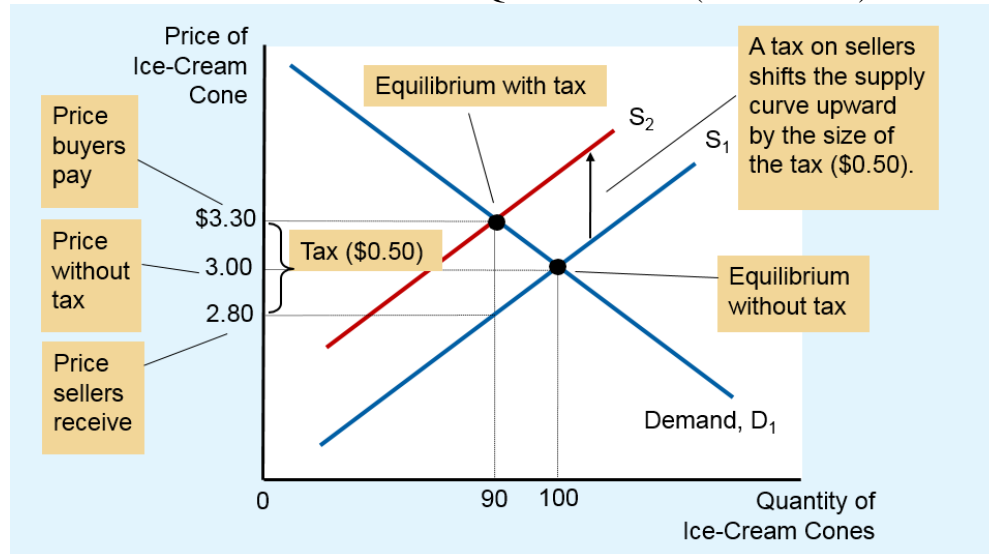
1. Tax is the source of gov revenue. Tax burden/incidence is shared by both consumer & producer.
2. Production T $\rightarrow S- \rightarrow P\uparrow, Q\downarrow, DWL > 0$; consumption T $\rightarrow D- \rightarrow P_T = P_1 + T > P_0, Q\downarrow, DWL > 0$
3. Subsidy is government's support to social groups. Subsidy $\rightarrow D+ \text{ or } S+ \rightarrow P\downarrow, Q\uparrow, DWL > 0$.

Market Equilibrium Model – Tax Analysis

Biwei Chen

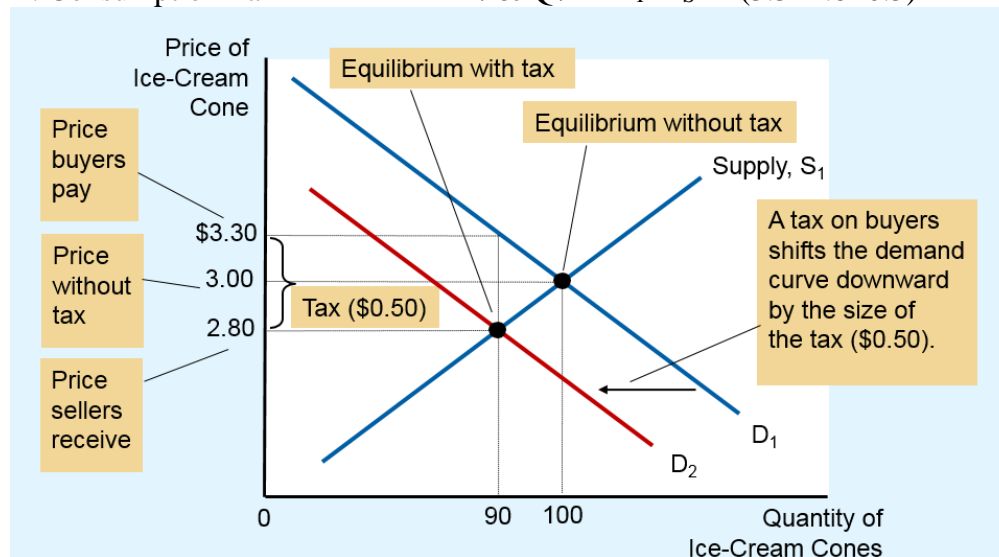
The demand and supply model (market equilibrium) is the most fundamental tool in market and policy analysis. This application focuses on the government taxation—its effect on market welfare.

I. Production Tax $T_+ \rightarrow S_- \rightarrow P \uparrow \text{ \& } Q \downarrow \rightarrow P_T = P_S + T$ ($3.3 = 2.8 + 0.5$)



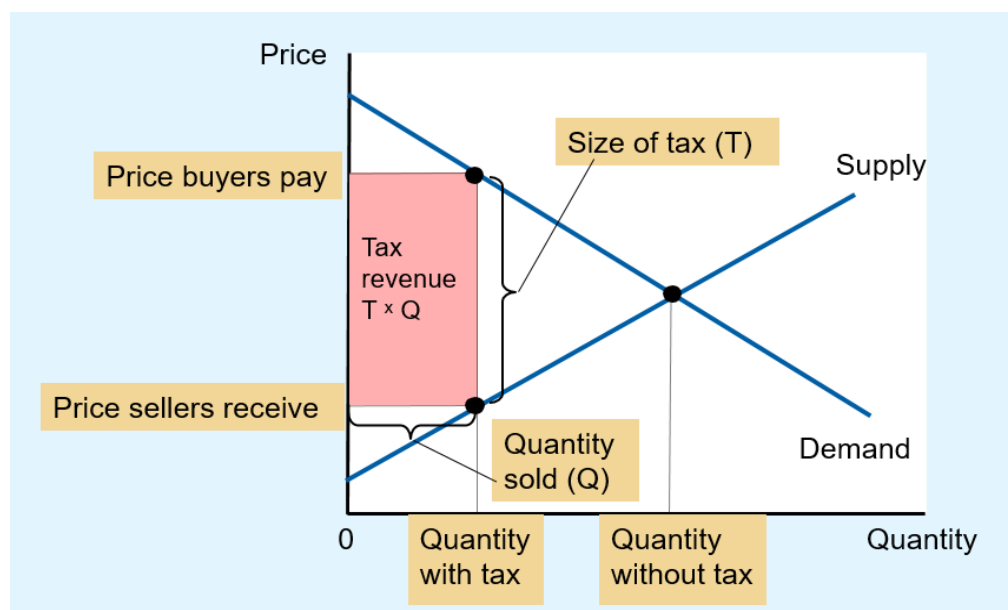
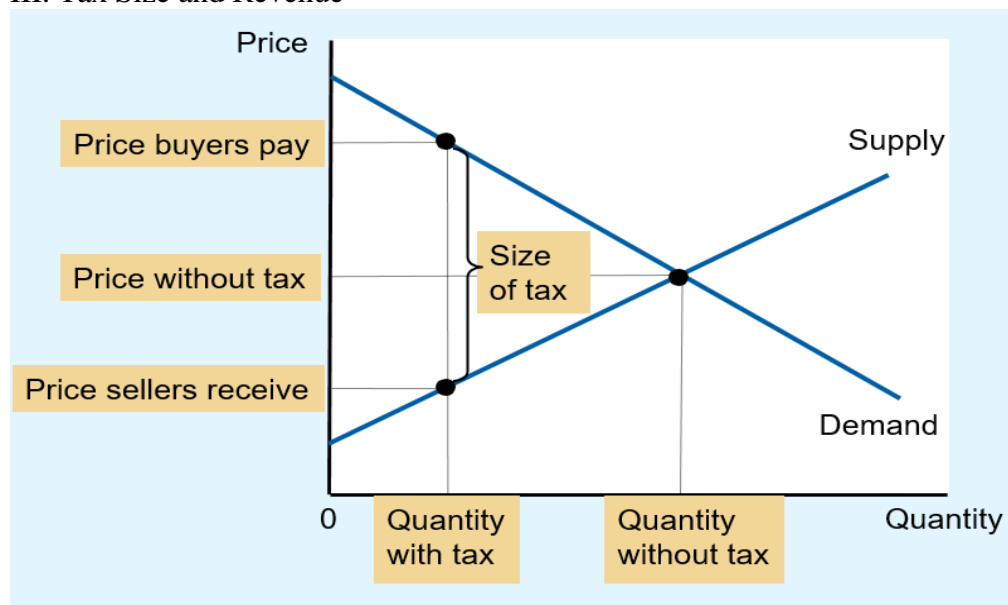
P_T is the after-tax price paid by the consumer and P_S is the effective price received by the seller.

II. Consumption Tax $T_+ \rightarrow D_- \rightarrow P \downarrow \text{ \& } Q \downarrow \rightarrow P_T = P_S + T$ ($3.3 = 2.8 + 0.5$)



How much tax can the government collect in total? Is tax efficient? Who suffer more from the taxation?

III. Tax Size and Revenue

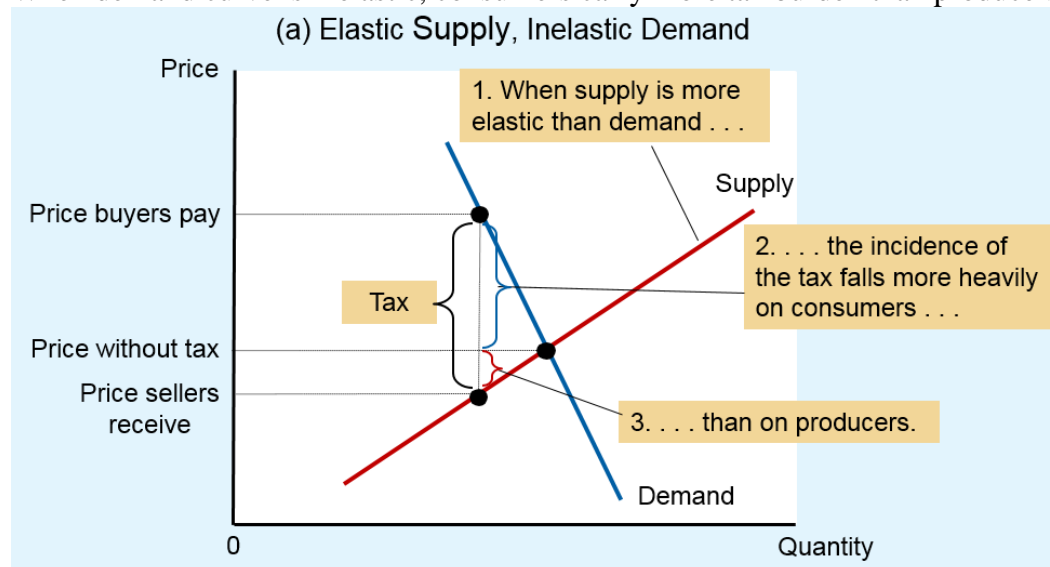


In the market equilibrium model, production tax shifts the supply curve by the size of the tax T , causing a new equilibrium with lower price P_s (received by the producer) and quantity produced. Adding the tax to the new lower price, the producers passed the tax to the consumers. $P_T = P_s + T$

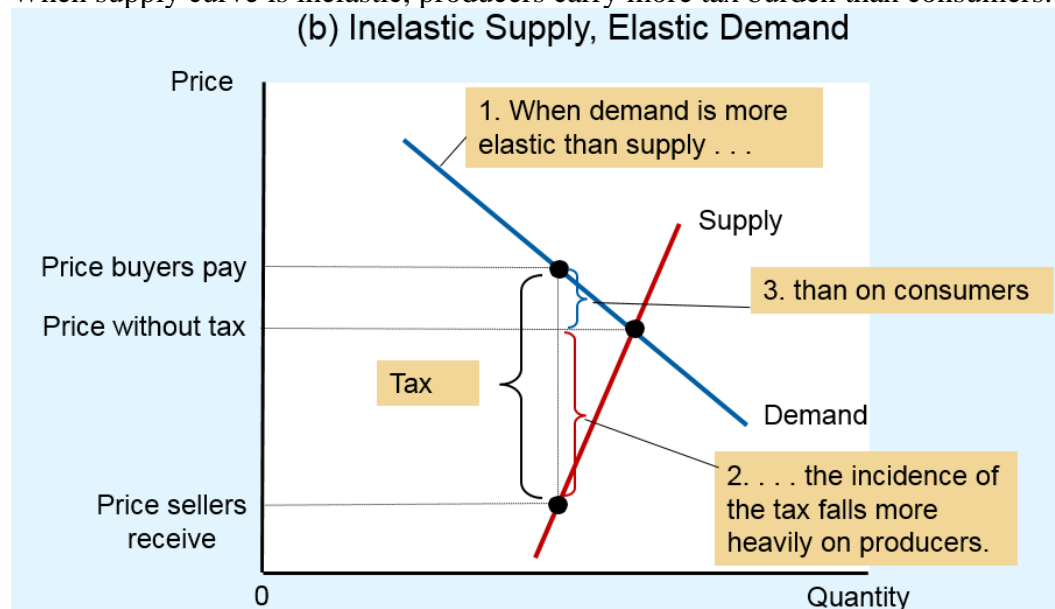
After the tax, the consumers must pay higher and producers receive lower price with lower outputs. Regardless of who pay the tax, the market welfare is reduced compared to without tax. This is the tax equivalence theorem. Since taxation drives a “wedge” between the demand and supply curve, it causes a deadweight loss (DWL) in the market.

IV. Tax Incidence or Burden (Equity)

When demand curve is inelastic, consumers carry more tax burden than producers.



When supply curve is inelastic, producers carry more tax burden than consumers.



How to determine the tax burden? Draw a horizontal line from the initial equilibrium P_0 . The tax burden on the consumers is $P_T - P_0$ and the tax burden on the producers is the and $P_0 - P_S$. Therefore, total tax burden is $(P_T - P_0) + (P_0 - P_S) = P_T - P_S = T$. Who suffers more? A golden rule of thumb: more “flexible” market participants carry less tax burden!

MRU Principles of Microeconomics – Taxes and Subsidies

<https://mru.org/courses/principles-economics-microeconomics/taxes-subsidies-definition-tax-wedge>

Lecture 19 Market Intervention Policies I

Price is determined by market demand and supply. Price controls aim to do the opposite, trying to set the market price at a “fixed socially desirable” level, either by law or by force. This lecture introduces how public policy and government intervention can change the market equilibrium and welfare.

I. Equilibrium Adjustment

1. Rising demand \rightarrow At P_0 , $Q_{D'} > Q_D \rightarrow$ consumers exert upward pressure on $P \rightarrow$ new E
2. Rising supply \rightarrow At P_0 , $Q_{S'} > Q_S \rightarrow$ producers exert downward pressure on $P \rightarrow$ new E

II. Price Ceilings ($P_{\text{Ceiling}} < P^* \rightarrow Q_D > Q_S$)

1. Definition: a maximum price imposed below the market equilibrium price.
2. Examples: 1) 1970-80 oil price control; 2) wartime price control; 3) metropolitan rent control
3. Purposes: 1) social equity and justice; 2) affordable government program
4. Model: a horizontal price line below the equilibrium price level, causing artificial shortage
5. Results: 1) $Q_D > Q_S$; 2) other competitive criteria will emerge; 3) SR vs LR effects
6. Market welfare: 1) $CS(?)$ 2) $PS \downarrow$; 3) $DWL > 0$; 4) greater DWL in the long run.
7. Equity and efficiency: 1) not fair to the producers; 2) not efficient due to DWL

II. Price Floors ($P_{\text{Floor}} > P^* \rightarrow Q_D < Q_S$)

1. Definition: a minimum price imposed above the market equilibrium price.
2. Examples: 1) minimum wage laws; 2) agricultural price support/subsidy
3. Purposes: 1) social equity and justice; 2) affordable public program
4. Model: a horizontal price line below the equilibrium price level, causing artificial surplus
5. Results: 1) $Q_D < Q_S$; 2) other competitive criteria will emerge; 3) SR vs LR effects
6. Market welfare: 1) $CS \downarrow$; 2) $PS(?)$ 3) $DWL > 0$; 4) greater DWL in the long run.
7. Equity and efficiency: 1) not fair to consumers; 2) not efficient due to DWL

III. Trade Tariff ($P_{\text{Tariff}} = P_{\text{Import}} + \text{Tariff}$)

1. Import tariff: additional amount charged on imported goods
2. Purposes: 1) protect domestic producer and employment; 2) increase government revenue
3. Model: import price is lower than equilibrium price and add tariff on top of the import price
4. Results: 1) $P_1 = P_0 + T$; 2) $Q_D \uparrow$ and $Q_S \uparrow$, so that $IM \downarrow$; 3) government collect tariff. Tariff makes import price higher and it causes fewer quantity imported from foreign countries.
5. Welfare: 1) $CS \downarrow$; 2) $PS \uparrow$; 3) Government revenue \uparrow ; 4) $MW(?) = CS + PS + GR$; 5) $DWL > 0$
6. Equity and efficiency: 1) not fair to the consumers and foreign exporters; 2) not efficient
7. Case study: Trump's 2018-2019 trade war and its market welfare implications

<https://www.piie.com/blogs/trade-investment-policy-watch/trump-trade-war-china-date-guide>

Whether market exchange is good or bad, right or wrong, that is a moral question. Though difficult, it is imperative to provide normative evaluation based on rigorous positive analysis.

Lecture 19 Market Intervention Policies II

Quantity restrictions include quota, rationing, and licenses. Production quotas are still by OPEC but not that effective. Rationing are not common nowadays than in our grandparents' generation in times of supply shortage and usually come together with price control. Business licenses are prevalent and the most common type of quantity restriction imposed by the government.

I. Production Quota and Rationing ($Q_{\text{Quota}} < Q^*$)

1. Definition: a limited quantity of the goods that can be supplied in the market
2. Examples: 1) oil market quota by OPEC; 1) wartime resource rationing; 2) communist economy
3. Purposes: 1) limit competition; 2) extract higher revenue; 3) social equity; 4) corruption
4. Model: a vertical line at a limited quantity supplied less than market equilibrium quantity
5. Results: 1) artificial shortage relative to initial Q^* ; 2) artificially higher price relative to P^* ;
6. Market welfare: 1) $CS \downarrow$; 2) $PS?$ 3) $DWL > 0$
7. Equity and efficiency: 1) unfair to consumers; 2) inefficient

II. Business License ($Q_{\text{License}} < Q^*$)

1. Definition: the right to do business under the government's regulation
2. Examples: 1) NYC medallion; 2) medical license; 3) CPA, CFA, BAR, etc.
3. Purposes: 1) regulate business practice; 2) regulate competition; 2) protect consumer rights
4. Model: a vertical line at a limited quantity supplied falling short of market equilibrium quantity
5. Results: 1) artificial shortage; 2) artificially high price; 3) perhaps overall higher quality
6. Market welfare: 1) $CS \downarrow$; 2) $PS?$ 3) $DWL > 0$; 4) innovation renders quota/license less effective
7. Equity and efficiency: 1) unfair to consumers; 2) inefficient. A caveat: in health care market, due to highly asymmetric information between doctors and patients, whether it is more efficient to regulate the market by issuing medical license is debatable.
8. Case study: NYC medallion and the introduction of Uber

*III. Trade Quota ($Q_{\text{Quota}} < Q_{\text{Import}}$)

1. Import quota: a limited quantity of goods that can be imported
2. Purposes: 1) protect domestic industry from foreign competition; 2) corrupted government can benefit from quota rents because administration distributes quota to eligible producers
3. Model: a limited quantity of imports set a wedge between D and S, causing higher import price
4. Results: 1) artificial shortage; 2) higher price; 3) higher quality → unintended consequences. Quota limits quantity of imports and causes higher import price.
5. Welfare: 1) $CS \downarrow$; 2) $PS \uparrow$; 3) government revenue(?) 4) $DWL > 0$
6. Equity and efficiency: 1) not fair to domestic consumers and foreign exporters; 2) inefficient

Government intervention and public policy can result in deadweight loss (DWL) inefficiency. However, free market competition, left on its own, does not always maximizes social welfare.

Lecture 20 Market Efficiency and “Failure”

This lecture summarizes the market mechanism and discusses the nature of market. Most people, including the best economists, do not understand the nature of market and accuse market of its inefficient outcomes, some even blame the market for causing monopoly, inequality, pollution, and other social problems. Fortunately, Ronald Coase shed lights on the nature of market and offered insightful solutions.

*I. General Equilibrium (Not required for the final exam)

1. Partial equilibrium analysis: individual unit—its external causes and internal effects
2. General equilibrium analysis: studies the system and its interconnectedness.
3. Market competition: price is the competitive criterion & property rights are the rules of the game.
4. Pareto efficiency: optimal resource allocation when no one can be made better off unless the other suffers. In such state, the only way to improve one’s welfare is to rob Peter to pay Paul.
5. Market efficiency ($MR=MC=P$): 1) production; 2) exchange; 3) public policy
6. First welfare theorem: competitive equilibrium is Pareto efficient (Market welfare is maximized under perfect competition whereas market power results in inefficiency DWL.)
7. Second welfare theorem: Pareto efficient can be attained via redistribution policy.

II. Market “Failure” (inefficiency): price system fails to allocate resources efficiently

1. Market power: a dominant player that can significantly change P and Q
 - 1) monopoly (goods market) → antitrust laws against large corporations
 - 2) monopsony (labor market) → labor laws against collective bargaining
2. Public goods: excludability and rivalry of a good or resources
 - 1) Non-excludable and non-rival consumption → MSB (social benefit) > MSC (social cost)
 - 2) Free rider problem → lack of incentive for private market business to supply
3. Externalities (external effects): divergence between private and social benefit (cost).
 - 1) Positive externality: $MSB > MPB$ (vaccine) → undersupply relative to the optimal level
 - 2) Negative externality: $MSC > MPC$ (pandemic) → oversupply relative to the optimal level
4. Asymmetric information: transaction counterparties with different information set
 - 1) Moral hazard: ex-post inefficiency (one party takes on excessive risk, the other suffers).
 - a. Insurance against on-the-job accidents → workers become careless or fake accident
 - b. Insurance against medical costs → patients overuse the medical resources
 - 2) Adverse selection: ex-ante inefficiency resulting in less or no transaction
5. **Coase theorem:** 1) delineation of rights is a prelude to market transaction; 2) market can be efficient if transaction cost is low enough. Ronald Coase: 1991 Economics Noble Prize Laureate.
6. The market success is quite often taken for granted. However, the formation of market takes a long process and sometimes very costly. (Recall the competitive criteria and rules of the game.)
7. Market transaction cost includes price adjustment cost, the key to economic efficiency. To understand how it affects economic behavior, refer to a timely interesting paper on sticky price, household hoarding, and shortage. <https://www.nber.org/papers/w27051>