

MICROECONOMIC TOOLS FOR HEALTH ECONOMICS

7MHPH010 – Health Economics and Health Policy

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ECONOMIC CONCEPTS AND MODELS

OUTLINE

- Production Possibility Curve
- Demand and Supply
- Consumer Behavior

ECONOMIC CONCEPTS AND MODELS

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- Production Possibility Curve
 - Opportunity cost
 - Allocative Efficiency
 - Production Efficiency
- Demand and Supply
- Consumer Behavior

ECONOMIC CONCEPTS AND MODELS

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- Production Possibility Curve
- Demand and Supply
 - Equilibrium
 - Elasticity
 - Demand and Supply Shifters
 - Consumer and Producers Surplus
 - Taxes and Subsidies – Dead Weight Loss
- Consumer Behavior

ECONOMIC CONCEPTS AND MODELS

OUTLINE

- Production Possibility Curve
- Demand and Supply
- Consumer Behavior
 - Commodity Space
 - Preferences, Utility and Indifference Curves
 - Marginal Rate Of Substitution And Marginal Utility
 - Budget Constraint
 - Utility Maximization
 - Derivation of Individual Demand

- Production Possibility Curve
 - Opportunity cost
 - Allocative Efficiency
 - Production Efficiency

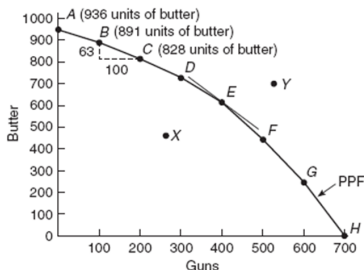
PRODUCTION POSSIBILITIES CURVE

TRADEOFFS AND OPPORTUNITY COST

- Consider a society's trade-off between producing guns and butter with its limited resources¹
- Tradeoffs imply **opportunity costs**: the value resources would yield if they were put to an alternative use
- **Opportunity Cost**: The value of forgone benefit which could be obtained from a resource in its next-best alternative use, i.e., the opportunity cost of an action, or a decision, is the *net value* from the best alternative course of action (including doing nothing)

Point	Butter	Guns	Opportunity Cost
A	936	0	
B	891	100	45
C	828	200	63
D	732	300	96
E	609	400	123
F	444	500	165
G	244	600	200
H	0	700	244

The last column shows the opportunity cost of producing 100 additional units of guns in terms of units of butter given up

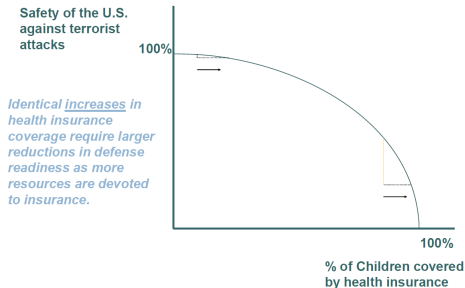


¹ Guns and butter are metaphors for production of goods and services for internal consumption or defence

PRODUCTION POSSIBILITIES CURVE

TRADEOFFS AND OPPORTUNITY COST

- The opportunity cost of raising health insurance coverage by 1% could be a 2% reduction in the armed forces trained to deal w/ terrorist attacks
- The PPC is concave
 - Resources are imperfectly substitutable
 - Each additional unit of production has a *rising opportunity cost*

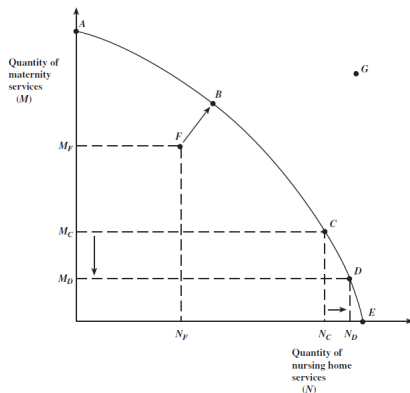


- Raising health insurance coverage from 10 to 20% may reduce the fool-proofness of the defense system from 95% to 94%
- But raising insurance coverage from 90% to 100% could reduce the readiness of the defense system from 10% to 0%

PRODUCTION POSSIBILITIES CURVE

PRODUCTION AND ALLOCATIVE EFFICIENCY

- The PPC shows the trade-off between any two goods given a fixed stock of resources and technology
- Any point on the PPC, such as points A through E, reflects **production efficiency** because units of one good must be given up to receive more of the other
- A point in the interior, such as F, reflects inefficiency because more of one good can be attained without necessarily reducing the other
- A point outside the PPC, such as G, is not yet attainable but can be reached with an increase in resources or through institutional or technological changes that improve productivity

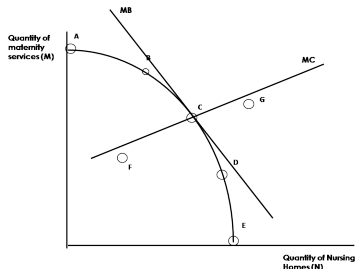


Allocative efficiency is attained when society chooses the best or most preferred point on the PPC. All points on the PPC are possible candidates for allocative efficiency. The ideal, or optimal, point for allocative efficiency depends on society's underlying preferences for the two medical services.

PRODUCTION POSSIBILITIES CURVE

PRODUCTION AND ALLOCATIVE EFFICIENCY

- When we cannot produce more of any one good without giving up some of the other good, we have achieved production efficiency and we are producing at a point on the PPC
 - When we cannot produce more of any one good without giving up some other good that we *value more highly*, we have archived allocative efficiency, and we are producing at *the* point on the PPC that we prefer above all other points
 - All points on the PPC are efficient, and the point which is chosen will depend on society's preferences
 - To determine which of the alternative points on PPC to produce, we compare costs and benefits and select the point where **marginal cost equals marginal benefit**
-
- The marginal cost of a product or service is the opportunity cost of the units chosen
 - To describe preferences, economists use the concept of marginal benefit – the marginal benefit of a good or service is the benefit received from consuming one more unit of it
 - We measure marginal benefit by the amount that a person is willing to pay for an additional unit of a good or service
 - Marginal benefit curve shows the relationship between the marginal benefit of a good and the quantity of that good consumed
 - The curve slopes downward to reflect the principle of decreasing marginal benefit



ECONOMIC CONCEPTS AND MODELS

DEMAND AND SUPPLY

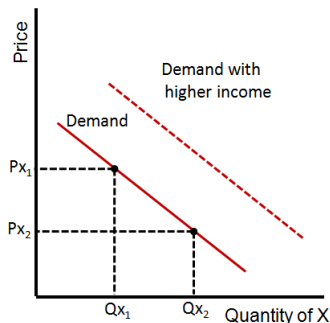
- Demand and Supply
 - Equilibrium
 - Elasticity
 - Demand and Supply Shifters
 - Consumer and Producers Surplus
 - Taxes and Subsidies – Dead Weight Loss

DEMAND AND SUPPLY

DEMAND CURVE

- A demand function for a good or service provides the relationship between the quantity demanded and its price
- For some good X , quantity demanded (Q_x) is function of
 - own price (P_x)
 - price of other goods (P_y such as substitutes and complements)
 - income (I)
 - other factors (Z , e.g. insurance, taste, etc.)
 - $Q_x = f(P_x, P_y, I, Z)$
- On a graph of price against quantity, demand curves slope left to right downwards (they need not be straight lines) showing that the **willingness to pay** for additional units declines
 - As consumption increases, the marginal benefit from extra units is assumed to decline (“diminishing marginal benefit”) – thus the willingness to pay for the product declines and gives us the left to right sloping demand curve

- When price changes we have movement *along* the demand curve
- Changes in income, price of complements and substitutes, and other factors *shift* the demand curve

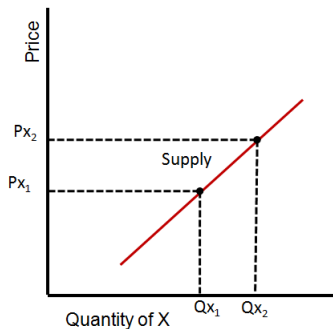


DEMAND AND SUPPLY

SUPPLY CURVE

- A supply function for a good or service provides the relationship between the quantity supplied and its price
- For some good X , quantity supplied (Q_x) is function of
 - own price (P_x)
 - factor prices
 - technological change
 - size of the industry
 - other factors (such as weather, expectations of future prices)
 - $Q_x = f(P_x, Z)$
- On a graph of price against quantity, supply curves slope left to right upwards (they need not be straight lines)
 - For a supplier to be willing to sell a product, its price must cover the cost of producing it – the cost of producing additional units often tends to rise (in the short run) and increased production is profitable only at higher prices

- When price changes we have movement *along* the supply curve
- When other factors (such as input prices) change, we have *shifts* of the supply curve

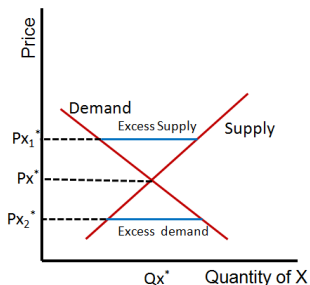
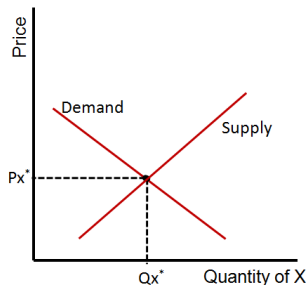


DEMAND AND SUPPLY

MARKET EQUILIBRIUM

In a free economy, how many units will be bought and sold and at what price?

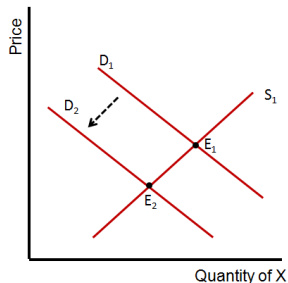
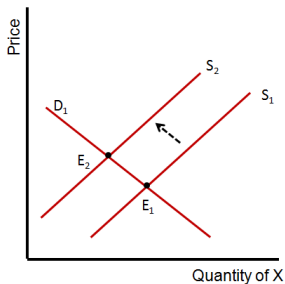
- Equilibrium price-quantity pair is the one at which both buyers and sellers are satisfied
- This is where the demand and supply curves intersect (Q_x^*, P_x^*)
- If price is above the equilibrium price ($P_{x1} > P_x^*$), suppliers would be willing to supply a great amount than there is demand at that price and it would lead to *excess supply*
- If price is below the equilibrium price ($P_{x2} < P_x^*$), quantity demanded will be greater than the amount suppliers are willing to provide and would lead to *excess demand*



DEMAND AND SUPPLY

SHIFTS IN DEMAND AND SUPPLY CURVES

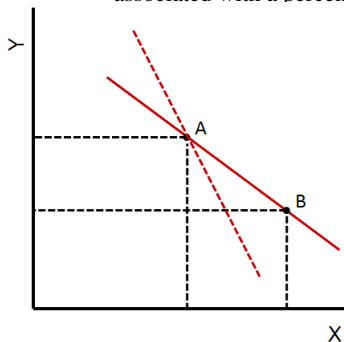
- *Shifts in the supply curve:* A new law requires that hospitals hire only nurses with B.A. degrees - cost of hospital care rises shifting supply curve to the left resulting in an increase in the equilibrium price and a reduction in the equilibrium quantity of care
- *Shifts in the demand curve:* A study published in BMJ announces risk of heart attack for patients taking certain diabetes drugs - demand curve shifts to the left resulting in a decrease in the equilibrium price and quantity



DEMAND AND SUPPLY

ELASTICITY – GENERAL CONCEPT

- Elasticity is a general concept used in many different contexts through out economics (and health economics)
 - It is a unit free measure of responsiveness of one variable to changes in another variable
 - Let Y and X be any two variables of interest
 - Then elasticity of Y with respect to X is defined as a percentage change in Y associated with a percentage change in X



- Elasticity: $\eta_{YX} = \frac{\% \Delta Y}{\% \Delta X} = \frac{\Delta Y / Y}{\Delta X / X} = \frac{\Delta Y}{\Delta X} \frac{X}{Y}$
- In the figure, elasticity at point A and B on the solid line is negative (because slope is negative)
- Elasticity at point A is smaller in magnitude than at B (they have the same slopes but the ratio of X to Y is smaller at A than at B)
- Point A on the solid line has smaller elasticity (in magnitude) than for the same point on the dotted line (ratio of X to Y is the same but the dotted line is steeper)

DEMAND AND SUPPLY

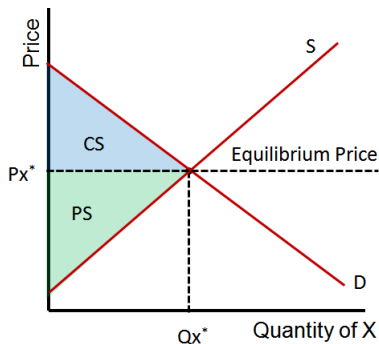
ELASTICITY OF DEMAND AND SUPPLY

- In demand/supply analysis we often speak of
 - Elasticity of demand (or supply) with respect to price (also referred to as own-price elasticity) – measures demand (or supply) responsiveness to changes in price
 - Price elasticity: $\eta_{QP} = \frac{\% \Delta Q}{\% \Delta P} = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P} \frac{P}{Q}$
 - For demand curves it is negative and for supply curves positive
 - If elasticity is less than one in magnitude, it is called inelastic and if more than one than elastic
 - Elasticity of demand with respect to income – measures changes in demand with respect to changes in income
 - Income elasticity: $\eta_{QI} = \frac{\% \Delta Q}{\% \Delta I} = \frac{\Delta Q/Q}{\Delta I/I} = \frac{\Delta Q}{\Delta I} \frac{I}{Q}$
 - Income elasticity is generally positive – if less than one for a good, it is a necessary good (e.g. medical care, food, etc.), if greater than one, it is classified as a luxury good (e.g. fast red cars)
 - Elasticity of demand with respect to the price of another good (also referred to as cross-price elasticity) – measures demand responsiveness of a good (say X) to changes in price of other good (say Y)
 - Cross-price elasticity: $\eta_{Q_x P_y} = \frac{\% \Delta Q_x}{\% \Delta P_y} = \frac{\Delta Q_x/Q_x}{\Delta P_y/P_y} = \frac{\Delta Q_x}{\Delta P_y} \frac{P_y}{Q_x}$
 - Substitutes (tea/coffee): $\eta_{Q_x P_y} > 0$
 - Complements (tea/sugar): $\eta_{Q_x P_y} < 0$

DEMAND AND SUPPLY

CONSUMER AND PRODUCER SURPLUS

- **Consumer surplus** is the difference between the total amount that consumers are willing and able to pay for a good or service (indicated by the demand curve) and the total amount that they actually pay (the market price)
- **Producers surplus** is the difference between what producers are willing and able to supply a good for and the price they actually receive

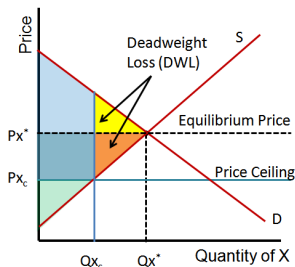


- CS is a measure of the welfare that people gain from the consumption of goods and services, or a measure of the benefits they derive from the exchange of goods
- CS is the area below the demand curve and above the price line
- PS is a measure of producers welfare
- PS is the area above the supply curve and below the price line

DEMAND AND SUPPLY

PRICE CEILINGS AND DEAD WEIGHT LOSS

- A price ceiling is the maximum price that can be charged for a product or service
 - A price ceiling below the equilibrium price will result in shortages/excess demand
 - Absent any externalities, price ceilings lead to allocative inefficiency or **dead weight loss**
-
- Deadweight loss is created due to a (binding) price ceiling
 - Producers surplus decreases
 - Consumers surplus may or may not increase
 - Decrease in producers surplus is greater than the increase (if any) in consumers surplus



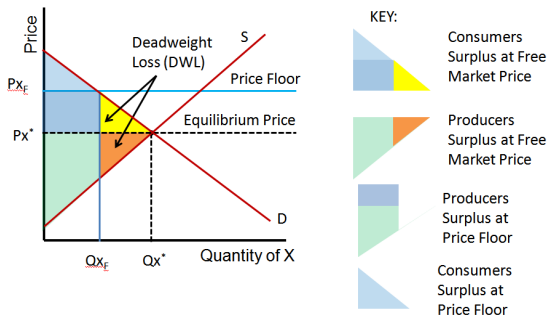
KEY:

- Consumers Surplus at Free Market Price
- Producers Surplus at Free Market Price
- Producers Surplus at Price Ceiling
- Consumers Surplus at Price Ceiling

DEMAND AND SUPPLY

PRICE FLOORS AND DEAD WEIGHT LOSS

- A price floor is the minimum price that can be charged for a product or service
 - A price floor above the equilibrium price will result in surplus
 - Absent any externalities, price floors lead to allocative inefficiency or **dead weight loss**
-
- Deadweight loss is created due to a (binding) price floor
 - Consumers surplus decreases
 - Producers surplus may or may not increase
 - Decrease in consumers surplus is greater than the increase (if any) in producers surplus



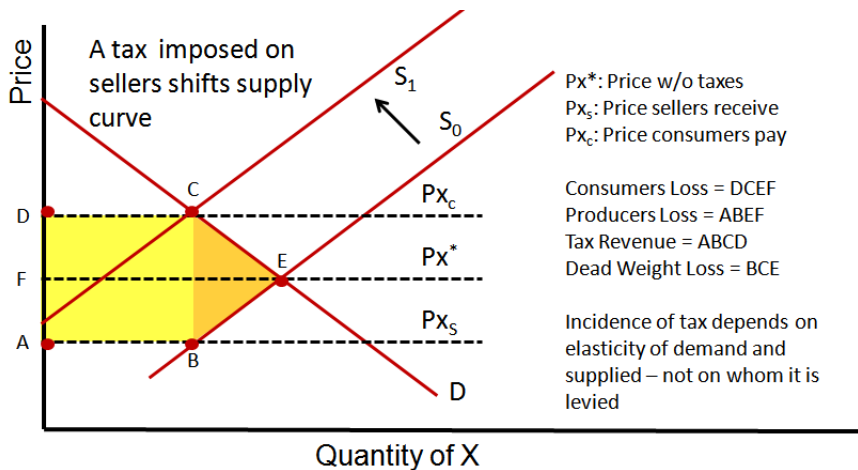
DEMAND AND SUPPLY

TAXES AND SUBSIDIES AND DEAD WEIGHT LOSS

- Taxes and subsidies (negative taxes) also create inefficiencies
- Taxes
 - Taxes decrease the producers and consumers surplus
 - Part of it is recovered as government revenue
 - Part is lost – dead weight loss
 - A tax imposed on the sellers shifts the supply curve, a tax imposed on the buyer shifts the demand curve
 - Incidence of tax depends on the elasticity of demand and supply – not on whom it is levied
- Subsidies
 - Analysis of subsidy (a negative tax) is similar
 - A subsidy increases the consumers and producers surplus
 - The gain in consumers and producers surplus is less than the revenue spent by the government – the difference is the dead weight loss

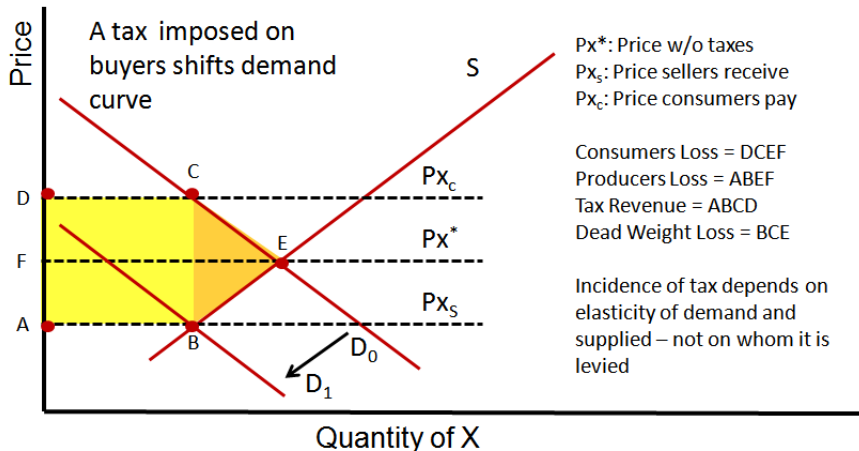
DEMAND AND SUPPLY

TAX ON SELLER



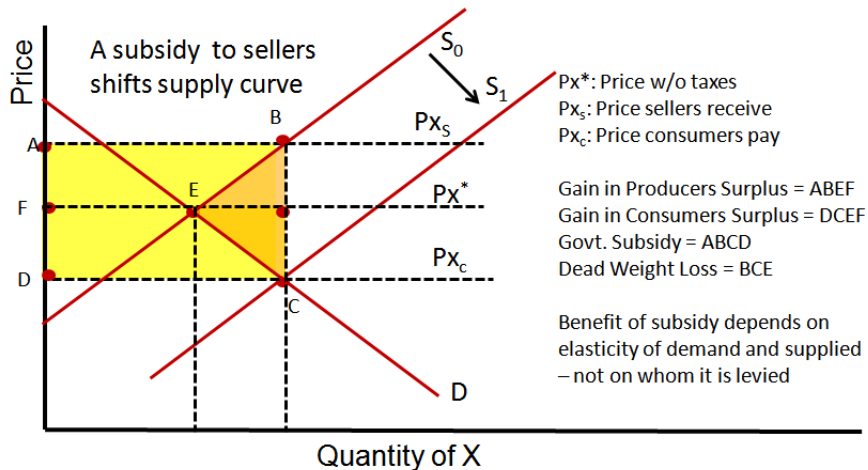
DEMAND AND SUPPLY

TAX ON BUYER



DEMAND AND SUPPLY

SUBSIDY TO SELLERS



DEMAND AND SUPPLY

SIZE OF DEAD WEIGHT LOSS

- The economic effect of a tax (or subsidy) is independent of which party makes (or receives) the payment to (or from) the government
- The deadweight loss of the tax will depend upon two factors
 - The size of the tax
 - The reduction in the quantity sold
- The reduction in the quantity sold will depend upon the elasticity of demand and supply
 - The more elastic demand or supply is the larger the deadweight loss will be
 - If either demand or supply is price inelastic then the deadweight loss will be small and could be zero if perfectly inelastic (no change in the quantity sold and consumed)

DEMAND AND SUPPLY

APPLICATION TO HEALTH CARE

- Say supply of labor is given by $W = 4L$ and demand is given by $W = 20 - L$.
- Then, the equilibrium quantity of labor and wage are:

$$4L = 20 - L \Rightarrow L^* = 4, W^* = 16$$

Supply elasticity = 1 and Demand elasticity = - 4

- Now suppose that health care costs increase by \$10 and employers asked to pay this \$10 increase, then the new demand is $W + 10 = 20 - L$
- New equilibrium quantity and wage are:

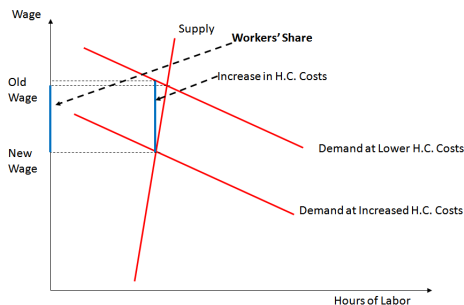
$$4L = 10 - L \Rightarrow L^{**} = 2, W^{**} = 8$$

- Employers share of \$10 health care cost increase (as percentage) is

$$[W^{**} + 10 - W^*]/10 = 0.2$$

- and workers share is

$$[W^* - W^{**}]/10 = 0.8$$



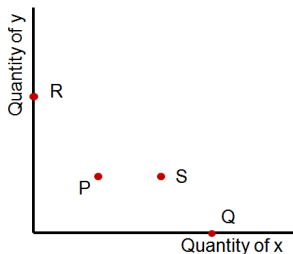
- Note that the 20/80 breakdown is because of the slopes of the demand and supply curves and does not depend on whom this increased cost (a per worker tax) is levied

- Consumer Behavior
 - Commodity Space
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CONSUMER BEHAVIOR

COMMODITY BUNDLES

- **Commodity Bundles:** Combination of Goods
- Consider two goods X and Y
 - Then points such as $P = (X = 1, Y = 1)$, $Q(X = 3, Y = 0)$, $R(X = 0, Y = 3)$, and $S = (X = 2, Y = 1)$ represent four such bundles



- The set of all such bundles is the commodity space
- Consumers can choose which commodities to consume and in what quantity ... this in turn requires some assumptions

CONSUMER BEHAVIOR

AXIOMS OF RATIONAL CHOICE

- Axioms of Rational Choice
 - Completeness
 - if A and B are any two bundles, an individual can always specify exactly one of these possibilities: 'A is preferred to B' or 'B is preferred to A' or 'A and B are equally preferred'
 - In other words, preferences must exist in order to be able to describe them through a simple method
 - Transitivity
 - if A is preferred to B, and B is preferred to C, then A is preferred to C
 - Assumes that the individuals choices are internally consistent
 - Continuity
 - if A is preferred to B, then bundles close to A must also be preferred to B
- If the first three axioms hold, then it is possible to show that people are able to rank all possible bundles from least desirable to most desirable

CONSUMER BEHAVIOR

PREFERENCES, UTILITY AND INDIFFERENCE CURVES

Utility functions allow us to capture the rankings of alternative bundles for a given individual

- A **utility function** is a function from the space of commodities bundles to the space of real numbers
 - If A is preferred to B, then the utility assigned to A exceeds the utility assigned to B $U(A) > U(B)$ where $U(A)$ and $U(B)$ are some numbers on the real line
 - If A and B are equally preferred, then the utility assigned to A equals utility assigned to B and hence $U(A) = U(B)$
- Utility is an **ordinal** concept (and not cardinal)
 - Cardinal: My utility from chocolate ice-cream is 10
 - Ordinal: My utility from eating chocolate ice-cream is more than that from butterscotch
 - All we really need is that if bundle A is preferred to bundle B, it should have a higher utility number than bundle B

CONSUMER BEHAVIOR

PREFERENCES, UTILITY AND INDIFFERENCE CURVES

- Assignment of numbers is arbitrary as long as it maintains rankings
 - Suppose A is preferred to B
 - If $U(A) = 10$ then $U(B)$ must be a number less than 10 (say $U(B) = 6$)
 - If you add a number like 10 or -10,000 to the utility of each bundle, or multiply the utility of all bundles by 0.5., the rankings do not change
- **Monotone Transformations:** There are many (infinitely many) utility functions that we can use
 - The only restriction is that if bundle A is better (has a higher value) than bundle B under one utility function, then it must remain so for all utility functions
 - Suppose

$$U(x, y) = \sqrt{xy}$$

is a utility function representing a given individual's preferences (where x and y are units of goods X and Y in any given bundle and the square root of the product represents the utility associated with the bundle) then

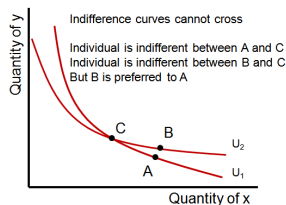
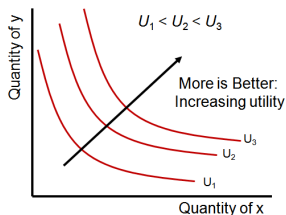
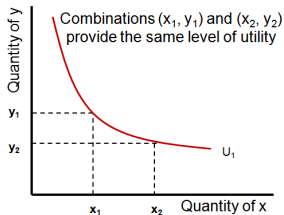
$$U(x, y) = 10\sqrt{xy} + 100 \text{ or } U(x, y) = \log(x) + \log(y)$$

also represents the preferences of the same individual

CONSUMER BEHAVIOR

PREFERENCES, UTILITY AND INDIFFERENCE CURVES

- **Indifference Curve:** When you join all the bundles with the same utility, you get an indifference curve
- An indifference curve shows a set of consumption bundles among which the individual is indifferent
- Completeness implies that each point must have an indifference curve through it
- Transitivity implies that an individual's indifference curves cannot intersect



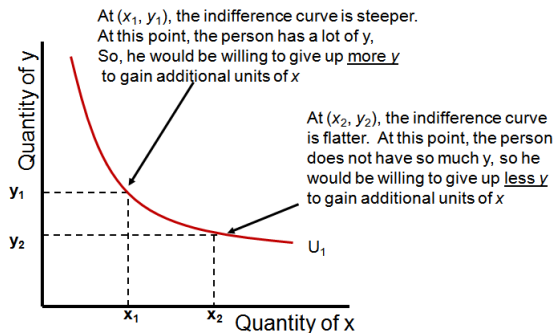
- Economist also often assume **more is better** and **convexity** of preferences (which means that individuals prefer a balanced bundle over extreme bundles)

CONSUMER BEHAVIOR

MARGINAL RATE OF SUBSTITUTION AND MARGINAL UTILITY

- **Marginal Rate of Substitution** (MRS_{yx}) is the number of units of good Y that a consumer is willing to give up in return for getting one more unit of X in order to keep her utility unchanged

- (MRS_{yx}) is the rate at which an individual would trade an amount of one good Y for one more unit of another

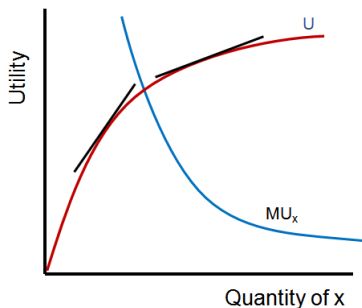


- MRS (of Y for X) is the negative of the slope of the indifference curve (where Y is in the ordinates axis) i.e., $MRS_{yx} = -\frac{dy}{dx} |_{U=U_1}$
- MRS_{yx} is decreasing for larger values of X (because of the convexity assumption)
- **Important!** MRS does not change under a monotonic transformation of the utility function
- This is important because MRS is a property of the shape of indifference curve

CONSUMER BEHAVIOR

MARGINAL RATE OF SUBSTITUTION AND MARGINAL UTILITY

- **Marginal Utility** of good X (MU_x) is the gain (or loss) in the total utility from consumption of an additional unit of X
 - If utility $U(x, y)$ is plotted against X , it is the slope of the curve (i.e., $MU_x = \partial U(x, y) / \partial x$)
 - **Diminishing Marginal Utility:** While total utility from consuming an additional unit of X may be increasing, it may be increasing at a decreasing rate, thus the marginal utility may be decreasing



- MRS (of Y for X) is equal to the ratio of the marginal utility of X to the marginal utility of Y
- $MRS_{yx} = \frac{MU_x}{MU_y}$

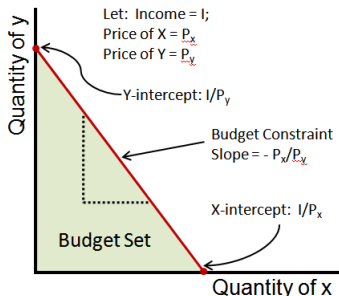
CONSUMER BEHAVIOR

BUDGET SET/CONSTRAINT

- **Budget Set** is the set of all all feasible bundles

- Suppose a person has £100 and is debating how to spend it among two goods, X and Y when the price of X is £5 per unit and the price of Y is £10 per unit
- Then the budget set is set of all possible bundles (x,y) for which the condition $5x + 10y \leq 100$ holds true

- The Budget Constraint (BC) is given by $P_x x + P_y y \leq I$

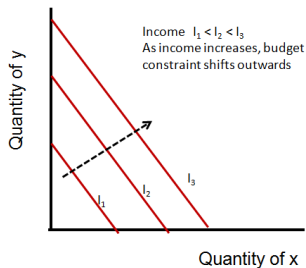


- Slope of the budget line $(-P_x/P_y)$ is the *opportunity cost* of one commodity in terms of another
- Slope of the budget line is the market rate of exchange for one commodity in terms of the other
- X-intercept (I/P_x) represents the maximum units of X that the consumer can purchase
- Y-intercept (I/P_y) represents the maximum units of Y that the consumer can purchase

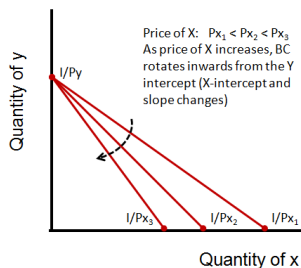
CONSUMER BEHAVIOR

BUDGET SET/CONSTRAINT

- When the income increases (decreases)
 - the budget constraint moves parallel to the original constraint and moves outwards (inwards)
 - the slope of the constraint remains the same but the X and Y intercepts shift out (shift in)



- If the price of X increases (decreases)
 - the budget constraint rotates inwards (outwards) from the Y intercept
 - the slope of the constraint increases (decreases) and the X intercept becomes smaller
 - Similar effects if the price of Y changes



CONSUMER BEHAVIOR

CONSUMER PROBLEM

- **Consumers Problem:** Given the level of income (I), prices (P_x, P_y), the consumers problem is to find the bundle of goods (x, y) that gives her maximum satisfaction, i.e., it maximizes her utility

- The problem is often stated mathematically as

$$\max U(x, y) \text{ such that } P_x x + P_y y \leq I$$

and the bundle (x, y) that solves this problem is often denoted as (x^*, y^*)

- Note that while the problem is stated in terms of only two goods, it is only for exposition purpose and can easily be extended to more than two goods
- **Solution:** The bundle that maximizes utility subject to the budget constraint can be found at the point(s) where

$$\frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

i.e., the ratio of marginal utilities (which is the MRS) equals the ratio of prices

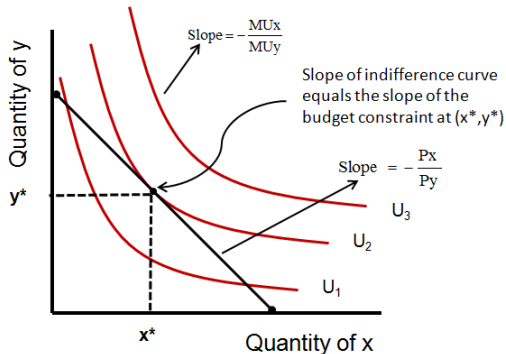
- In economic terms it means that the solution can be found where the individual's "internal" rate of exchange between goods equals the economy's "external" rate of exchange

CONSUMER BEHAVIOR

CONSUMER PROBLEM

Graphical Solution

- Consumer would prefer to be on as high a utility curve as possible (more is better) – hence moves from U_1 to a higher curve such as U_2
- Consumer cannot be on a curve such as U_3 because it is outside the budget constraint
- The best the consumer can do is be on a curve such as U_2 , i.e., where the indifference curve is *tangent* to the budget constraint (see point (x^*, y^*))



- Tangency condition is that the slope of the budget constraint is equal to the slope of the indifference curve, which gives the same condition as before

$$\frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

CONSUMER BEHAVIOR

DERIVATION OF DEMAND CURVE

- Demand is the quantity of a good that a person will buy at various prices
- The point of tangency of the indifference curve and the budget line gives the quantity that a person would buy at a given price
- By varying the price of one of the goods while holding the price of other constant, the points of tangency will change
- This gives alternative price/quantity combinations

