

Consumer Behavior:

Preference, Choice and theory of demand

EE311

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The author thanks for his kindness in sharing this handout.

Outline

- Preference: How are consumer preferences used to determine demand?
- Budget: How do consumers allocate income to the purchase of different goods?
- Optimal choice: How do consumers with limited income decide what to buy?
- How to derive an individual demand?
- Income and Substitution Effects
- Applications



Reading

- **Besanko Ch. 3 – Ch. 5**

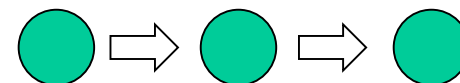
Consumer Preferences – Basic Assumptions



1. Preferences are *complete*.

- Consumers **can rank** market baskets; i.e., either prefer A to B, B to A, or indifferent

2. Preferences are *transitive*.



- If prefer A to B, and B to C, then must prefer A to C

3. Consumers *always prefer more* of any good to less.

- More is better --> rule out “Bads”. This assumption can be relaxed.

4. Variety is preferred to extreme



Consumer preferences: Representation

- Consumer preferences can be represented into two ways
 - Utility functions
 - Indifference curves
- Both ways are related

Consumer preferences: Utility function

- Consumer preferences can be represented mathematically using the concept of utility function.
- A utility function is...
 - A function that measures the level of satisfaction a consumer receives from any basket of goods and services.
 - Assigns a number to each basket so that more preferred baskets get a higher number than less preferred baskets.
 - Written as $U = u(y)$

Utility function implications

- It is an ordinal concept
 - The precise magnitude of the number that the function assigns has no significance
- Utility not comparable across individuals
- Any transformation of a utility function that preserves the original ranking of bundles is an equally good representation of preferences
 - For example, $U = \sqrt{y}$ and $U = \sqrt{y} + 2$ represent the same function

Marginal utility

- Marginal Utility of a good y is the additional utility that the consumer gets from consuming a little more of y
 - In other words, the rate at which total utility changes as the level of consumption of good y rises
- $MU_y = \frac{\Delta U}{\Delta y} \left(\text{or } \frac{dU}{dy} \right)$
 - It is the slope of the utility function with respect to y

The law of diminishing marginal utility

- The principle of diminishing marginal utility states that the marginal utility falls as the consumer consumes more of a good
 - More happiness
 - Increase at a decreasing rate.
- To satisfied the law of diminishing marginal utility, the utility function must be (i) increasing and (ii) concave.

$$- MU_y = \frac{dU}{dy} > 0 \text{ and } \frac{dMU_y}{dy} = \frac{d^2U}{dy^2} < 0$$

Utility function of multiple goods

- Simply represent the consumer preferences over multiple goods using the concept of multivariate function

- 2-goods example (x and y)

$$U = U(x, y)$$

- N-goods example (goods is indexed by number)

$$U = U(x_1, x_2, x_3, \dots, x_N)$$

Marginal utility – Multiple goods

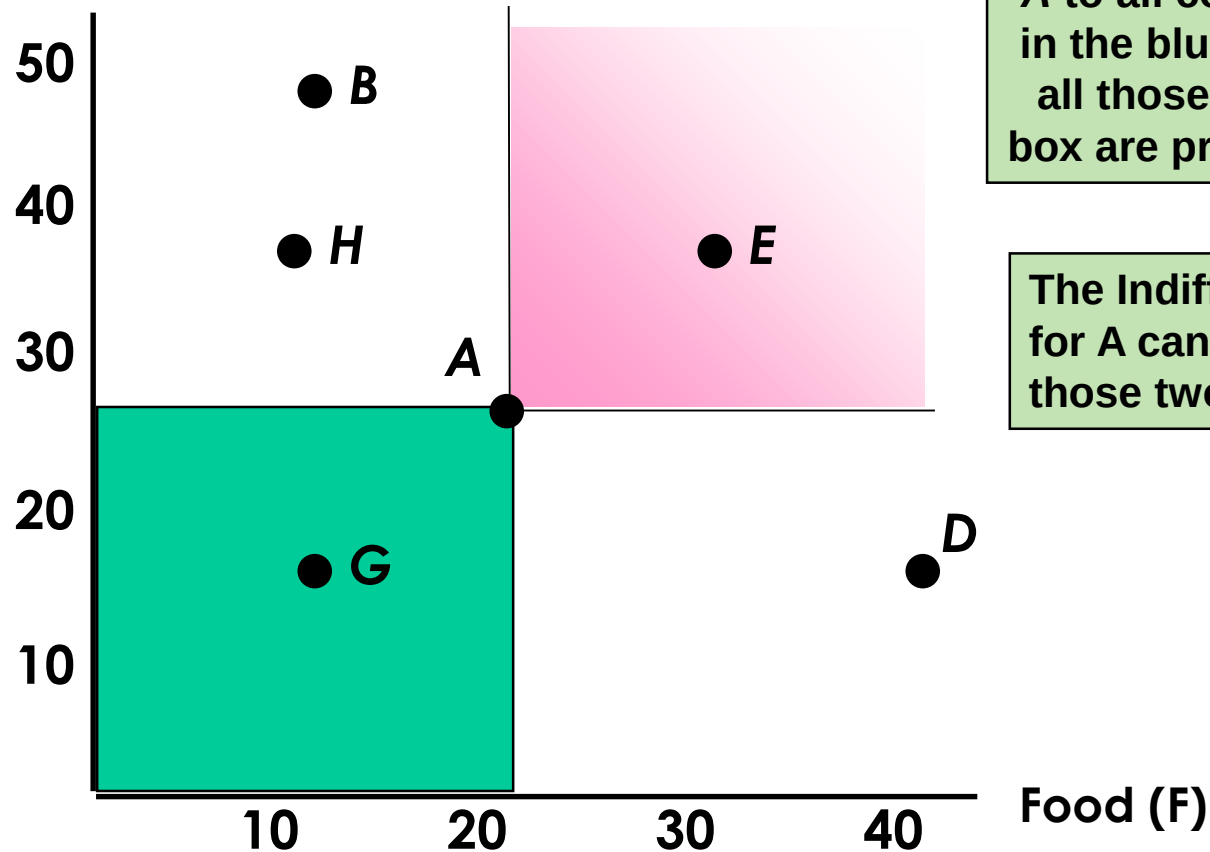
- $U = xy^2$
- $MU_x =$
- $MU_y =$
- Is more better?
- Are there diminishing marginal utility?

Consumer Preferences: Indifference curves

- Related to the concept of utility function, consumer preferences can be also represented graphically using *indifference curves or ICs*
- Indifference curves represent all combinations of market baskets that the person is *indifferent to*
 - A person will be equally satisfied with either choice or attain the same utility level

Indifference Curves: An Example

Clothing (C)



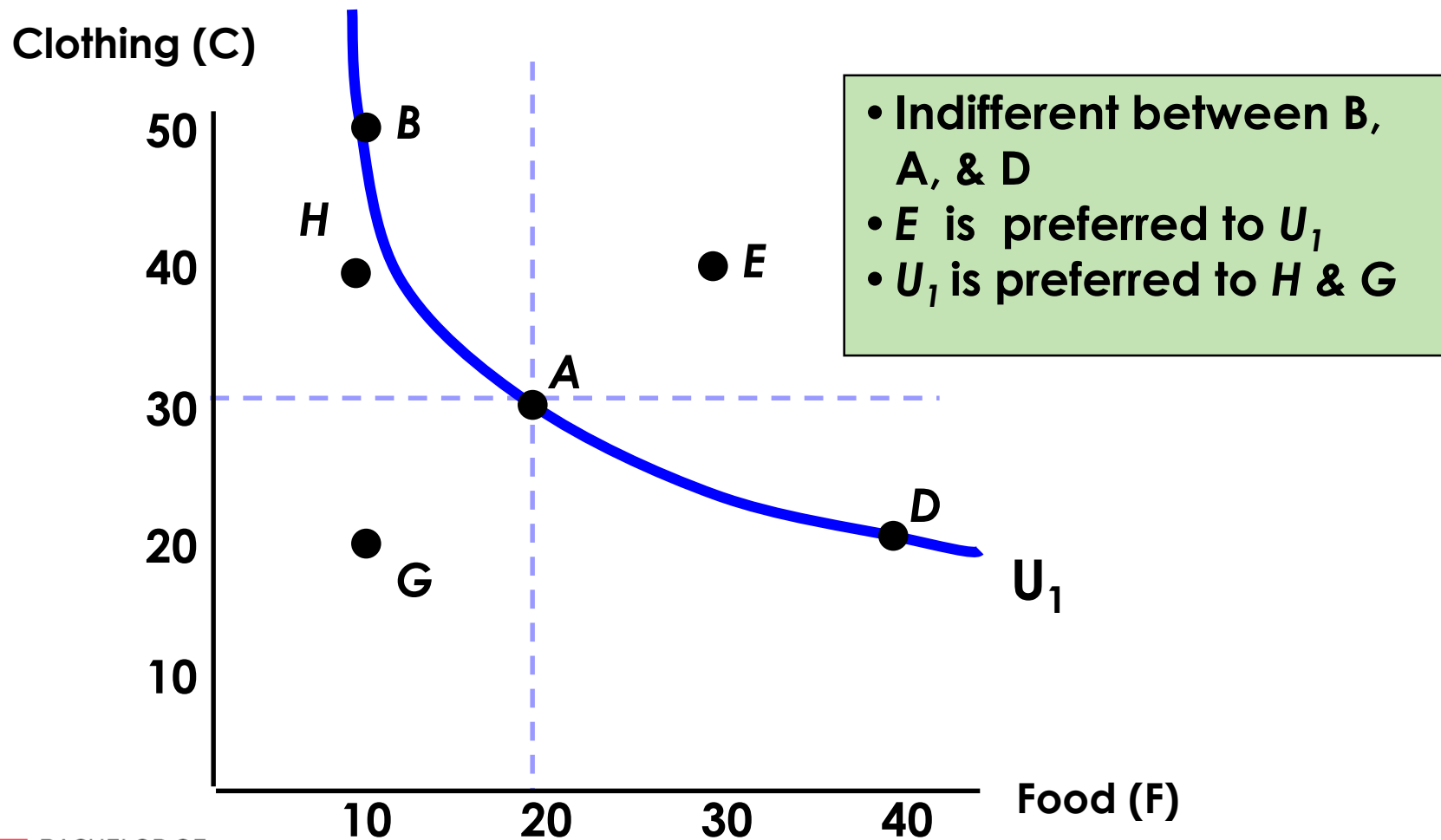
The consumer prefers A to all combinations in the blue box, while all those in the pink box are preferred to A.

The Indifferent curve for A cannot lie in those two areas.

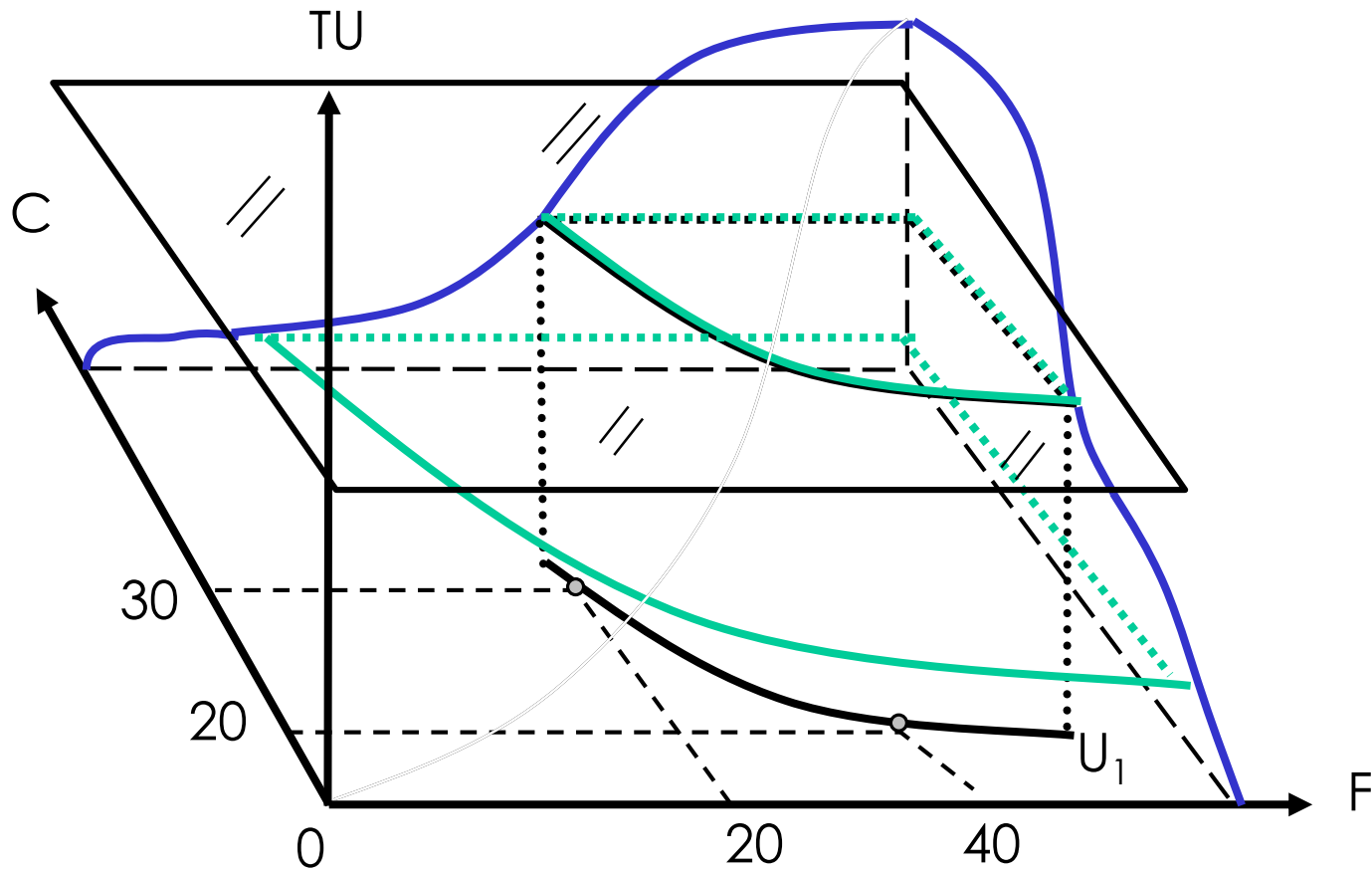
Indifference Curves: An Example

- Points such as B & D have more of one good but less of another compared to A
 - Need more information about consumer ranking
- Consumer may decide they are indifference between B, A and D
 - We can then connect those points with an indifference curve

Indifference Curves: An Example



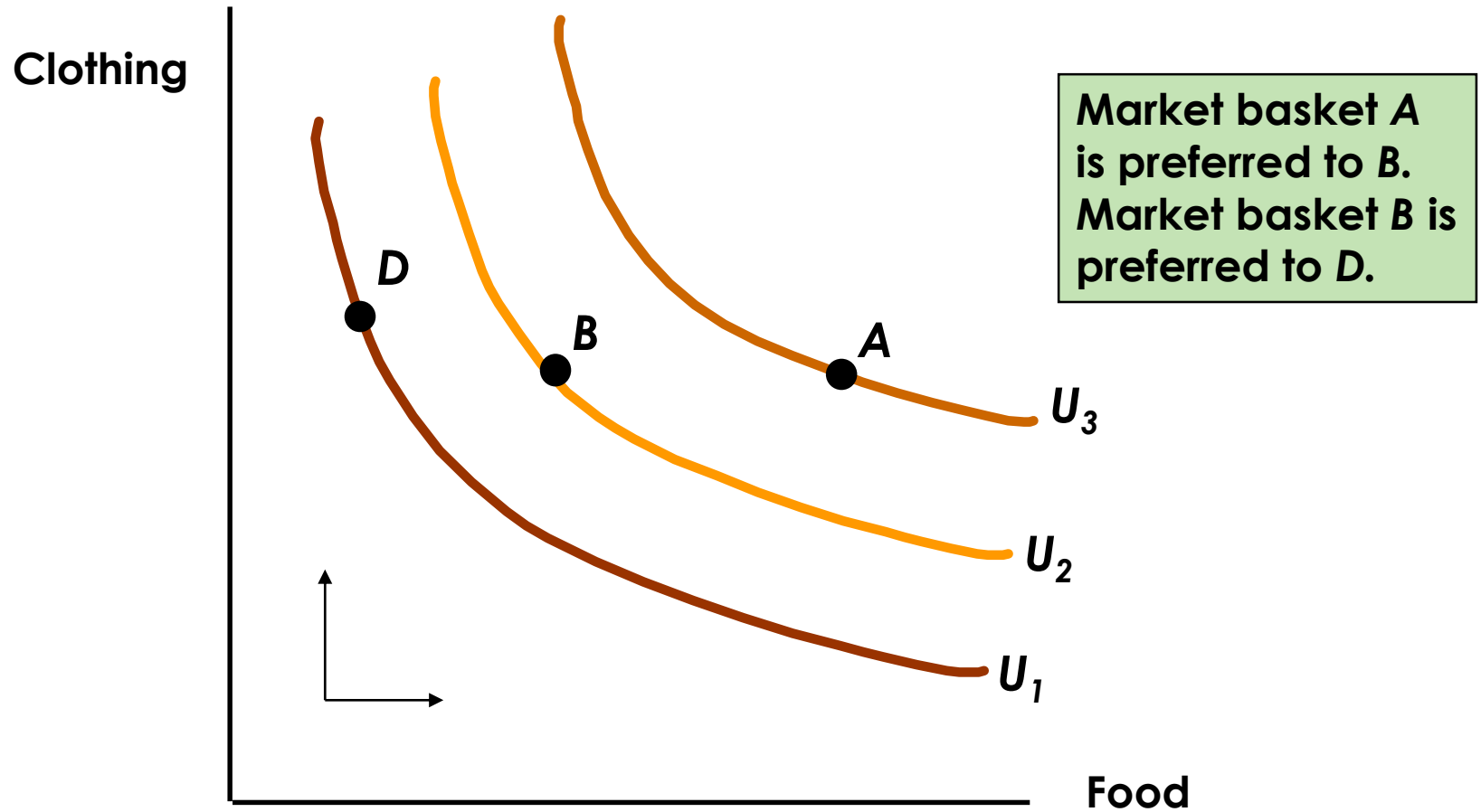
Indifference curves are the contour on the utility hill



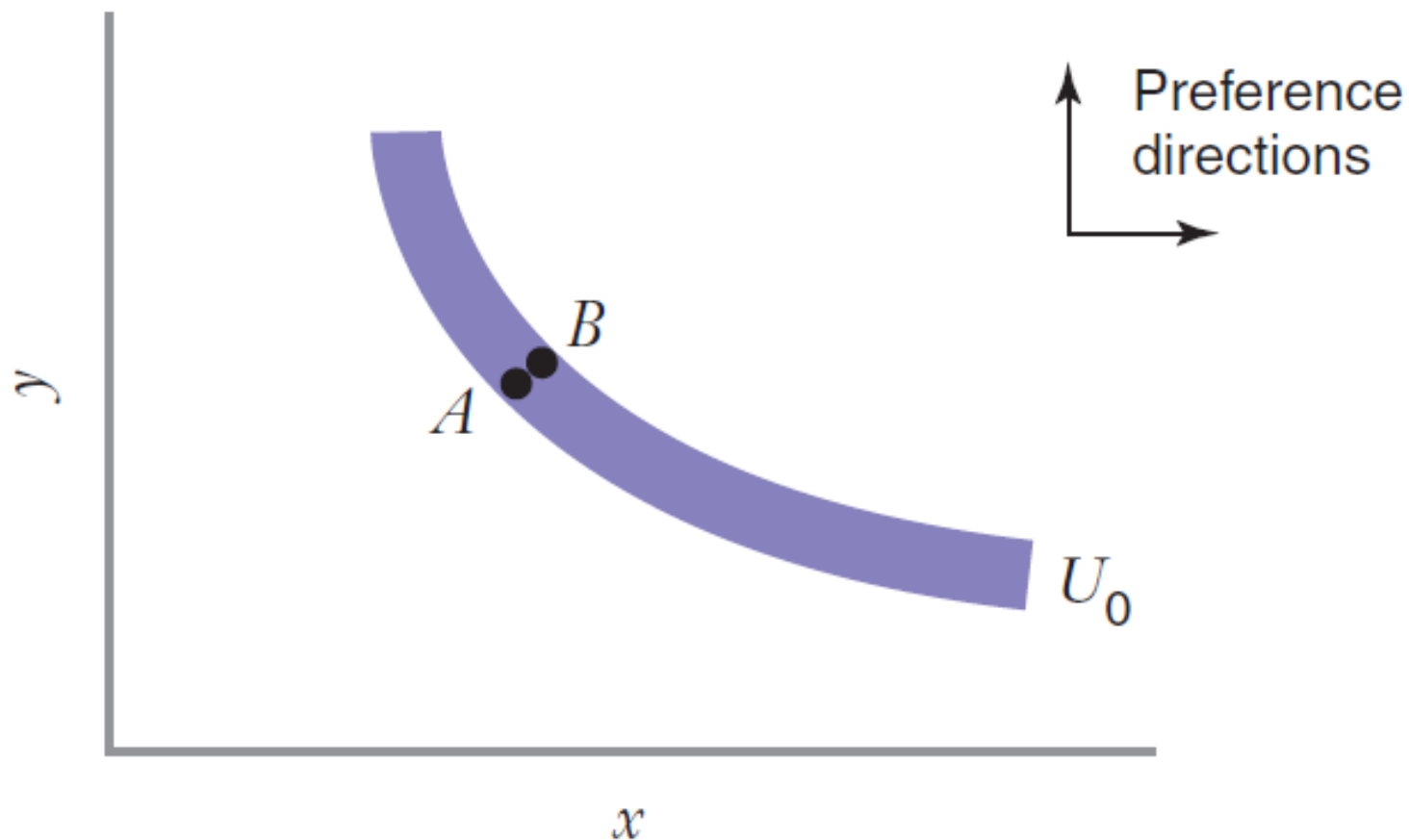
Indifference Curves: Properties

- They slope downward to the right.
 - Goods are substitutable
 - If F rises, C must fall to maintain the same U_1 .
- Any basket lying northeast of an IC is preferred to any on the IC
- Indifference curves are not “thick”
- Convex to the origin
 - Variety is preferred to extreme
- Indifference curves can not cross
- Continuous: no gaps

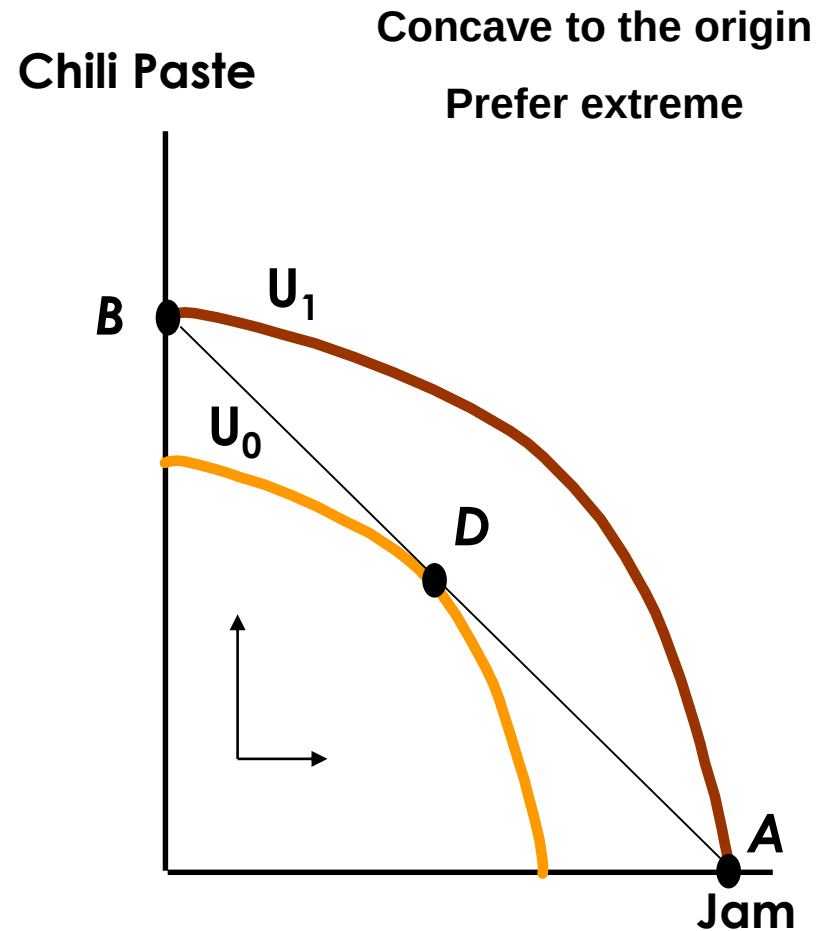
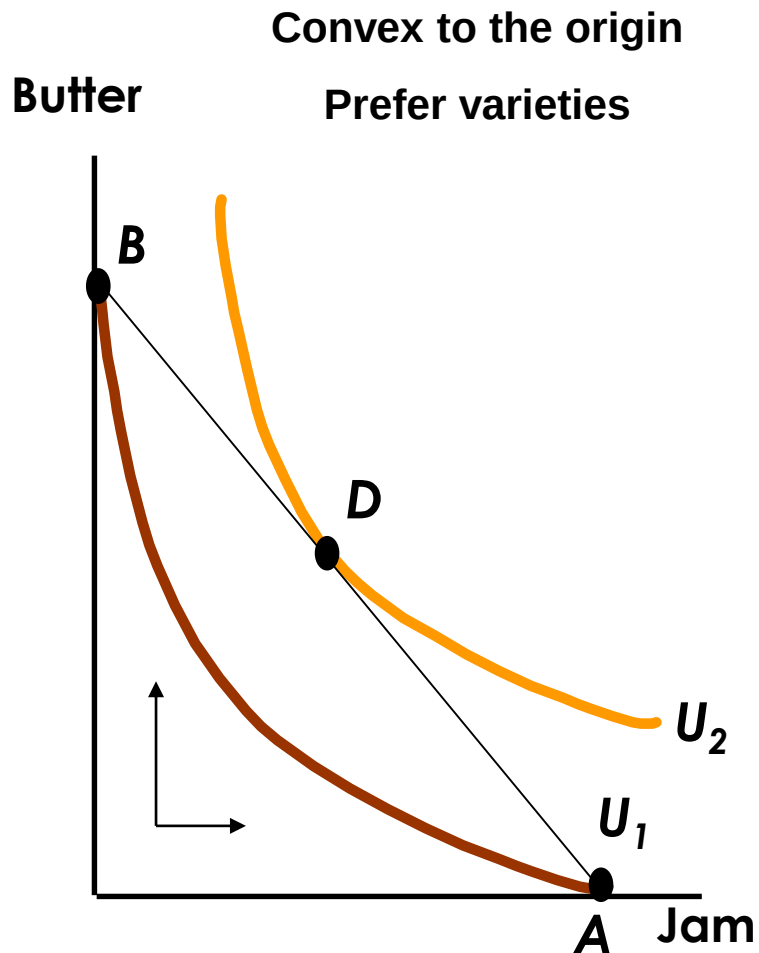
Indifference Map



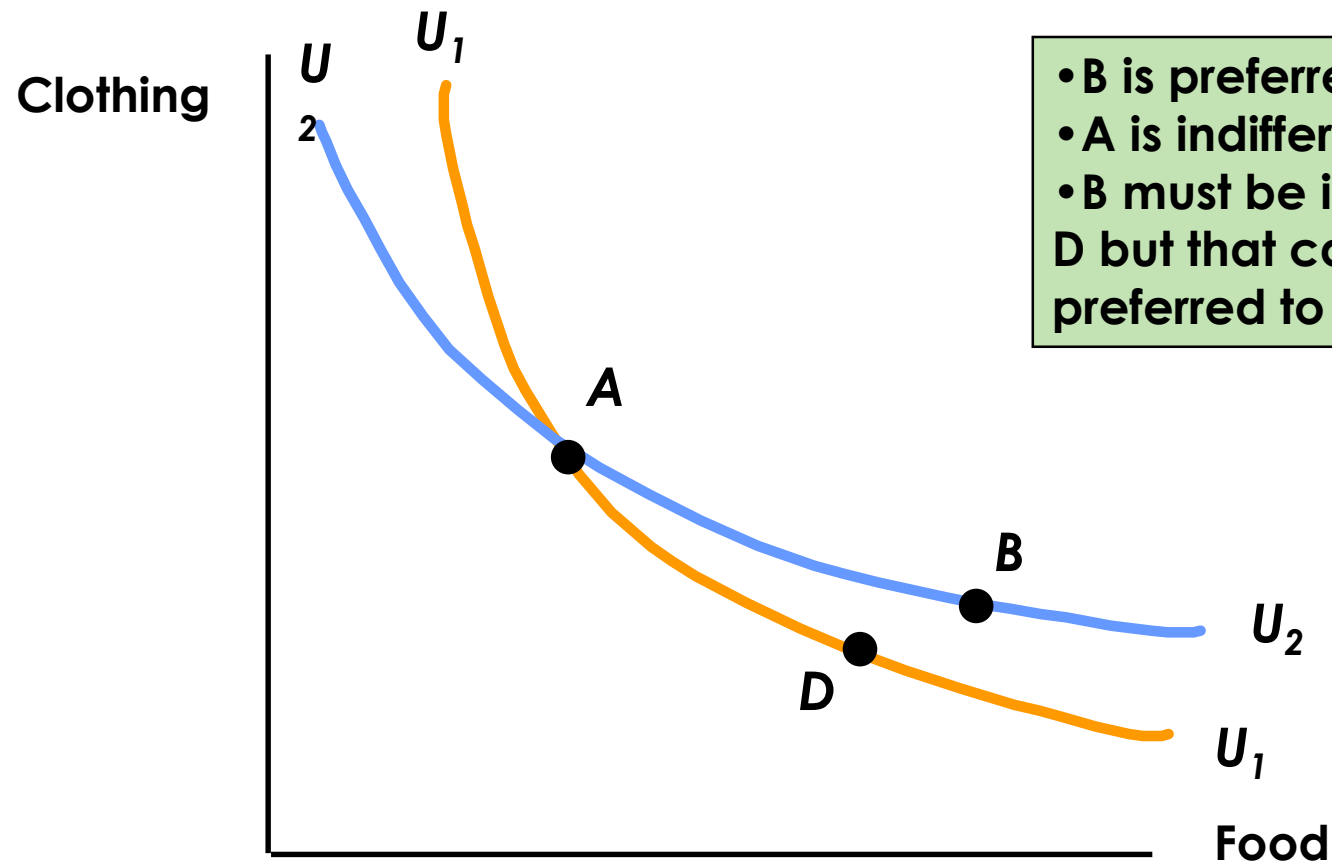
Indifference Map



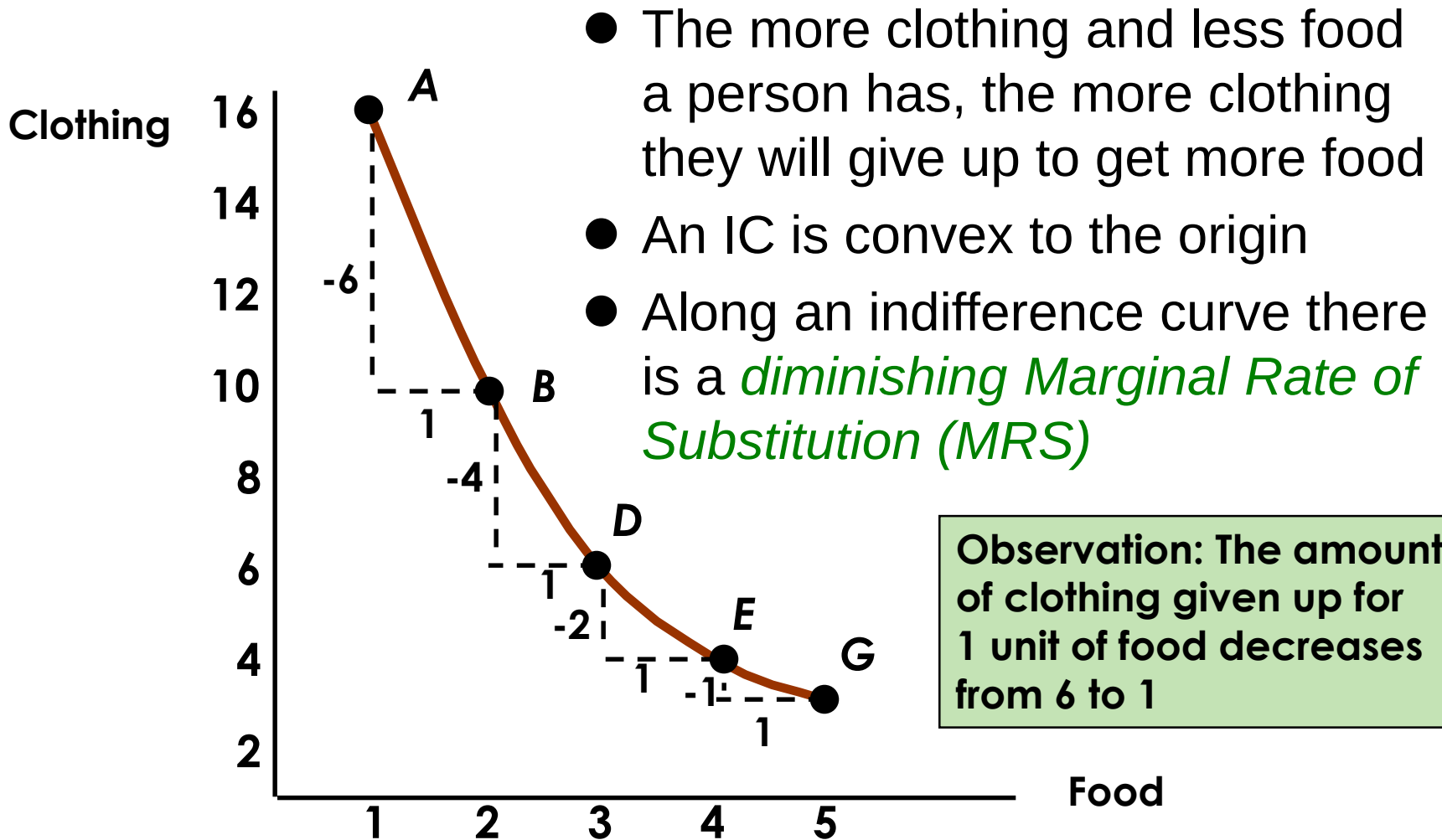
Indifference Map



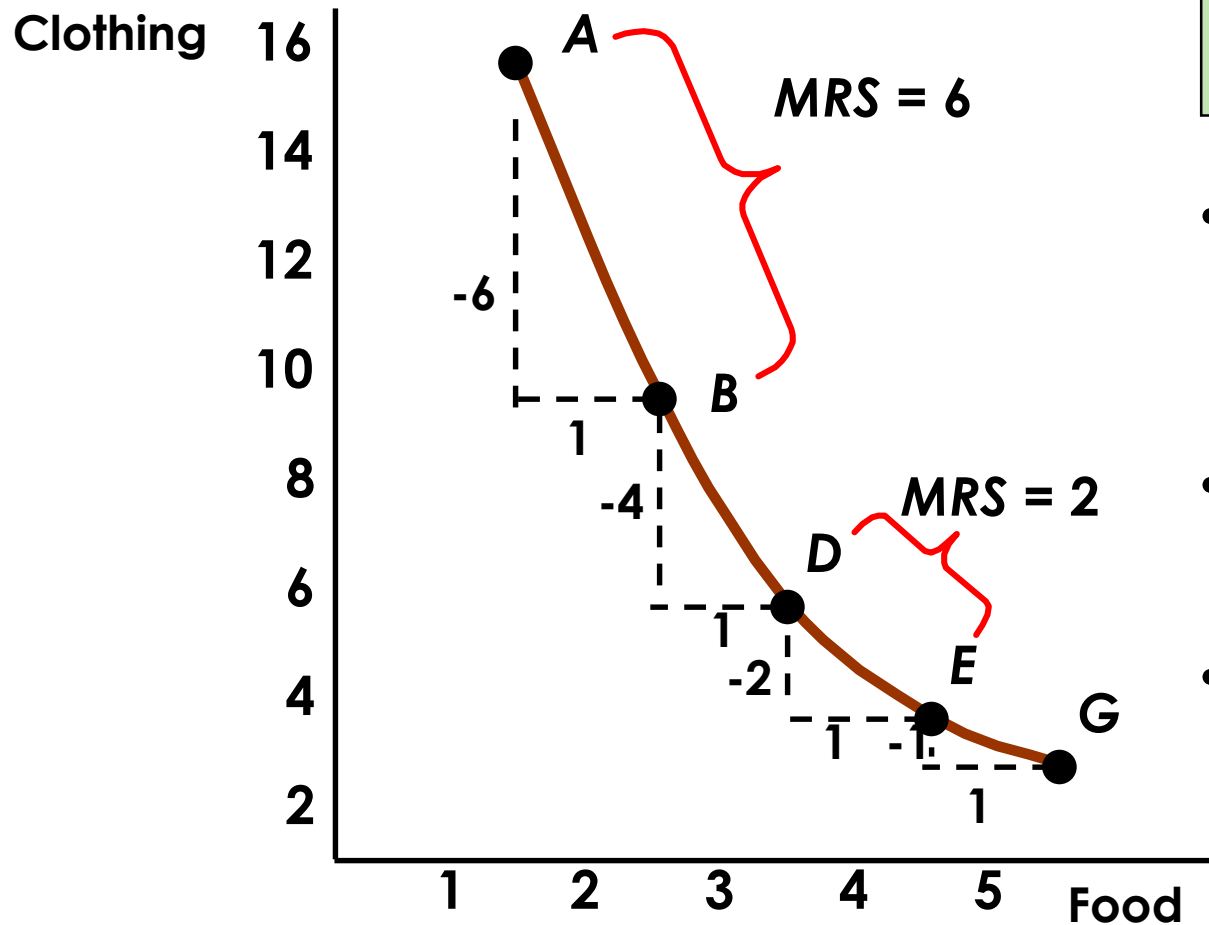
Crossing Indifference Curves



Indifference Curves



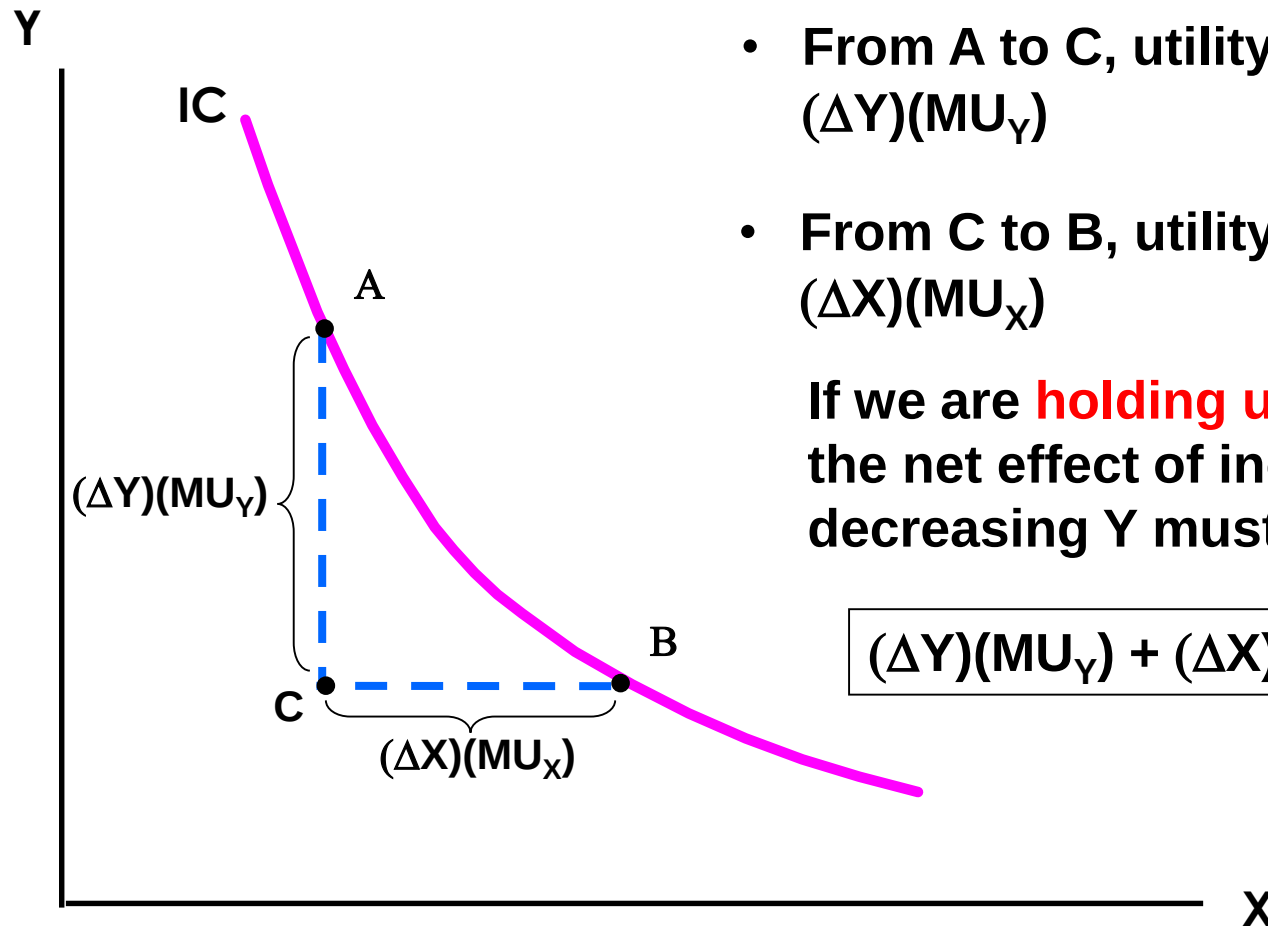
Marginal Rate of Substitution



$$MRS = \frac{\Delta C}{\Delta F}$$

- MRS measures how a person trades one good for another
- It is the slope of the IC
- The willingness to substitute is less as we consume more of one good.

Marginal Rate of Substitution



- From A to C, utility decreases by $(\Delta Y)(MU_Y)$
- From C to B, utility increases by $(\Delta X)(MU_X)$

If we are **holding utility constant**, the net effect of increasing X and decreasing Y must be zero

$$(\Delta Y)(MU_Y) + (\Delta X)(MU_X) = 0$$

Marginal Rate of Substitution

- Rearranging equation, we can see the relationship between MRS and MUs

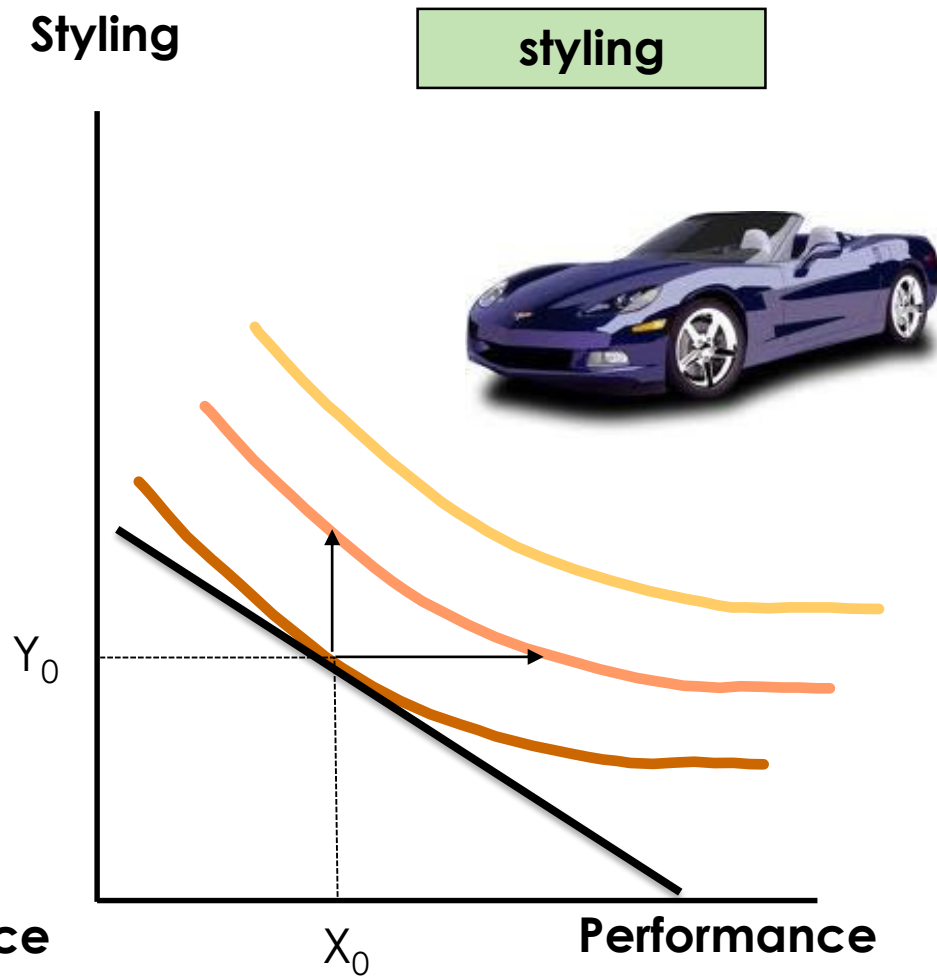
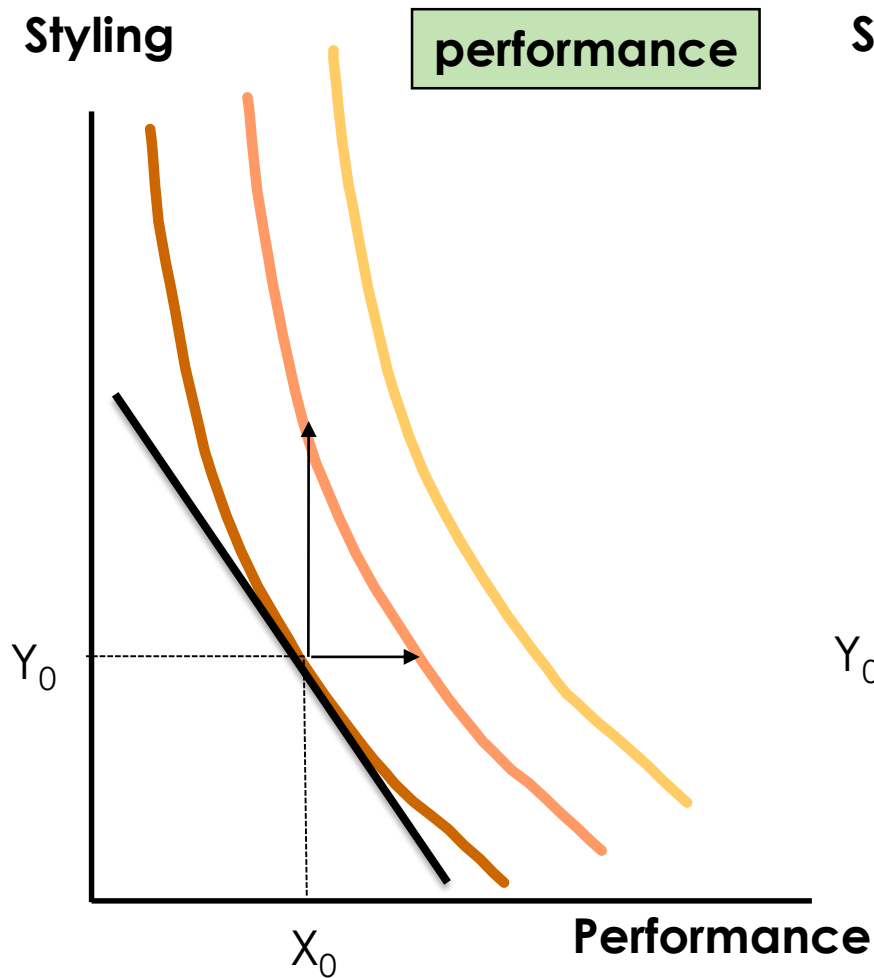
$$(\Delta Y)(MU_Y) + (\Delta X)(MU_X) = 0$$

$$(\Delta Y)(MU_Y) = -(\Delta X)(MU_X)$$

$$\frac{\Delta Y}{\Delta X} = - \frac{(MU_X)}{(MU_Y)} = \text{MRS}$$

MRS and Preferences

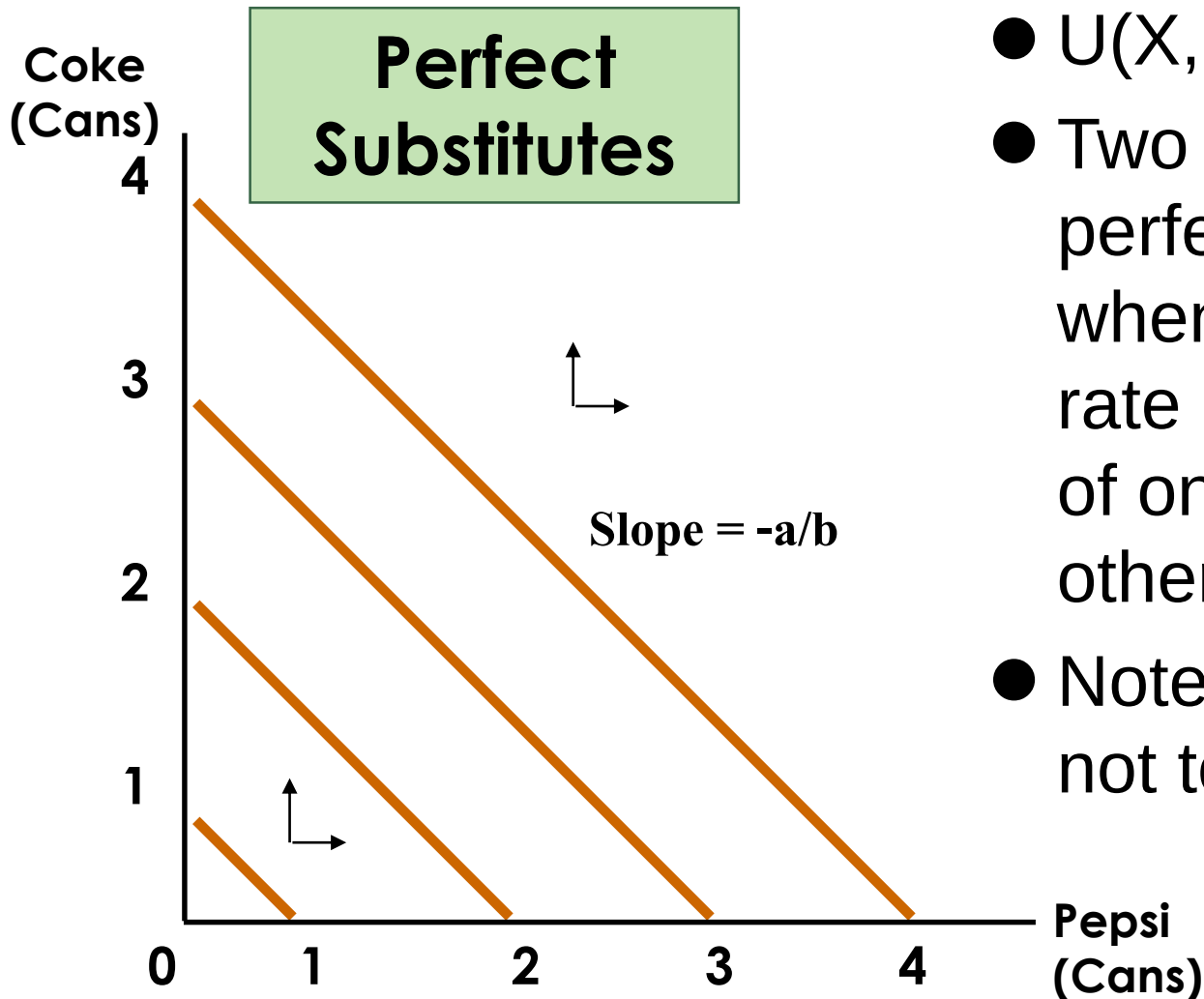
MRS performance > MRS styling



Shapes of the IC and types of goods

- Indifference curves with different shapes imply a different willingness to substitute
- Two polar cases are of interest
 - Perfect substitutes
 - Perfect complements
- Other types
 - Neuters
 - Bads

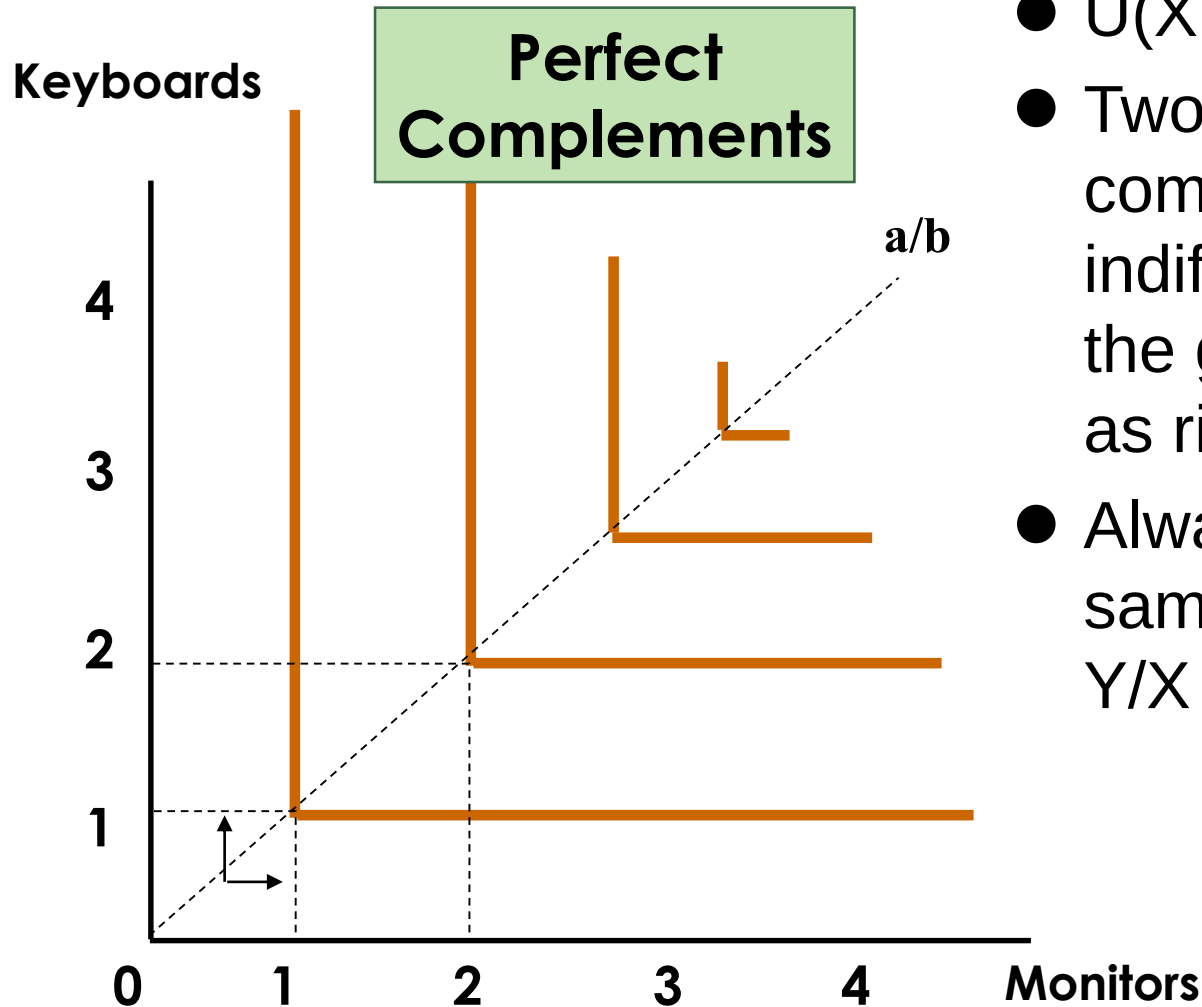
Consumer Preferences



- $U(X, Y) = aX + bY$
- Two goods are perfect substitutes when the marginal rate of substitution of one good for the other is constant.
- Note: MRS needs not to be 1.



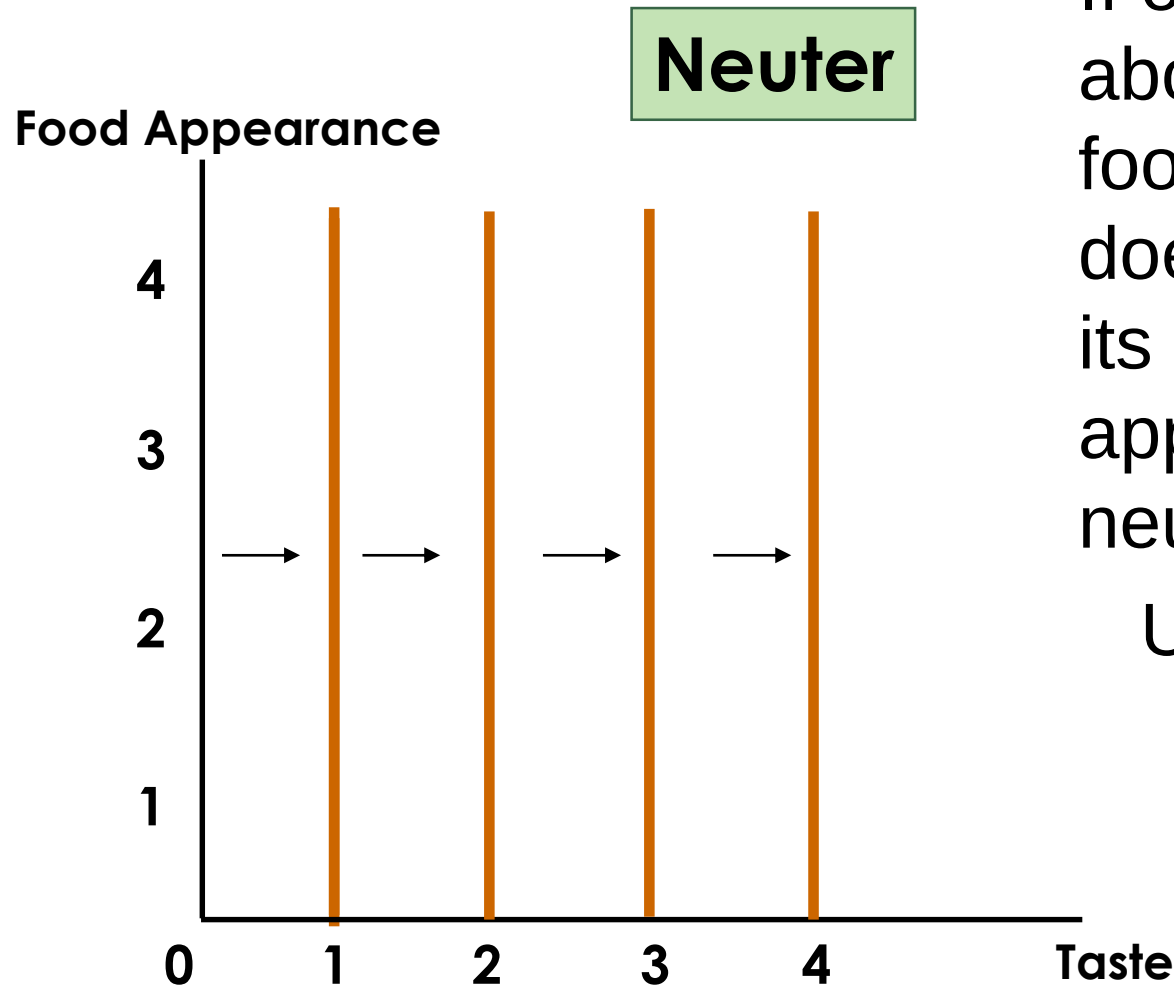
Consumer Preferences



- $U(X, Y) = \text{Min} \{aX, bY\}$
- Two goods are perfect complements when the indifference curves for the goods are shaped as right angles.
- Always consume in the same proportion $Y/X = a/b$.



Consumer Preferences

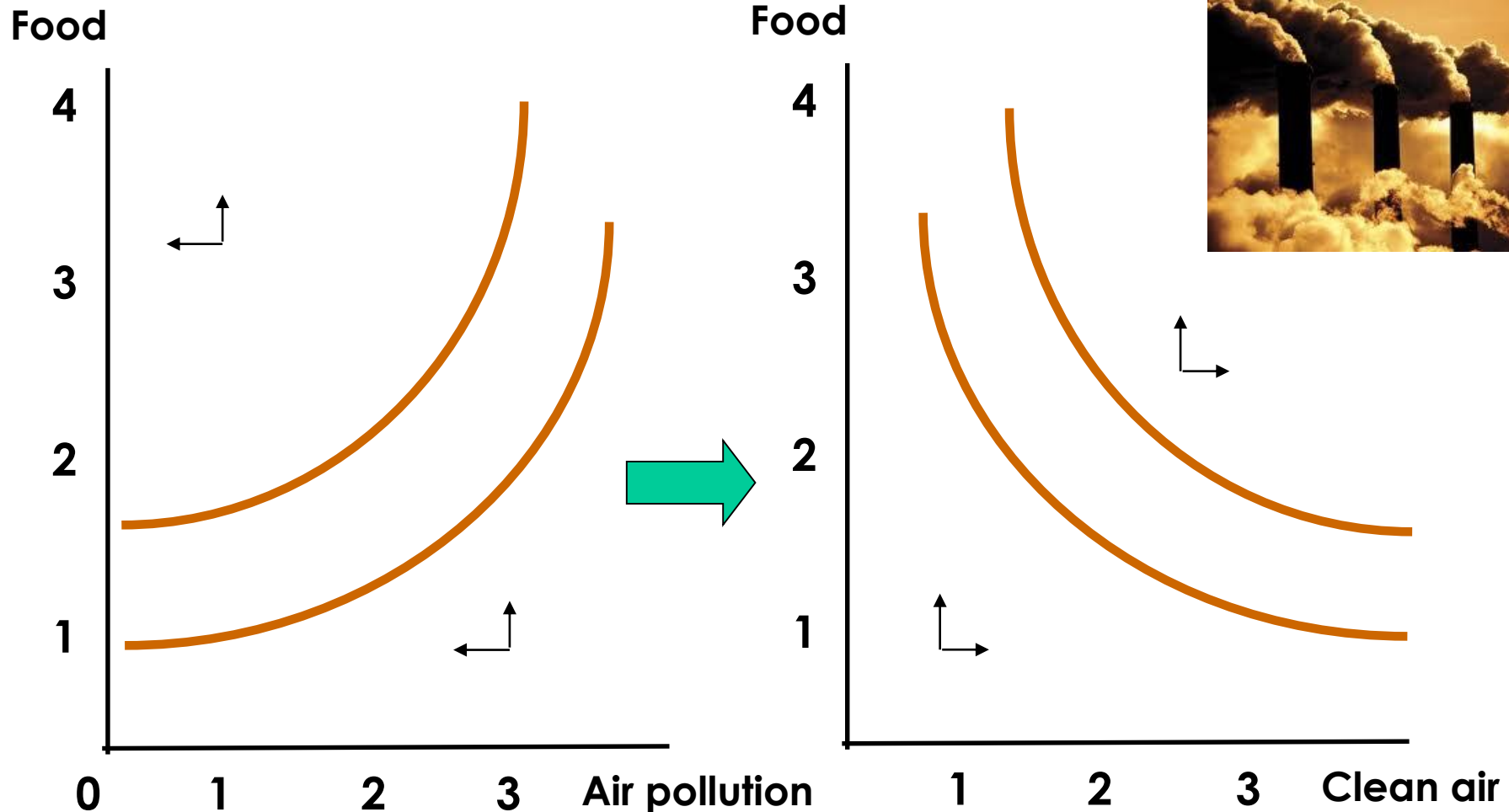


If one care only about the taste of the food he eats, but does not care about its appearance, the appearance is a neuter to him.

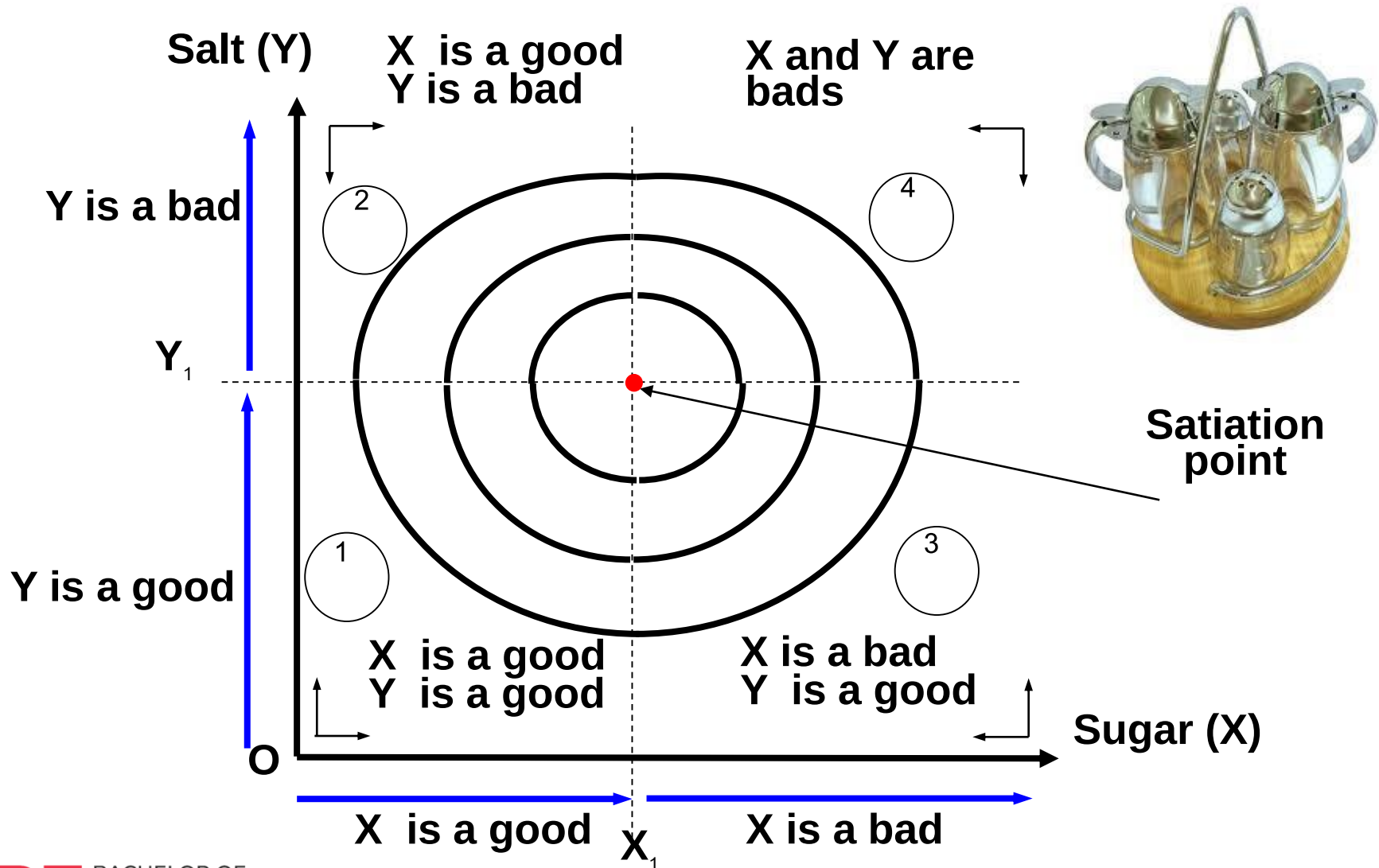
$$U(X) = aX$$



Bads are commodities we don't want more of; e.g.,
air pollution, stress



Satiation or Bliss point



Budget Constraints

- The Budget Line
 - Indicates all combinations of two commodities for which total money spent equals total income.
 - We assume only 2 goods are consumed, so we do not consider savings for the time being

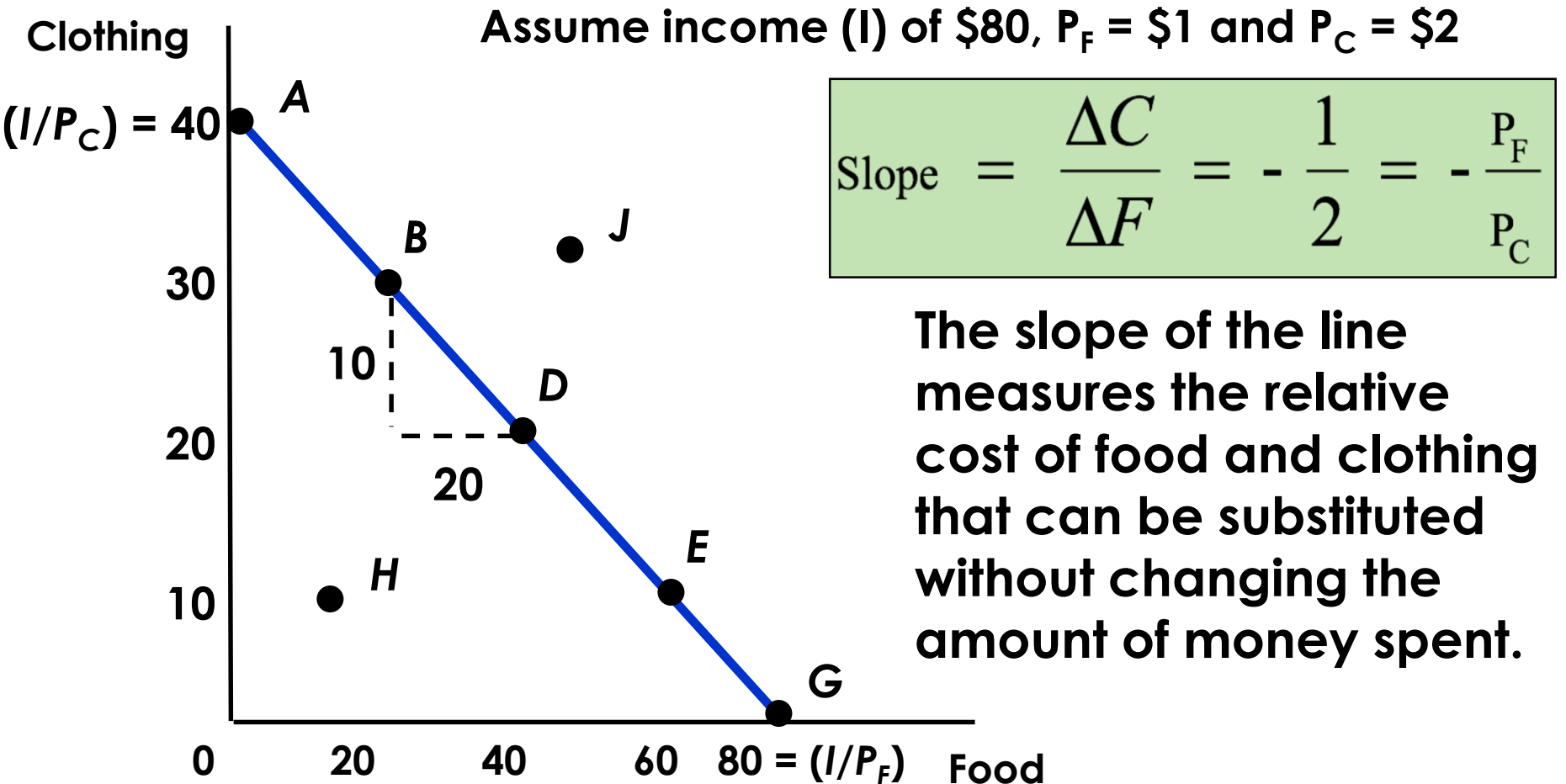
The Budget Line

- A consumer chooses food (F) and Clothing (C)
- Price of food = P_F and price of clothing = P_C
- The budget line then can be written:

$$P_F F + P_C C = I$$

All income is allocated to food (F) and/or clothing (C)

The Budget Line



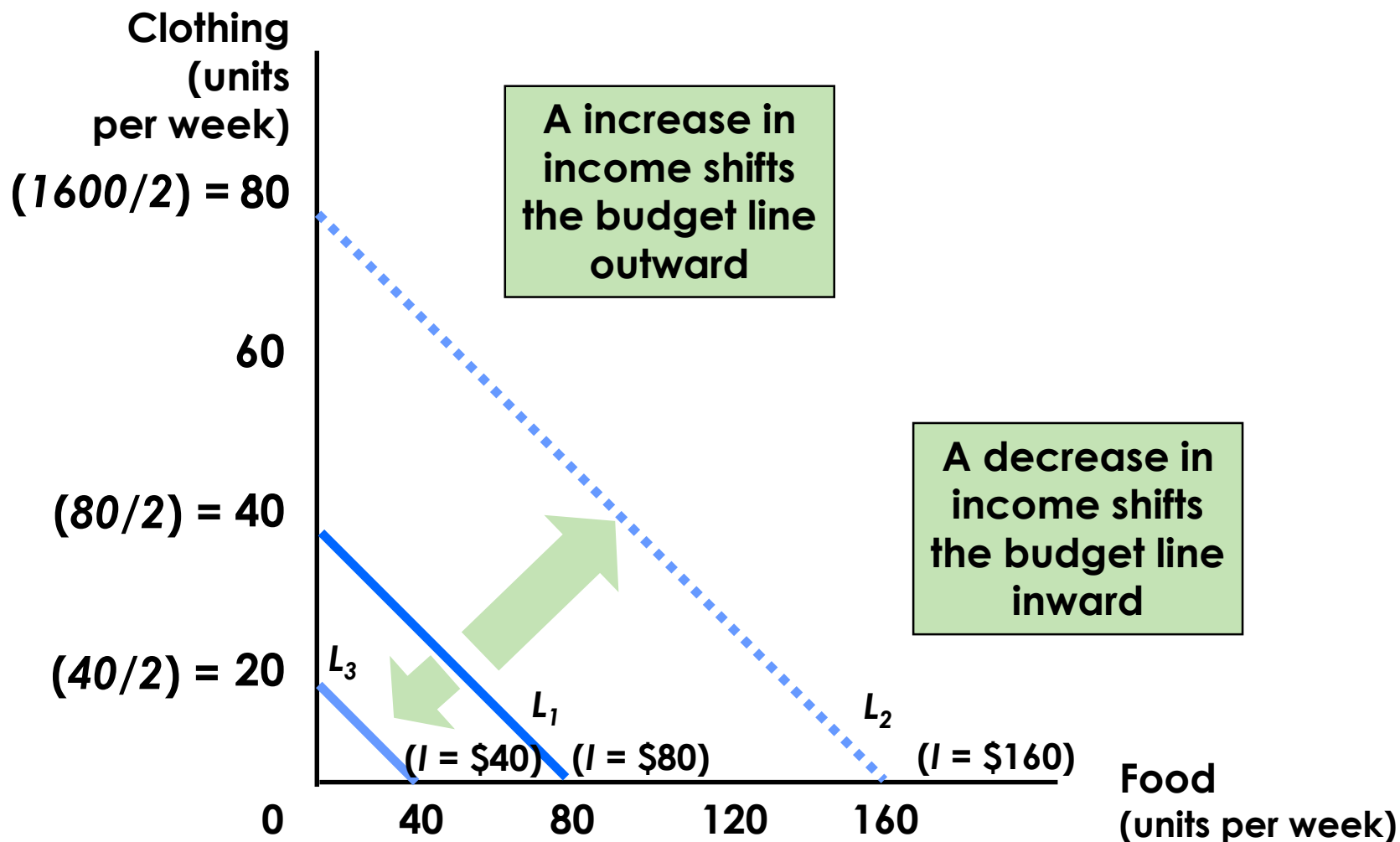
The Budget Line

$$\begin{aligned} I &= P_F F + P_C C \\ P_C C &= I - P_F F \\ C &= \frac{I}{P_C} - \frac{P_F}{P_C} F \end{aligned}$$

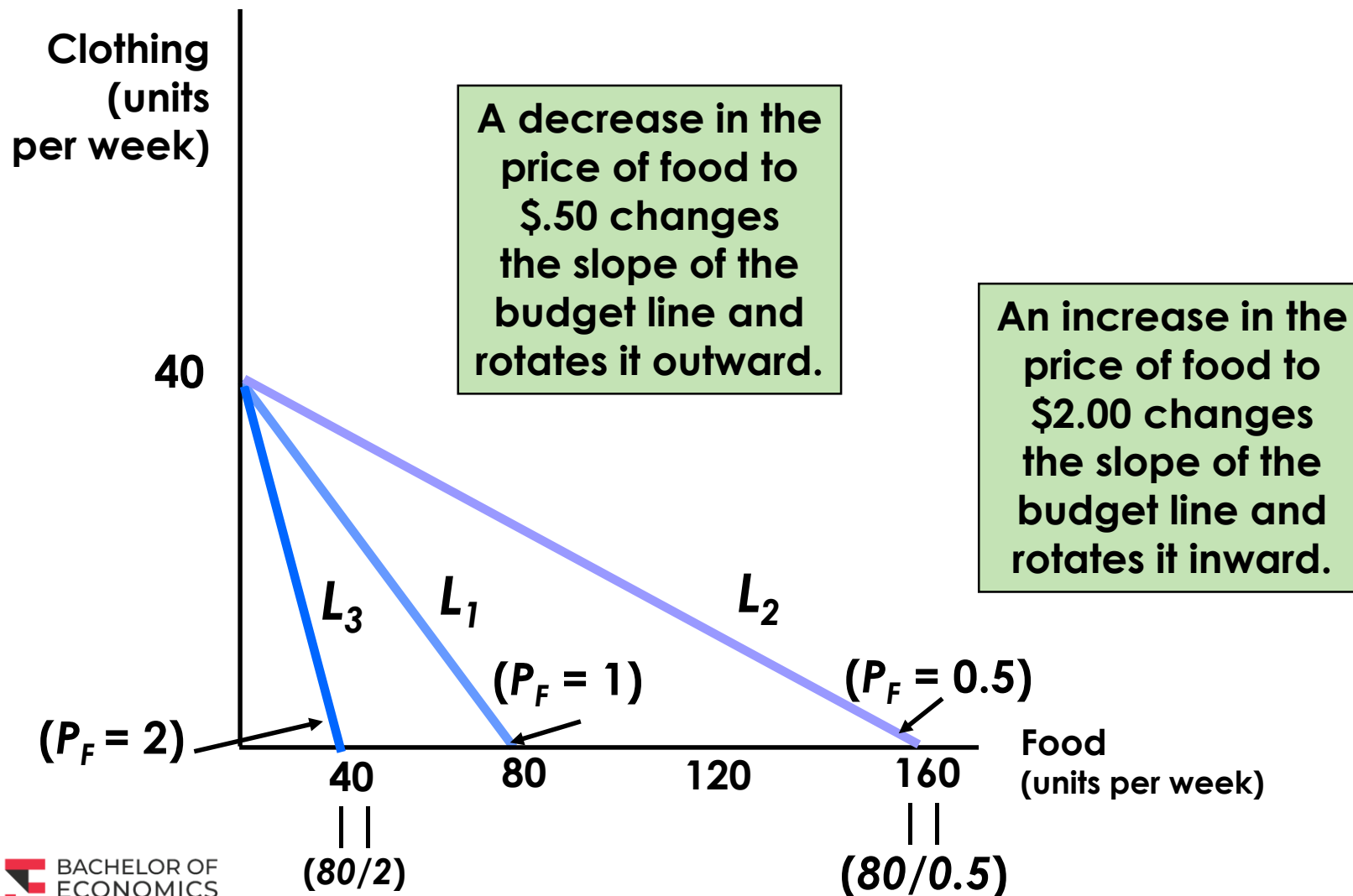
Y intercept

slope

The Budget Line: Changes in income



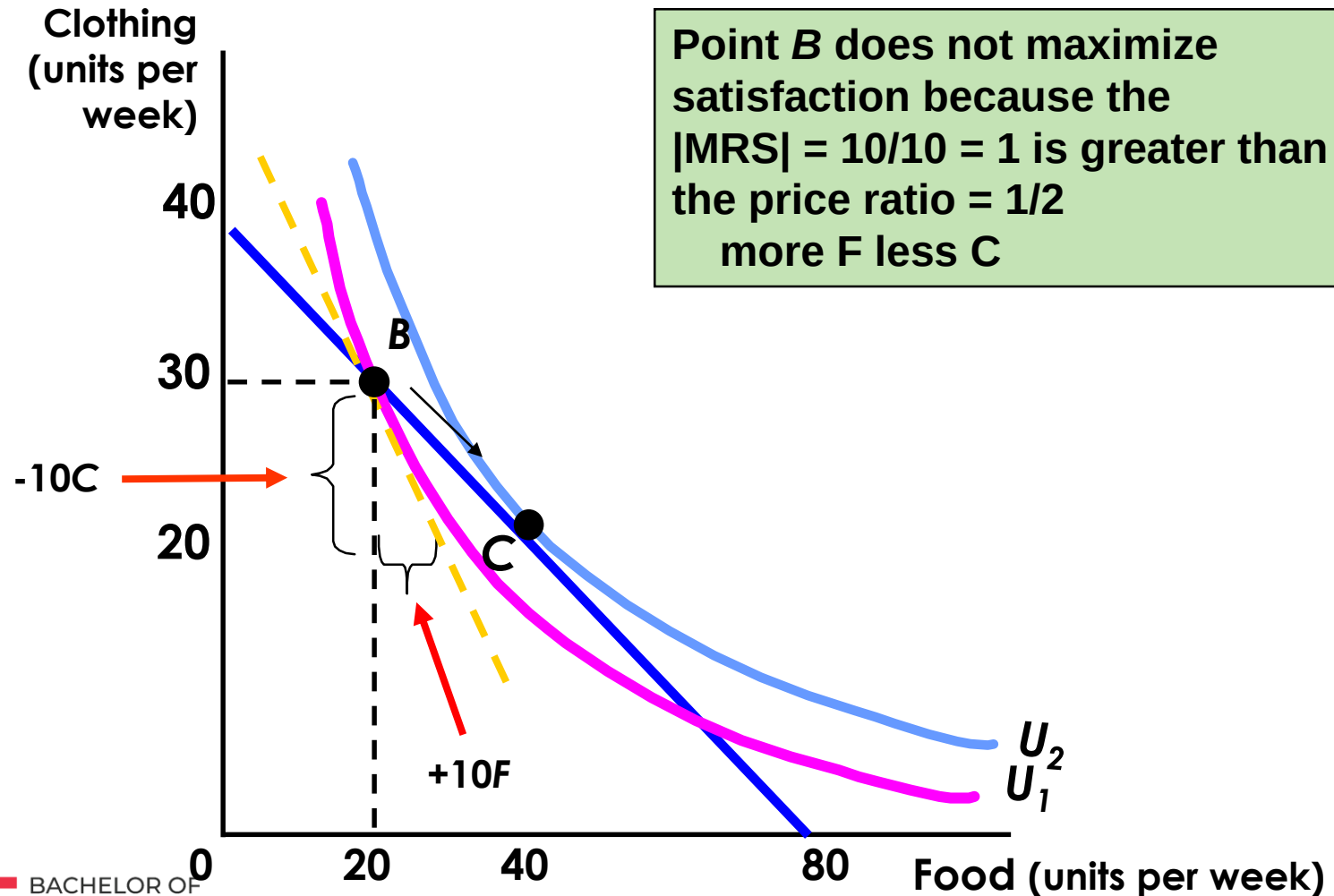
The Budget Line: Changes in a price



Consumer Choice

- **Optimal consumption point is where MRS = the relative prices**
- MRS = the rate that the consumer is willing to sacrifice some clothing to get 1 unit of food
- P_F/P_C = cost of additional unit of food in terms of clothing

Consumer Choice



Consumer Choice

- If $|MRS| \neq P_F/P_C$ then individuals can reallocate basket to increase utility
- If $|MRS| > P_F/P_C \rightarrow$ Consumer is willing to give up clothing for food more than what the market requires
 - Will increase food and decrease clothing until $|MRS| = P_F/P_C$
- If $|MRS| < P_F/P_C$
 - Will increase clothing and decrease food until $|MRS| = P_F/P_C$

Optimal condition

Max $U(X,Y)$ such that $I = P_X X + P_Y Y$

Since $I = P_X X + P_Y Y$ implies

$$Y = I/P_Y - X P_X/P_Y.$$

Substituting this gives

$$\text{Max } U(X, I/P_Y - X P_X/P_Y)$$

$$\text{MU}_X - \text{MU}_Y P_X/P_Y = 0$$

$$\text{MRS} = \frac{\text{MU}_X}{\text{MU}_Y} = \frac{P_X}{P_Y}$$

Optimal condition: Lagrange approach

Max $U(X, Y)$ such that $I = P_X X + P_Y Y$

$$L = U(X, Y) + \lambda(I - P_X X - P_Y Y)$$

$$dL/dX = MU_X - \lambda P_X = 0$$

$$dL/dY = MU_Y - \lambda P_Y = 0$$

$$dL/d\lambda = I - P_X X - P_Y Y = 0$$

$$\left. \begin{array}{l} dL/dX = MU_X - \lambda P_X = 0 \\ dL/dY = MU_Y - \lambda P_Y = 0 \end{array} \right\} \Rightarrow MRS = \frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$$

$\lambda = MU_X/P_X = MU_Y/P_Y$ It is the marginal

utility per baht. It is also equal to the shadow

price of money or the marginal utility of money

Types of optimal consumer Choice

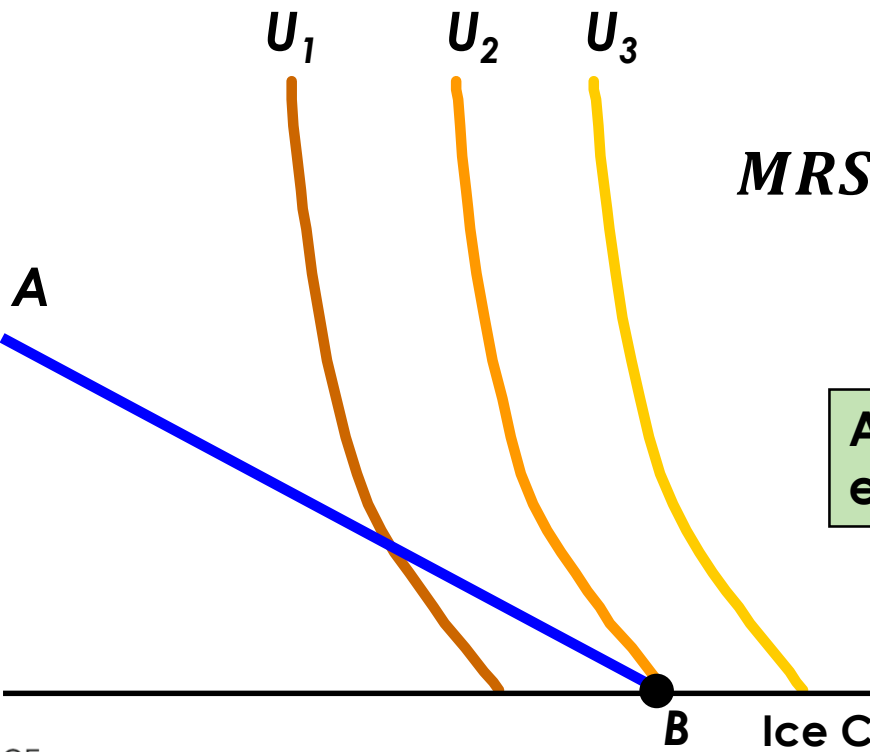
- Normally MRS should equal P_X/P_Y and the equilibrium is call an *interior solution*
- A *corner solution* exists if a consumer buys in extremes, and buys all of one category of good and none of another.
 - MRS is **not** necessarily equal to P_X/P_Y

A Corner Solution

Frozen
Yogurt
(cups
monthly)

A **corner solution** exists if a consumer buys all of one good and none of another.

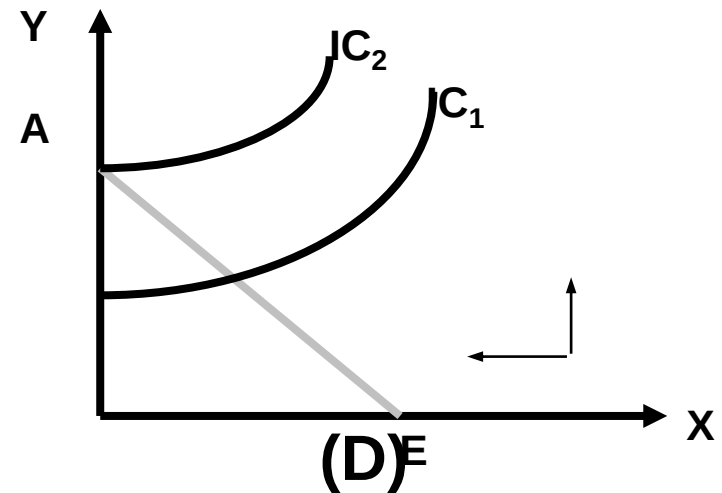
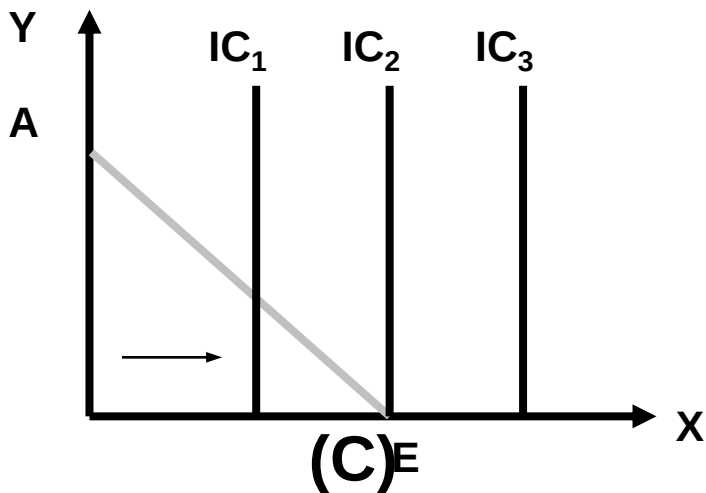
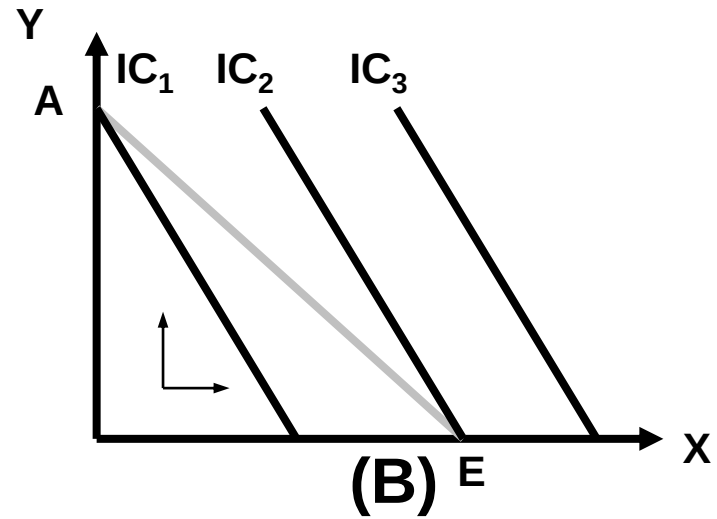
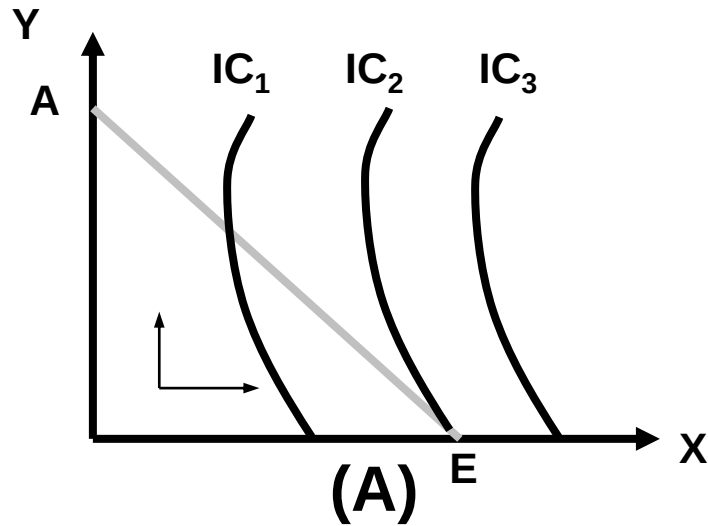
MRS is not necessarily equal to P_X/P_Y



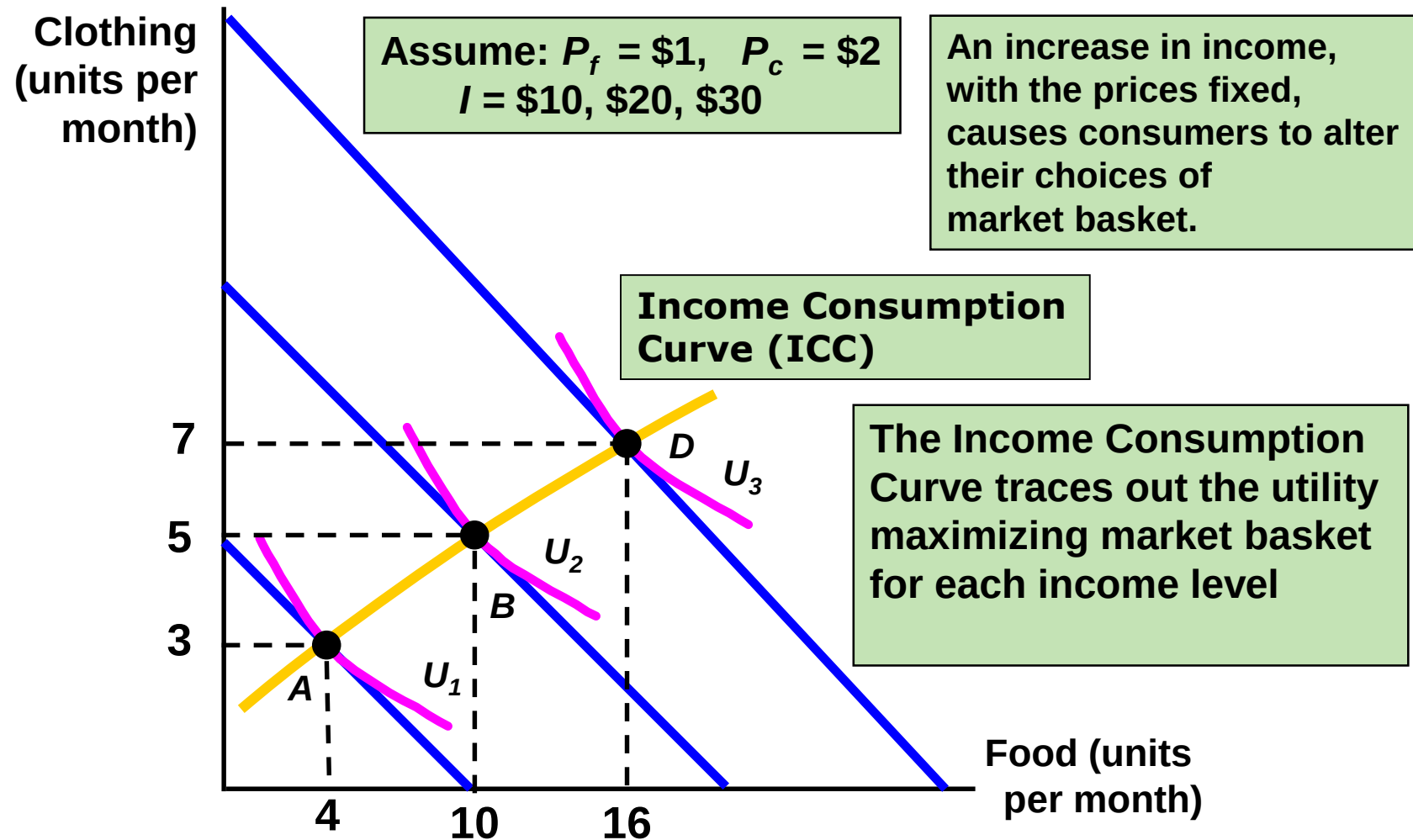
$$MRS \geq \frac{P_{ice\ cream}}{P_{Frozen\ yogurt}}$$

A corner solution exists at point B.

Corner Solutions



Effects of Income Changes



Individual Demand

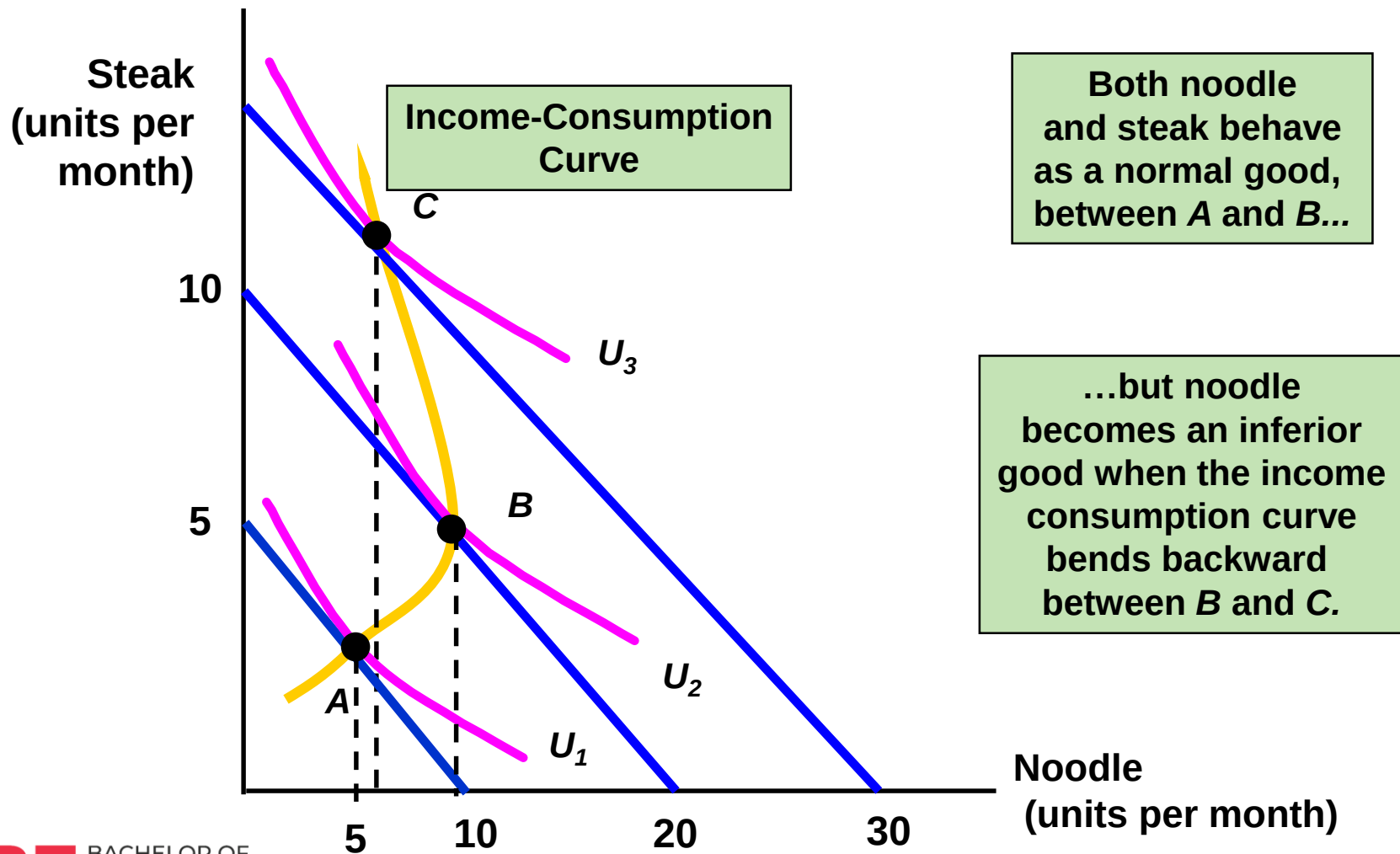
- Income Changes
 - When the income-consumption curve moves from left to right as income increases:
 - The quantity demanded increases with income.
 - The income elasticity of demand is positive.
 - The good on the X axis is a **normal good**.

Individual Demand

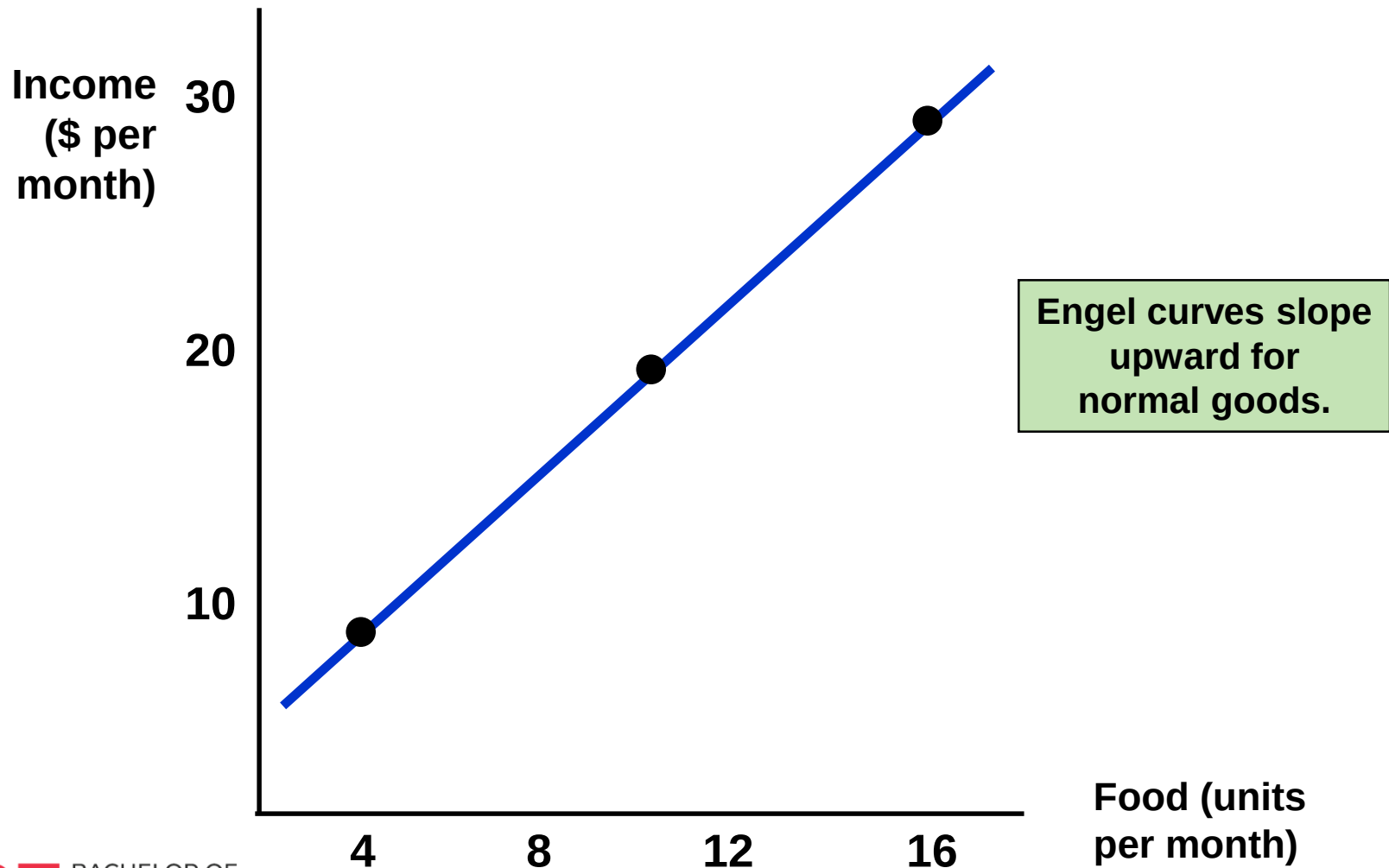
- Income Changes
 - When the income-consumption curve move from right to left as income increases:
 - The quantity demanded decreases with income.
 - The income elasticity of demand is negative.
 - The good on the X axis is an **inferior good**.



An Inferior Good



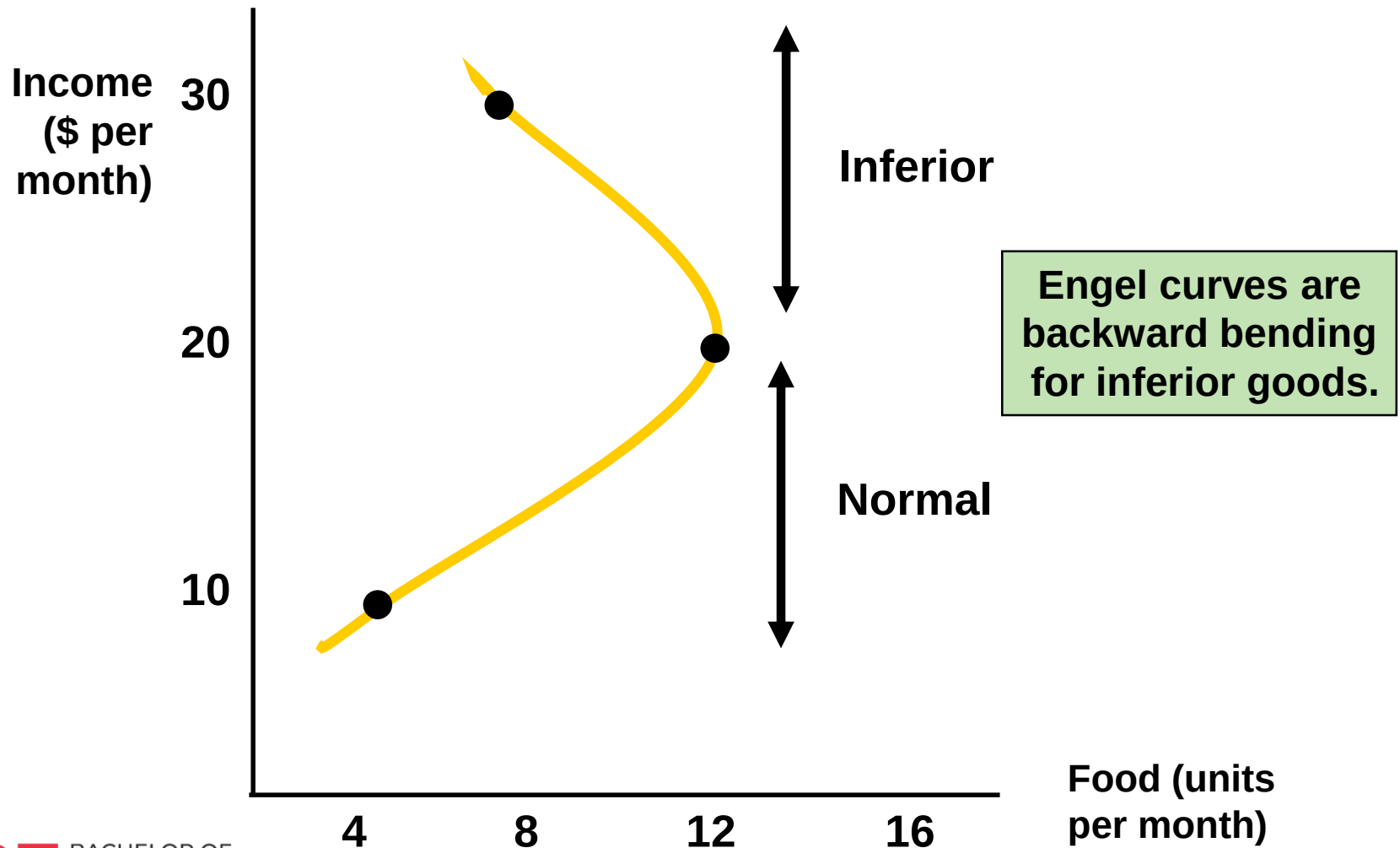
Engel Curves



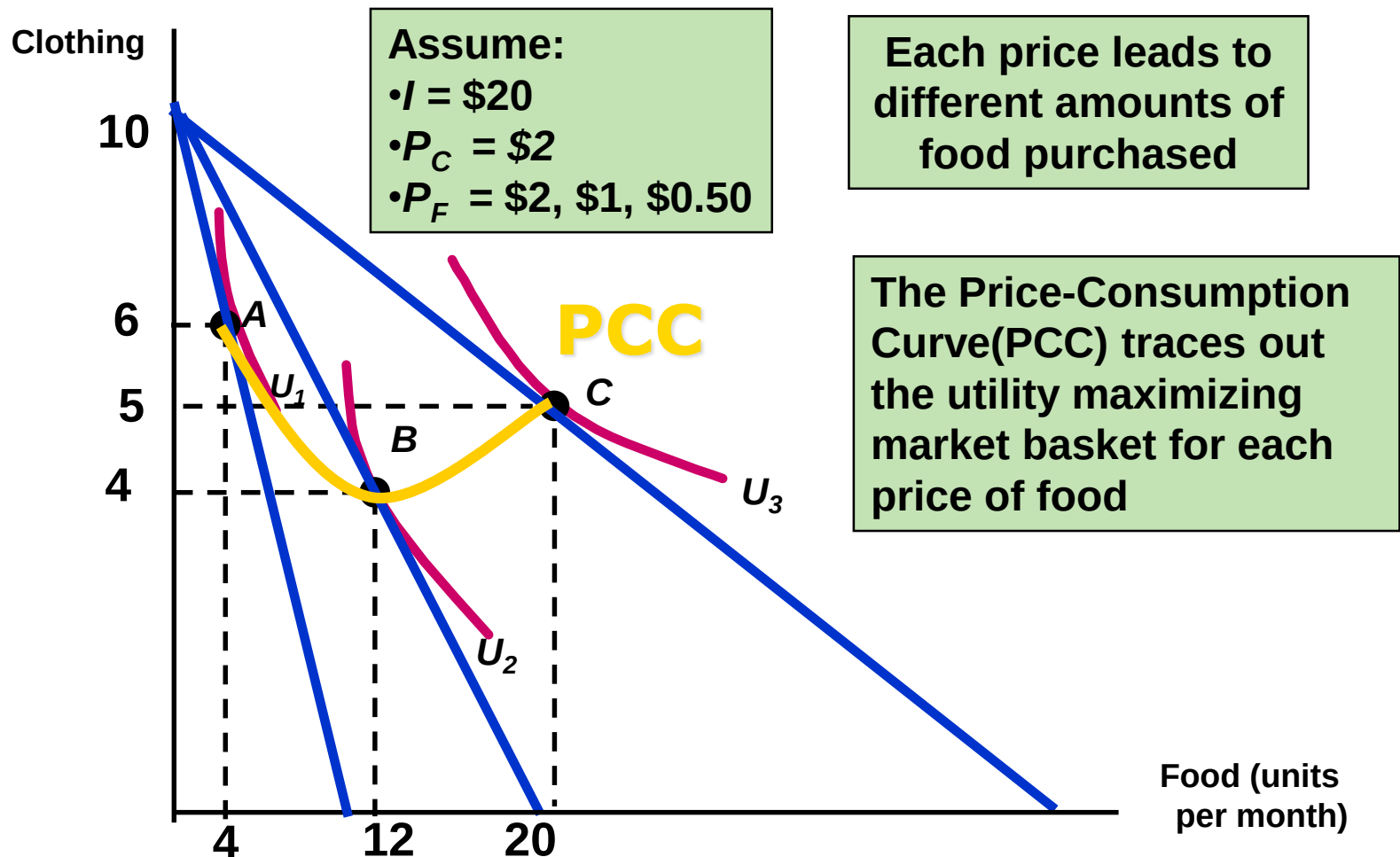
Individual Demand

- Engel Curves
 - Engel curves relate the quantity of good consumed to income.
 - If the good is a normal good, the Engel curve is upward sloping.
 - If the good is an inferior good, the Engel curve is downward sloping.

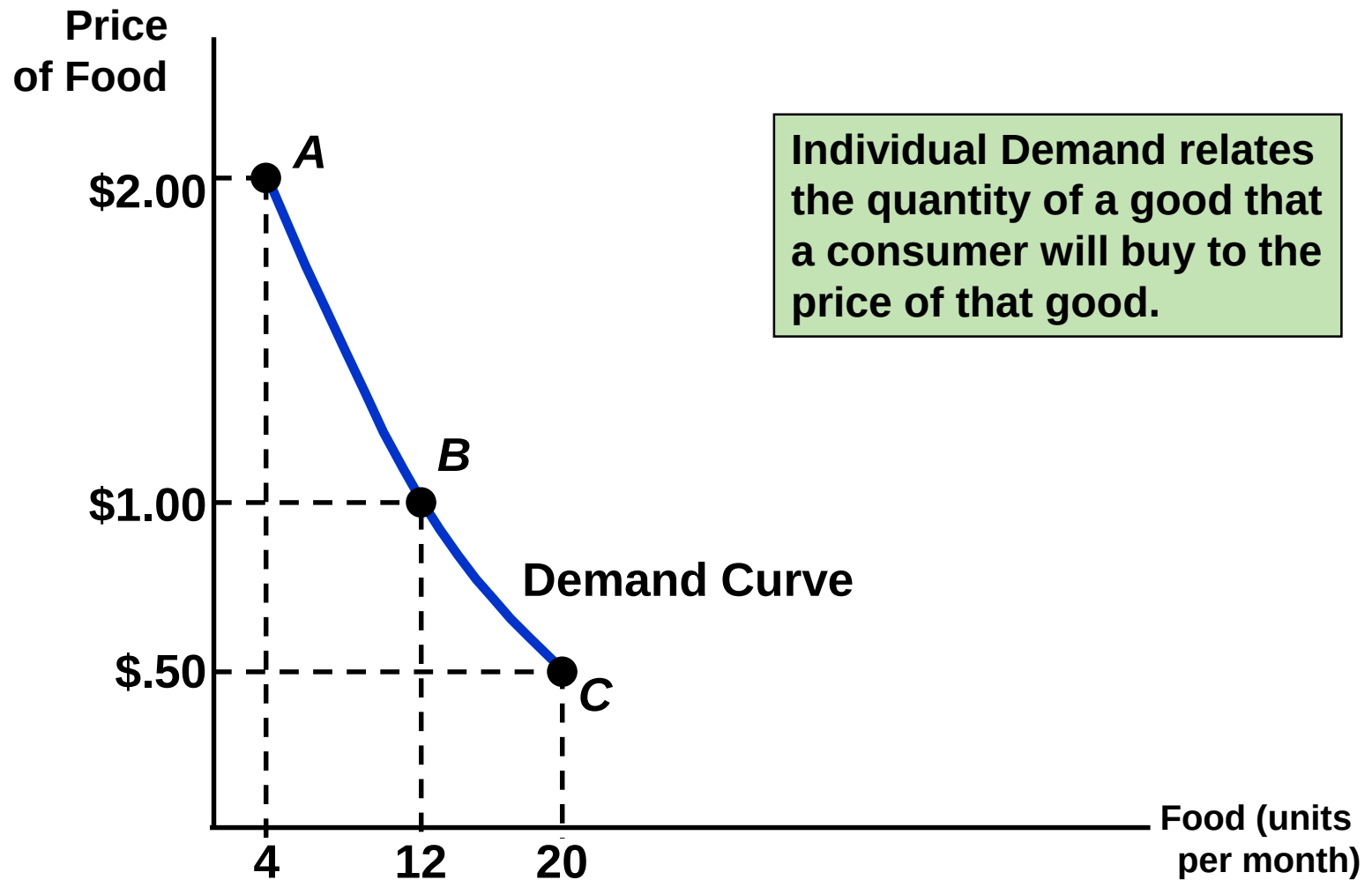
Engel Curves



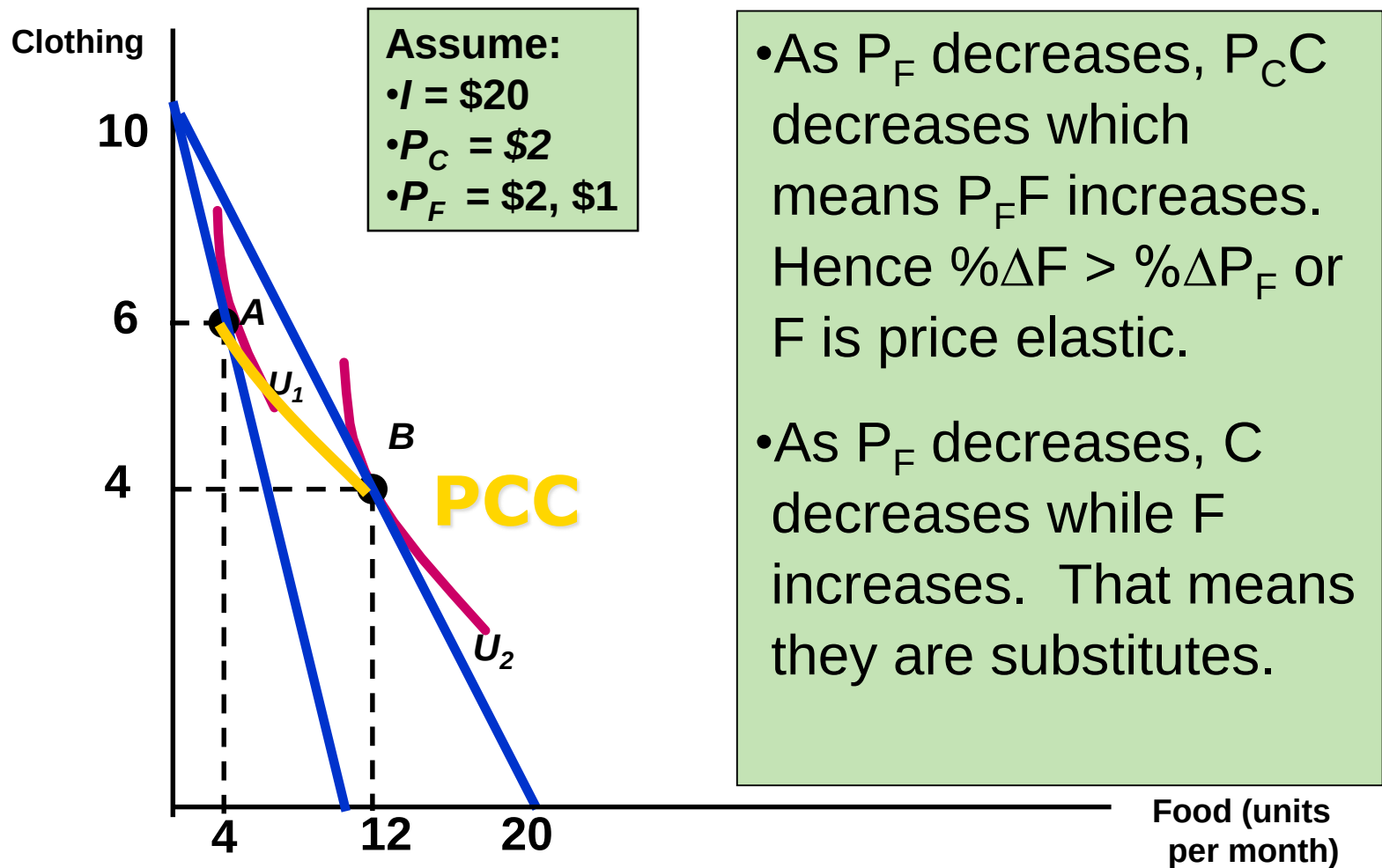
Effect of a Price Change



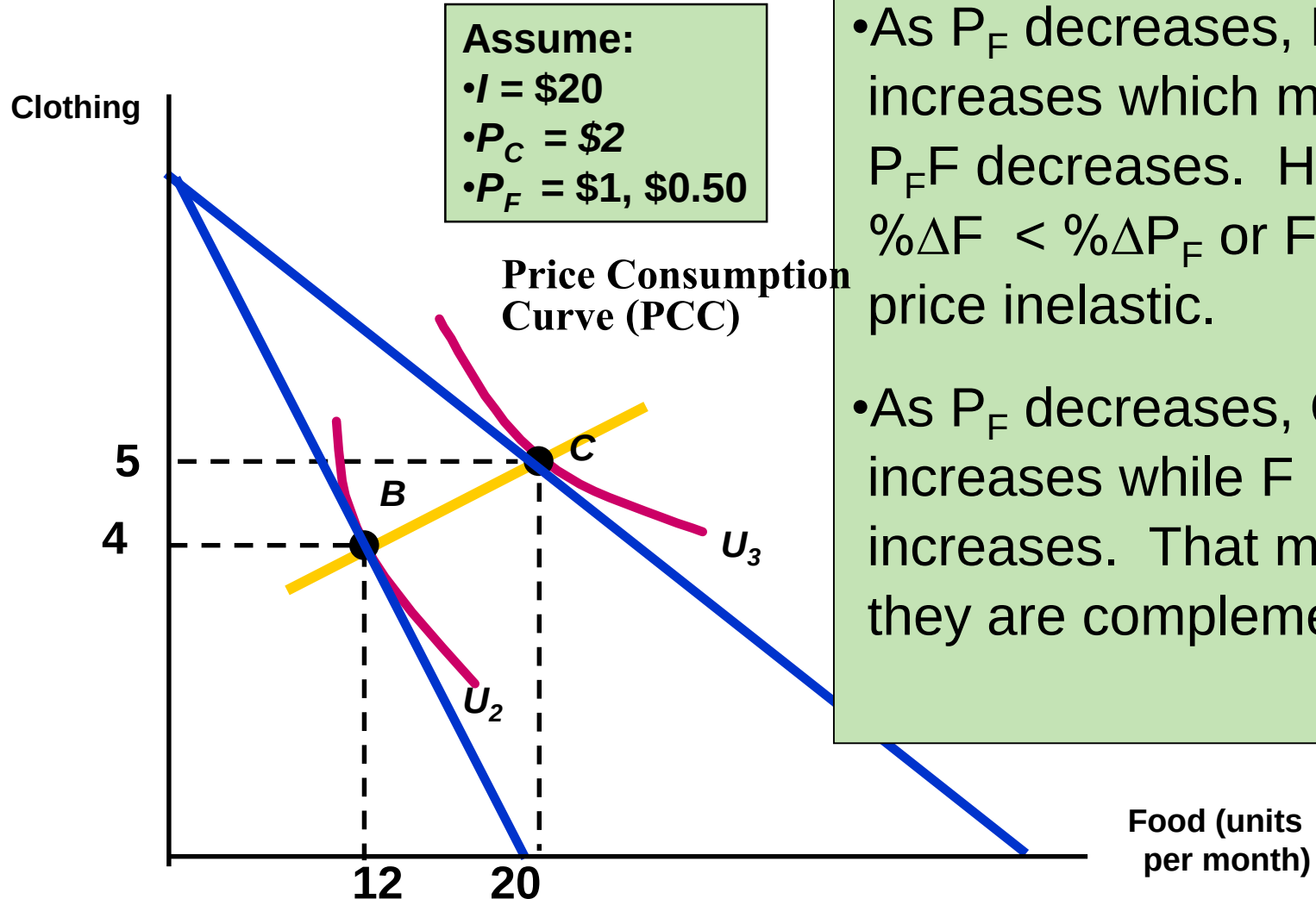
Effect of a Price Change



Decreasing PCC



Effect of a Price Change



Substitutes & Complements

- If the price consumption curve is downward-sloping, the two goods are considered substitutes.
- If the price consumption curve is upward-sloping, the two goods are considered complements.
- They could be both.

Income and Substitution Effects

- Substitution Effect
 - Relative price of a good changes when price changes
 - Consumers will tend to buy more of the good that has become relatively cheaper, and less of the good that is relatively more expensive.
- Income Effect
 - Consumers experience an increase in real purchasing power when the price of one good falls.

Income and Substitution Effects

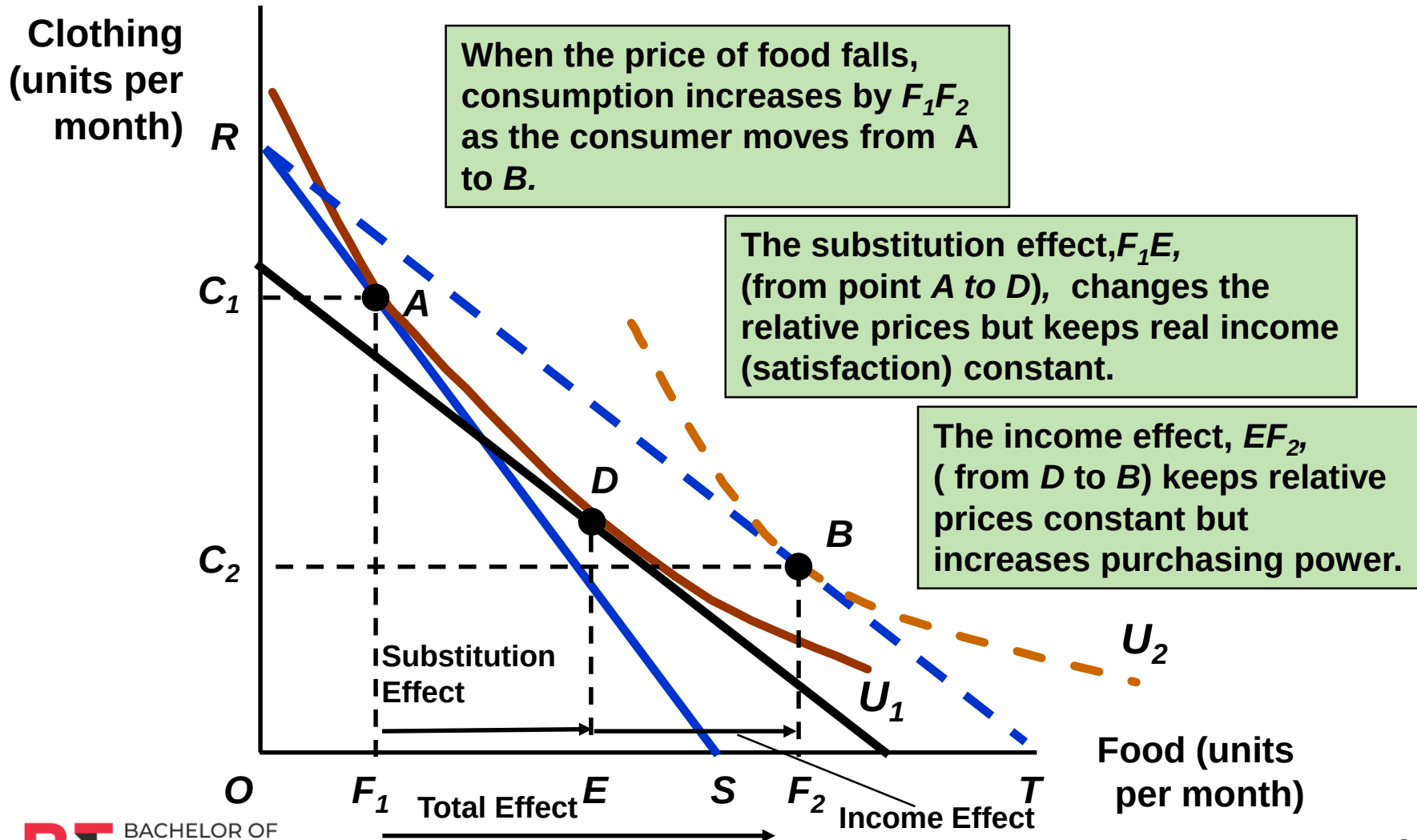
- Substitution Effect
 - The substitution effect is the change in an item's consumption associated with a change in the price of the item, with **the level of utility held constant**.
 - When the price of an item declines, the substitution effect always leads to an increase in the quantity demanded of the good.

Income and Substitution Effects

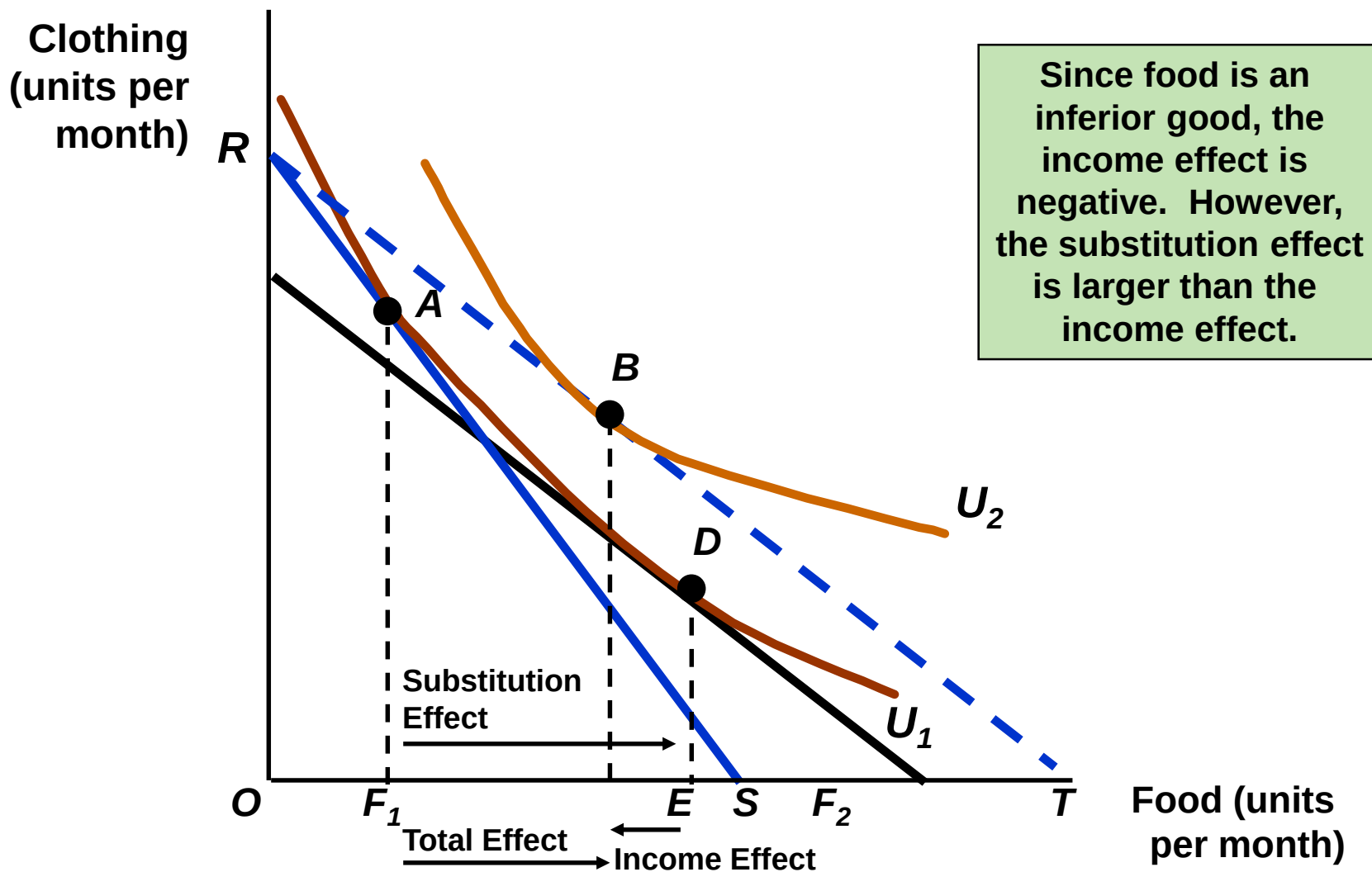
- Income Effect
 - The income effect is the change in an item's consumption brought about by the change in purchasing power, with the **price of the item held constant**.
 - When a person's income increases, the quantity demanded for the product may increase or decrease.
 - Even with inferior goods, the income effect is rarely large enough to outweigh the substitution effect.



Income and Substitution Effects: Normal Good



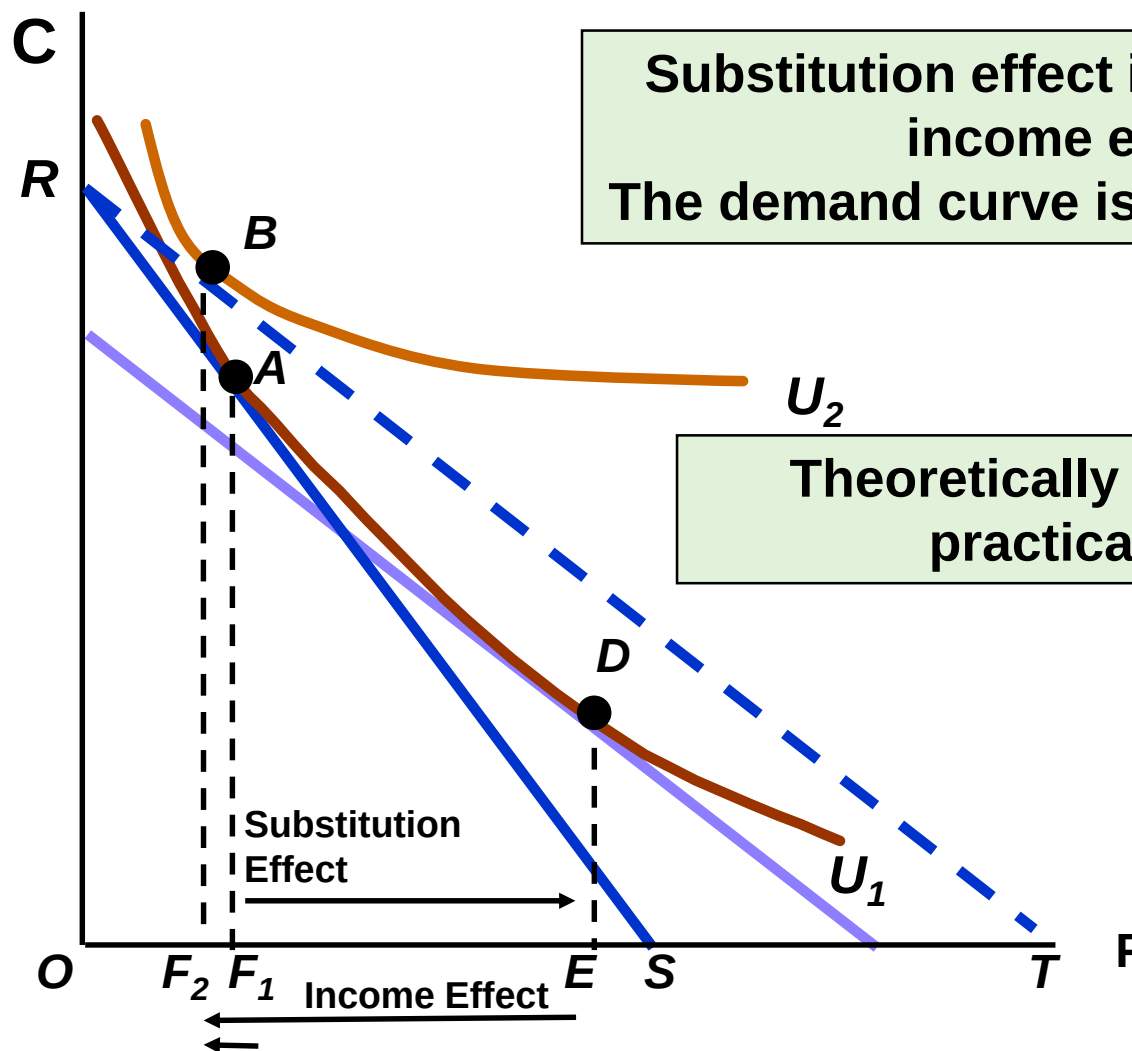
Income and Substitution Effects: Inferior Good



Income and Substitution Effects

- A Special Case--The Giffen Good
 - The income effect may theoretically be large enough to cause the demand curve for a good to slope upward.
 - This rarely occurs and is of little practical interest.

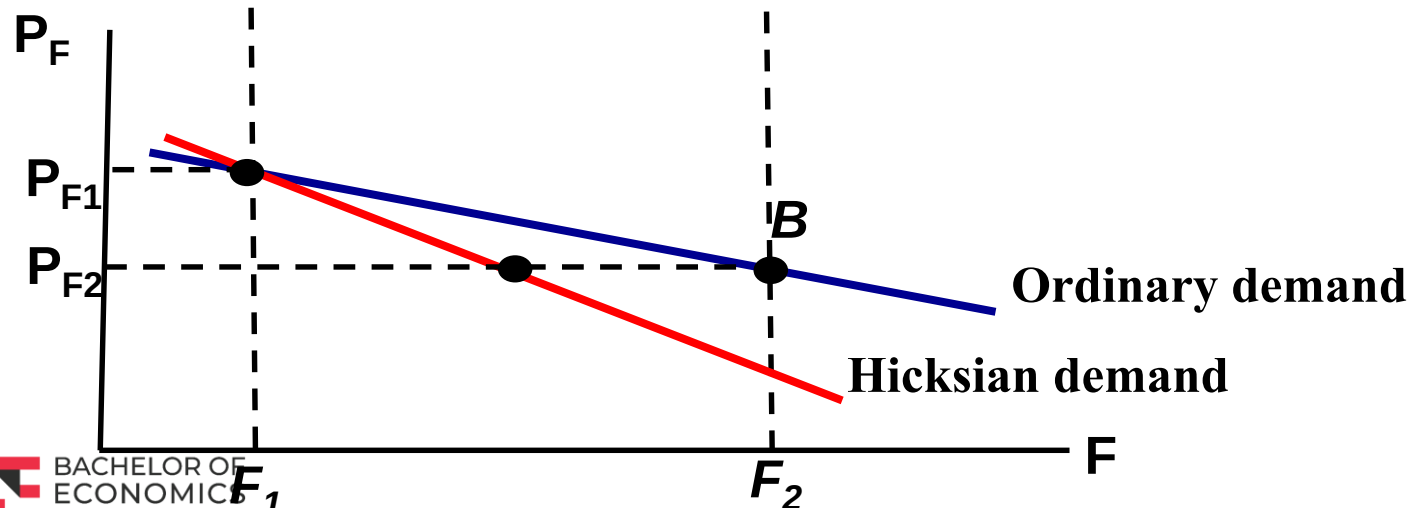
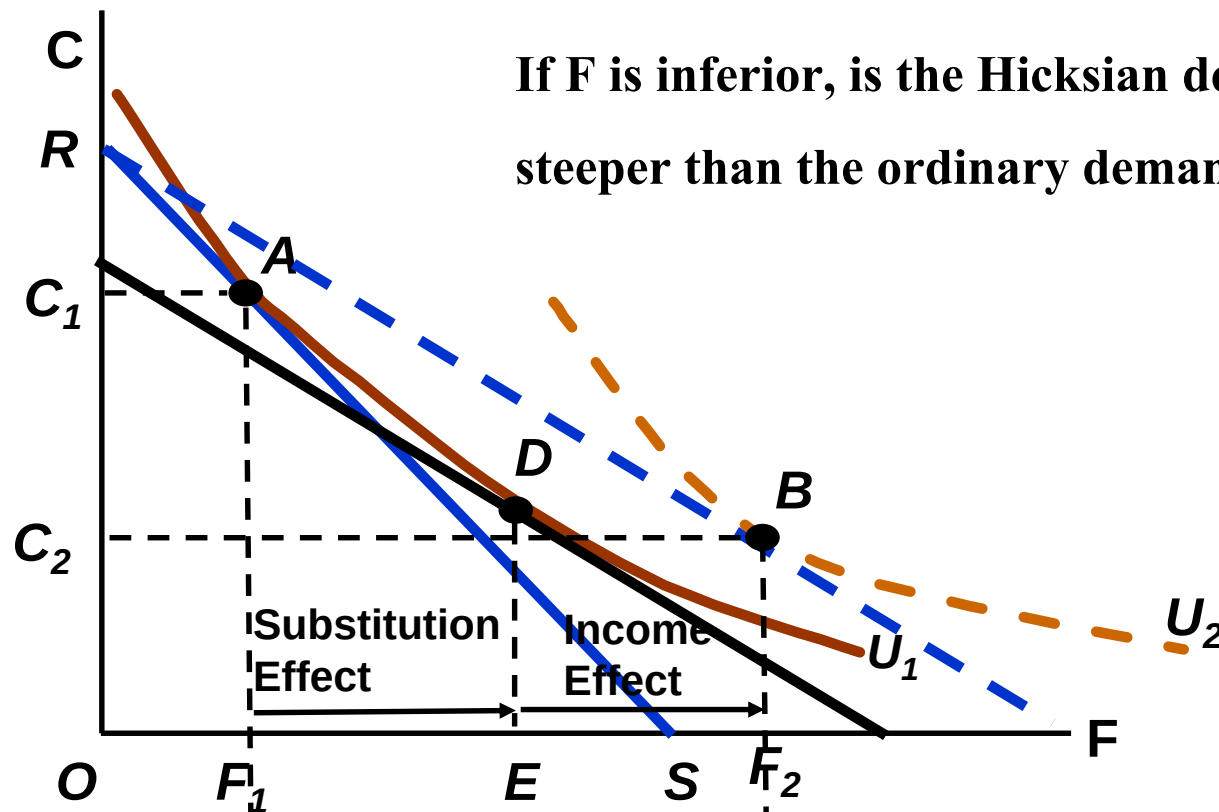
Income and Substitution Effects: Giffen Good



Compensated demand curve

- Ordinary demand or Marshallian demand always has income effect
 - Derived by fixing income.
 - It may slope upward if it is a Giffen good.
- Compensated demand of Hicksian demand excludes income effect or compensated for income
 - Derived by fixing utility
 - It always slopes downward.
 - **It is used for calculating welfare change.**

If F is inferior, is the Hicksian demand still steeper than the ordinary demand? Why?



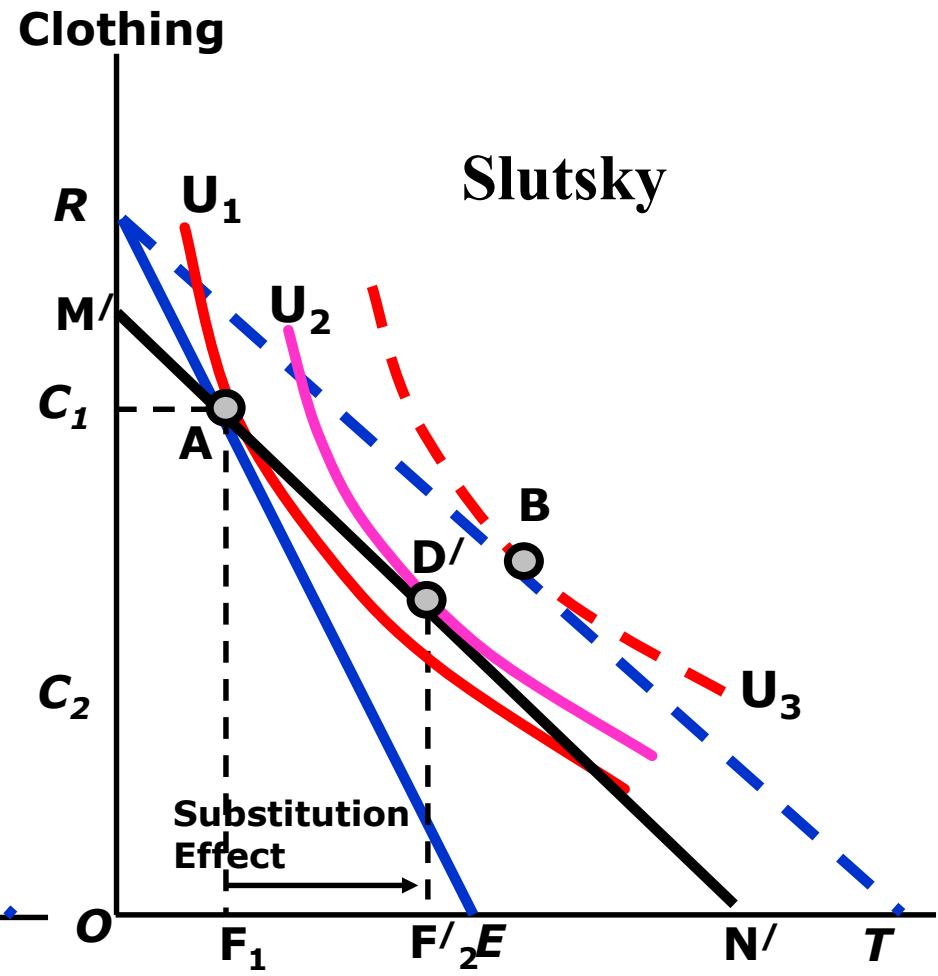
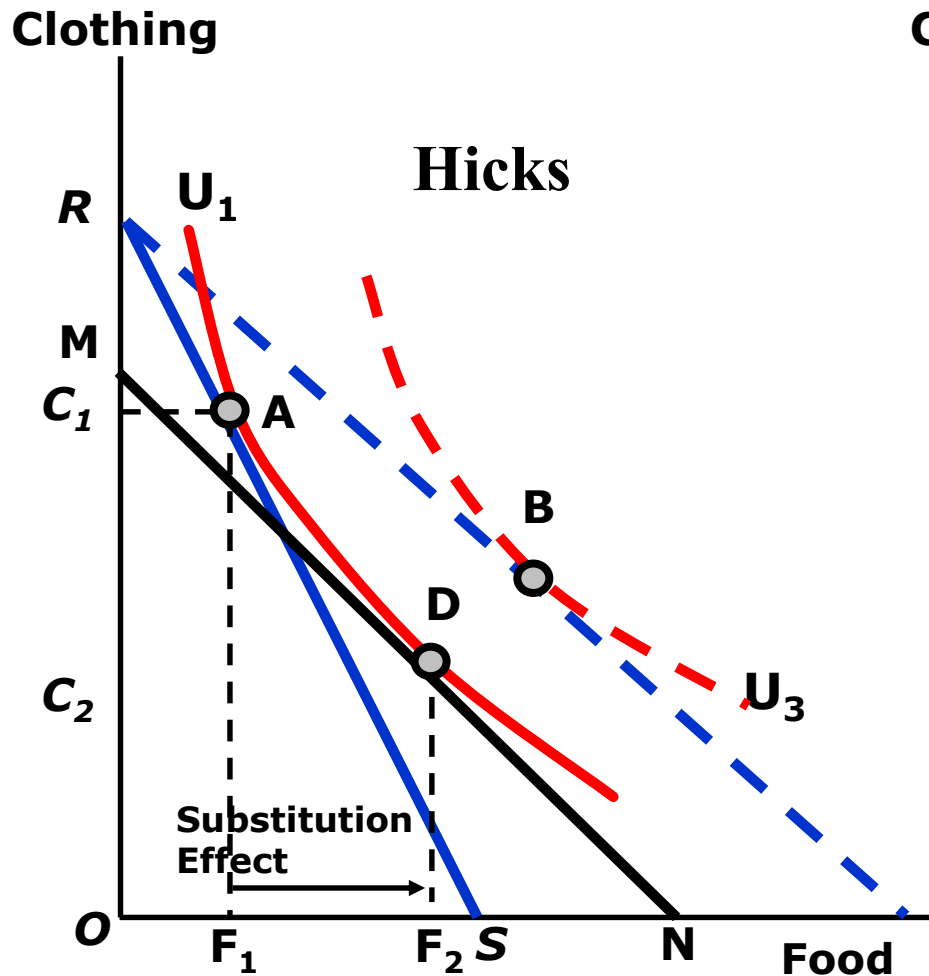
Hicks and Slutsky substitution effect

- To calculate the substitution effect, we need to compensate the consumer for the change in real income.
- The substitution effect defined earlier compensate the income change until the consumer receives the same level of utility.
 - This is called **Hicks substitution effect**.
- But we cannot measure utility, so Hicks substitution effect is not observable.

Hicks and Slutsky substitution effect

- The alternative way is to compensate the income change until the consumer can consume exactly the same bundle.
 - This is called Slutsky substitution effect.
- With this new budget, at the new relative prices, the consumer will choose a new optimal bundle which is observable.

Hicks v.s. Slutsky Substitution Effect

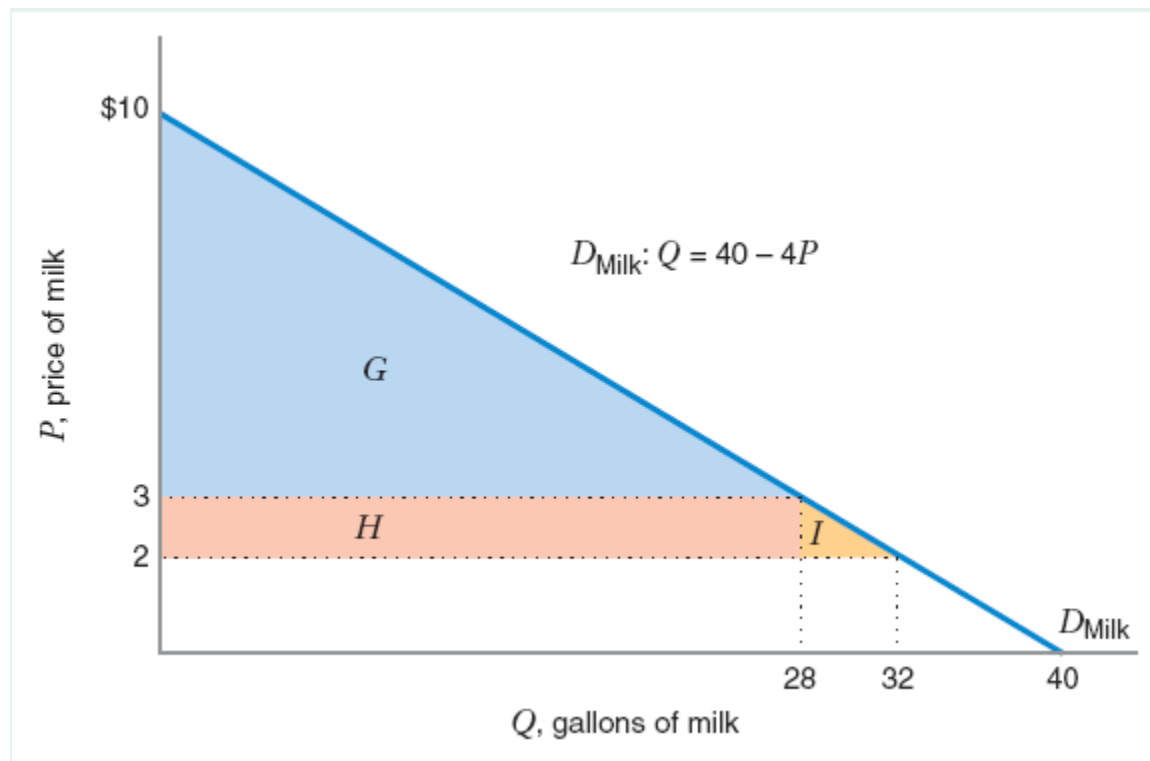


Consumer Surplus

- The individual's demand curve can be seen as the individual's *willingness to pay* curve.
- On the other hand, the individual *actually* pay the market price for (all) the units consumed.
- Consumer Surplus is the difference between what the consumer is willing to pay and what the consumer actually pays.

Consumer Surplus

The area *under* an ordinary demand curve and *above* the market price provides a measure of consumer surplus.



Consumer Welfare (Hicksian Approach)

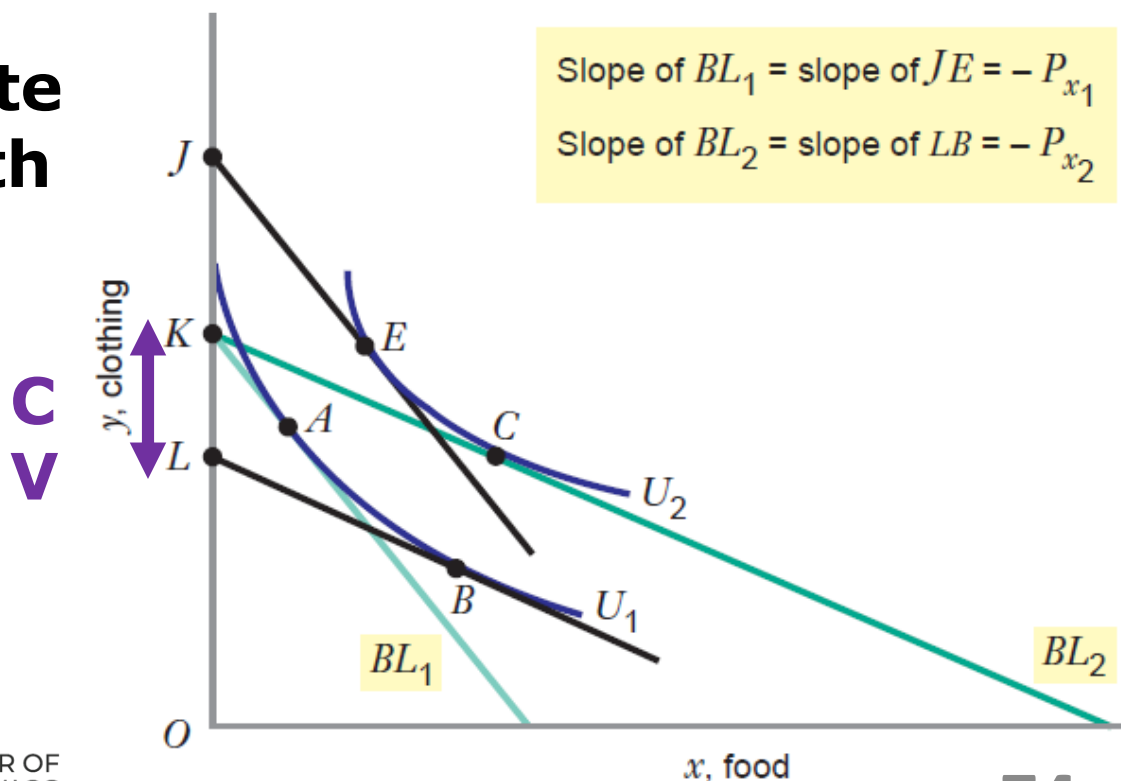
- Economists often measures the impact of price changes on a consumer's well-being in monetary terms.
- This is why we learn about consumer surplus.
- Other measures include
 - Compensating Variation (CV)
 - Equivalent Variation (EV)

Compensating Variation (CV) is calculated by $K - L$.

The amount of additional money a consumer would need to reach his initial utility after a change in prices.

CV: Difference b/w the income required to buy A at initial price and the income required to buy B (SE bundle) at final price.

Y is a composite good with $P_y = 1$.



Equivalent Variation (EV) is calculated by $J - K$.

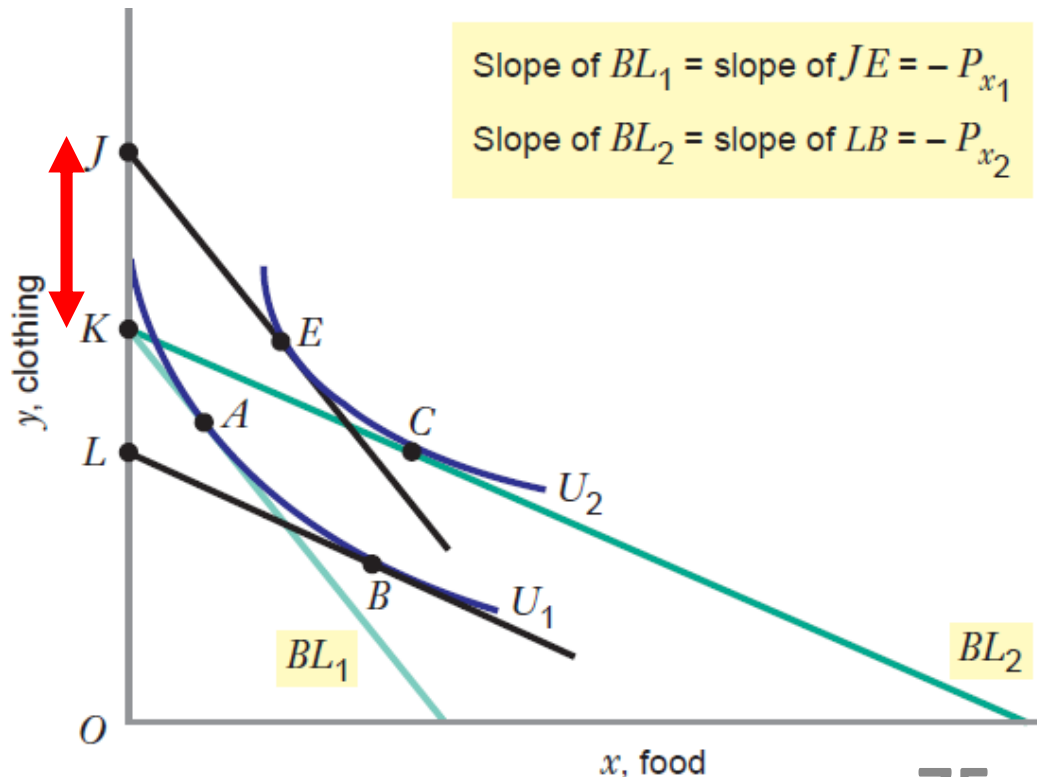
The change in income, at current prices, that would have the same effect on consumer welfare as would the change in prices, at current income.

EV: Difference b/w the income required to buy A at initial price and the income required to buy E at initial price.

Note: E gives the same utility as C does.

Y is a composite good with $P_y = 1$.

EV



Consumer Price Index (CPI)

- CPI is an index (a number) that tells us about the cost of living of typical consumers.
- It measures changes in the price level and can be used to calculate the inflation rate.
- CPI is a fixed-weight index, calculated from a fixed basket of goods.

Consumer Price Index (CPI)

- Since CPI is calculated from a fixed basket of goods, it ignores the fact that people would “substitute” expensive goods with cheaper goods.
- **This is called the “substitution bias” and causes CPI to overestimate the cost of living when the price level rises.**

Consumer Price Index (CPI)

Example

- Assume a consumer buys two goods:
food with $P_{F,1} = \$3$ and clothing with $P_{C,1} = \$8$.
- At these prices, the consumer buy 80 units of food and 30 units of clothing, $(F, C) = (80, 30)$.
- Thus, the cost of living before the price change is \$480.

Consumer Price Index (CPI)

Example (cont)

- Suppose the prices of food and clothing rises; the new prices are $P_{F,2} = \$6$ and $P_{C,2} = \$9$.
- CPI assumes that the consumer would still buy the original bundle, $(F, C) = (80, 30)$. With this approach, the cost of living after the price change would be \$750.
- $CPI = 750/480 = 1.56$. Inflation = 56%.

Consumer Price Index (CPI)

Example (cont)

- In reality, there exists a bundle that could give the consumer the same happiness as $(F, C) = (80, 30)$.
- From the diagram, such bundle is $(40, 60)$ and costs \$720 after the price change.
- If CPI were to account for the substitution, CPI would be $720/480 = 1.5$. Inflation = 50%.

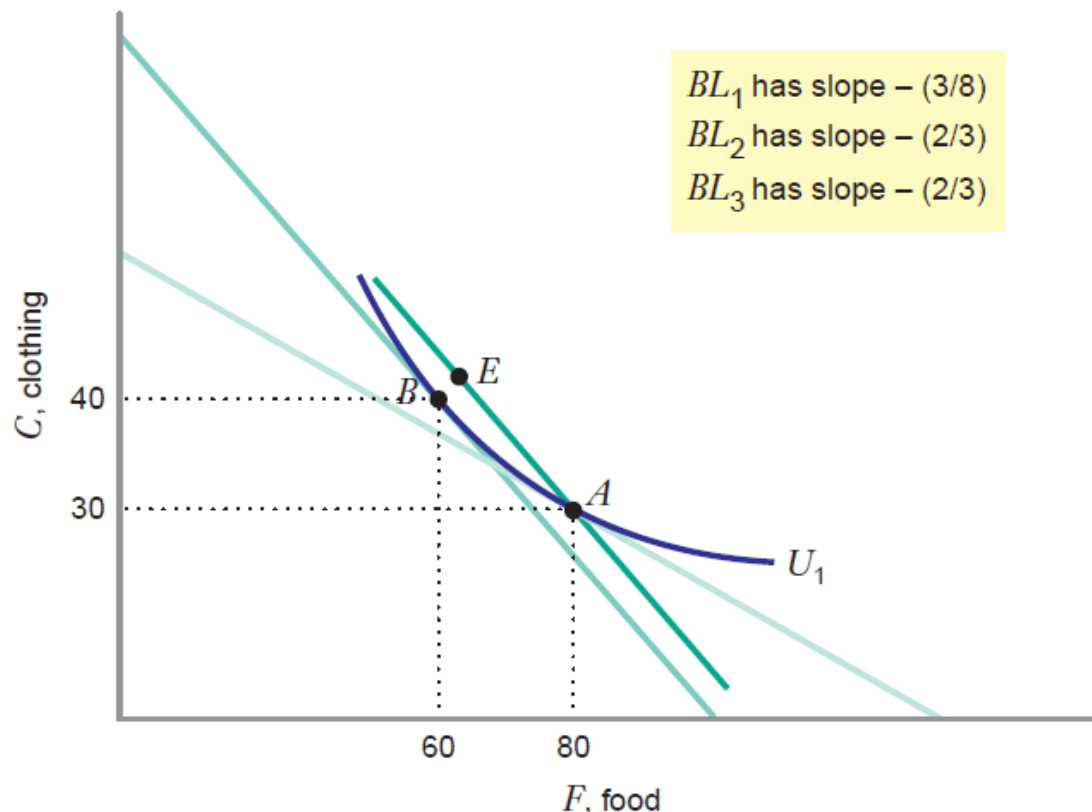


FIGURE 5.27 Substitution Bias in the Consumer Price Index

In year 1 the consumer has an income of \$480, the price of food is \$3, and the price of clothing is \$8. The consumer chooses basket A. In year 2 the price of food rises to \$6, and the price of clothing rises to \$9. The consumer could maintain his initial level of utility U_1 at the new prices by purchasing basket B, costing \$720. An ideal cost of living index would be 1.5 ($=\$720/\480), telling us that the cost of living has increased by 50 percent. However, the actual CPI assumes the consumer does not substitute clothing for food as relative prices change, but continues to buy basket A at the new prices, for which he would need an income of \$750. The CPI ($\$750/\$480 = 1.56$) suggests that the consumer's cost of living has increased by about 56 percent, which overstates the actual increase in the cost of living. In fact, if the consumer's income in year 2 were \$750, he could choose a basket such as E on BL_3 and achieve a higher level of utility than U_1 .

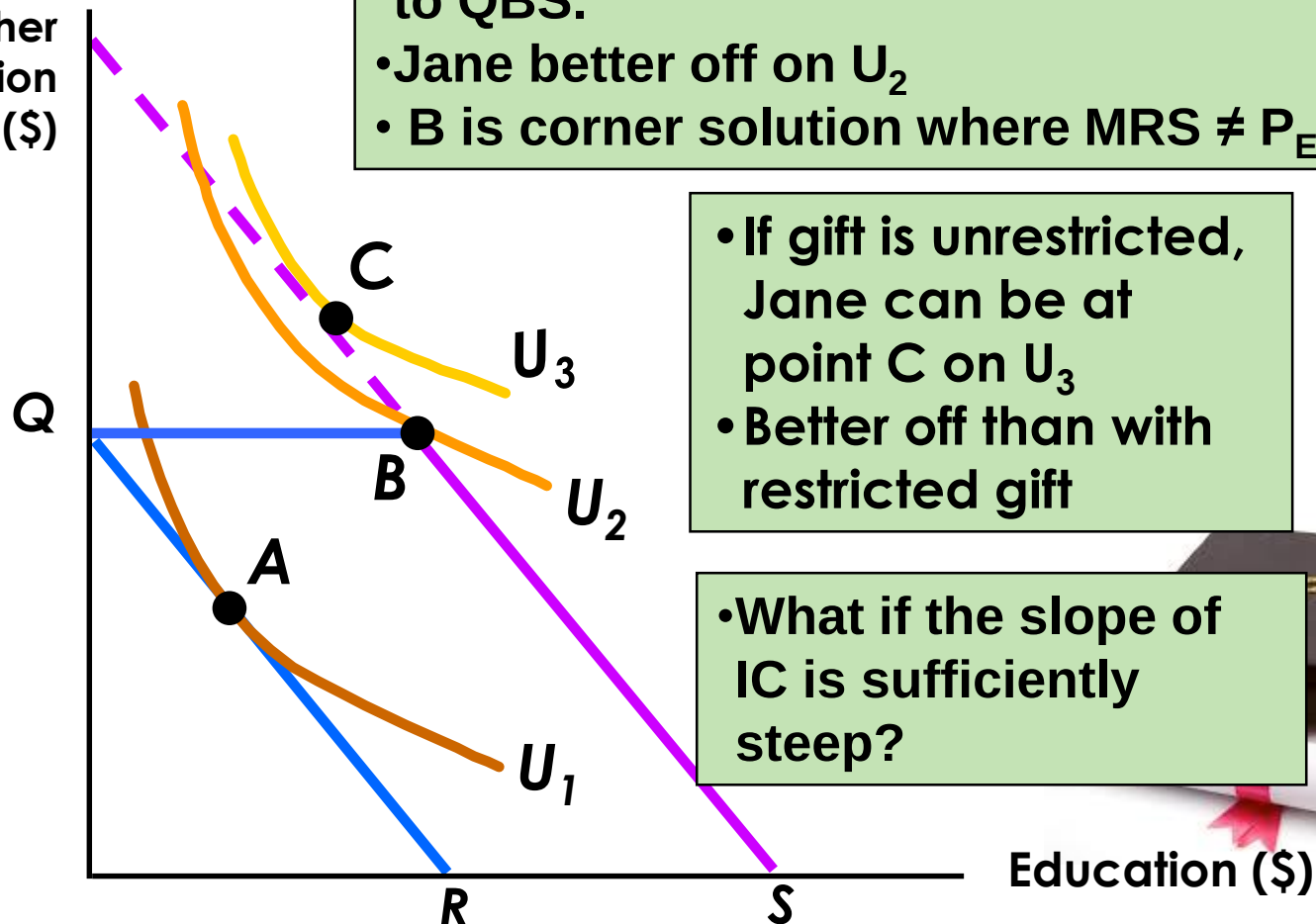
Application: Cash or Gifts

- Suppose Jane Doe's parents set up a trust fund for her college education.
- The money must be used only for education.
- Original budget line, QR, with a market basket, A, of education and other goods
- Trust fund shifts out the budget line as long as trust fund, QB, spent on education
- Jane increases satisfaction moving to higher indifference curve, U_2
- Although a welcome gift, an unrestricted gift might be better since she can get U_3

Application: Cash or Gifts



Other
Consumption
(\$)



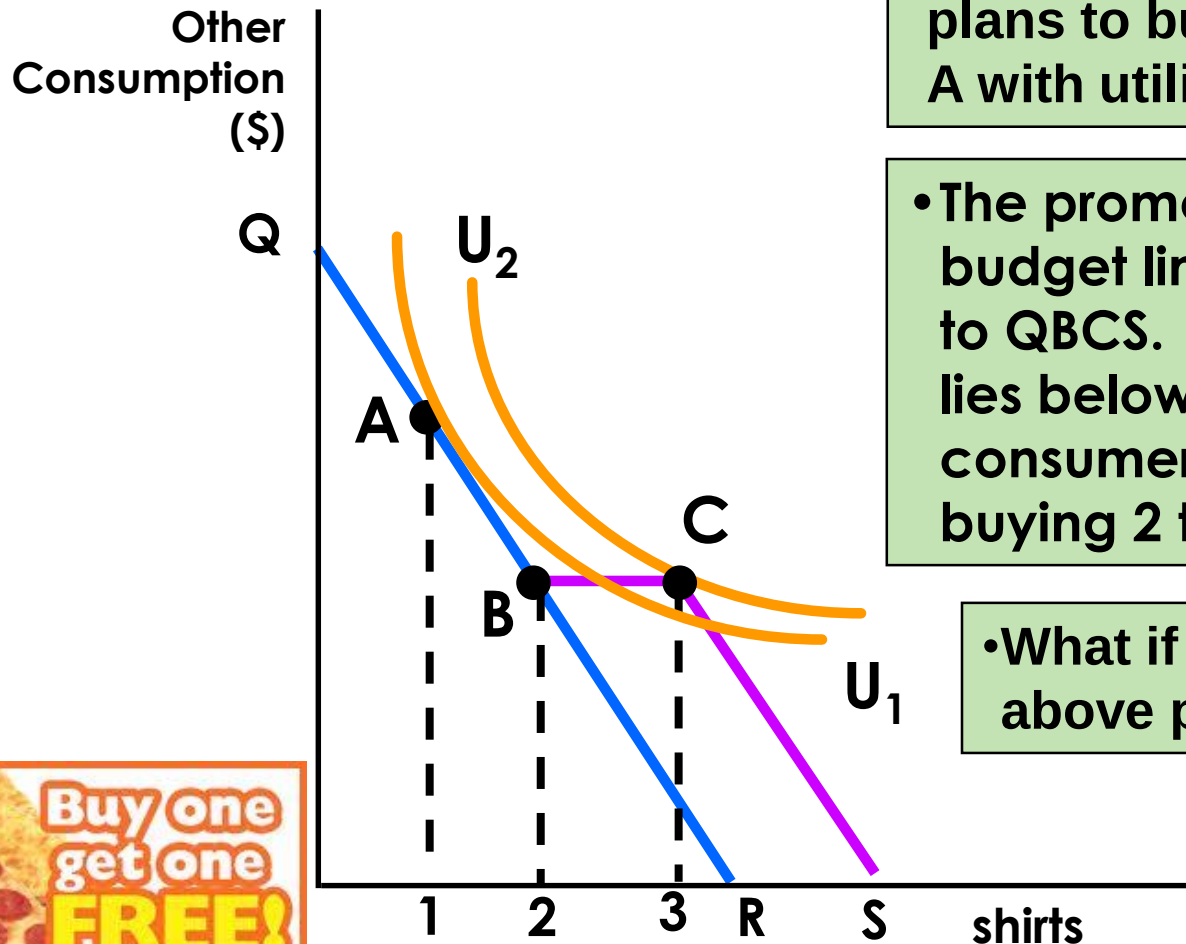
- The gift changes the budget line from QR to QBS.
- Jane better off on U_2
- B is corner solution where $MRS \neq P_E/P_{OG}$

- If gift is unrestricted, Jane can be at point C on U_3
- Better off than with restricted gift

- What if the slope of IC is sufficiently steep?

- What if education becomes bad before he graduates?

Application: Buy two, get one free



•Originally, this consumer plans to buy 1 shirt at point A with utility U_1 .

•The promotion causes the budget line QR to change to QBCS. If the original IC lies below point C, this consumer is better off buying 2 to get 1 more shirt.

•What if the original IC is above point C?



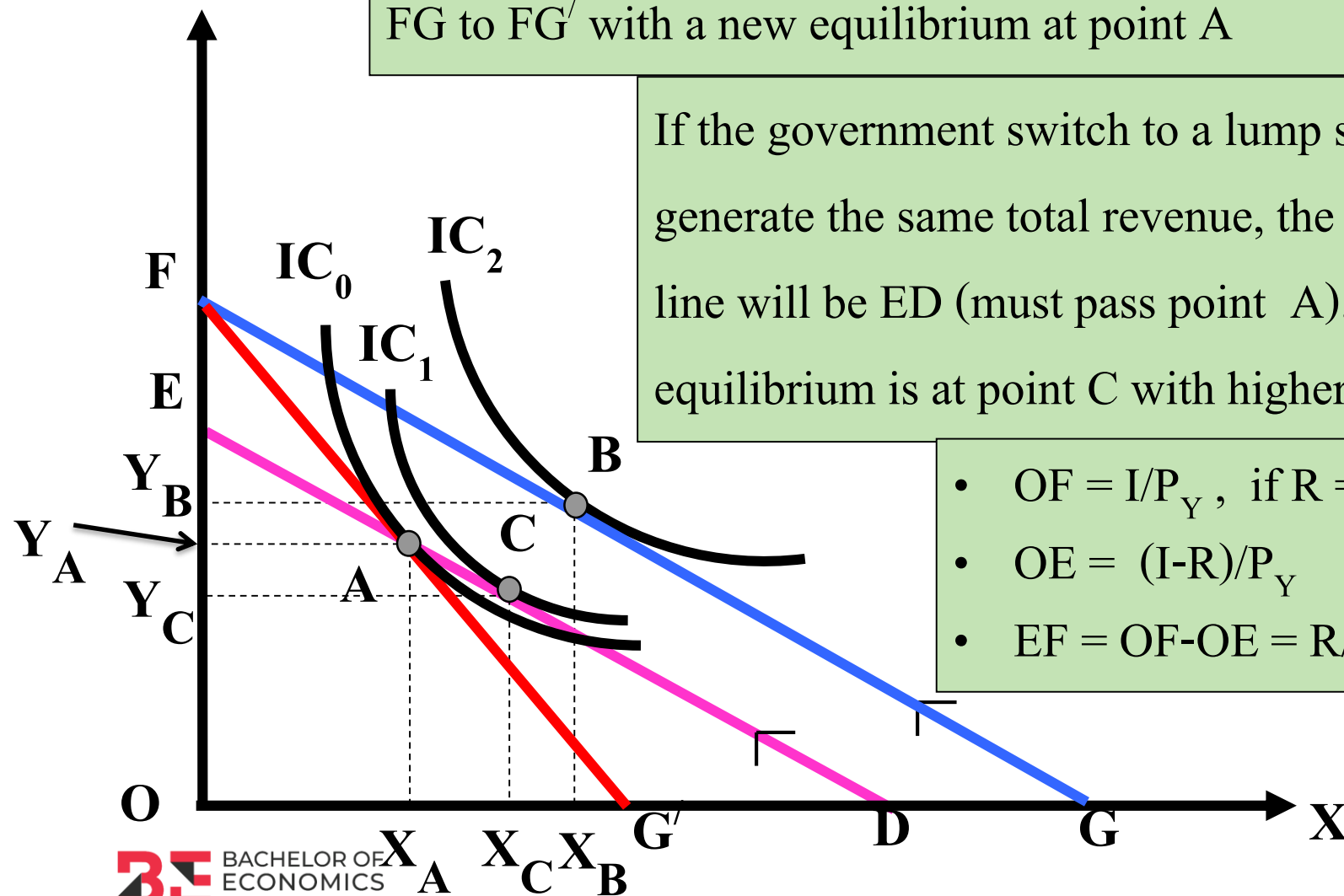
Lump sum versus ad valorem tax

Other goods

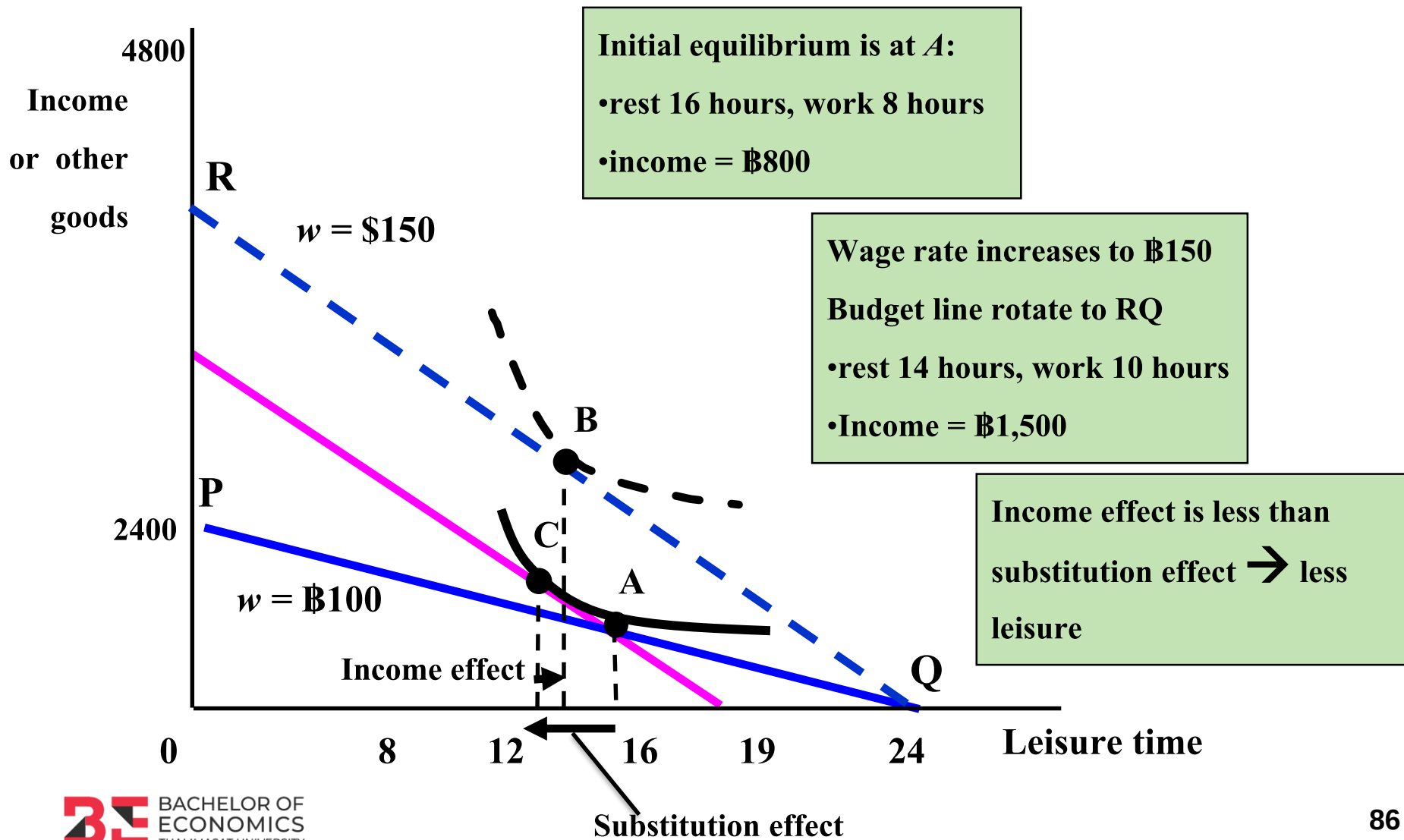
An ad valorem tax (%) on X will rotate the budget line from FG to FG' with a new equilibrium at point A

If the government switch to a lump sum tax that generate the same total revenue, the new budget line will be ED (must pass point A). A new equilibrium is at point C with higher utility

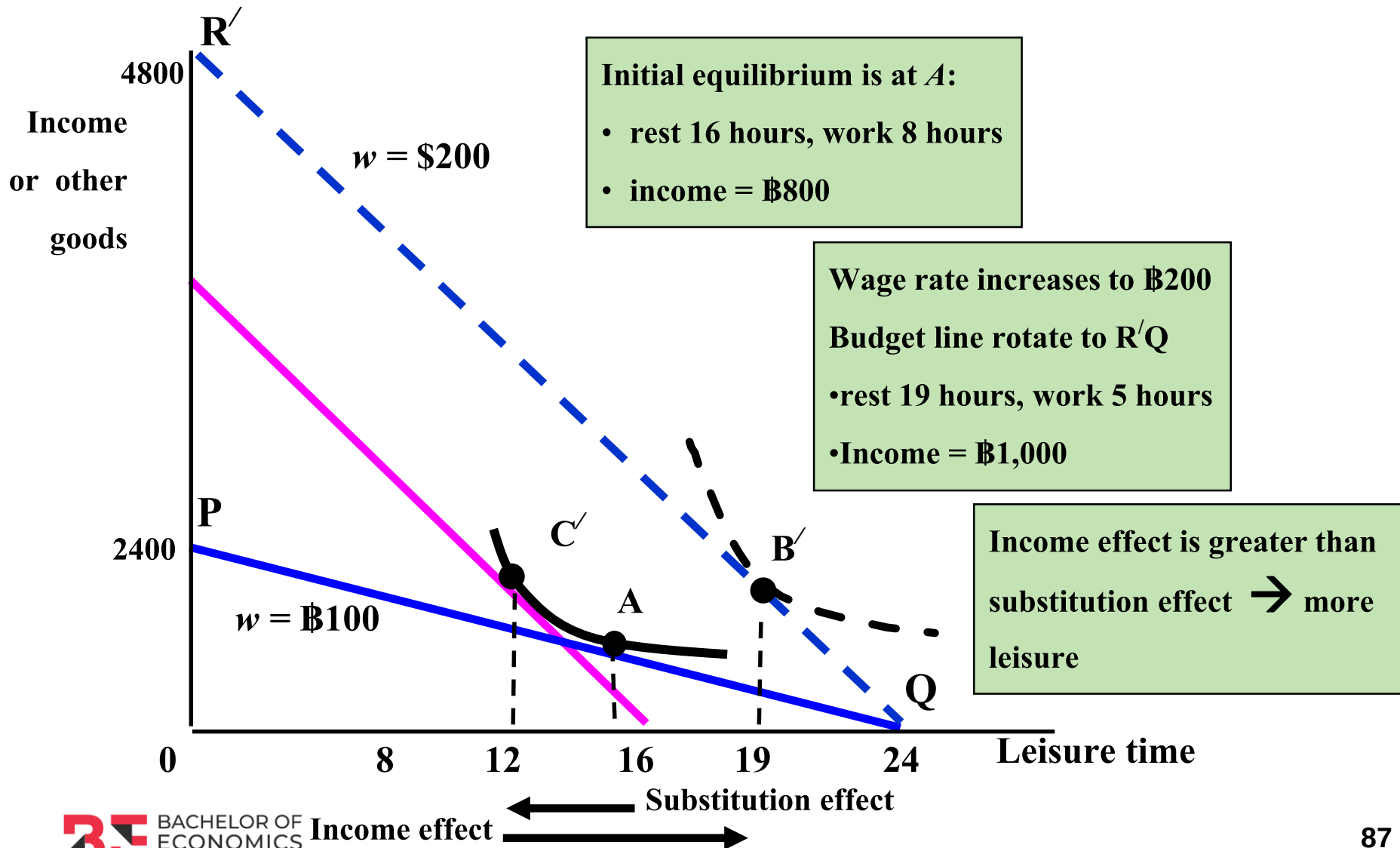
- $OF = I/P_Y$, if R = tax revenue
- $OE = (I-R)/P_Y$
- $EF = OF - OE = R/P_Y$



Substitution and income effect of the change in wage rate



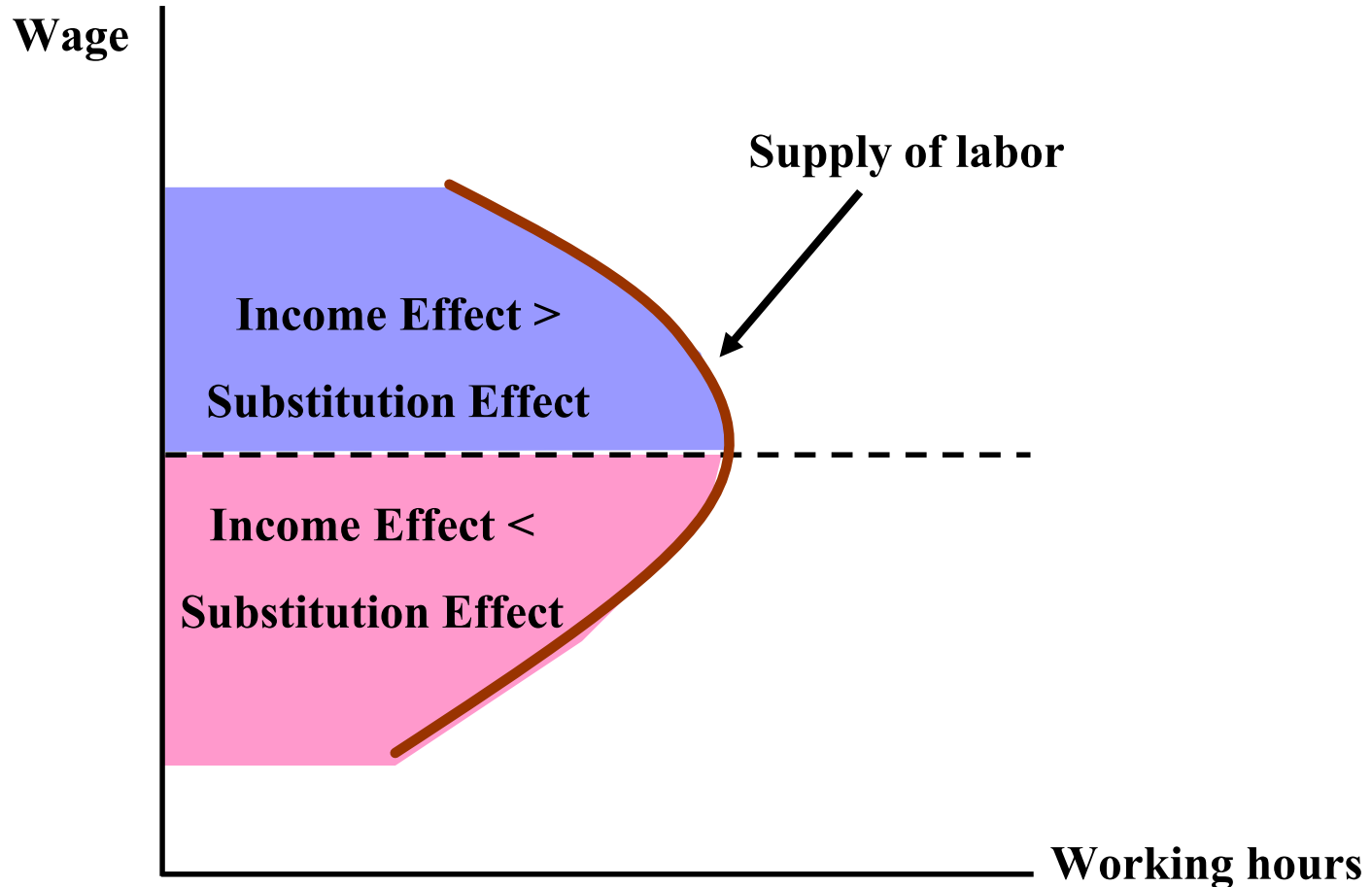
Substitution and income effect of the change in wage rate



Supply of labor

- The higher wage increases the opportunity cost of leisure.
Substitute leisure for other goods, more working hours
 - The substitution effect
- The higher wage also increases income, want to consume more normal goods, including leisure; less working hours
 - The income effect
- If the income effect is higher, the labor supply curve will bend backward

Backward-Bending Supply of Labor



Donation

- Most people treat income level of others as neuter; hence, they will not donate when others are richer
- Some donors will donate when they see some one poorer than they are. Others' income are substitutes for their income when others are poorer, but they will be neuters when others are richer

Donation

If I envy the one who is richer than me, how should the ICs look like?

