

Consumer Behavior:
Advanced topics
EE311

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Agenda



- Hicks and Slutsky substitution effect
- Revealed Preferences
- Index numbers

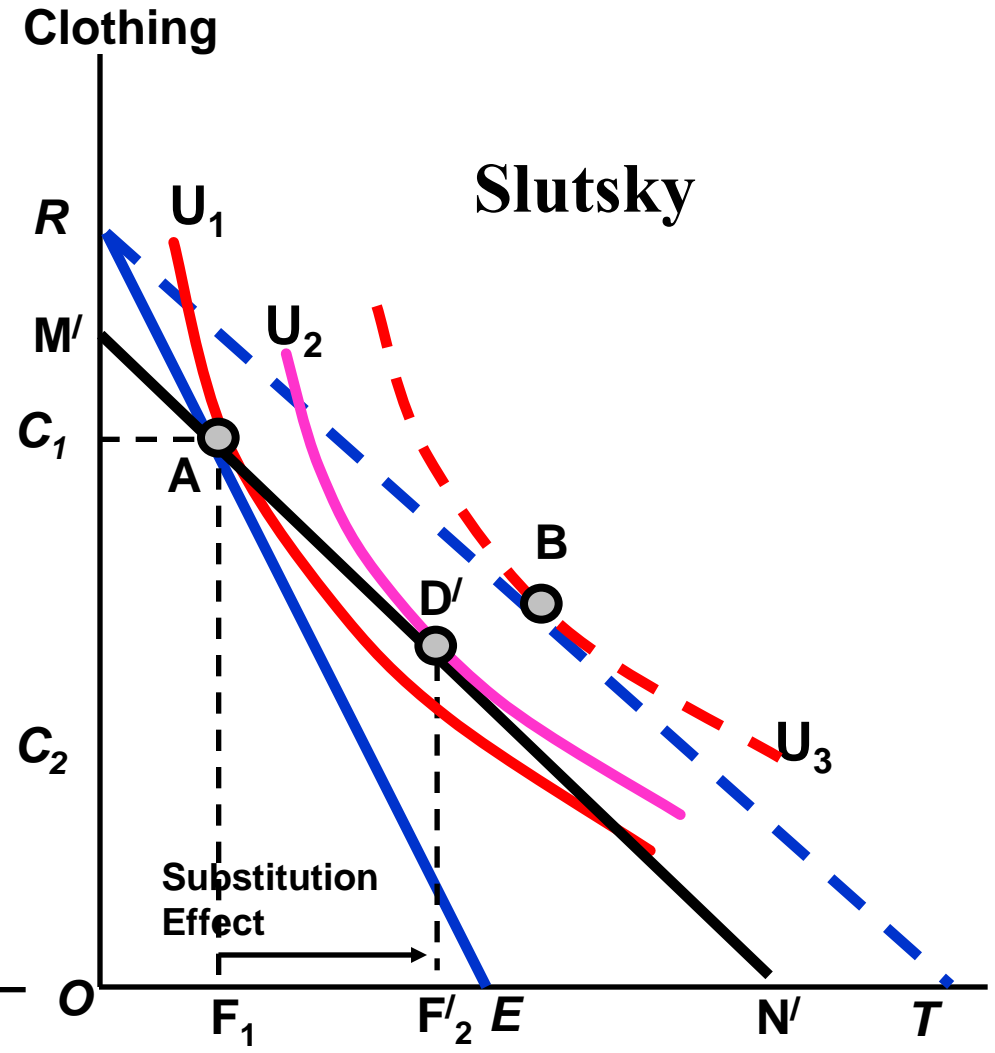
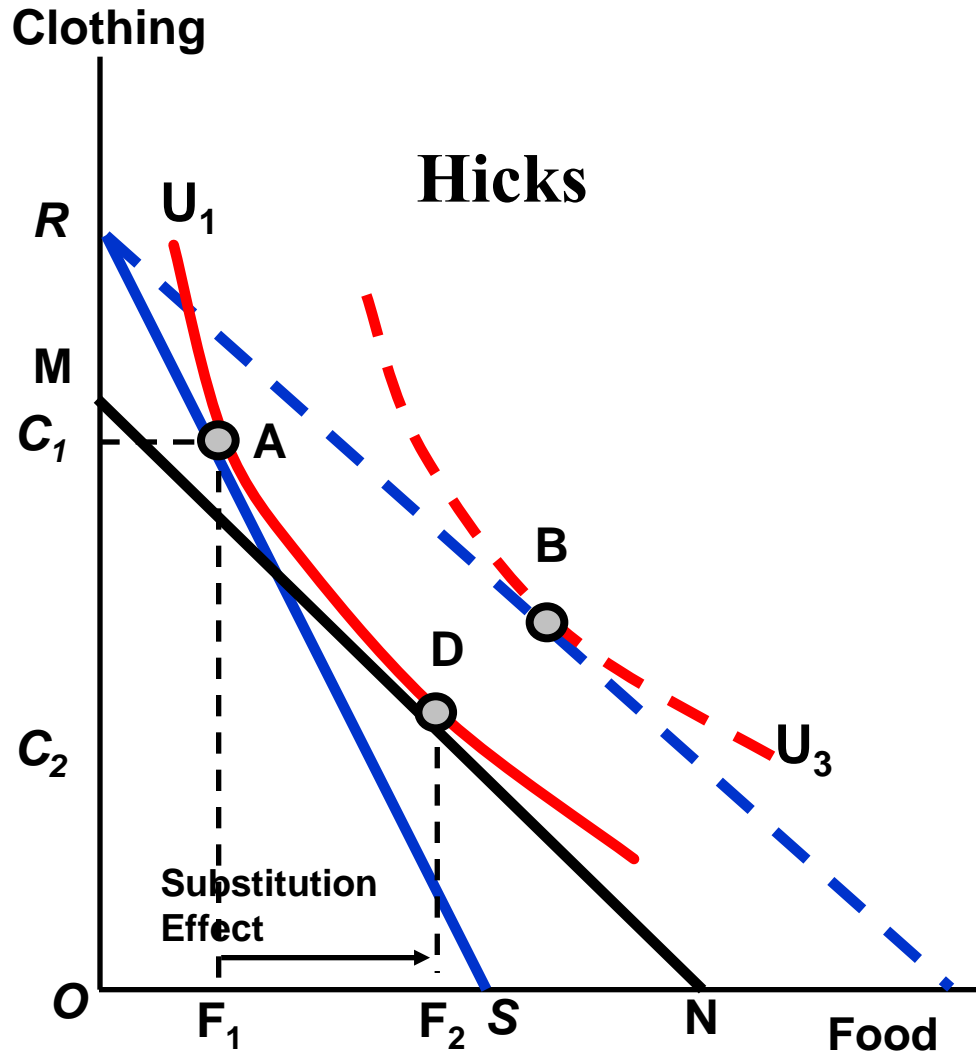
Hicks and Slutsky substitution effect

- 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.

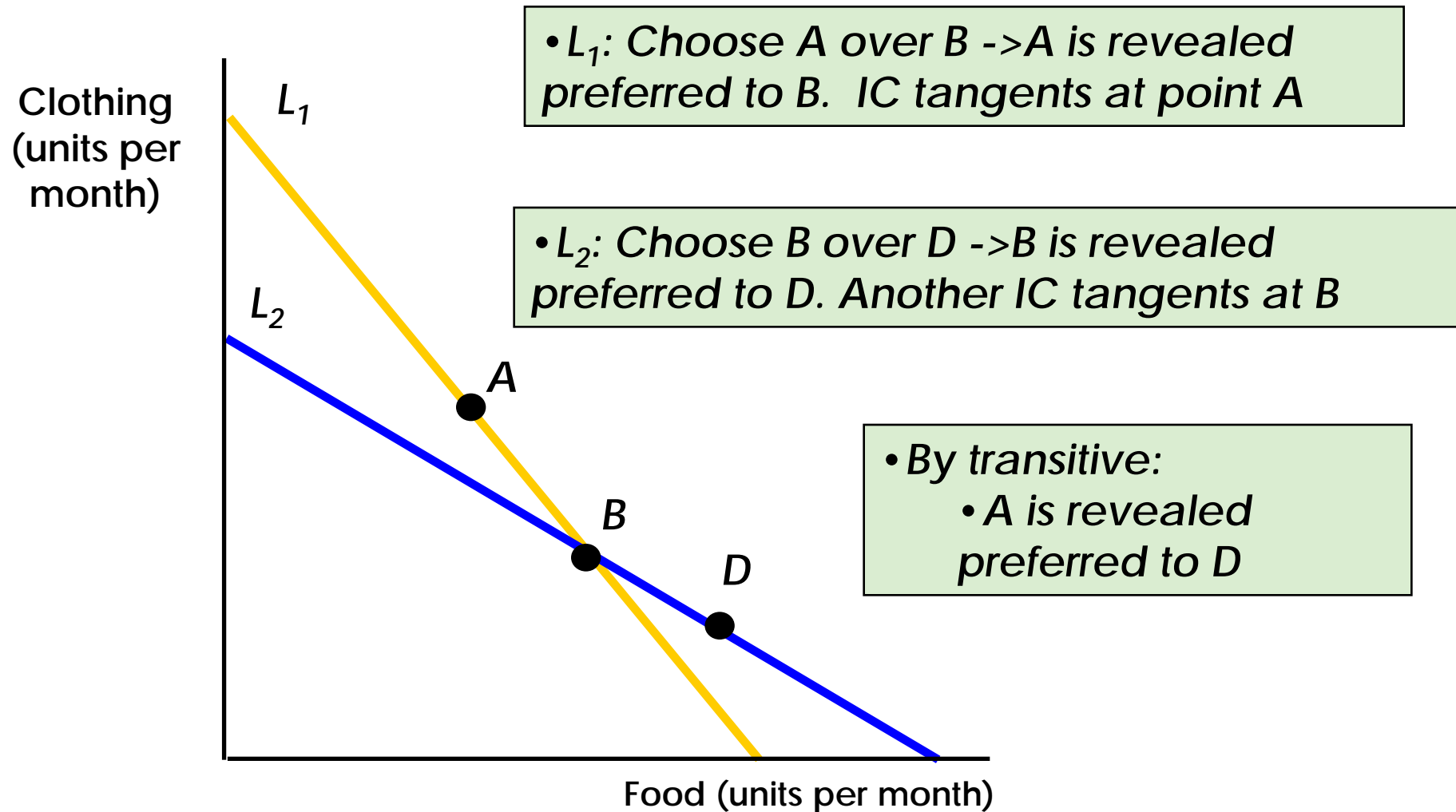
Hicks v.s. Slutsky Substitution Effect



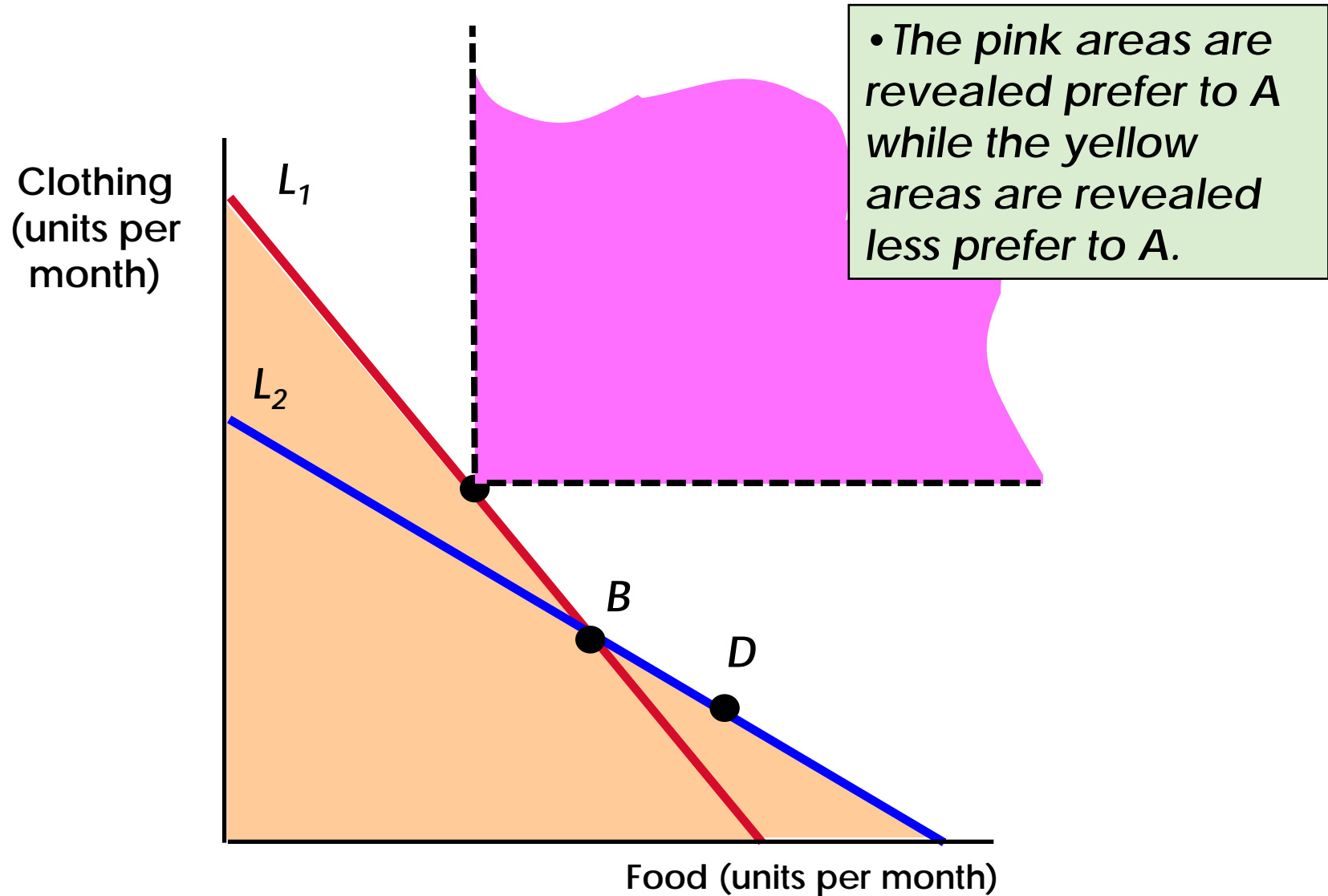
Revealed Preferences

- According to the theory, for given preferences, a consumer will choose bundle of goods subject to the budget constraint.
- In reality, preferences are unknown and unobservable.
- But if we know the choices a consumer has made, we can determine what their preferences are if we have information about a sufficient number of choices that are made when prices and incomes vary.
- [Read Varian, Ch. 7 - 8]

Revealed Preferences – Two Budget Lines



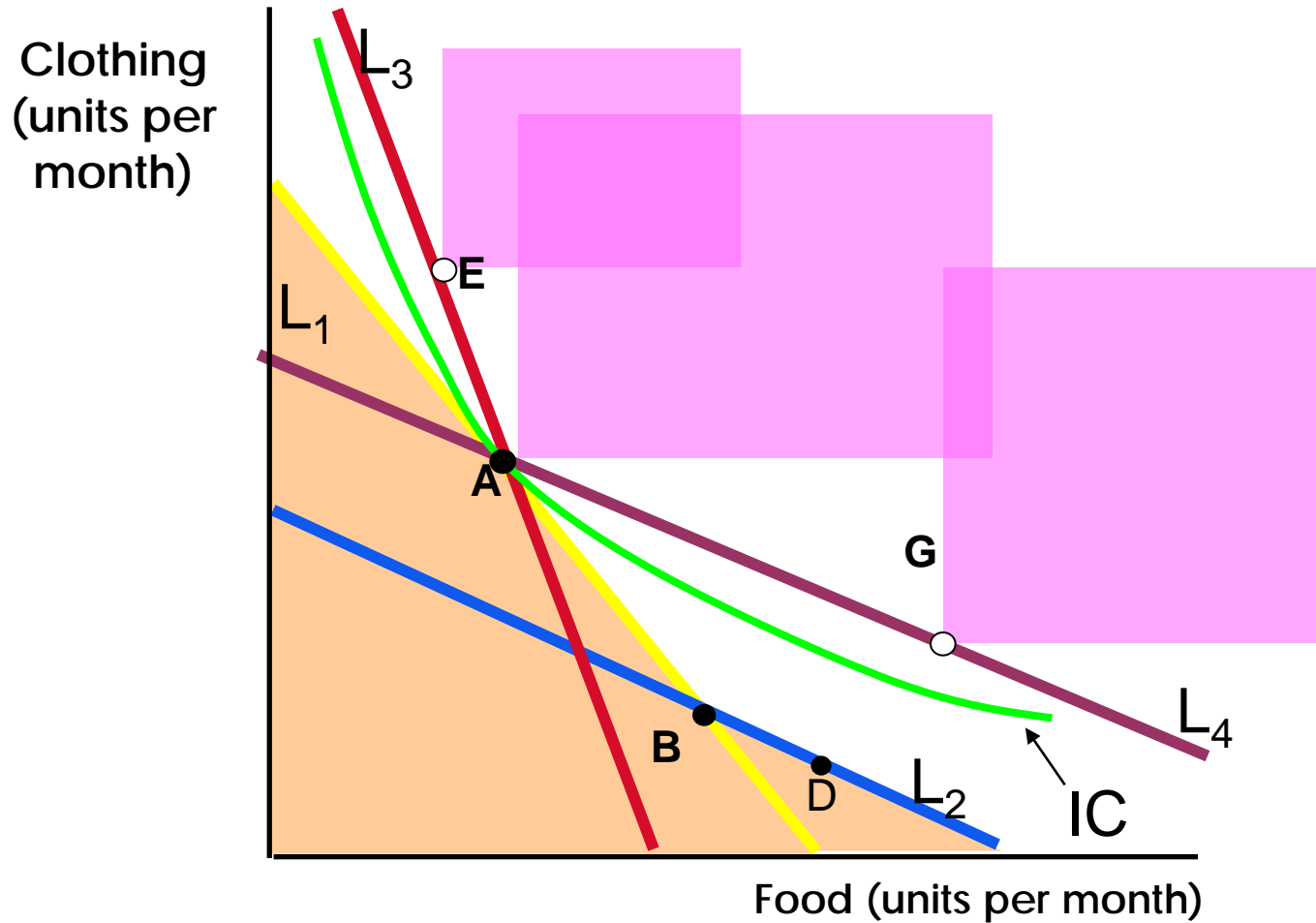
Revealed Preferences – Two Budget Lines



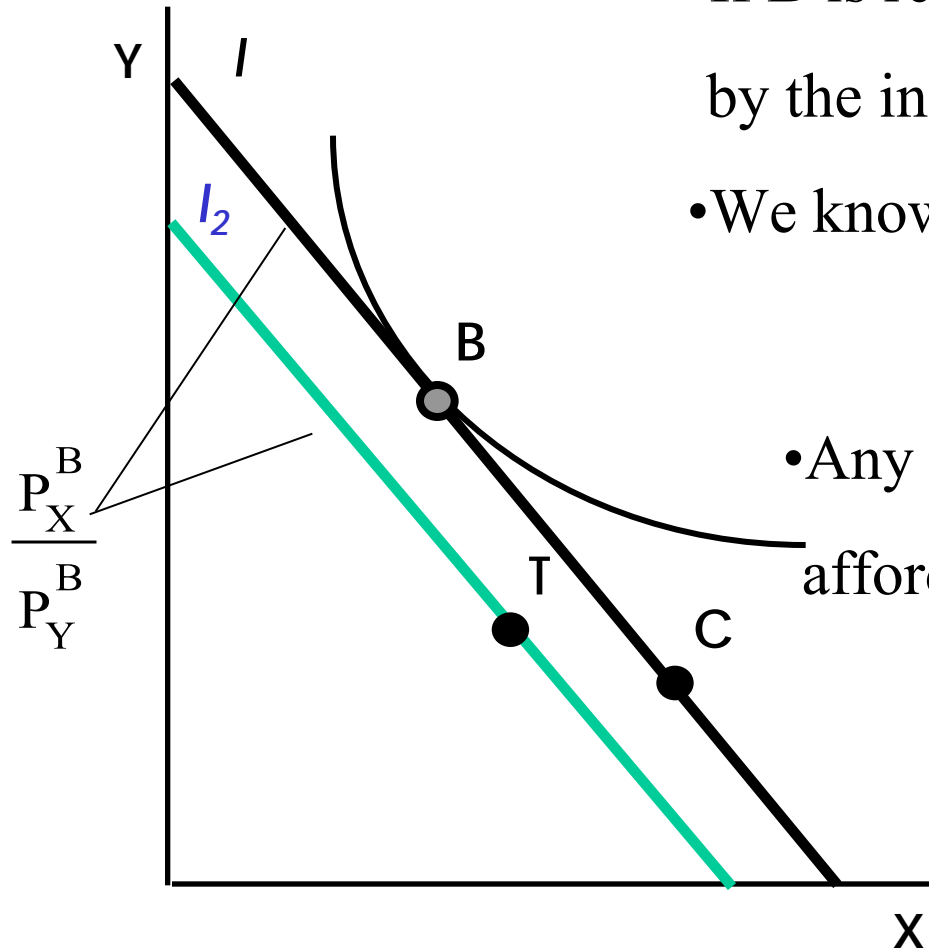
Revealed Preference

- As you continue to change the budget line, individuals can tell you which basket they prefer to others.
- The more the individuals reveal, the more you can discern about their preferences
- Eventually you can map out an indifference curve

Revealed preferences and the construction of an IC



Reveal preference condition



- If B is revealed prefer to any bundle affordable by the income I.
- We know that

$$P_X^B X^B + P_Y^B Y^B = I$$

- Any other bundle, such as T or C, is affordable by income I, hence

$$P_X^B X^T + P_Y^B Y^T \leq I$$

Reveal preference condition



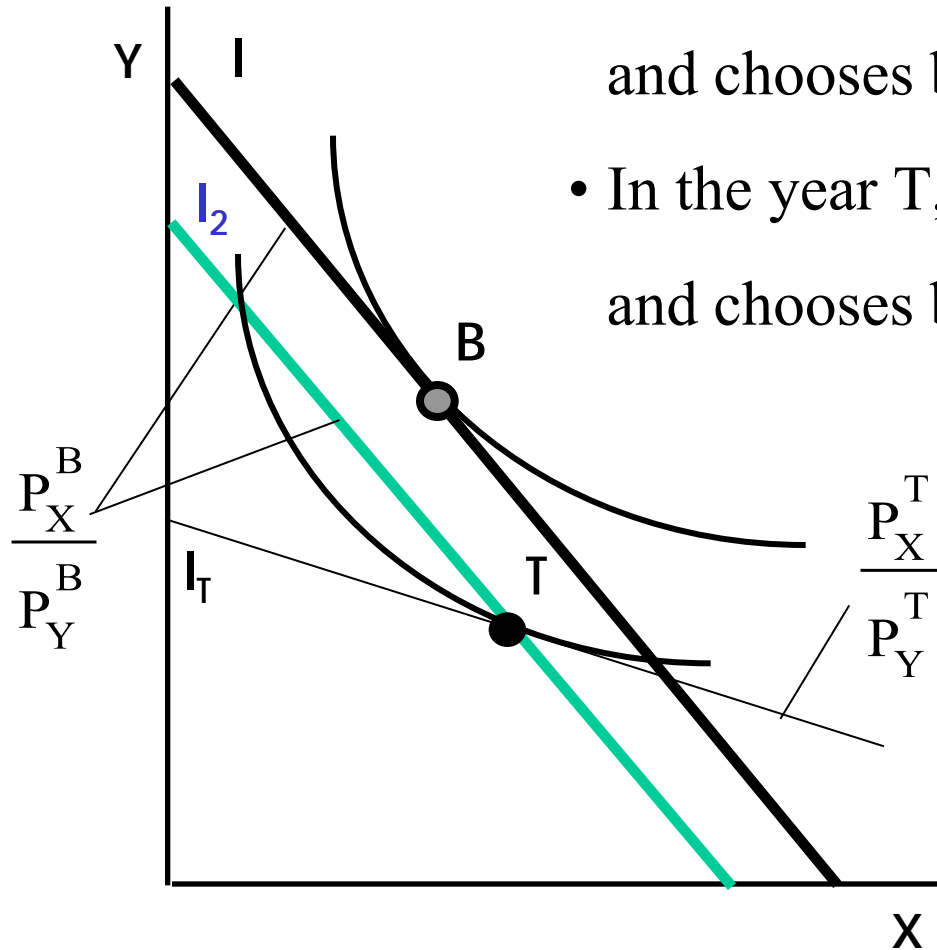
$$P_X^B X^B + P_Y^B Y^B = I$$

$$P_X^B X^T + P_Y^B Y^T \leq I$$

$$P_X^B X^B + P_Y^B Y^B \geq P_X^B X^T + P_Y^B Y^T$$

- For a given income I , if a consumer chooses bundle B , the expenditure for B must be greater than or equal to the expenditure for any other bundle.
- If the expenditure for bundle B is greater than or equal to the expenditure for bundle T and the consumer chooses B , B must be preferred to T .

Reveal preference condition



- In the base year, consumer is facing budget line I and chooses bundle B.
- In the year T, consumer is facing budget line I_T and chooses bundle T.

• If we know that

$$P_X^B X^B + P_Y^B Y^B \geq P_X^B X^T + P_Y^B Y^T$$

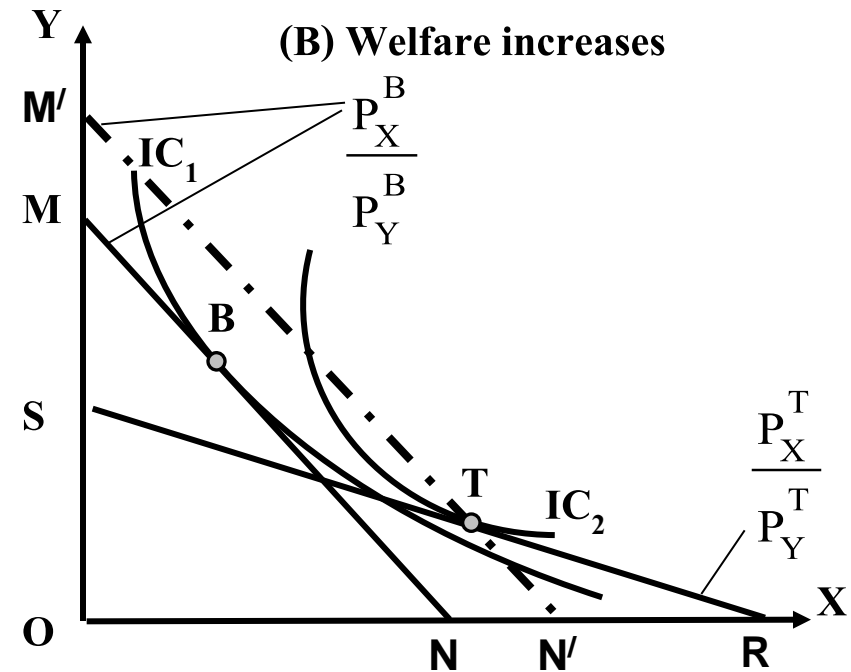
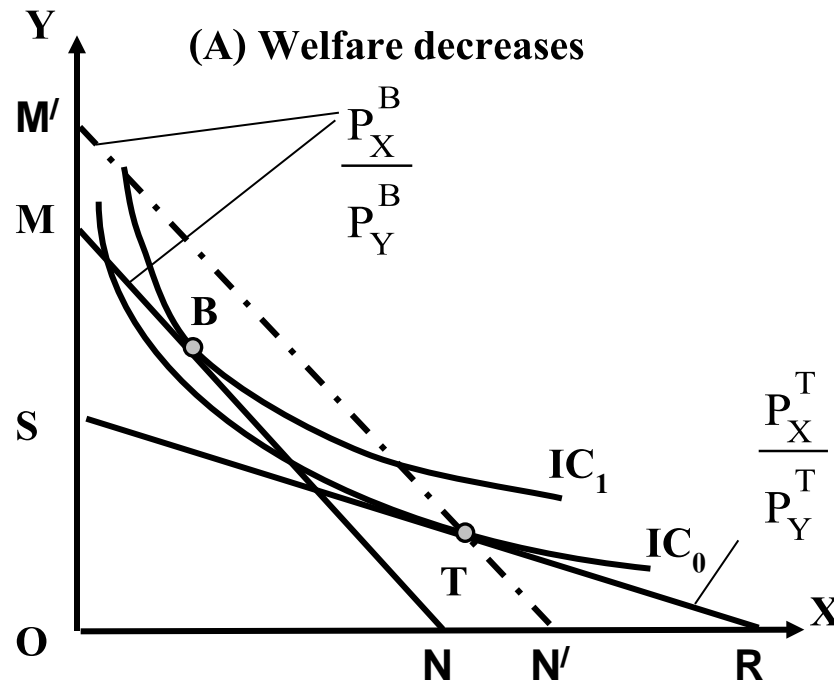
B must be preferred to T or the consumer is worse off at T compared to B.

Reveal preference condition



- However, we cannot conclude anything if

$$P_X^B X^B + P_Y^B Y^B < P_X^B X^T + P_Y^B Y^T$$



- This is because bundle T is not affordable in period B



Index numbers



- We may construct quantity indexes or price indexes to estimate welfare change from period B to period T.

Period	Prices	Quantities
Base (B)	P_X^B, P_Y^B	X^B, Y^B
Present time (T)	P_X^T, P_Y^T	X^T, Y^T

Quantity Indexes

$$I_Q = \frac{w_X X^T + w_Y Y^T}{w_X X^B + w_Y Y^B}$$

- where I_Q is a general form of quantity index; w_i is the weight for each good i .
- One possible weight is the price.
- **Laspeyres** uses the base period price in the past, **Paasche** uses the current period price.

Quantity Indexes

- **Laspeyres** uses the base period prices P^B as weights to construct **Laspeyres Quantity Index**

$$L_Q = \frac{P_X^B X^T + P_Y^B Y^T}{P_X^B X^B + P_Y^B Y^B} = \frac{\sum P_i^B Q_i^T}{\sum P_i^B Q_i^B}$$

- **Paasche** uses the period T prices P^T as weights to construct **Paasche Quantity Index**

$$P_Q = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^T X^B + P_Y^T Y^B} = \frac{\sum P_i^T Q_i^T}{\sum P_i^T Q_i^B}$$

Quantity Indexes

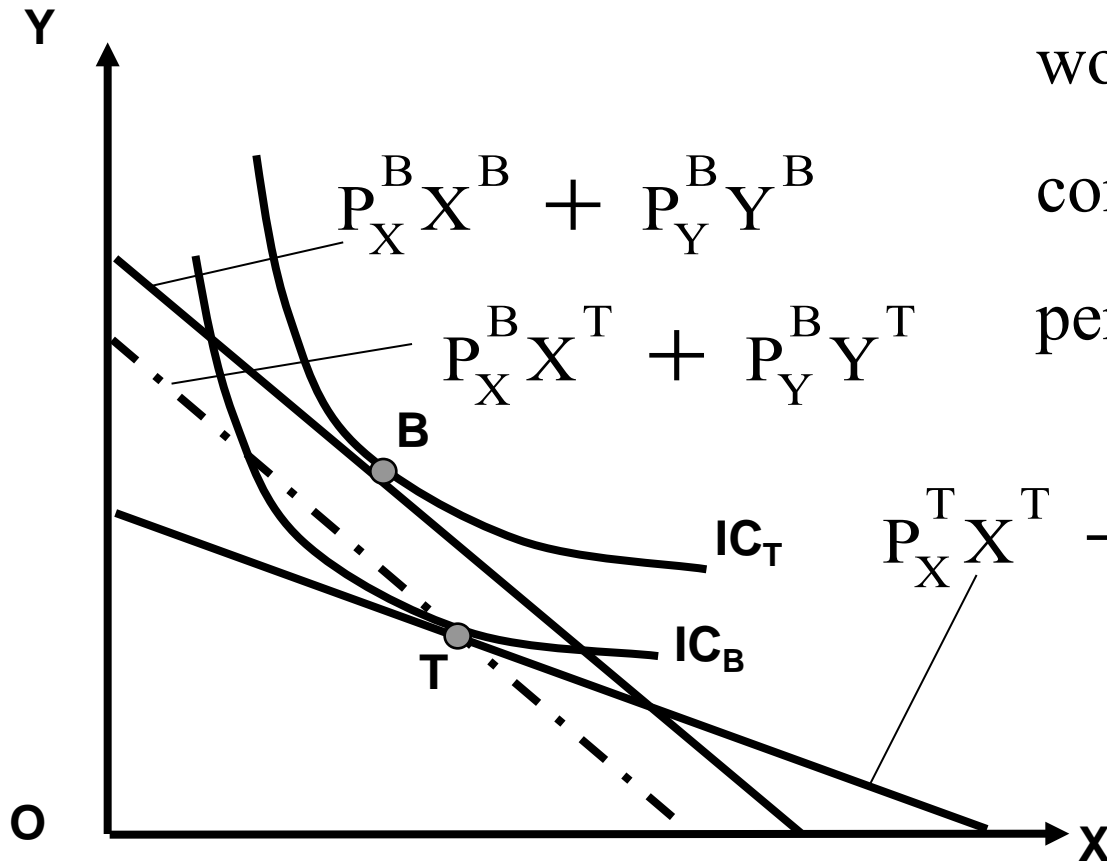
1) If L_Q is less than or equal to 1

$$L_Q = \frac{P_X^B X^T + P_Y^B Y^T}{P_X^B X^B + P_Y^B Y^B} \leq 1$$

$$P_X^B X^T + P_Y^B Y^T \leq P_X^B X^B + P_Y^B Y^B$$

- This is a reveal preference condition.
- Consumers choose B over T when both are affordable
-> **worse off in period T compared to the base period B.**

L_Q is less than or equal to 1



worse off in period T
compared to the base
period B.



Quantity Indexes

2) If L_Q is greater than 1

$$L_Q = \frac{P_X^B X^T + P_Y^B Y^T}{P_X^B X^B + P_Y^B Y^B} > 1$$

$$P_X^B X^T + P_Y^B Y^T > P_X^B X^B + P_Y^B Y^B$$

- This is **not** a revealed preference condition.
- It only tells that bundle T is not affordable in period B.
- **Inconclusive** about the welfare change.



Quantity Indexes

3) If P_Q is greater than or equal to 1

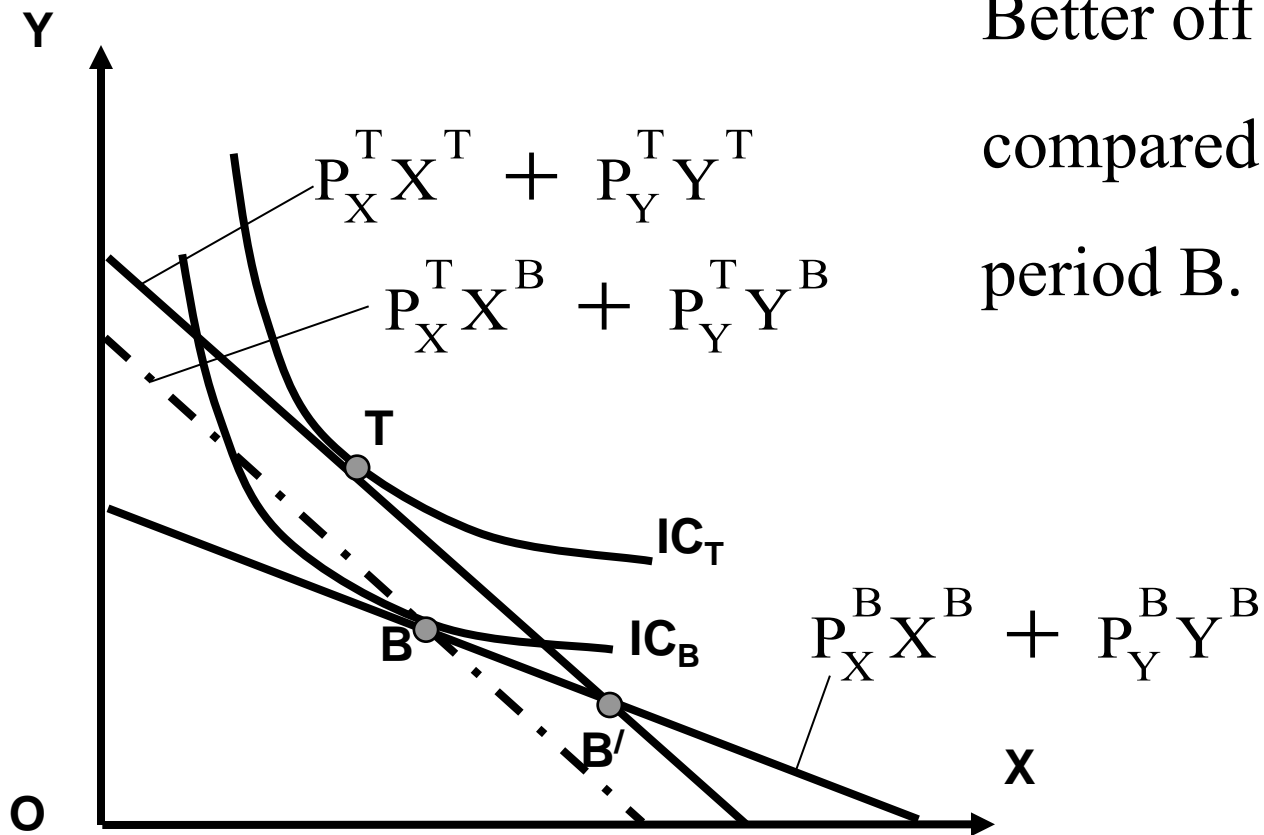
$$P_Q = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^T X^B + P_Y^T Y^B} \geq 1$$

$$P_X^T X^T + P_Y^T Y^T \geq P_X^T X^B + P_Y^T Y^B$$

- This is a reveal preference condition.
- Consumers choose T over B when both are affordable -> **Better off in period T compared to the base period B.**



P_Q is greater than or equal to 1



Better off in period T compared to the base period B.



Quantity Indexes

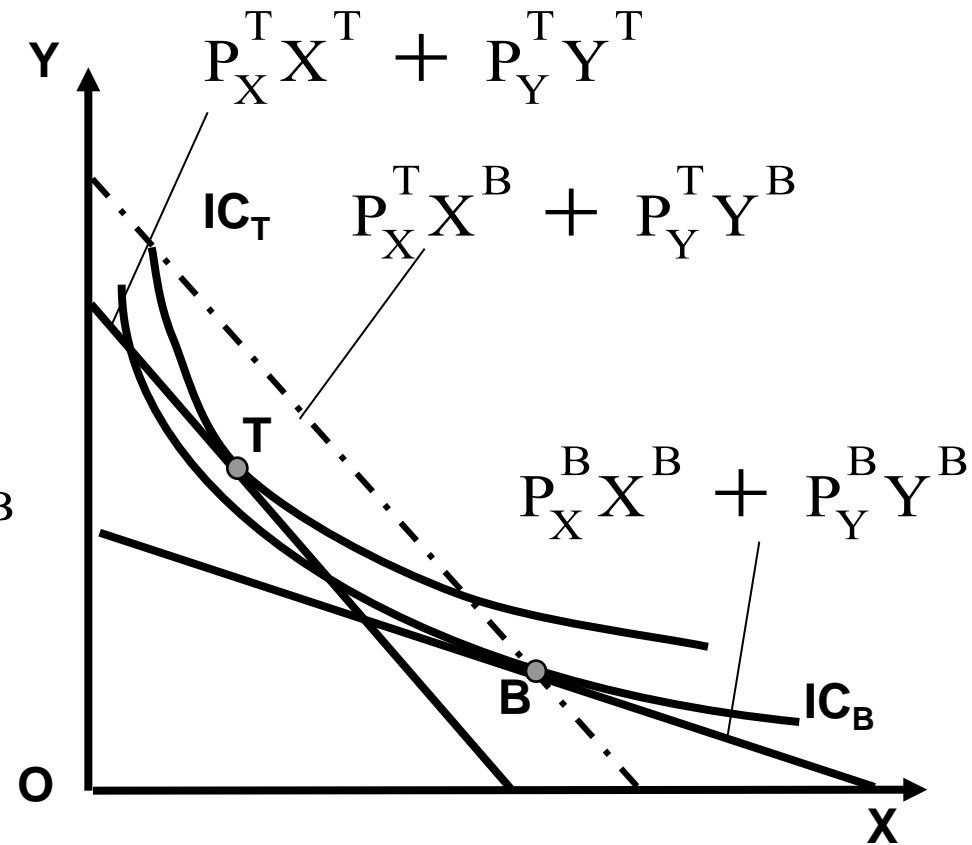
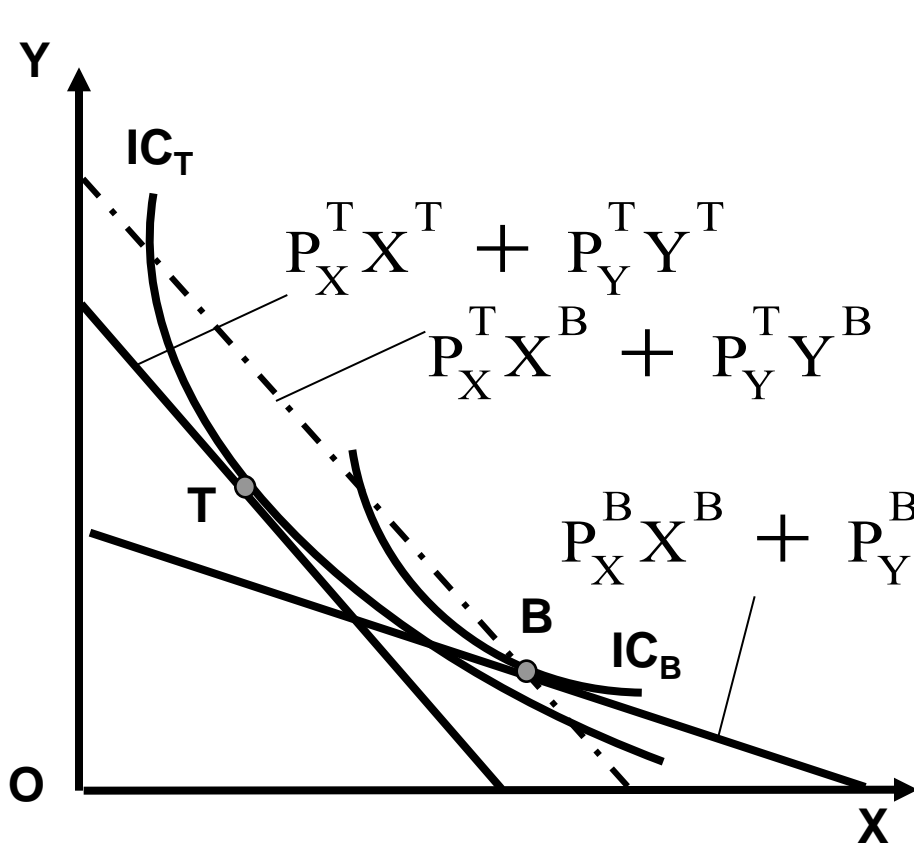
4) If P_Q is less than 1

$$P_Q = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^T X^B + P_Y^T Y^B} < 1$$

$$P_X^T X^T + P_Y^T Y^T < P_X^T X^B + P_Y^T Y^B$$

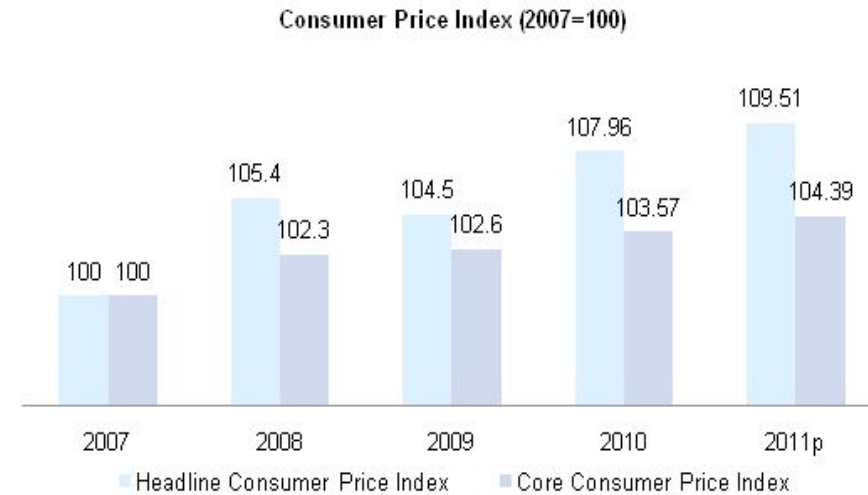
- This is **not** a revealed preference condition.
- Inconclusive about the welfare change.

Inconclusive when $P_Q < 1$



Price Indexes

$$I_P = \frac{w_X P^T + w_Y P^T}{w_X P^B + w_Y P^B}$$



- Where I_p is a general form of price index, w_i is the weight for each good i .
- One possible weight is the quantity.
- **Laspeyres** uses the base period quantity in the past,
Paasche uses the current period quantity.

Price Indexes

- **Laspeyres** uses the base period quantity Q^B as weight to construct

Laspeyres Price Index

$$L_P = \frac{P_X^T X^B + P_Y^T Y^B}{P_X^B X^B + P_Y^B Y^B} = \frac{\sum P_i^T Q_i^B}{\sum P_i^B Q_i^B}$$

- **Paasche** uses the period T quantity Q^T as weight to construct

Paasche Price Index

$$P_P = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^T + P_Y^B Y^T} = \frac{\sum P_i^T Q_i^T}{\sum P_i^B Q_i^T}$$

Price Indexes

- We cannot simply compare the price index with 1 as in the case of the quantity index.
- For instance if $P_p > 1$, this means

$$P_X^T X^T + P_Y^T Y^T > P_X^B X^T + P_Y^B Y^T$$

- This is not a reveal preference condition because the price on both sides are not the same.

Price Indexes

- To solve the problem we need to construct another index to help, called expenditure index.

$$M = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^B + P_Y^B Y^B} = \frac{\sum P_i^T Q_i^T}{\sum P_i^B Q_i^B}$$

- It is the ratio between the actual expenditure in period T and the actual expenditure in the base period.

Price Indexes

1) If L_P is less than or equal to M

$$L_P = \frac{P_X^T X^B + P_Y^T Y^B}{P_X^B X^B + P_Y^B Y^B} \leq \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^B + P_Y^B Y^B} = M$$

$$P_X^T X^B + P_Y^T Y^B \leq P_X^T X^T + P_Y^T Y^T$$

- This is the same as $P_Q > \text{or} = 1$.
- Consumers choose T over B when both are affordable -> **Better off in period T compared to the base period B.**

Price Indexes

2) If L_P is greater than M

$$L_P = \frac{P_X^T X^B + P_Y^T Y^B}{P_X^B X^B + P_Y^B Y^B} > \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^B + P_Y^B Y^B} = M$$

$$P_X^T X^B + P_Y^T Y^B > P_X^T X^T + P_Y^T Y^T$$

- This is the same as $P_Q < 1$.
- **Inconclusive** about the welfare change.

Price Indexes

3) If P_p is greater than or equal to M

$$P_p = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^T + P_Y^B Y^T} \geq \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^B + P_Y^B Y^B} = M$$

$$P_X^B X^B + P_Y^B Y^B \geq P_X^B X^T + P_Y^B Y^T$$

- This is the same as $L_Q < OR = 1$
- Consumers choose B over T when both are affordable
 -> **worse off in period T compared to the base period B.**

Price Indexes

4) If P_p is less than M

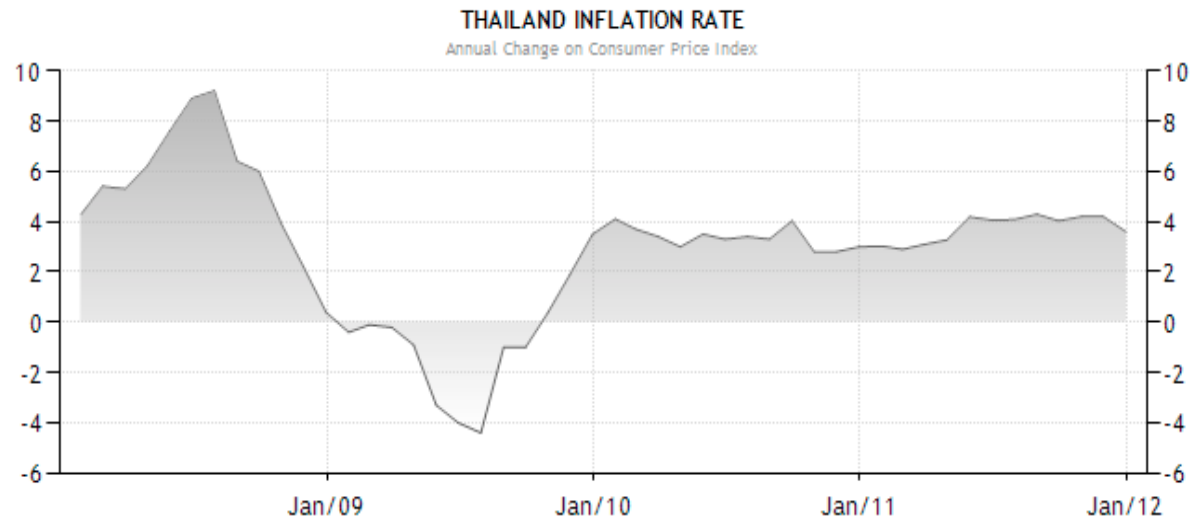
$$P_p = \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^T + P_Y^B Y^T} < \frac{P_X^T X^T + P_Y^T Y^T}{P_X^B X^B + P_Y^B Y^B} = M$$

$$P_X^B X^B + P_Y^B Y^B < P_X^B X^T + P_Y^B Y^T$$

- This is the same as $L_Q > 1$
- Inconclusive about the welfare change.

Cost-of-Living Indexes

- Social security payments can be adjusted to compensate for inflation.
- The inflation rate is calculated from the Consumer Price Index (CPI) based on Laspeyres price index.
- Should we increase the payments equal to the rate of increase of the CPI?



Cost-of-Living Indexes

- Laspeyres price index
 - Amount of money at current year prices that an individual requires to purchase a bundle of goods/services chosen in a base year divided by the cost of purchasing the same bundle at base-year prices

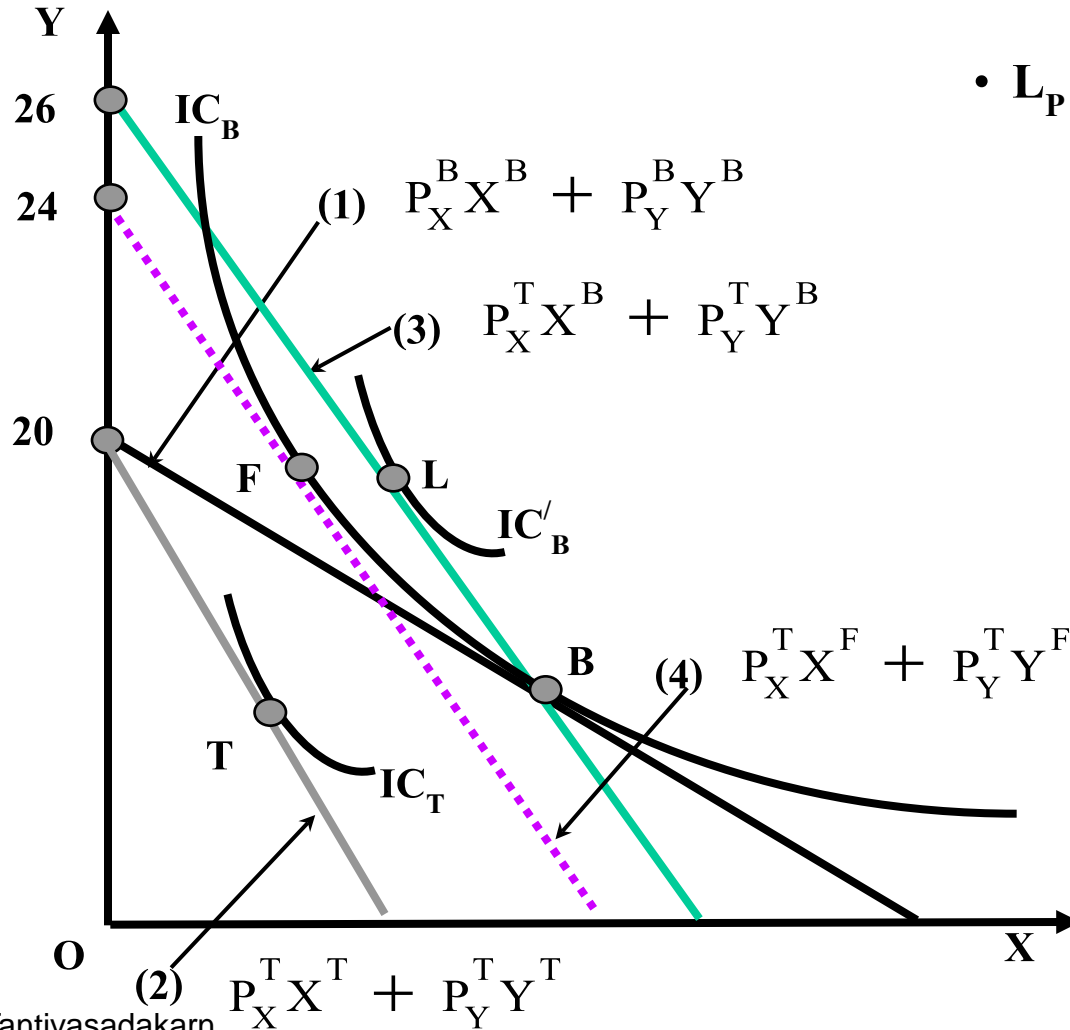
$$L_P = \frac{P_X^T X^B + P_Y^T Y^B}{P_X^B X^B + P_Y^B Y^B} = \frac{\sum P_i^T Q_i^B}{\sum P_i^B Q_i^B}$$

Cost-of-Living Indexes

- The Laspeyres price index assumes that consumers do not alter their consumption patterns as prices change
- Tend to overstate the true cost of living index
- Using the CPI to adjust retirement benefits will tend to overcompensate most recipients requiring greater government expenditure

Laspeyres price index overstates the cost of living

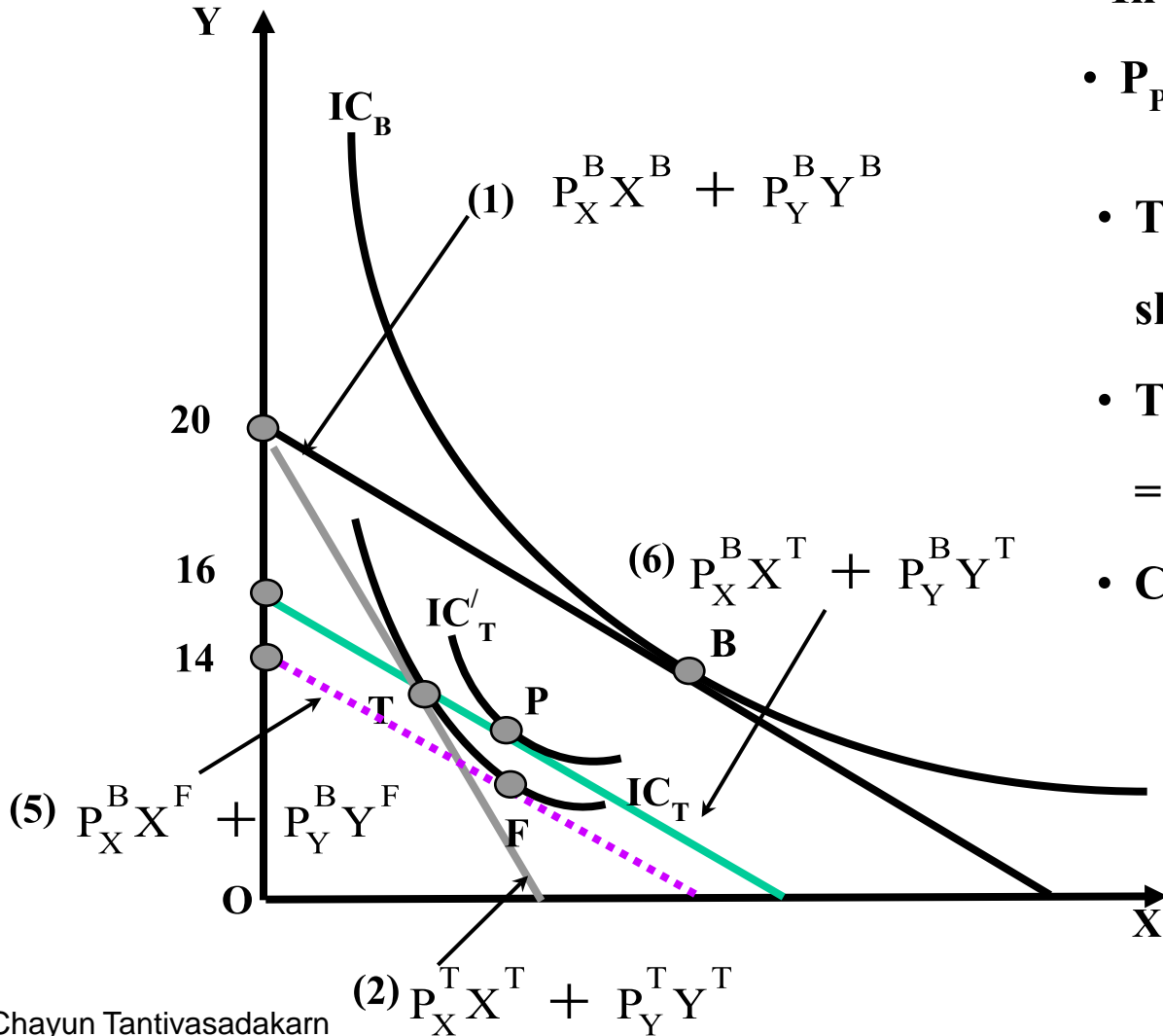
Assuming that $P_Y = 1$, Y axis also measure income.



- The expenditure in period B is (1) = 20.
 - In period T price of X increases.
 - $L_p =$ old bundle at new prices
old bundle at old prices
 - The income needed to compensate is only (4) - (2) = 24 - 20 = 4.
 - The income implies by L_p is (3) - (2) = 26 - 20 = 6.
 - Consume at L instead of F.
 - $L_p = (3)/(1) = 26/20 = 1.3$
 - True cost-of-living index = (4)/(1) = 24/20 = 1.2
- > over estimate

Paasche price index understates the cost of living

Assuming that $P_Y = 1$, Y axis also measure income.



- The expenditure in period B is (1) = 20.
- In period T price of X increases.
- $P_p = \frac{\text{new bundle at new prices}}{\text{new bundle at old prices}}$
- The income needed to compensate should be (1) - (5) = 20 - 14 = 6.
- The income implied by P_p is (1) - (6) = 20 - 16 = 4.
- Consume at P instead of F.
 - $P_p = (2)/(6) = 20/16 = 1.25$
 - True cost-of-living index = (2)/(5) = 20/14 = 1.43
 - --> under estimate

Fisher Ideal Price Index

- To solve the over and under estimate problems of both indices, Irving Fisher has proposed the Fisher Ideal Price Index

$$F_P = \sqrt{L_P \cdot P_P}$$