

Demand

Lecture 3

Reading: Perloff Chapter 4

August 2015

Introduction

- We saw the demand curve in chapter 2.
- We learned about consumer decision making in chapter 3.
- Now we bridge the gap between the two concepts.
- In this lecture, we see how the demand curve is derived.

- **Deriving demand curves** - Use consumer theory to see how a change in price causes a movement along demand.
- **Effects of an increase in income** - How does an income change affect demand?
- **Effects of a price increase** - How does the change in price affect demand?
- **Cost-of-Living Adjustment** - How do policy makers measure price changes?
- **Revealed preferences** - We can recover an individual's preferences by observing their demand.

Deriving the Demand Curve

- The **demand curve** plots quantity demanded against the price.
- If we want to draw my demand curve for beer, we need to find my optimal consumption of beer for different prices.
- We can do this derive demand graphically or analytically.

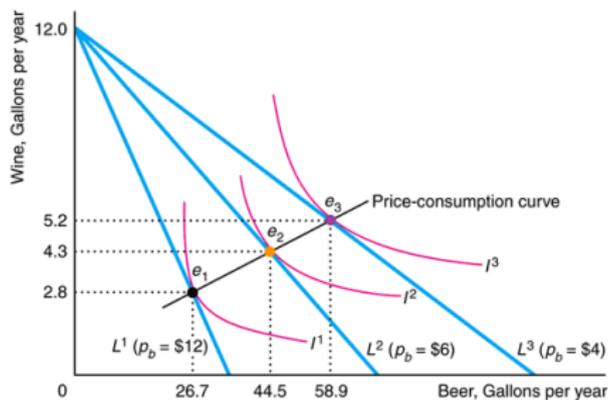
Deriving the Demand Curve

- We do it graphically first.
- The optimal bundle occurs where the indifference curve is tangent to the budget constraint.
- The intercepts of the budget constraint for goods q_1 and q_2 are $\frac{Y}{p_1}$ and $\frac{Y}{p_2}$.
- If the price of a good 1 decreases, the budget constraint will rotate out and we have a new optimal bundle.

Deriving the Demand Curve

- The **price consumption curve** traces the optimal consumption bundles for different prices.

(a) Indifference Curves and Budget Constraints

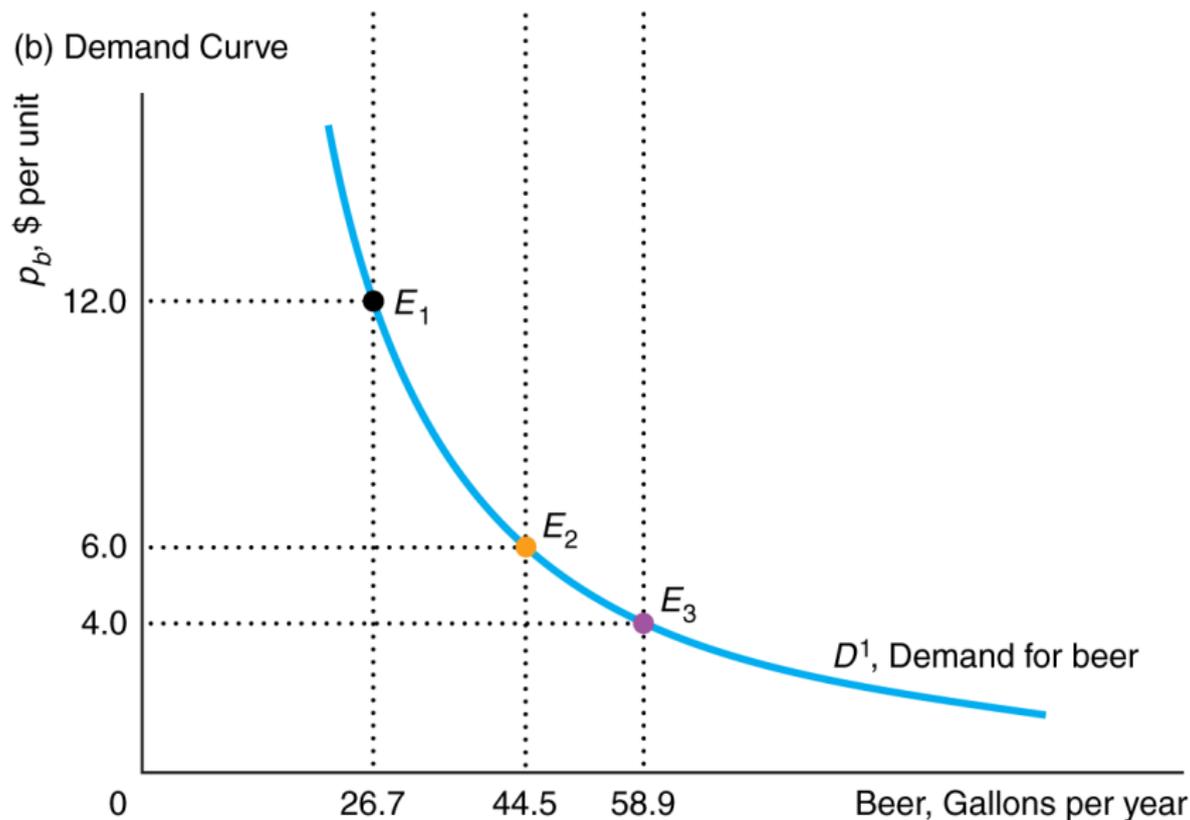


Deriving the Demand Curve

- I drink 26.7 gallons of beer when the price of beer is \$12, 44.5 gallons when it is \$6, and 58.9 gallons when it is \$4.
- Just plot these points in price of beer and gallons of beer consumed space and we have demand.

Deriving the Demand Curve

(b) Demand Curve



EXAMPLE

- Let's graphically derive the demand curve for wine (the good on the vertical axis).

Deriving the Demand Curve

- We can do the same thing using math.
- We want to find the optimal consumption of a good for different prices.

Deriving the Demand Curve

- If we have a Cobb Douglas utility function

$$U(q_1, q_2) = (q_1)^a (q_2)^{1-a}$$

- Knowing that the optimal bundle occurs where $MRS = \frac{p_1}{p_2}$ we can find the demand curves.
- The marginal rate of substitution is

$$\frac{MU_1}{MU_2} = \frac{\partial U / \partial q_1}{\partial U / \partial q_2} = \frac{a (q_1)^{a-1} (q_2)^{1-a}}{(1-a) (q_1)^a (q_2)^{-a}} = \frac{a}{1-a} \frac{q_2}{q_1}$$

Deriving the Demand Curve

- Set this equal to the price ratio to find the optimal consumption ratio.

$$\frac{a}{1-a} \frac{q_2}{q_1} = \frac{p_1}{p_2}$$
$$\Rightarrow \frac{a}{1-a} \frac{q_2}{q_1} p_2 = p_1$$

- Plug this into the budget constraint $Y = q_1 p_1 + q_2 p_2$ and solve for q_2 .

$$q_2 = (1-a) \frac{Y}{p_2}$$

- We would solve for p_2 and plug that into the budget constraint to find demand for q_1 .

EXAMPLE

- Find the demand curve for good x_1 for the utility function $U = x_1 x_2$.

EXAMPLE

- Find the demand curve for good x_1 for the utility function $U = \ln(x_1) + x_2$.
- What does this tell you about quasi-linear utility functions?

EXAMPLE

- Find the demand curve for x_1 for the utility function $U = \min\{x_1, x_2\}$.

EXAMPLE

- Find the demand curve for x_1 for the utility function $U = \max\{x_1, x_2\}$.

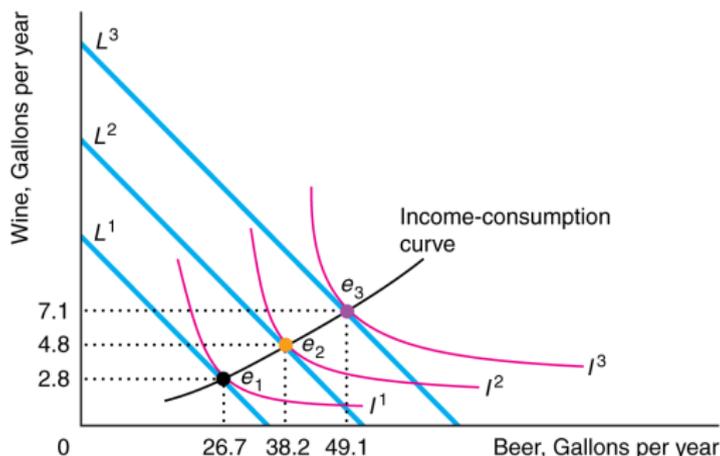
Effect of an Increase in Income

- If the price of beer changes, we move along the demand curve for beer.
- If something other than the price of beer changes (which affects how much beer you drink) the demand curve shifts.
- Now lets look at what happens when our income changes

Effect of an Increase in Income

- a change in income leads to a parallel shift in the budget constraint (the intercepts are $\frac{Y}{p_1}$ and $\frac{Y}{p_2}$, leading to a new optimal bundle).

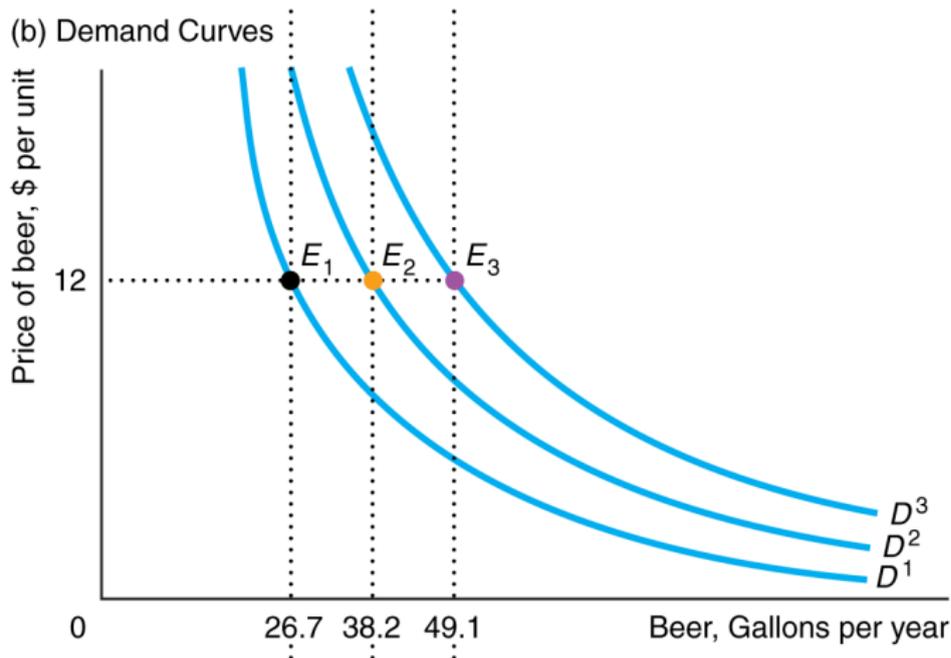
(a) Indifference Curves and Budget Constraints



- The **income consumption curve** plots the optimal consumption levels of beer and wine for different levels of income.

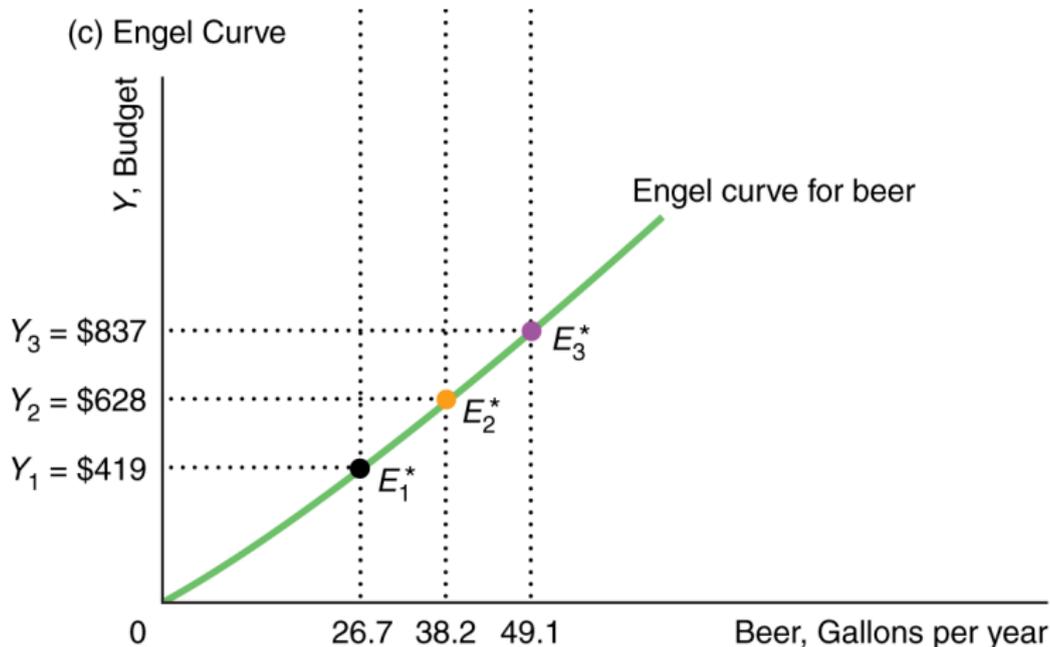
Effect of an Increase in Income

- Our income is higher. *At every price we will now demand more beer so our demand curve shifts right.*



Effect of an Increase in Income

- It is also useful to draw the **Engel curve**, which shows the relationship between quantity demanded of a single good and income.



Effect of an Increase in Income

- We mentioned **income elasticity of demand** before, this tells us the shape of the income consumption curve and the Engel curve.
- Income elasticity of demand ζ tells us the percentage change in quantity demanded to a given percentage change in income.

$$\zeta = \frac{\% \Delta Q}{\% \Delta Y} = \frac{\Delta Q / Q}{\Delta Y / Y} = \frac{\Delta Q}{\Delta Y} \frac{Y}{Q}$$

- and as ΔQ and ΔY go to zero we just use calculus

$$\zeta = \frac{\partial Q}{\partial Y} \frac{Y}{Q}$$

EXAMPLE

- Find the income elasticity of demand for the demand curve where $Y = 20$ is income and $q_2 = 1000$.

$$q_2 = 100Y - 10p_1$$

Effect of an Increase in Income

- Is this always positive?
- That is, does any increase in income always lead to an increase in quantity demanded?
- Of course not, there are some goods you only consume when you are poor.

Effect of an Increase in Income

- If $\xi > 0$, a good is a **normal good**, we demand more of it when income rises.
- If $\xi < 0$, it is an **inferior good**, we demand less of it when income rises.
- if $\xi > 1$, we say it is a **luxury good**, quantity demanded rises more in proportion to a person's income.
- If $0 \leq \xi \leq 1$ it is a **necessity**.

Effect of an Increase in Income

- Books

$$\xi = 1.44$$

- Restaurant Meals

$$\xi = 1.40$$

- Tobacco

$$\xi = .64$$

- Public Transportation

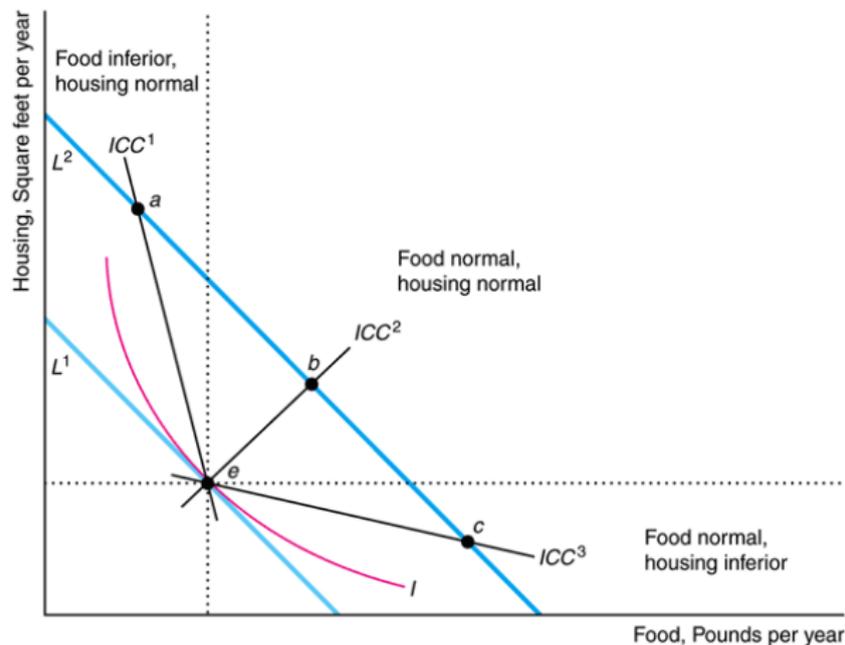
$$\xi = -.36$$

- Automobiles

$$\xi = 2.46$$

Effect of an Increase in Income

- The shape of the income consumption curve is determined by income elasticities.
- Income increases, do we consume more or less of a good?



EXAMPLE

- Is x_1 a normal good or an inferior good if the demand for x_1 is

$$x_1 = (1 - a) \frac{Y}{p_1}$$

EXAMPLE

- Draw the income consumption curve and the Engel curve for a good which is normal for low levels of income and inferior for high levels of income.

Effect of an Increase in Income

- It is not possible for all goods to be inferior.
- If both goods are inferior, the consumer would purchase less of both goods as income goes up.
- This new basket would like in her original budget set, this violates the axiom of revealed preferences.

Effects of a Price Increase

- What exactly happens when prices change?
- We can break a price change down into the **income effect** and the **substitution effect**.
- Income effect + substitution effect = total effect of a price change.

Effects of a Price Increase

- Suppose we have apples and oranges, and the price of apples decreases.
- Apples are now relatively cheaper than oranges.
- If we were to *hold utility constant*, the consumer will always substitute towards the relatively cheaper good.
- The substitution effect always works in this direction.

Effects of a Price Increase

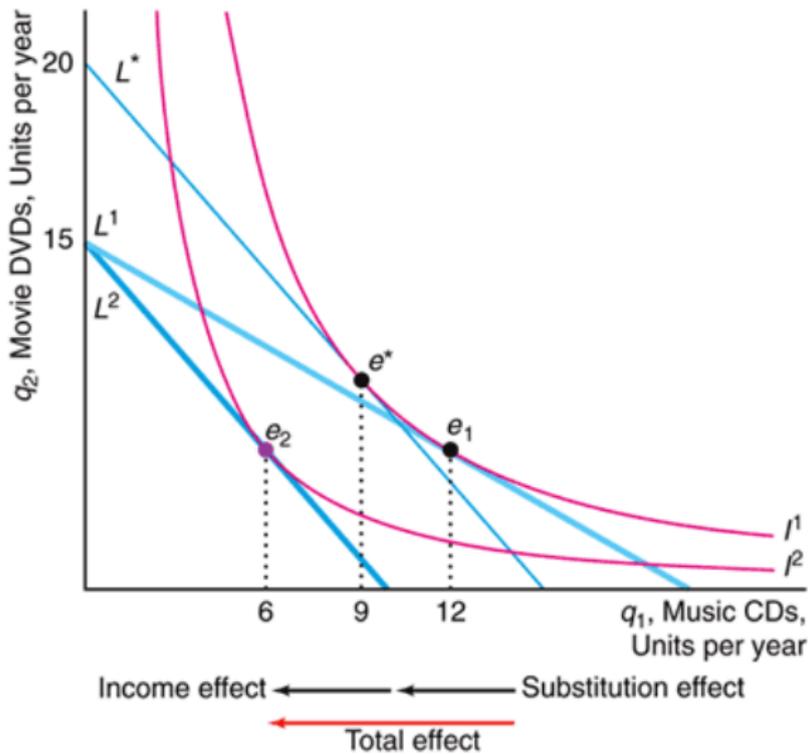
- BUT, the change in price changes the consumers purchasing power.
- If the price of apples went down, it is just as if I am richer. I can use the leftover money to purchase more apples or more bananas.
- The change in quantity demanded as a result of the change in purchasing power, holding relative prices constant, is the **income effect**.
- We don't always know which way this works.

Effects of a Price Increase

- Recall that if a good is inferior, an increase in income will cause you to consume less of that good.
- If a good is normal, an increase in income will cause you to consume more of that good.

Effects of a Price Increase

- Notice the income and substitution effect go the same way... the good below is normal.



Effects of a Price Increase

- With an inferior good, you eat less of it when your income goes up (and more when it goes down).
- The income and substitution effects work in opposite directions.

EXAMPLE

- Lets show the income and substitution effects when a good is inferior.

Effects of a Price Increase

- Suppose the price of q_1 decreases.
- The substitution effect will cause you to consume **more** q_1 .
- If q_1 is inferior, the income effect will cause you to consume **less** q_1 .
- If the income effect causes you to consume less of q_1 than you did initially, this good is a **Giffen good**.

Effects of a Price Increase

- That is, a decrease in the price will cause you to consume less of that good if it is Giffen.
- Giffen goods violate the law of demand (their demand curves slope upwards).
- Potatoes during the Irish potato famine were an example of a Giffen good.
- The price of potatoes went up and people started consuming more potatoes.

EXAMPLE

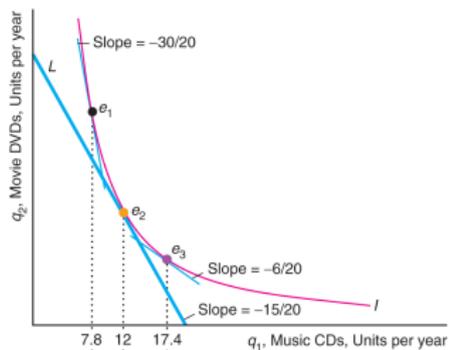
- Lets draw the income and substitution effects for a Giffen good.

Effects of a Price Increase

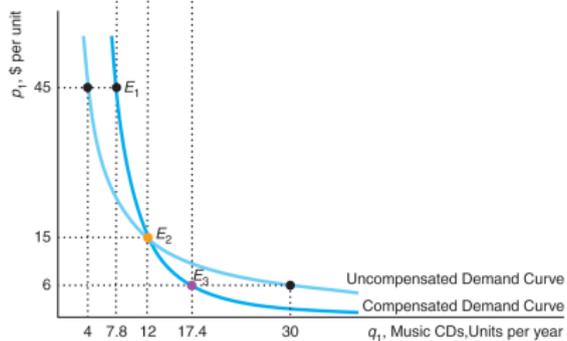
- At the start of the lecture, we derived the **Marshallian demand**.
- The Marshallian demand curve shows the total effect of a price change (both the income and substitution effect).
- **Compensated** (or Hicksian) looks at the change in demand from a price change resulting only from the substitution effect.
- Utility is constant at all points on the compensated demand curve.
- We cannot observe compensated demand because we cannot observe utility levels.

Effects of a Price Increase

(a) Indifference Curve and Budget Constraints



(b) Compensated and Uncompensated Demand Curves for CDs



Effects of a Price Increase

- The law of demand must hold for compensated demand curves.
Why?
- If the good is normal, the uncompensated demand curve will be shallower because the income effect reinforces the substitution effect.
- If the good is inferior, the uncompensated demand curve will be steeper because the income effect and substitution effect work in opposite directions.

EXAMPLE

- Graphically derive the compensated and uncompensated demand curves for an inferior good.

EXAMPLE

- Will the compensated demand curve of a Giffen good slope downwards? Why?

Effects of a Price Increase

- We saw price changes broken down into income and substitution effects on a graph.
- Now lets do it with math. This is called the **Slutsky equation**.

Effects of a Price Increase

- We want to know how demand changes when the price changes.
- We are looking for ε , the price elasticity of demand.
- The price elasticity of demand can be broken down into the income effect and the substitution effect.

Effects of a Price Increase

- ε^* the substitution elasticity of demand, the percentage change in demand for a given increase in price compensating the consumer to keep utility constant. (substitution effect)
- $\zeta * \theta$, which is the income elasticity of demand ζ times the share of budget spent on the good θ .

$$\varepsilon = \varepsilon^* + (-\theta * \zeta)$$

- The larger is the θ , the larger is the income share of the good. What does this tell you about Giffen goods?

EXAMPLE

- You spend $\frac{3}{4}$ of your income on potatoes. The income elasticity of demand for potatoes is -4 .
- The substitution elasticity of demand is -1 .
- What can you say about potatoes?

Cost of Living Adjustments

- The price of goods rise over time, and we have seen what consumers do when the price of goods rises.
- It is important to have an accurate measure of price changes. Think of long-term employment contracts which tract some measure of price changes.
- The government frequently uses the **consumer price index (CPI)**, which measures the cost of a given bundle of goods over time.

Cost of Living Adjustments

- The **consumer price index** identifies a "typical" basket of goods.
- For example, the basket of goods can be 3 bananas, 3 oranges and a car.
- The CPI measure the price of this basket of goods over time.

Cost of Living Adjustments

- Suppose the price of oranges increases much faster than the price of bananas.
- A contract which tracks the CPI would compensate you for the increase in the price of bananas... but ignores the fact that people will substitute towards oranges.
- The CPI overcompensates people for inflation by ignoring the fact that substitution towards cheaper goods occurs.

Cost of Living Adjustments

- We need a cost-of-living adjustment that takes the substitution into account.
- Utility is what we want to keep constant over time.
- Should give people just enough more money such that their utility remains the same.

Revealed Preferences

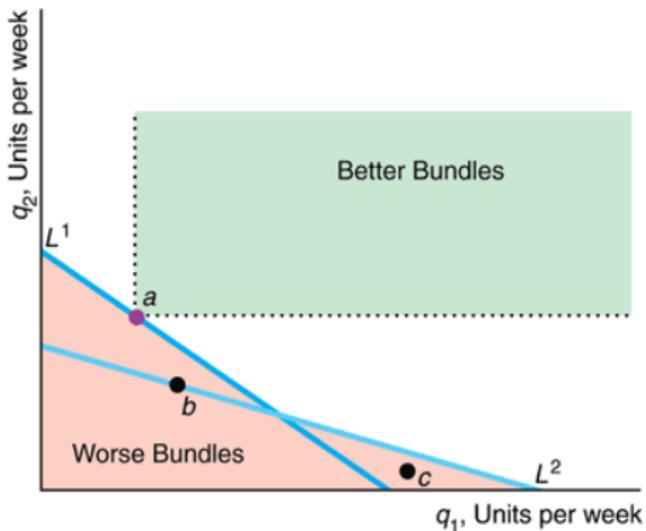
- It is never possible to exactly see people's preferences.
- Preferences can be recovered, however, by observing purchasing behaviour of individuals.
- Recovering preferences from observed behaviour is known as the **theory of revealed preferences**.

Revealed Preferences

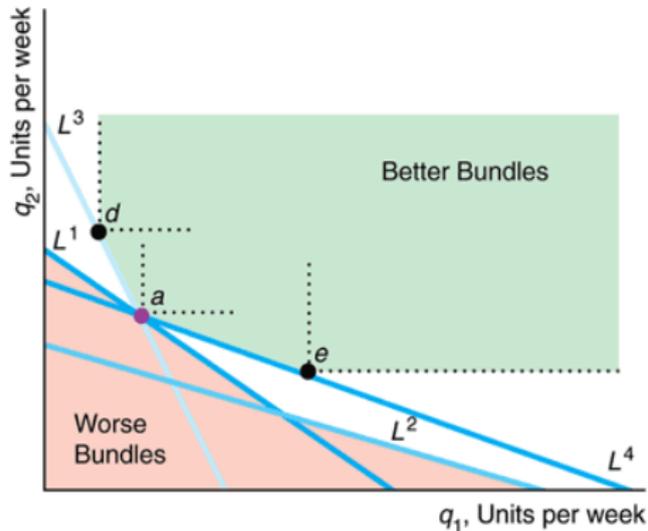
- For example.
- Suppose bundle a is more expensive than bundle b .
- If the consumer purchases bundle a , we can say that this individual prefers bundle a to bundle b .
- Both a and b were available, and the consumer picked a .
- As we observe the consumer's behaviour in more situations, we can learn more about her preferences.

Revealed Preferences

(a) Two budget constraints

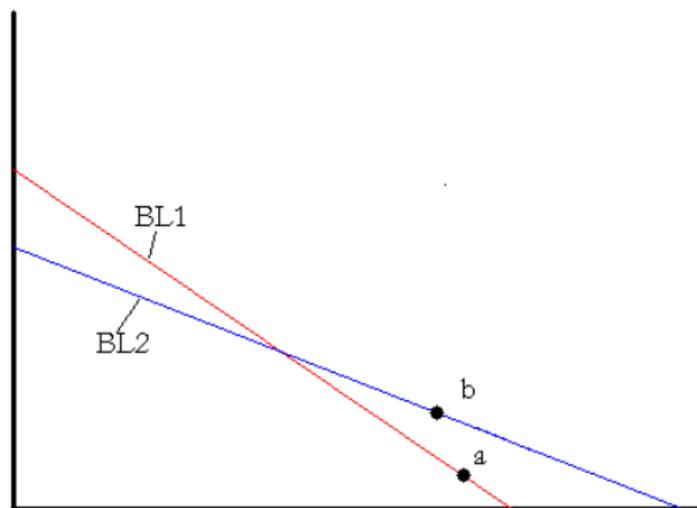


(b) Four budget constraints



EXAMPLE

- The consumer faces budget line BL1 yesterday and chose bundle *a*.
- The consumer faced budget line BL2 today and chose bundle *b*.
- Use the concept of revealed preferences to show she is better off today than yesterday.



Summary

- How do you derive the demand curve?
- What is the income consumption curve and the price consumption curve?
- What is the Engel curve?
- What is the substitution effect and income effect?

Summary

- What is an inferior good?
- What is a Giffen good?
- What is the difference between compensated and uncompensated demand?
- What is the Slutsky equation?
- Why does the CPI overcompensate for price changes?
- What are revealed preferences?