Lecture 5 - Theory of Demand

ECON 3070 - Intermediate Microeconomic Theory

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Overview

In previous lectures, we looked at how consumers rank bundles of goods, and how, given prices and their budget, they choose the utility maximizing bundle.

- We also considered several applications of this theory of consumer choice.

In this lecture, we will consider where a demand curve for a product comes from...

- ...and what happens to that demand curve when exogenous variables, such as prices or income, change.
- We will also extend the analysis to the labor-leisure tradeoff.

Optimal Choice and Demand

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Optimal Choice and Demand

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$$MU_x/p_x = MU_y/p_y$$

The Law of Demand says that as the price of x decreases, the quantity of x consumed increases.

Try It Yourself

Which of the following demand functions violates the law of demand?

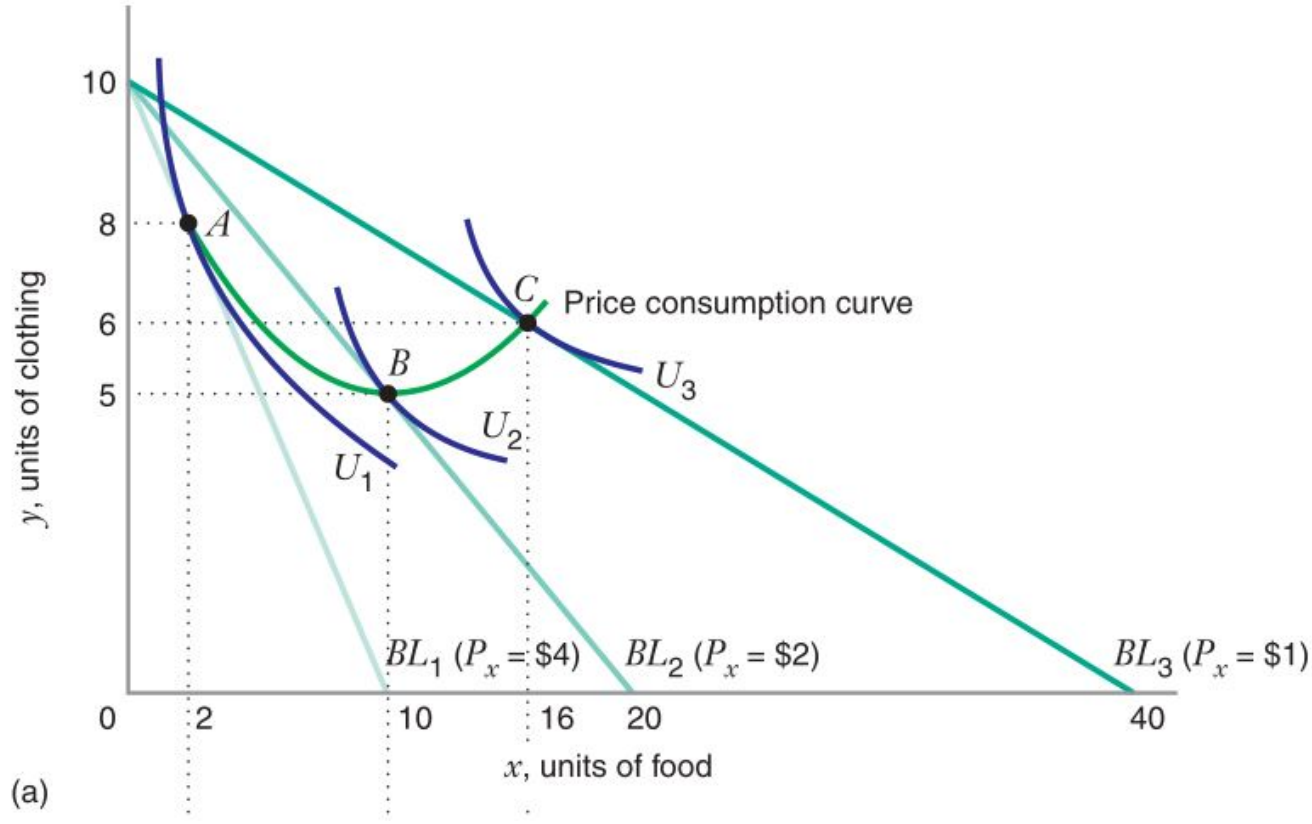
A) $x^*(P_x, P_y, I) = 20 - P_x + P_y$

B) $x^*(P_x, P_y, I) = \frac{20 - P_y}{I - P_x}$

C) $x^*(P_x, P_y, I) = \frac{20 * I}{P_x + P_y}$

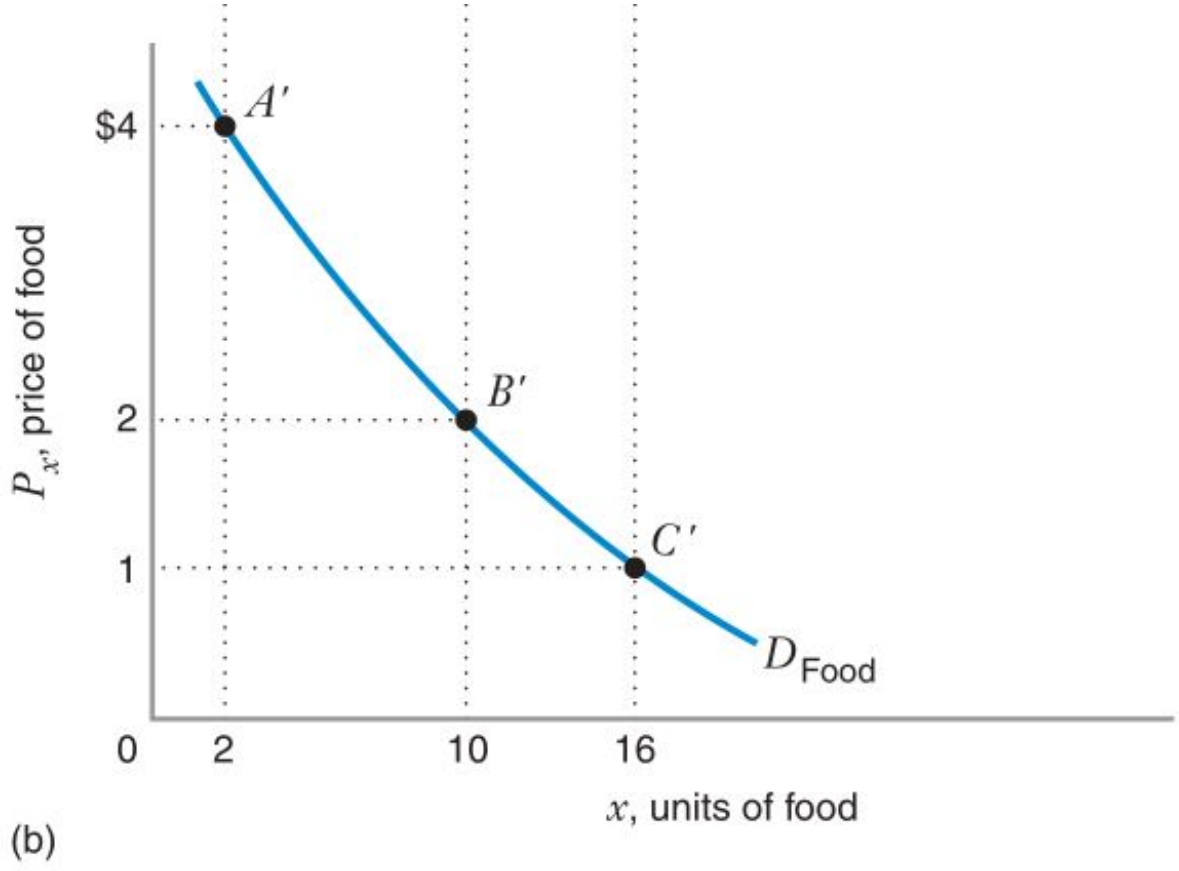
Optimal Choice and Demand

Below is a set of optimal bundles corresponding to various prices for good x. The line connecting these bundles is the **price consumption curve**.



Optimal Choice and Demand

These optimal bundles also map out the consumer's demand curve for good x.



Optimal Choice and Demand

Note that as we move further *along* the demand curve (i.e. as price falls), we reach higher and higher indifference curves.

Optimal Choice and Demand

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Remember that the demand curve represents a consumer's **willingness to pay** for a good. Two ways to think about the demand curve:

1. A consumer's demand curve tells us how much the consumer is willing to pay *for a given quantity*.
2. A consumer's demand curve tells us how much the consumer is willing to purchase *for a given price*.

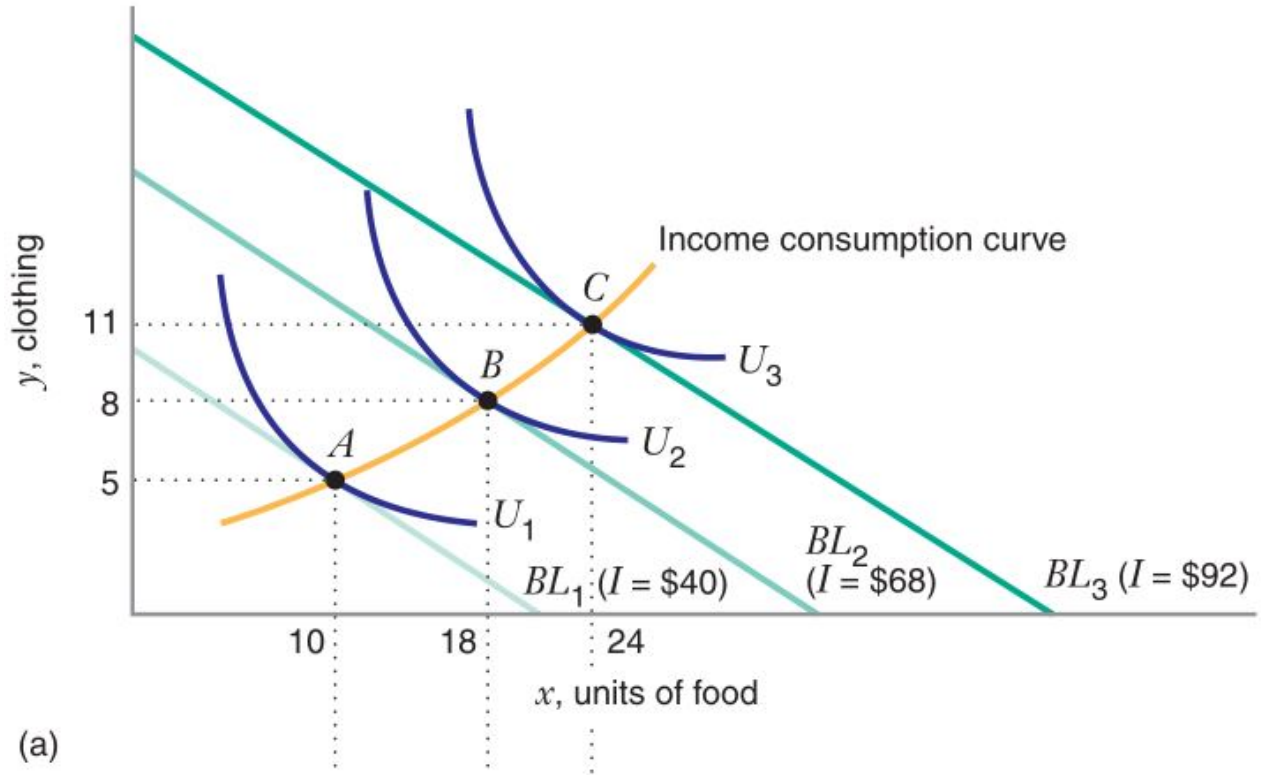
Optimal Choice and Demand

What about a change in income?

- We can also map out (in a similar way to the price-consumption curve) what happens to a consumer's demand when their *income* changes.
- This is called an **income consumption curve**.

Optimal Choice and Demand

Below is the set of optimal bundles corresponding to various income levels. The connecting line is the **income consumption curve**.



Optimal Choice and Demand

Remember that as income increases, the slope of the budget line doesn't change.

- Ratio of prices stays the same!

Optimal Choice and Demand

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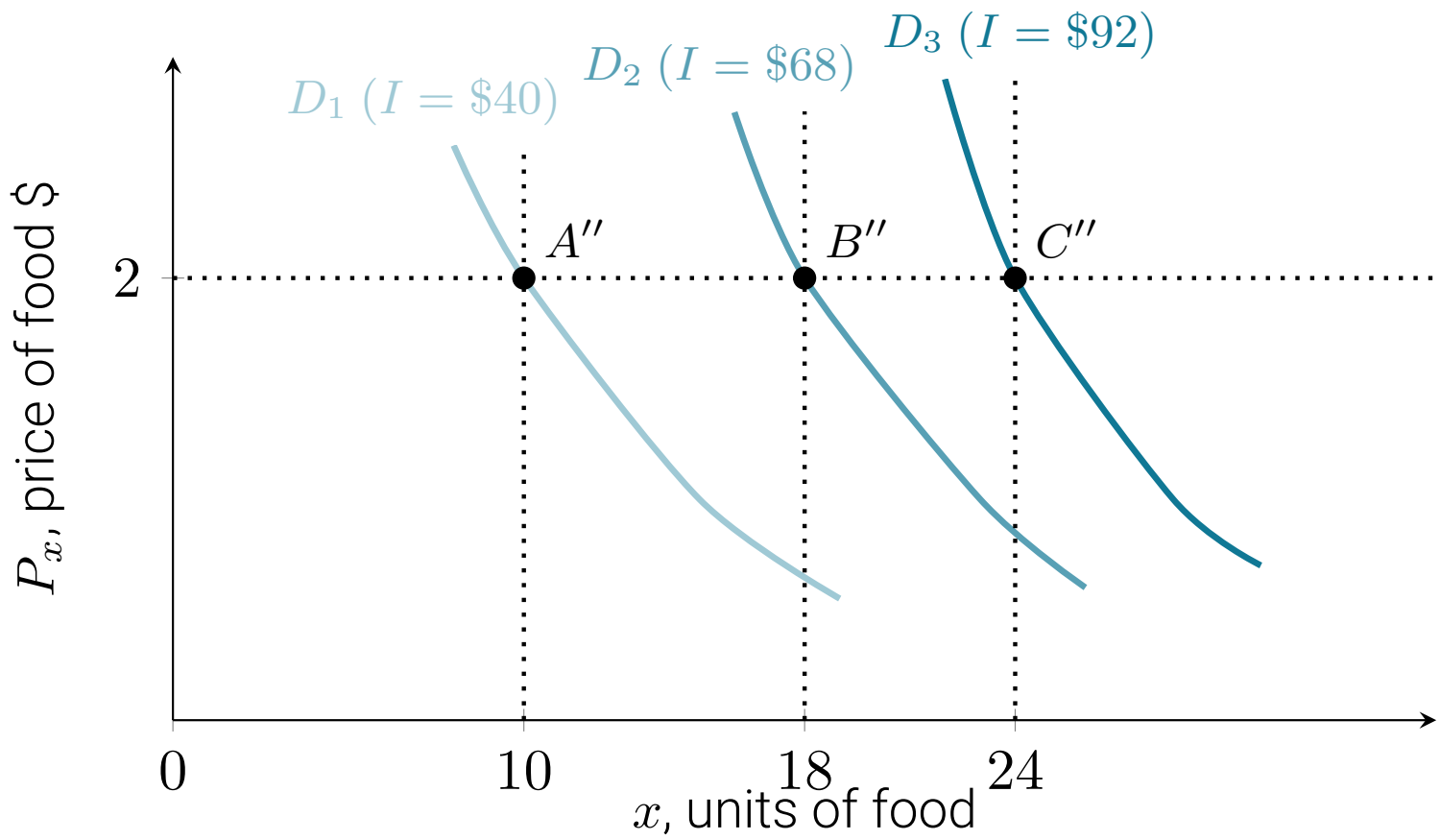
- Ratio of prices stays the same!

The optimal bundles derived from various income levels can be used to map out *shifts* of the demand curve (as in the following graph).

- The income consumption curve is *not always* upward sloping (e.g. stop buying ramen as your income grows)

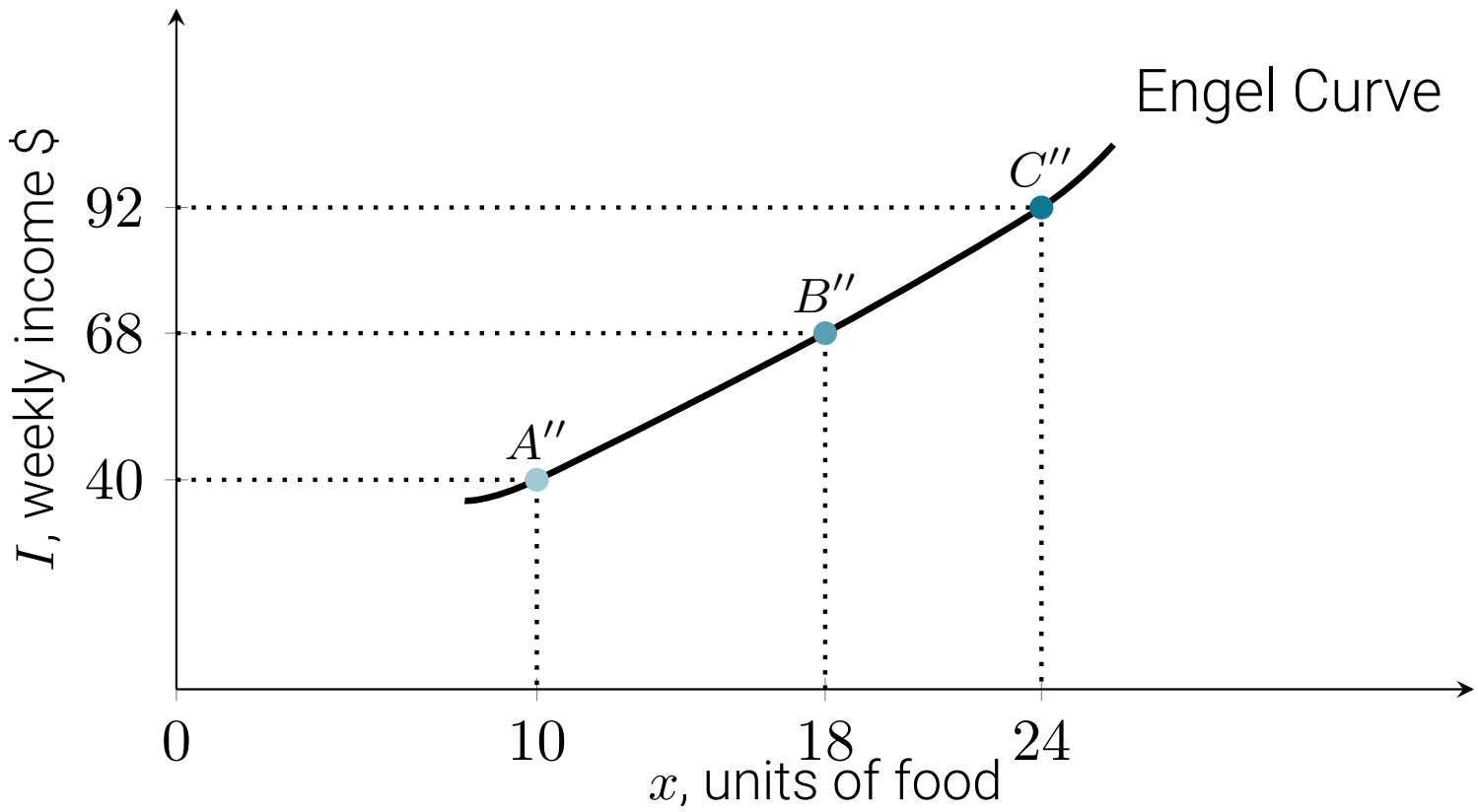
Optimal Choice and Demand

Below you can see how changes in income lead to shifts in the demand curve.



Engel Curves

Another way of showing how a consumer's demand for a particular good varies with income is to draw an **Engel curve** which relates quantity demanded to income



Engel Curves

If a consumer's Engel curve for a good is upward sloping (i.e. if as income rises, their consumption of the good increases), then the good is a **normal good**.

If the opposite is true, then the good is an **inferior good**.

Engel Curves

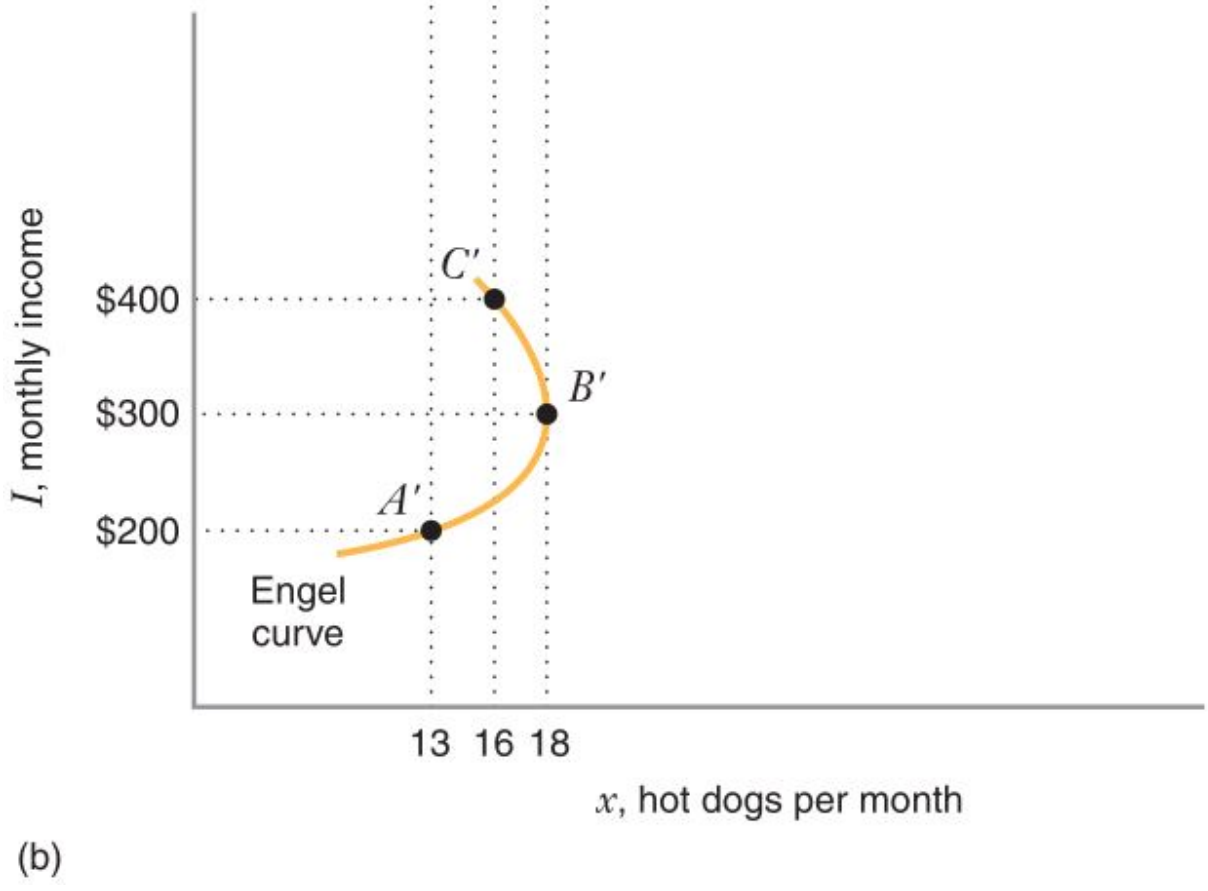
If a consumer's Engel curve for a good is upward sloping (i.e. if as income rises, their consumption of the good increases), then the good is a **normal good**.

If the opposite is true, then the good is an **inferior good**.

- It is possible for a good to be a normal good over some interval, and an inferior good over another interval.
- What are some examples of normal and inferior goods?

Engel Curves

In this example, hot dogs are a normal good when the consumer's income is lower, and an inferior good once their income is higher.



Try It Yourself

Which of the following product demand functions indicates that the good is an **inferior** good?

A) $x^*(p_x, I) = 2\frac{I}{P_x}$

B) $x^*(p_x, I) = 2 * I * P_x$

C) $x^*(p_x, I) = 2 * I * (10 - P_x)$

D) $x^*(p_x, I) = 2\left(\frac{40-I}{P_x}\right)$

Substitution and Income Effects

Previously, we looked at the overall effect of changes in prices and income on demand for two goods.

Here we will break that overall effect into two parts:

1. One due to the change in marginal utility per dollar of the affected good MU_x/p_x
2. The other due to the fact that that I/p_x increases

Substitution and Income Effects

1. The **substitution effect** refers to the change in demand caused by a change in the relative prices of two goods.
2. The **income effect** refers to the change in demand for a good caused by a change in the consumer's *purchasing power* due to the price change.

Substitution and Income Effects

Consider a case where the price of good x decreases

Substitution Effect

At the original bundle, MU_x/p_x is now greater than MU_y/p_y (since before the price changes, the two were equal)

You can now reach the same level of utility for less money by buying less of y and more of x. This is the **substition effect**

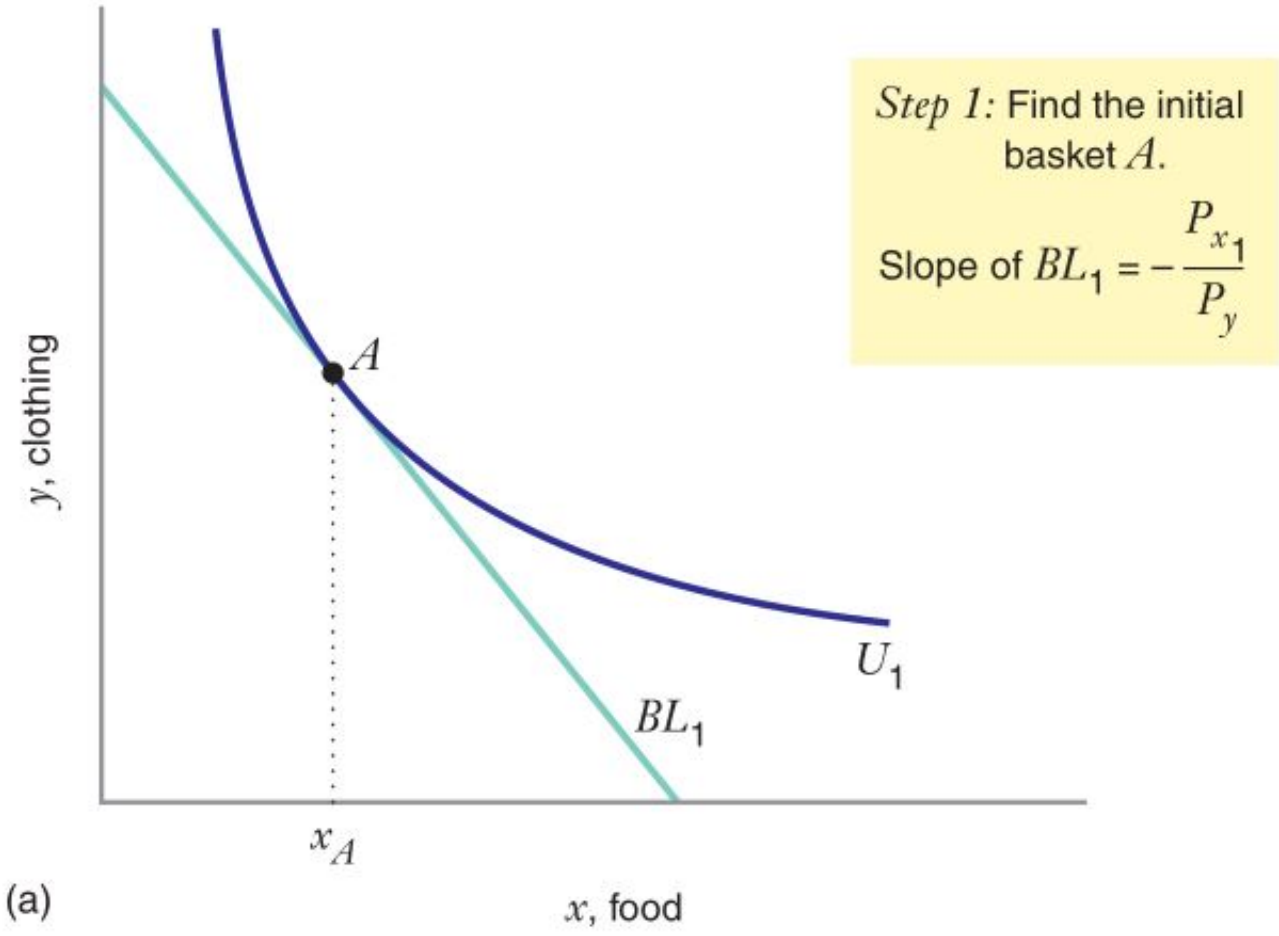
Income Effect

The **substitution effect** told use we reached the original utility for less money. So we have money left to spend.

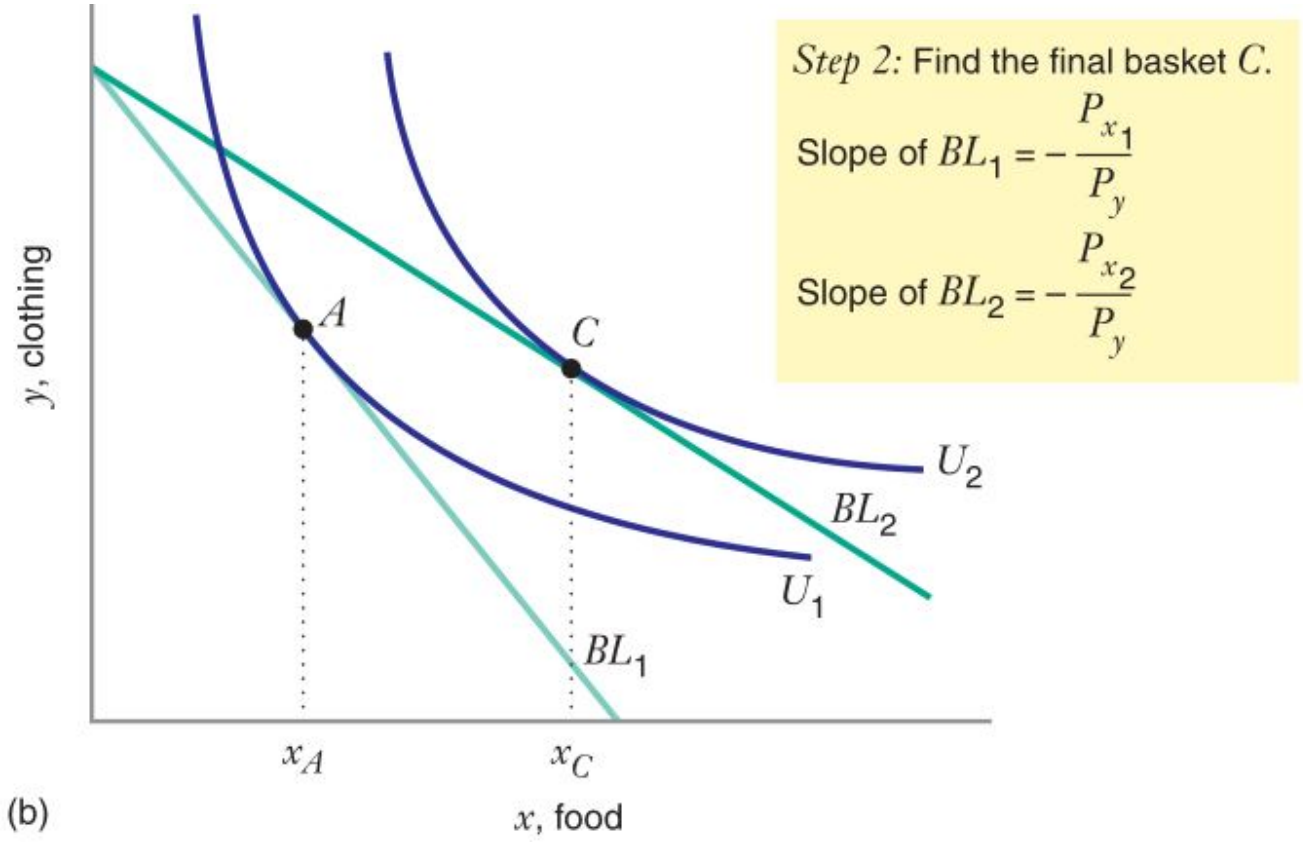
The additional consumption is the **income effect**!

Substitution and Income Effects

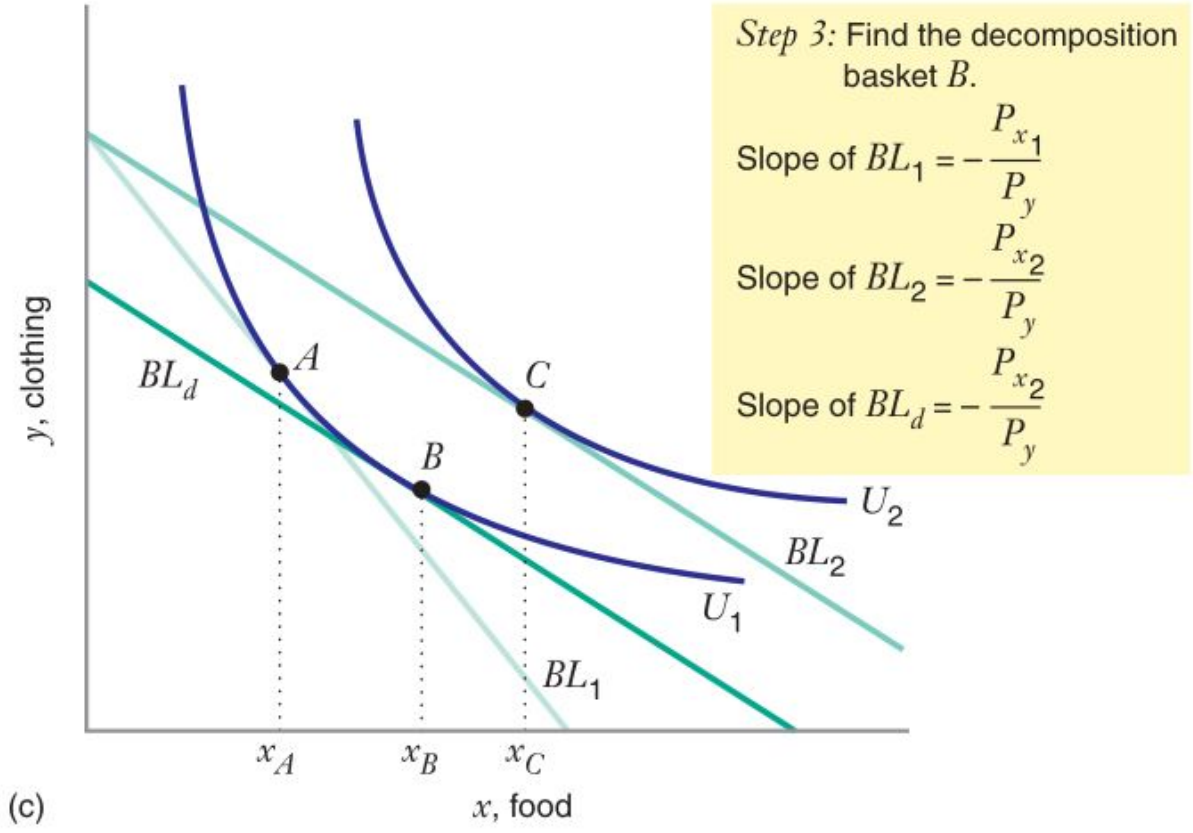
On the following slides, we will look at how to graphically decompose a price change into income and substitution effects.



Substitution and Income Effects

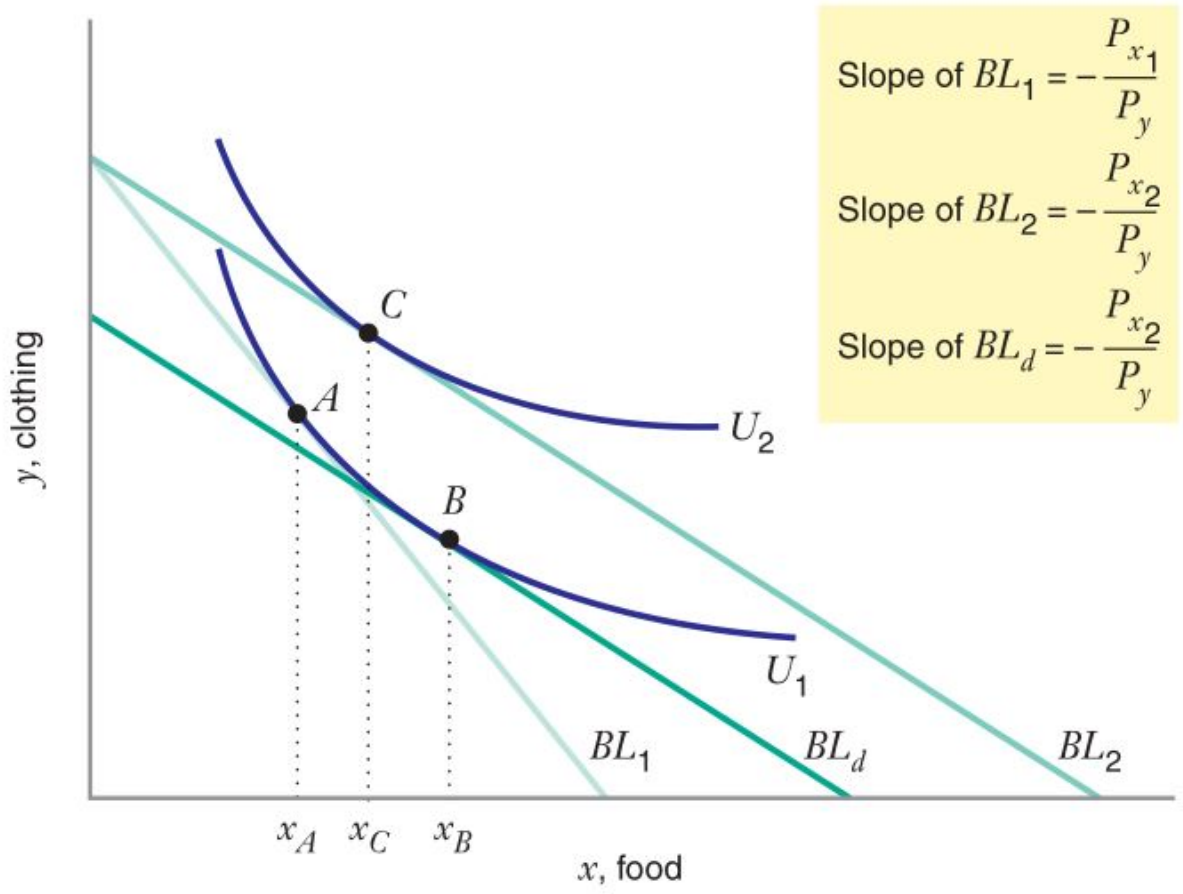


Substitution and Income Effects



Notice that in this case, the income effect leads to an increase in consumption of good x. That is, food is a normal good.

Substitution and Income Effects



This is a case where food is an inferior good. The income effect leads to a decrease in consumption of good x.

Substitution and Income Effects

For both normal and inferior goods, the overall effect of an increase in price is a decrease in demand.

- For normal goods, both the income and the substitution effects are negative.
- For inferior goods, the income effect is positive, but the substitution effect is negative, and the overall effect is negative.

Try It Yourself

Suppose that peanut butter is an inferior good for many people.

If the price increases, then would we expect demand for good x to increase or decrease as a result of the substitution effect? What about due to the income effect?

A) Increase, increase

B) Increase, decrease

C) Decrease, increase

D) Decrease, decrease

Estimating Changes in Consumer Welfare

Suppose the government wants to impose a tax on fast food. How can we measure the impact on consumer welfare?

- As we've talked about, we are not able to measure utility directly.
- But maybe we can measure changes to consumer wellbeing in monetary terms.
- We can do this in a few different ways.

Consumer Surplus

Consumer Surplus is the difference between the maximum amount that a consumer is *willing to pay* for a good and the amount they must *actually pay* in the marketplace.

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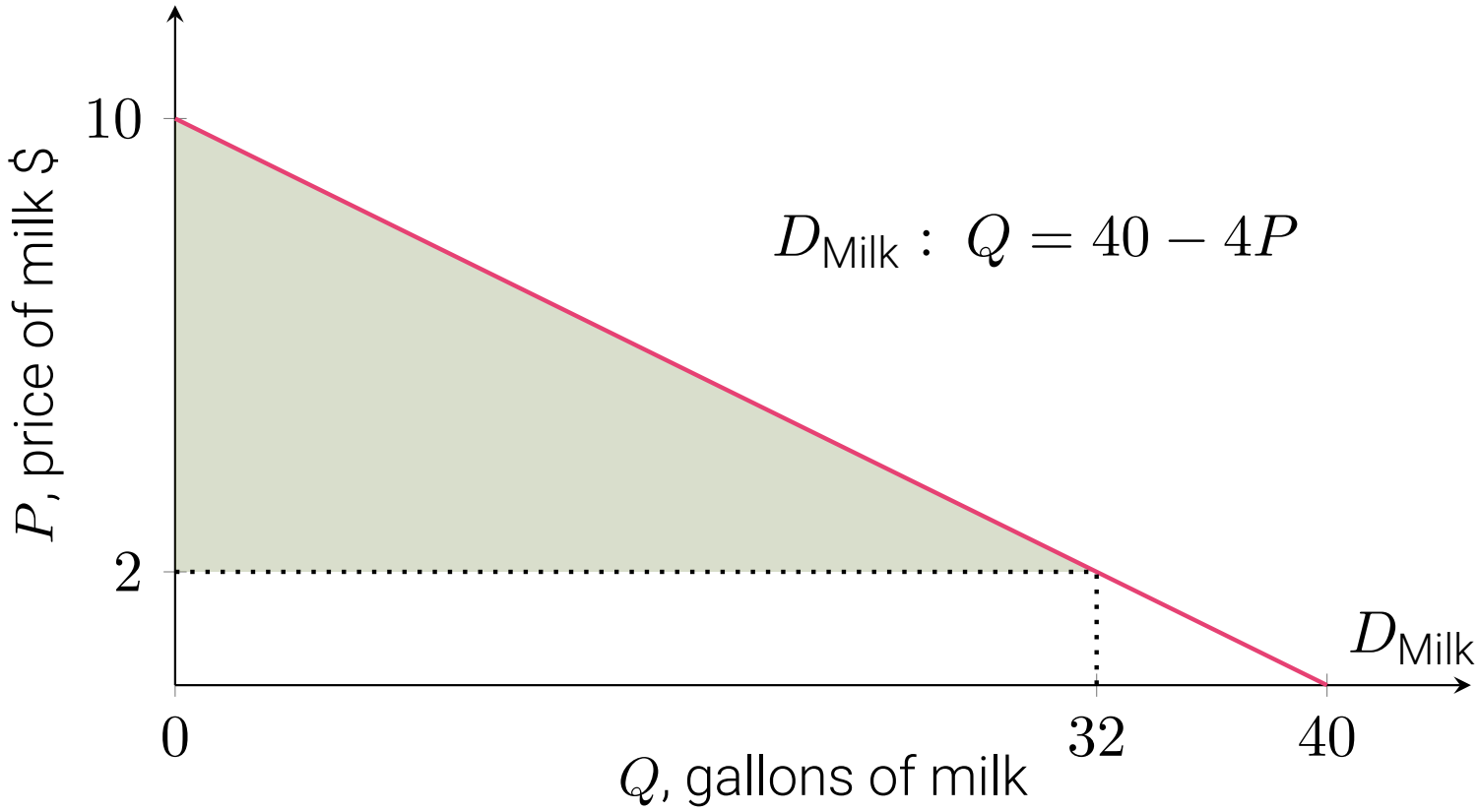
For example, suppose you want to buy a new pair of Nike running shoes. You would be willing to pay up to $120 for them, but they are on sale for $80.

- Your consumer surplus if you buy the shoes is $40.
- If the government then imposed a tax on Nike shoes, such that the price consumers pay increased by $15, then your consumer surplus will decrease by $15.

Consumer Surplus

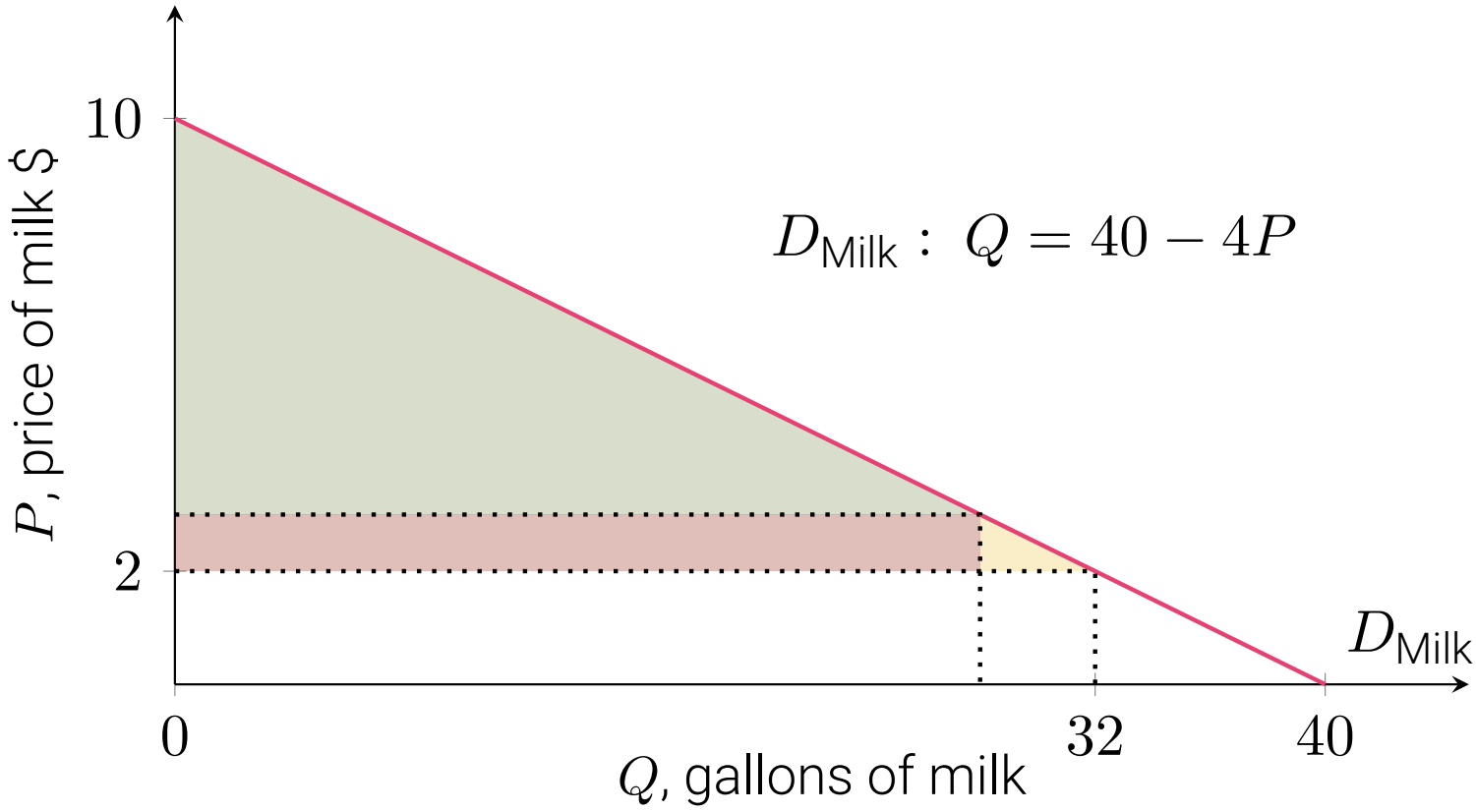
Graphically, consumer surplus is calculated as the area below the demand curve and above the market price.



Consumer Surplus

Suppose that you know the demand function for some market. In order to find the consumer surplus:

1. First, plot the demand function
2. Then, calculate the area of the triangle created by the market price and the demand curve.



When you increase the price, the consumer surpluse goes down for two reasons:

- First, people who just barely bought no longer buy items
- Second, people that still buy after the price change have to pay more

Try It Yourself

Suppose that consumer demand for organic, gluten-free dog food in Boulder can be represented by the following equation: $Q_D = 80 - 5P$.

If the price of organic, gluten-free dog food is $10 per pound, what is the consumer surplus?

Try It Yourself

Suppose that consumer demand for organic, gluten-free dog food in Boulder can be represented by the following equation: $Q_D = 80 - 5P$.

If the price of organic, gluten-free dog food increases to $12 per pound (from $10), what is the decrease in consumer surplus?

Compensating and Equivalent Variation

When considering the effects of price changes, we have two additional measures that may be useful: compensating variation and equivalent variation.

Compensating and Equivalent Variation

When considering the effects of price changes, we have two additional measures that may be useful: compensating variation and equivalent variation.

Compensating variation (CV) measures how much a consumer's income would have to change to keep them at the **same** utility level as before a price change, **after** the price change has occurred.

- For example, suppose that the government wants to impose a tax on Nike shoes.
- CV tells us how much the government would have to compensate consumers to make up for the decreased wellbeing caused by the price increase.

Compensating and Equivalent Variation

Equivalent variation (EV) measures how much a consumer's income would have to change **before** a price change has occurred to make them indifferent between the price change and the additional income.

- For example, suppose the government announces a tax break on home purchases (essentially lowering the price of houses), but then decides to instead just give taxpayers an income tax credit instead.
- EV measures how much of an income tax credit taxpayers would have to receive to be indifferent between the proposed home tax break and the income tax credit.
- Note that, unlike the CV example, the price change **has not** actually occurred.

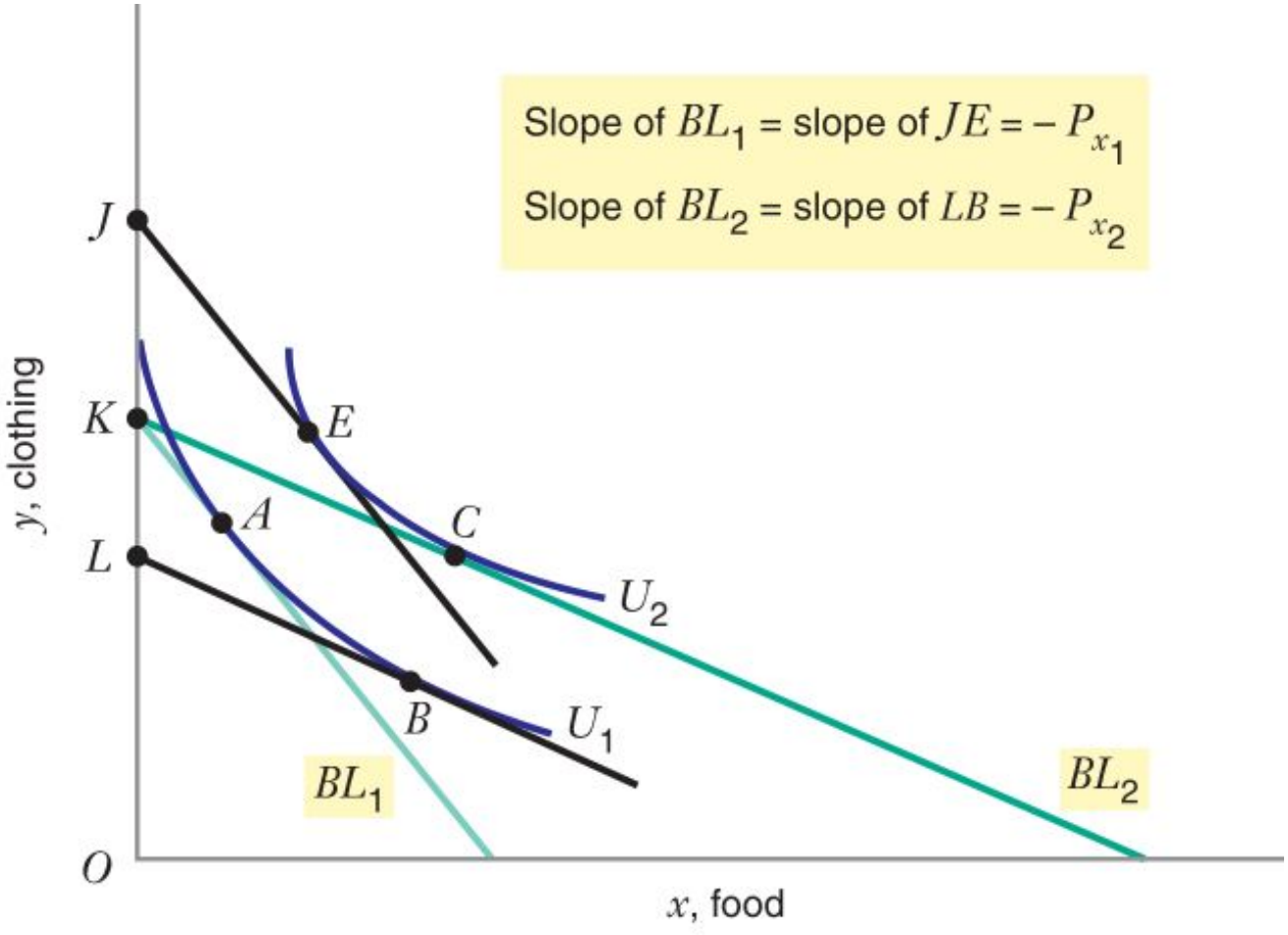
Compensating and Equivalent Variation

Here's another way to remember the difference between EV and CV:

- Compensating variation measures the income that would be needed to **compensate** the consumer for a price change.
- Equivalent variation measures the income change that would be **equivalent** to a hypothetical or proposed price change.

Compensating and Equivalent Variation

Below is a graphical representation of EV and CV.



Compensating and Equivalent Variation

Note that CV and EV are often not the same.

- This is due to income effects.
- EV measures income needed to get to the new level of utility at **old** prices, and CV measures income needed to get back to the original utility level at **new** prices.

Compensating and Equivalent Variation

Which measure you should use depends on the situation:

- If the government wants to impose a larger tax on marijuana to reduce consumption, but doesn't want people to be worse off, CV is appropriate.
- If the government promised a subsidy on electric vehicles, and then decided to give income tax credits instead, EV is appropriate.

Try It Yourself

Suppose that a private company offered it's workers an employee discount on all products, but then later decided to instead increase their wages. They want to know how much the need to increase wages by to make people as well off as the proposed discount would have. Should you use the Compensating Variation or the Equivalent Variation?

The Labor-Leisure Decision

One decision that almost every individual must make is whether to work, and how much. Economists refer to this as the **labor-leisure decision**.

- Leisure refers to all nonwork activies, such as eating, sleeping, recreation, and entertainment.
- Many people would love to allocate **all** of their time toward leisure.
- But why can't they?

The Labor-Leisure Decision

A consumer has to earn money to spend it on goods. So she must give up some leisure in order to earn money.

A consumer has 24 hours in a day. She spends L of those on leisure activies, and $(24 - L)$ on labor activities. Suppose her wage is w

- Then her daily income is therefore $w(24 - L)$
- This can use to buy a composite good at a price of $\$1$.

The Labor-Leisure Decision

The consumer's budget contraint can be written as

$$Y = w(24 - L)$$

We can also rearrange that, so that it looks more like our typical budget constraint.

$$24w = wL + Y$$

The Labor-Leisure Decision

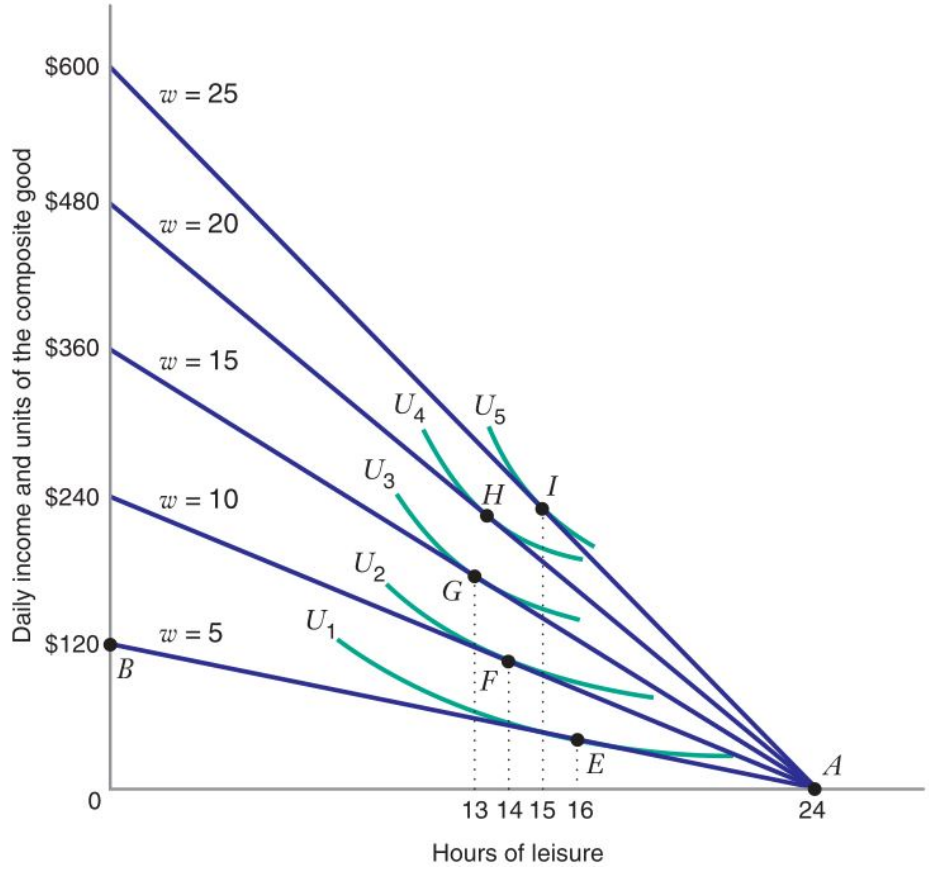
$$24w = wL + Y$$

Written this way, we can think of it in more conventional terms.

- We can think of her income as $24w$.
- She can spend her income on leisure (at a 'price' of w, her wage).
- And she can spend it on the composite good.
- Her utility U depends on the amount of leisure time she has, and on how much of the composite good she can buy.

The Labor-Leisure Decision

Below is an illustration of the budget lines and optimal leisure-composite good bundles for a consumer at various wages.



The Labor-Leisure Decision

Let's consider the trade-off at play here:

- If the consumer spends all of their time on leisure, they will earn no money and have nothing to spend on the composite good.
- On the other hand, if they work, they can buy more stuff

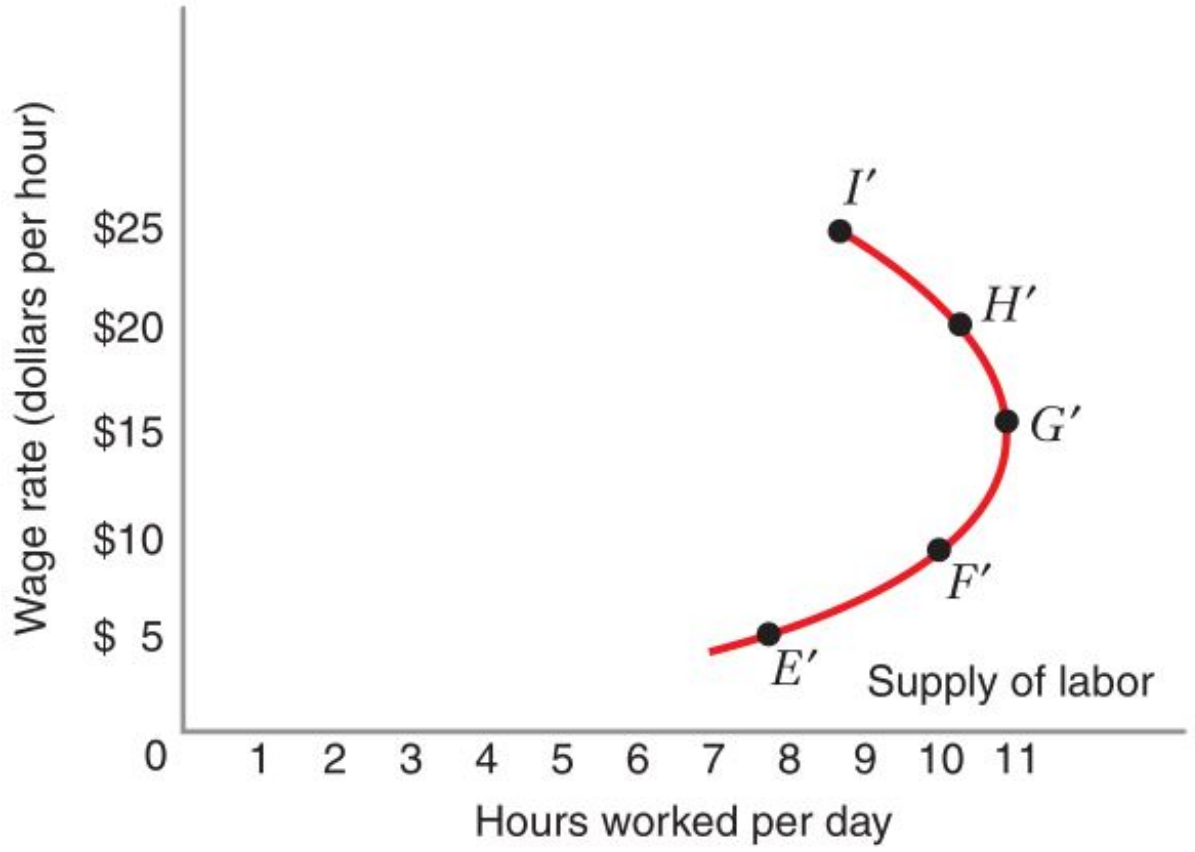
The Labor-Leisure Decision

In general, we assume that the consumer's labor supply curve (the curve tracing out all of the optimal bundles for various wages) is backward bending.

- That is, as their wage increases, they works more up to a certain point.
- Beyond that, as their wage increases they works less.
- This again relates to the *income* and *substitution* effects on labor supply.

The Labor-Leisure Decision

Below is a backward-bending supply curve. At low wages, an increase in the wage results in a greater supply of labor. But eventually, supply diminishes as the wage rises.



The Labor-Leisure Decision

In this model, the substitution effect is negative;

- As the wage increases, the opportunity cost of an hour of leisure, w, increases, and leisure becomes more 'expensive'.
- So the worker will substitute some leisure for more of the composite good.

The Labor-Leisure Decision

In this model, the substitution effect is negative;

- As the wage increases, the opportunity cost of an hour of leisure, w, increases, and leisure becomes more 'expensive'.
- So the worker will substitute some leisure for more of the composite good.

The income effect is positive.

- As a consumer's wage increases, their income increases, so they 'buy' more leisure (because leisure is a normal good).

The Labor-Leisure Decision

Initially, the substitution effect dominates. As the wage rises, people work more.

But eventually, the income effect dominates. As the wage rises, people work less

Try It Yourself

Suppose that a worker in the U.S initially earns $10/hour. Then, due to company-wide pay cuts, the worker is given a pay cut of $1.50/hour, and as a result, decides to work more. The worker's decision to work more implies that which effect (the income or substitution effect) is dominating?

Conclusion

This wraps up the content on consumer theory.

- We discussed how consumers rank various bundles of goods.
- And how consumers make decisions in a variety of contexts.
- We've also discussed how consumer welfare, and changes in it, can be measured.