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Intermediate microeconomics

Lecture 2: Consumer Theory II: demand.

Varian, chapters 6, 8, 9

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Agenda

1. Normal and inferior goods
2. Income offer curves and Engel curves
3. Ordinary goods and Giffen goods
4. Price offer curves and demand curves
5. Substitutes and complements
6. The Slutsky equation
7. The Law of Demand
8. The Slutsky equation with enowments

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1. Normal and inferior goods

Definition 1 (normal good). A good is normal if the demanded quantity increases if non-labour income increases:

$$\frac{dx_i}{dm} > 0.$$

Definition 2 (inferior good). A good is inferior if the demanded quantity decreases if non-labour income increases:

$$\frac{dx_i}{dm} < 0.$$

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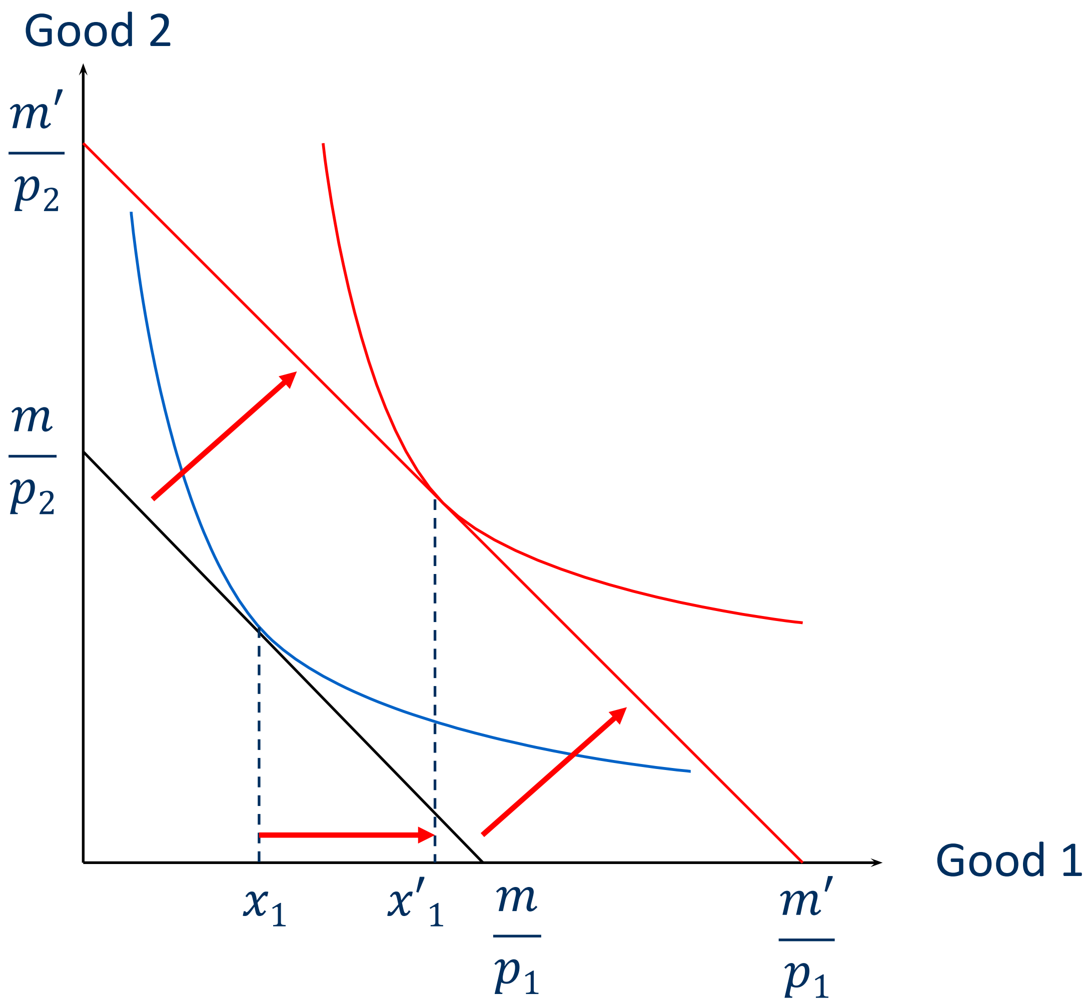
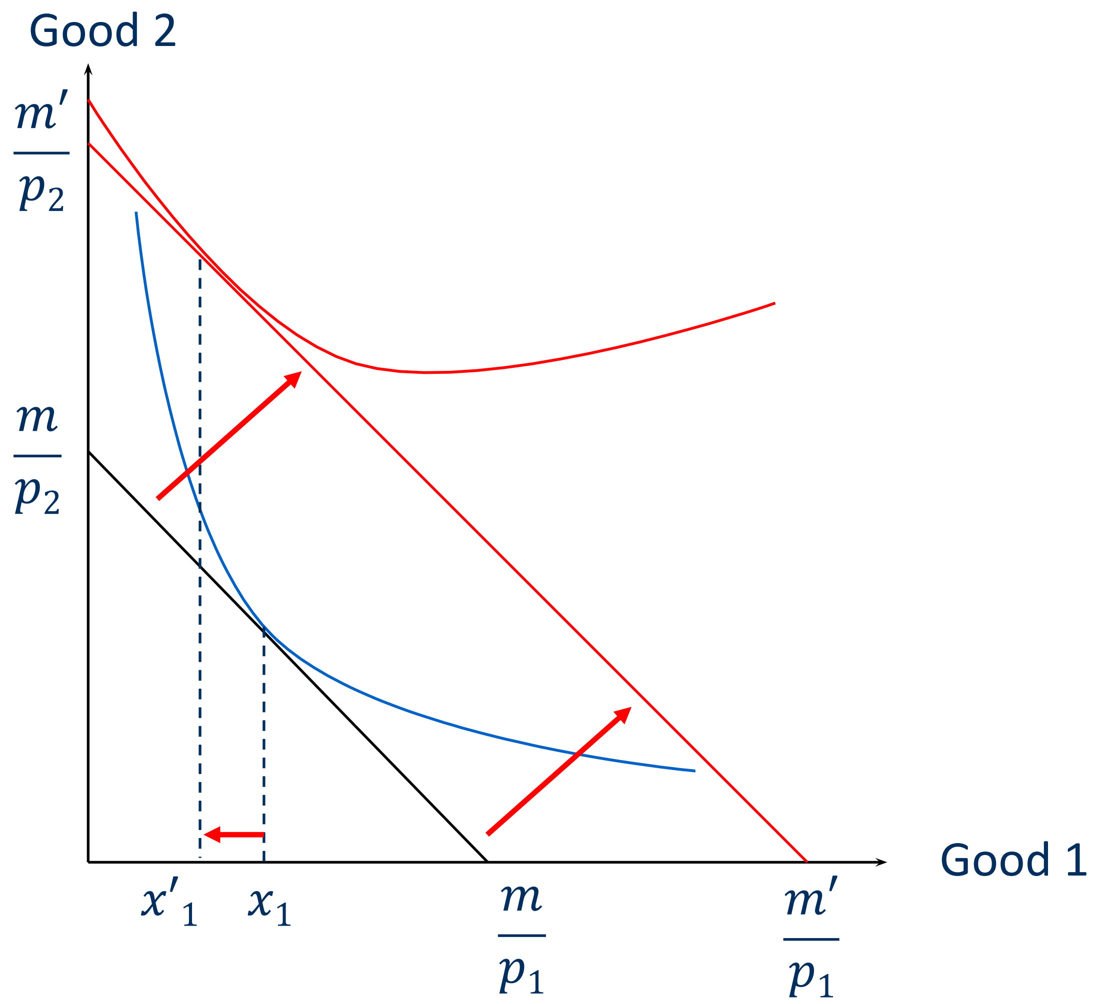
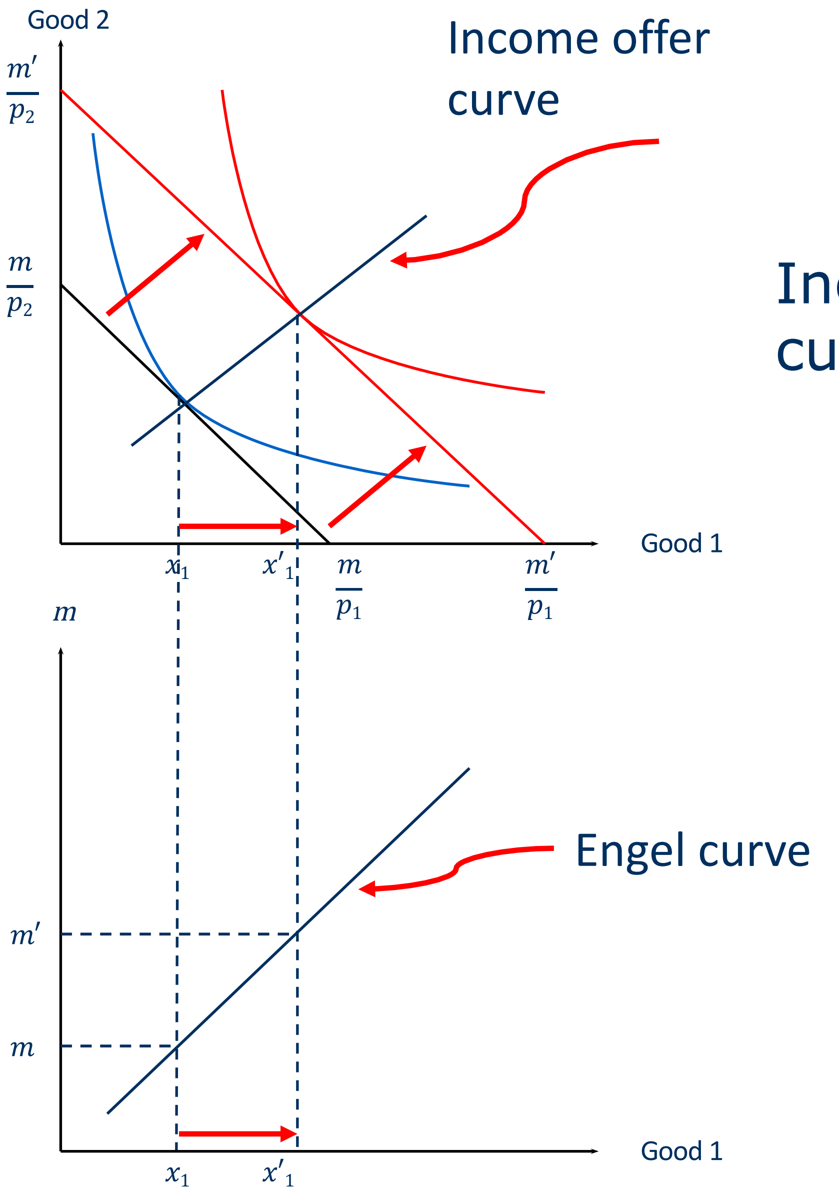
Example: Normal good: m increases: $m < m'$



Example: Inferior good: m increases: $m < m'$



Income offer and Engel curves $m' > m$



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3. Ordinary and Giffen goods

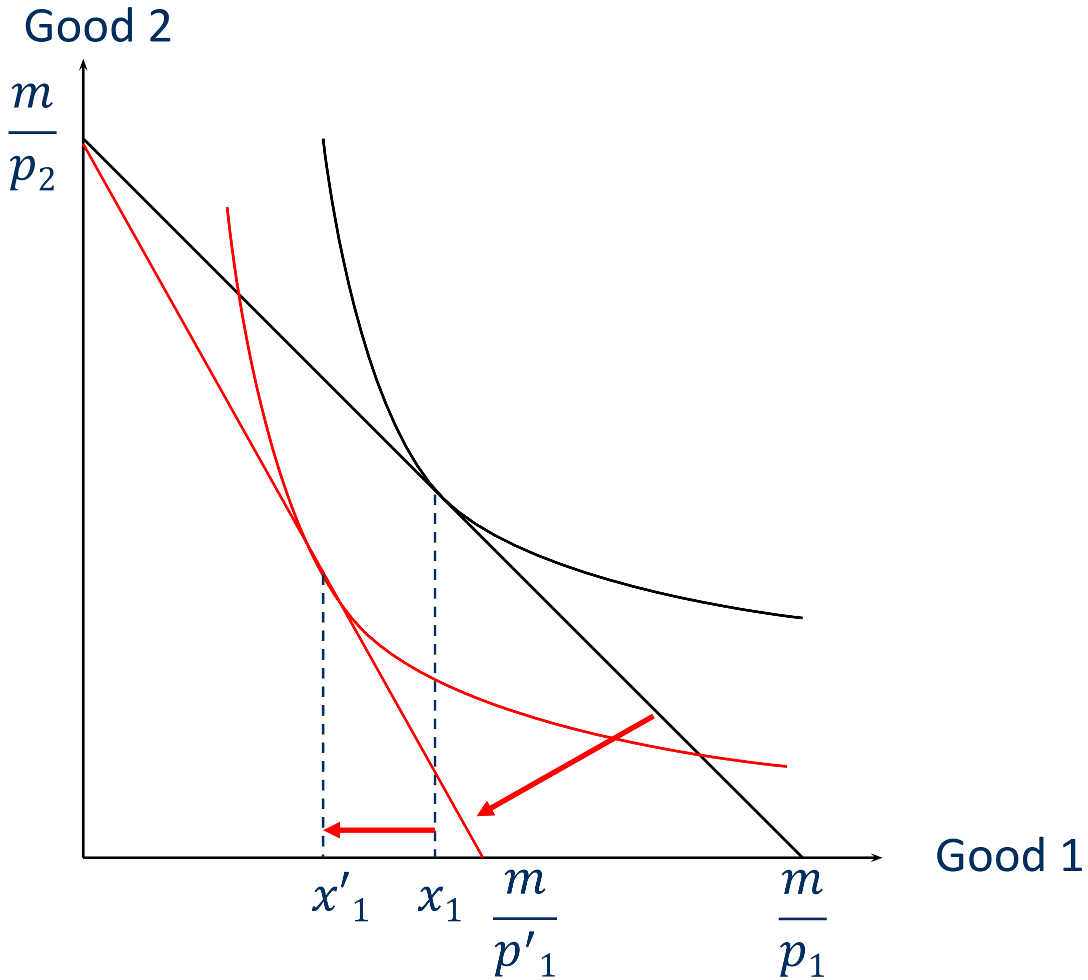
Definition 3 (Ordinary good). A good is ordinary if the demanded quantity decreases when the price of the good increases:

$$\frac{dx_i}{dp_i} < 0.$$

Definition 4 (Giffen good). A good is a Giffen good if the demanded quantity increases when the price of the good increases:

$$\frac{dx_i}{dp_i} > 0$$

Example: Ordinary good: p_1 increases: $p_1 < p'_1$



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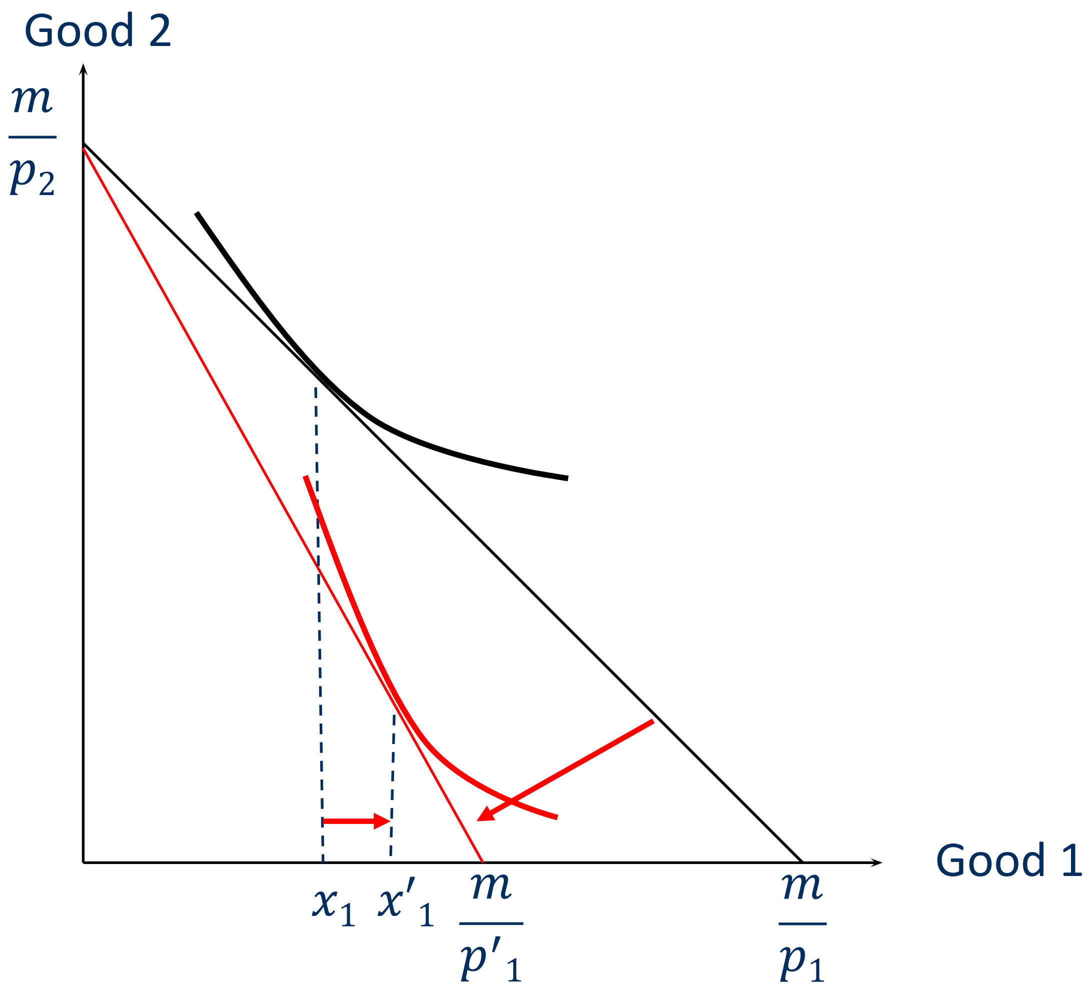
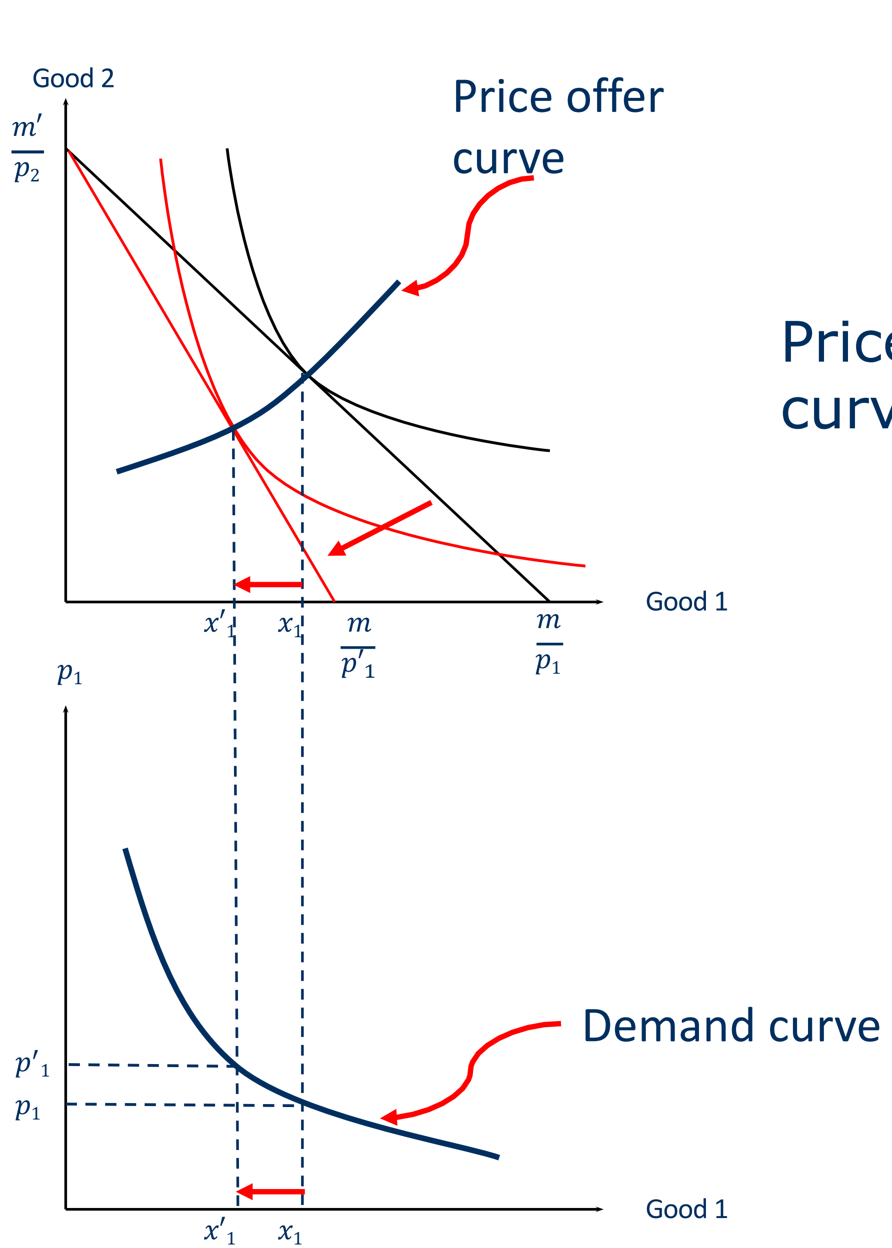
Example: Giffen good: p_1 increases: $p_1 < p'_1$



Price offer and Demand curves $p_1 < p'_1$



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5. Substitutes and Complements

Definition 5. Good 1 is a substitute for good 2 if

$$\frac{dx_1}{dp_2} > 0.$$

Definition 6. Good 1 is a complement for good 2 if

$$\frac{dx_1}{dp_2} < 0.$$

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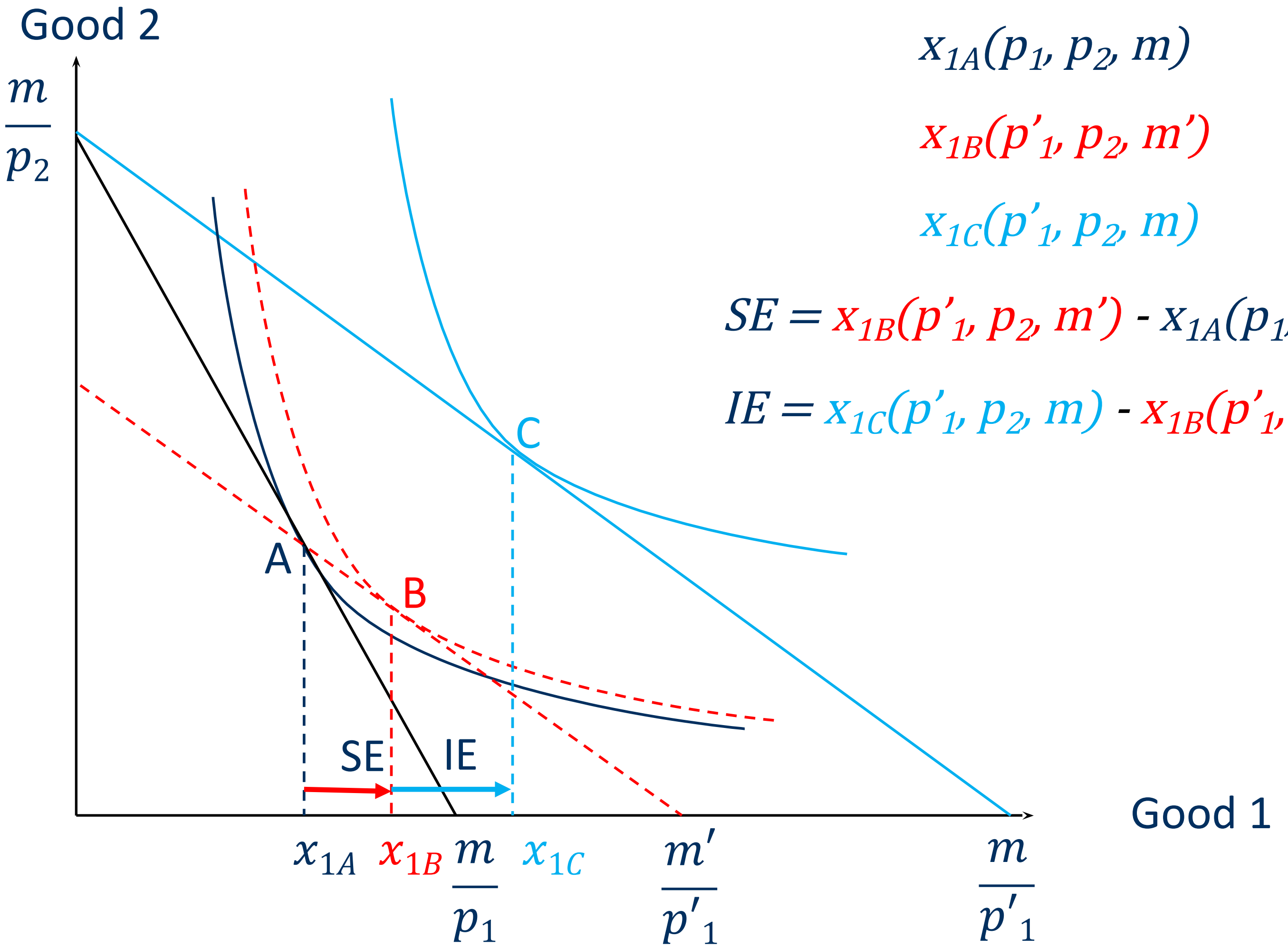
6. The Slutsky equation

A change in the price of a good has two effects:

1. The relative price of the good is affected:
   – Substitution effect
2. The purchasing power is affected:
   – Income effect

Deriving the Slutsky equation, method 1: (p_1 decreases: $p_1 > p'_1$)



$x_{1A}(p_1, p_2, m)$

$x_{1B}(p'_1, p_2, m')$

$x_{1C}(p'_1, p_2, m)$

$SE = x_{1B}(p'_1, p_2, m') - x_{1A}(p_1, p_2, m)$

$IE = x_{1C}(p'_1, p_2, m) - x_{1B}(p'_1, p_2, m')$

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The total change in demanded quantity is SE+IE!

$$\Delta x_1 = \underbrace{x_{1B}(p'_1, p_2, m') - x_{1A}(p_1, p_2, m)}_{\Delta x^s_1} + \underbrace{x_{1C}(p'_1, p_2, m) - x_{1B}(p'_1, p_2, m')}_{\Delta x^n_1}$$

We define $\Delta x^m{}_1 = -\Delta x^n{}_1$. We then get:

$$\Delta x_1 = \Delta x^s{}_1 - \Delta x^m{}_1 \qquad (1)$$

Divide both sides by Δp_1 to get the "rates of change":

$$\frac{\Delta x_1}{\Delta p_1} = \frac{\Delta x^s{}_1}{\Delta p_1} - \frac{\Delta x^m{}_1}{\Delta p_1} \qquad (2)$$

For m and m' we have:

$$\left.\begin{aligned} m &= p_1x_1 + p_2x_2 \\ m' &= p'_1x_1 + p_2x_2 \end{aligned}\right\} \qquad (3)$$

Where the budget lines intersect (point A) we have:

$$\Delta m = m' - m = x_1[p'_1 - p_1] = x_1\Delta p_1 \qquad (4)$$

or

$$\Delta p_1 = \frac{\Delta m}{x_1} \qquad (5)$$

Equations (5) and (2) give us the Slutsky equation

The Slutsky equation

$$\Delta p_1 = \frac{\Delta m}{x_1}$$

Use (5) in (2) to rewrite the income effect:

First let us rewrite the income effect: $\frac{\Delta x^m{}_1}{\Delta p_1} = x_1 \frac{\Delta x^m{}_1}{\Delta m}$

(2) Then becomes:

$$\underbrace{\frac{\Delta x_1}{\Delta p_1}}_{Total\ effect} = \underbrace{\frac{\Delta x^s{}_1}{\Delta p_1}}_{Subst\ eff.} - \underbrace{x_1 \frac{\Delta x^m{}_1}{\Delta m}}_{Income\ eff.} \qquad (6)$$

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Example: normal good and p_1 increases

$\frac{\Delta x^s_1}{\Delta p_1} < 0$ a negative substitution effect &

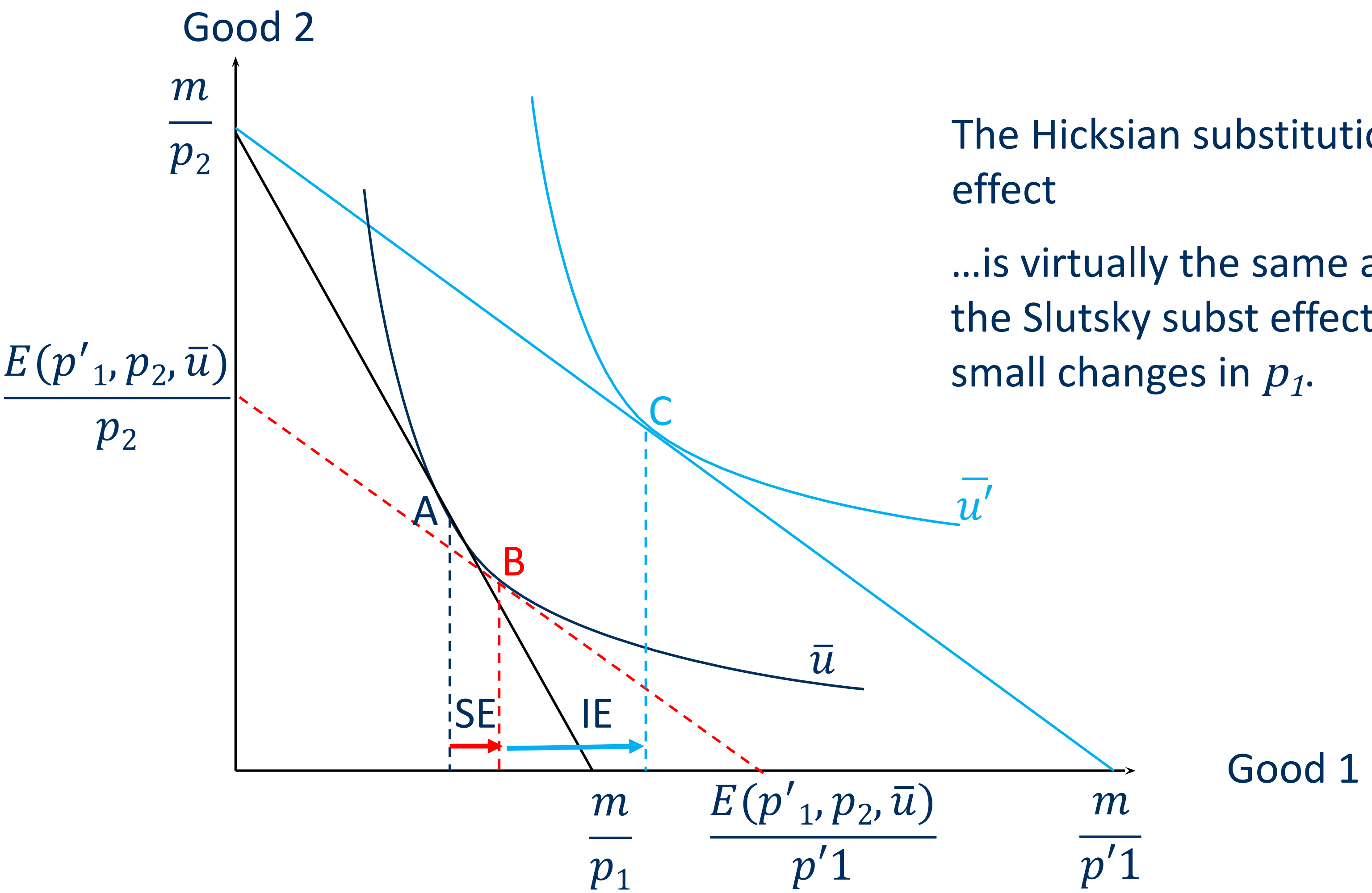
$x_1 \frac{\Delta x^m_1}{\Delta m} > 0$ a positive income effect yields:

$$\underbrace{\frac{\Delta x_1}{\Delta p_1}}_{Total\ effect} = \underbrace{\frac{\Delta x^s_1}{\Delta p_1}}_{Subst\ eff.} - \underbrace{x_1 \frac{\Delta x^m_1}{\Delta m}}_{Income\ eff.} < 0$$

Let us work through an example!

Deriving the Slutsky equation, method 2: (p_1 decreases: $p_1 > p'_1$)

Now we keep the utility constant instead of purchasing power.



The Hicksian substitution effect

…is virtually the same as the Slutsky subst effect for small changes in p_1.

7. The law of demand

If demand for a good increases when non-labour income increases, then demand for the same good will decrease if the price of the good increases.

That is: If a good is normal, then it must be ordinary.

Proof: $$\underbrace{\frac{\Delta x_1}{\Delta p_1}}_{Total\ effect} = \underbrace{\frac{\Delta x^s{}_1}{\Delta p_1}}_{(-)} \underbrace{- \underbrace{x_1 \frac{\Delta x^m{}_1}{\Delta m}}_{(+)}}_{(-)} < 0$$

The opposite need not be true!

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8. The Slutsky equation with endowments

- Now assume that individuals' income (m) is composed of endowments of the two goods:

$$m = p_1\omega_1 + p_2\omega_2$$

- Where ω_1 is the endowment of good 1 and ω_2 is the endowment of good 2.
  - (ω_1 could be the amount of apples and ω_2 the amount of oranges that a farmer produces each year)
- A change in, for example p_1, will have the following effects:
  - a substitution effect (as before),
  - an ordinary income effect (as before), and
  - an endowment income effect.

- Assume p_1 increases to p'_1 which means the value of the endowment (income) is now:

$$m'' = p'_1\omega_1 + p_2\omega_2$$

Can be re-written as: $\Delta p_1 = \frac{m''-m}{\omega_1}$

This means that:

$$\Delta m = (p'_1\omega_1 + p_2\omega_2) - (p_1\omega_1 + p_2\omega_2) = m'' - m = \Delta p_1\omega_1$$

Proceeding as we did with the first Slutsky equation:

$$\frac{x_1(p'_1, p_2, m'') - x_1(p_1, p_2, m)}{\Delta p_1} =$$

$$\frac{x_1(p'_1, p_2, m') - x_1(p_1, p_2, m)}{\Delta p_1} \textit{ (Marshallian substitution effect)}$$

$$- \frac{x_1(p'_1, p_2, m') - x_1(p'_1, p_2, m)}{\Delta p_1} \textit{ (ordinary income effect)}$$

$$+ \frac{x_1(p'_1, p_2, m'') - x_1(p'_1, p_2, m)}{\Delta p_1} \textit{ (endowment income effect)}$$

- By definition of the ordinary income effect, see equation (5):

$$\Delta p_1 = \frac{m' - m}{x_1}$$

- … and by definition of the endowment income effect:

$\Delta p_1 = \frac{m'' - m}{\omega_1}$, we can rewrite the new Slutsky equation:

$$\frac{x_1(p'_1, p_2, m'') - x_1(p_1, p_2, m)}{\Delta p_1} = \frac{x_1(p'_1, p_2, m') - x_1(p_1, p_2, m)}{\Delta p_1}$$

$$- \frac{x_1(p'_1, p_2, m') - x_1(p'_1, p_2, m)}{m' - m} x_1$$

$$+ \frac{x_1(p'_1, p_2, m'') - x_1(p'_1, p_2, m)}{m'' - m} \omega_1$$

- Re-writing using Δs:

$$\underbrace{\frac{\Delta x_1}{\Delta p_1}}_{Total\ effect} = \underbrace{\frac{\Delta x^s{}_1}{\Delta p_1}}_{Subst\ eff.} - \underbrace{x_1 \frac{\Delta x^m{}_1}{\Delta m}}_{Ord.\ income\ eff.} + \underbrace{\omega_1 \frac{\Delta x^\omega{}_1}{\Delta m}}_{End.\ income\ eff.}$$

- For small changes i price: $\frac{\Delta x^m{}_1}{\Delta m} \approx \frac{\Delta x^\omega{}_1}{\Delta m} \Longrightarrow$

$$\underbrace{\frac{\Delta x_1}{\Delta p_1}}_{Total\ effect} = \underbrace{\frac{\Delta x^s{}_1}{\Delta p_1}}_{Subst\ eff.} + \underbrace{(\omega_1 - x_1)\frac{\Delta x^m{}_1}{\Delta m}}_{Total\ \ income\ eff.}$$