EC2101: Microeconomic Analysis I

Lecture 4

Theory of the Consumer

- Types of Demand Functions:
  $x(M), x(p_x), x(p_y), x(p_x, p_y, M)$
- Substitution Effect and Income Effect

Types of Demand Functions

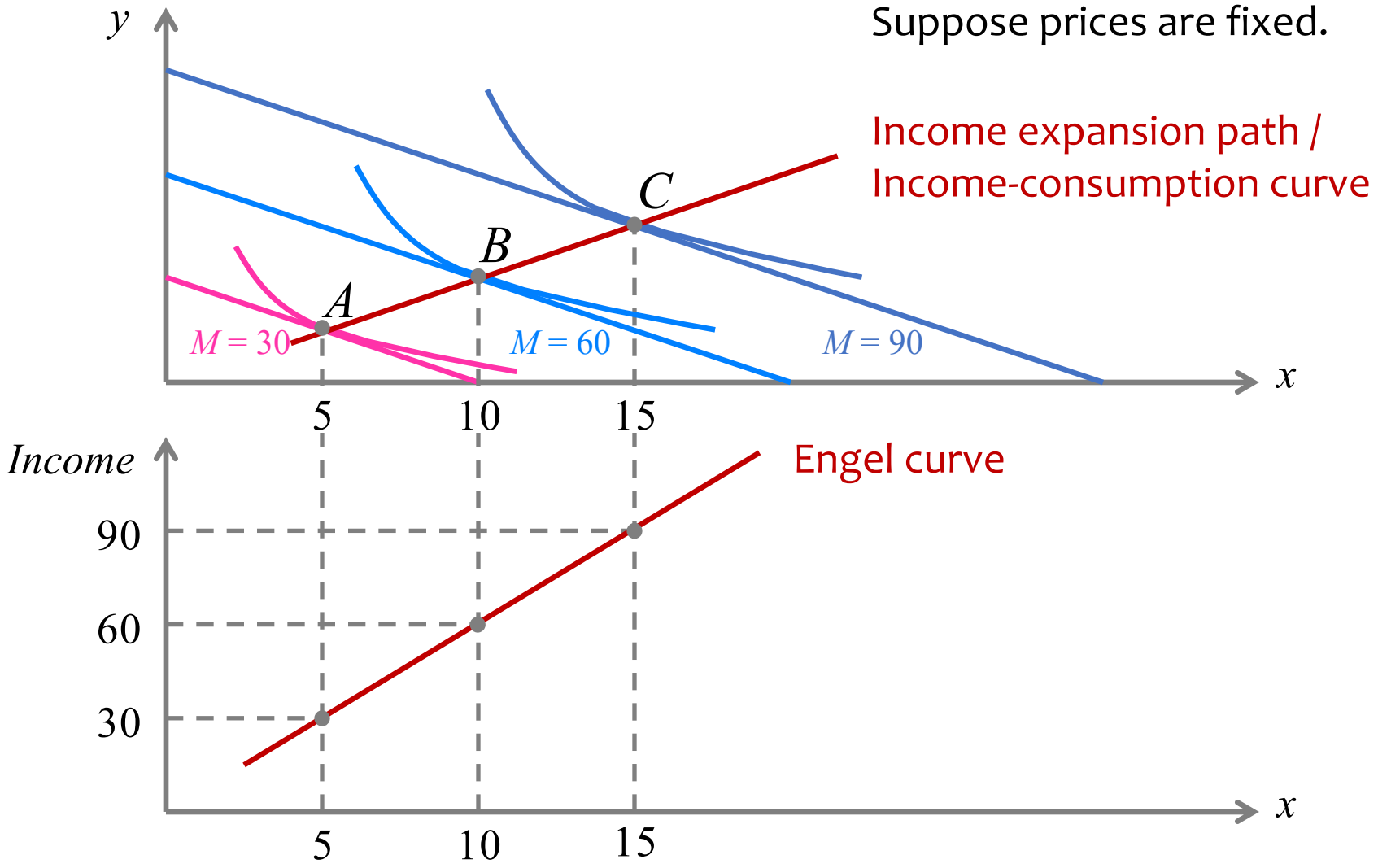
Types of Demand Functions:

Demand as a Function of Income

Normal Good and Inferior Good

- A good is a normal good if:
  - As income rises,
    the quantity demanded of the good increases,
    holding other factors constant.
- A good is an inferior good if:
  - As income rises,
    the quantity demanded of the good decreases,
    holding other factors constant.

Change in Income



Income Expansion Path

- Income Expansion Path:
  - Also known as the income-consumption curve.
  - The curve that connects the consumer's optimal choices at different income levels.

Engel Curve

- Engel Curve:
  - The relationship between
    income and optimal consumption of a good,
    holding all other factors fixed.

- If the good is normal,
  the Engel curve is upward sloping.

- If the good is inferior,
  the Engel curve is downward sloping.

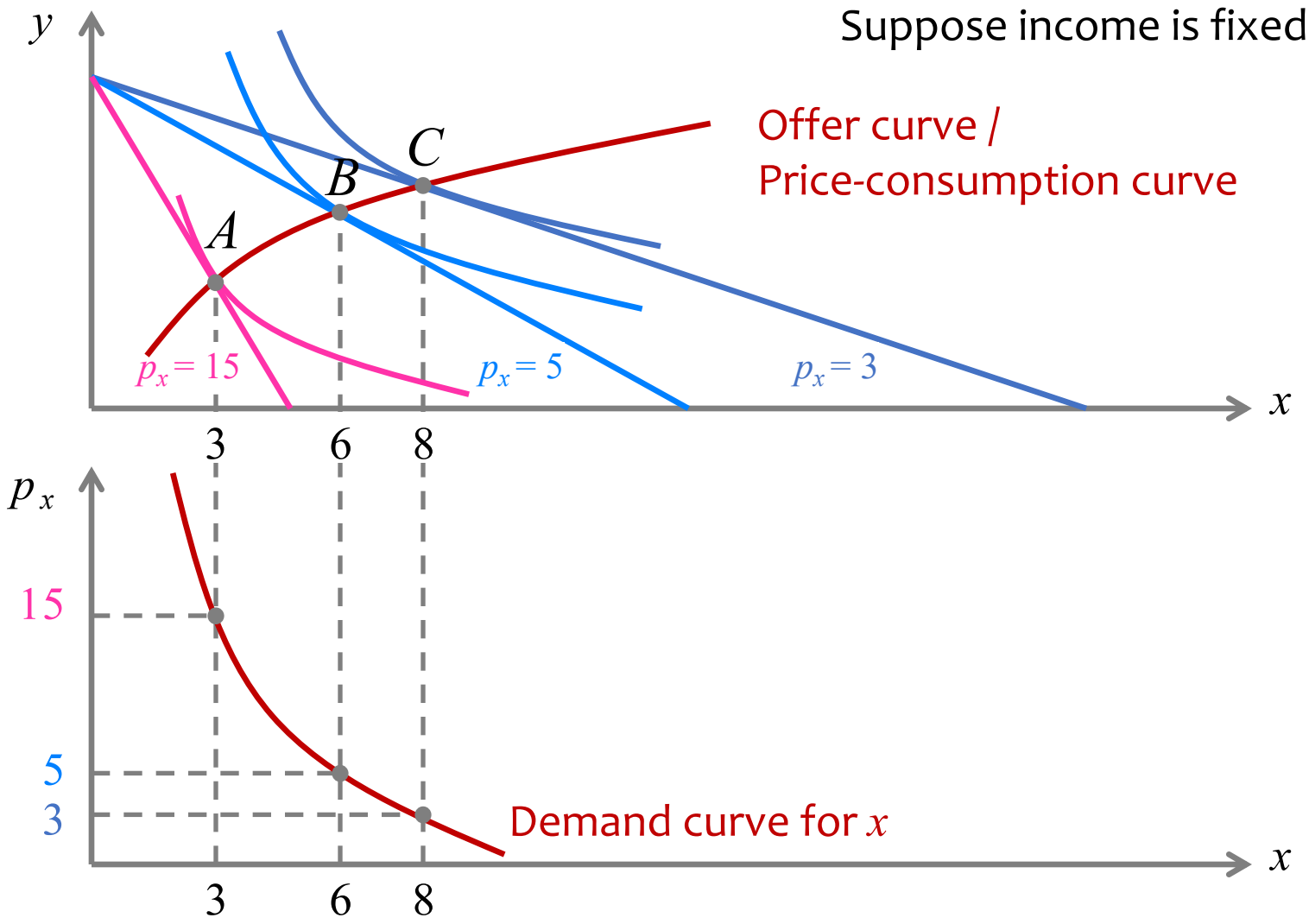
Types of Demand Functions:

Demand as a Function of Price

From Optimal Baskets to the Individual Demand Curve

- Naomi consumes gelato and coffee.
- Suppose the price of gelato changes, while the price of coffee and income are unchanged.
- Naomi's optimal consumption of gelato will change.
- Naomi's individual demand curve for gelato is the quantity demanded (optimal consumption) of gelato as a function of the price of gelato.

Change in Price



Offer Curve

- Offer curve:
  - Also known as the price-consumption curve.
  - The curve that connects the consumer's optimal choices at different prices.

Individual Demand Curve

- Individual demand curve:
  - The quantity demanded of a good as a function of the price of the good, holding all other factors fixed.
  - Downward sloping.
- Law of demand:
  - The higher the price, the lower the quantity demanded.

Deriving the Individual Demand Curve: Example

- Suppose Naomi has utility function $U(x, y) = xy.$
- Suppose coffee (y) costs $\$5$ a cup, and Naomi's income is $\$90.$
- What is Naomi's demand curve for gelato (x)?
- Naomi's constrained maximization problem is:

$$\max_{x,y} U(x, y) = xy$$

$$subject\ to \quad p_x x + 5y = 90$$

Deriving the Individual Demand Curve: Example

- Budget line: $p_x x + 5y = 90$
- Tangency condition: $MRS_{x,y} = \frac{p_x}{p_y}$

$$\frac{y}{x} = \frac{p_x}{5}$$

$$p_x x = 5y$$

- Demand curve for x: $p_x x + p_x x = 90$

$$x = \frac{45}{p_x}$$

Ordinary Good

- A good is an ordinary good if:
  - As the price decreases,
    the quantity demanded of the good increases,
    holding other factors constant.
  - As the price increases,
    the quantity demanded of the good decreases,
    holding other factors constant.

Slope of the Individual Demand Curve

- Law of demand revisited:
  - Is the individual demand curve always downward sloping?
- Not if the good is a Giffen good.
  - The individual demand curve is upward sloping for a Giffen good.

Giffen Good

- A good is a Giffen good if:
  - As the price decreases,
    the quantity demanded of the good decreases,
    holding other factors constant.
  - As the price increases,
    the quantity demanded of the good increases,
    holding other factors constant.

Do Giffen Goods exist?

- Jensen and Miller (2008) conducted field experiments on extremely poor urban households in China.
  - Hunan province: subsidy on rice.
  - Gansu province: subsidy on wheat.
- Introducing a subsidy on a good is equivalent to decreasing the price of the good.
- Removing a subsidy on a good is equivalent to increasing the price of the good.

Do Giffen Goods exist?

- Decreasing the price of rice (via the subsidy) caused households to reduce their demand for rice.
  - A 1% decrease in the price of rice caused a 0.22% decrease in rice consumption.
- Increasing the price of rice (via removal of the subsidy) caused households to increase their demand for rice.
  - A 1% increase in the price of rice caused a 0.22% increase in rice consumption.

Source: Jensen and Miller. 2008. "Giffen Behavior and Subsistence Consumption." *American Economic Review,* 98:4, 1553–1577.

Veblen Good

- A good is a Veblen good if:
  - As the price decreases,
    the quantity demanded of the good decreases,
    holding other factors constant.
  - As the price increases,
    the quantity demanded of the good increases,
    holding other factors constant.

Preference and Prices

- In the standard economic model of consumer behavior, the consumer's preference (utility function) depends only on the intrinsic attributes of the goods consumed, and not on the prices of those goods.

- What if the consumer's preference (utility function) depends also on the prices of the goods consumed?

Veblen Good

- For a Giffen good, the increase in demand is directly attributable to the increase in price.
- For a Veblen good, the increase in demand reflects the consumer's preference and utility function, which in turn partially depend on the increase in price.
- Veblen good:
  - A type of luxury good whose value as a status symbol is partially derived from the price of the good.
  - Named after Thorstein Veblen (1857–1929) who coined the term "conspicuous consumption."

Types of Demand Functions:

Demand as a Function of Price of the Other Good

Substitutes and Complements

- Two goods are substitutes if:
  - An increase in the price of one good causes the demand for the other good to increase.
- Two goods are complements if:
  - An increase in the price of one good causes the demand for the other good to decrease.
- While the terms "substitutes" and "complements" are useful for the intuitive understanding they provide, they are not mathematically precise.

Exercise 4.1

Offer Curve

Consider two goods, x and y. Suppose the price of good y rises. For each of the following cases, graph the offer curve and indicate the optimal choice.

(a) When the two goods are substitutes.

(b) When the two goods are complements.

Exercise 4.1(a)

Offer Curve for Substitutes

Exercise 4.1(b)

Offer Curve for Complements

Exercise 4.2

Types of Goods

There are two goods: banana bread and latte. In each case, determine whether the goods are normal or inferior, ordinary or Giffen, substitutes or complements.

1. The price of banana bread rises. Bob consumes less banana bread.

2. Helen's income rises. Helen increases her consumption of banana bread and decreases her consumption of latte.

Exercise 4.2

Types of Goods

There are two goods: banana bread and latte. In each case, determine whether the goods are normal or inferior, ordinary or Giffen, substitutes or complements.

3. The price of latte falls. Violet's consumption of banana bread increases.

4. The price of latte falls. Dash buys fewer cups of latte.

5. The price of banana bread rises. Jack Jack increases his consumption of latte.

Types of Demand Functions:

Demand Function

Demand Function

- The quantity demanded (optimal consumption) of a good depends on:
  - Income.
  - Price of the good.
  - Price of other goods.
- Demand function:
  - The quantity demanded of a good as a function of income and all relevant prices.
- The demand function for good x is $x(p_x, p_y, M)$.

Deriving the Demand Function for Cobb-Douglas Utility Function: Example

- Suppose Naomi has utility function $U(x, y) = Ax^{\alpha}y^{\beta}$.
- Suppose gelato (x) costs p_x, coffee (y) costs p_y, and Naomi's income is M.
- What is Naomi's demand function for gelato (x)?
- Naomi's constrained maximization problem is:

$$\max_{x,y} U(x, y) = Ax^{\alpha}y^{\beta}$$

$$subject\ to \quad p_x x + p_y y = M$$

Deriving the Demand Function for Cobb-Douglas Utility Function: Example

- Utility function: $U(x,y) = Ax^{\alpha}y^{\beta}$

- Budget line: $p_x x + p_y y = M$

- Tangency condition: $\frac{MU_x}{MU_y} = \frac{p_x}{p_y}$

$$\frac{A\alpha x^{\alpha-1}y^{\beta}}{A\beta x^{\alpha}y^{\beta-1}} = \frac{p_x}{p_y}$$

$$\frac{\alpha y}{\beta x} = \frac{p_x}{p_y}$$

$$p_y y = \frac{\beta}{\alpha} p_x x$$

Deriving the Demand Function for Cobb-Douglas Utility Function: Example

- Budget line: $p_x x + p_y y = M$ (i)
- Tangency condition: $p_y y = \frac{\beta}{\alpha} p_x x$ (ii)
- Demand function for x:

$$p_x x + \frac{\beta}{\alpha} p_x x = M$$

$$\frac{\alpha + \beta}{\alpha} p_x x = M$$

$$x = \frac{\alpha}{\alpha + \beta} \cdot \frac{M}{p_x}$$

Deriving the Demand Function for Cobb-Douglas Utility Function: Example

- Budget line: $p_x x + p_y y = M$ (i)
- Tangency condition: $p_y y = \frac{\beta}{\alpha} p_x x$ (ii)
- Demand function for y: $\frac{\alpha}{\beta} p_y y + p_y y = M$

$$\frac{\alpha + \beta}{\beta} p_y y = M$$

$$y = \frac{\beta}{\alpha + \beta} \cdot \frac{M}{p_y}$$

Properties of Cobb-Douglas Utility Function

- Demand functions: $x = \frac{\alpha}{\alpha+\beta} \cdot \frac{M}{p_x}$ and $y = \frac{\beta}{\alpha+\beta} \cdot \frac{M}{p_y}$

- Demand for one good
  does not depend on the price of the other good.

Properties of Cobb-Douglas Utility Function

- Demand functions: $x = \frac{\alpha}{\alpha+\beta} \cdot \frac{M}{p_x}$ and $y = \frac{\beta}{\alpha+\beta} \cdot \frac{M}{p_y}$
- The total expenditure on x is:

$$p_x x = p_x \left(\frac{\alpha}{\alpha+\beta} \cdot \frac{M}{p_x} \right) = \left(\frac{\alpha}{\alpha+\beta} \right) M$$

- The total expenditure on y is:

$$p_y y = p_y \left(\frac{\beta}{\alpha+\beta} \cdot \frac{M}{p_y} \right) = \left(\frac{\beta}{\alpha+\beta} \right) M$$

- The consumer always spends a fixed proportion of income on each good.

Exercise 4.3

Demand Function

Suppose Chris's utility function is:

$$U(x, y) = x^2 y$$

Suppose the price of x is p_x, the price of y is p_y,
and Chris's income is K.

(a) Find Chris's demand function for x.

(b) What happens to Chris's consumption of x
if the price of x doubles (and the price of y is unchanged)?

(c) Find Chris's demand function for y.

(d) What happens to Chris's consumption of y
if the price of x doubles (and the price of y is unchanged)?

Exercise 4.3(a)–(b)

Demand Function

Exercise 4.3(c)–(d)

Demand Function

Summary

Types of Goods

- Ordinary good:
- Giffen good:
- Veblen good:
- Normal good:
- Inferior good:
- Substitutes:
- Complements:

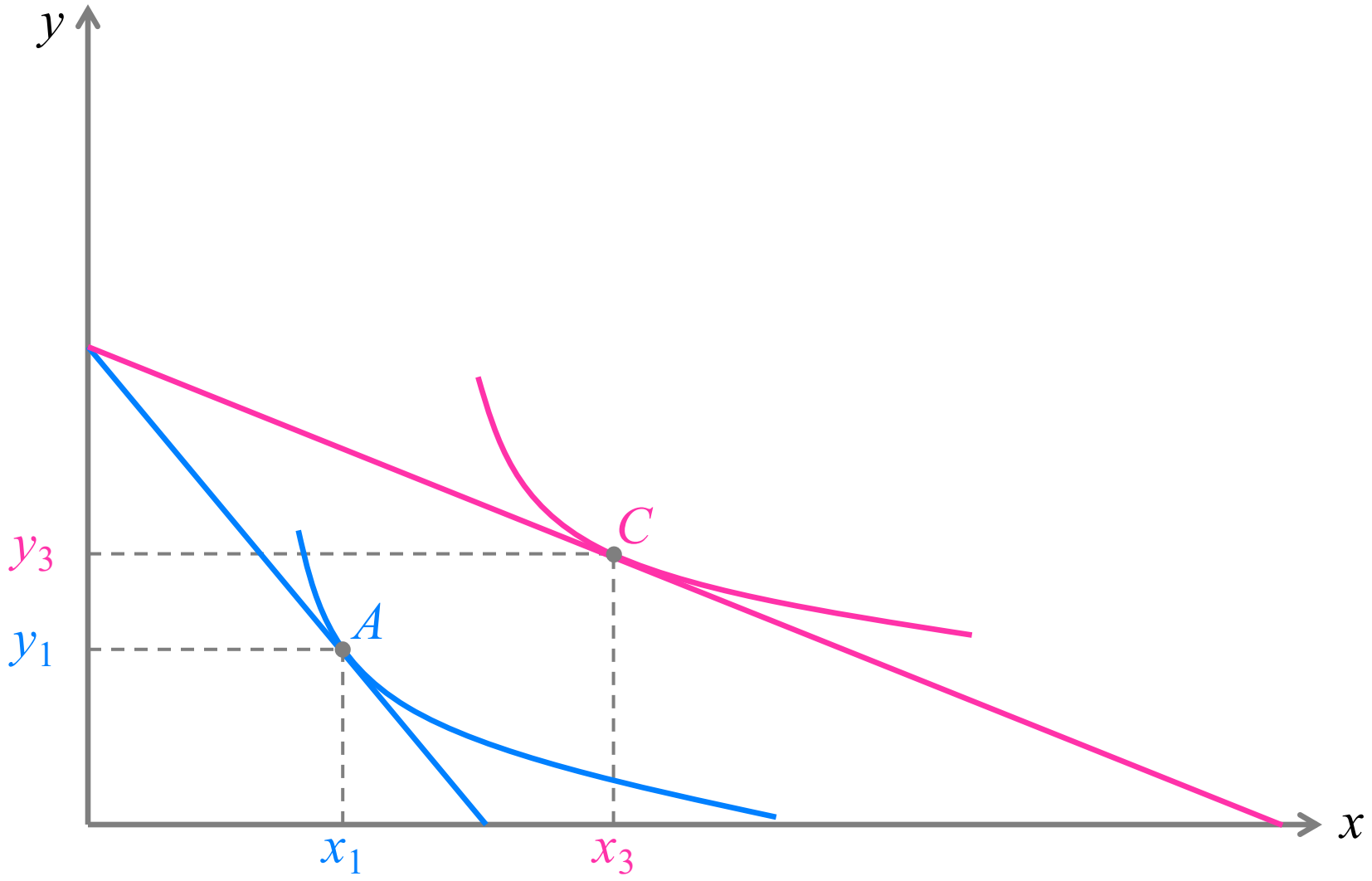
Summary

Types of Curves

- Offer curve:
- Individual demand curve:
- Income expansion path:
- Engel curve:

Substitution Effect & Income Effect

What happens to the consumption of gelato when the price of gelato falls?



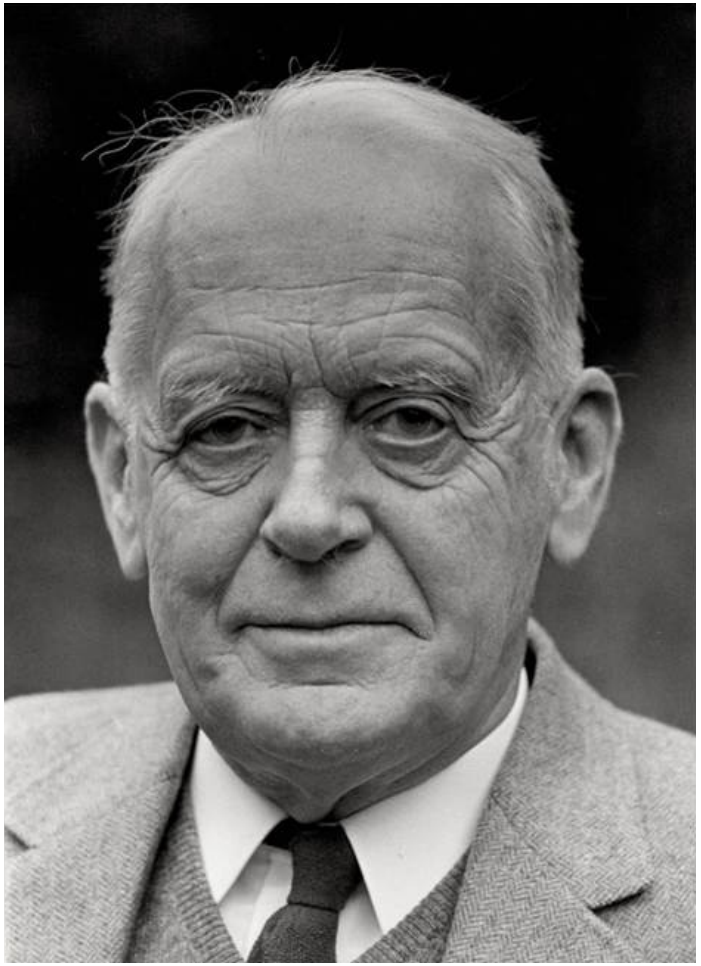
Why Does Naomi Buy More Gelato?

- A change in the relative price of gelato.
  - Gelato becomes cheaper relative to coffee, compared to previously.
  - The budget line becomes flatter.
  - Naomi buys more gelato and less coffee.

Why Does Naomi Buy More Gelato?

- A change in the price of gelato also leads to a change in purchasing power.
  - Naomi is effectively "richer."
  - The budget set expands, i.e., the new budget line is "higher."
  - Naomi buys more gelato if gelato is a normal good.

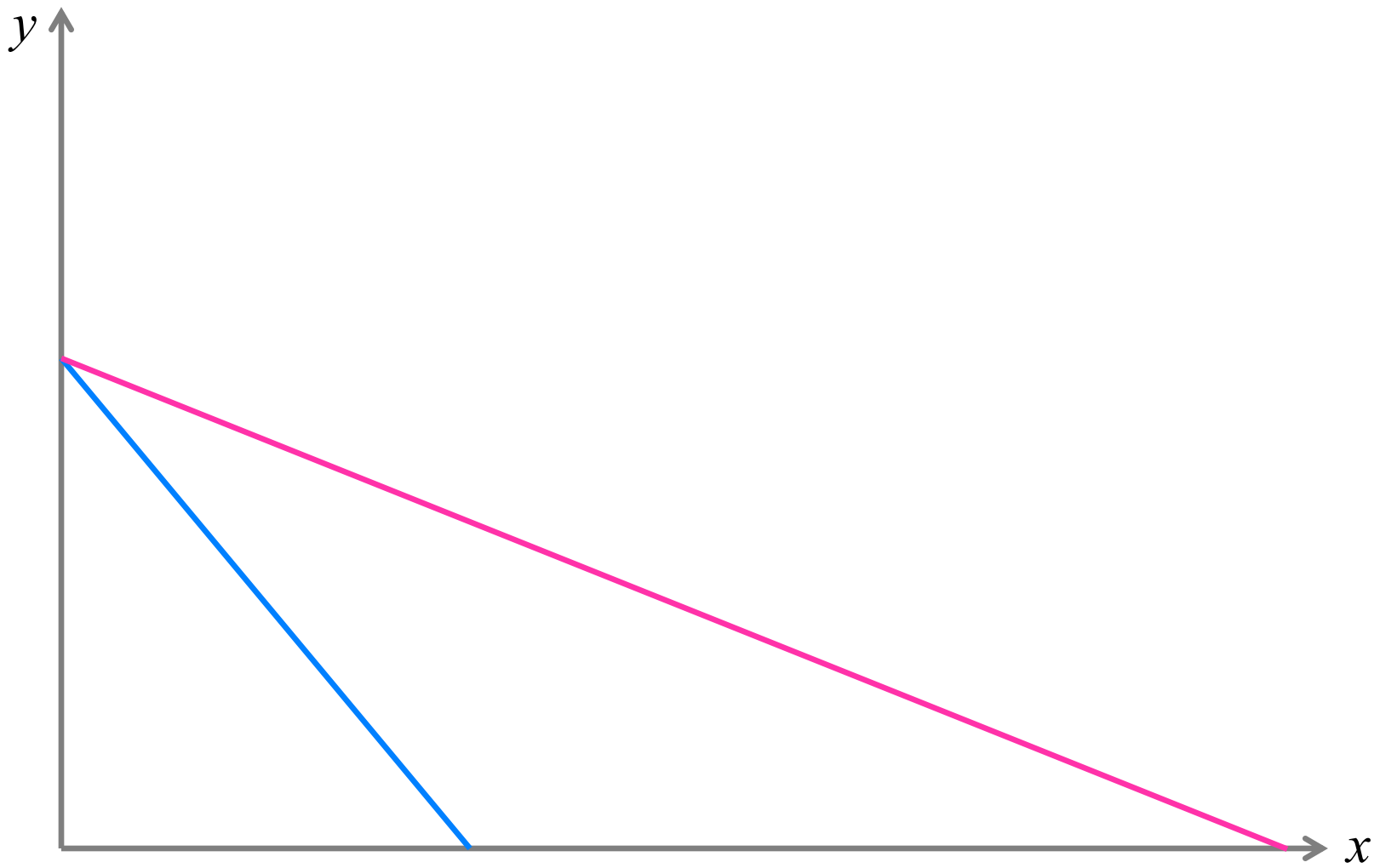
John Hicks



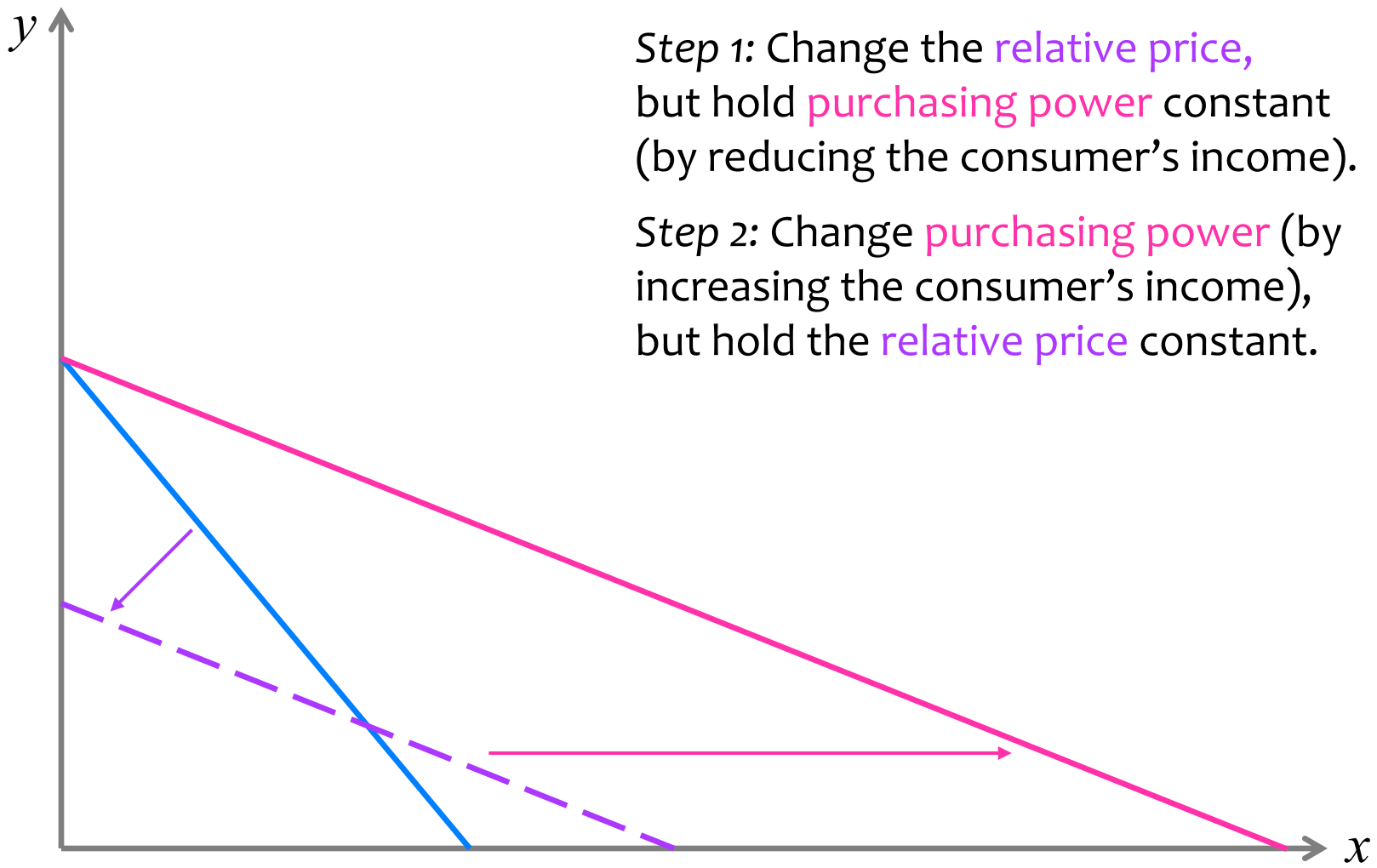
Sir John Hicks
1904–1989

- Awarded the 1972 Nobel in Economics along with Kenneth J. Arrow "for their pioneering contributions to general economic equilibrium theory and welfare theory."
- Contributions include: IS-LM model, compensated (Hicksian) demand function, Hicksian decomposition, Kaldor–Hicks efficiency

Hicksian Decomposition



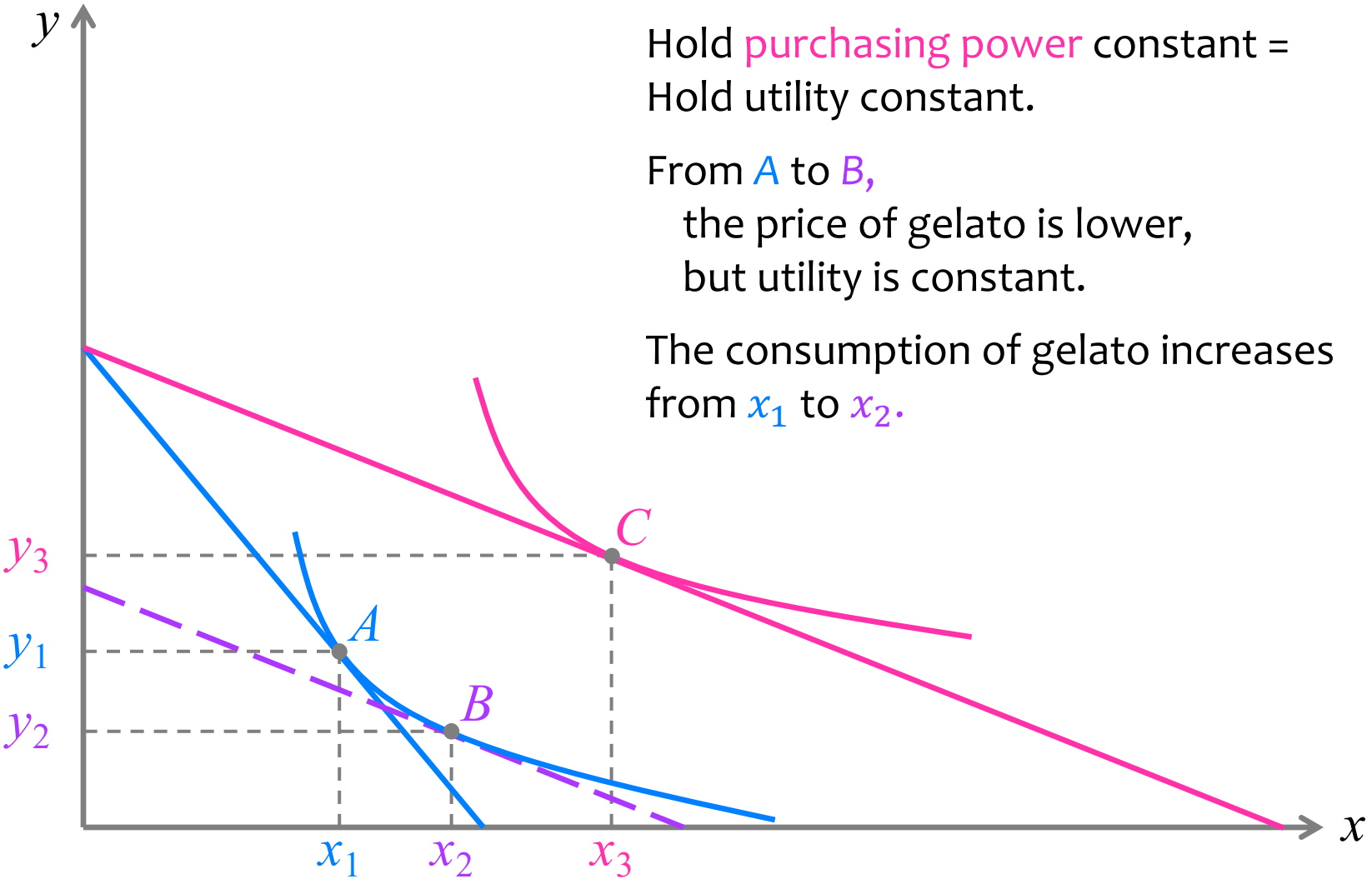
Hicksian Decomposition



Step 1: Change the relative price, but hold purchasing power constant (by reducing the consumer's income).

Step 2: Change purchasing power (by increasing the consumer's income), but hold the relative price constant.

From *A* to *B*



Hold purchasing power constant =
Hold utility constant.

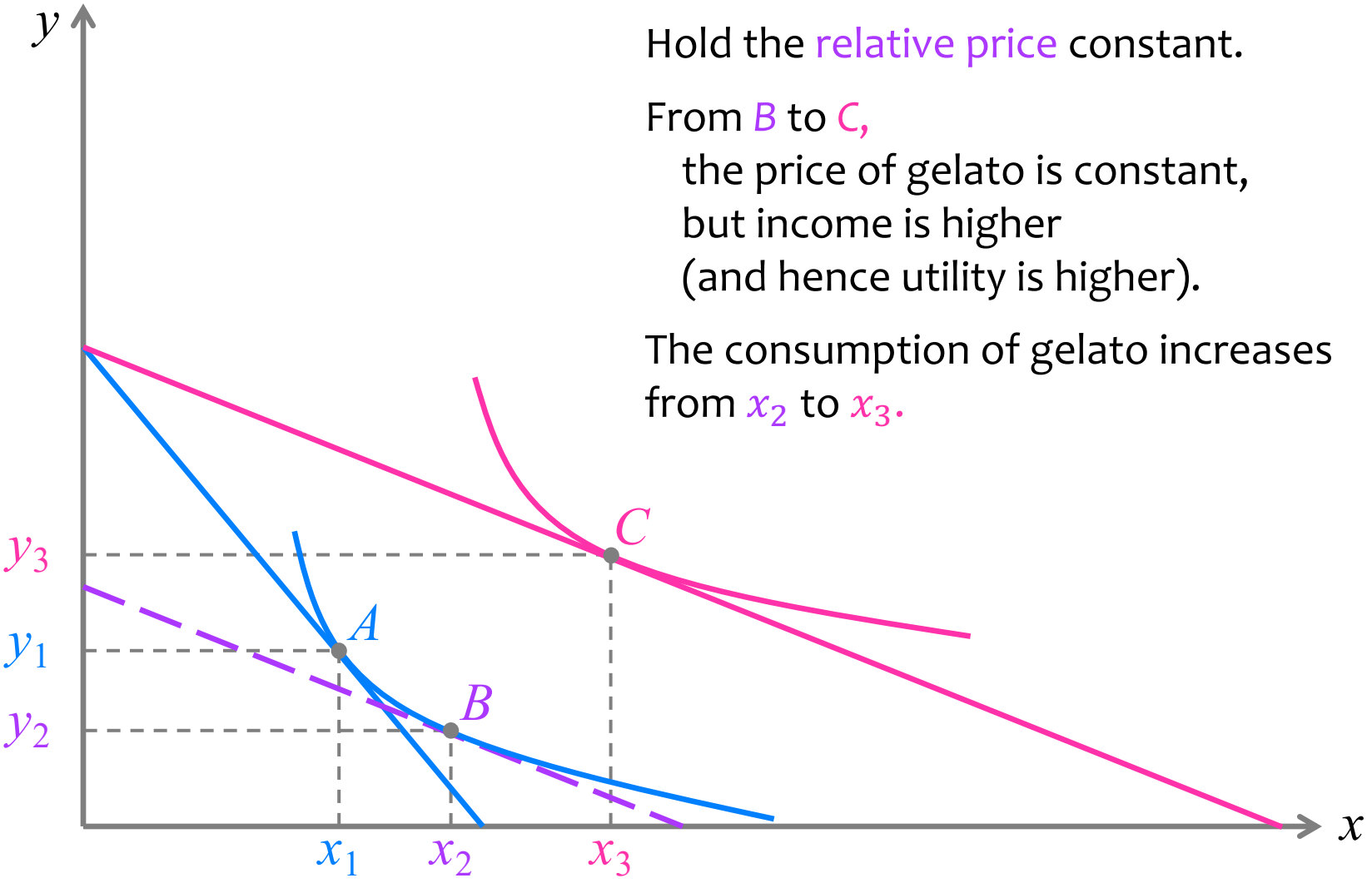
From *A* to *B*,
the price of gelato is lower,
but utility is constant.

The consumption of gelato increases from x_1 to x_2.

Substitution Effect

- Substitution effect:
  - The change in the consumption of a good that is associated with a change in its price, holding the level of utility and other prices constant.
- The substitution effect for gelato is $x_2 - x_1$.

From *B* to *C*



Hold the relative price constant.

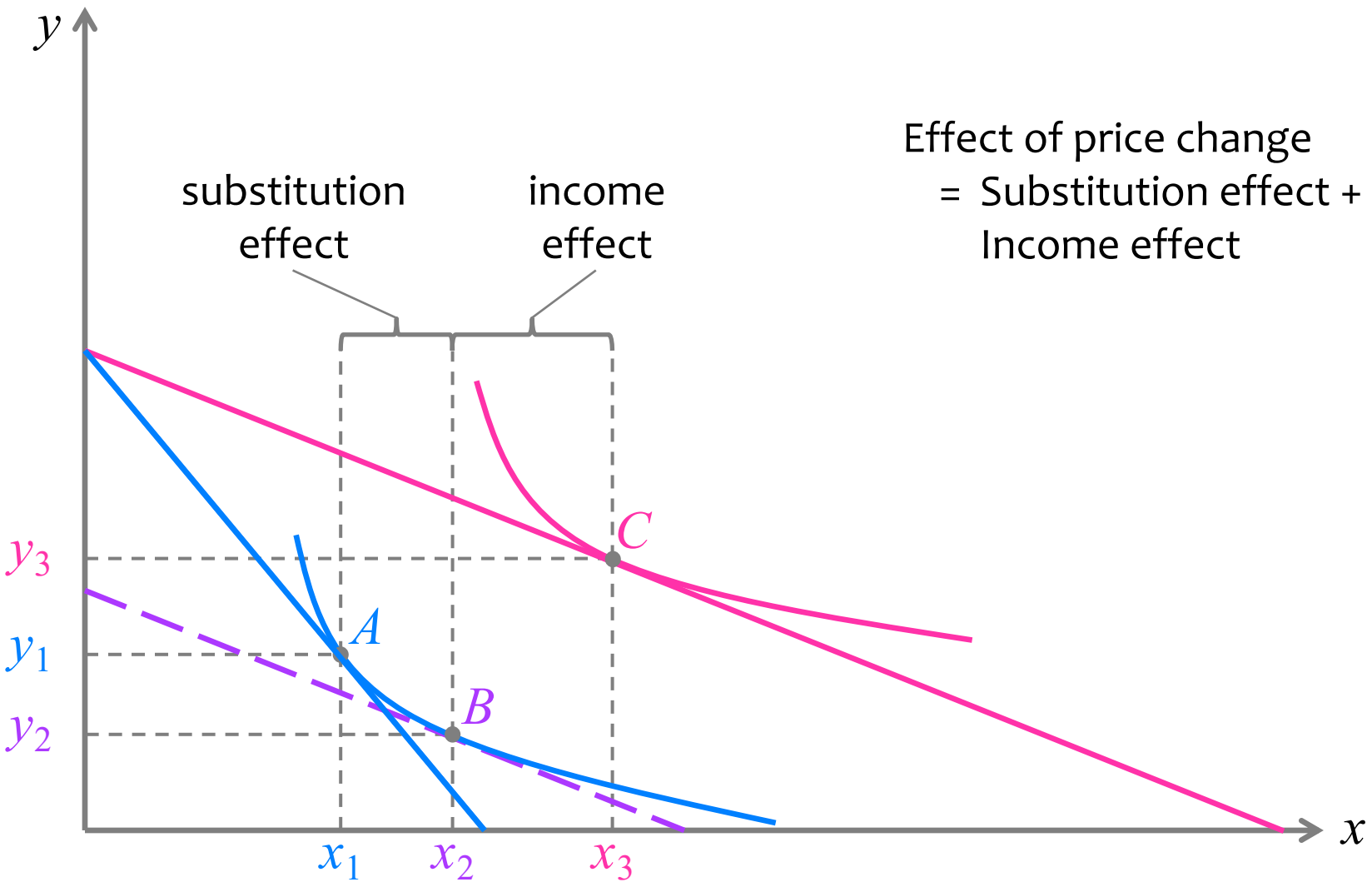
From *B* to *C*,
the price of gelato is constant,
but income is higher
(and hence utility is higher).

The consumption of gelato increases from x_2 to x_3.

Income Effect

- Income effect:
  - The change in the consumption of a good that is associated with a change in purchasing power, holding all prices constant.
- The income effect for gelato is $x_3 - x_2$.

Decomposing the Effect of a Price Change



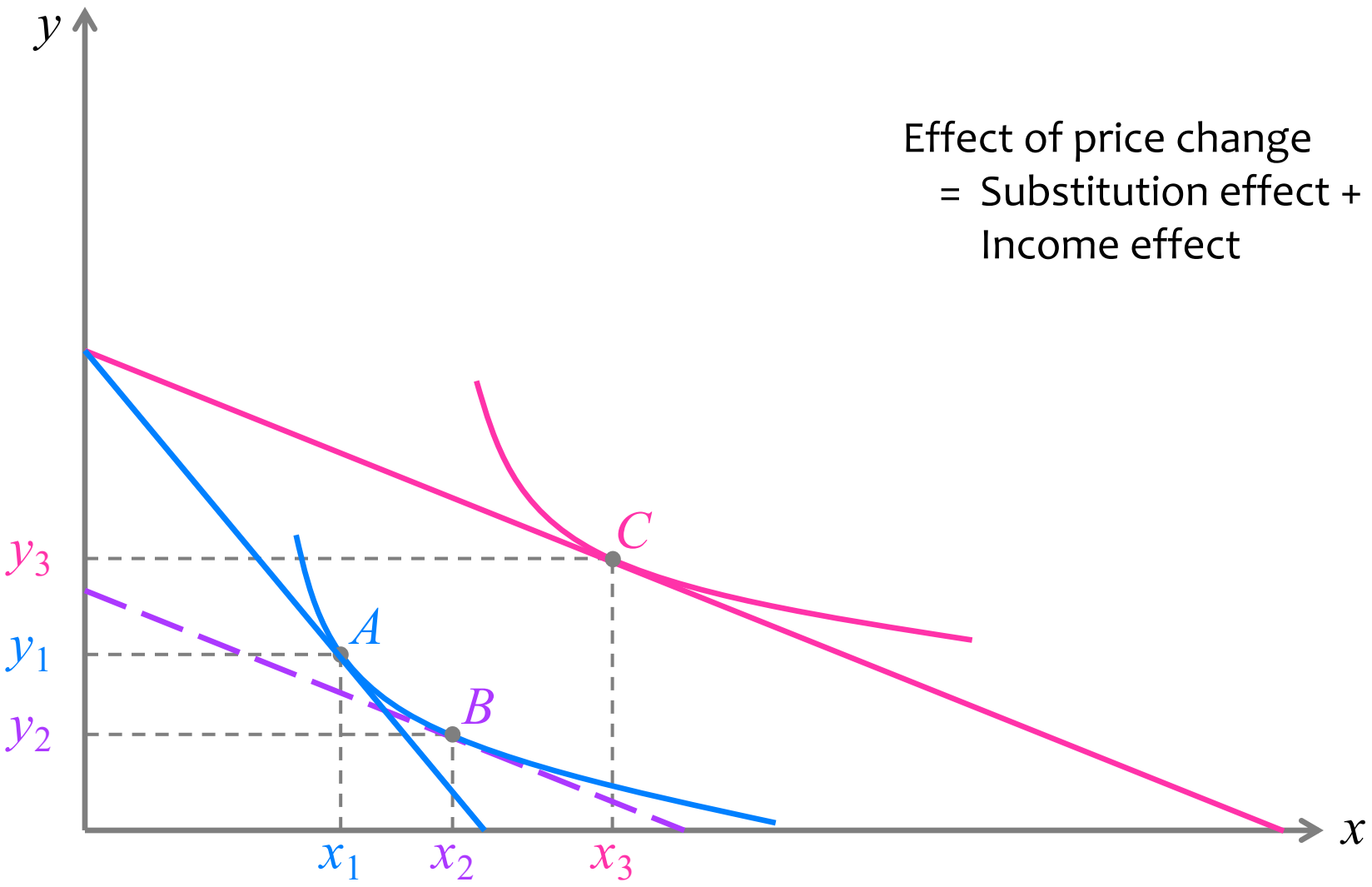
Substitution Effect & Income Effect:

Example

Substitution and Income Effects: Example

- Suppose Naomi has utility function $U(x, y) = xy.$
- Suppose gelato (x) costs $\$10$ a pint, coffee (y) costs $\$5$ a cup, and Naomi's income is $\$90.$
  - Naomi's optimal choice (Basket *A*) is $x_1 = 4.5, y_1 = 9.$
  - Naomi's utility is $U_A = 40.5.$
- Suppose the price of gelato (x) falls to $\$6$ a pint.
  - Naomi's new optimal choice (Basket *C*) is $x_3 = 7.5, y_3 = 9.$
  - Her consumption of gelato increases by $7.5 - 4.5 = 3.$

Decomposing the Effect of a Price Change



Effect of price change
= Substitution effect +
Income effect

Substitution and Income Effects: Example

- The hypothetical budget line is
  tangent to the old indifference curve,
  and parallel to the new budget line.

- The intermediate basket (basket B) is
  on the old indifference curve,
  and tangent to the hypothetical budget line.

- The intermediate basket must satisfy:

$$U_B = U_A \quad \Rightarrow \quad xy = 40.5$$

$$MRS_{x,y} = \frac{p'_x}{p_y} \quad \Rightarrow \quad \frac{y}{x} = \frac{6}{5}$$

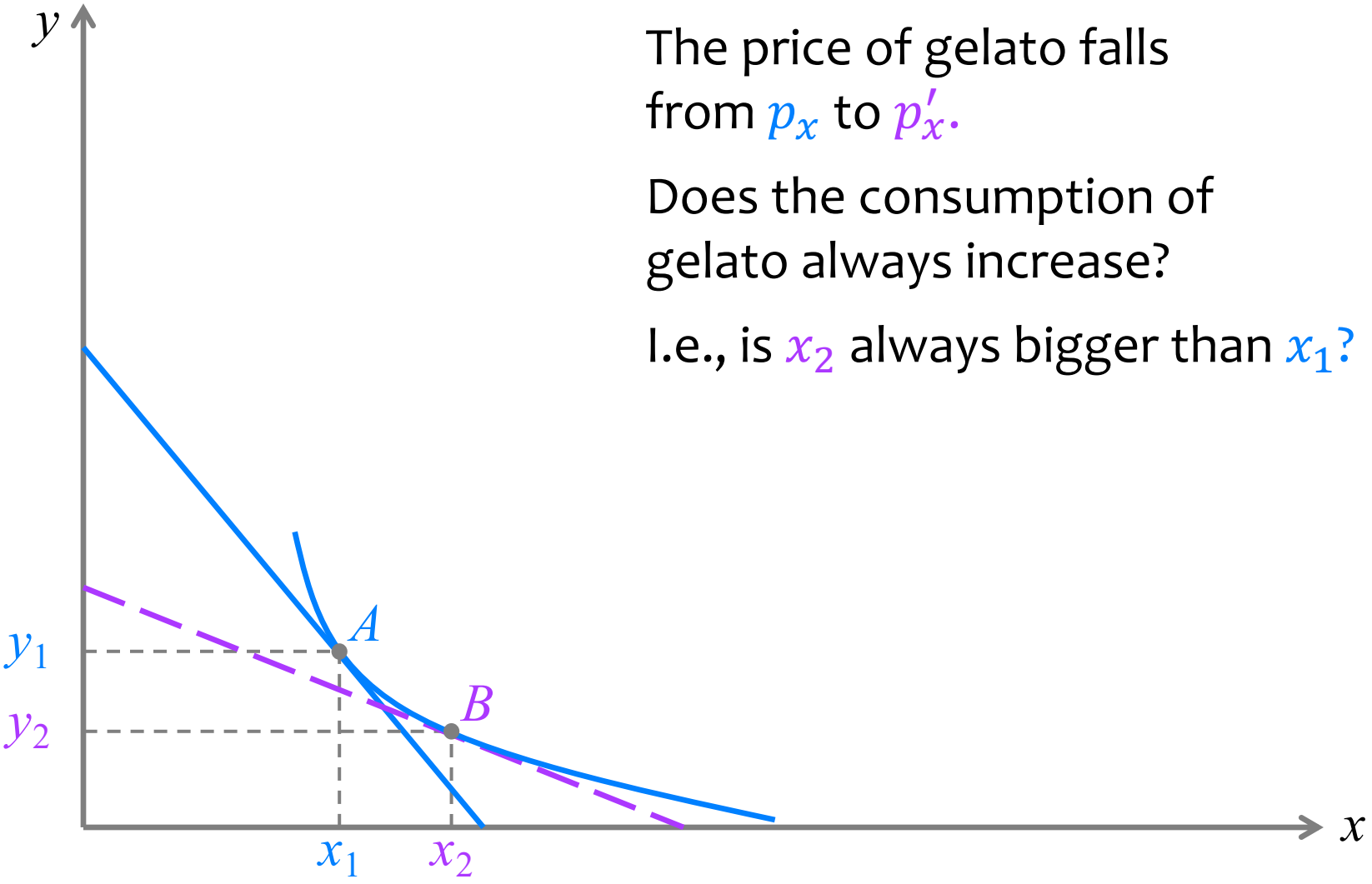
Substitution and Income Effects: Example

- The intermediate basket must satisfy:
  - $xy = 40.5$
  - $\frac{y}{x} = \frac{6}{5}$
- The intermediate basket is $x_2 = 5.81, y_2 = 6.97.$
- The substitution effect for gelato is $5.81 - 4.5 = 1.31.$
- The income effect for gelato is $7.5 - 5.81 = 1.69.$

Substitution Effect & Income Effect:

Direction of Substitution Effect

Direction of Substitution Effect



The price of gelato falls from p_x to p'_x.

Does the consumption of gelato always increase?

I.e., is x_2 always bigger than x_1?

Direction of Substitution Effect

- If the price of gelato falls,
  the quantity demanded increases or is unchanged,
  i.e., the substitution effect is always non-negative.

Direction of Substitution Effect

- From $A\ (x_1, y_1)$ to $B\ (x_2, y_2)$, the price of x falls from p_x to p'_x.
- Naomi is indifferent between $A\ (x_1, y_1)$ and $B\ (x_2, y_2)$.
  - A is optimal given the old budget line (with p_x).
  - B is optimal given the hypothetical budget line (with p'_x).

Direction of Substitution Effect

- Naomi is indifferent between $A\ (x_1, y_1)$ and $B\ (x_2, y_2)$.
  - A is optimal given the old budget line (with p_x).
  - B is optimal given the hypothetical budget line (with p_x').
- Consider the old budget line (with p_x):
  - Either B is on the old budget line
    or B is above the old budget line.

$$p_x x_2 + p_y y_2 \geq p_x x_1 + p_y y_1 \qquad \text{(i)}$$

Direction of Substitution Effect

- Naomi is indifferent between $A\ (x_1, y_1)$ and $B\ (x_2, y_2)$.
  - A is optimal given the old budget line (with p_x).
  - B is optimal given the hypothetical budget line (with p_x').
- Consider the hypothetical budget line (with p_x'):
  - Either A is on the hypothetical budget line
    or A is above the hypothetical budget line.

$$p_x' x_1 + p_y y_1 \geq p_x' x_2 + p_y y_2 \qquad \text{(ii)}$$

Direction of Substitution Effect

- Given: $p_x x_2 + p_y y_2 \geq p_x x_1 + p_y y_1$ (i)

  $p'_x x_1 + p_y y_1 \geq p'_x x_2 + p_y y_2$ (ii)

- Rearranging: $p_x(x_2 - x_1) + p_y(y_2 - y_1) \geq 0$ (iii)

  $p'_x(x_1 - x_2) + p_y(y_1 - y_2) \geq 0$ (iv)

- (iii) + (iv): $(p_x - p'_x)(x_2 - x_1) \geq 0$

- Since $p_x > p'_x$

- Therefore $x_2 \geq x_1$

Substitution Effect & Income Effect:

Direction of Income Effect

Direction of Income Effect: Normal Good

- Suppose gelato is a normal good.
- Suppose the price of gelato ↓.
  - Substitution effect: Relative price ↓
    ⇒ ↑ consumption of gelato.
  - Income effect: Purchasing power ↑
    ⇒ ↑ consumption of gelato.

Direction of Income Effect: Normal Good

- Suppose gelato is a normal good.
- Suppose the price of gelato ↑.
  - Substitution effect: Relative price ↑
    ⇒ ↓ consumption of gelato.
  - Income effect: Purchasing power ↓
    ⇒ ↓ consumption of gelato.
- The substitution effect and income effect are in the same direction for a normal good.

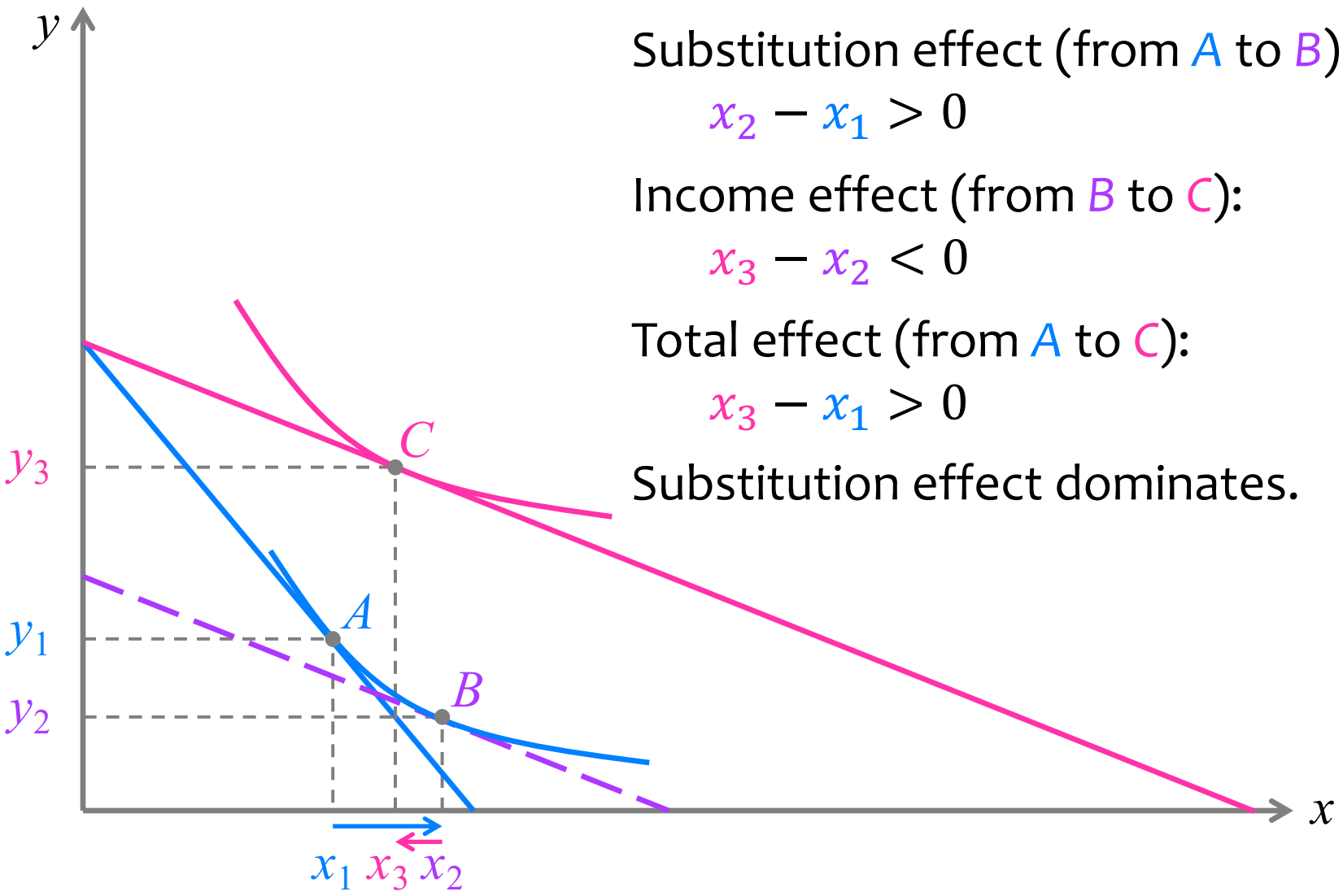
Direction of Income Effect: Inferior Good

- Suppose gelato is an inferior good.
- Suppose the price of gelato ↓.
  - Substitution effect: Relative price ↓
    ⇒ ↑ consumption of gelato.
  - Income effect: Purchasing power ↑
    ⇒ ↓ consumption of gelato.

Direction of Income Effect: Inferior Good

- Suppose gelato is an inferior good.
- Suppose the price of gelato ↑.
  - Substitution effect: Relative price ↑
    ⇒ ↓ consumption of gelato.
  - Income effect: Purchasing power ↓
    ⇒ ↑ consumption of gelato.
- The substitution effect and income effect are in opposite directions for an inferior good.

Income Effect for an Inferior Good



Substitution effect (from *A* to *B*):

$x_2 - x_1 > 0$

Income effect (from *B* to *C*):

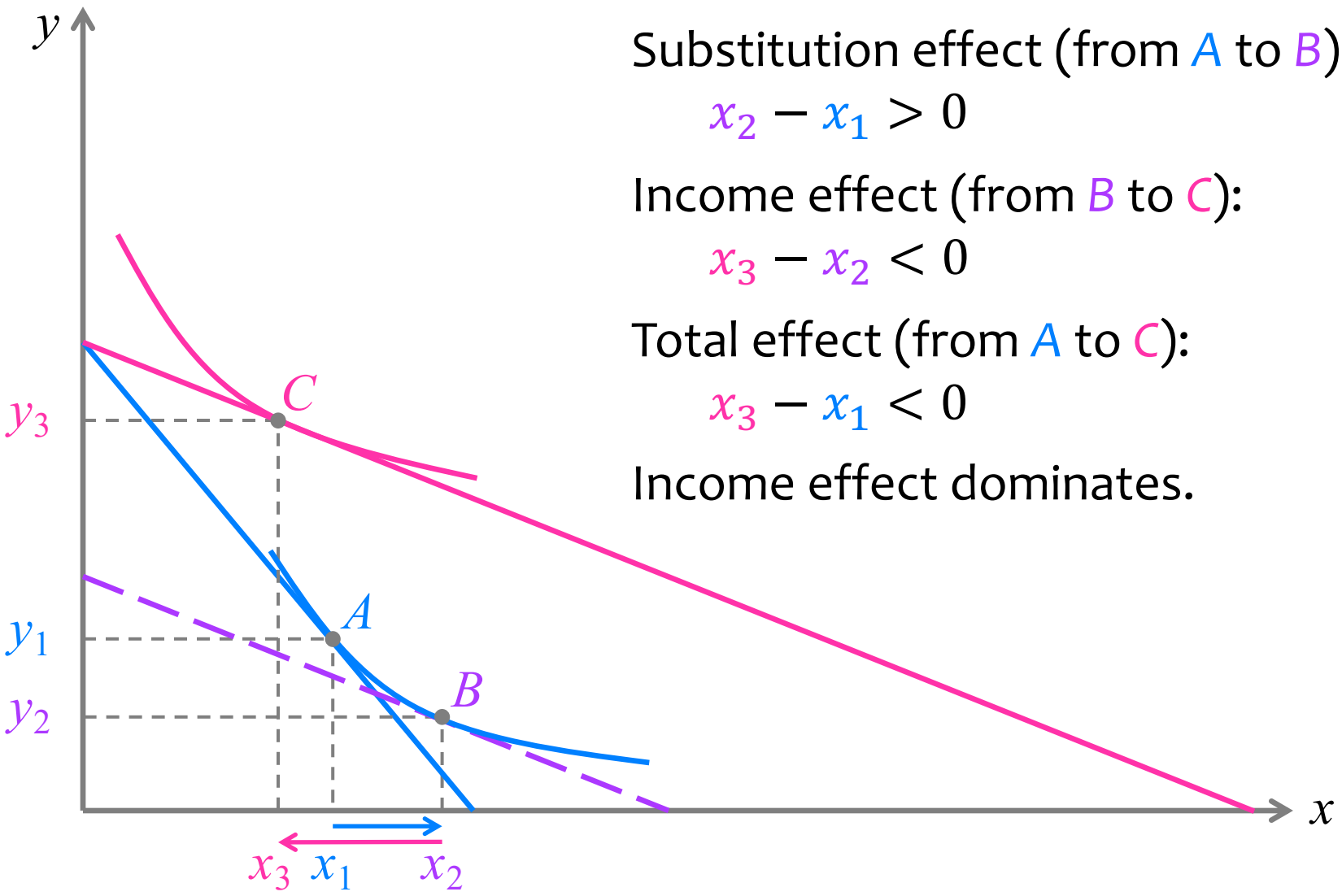
$x_3 - x_2 < 0$

Total effect (from *A* to *C*):

$x_3 - x_1 > 0$

Substitution effect dominates.

Income Effect for an Inferior Good



Substitution effect (from *A* to *B*):

$x_2 - x_1 > 0$

Income effect (from *B* to *C*):

$x_3 - x_2 < 0$

Total effect (from *A* to *C*):

$x_3 - x_1 < 0$

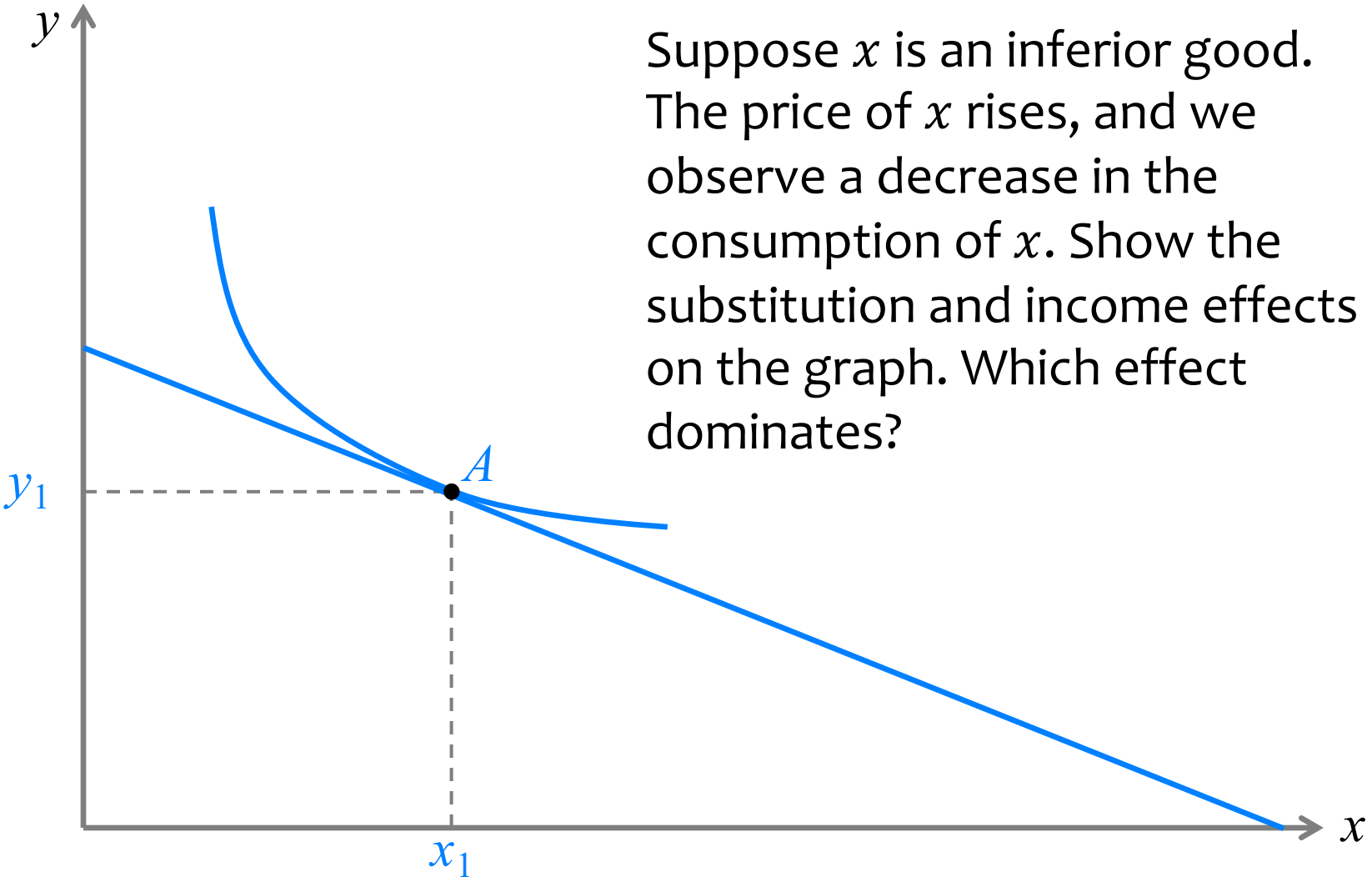
Income effect dominates.

Giffen Good

- A good is a Giffen good if:
  - As the price decreases,
    the quantity demanded of the good decreases,
    holding other factors constant.
  - As the price increases,
    the quantity demanded of the good increases,
    holding other factors constant.
- A Giffen good is an inferior good
  where the income effect dominates the substitution effect.

Exercise 4.4

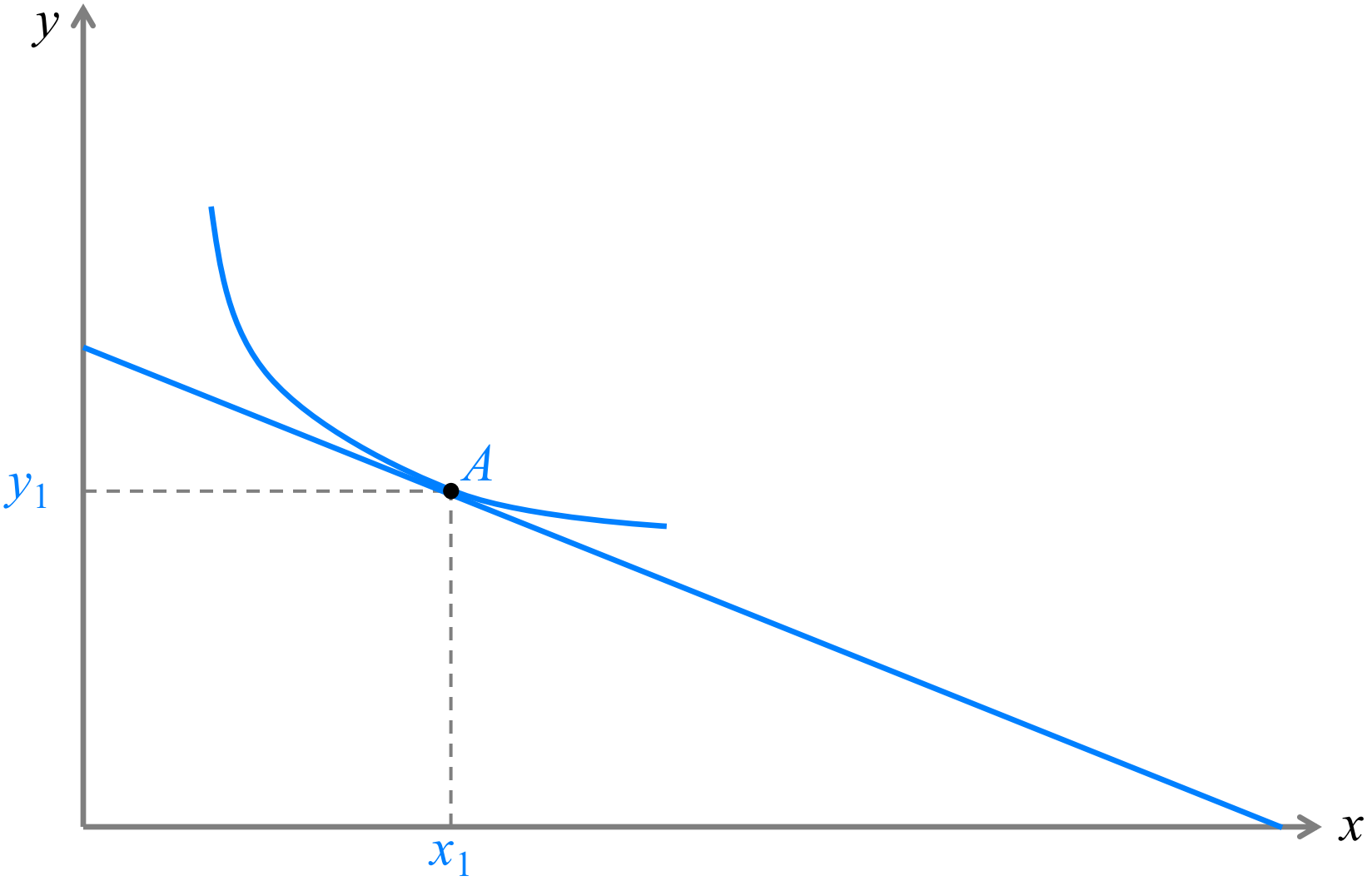
Substitution Effect and Income Effect



Suppose x is an inferior good. The price of x rises, and we observe a decrease in the consumption of x. Show the substitution and income effects on the graph. Which effect dominates?

Exercise 4.4

Substitution Effect and Income Effect



Exercise 4.5

Signs of Substitution Effect and Income Effect

- Explain whether the following statements are true or false.
- For a normal good:
  - The substitution effect is always positive.
  - The income effect is always positive.
- For an inferior good:
  - The substitution effect is always positive.
  - The income effect is always negative.
- *Hint: "Substitution effect" / "Income effect" refers to the change in quantity demanded. What happens when the price falls? What happens when the price rises?*

Exercise 4.5

Signs of Substitution Effect and Income Effect

Exercise 4.5

Signs of Substitution Effect and Income Effect

Exercise 4.6

Giffen Good vs. Inferior Good

- Giffen good:
  - Positive correlation between price and quantity demanded.
- Inferior good:
  - Negative correlation between income and quantity demanded.
- Are all Giffen goods inferior goods?
- Are all inferior goods Giffen goods?

Exercise 4.6

Giffen Good vs. Inferior Good