1.6 — Income & Substitution Effects

ECON 306 • Microeconomic Analysis • Spring 2023

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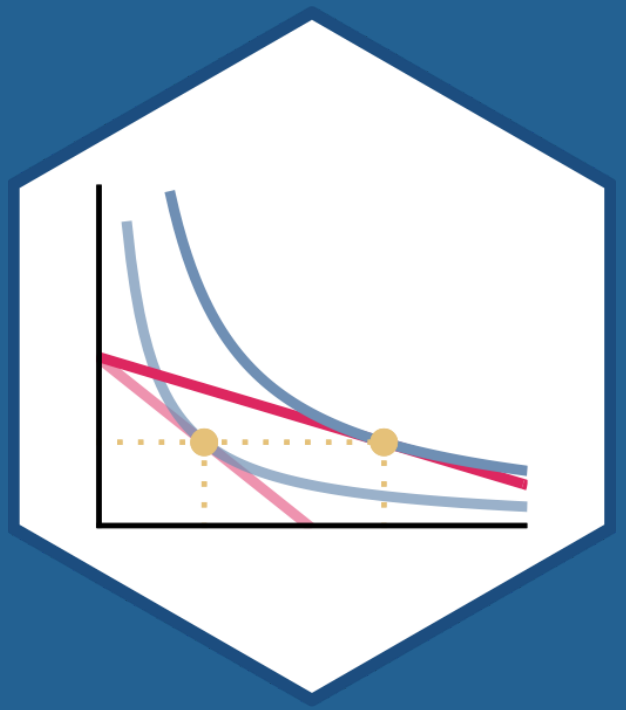
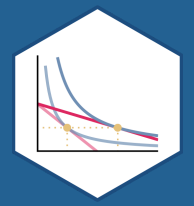


Outline



The (Own) Price Effect

(Real) Income Effect

Substitution Effect

Putting the Effects Together

What About Inferior Goods?

On to Demand Curves

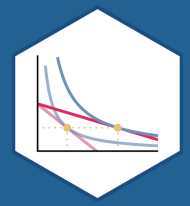
A Demand Function (Again)

- A consumer's **demand** (for good x) depends on **current prices & income**:

$$q_x^D = q_x^D(m, p_x, p_y)$$

- **How does demand (for x) change?**

1. **Income effects** $\left(\frac{\Delta q_x^D}{\Delta m}\right)$: how q_x^D changes with changes in income
2. **Cross-price effects** $\left(\frac{\Delta q_x^D}{\Delta p_y}\right)$: how q_x^D changes with changes in prices of *other* goods (e.g. y)
3. **(Own) Price effects** $\left(\frac{\Delta q_x^D}{\Delta p_x}\right)$: how q_x^D changes with changes in price (of x)



The (Own) Price Effect

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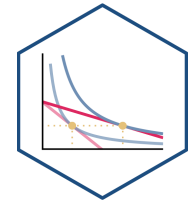


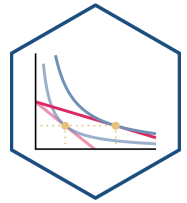
- **Price effect**: change in optimal consumption of a good associated with a change in its price, holding income and other prices constant

$$\frac{\Delta q_x^D}{\Delta p_x} < 0$$

The law of demand: as the price of a good rises, people will tend to buy less of that good (and vice versa)

- i.e. **the price effect is negative!**

Decomposing the Price Effect

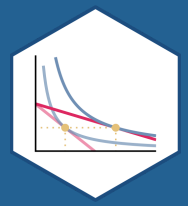


The **price effect** (law of demand) is actually the **net result of two effects**

1. **(Real) income effect**: change in consumption due to change in real purchasing power

2. **Substitution effect**: change in consumption due to change in relative prices

$$\textbf{Price Effect} = \textbf{Real income effect} + \textbf{Substitution Effect}$$



(Real) Income Effect

(Real) Income Effect: Demonstration

- Suppose there is only 1 good to consume, x. You have a \$100 income, and the price of x is \$10. You consume 10 units of x
- Suppose the price of x rises to \$20. You now consume 5 units of x.
- This is the **real income effect**

(Real) Income Effect: Demonstration

- **Real income effect**: your consumption mix changes because of the change in the price of x changes your **real income** or **purchasing power** (the amount of goods you can buy)

- Note your ***actual* (nominal) income** ($100) **never changed!**

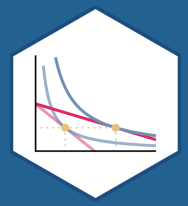
(Real) Income Effect: Size

- The *size* of the income effect depends on how large a *portion of your budget* you spend on the good
- **Large-budget items**:
    - e.g. Housing/apartment rent, car prices
    - Price increase/decreases makes you much poorer/wealthier

(Real) Income Effect: Size

- The *size* of the income effect depends on how large a *portion of your budget* you spend on the good

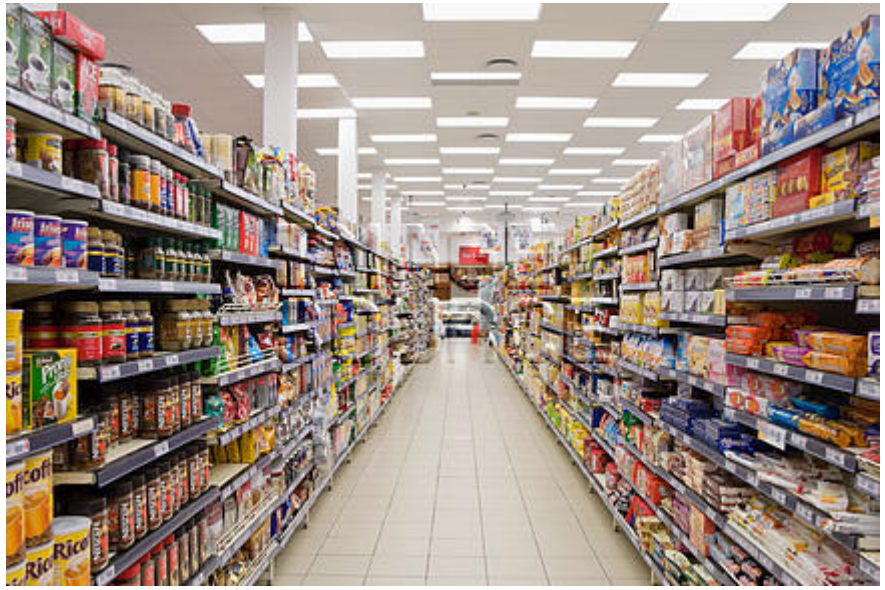
- **Small-budget items**:
    - e.g. pencils, toothpicks, candy
    - Price changes don't have much of an effect on your wealth or change your behavior much



Substitution Effect

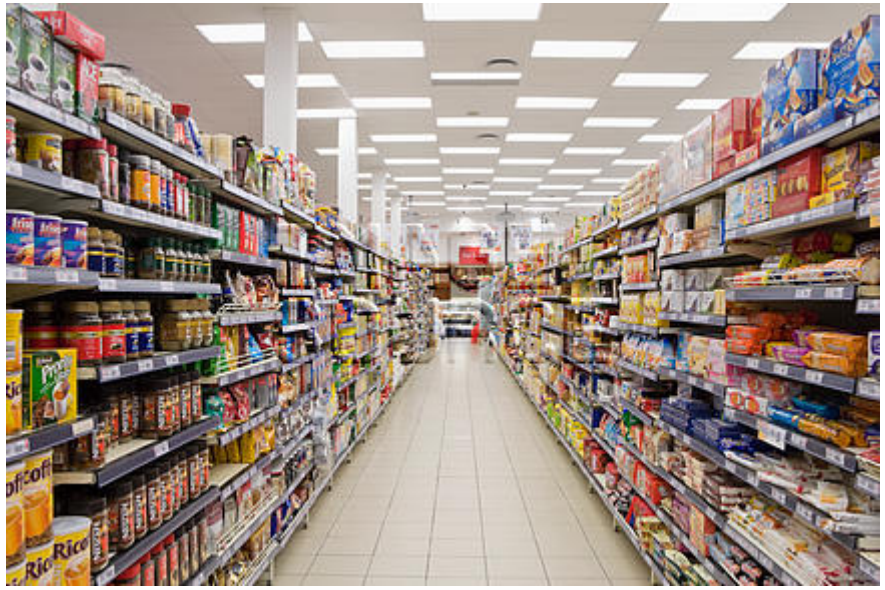
Substitution Effect: Demonstration

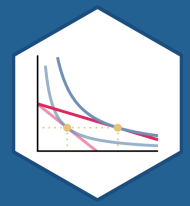
- Suppose there are 1000's of goods, none of them a major part of your budget
    - So real income effect is insignificant
- Suppose the price of good x increases
- You would consume *less* of x relative to other goods because x is now *relatively* more expensive
- That's the **substitution effect**



Substitution Effect: Demonstration

- **Substitution effect**: consumption mix changes because of a change in **relative prices**
- Buy more of the (now) relatively cheaper items
- Buy less of the (now) relatively more expensive item (x)





Putting the Effects Together

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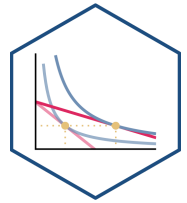


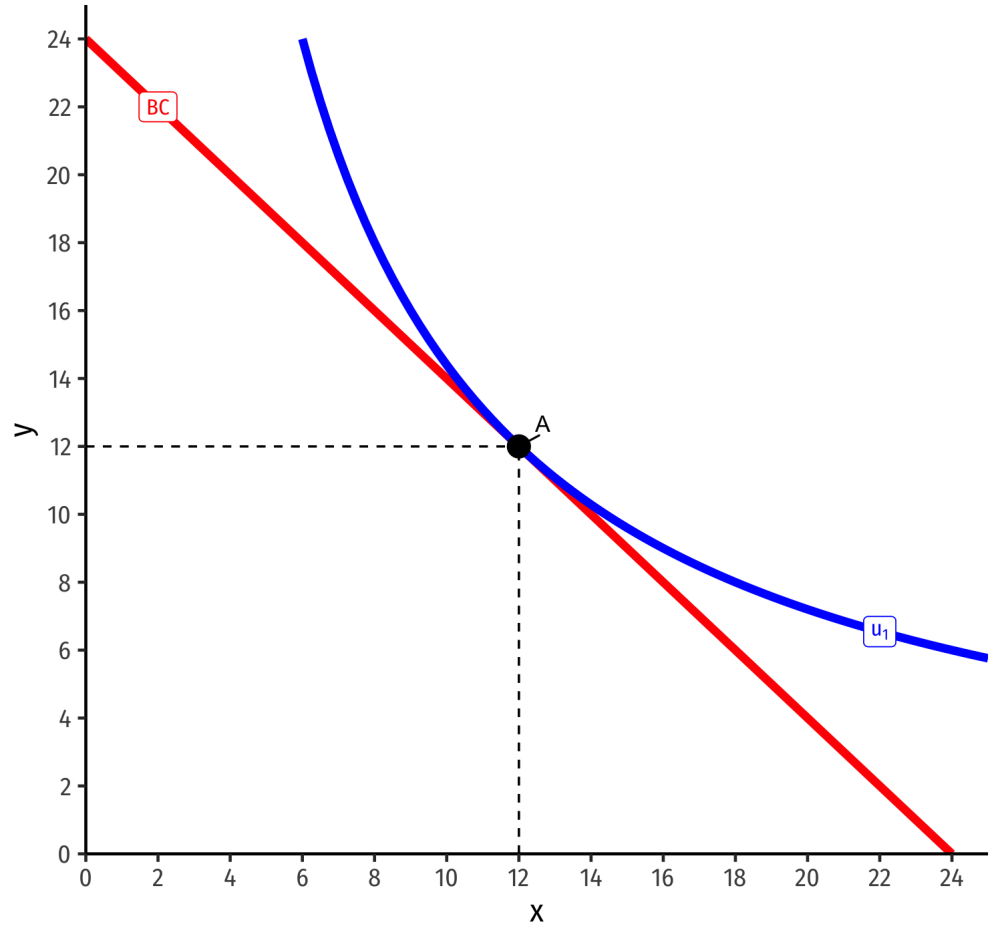
- **Real income effect**: change in consumption due to change in real purchasing power
  - **Could go in different directions**: positive (**normal goods**) or negative (**inferior goods**)
  - Higher price of x means you must buy less x, y, or *both* (depending on your preferences)

- **Substitution effect**: change in consumption due to change in relative prices
  - If x gets more expensive relative to y, consume $\downarrow x$ (and $\uparrow y$)
  - **Always the same direction:** ($\downarrow$ relatively expensive goods, $\uparrow$ relatively cheaper goods)
  - **This is why demand curves slope downwards!**

$$\textbf{Price Effect} = \textbf{Real income effect} + \textbf{Substitution Effect}$$

Real Income and Substitution Effects, Graphically I

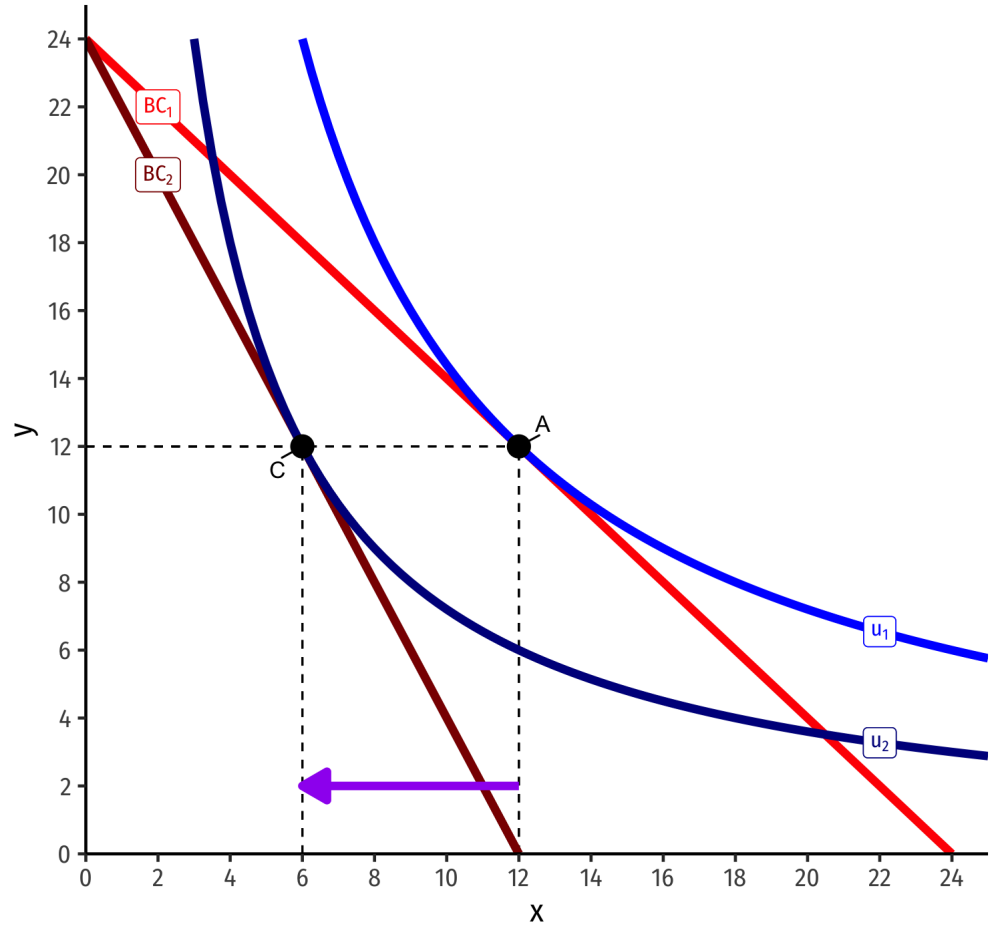
- Original optimal consumption (A)



Optima with $u(x, y) = x^{0.5}y^{0.5}$, $m = 24$, $p_y = 1$

Real Income and Substitution Effects, Graphically I

- Original optimal consumption (A)
- **(Total) price effect:** $A \rightarrow C$
- Let's decompose this into the two effects



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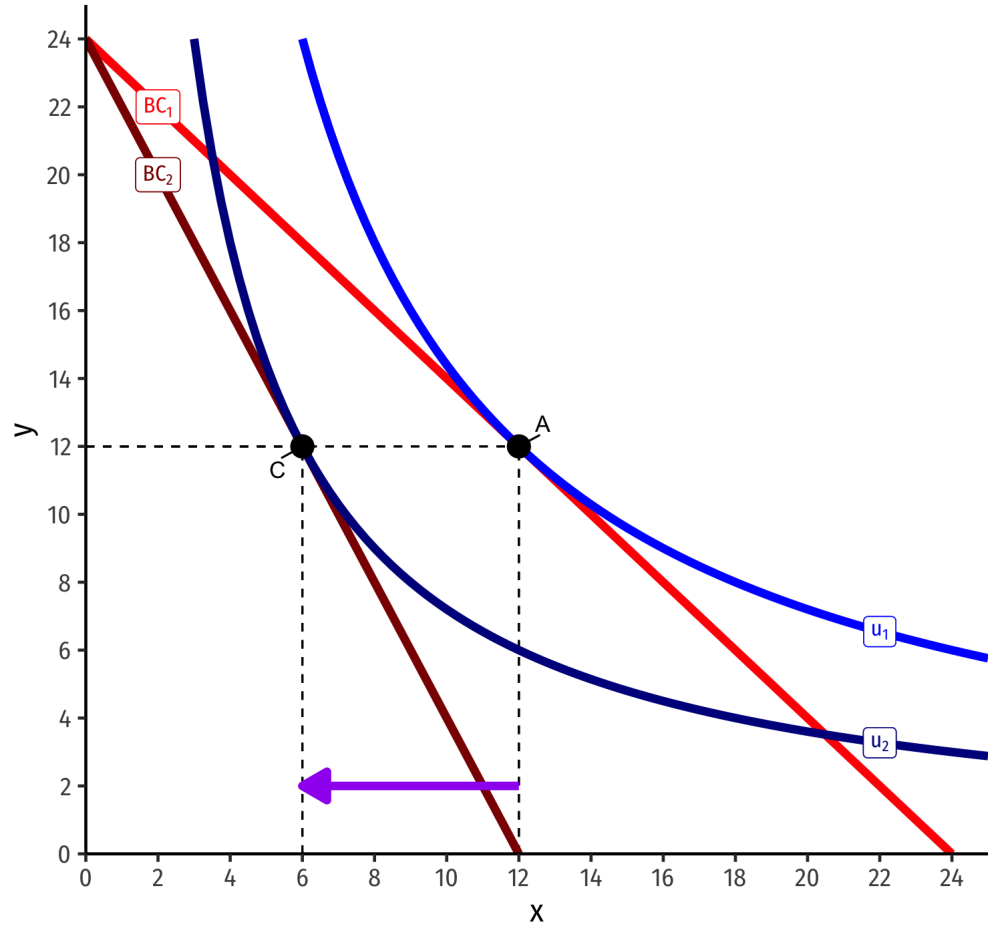
Real Income and Substitution Effects, Graphically II

- **Substitution effect:** what you would choose under the **new exchange rate** to **remain indifferent** as before the change



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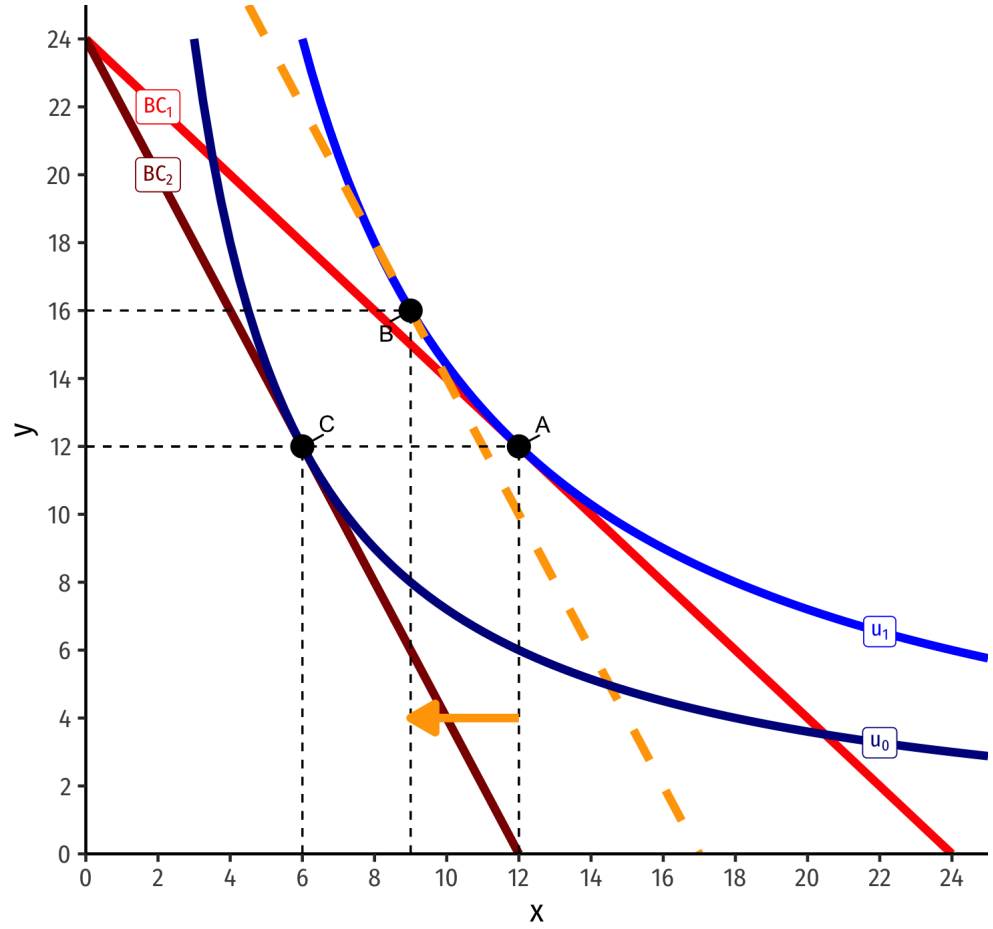
Real Income and Substitution Effects, Graphically II

- **Substitution effect:** what you would choose under the **new exchange rate** to **remain indifferent** as before the change
- Graphically: shift *new* budget constraint inwards until tangent with *old* indifference curve
- $A \rightarrow B$ on same I.C. $(\downarrow x, \uparrow y)$
  - Note: Point B *must* be a *different* point on the original curve! Why?



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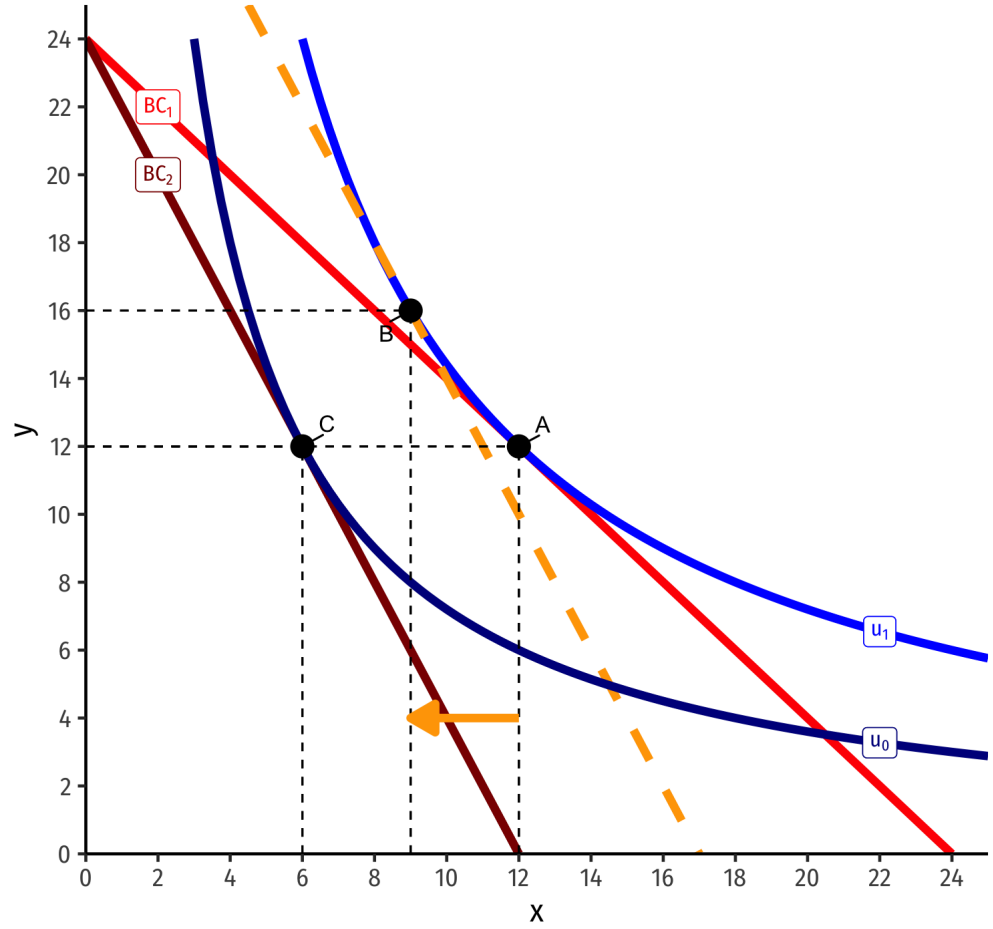
Real Income and Substitution Effects, Graphically III

- **(Real) income effect:** change in consumption due to the **change in purchasing power** from the price change



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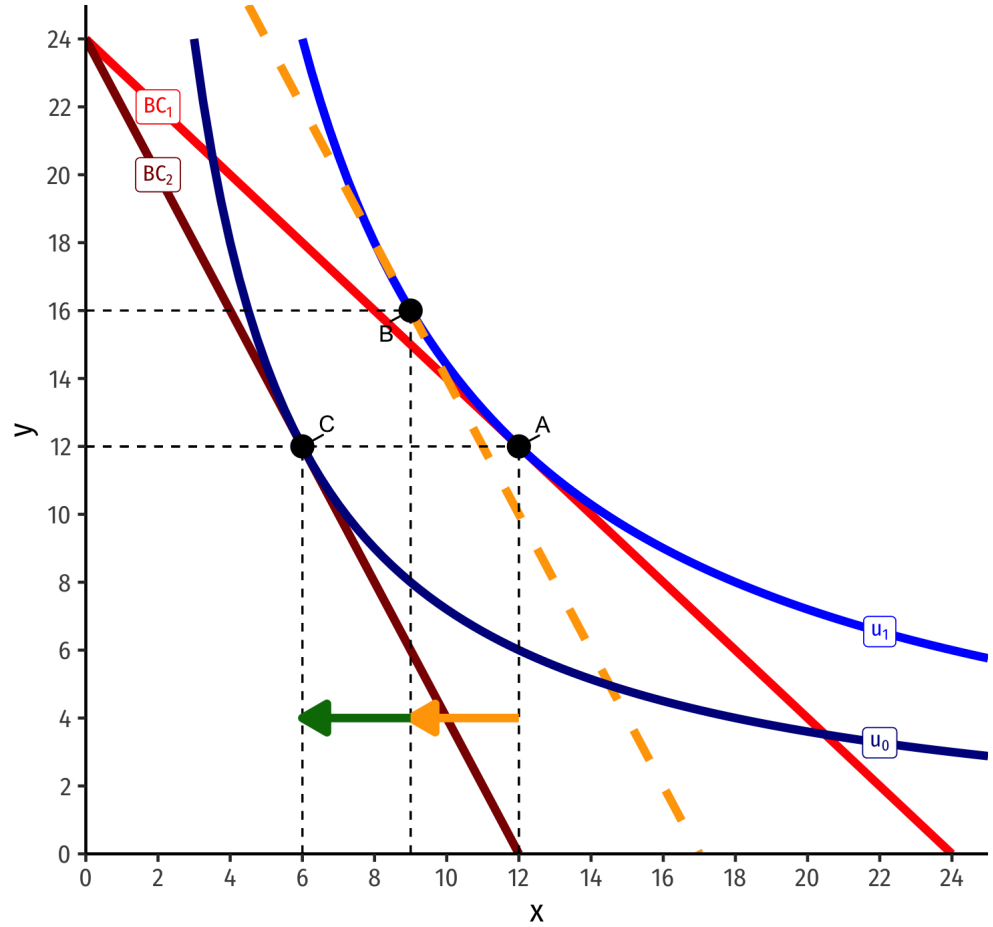
- $B \rightarrow C$ to new budget constraint (can buy less of x and/or y)



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Real Income and Substitution Effects, Graphically IV

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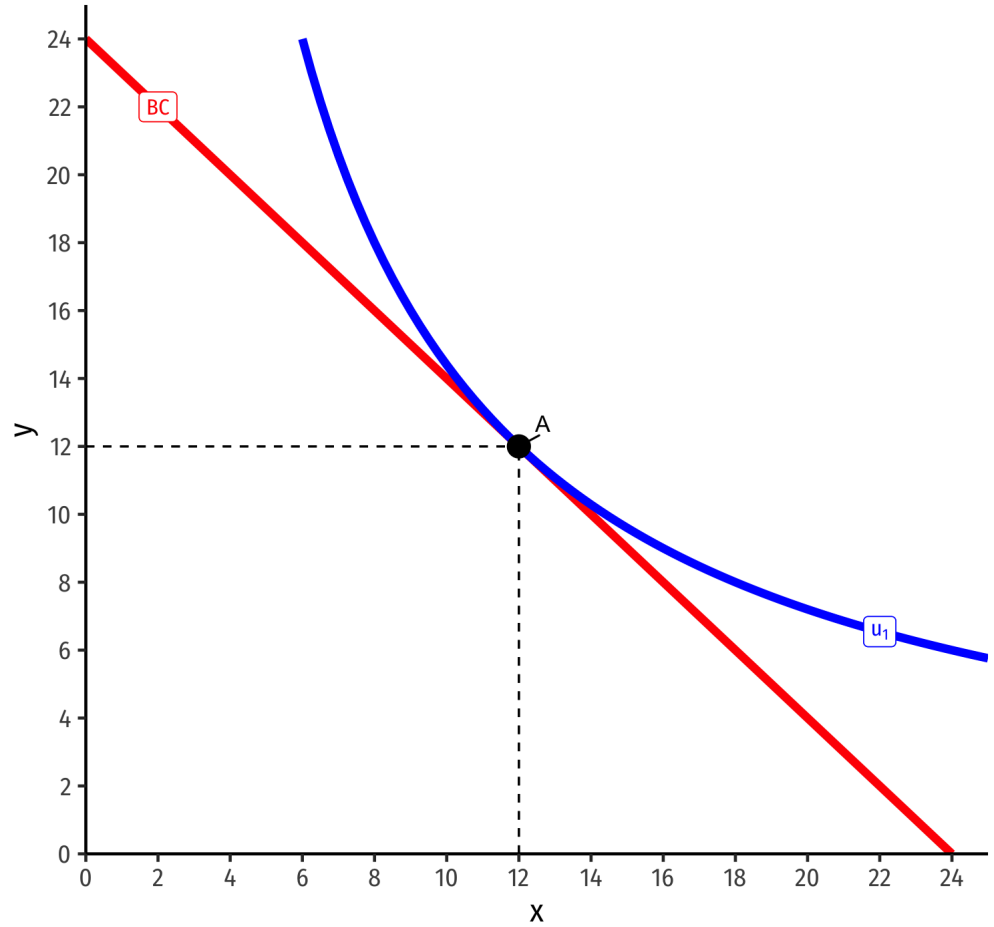

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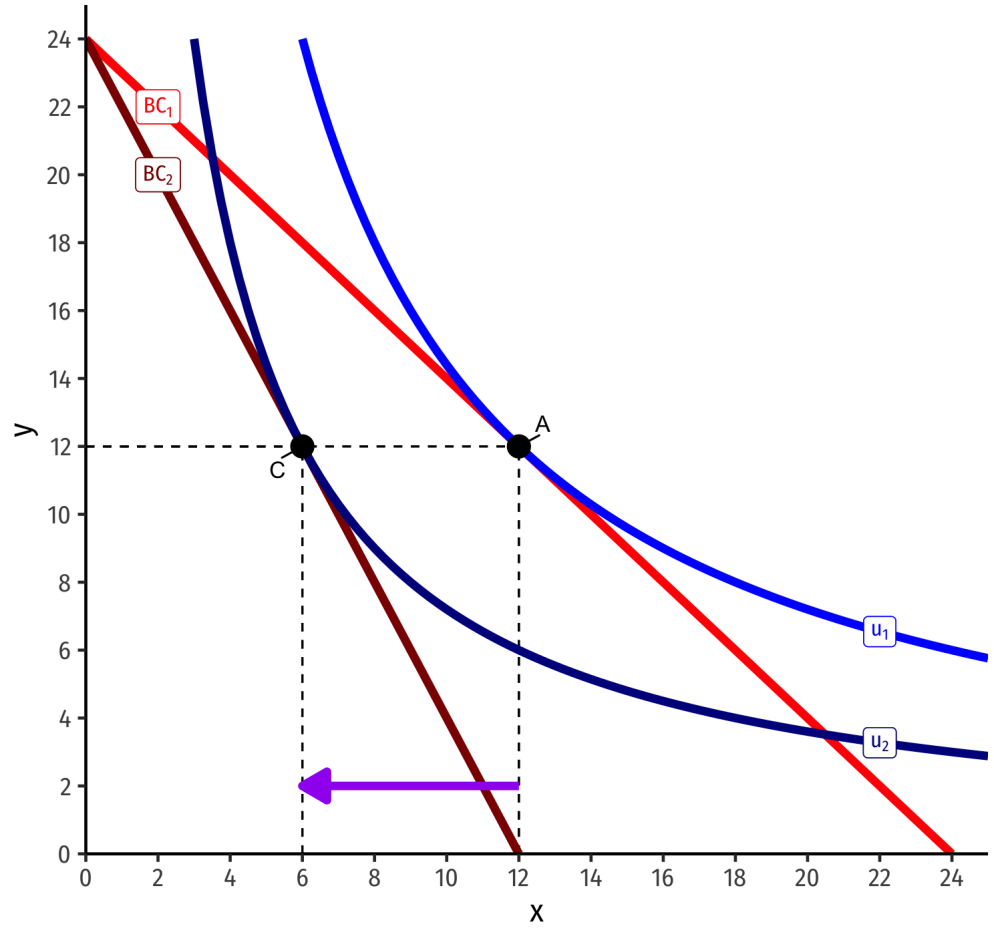
Real Income and Substitution Effects, Graphically IV

- Original optimal consumption (A)
- Price of x rises, new optimal consumption at (C)



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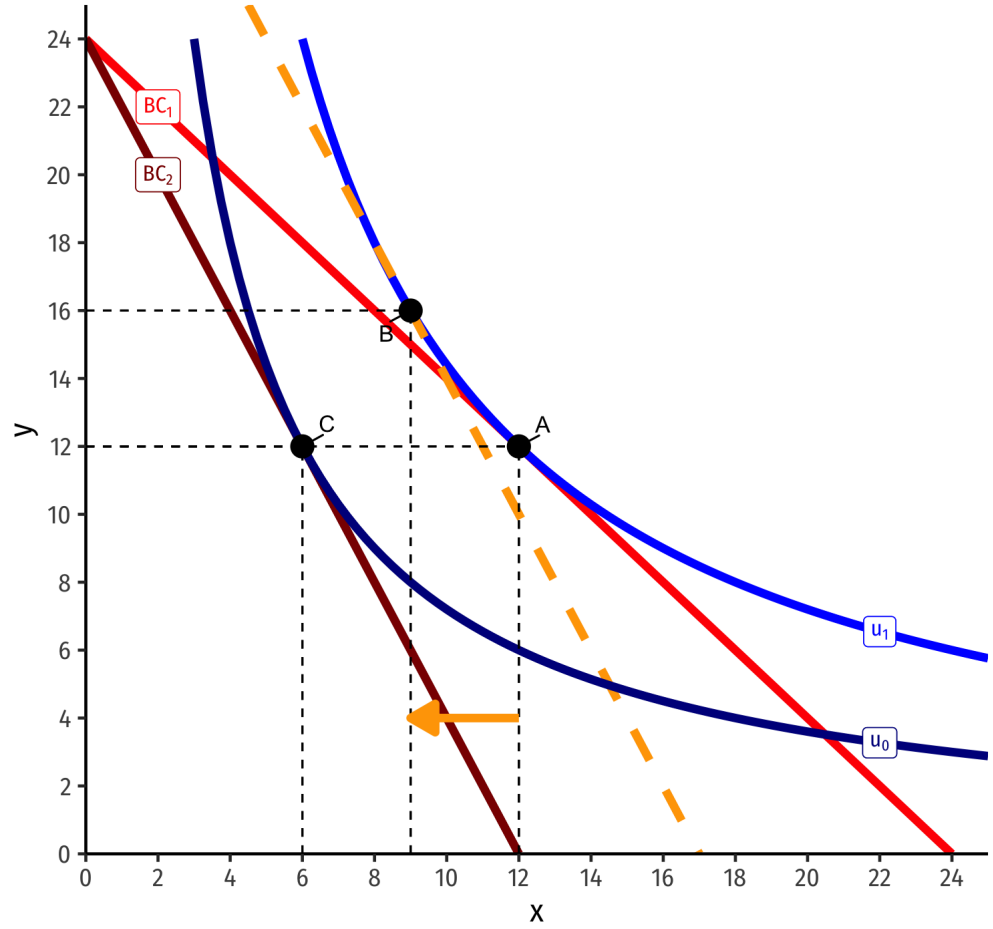

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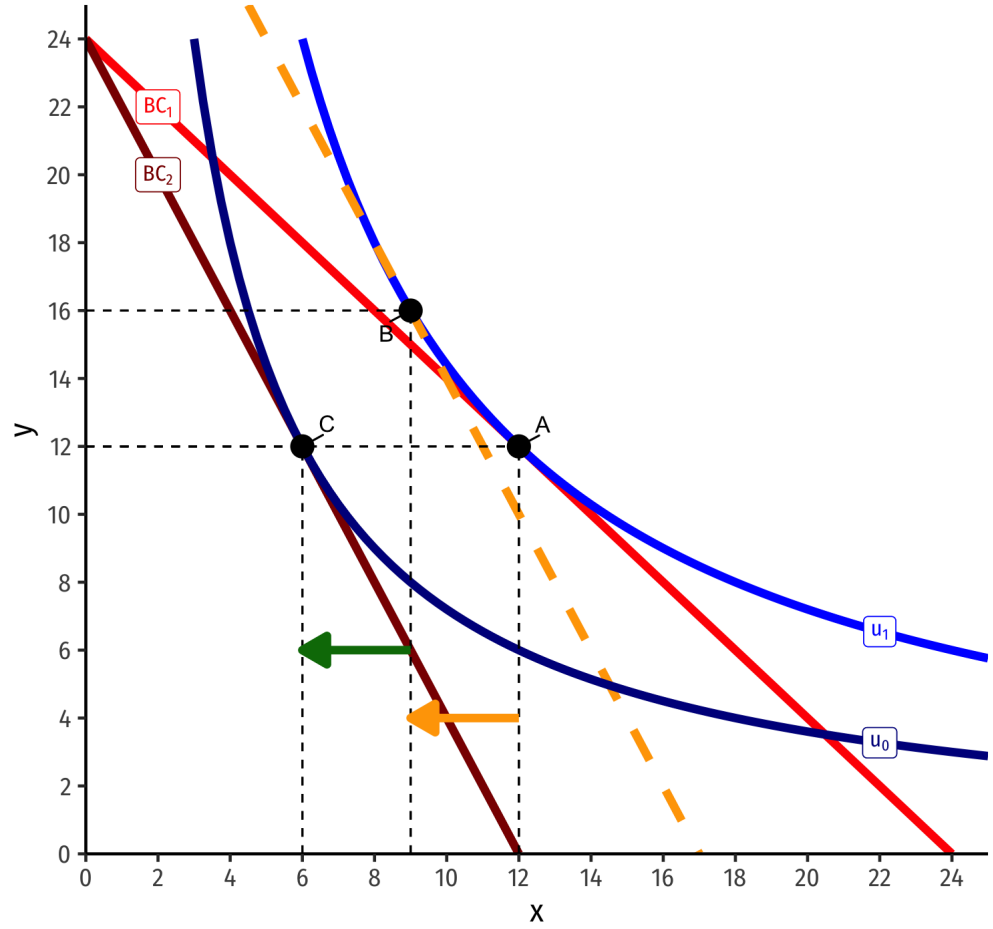

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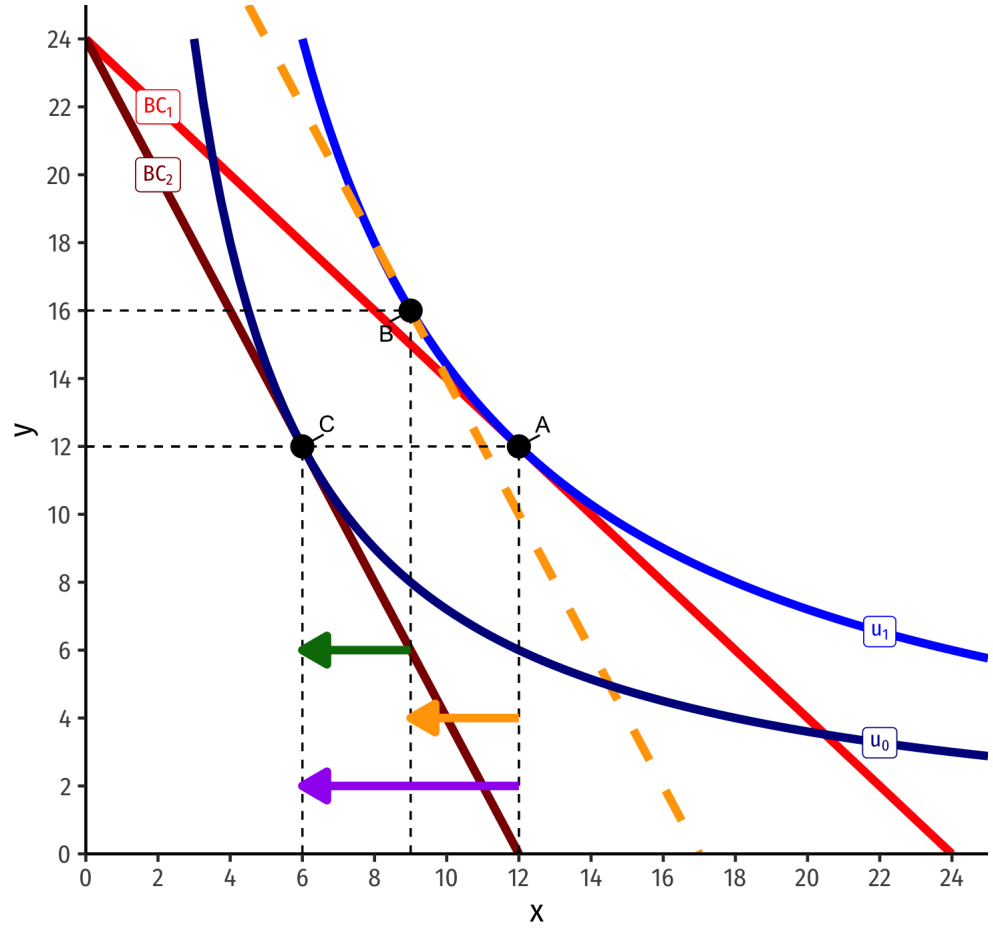

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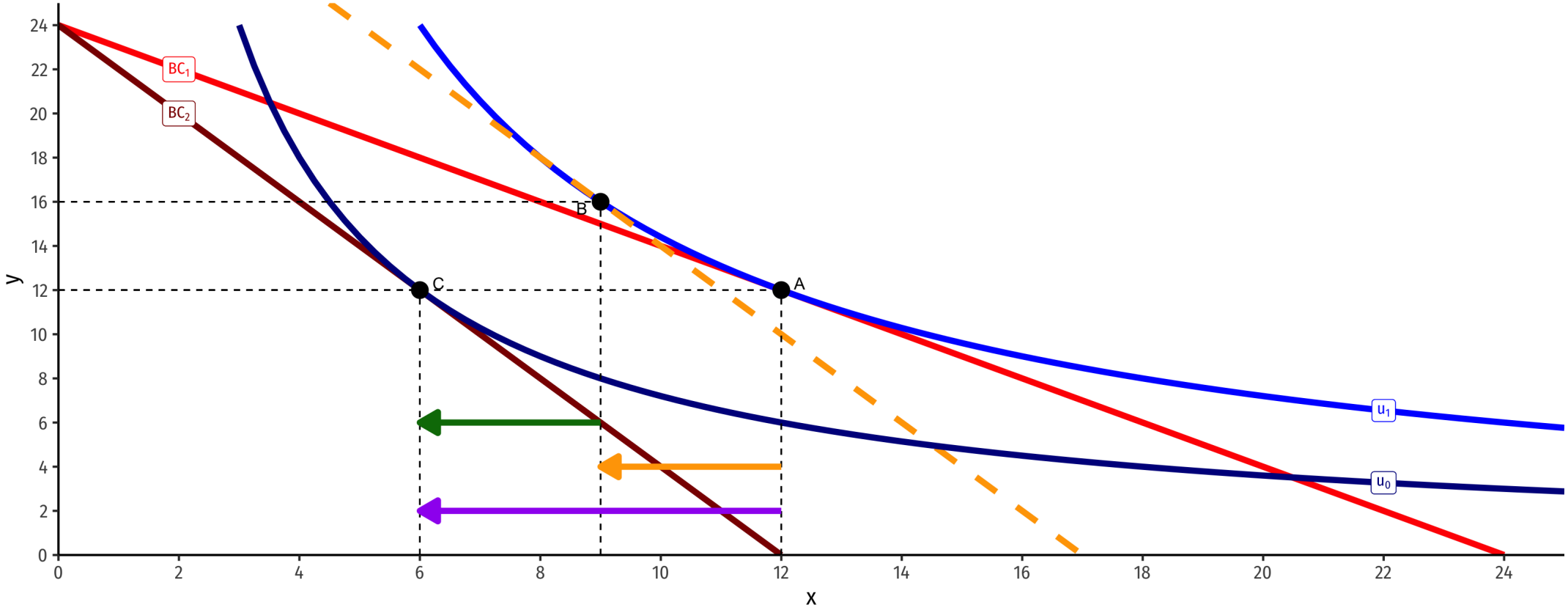
Change in Consumption From an Increase in Price

Normal Good



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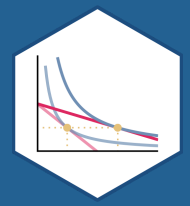
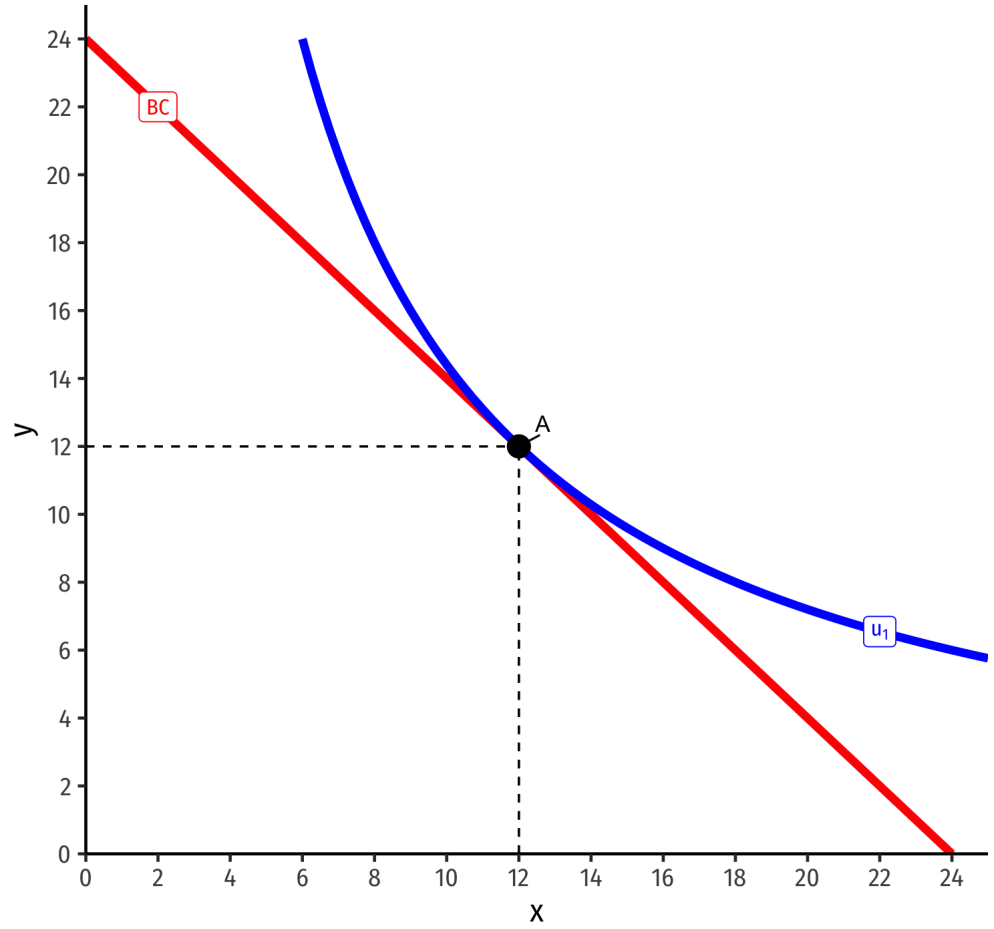


What About Inferior Goods?

Inferior Goods, Graphically I

- Original optimal consumption (A)



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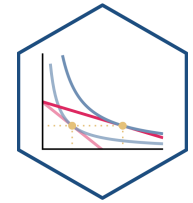

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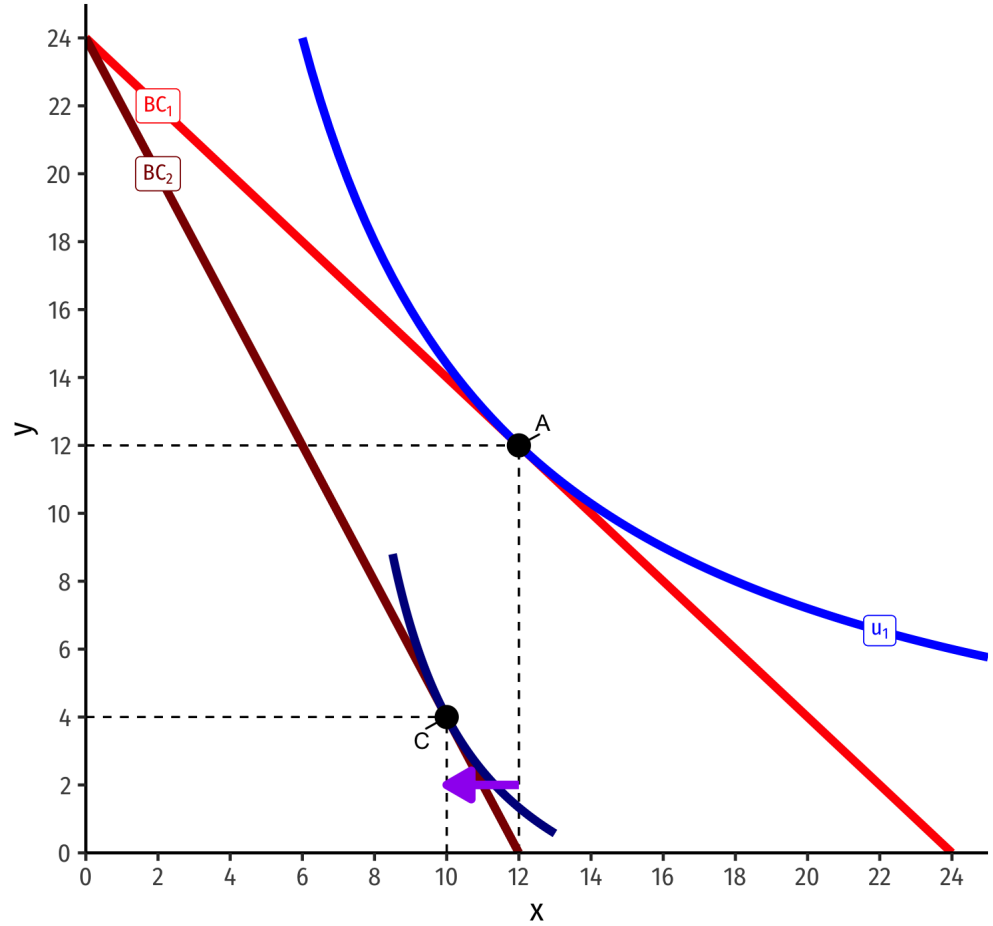

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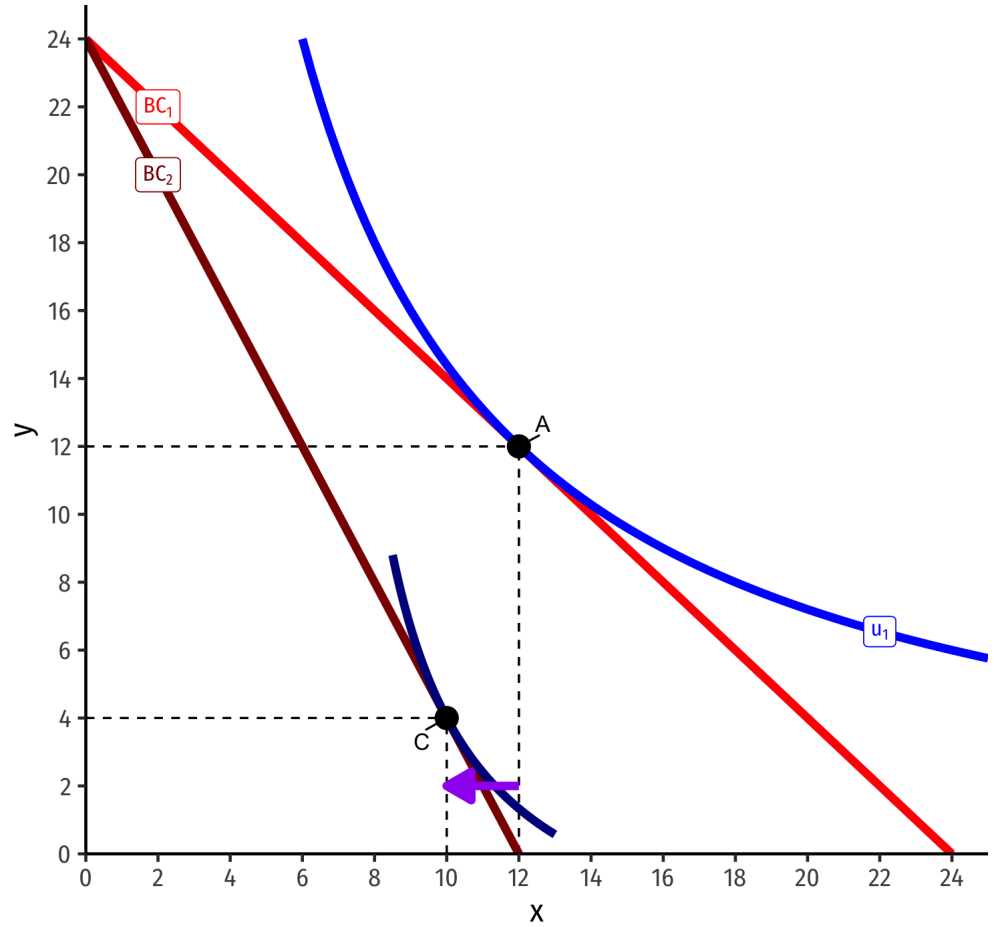

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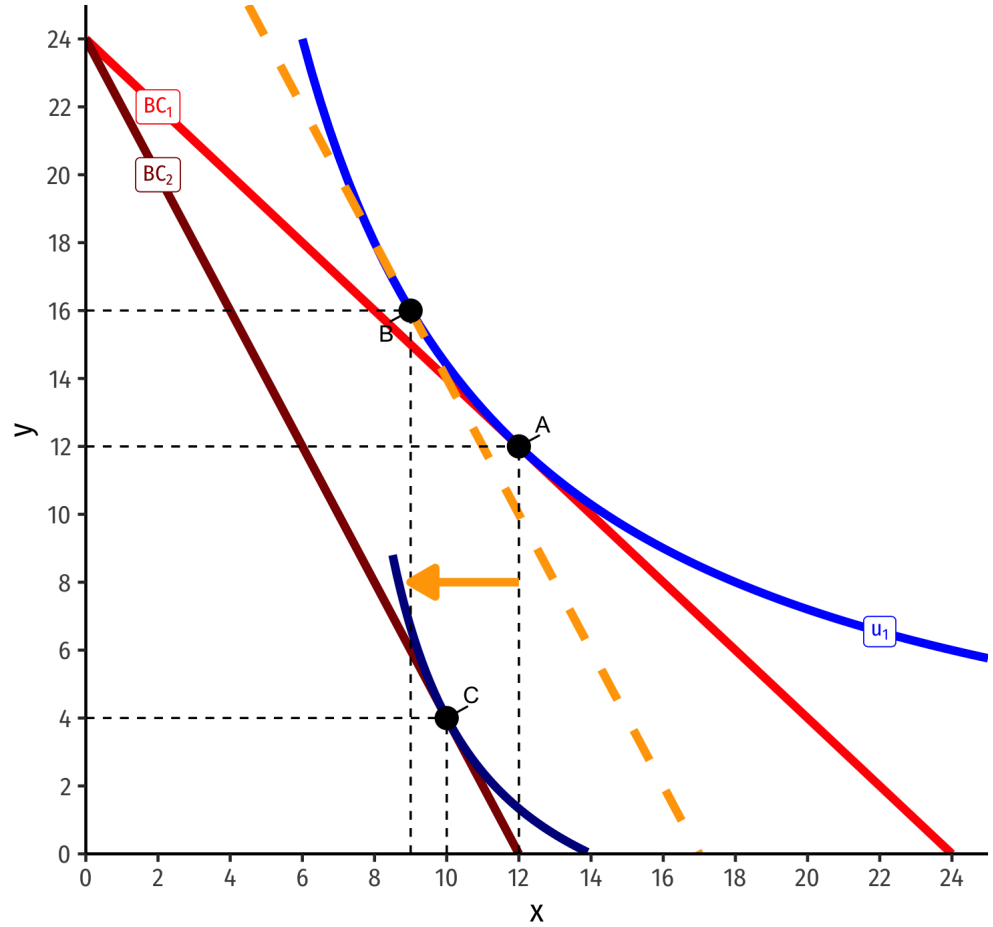

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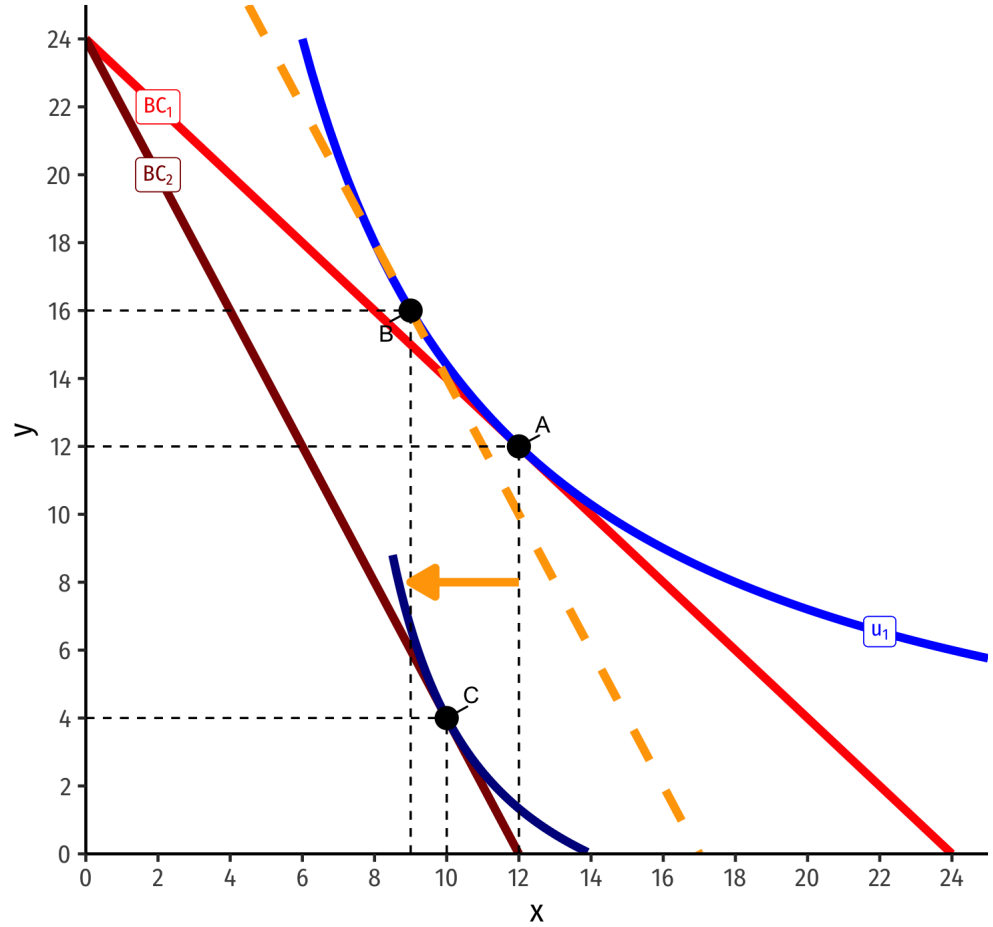

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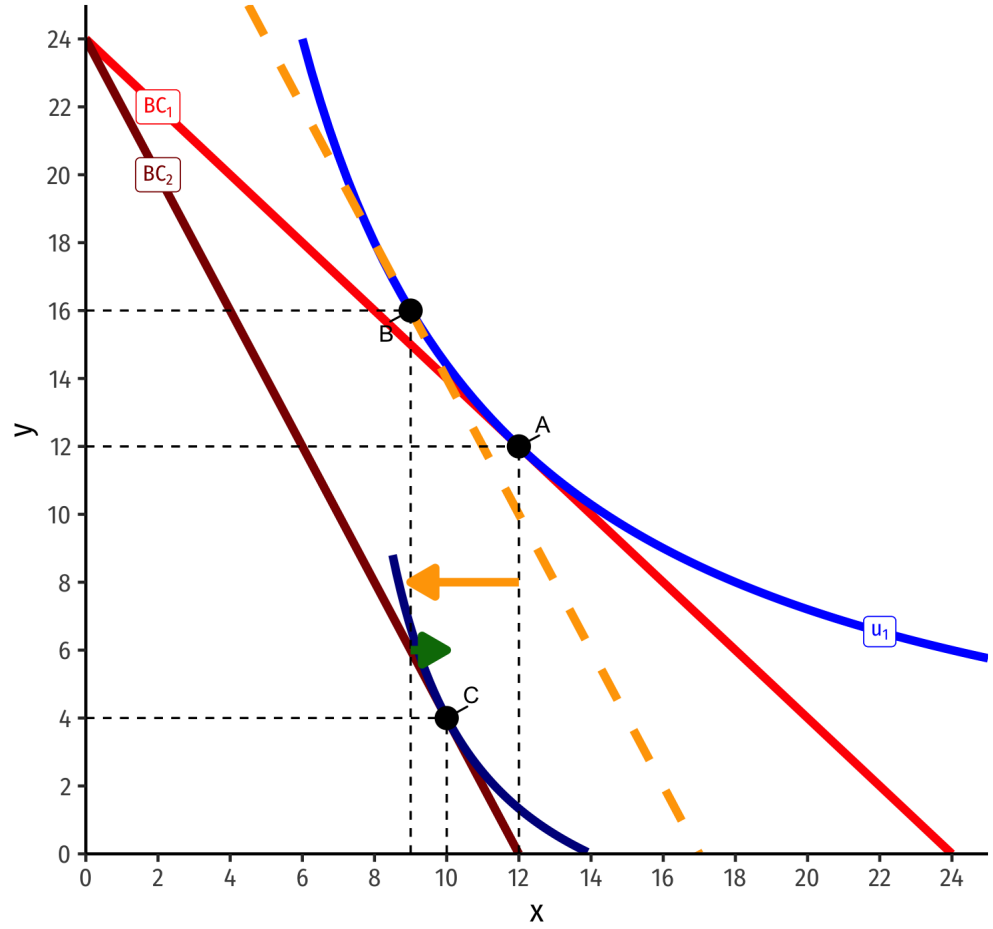

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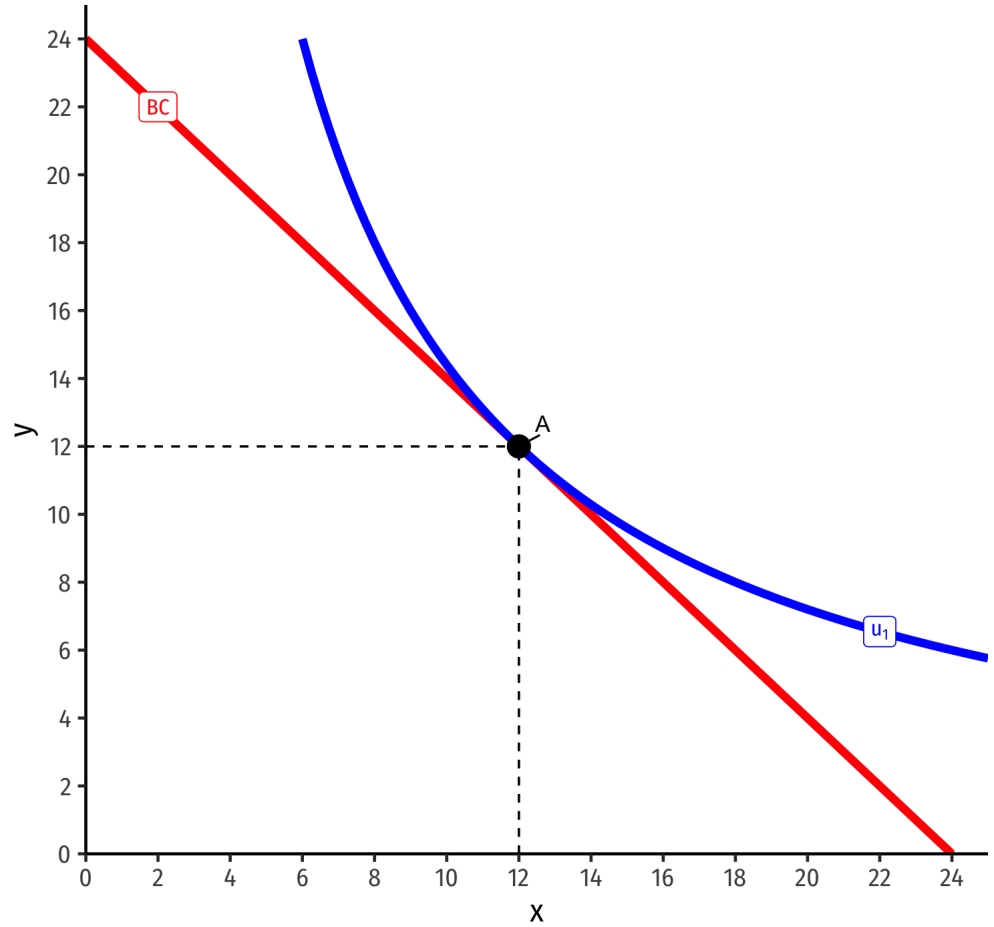

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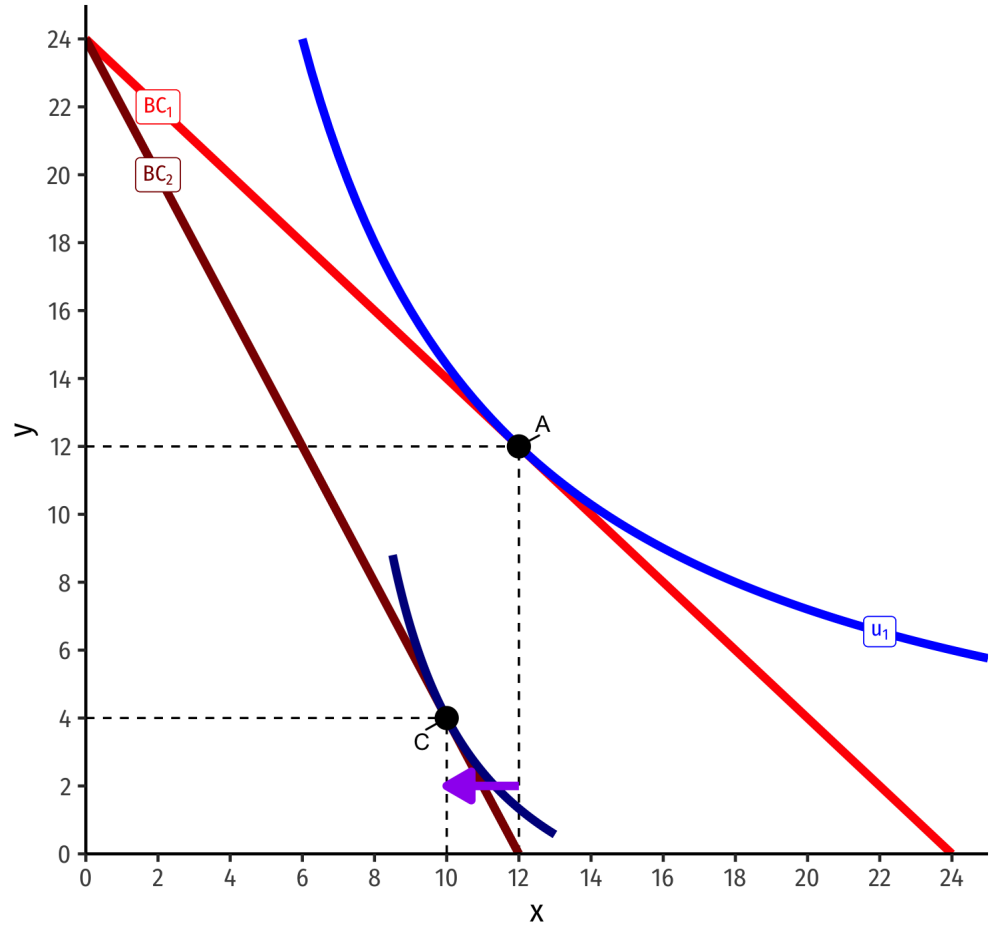

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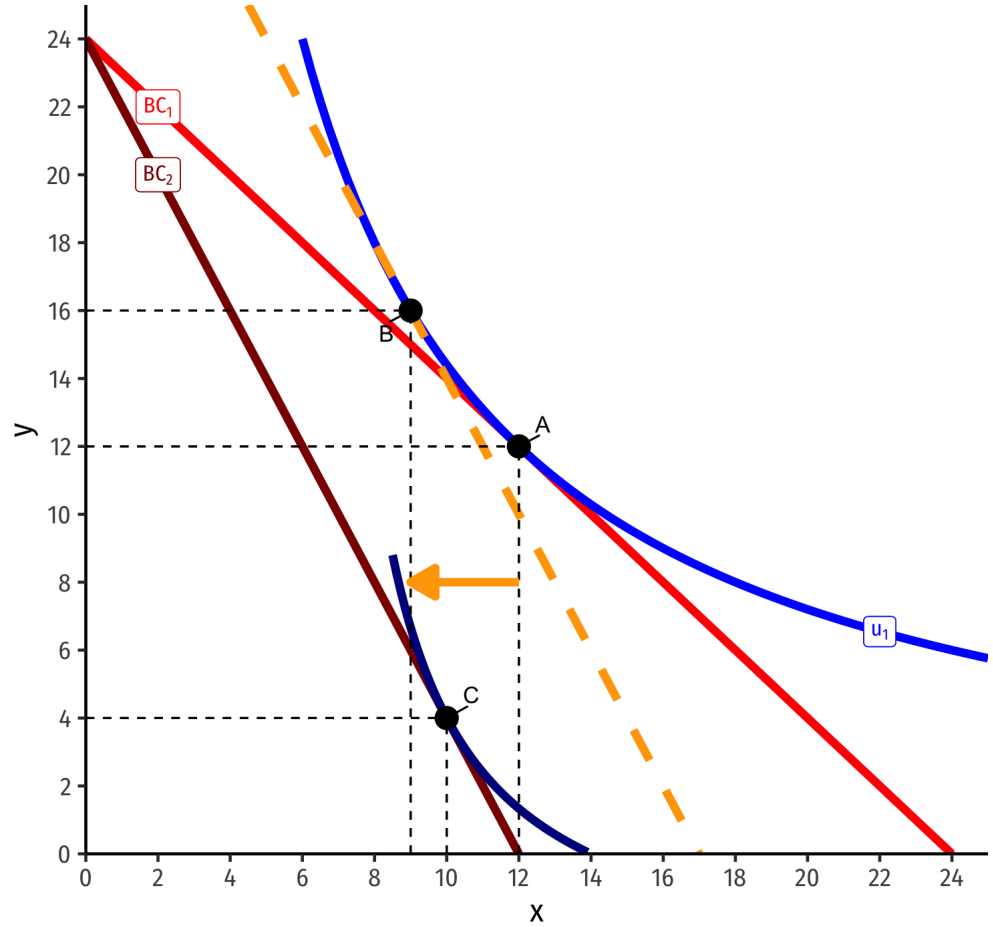

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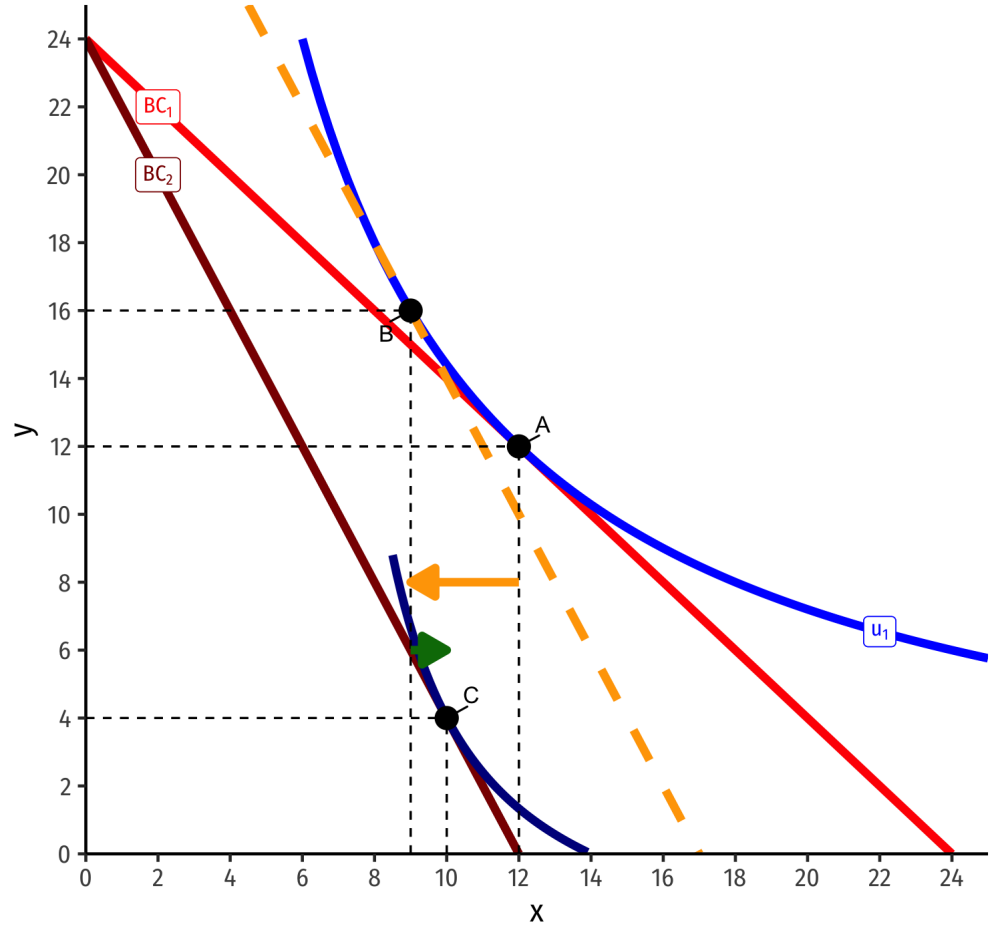

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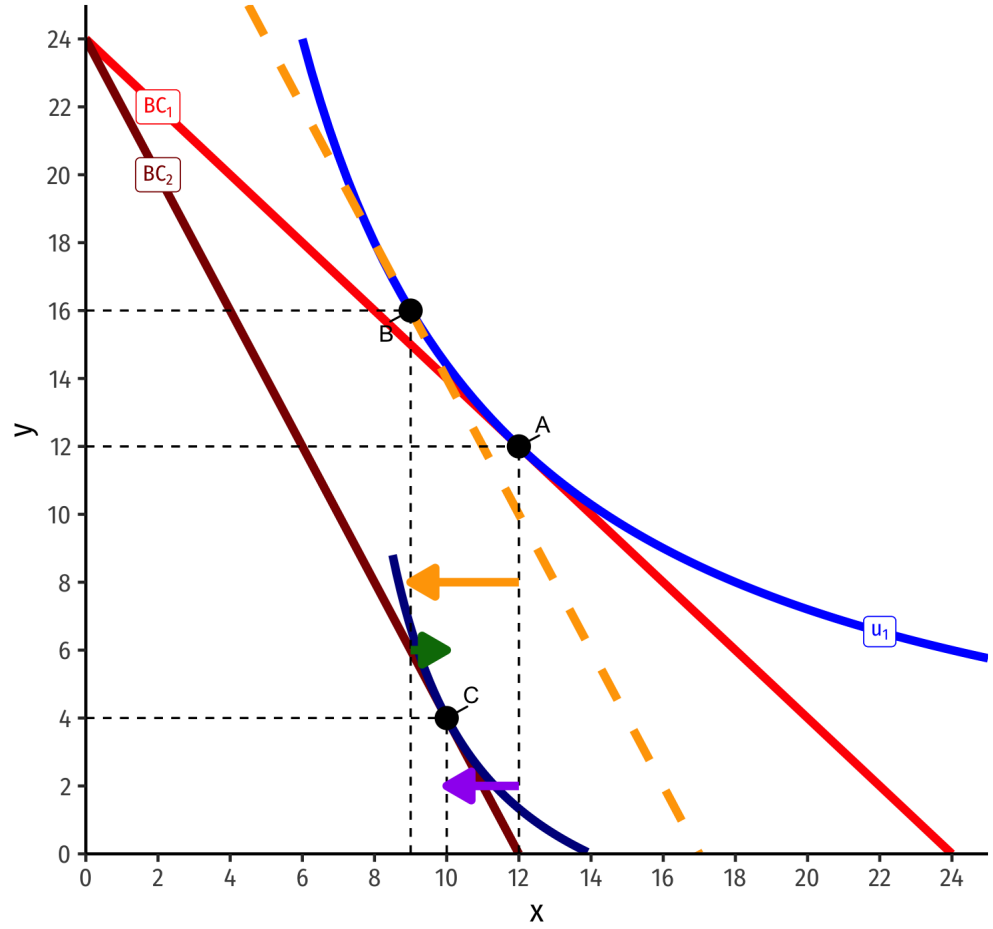

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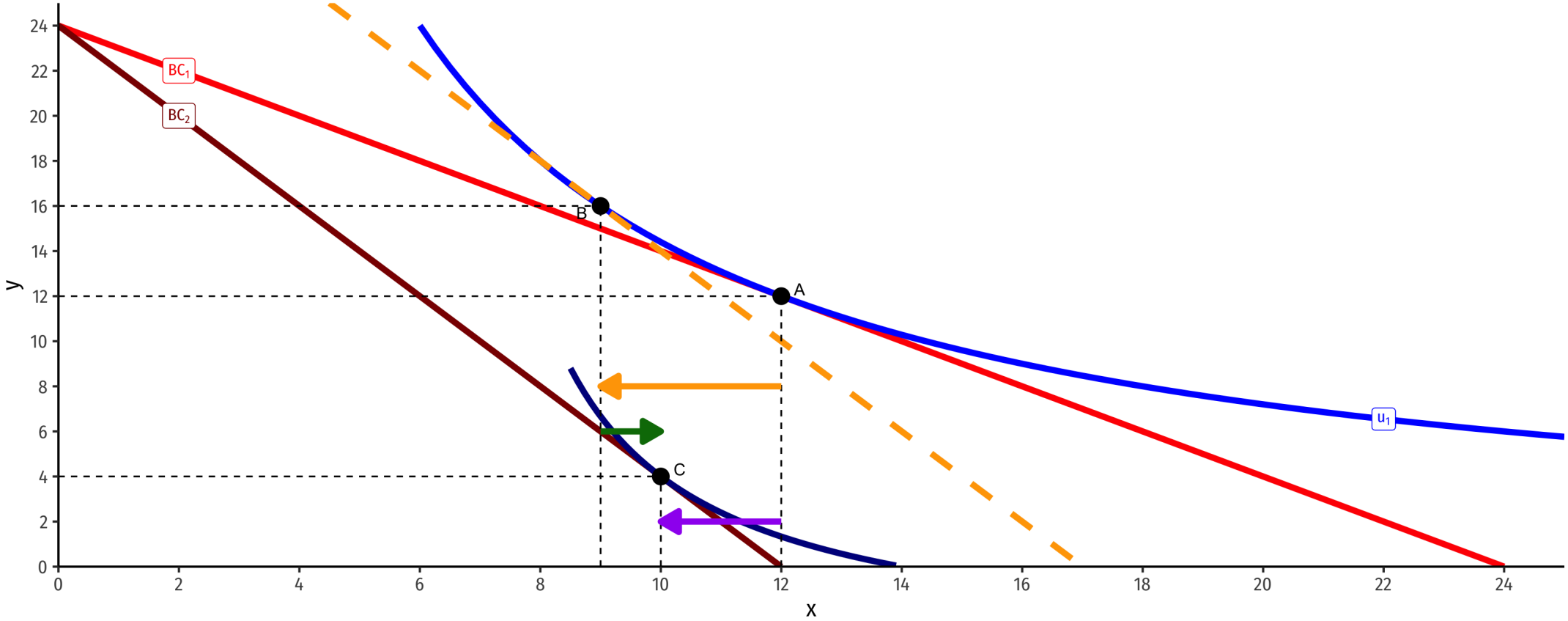
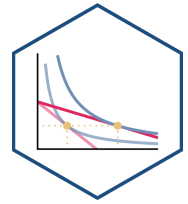
Change in Consumption From an Increase in Price

Inferior Good



Violating the Law of Demand



Example: What would it take to violate the law of demand?

A Giffen Good

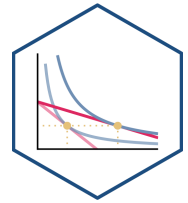
- **Giffen good**: theoretical good that violates law of demand

(negative) real income effect > **substitution effect**

1. Few substitutes (small substitution effect)
2. An inferior good (negative real income effect)
3. A large portion of income spent on it (large real income effect)

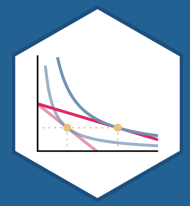
- Price increase (decrease) causes person to buy *more* (less)

Recap: Real Income and Substitution Effects



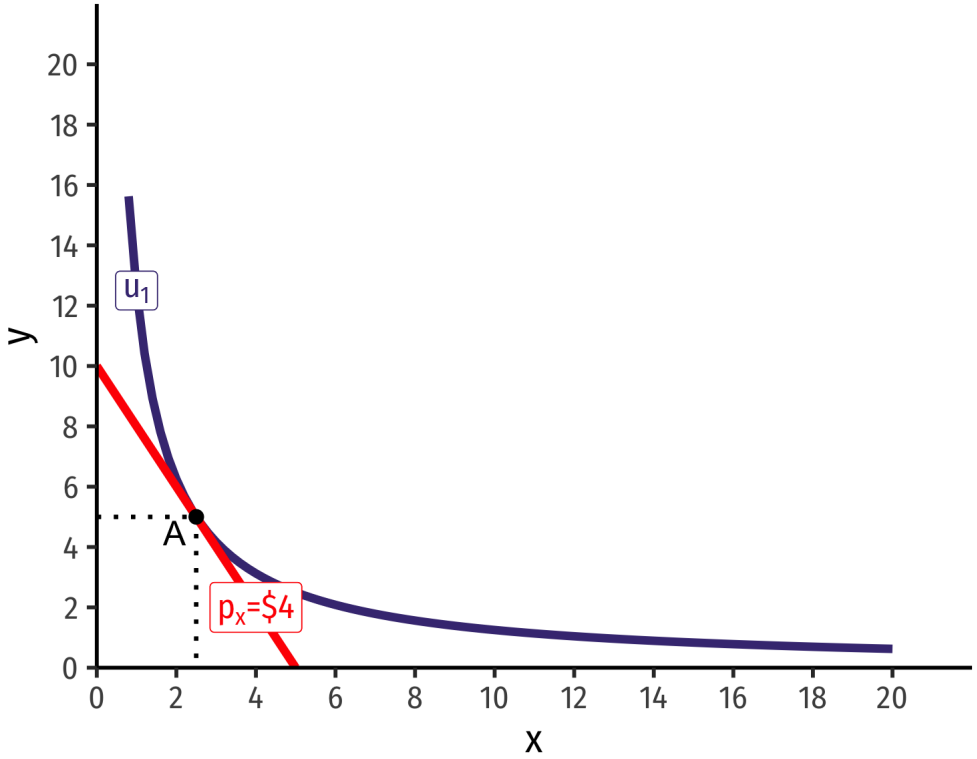
$$\text{Price Effect} = \text{Real income effect} + \text{Substitution Effect}$$

- **Substitution effect**: is always in the direction of the cheaper good
- **Real Income effect**: can be positive (normal) or negative (inferior)
- **Law of Demand**/Demand curves slope downwards (**Price effect**) mostly because of the substitution effect
    - Even (inferior) goods with negative real income effects overpowered by substitution effect
- Theoretical **Giffen good** exception: negative R.I.E. $>$ S.E.

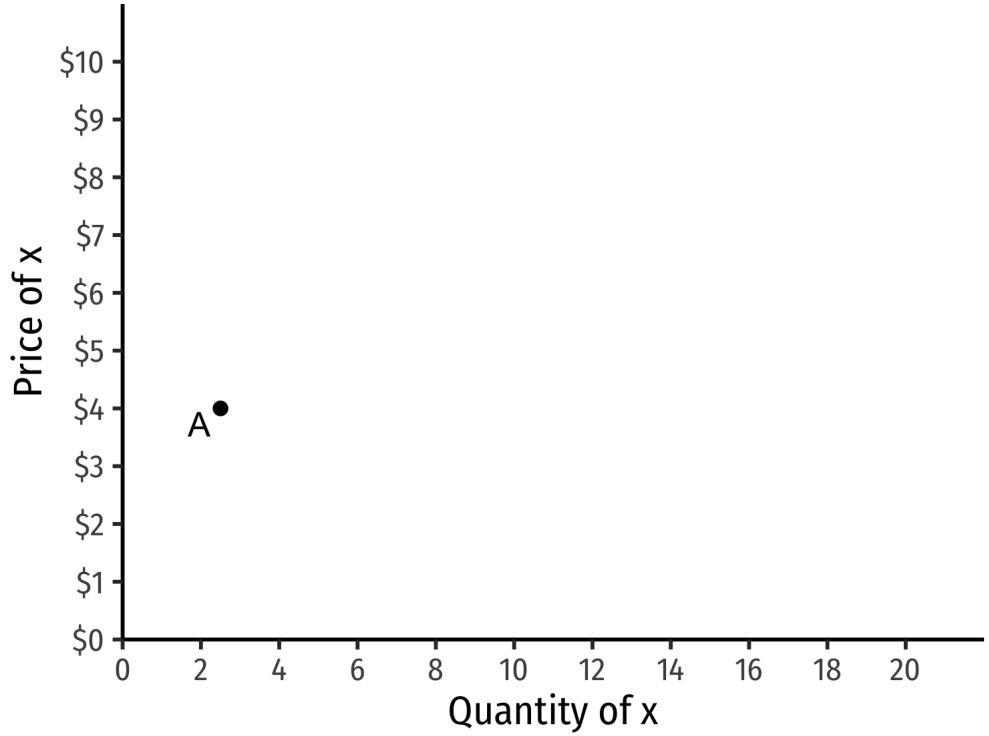


On To Demand Curves

Deriving a Demand Curve Graphically



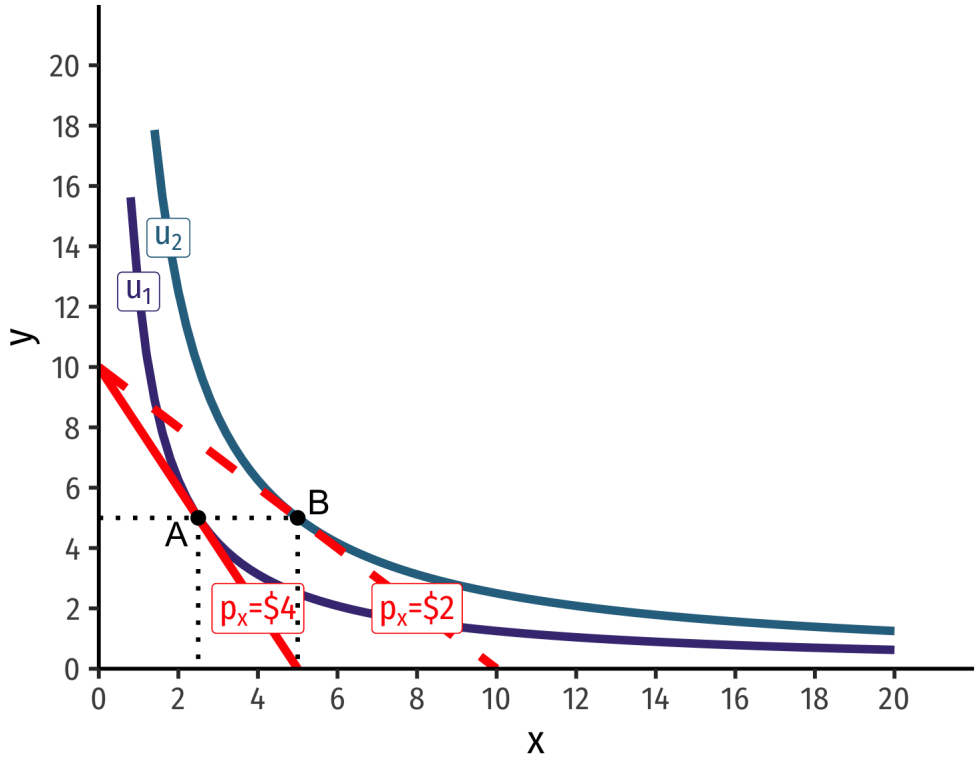
Optima with $u(x, y) = x^{0.5}y^{0.5}$, $m = 20$, $p_y = 2$



Demand function: $\frac{m}{2p}$; Inverse Demand function: $p = \frac{m}{2q}$

- Demand curve for x relates optimal consumption of x ("quantity") as price of x changes
- At $p_x = 4$, consumer buys 2 x

Deriving a Demand Curve Graphically



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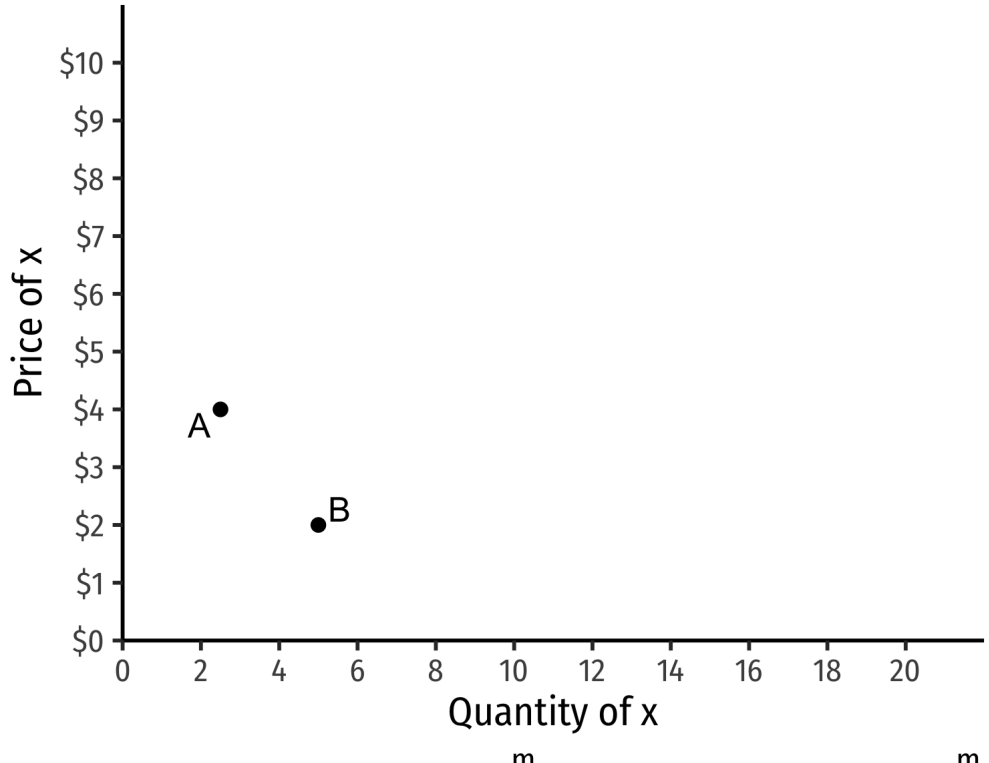
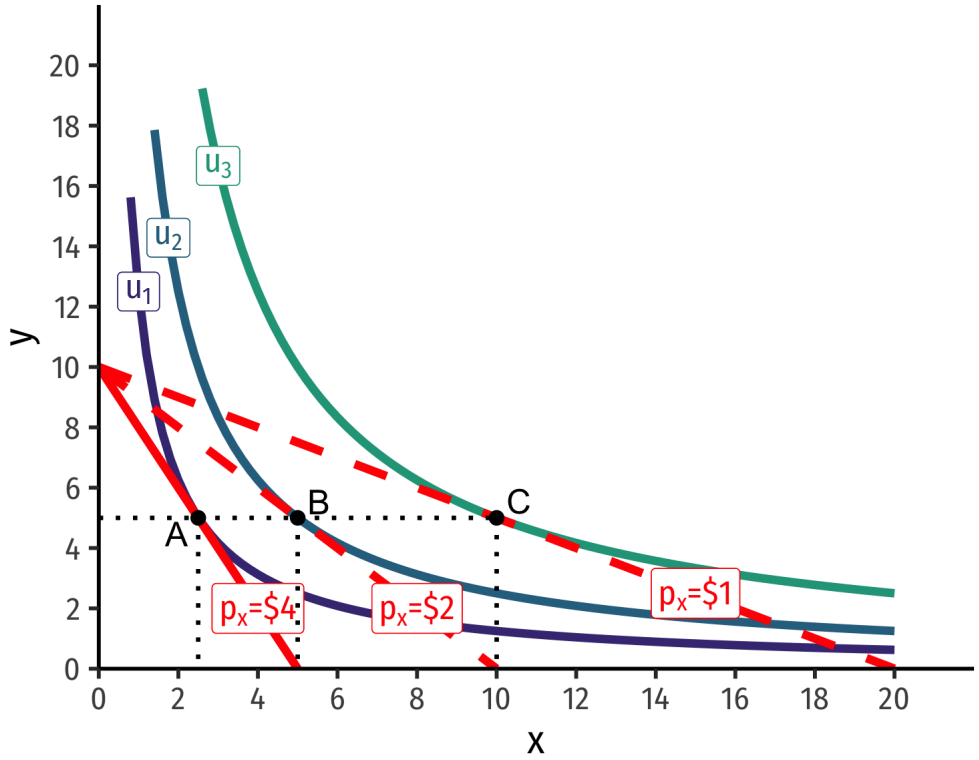


Demand function: $\frac{m}{2p}$; Inverse Demand function: $p = \frac{m}{2q}$

- Demand curve for x relates optimal consumption of x ("quantity") as price of x changes
- At $p_x = 4$, consumer buys 2 x; at $p_x = 2$, consumer buys 5 x

Deriving a Demand Curve Graphically



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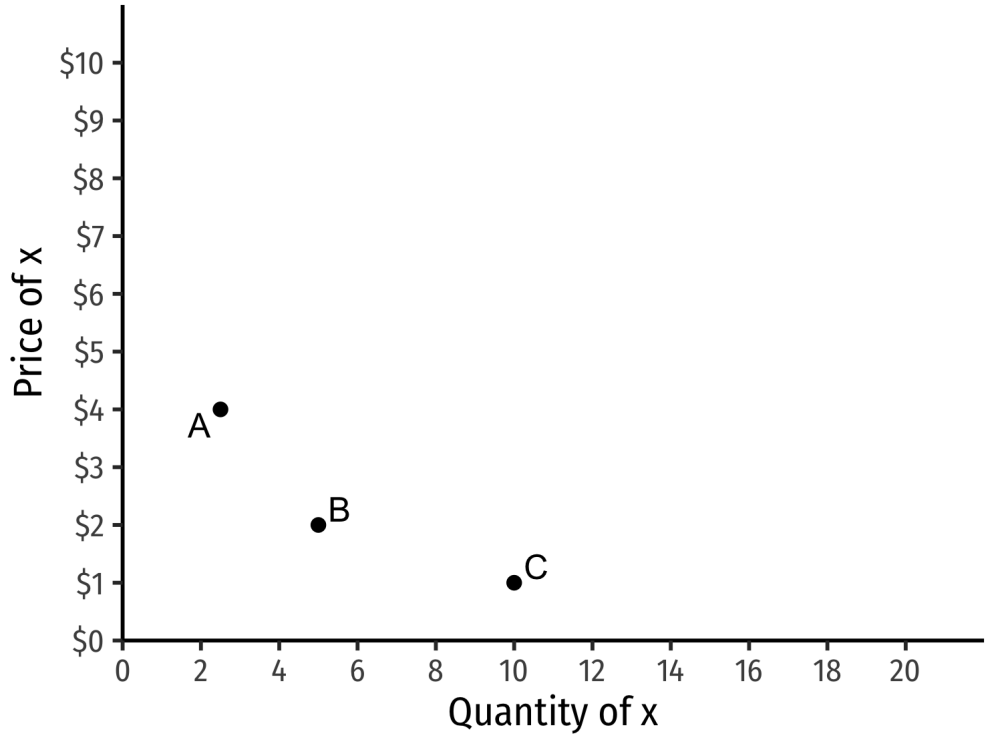

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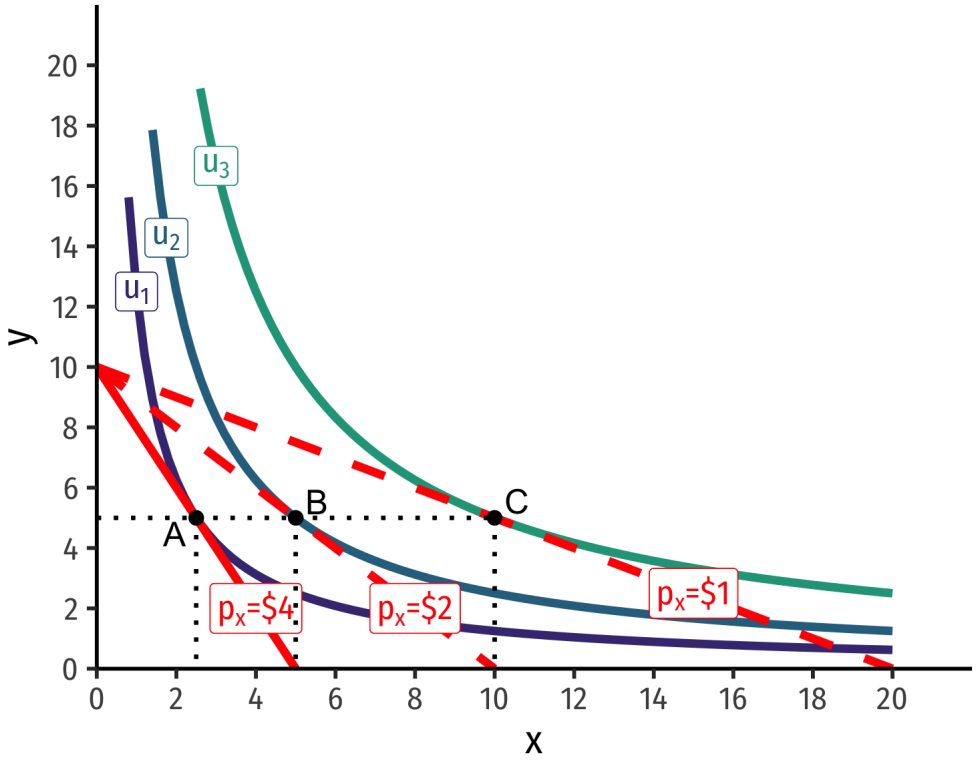
Deriving a Demand Curve Graphically



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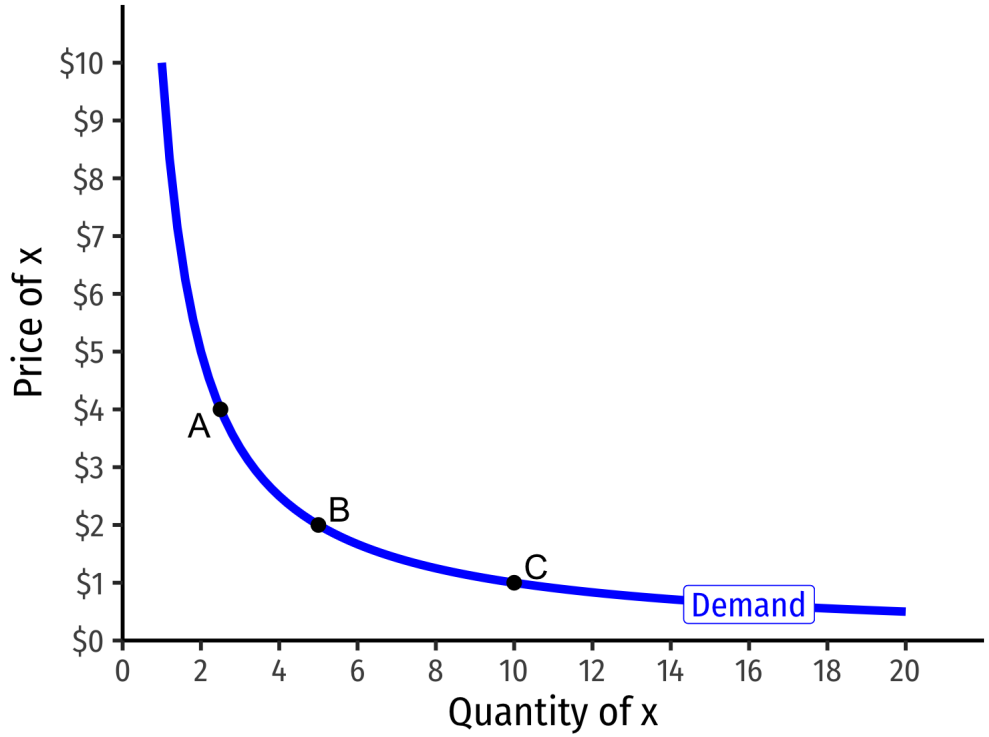

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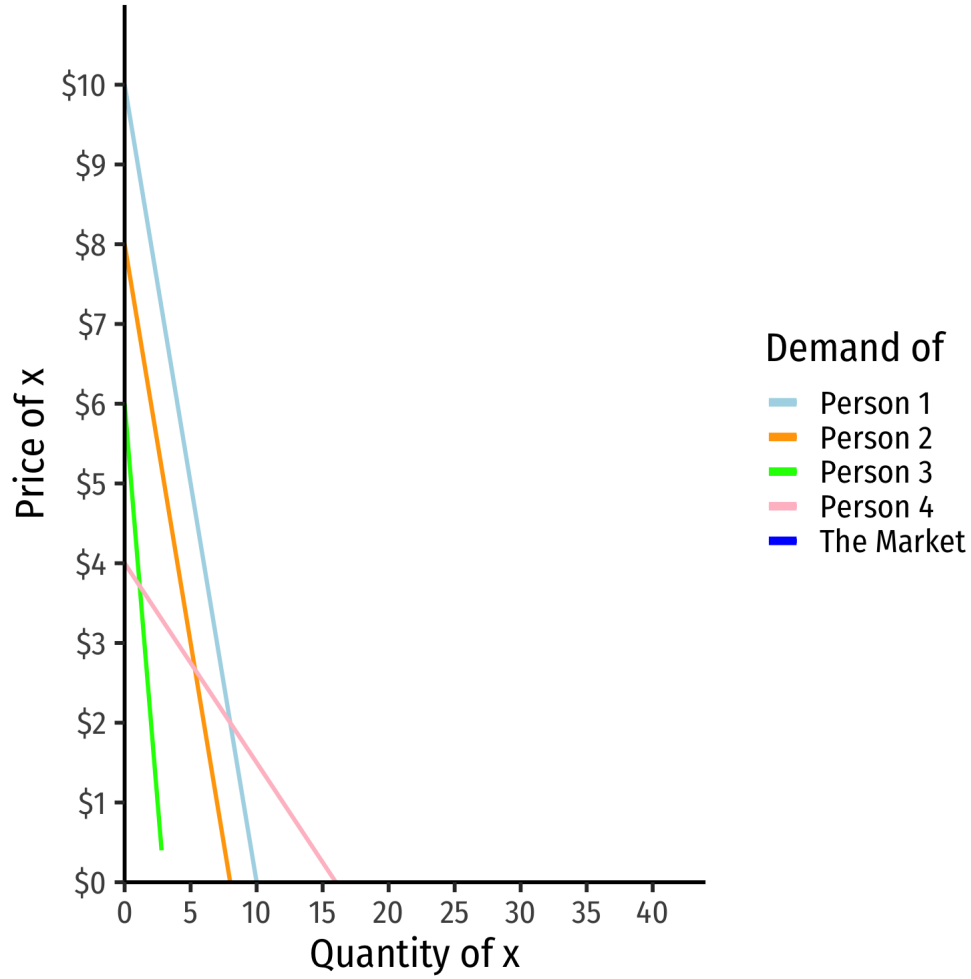
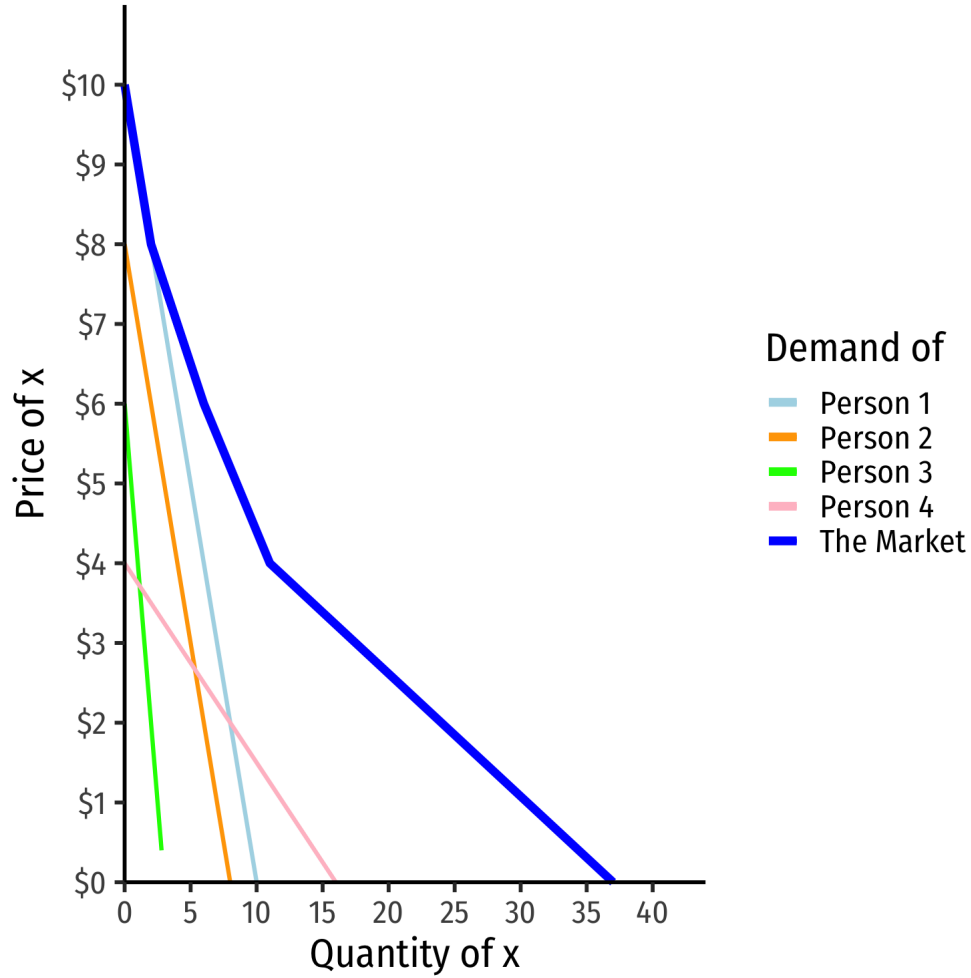
From Individual Demand to Market Demand

- Note so far we have been talking about *an individual person's* demand
- In principles, you learned about the entire **market demand**

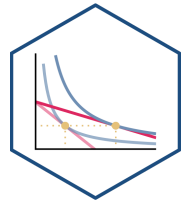


From Individual Demand to Market Demand

- Note so far we have been talking about *an individual person's* demand
- In principles, you learned about the entire **market demand**
- This is simply the sum of all individuals' demands



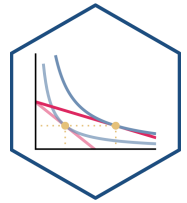
Demand Schedule (For Individual Or Market)



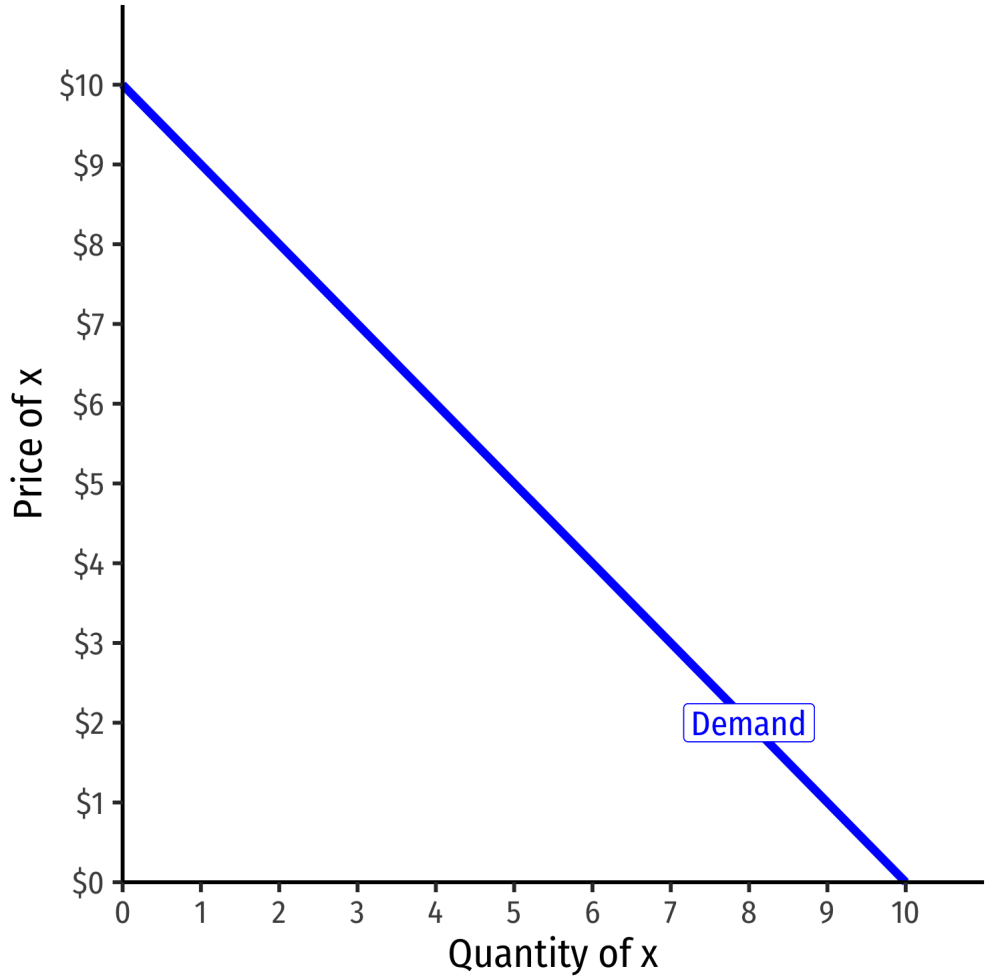
- **Demand schedule** expresses the quantity of good a person(s) would be willing to buy (q_D) at any given price (p_x)
    - Holding constant all other prices (p_y) and income (m)! (**"ceterus paribus"**)
- Note: **each of these is a consumer's optimum at a given price!**

price	quantity
10	0
9	1
8	2
7	3
6	4
5	5
4	6
3	7
2	8
1	9
0	10

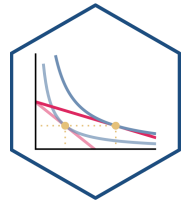
Demand Curve



- **Demand curve** graphically represents the demand schedule
- Also measures a person's **maximum willingness to pay (WTP)** for a given quantity
- **Law of Demand (price effect)** $\Longrightarrow$ demand curves always slope downwards



Demand Function



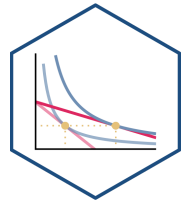
- **Demand function** relates quantity to price

Example:

$$q = 10 - p$$

- Not graphable (wrong axes)!

Inverse Demand Function

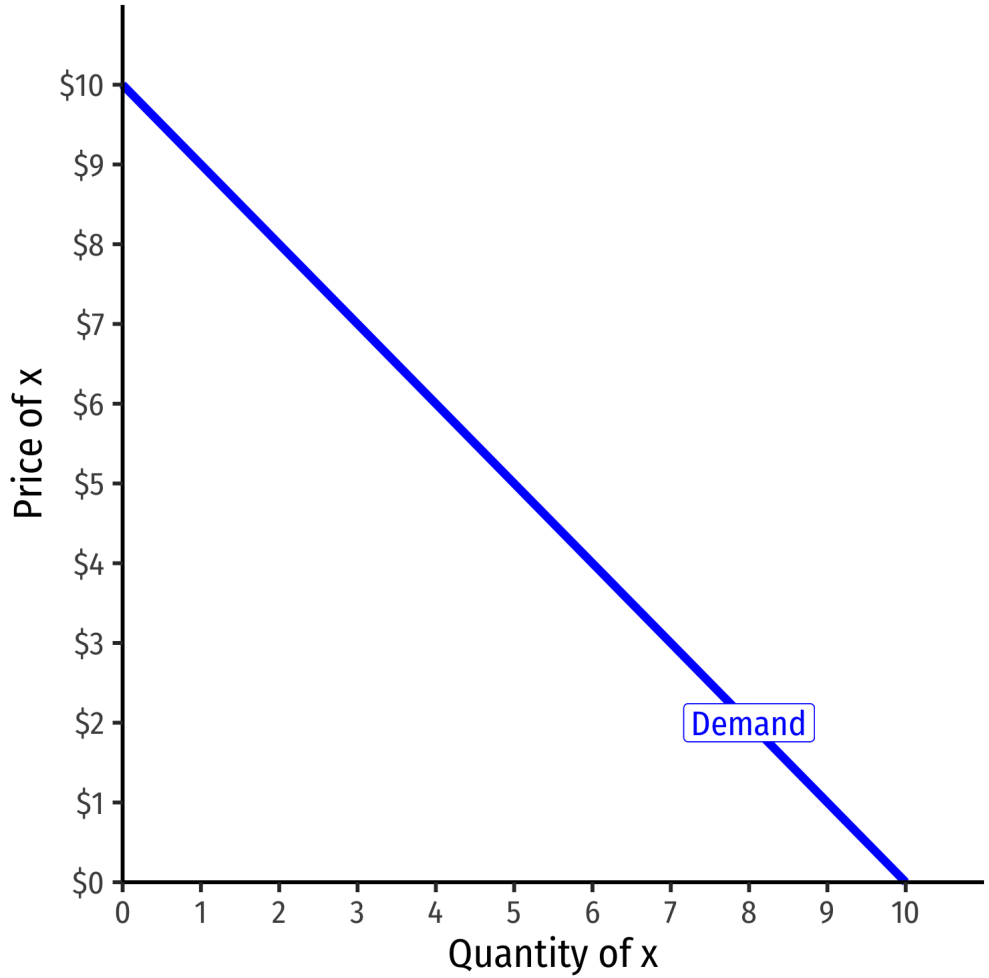


- ***Inverse* demand function** relates price to quantity
  - Take demand function and solve for p

Example:

$$p = 10 - q$$

- Graphable (price on vertical axis)!



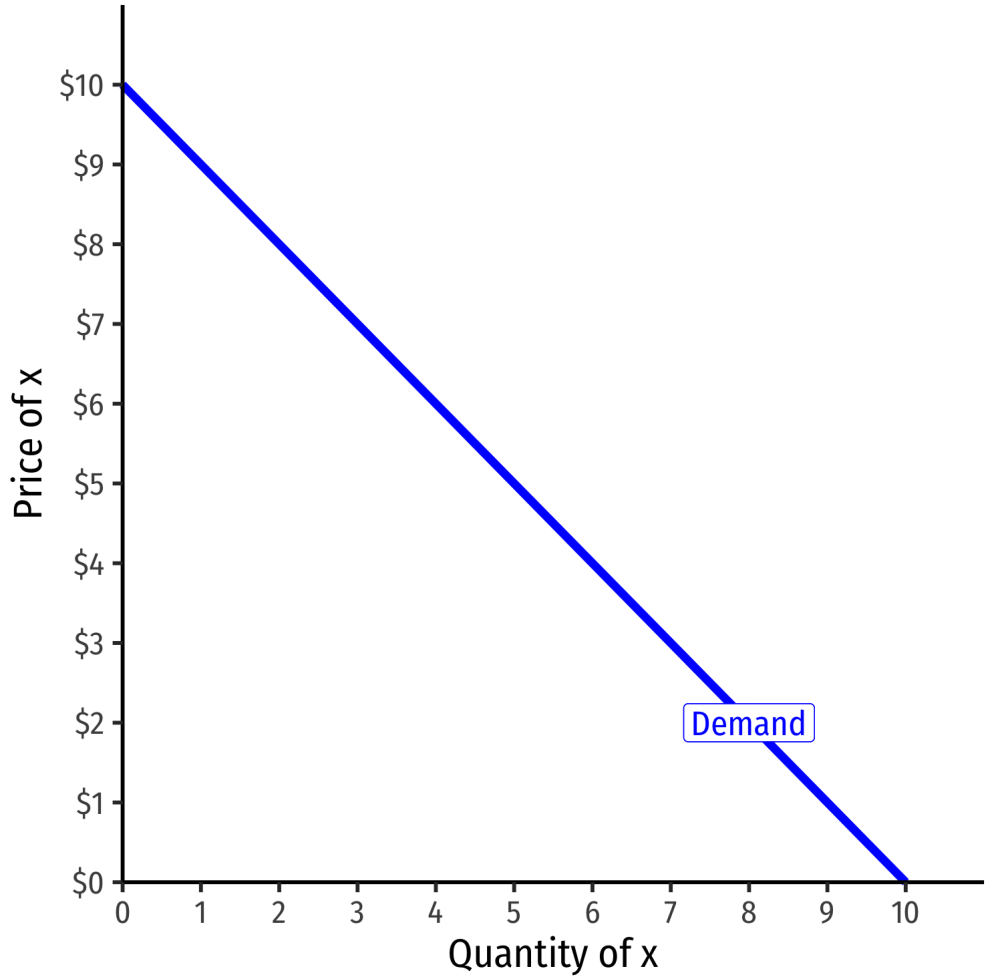
Inverse Demand Function

- ***Inverse* demand function** relates price to quantity
  - Take demand function and solve for p

Example:

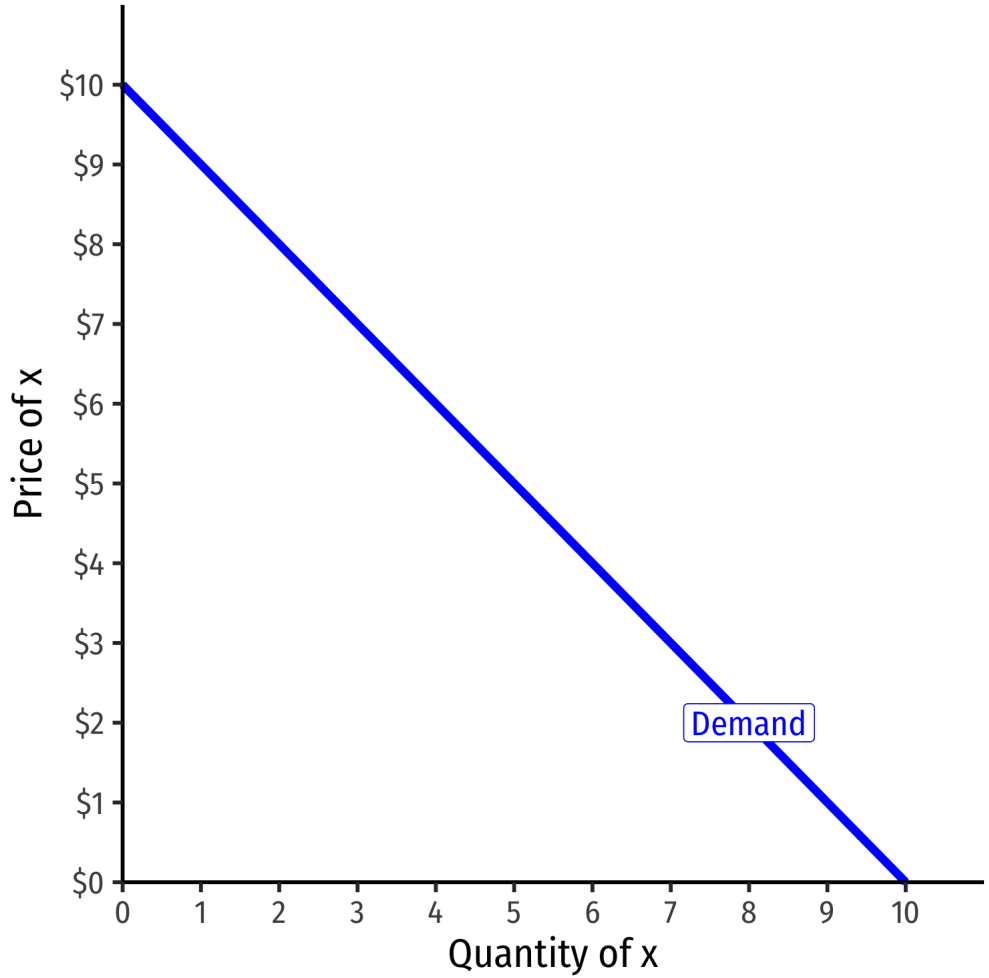
$$p = 10 - q$$

- Vertical intercept (**"Choke price"**): price where $q_D = 0$ ($10), just high enough to discourage *any* purchases



Inverse Demand Function

- Read two ways:
- Horizontally: at any given price, how many units person wants to buy
- Vertically: at any given quantity, the **maximum willingness to pay (WTP)** for that quantity
    - This way will be very useful later



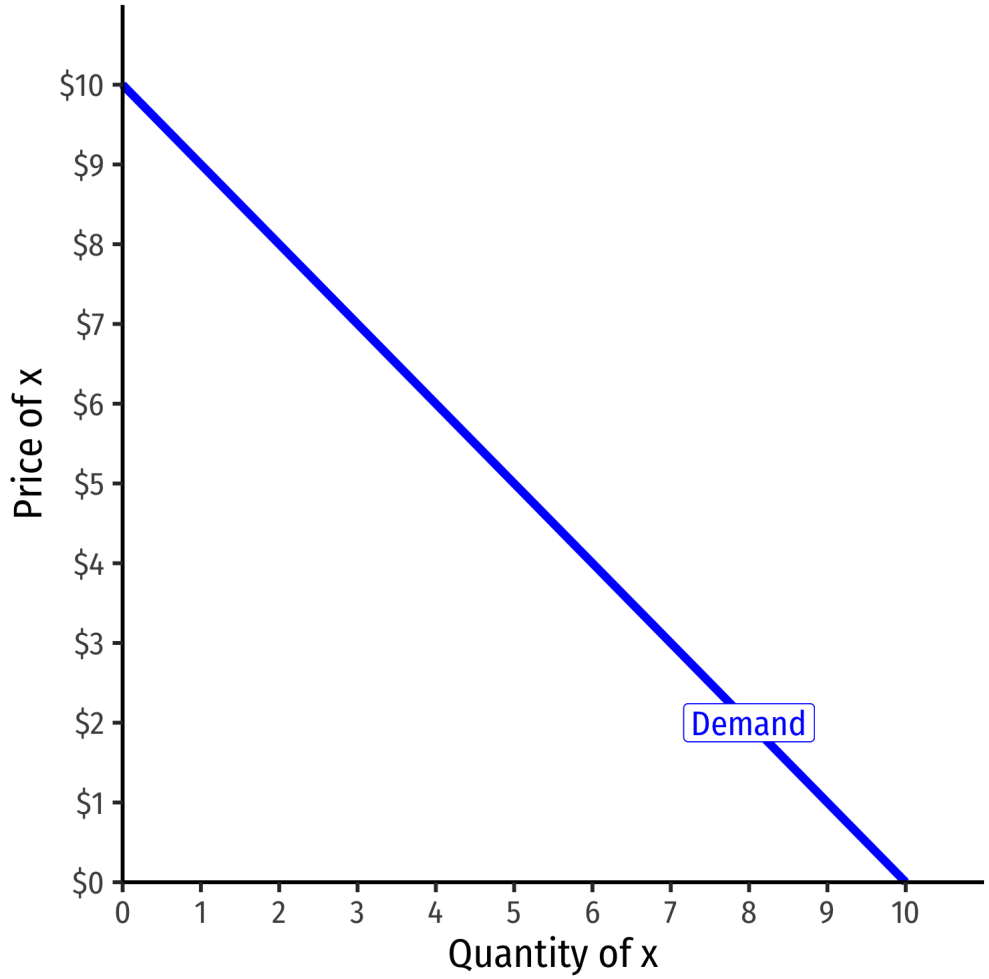
Shifts in Demand I

- Note a simple (inverse) demand function only relates (own) **price** and **quantity**

Example: $q = 10 - p$ or $p = 10 - q$

- What about all the other **"determinants of demand"** like income and other prices?

- They are captured in the vertical intercept (choke price)!



Shifts in Demand II

- A change in one of the **"determinants of demand"** will **shift** demand curve!

  1. Change in **income** m
  2. Change in **price of other goods** p_y
  3. Change in **preferences** or **expectations** about good x

- Shows up in (inverse) demand function by a **change in intercept (choke price)**!

- See my Visualizing Demand Shifters