1.6 — Income & Substitution Effects

ECON 306 • Microeconomic Analysis • Fall 2021

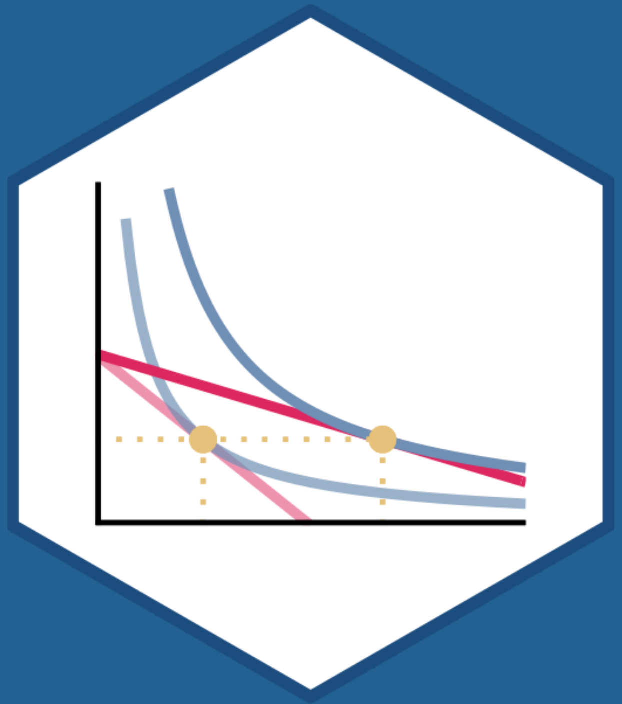
Ryan Safner

Assistant Professor of Economics

safner@hood.edu

ryansafner/microF21

microF21.classes.ryansafner.com



Outline

The (Own) Price Effect

(Real) Income Effect

Substitution Effect

Putting the Effects Together

From Optimal Consumption Points to Demand

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

The (Own) Price Effect

- **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

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

(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 falls to $5. Your now consume 20 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 makes you much poorer
    - Price decrease makes you much wealthier

(Real) Income Effect: Size

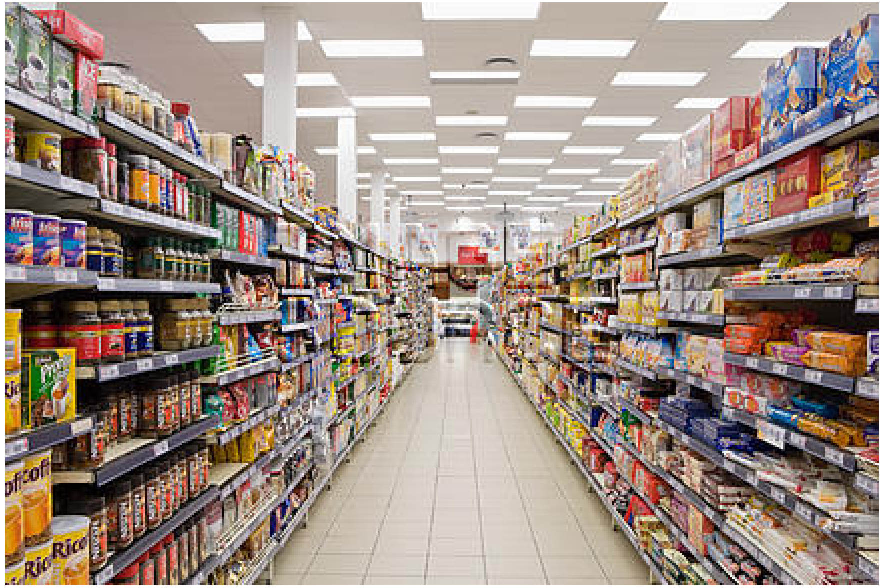
- The *size* of the income effect depends on how large a *portion of your budget* you spend on the good

- **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

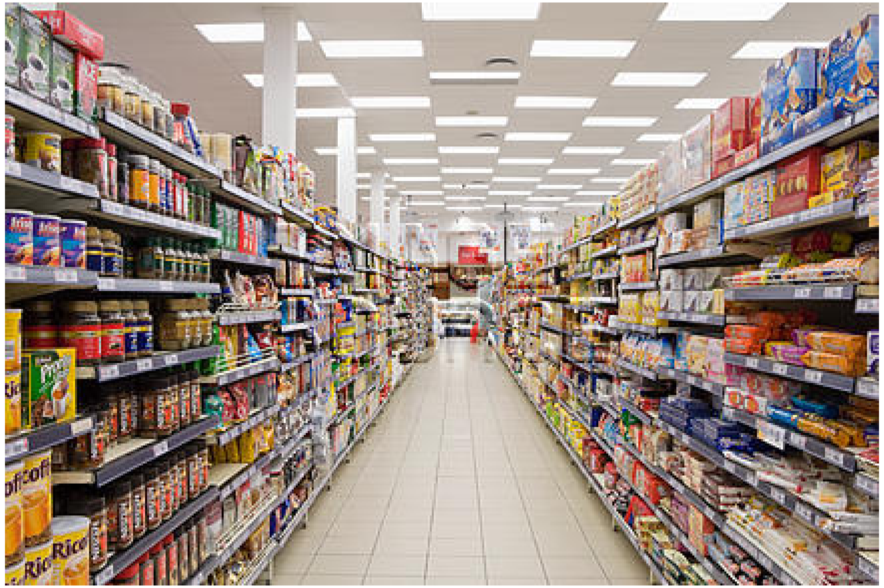
Substitution Effect: Demonstration

- 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 one 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

Putting the Effects Together

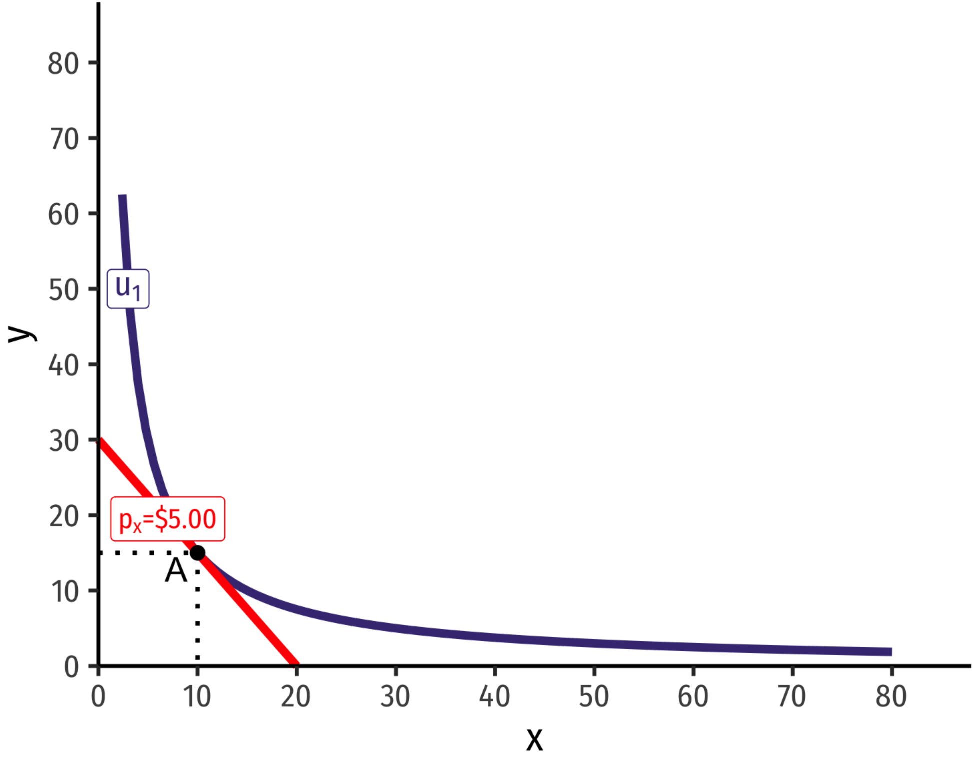
- **Real income effect**: change in consumption due to change in real purchasing power
  - Can be positive (**normal goods**) or negative (**inferior goods**)
  - Lower price of x means you can buy more x, y, or *both* (depending on your preferences between x and y)

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

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

Real Income and Substitution Effects, Graphically I

- Original optimal consumption (A)



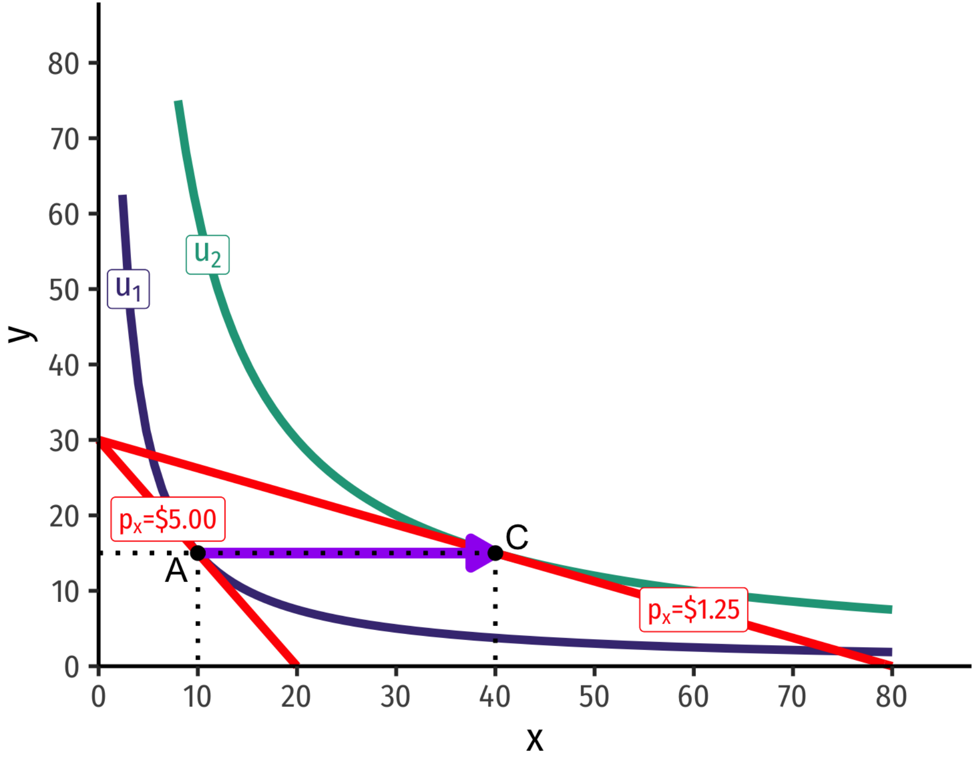
Optima with $u(x, y) = x^{0.5}y^{0.5}$, $m = 100$, $p_y = 3.33$

Real Income and Substitution Effects, Graphically I

- Original optimal consumption (A)

- **(Total) price effect:** $A \to C$

- Let's decompose this into the two effects



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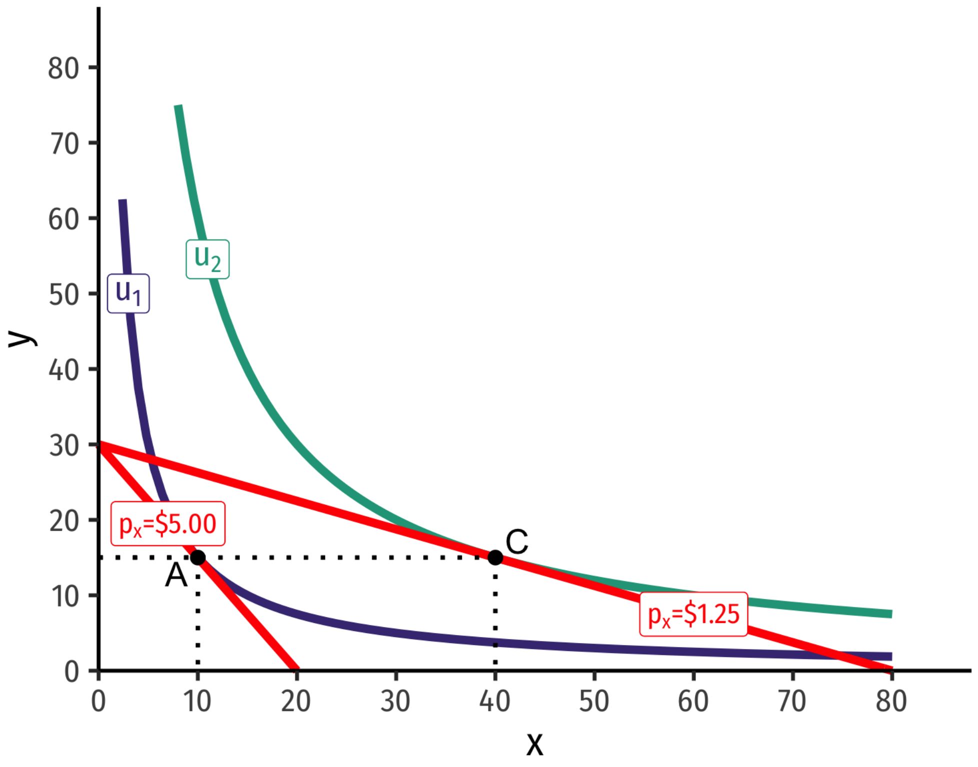
Real Income and Substitution Effects, Graphically II

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



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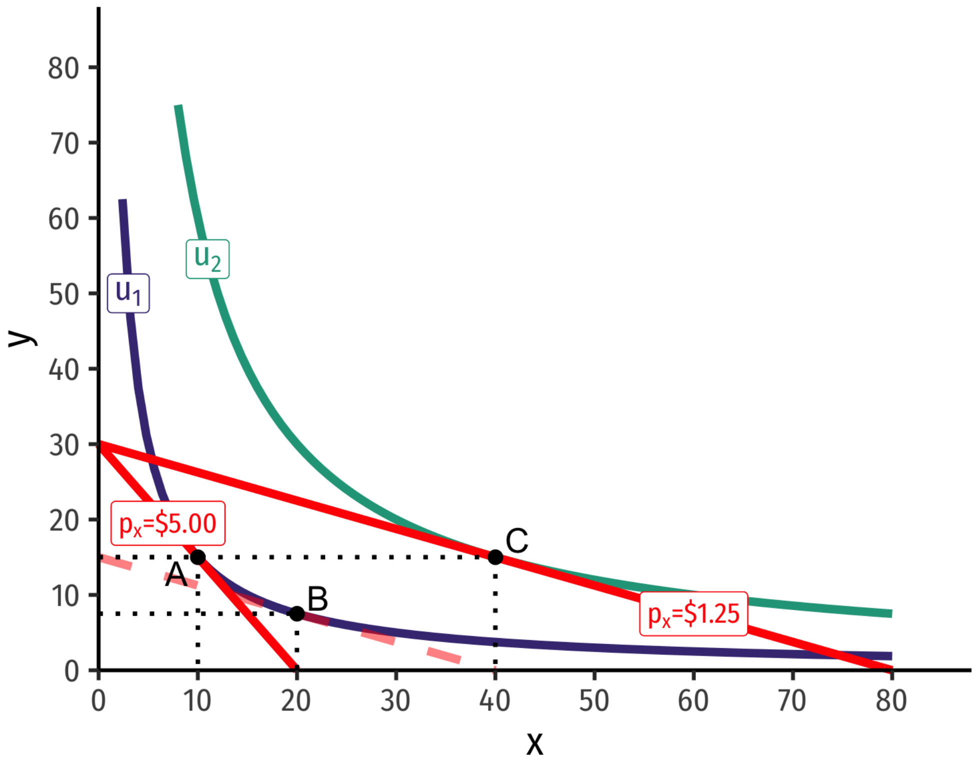
Real Income and Substitution Effects, Graphically II

- **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. $(\uparrow x, \downarrow y)$
  - Point B *must* be a *different* point on the original curve!



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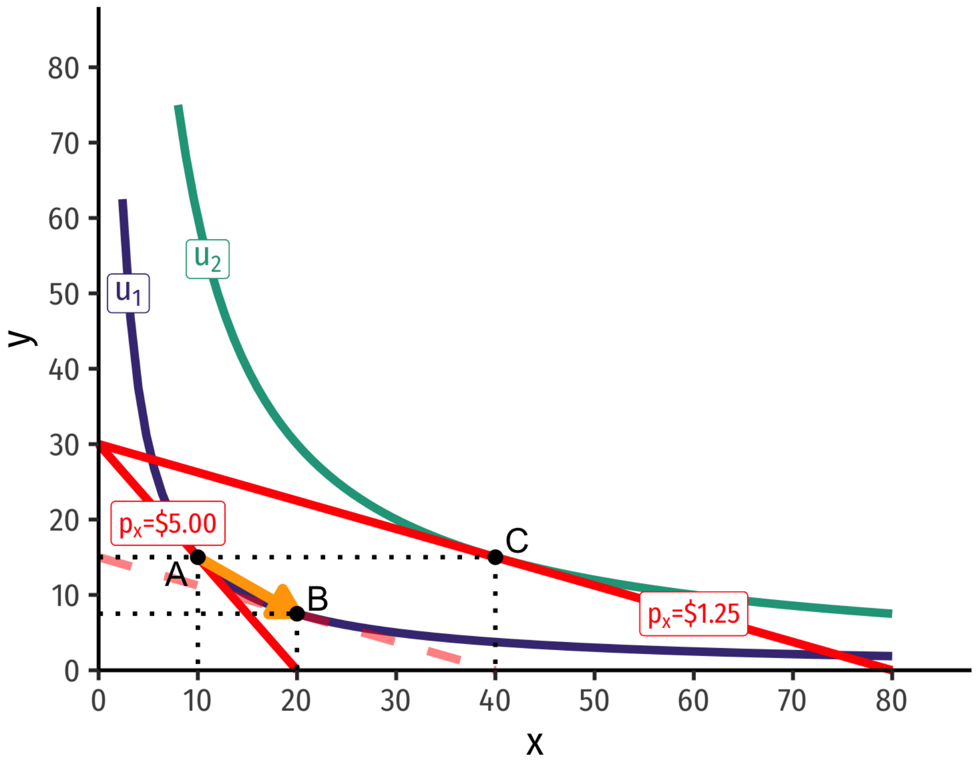

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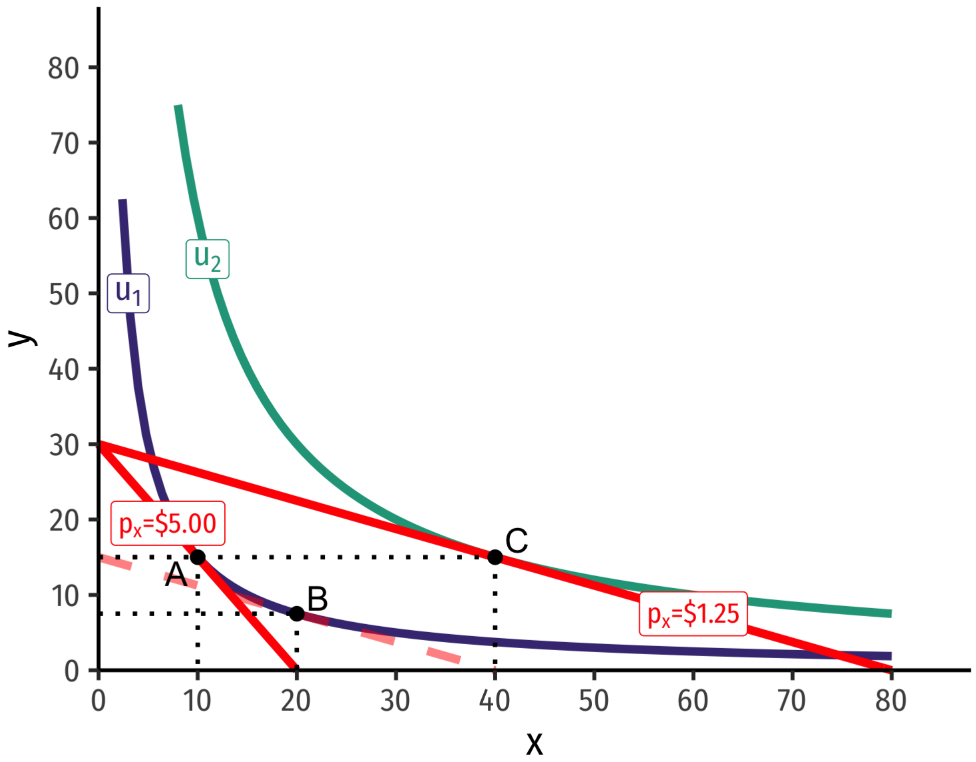
Real Income and Substitution Effects, Graphically III

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



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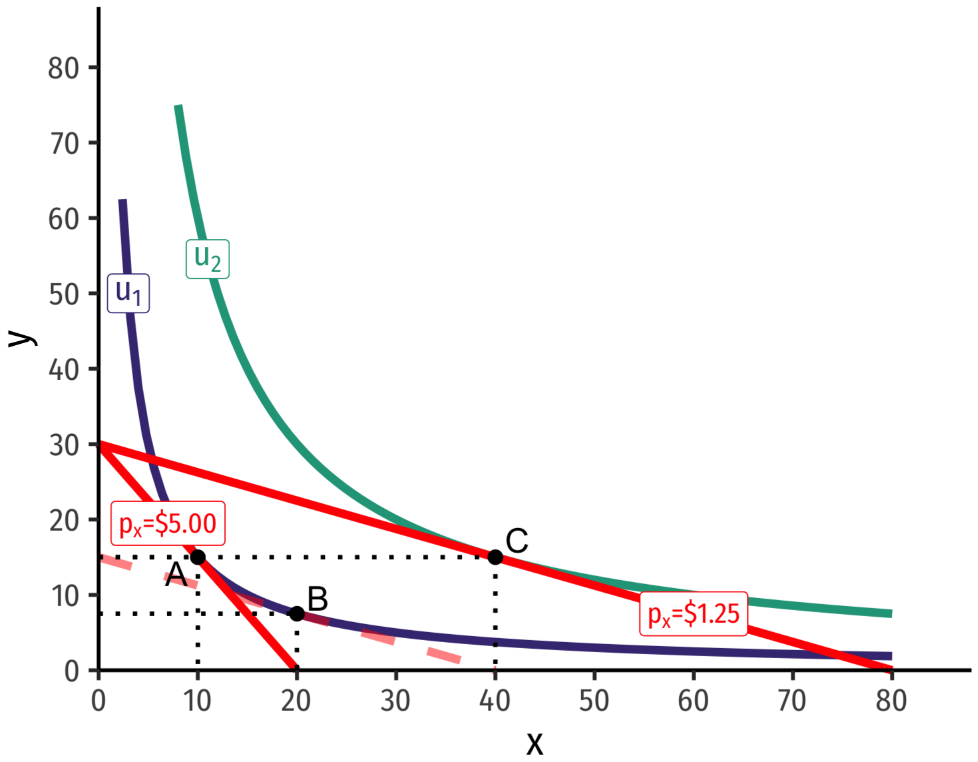

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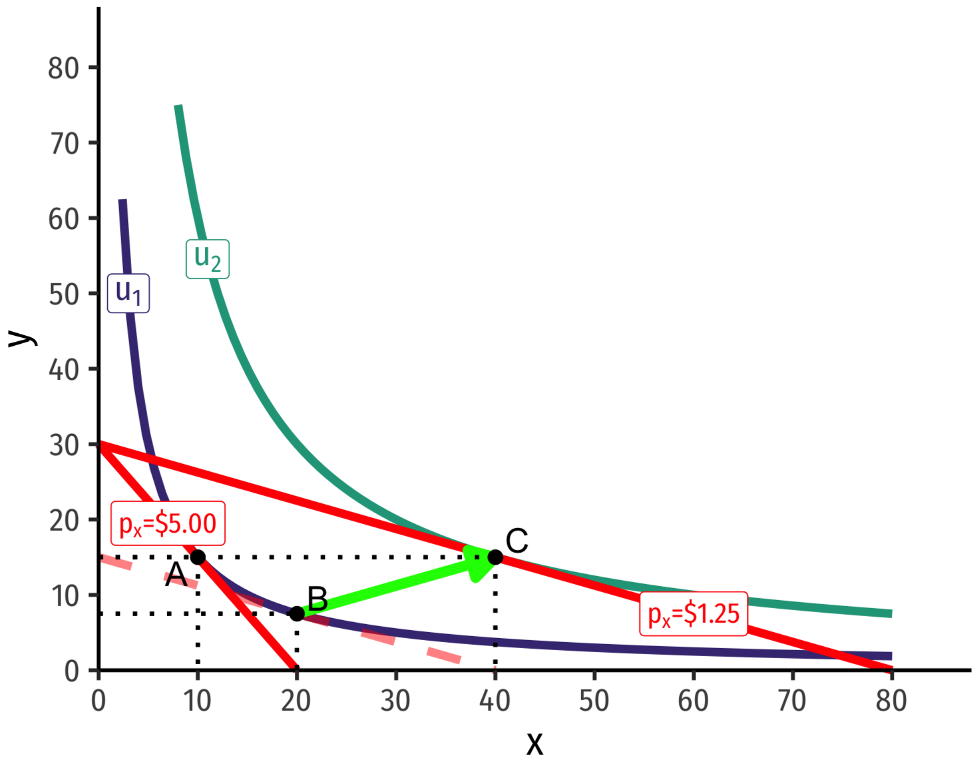

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Real Income and Substitution Effects, Graphically IV

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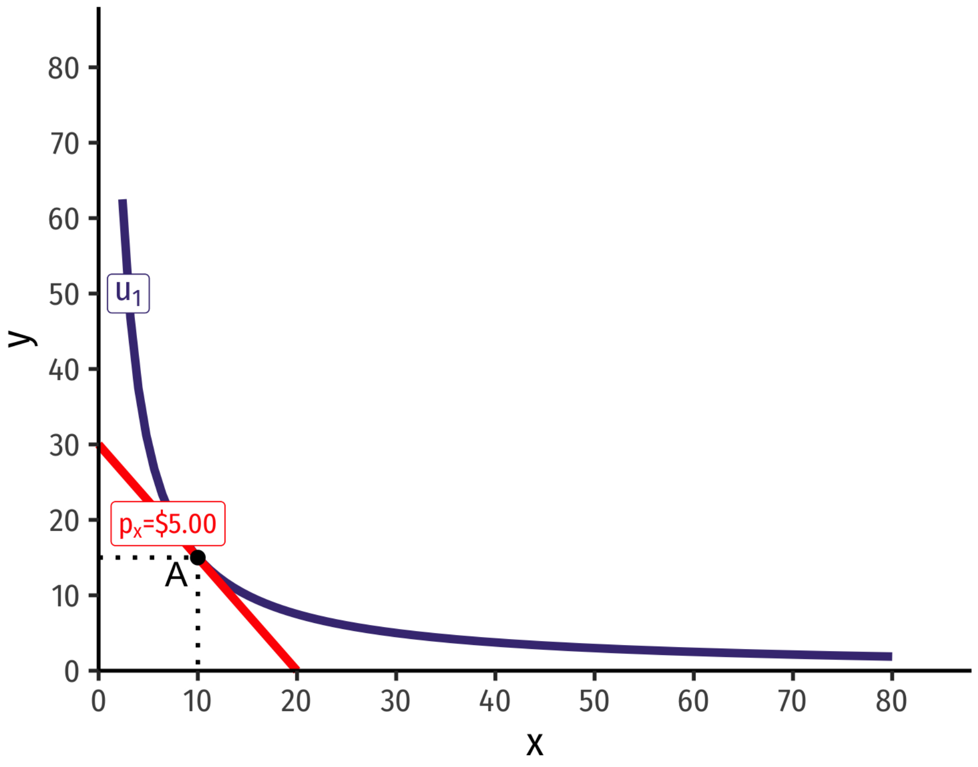

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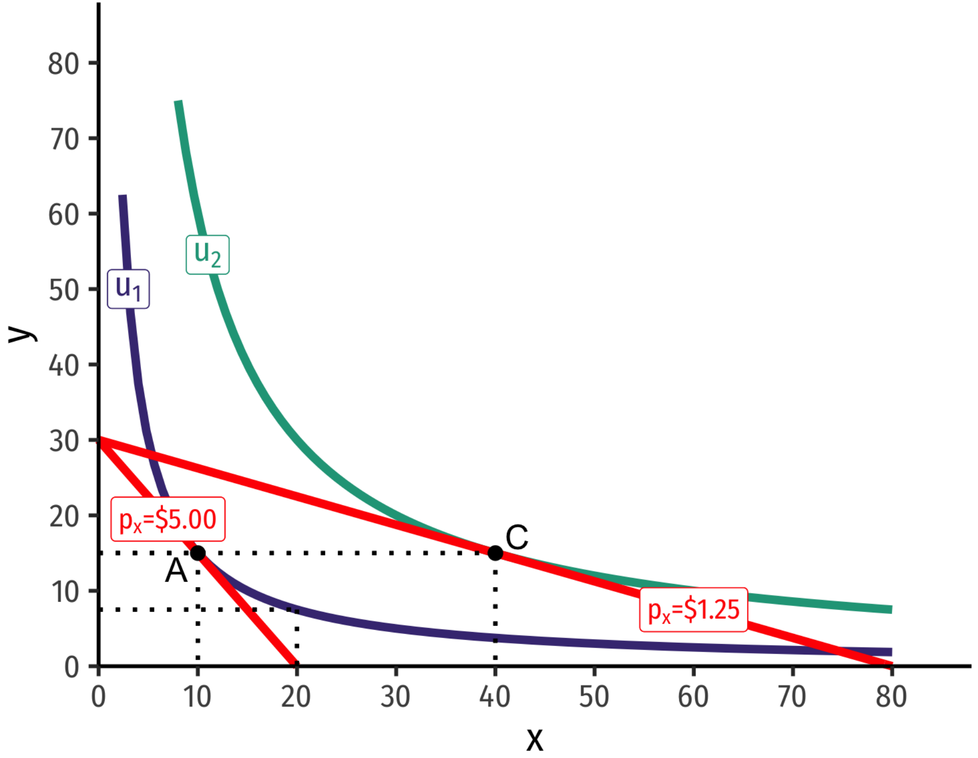
Real Income and Substitution Effects, Graphically IV

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



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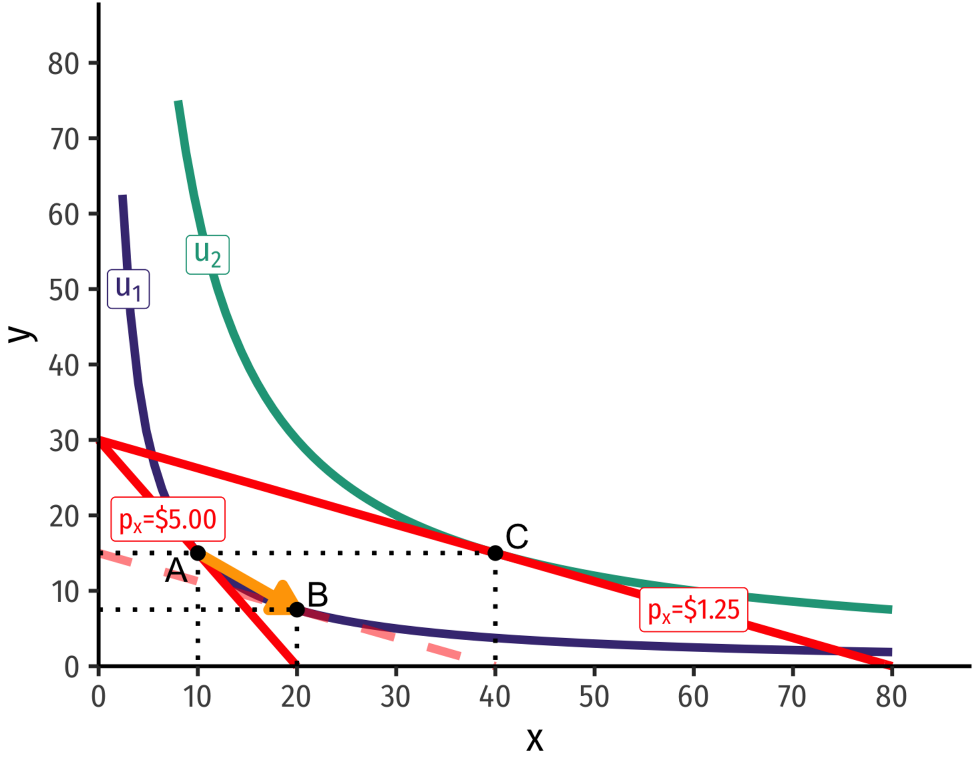
- **Substitution effect:** $A \rightarrow B$ on same I.C. ($\uparrow$ cheaper x and $\downarrow y$)



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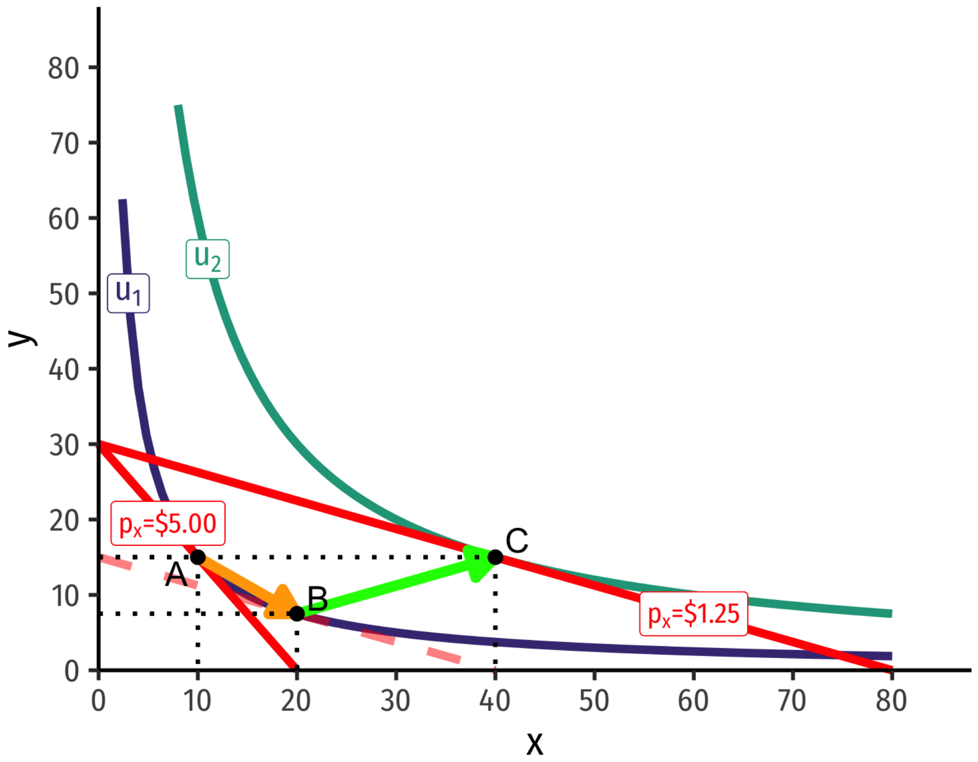

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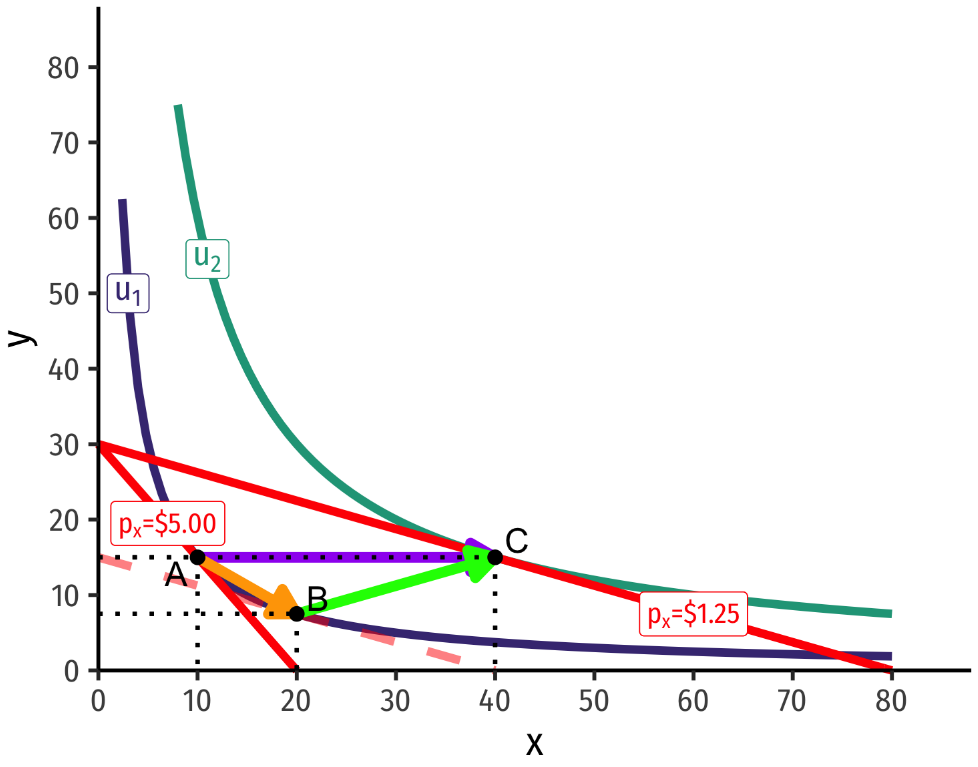

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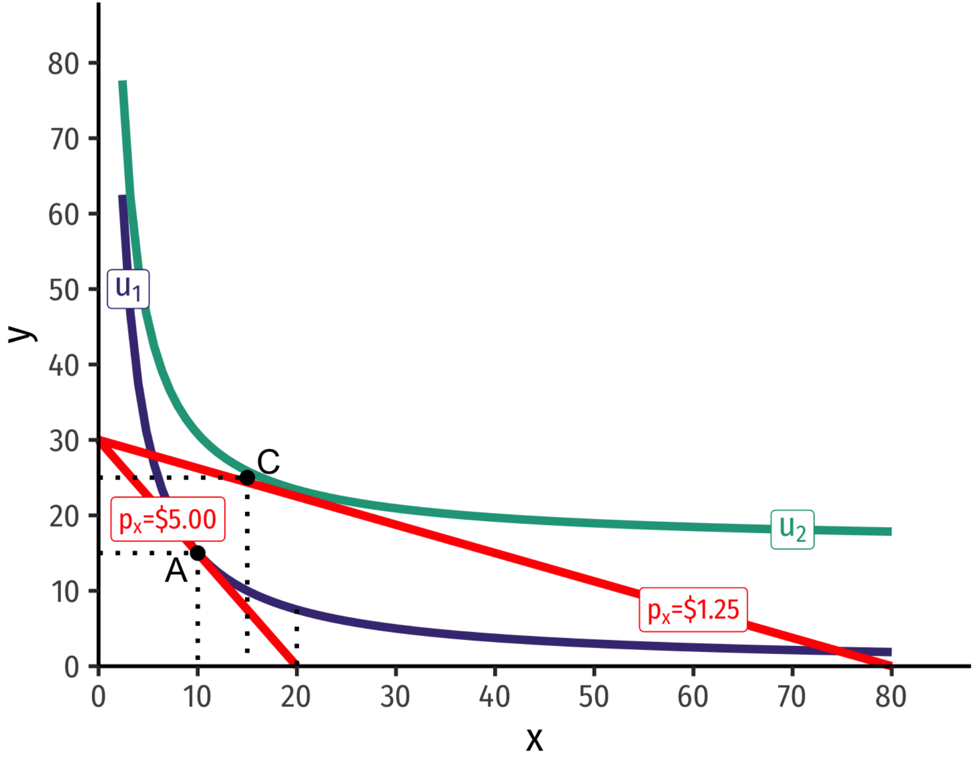
Real Income and Substitution Effects: Inferior Good

- What about an **inferior** good (Ramen)?



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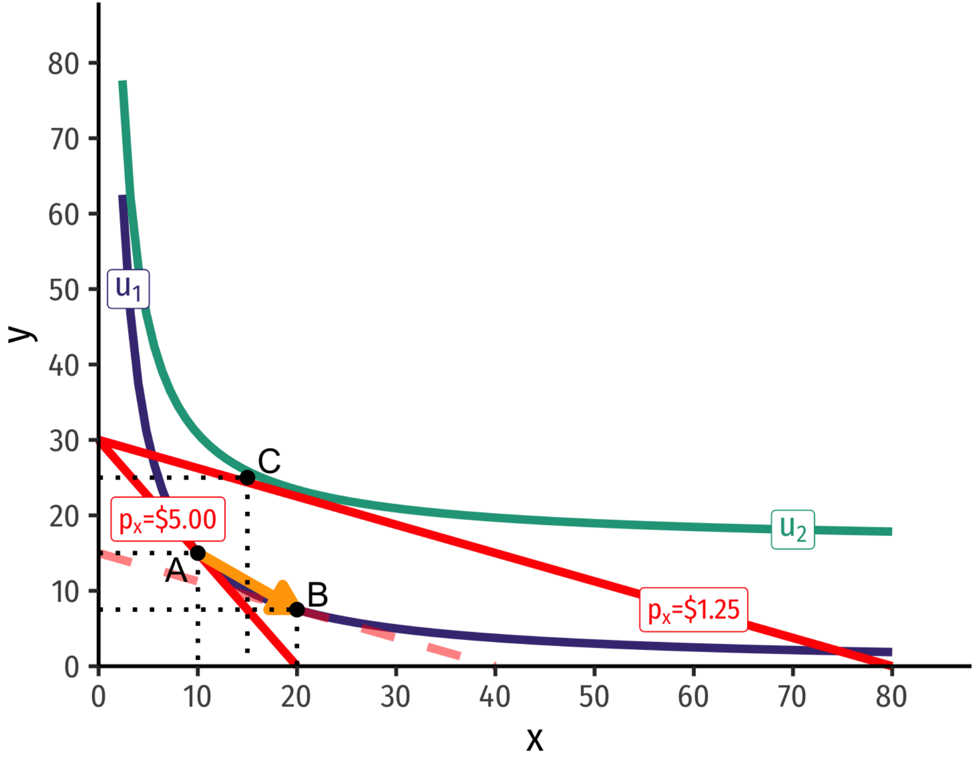

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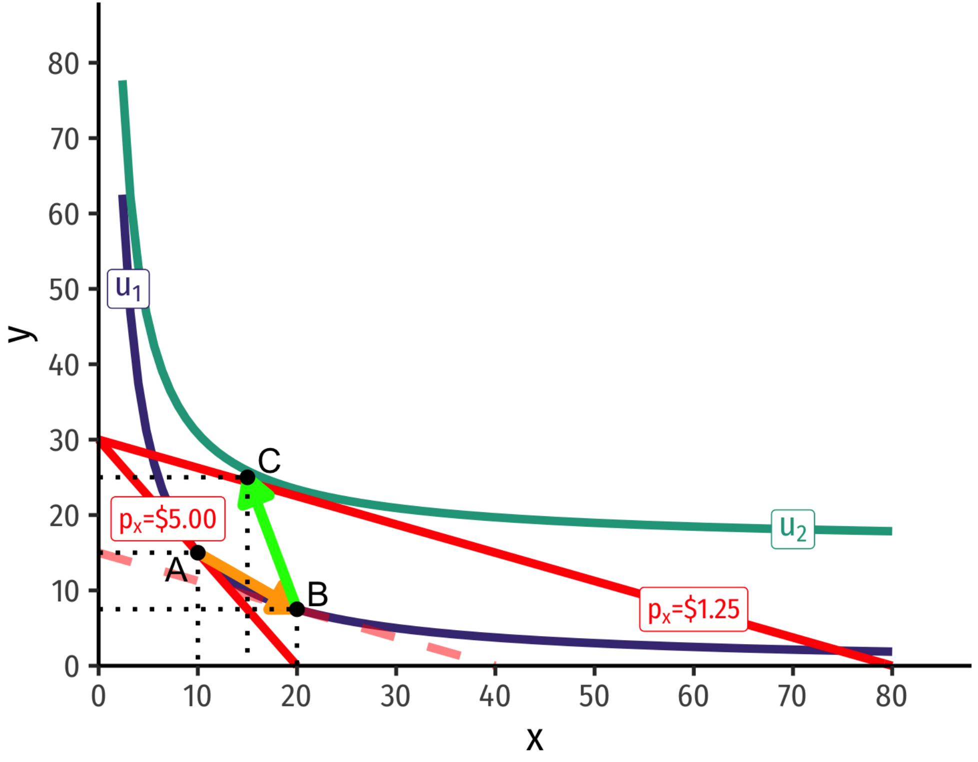
- **Substitution effect:** $A \rightarrow B$ on same I.C. (↑ cheaper x and ↓ y)
- **(Real) income effect:** $B \rightarrow C$ to new budget constraint (can buy more of x and/or y) **is negative**



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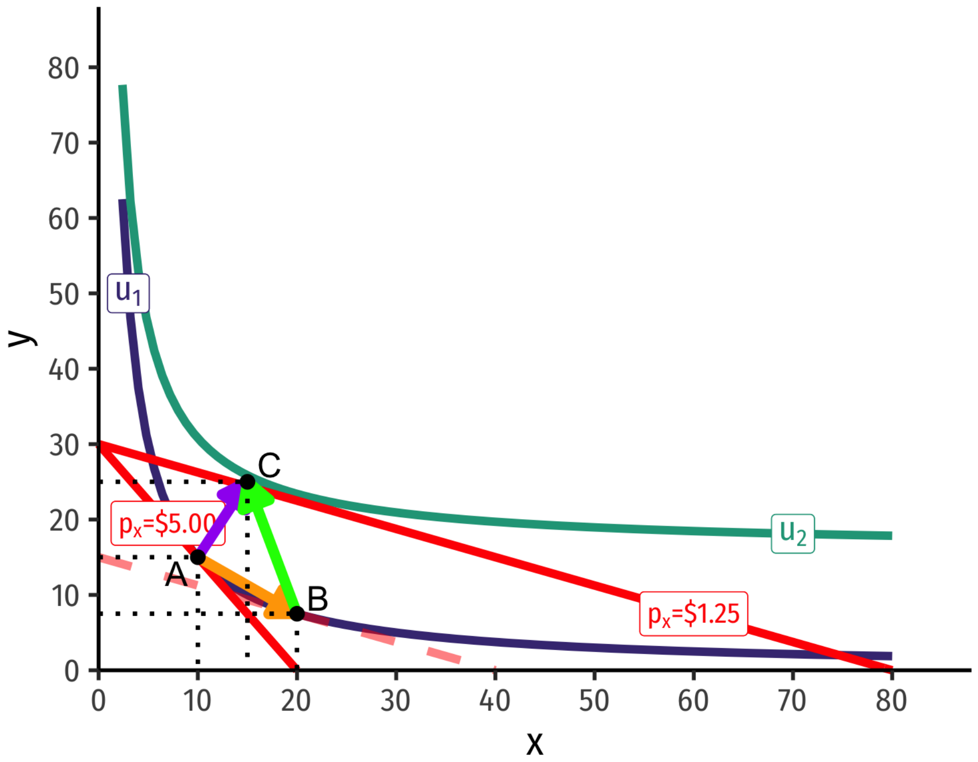

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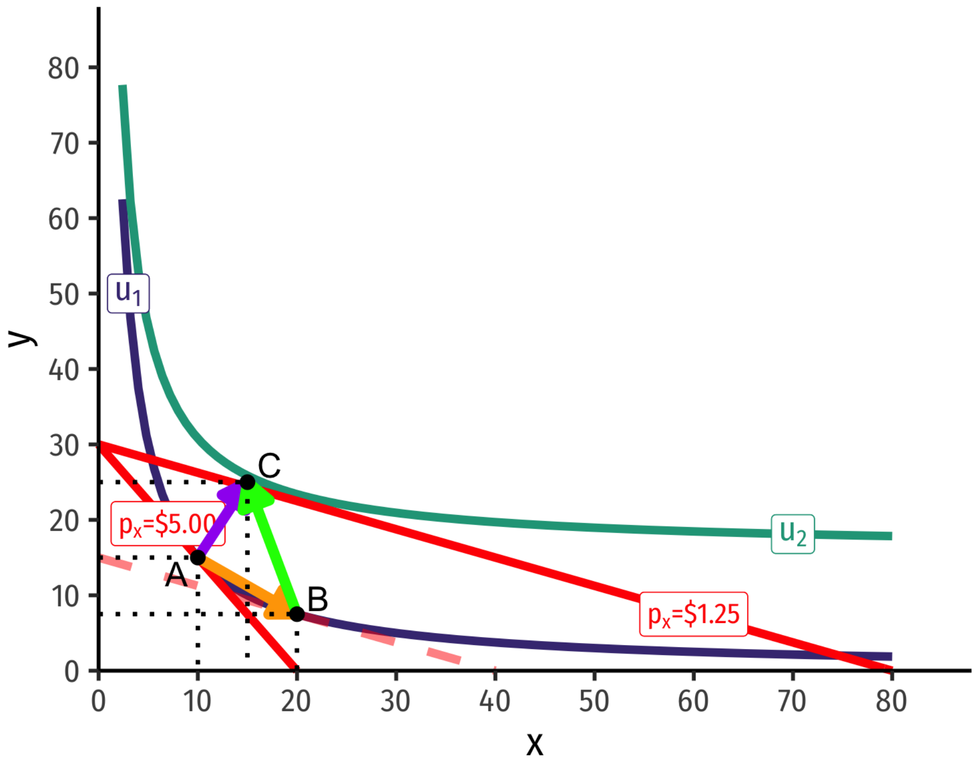
- **(Total) price effect:** $A \rightarrow C$
- Price effect is *still* an $\uparrow x$ from a $\downarrow p_x$!
  - Person would just prefer to spend more new purchasing power on other goods



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Violating the Law of Demand

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

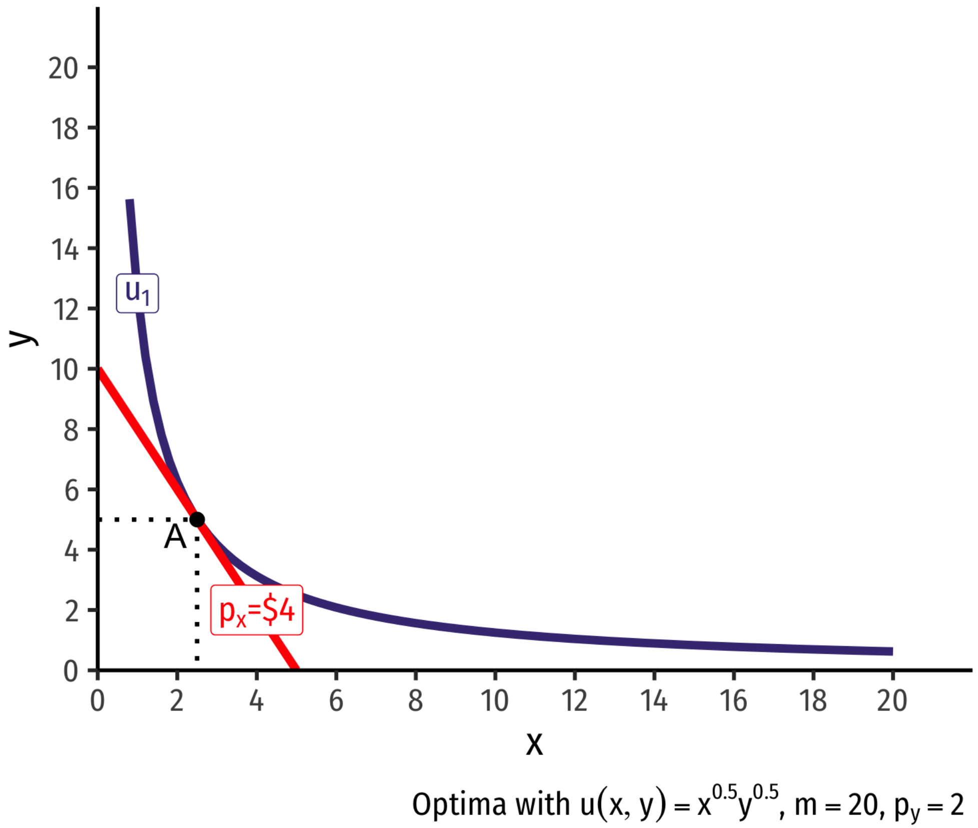
Recap: Real Income and Substitution Effects

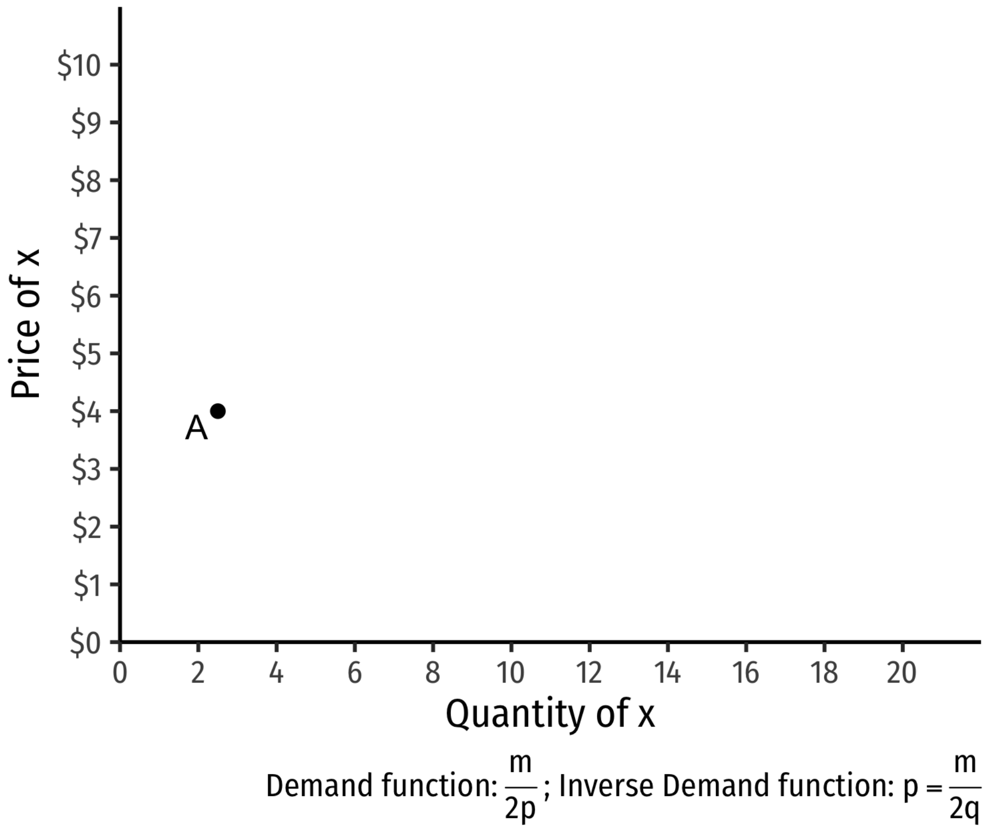
$$\text{Price Effect} = \text{Real income effect} + \text{Substitution Effect}$$

- **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
- Exception in the theoretical **Giffen good**: negative R.I.E. $>$ S.E.
  - An upward sloping demand curve!

From Optimal Consumption Points to Demand

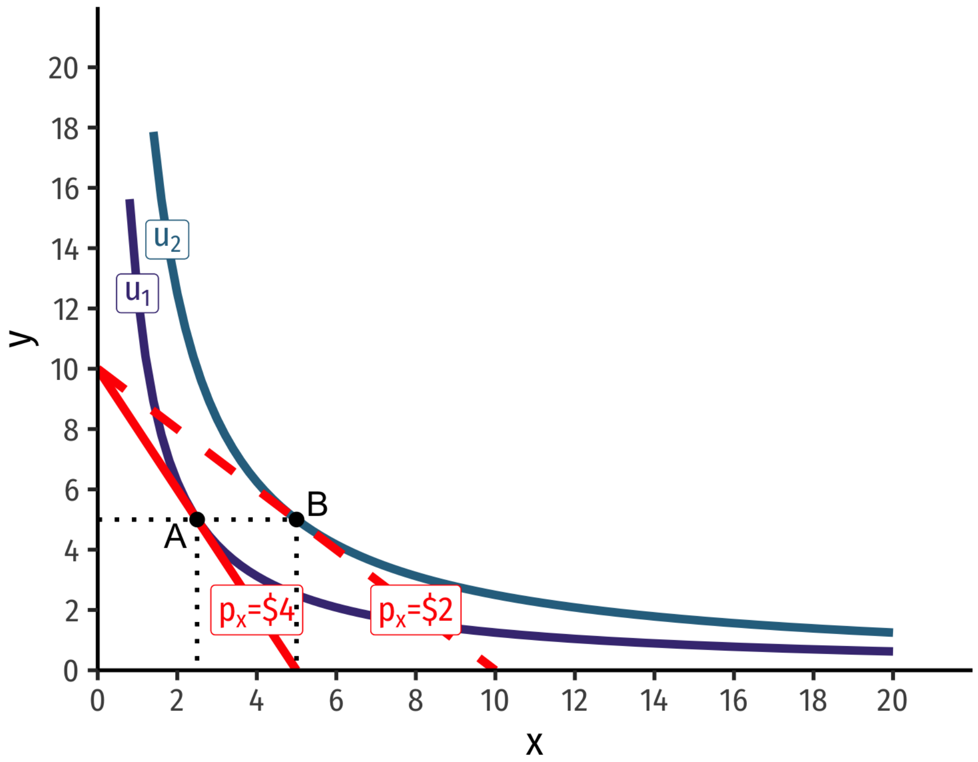
Deriving a Demand Curve Graphically



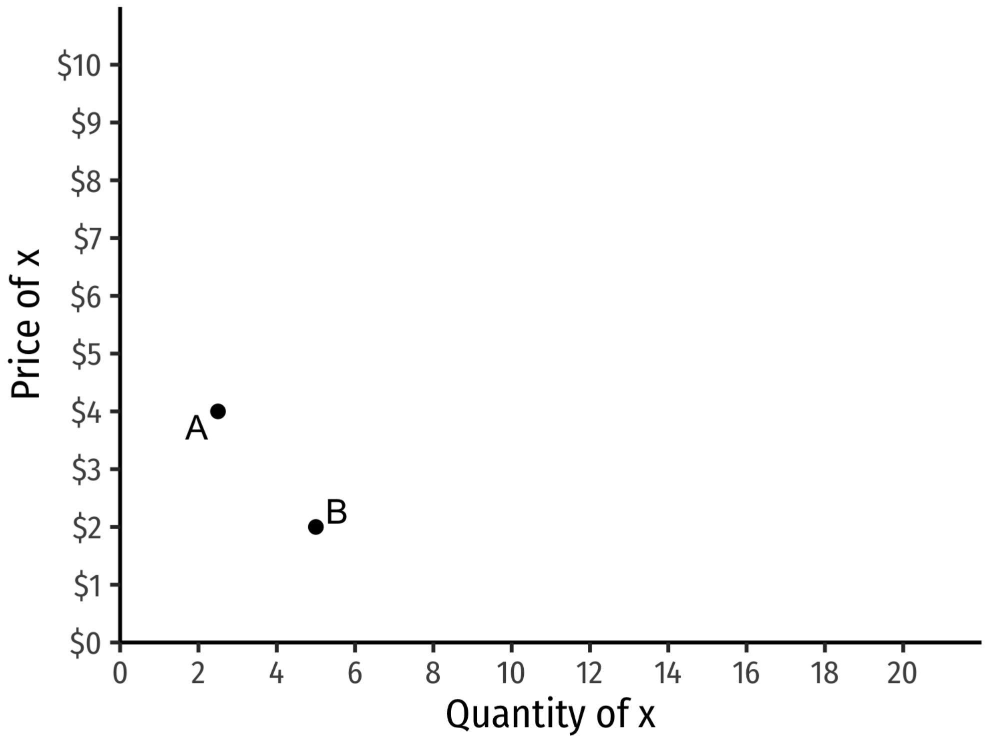


- Demand curve for x relates optimal consumption of x ("quantity") as price of x changes
- At $p_x = 4$, consumer buys 2 x

Deriving a Demand Curve Graphically



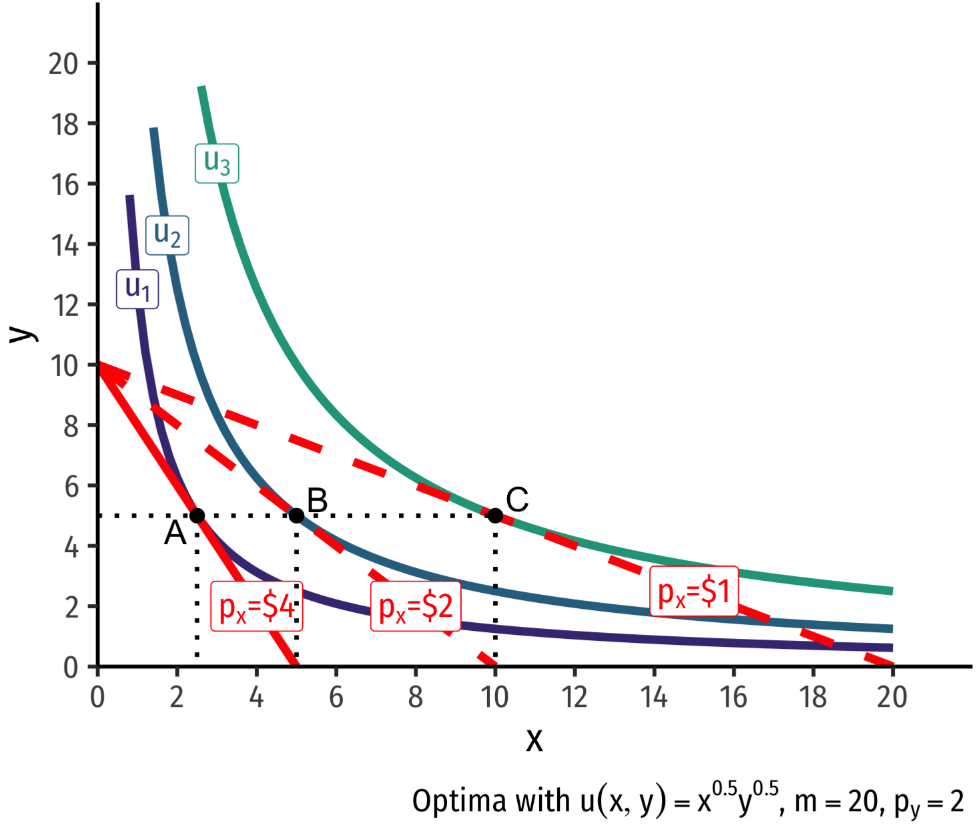
Optima with $u(x, y) = x^{0.5}y^{0.5}$, $m = 20$, $p_y = 2$

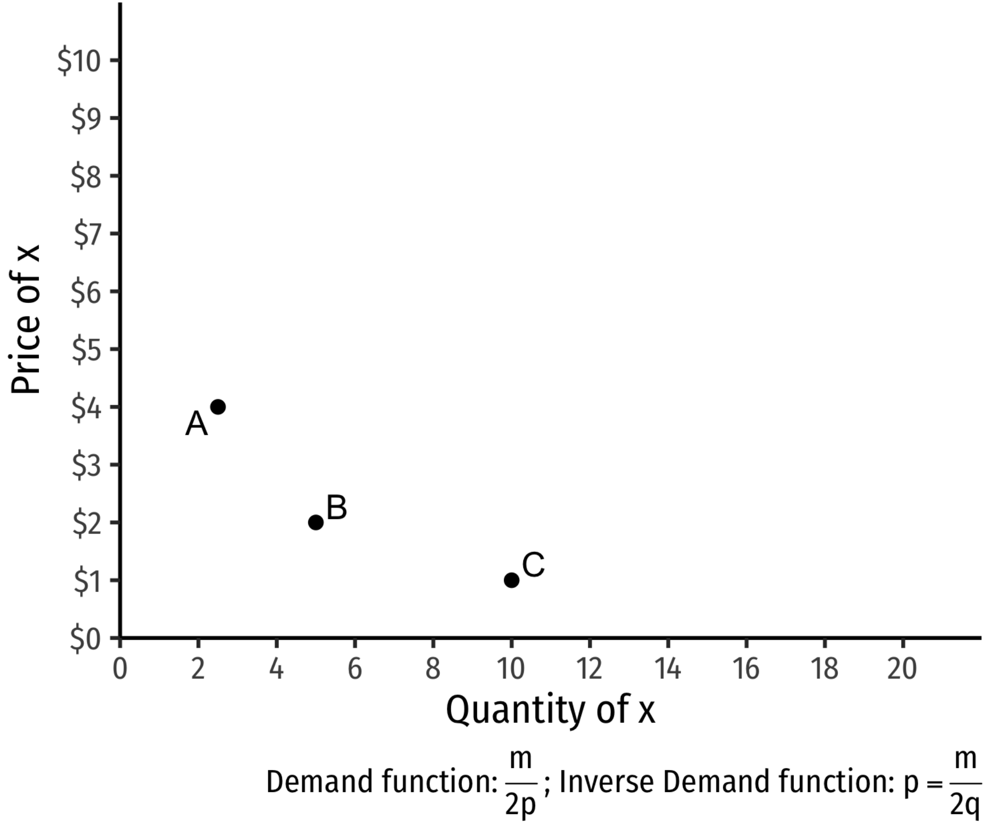


Demand function: $\frac{m}{2p}$; Inverse Demand function: $p = \frac{m}{2q}$

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

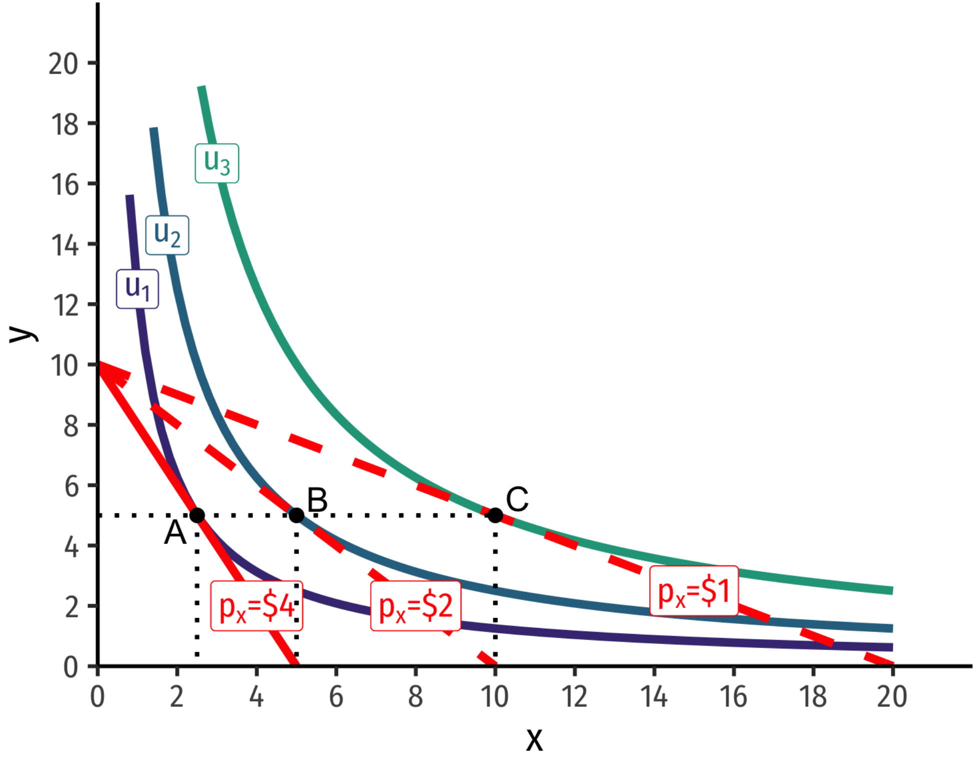
Deriving a Demand Curve Graphically





- 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; at $p_x = 1$, consumer buys 10 x

Deriving a Demand Curve Graphically



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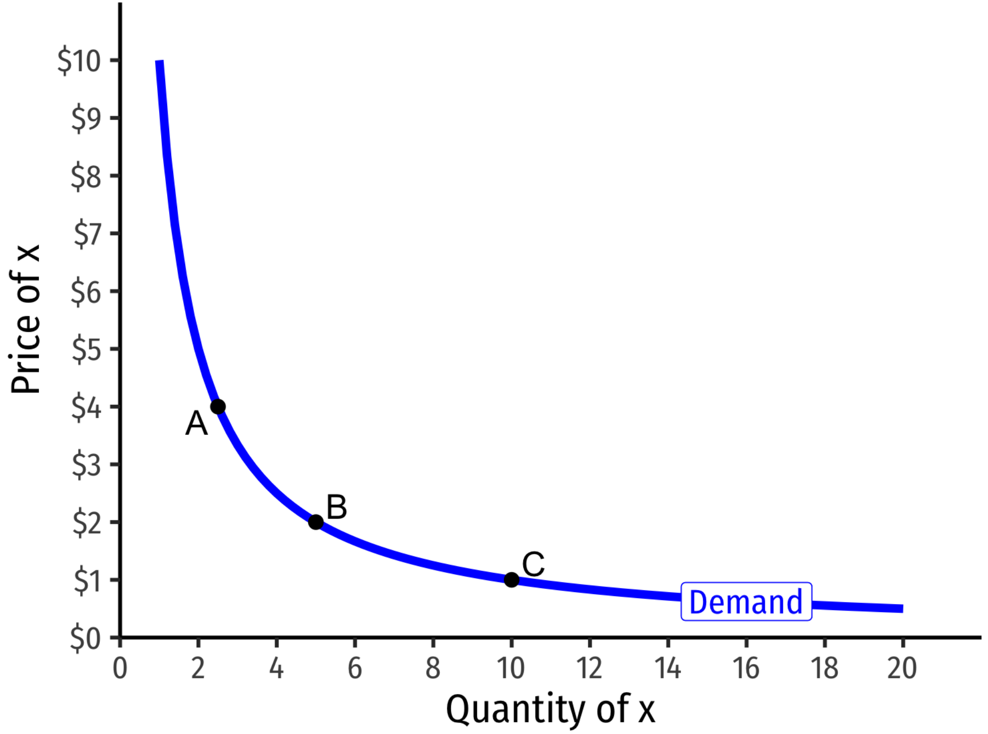

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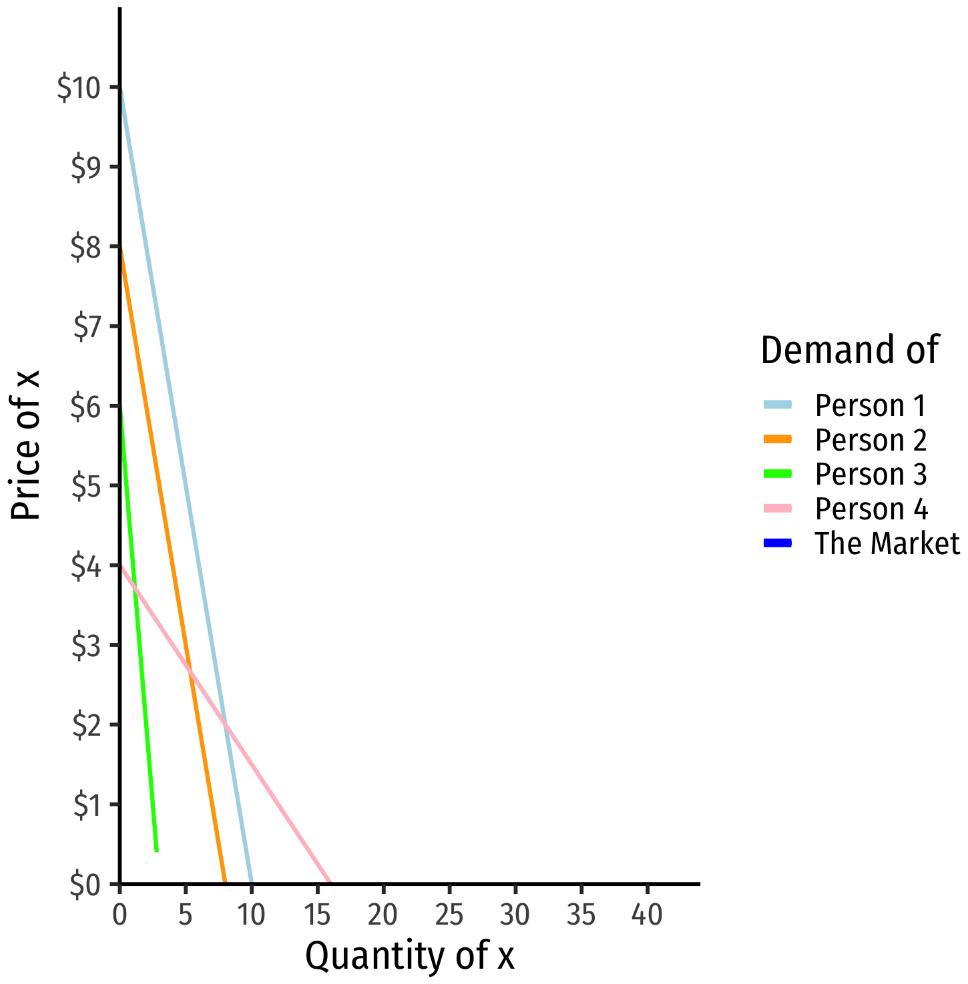
From Individual Demand to Market Demand

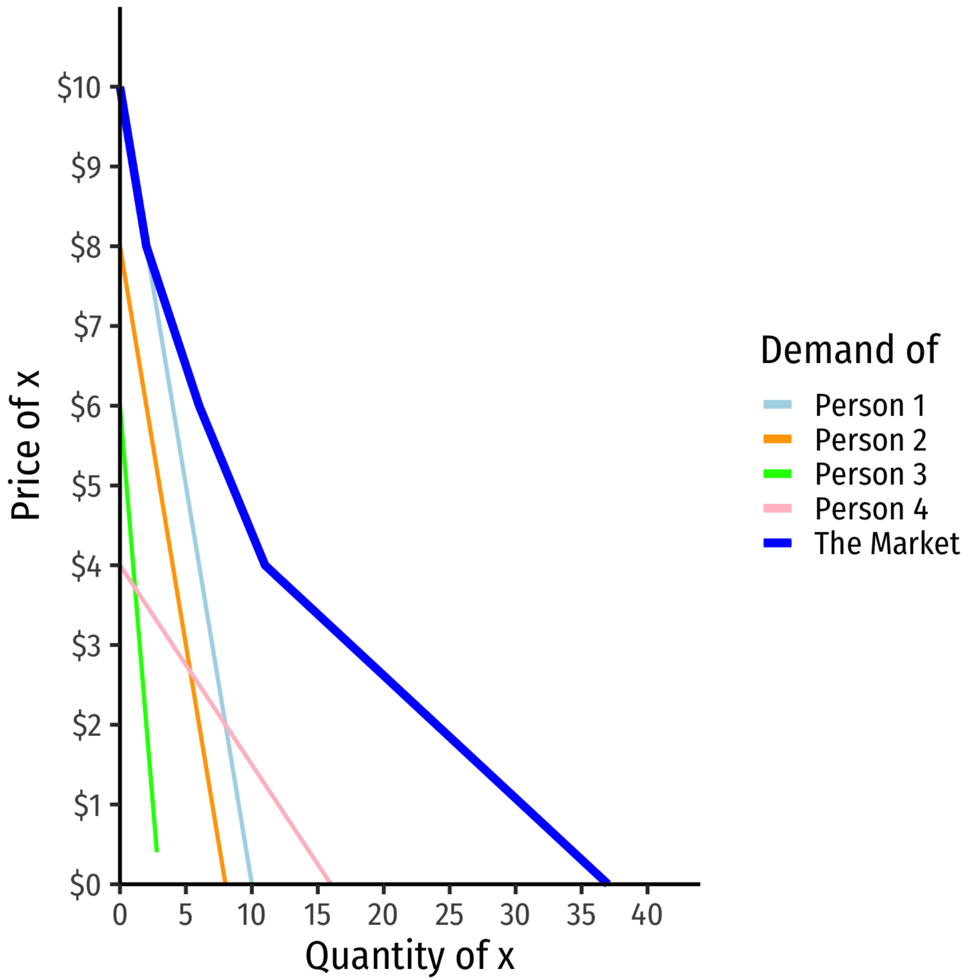
- Note so far we have been talking about *an individual person's* demand

- 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!**

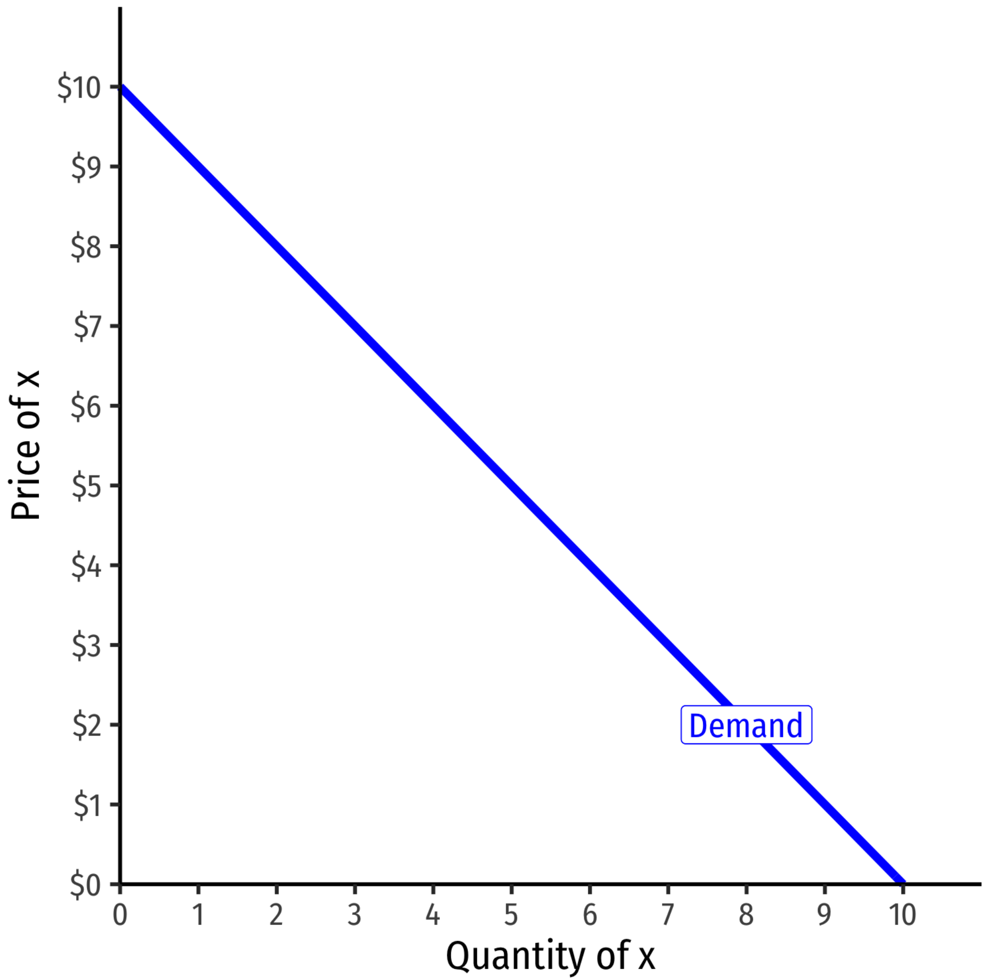
price	quantity
10	0
9	1
8	2
7	3
6	4
5	5
4	6
3	7
2	8
1	9
0	10

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)** $\implies$ demand curves always slope downwards



Demand Function

- **Demand function** relates quantity to price

Example:

$$q = 10 - p$$

- Not graphable (wrong axes)!

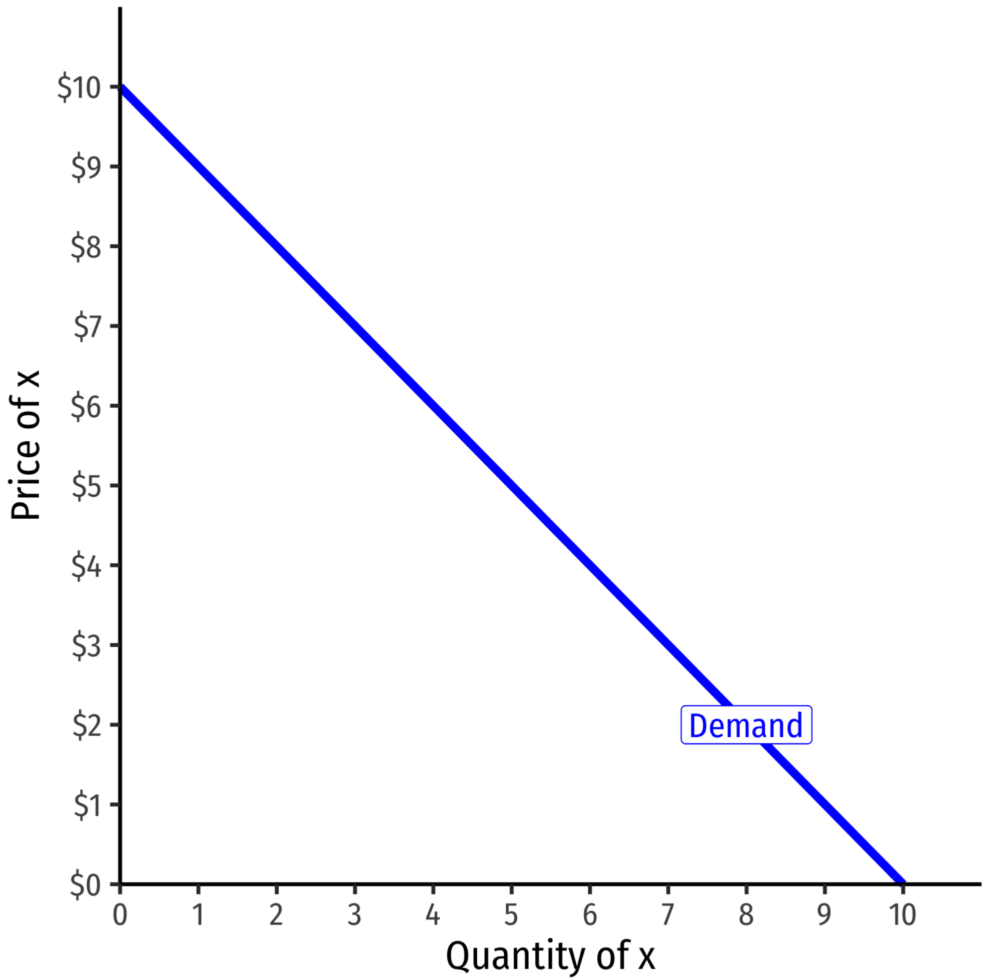
Inverse Demand Function

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

Example:

$$p = 10 - q$$

- Graphable (price on vertical axis)!



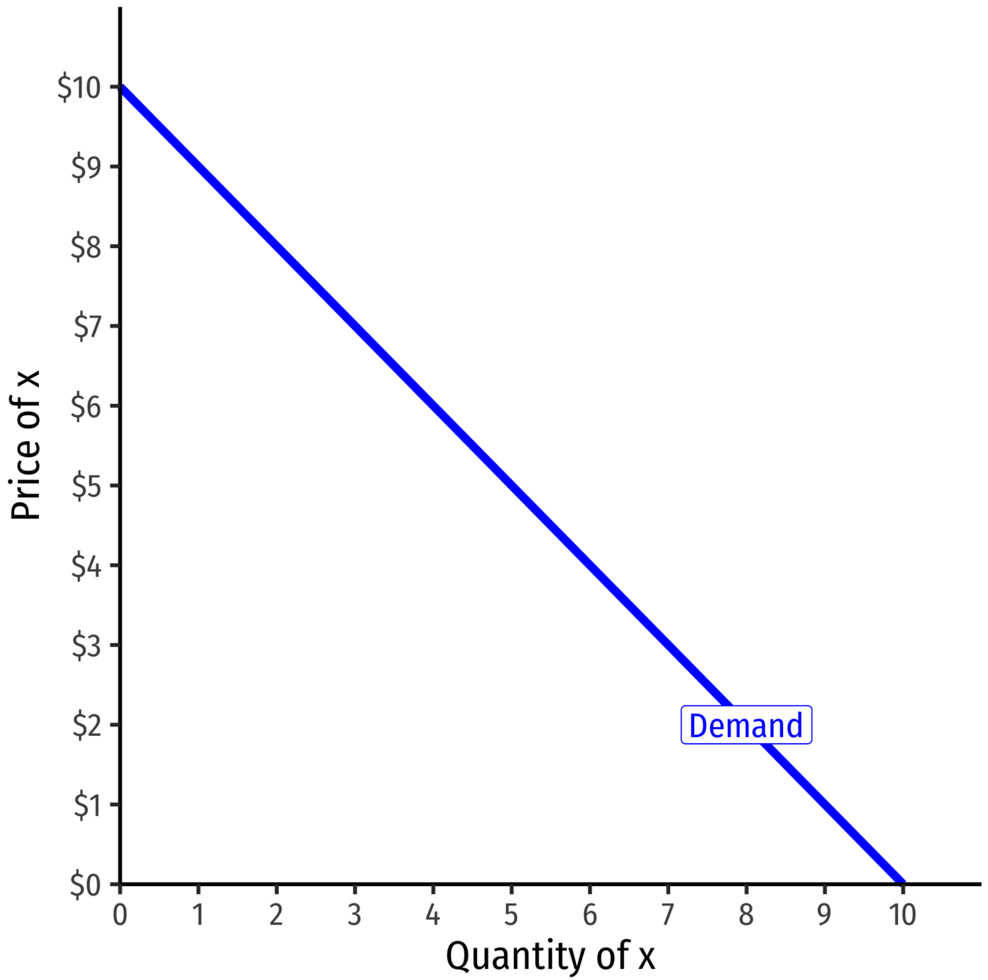
Inverse Demand Function

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

Example:

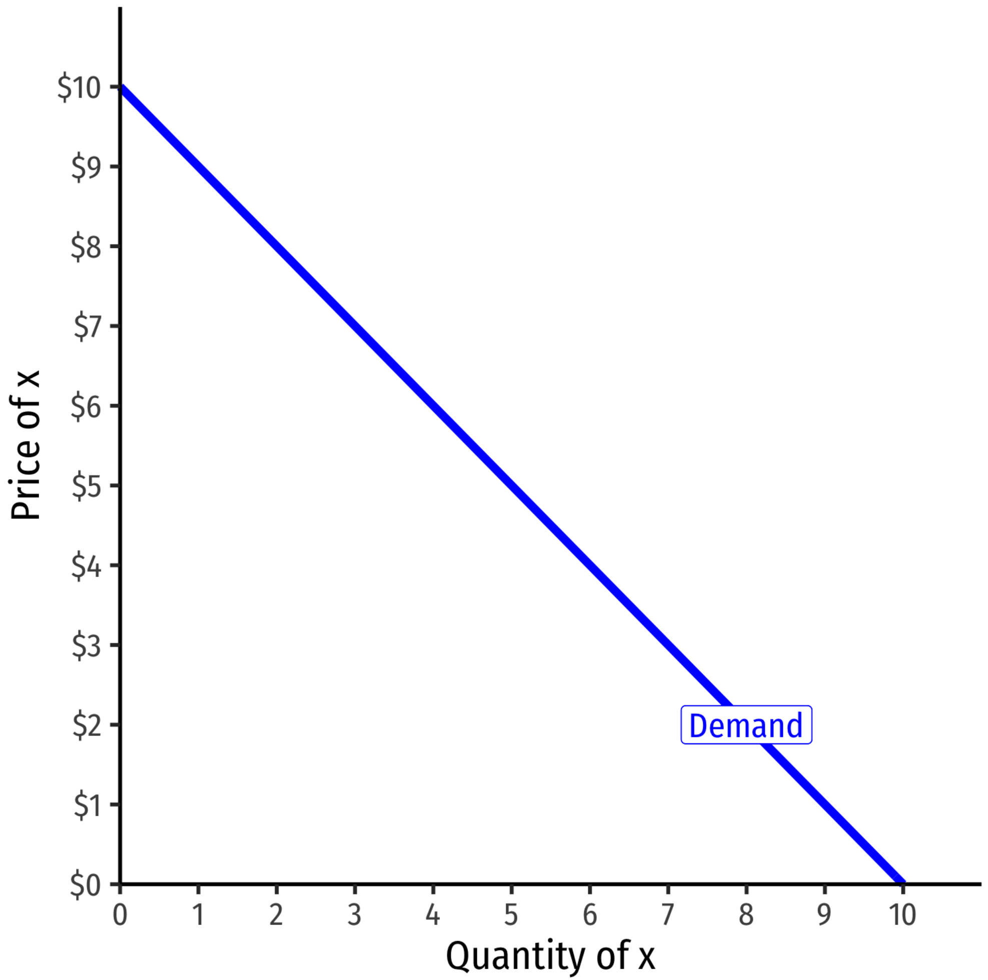
$$p = 10 - q$$

- 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

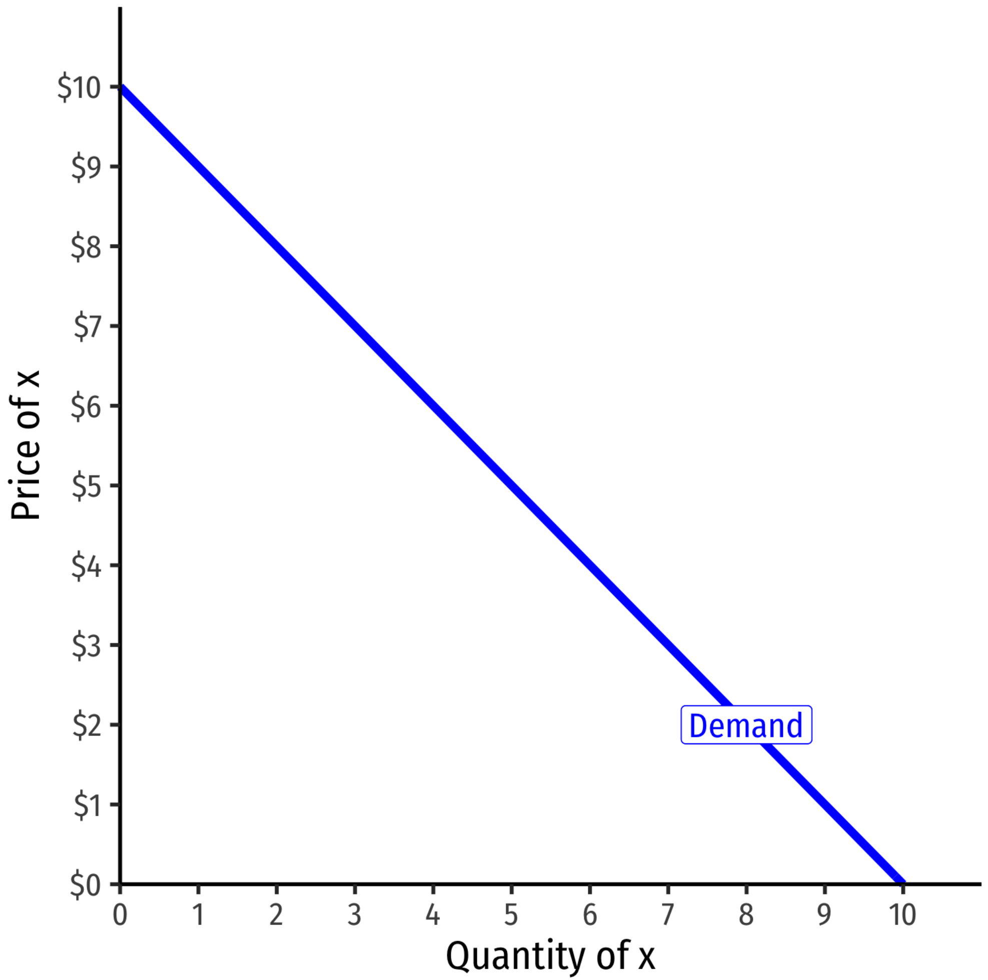


Shifts in Demand I

- 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?



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