1.6 — The Standard Trade Model

ECON 324 • International Trade • Fall 2020

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Outline

From Ricardian to Neoclassical Model

The Standard Trade Model

- The **standard** (or **neoclassical**) **trade model** is a more general model
    - Ricardian one-factor model: *special case*
    - Same with H-O (next) model
- We will extend the concepts we learned from the Ricardian model
    - more traditional neoclassical assumptions
- **A straightfoward neoclassical story about relative prices changing**

What We're Adding to Ricardo

- Money prices (in dollars), p_x, p_y
- Other factors of production with diminishing returns
  - Increasing opportunity costs of production
- Determination of global equilibrium relative prices via supply & demand
- Effects of the terms of trade changing
- Effects of countries' economies development & trade policy

Tools for the Standard Model

- We will do everything with graphs rather than equations
  - I expect you to understand and be able to interpret, if not be able to draw own graphs
- I will break today up into separate tools we will then combine
  1. PPF with increasing costs
  2. Indifference curves
  3. Comparative advantage in autarky
  4. Global market relative demand and relative supply
  5. International trade equilibrium
  6. Terms of trade changes (next class)

PPF: Increasing Costs

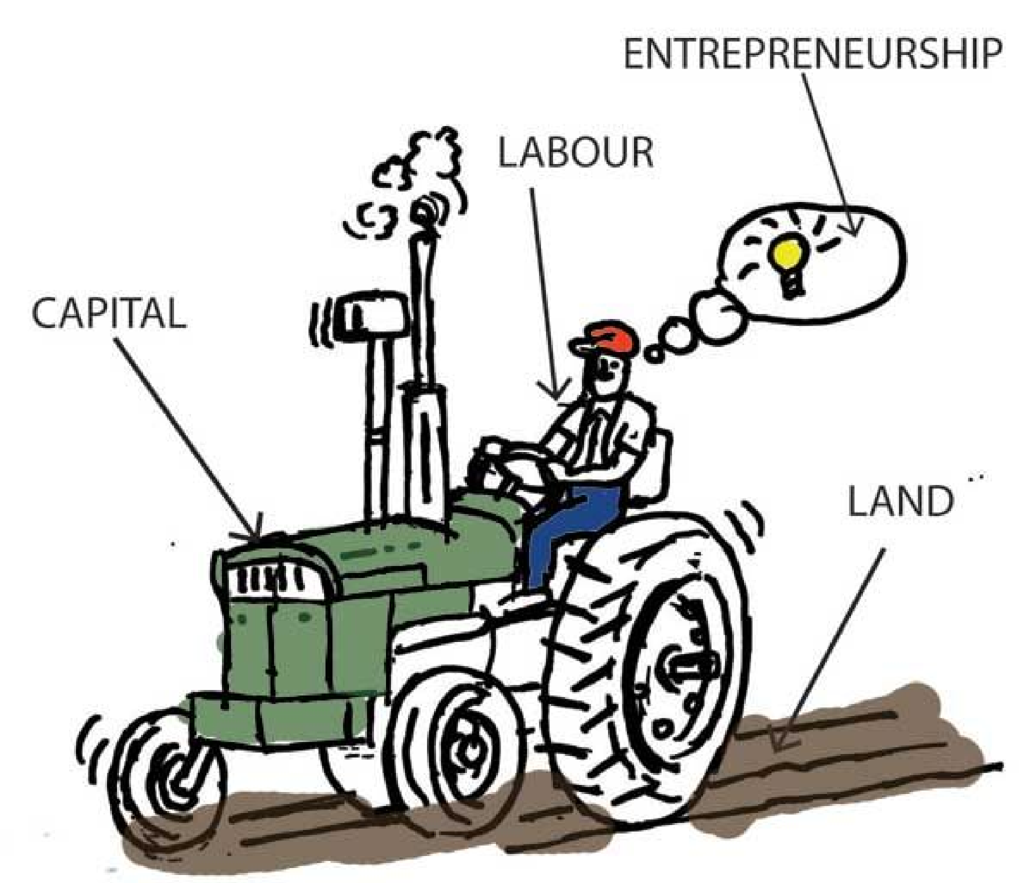
Factors of Production I

$$q = Af(t, l, k)$$

- Economists typically classify inputs, known as **factors of production (FOP)**:

Factor	Owned By	Earns
Land (t)	Landowners	Rent
Labor (l)	Laborers	Wages
Capital (k)	Capitalists	Interest

- A: "total factor productivity" (ideas/knowledge/institutions)
- and Entrepreneurs/Owners who earn Profit

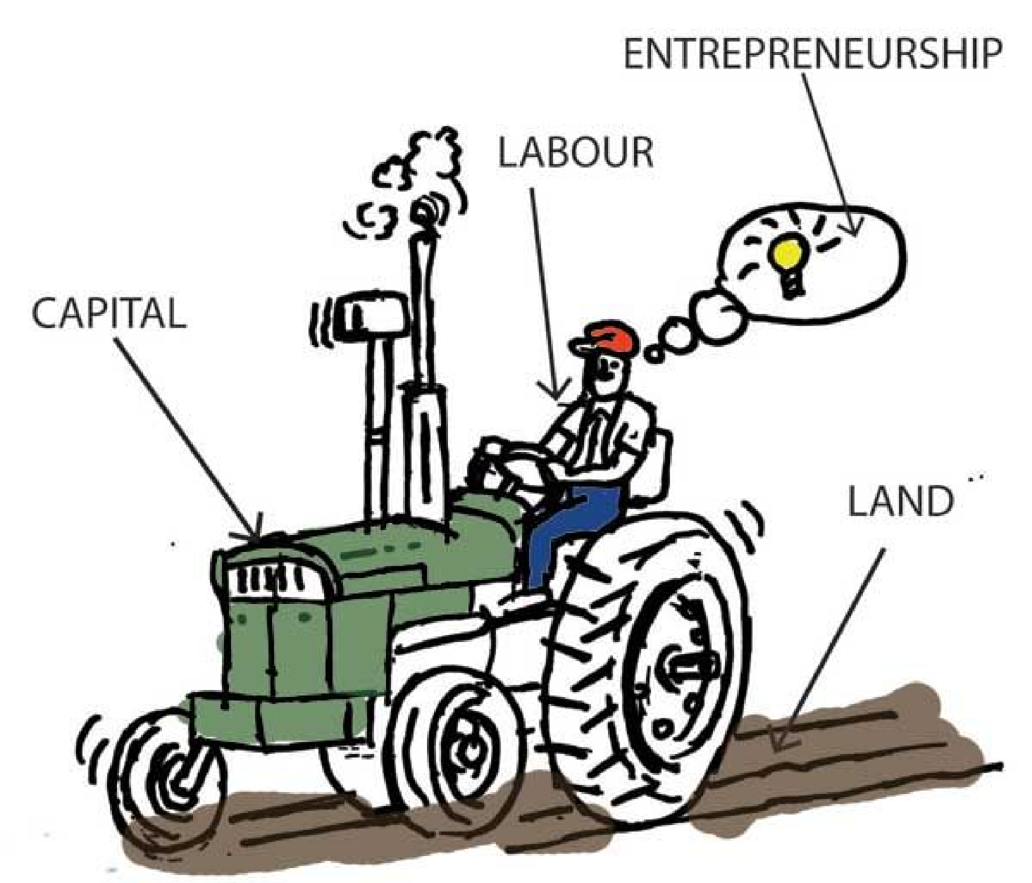


Factors of Production II

$$q = f(l, k)$$

- We often assume just two inputs: labor l and capital k

Factor	Owned By	Earns
Labor (l)	Laborers	Wages
Capital (k)	Capitalists	Interest



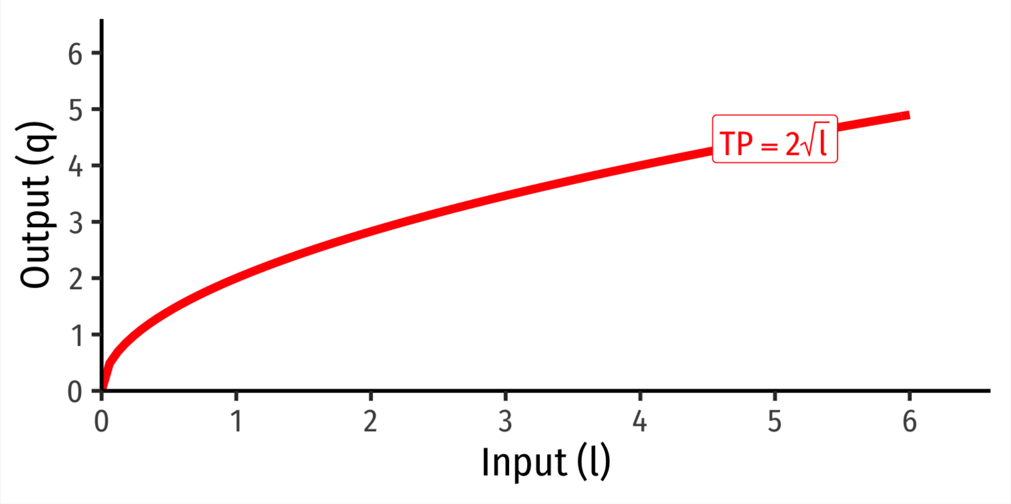
Marginal Product of Labor

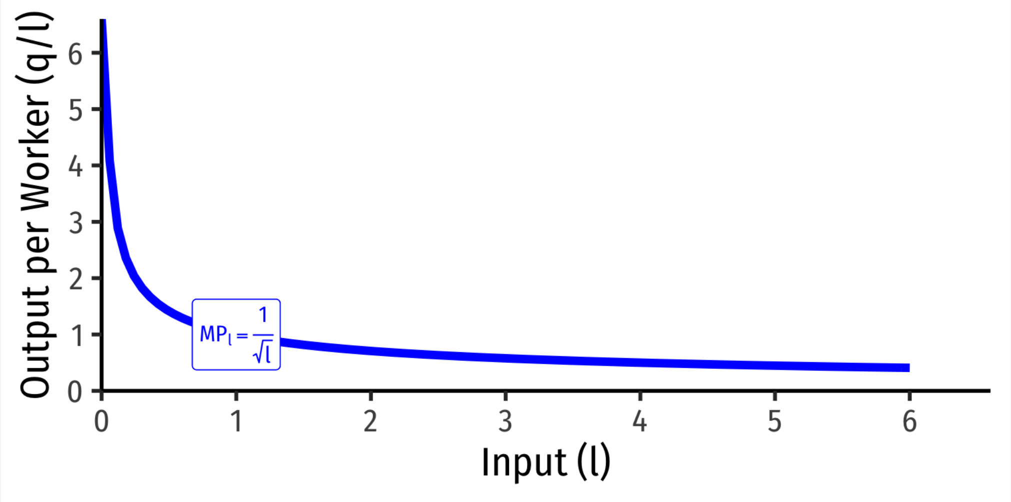
- **Marginal product of labor (MP_l)**: additional output produced by adding one more unit of labor (holding k constant)

$$MP_l = \frac{\Delta q}{\Delta l}$$

- MP_l is slope of TP at each value of l!

- Note: via calculus: $\frac{\partial q}{\partial l}$





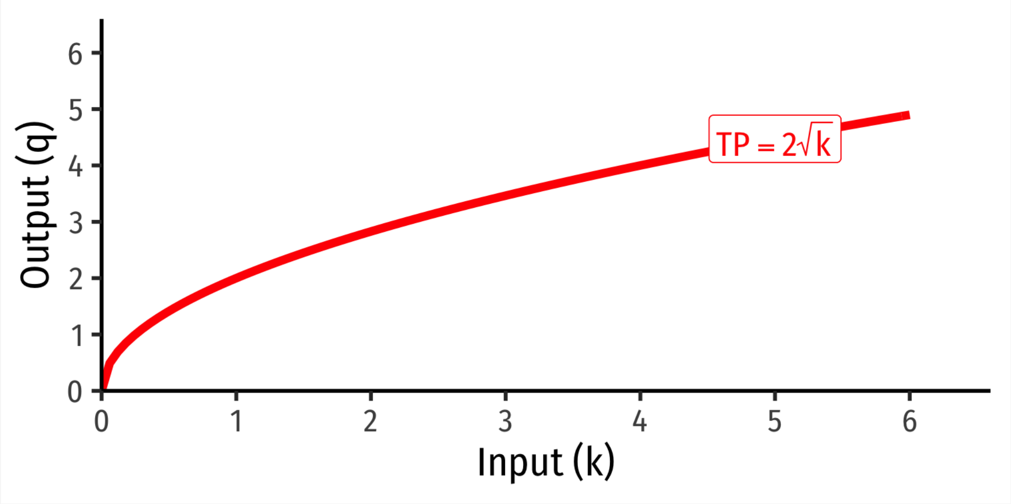
Marginal Product of Capital

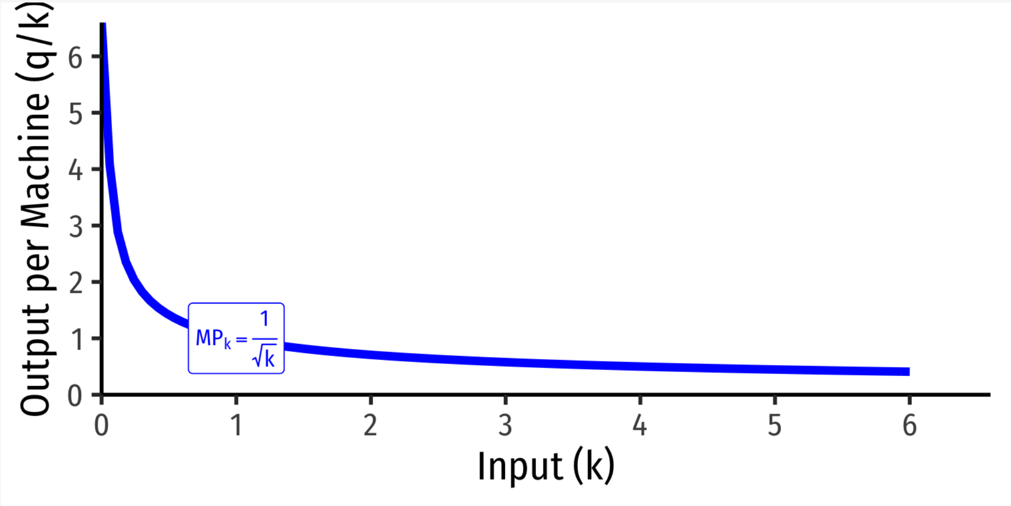
- **Marginal product of capital** (MP_k): additional output produced by adding one more unit of capital (holding l constant)

$$MP_k = \frac{\Delta q}{\Delta k}$$

- MP_k is slope of TP at each value of k!

- Note: via calculus: $\frac{\partial q}{\partial k}$

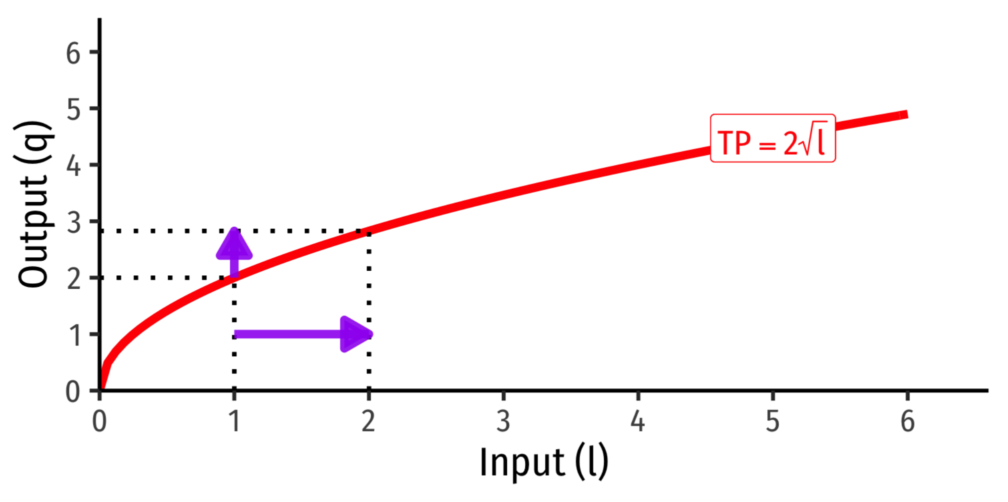


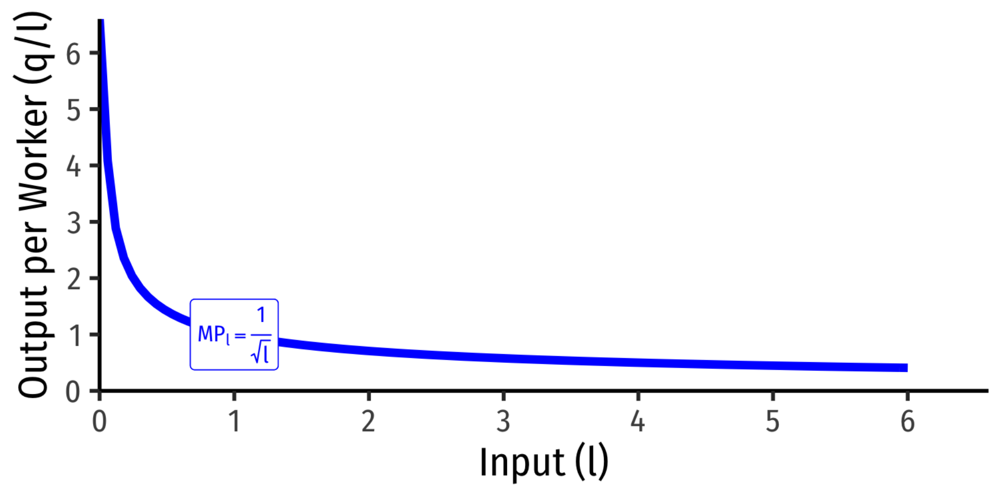


Diminishing Returns

- **Law of Diminishing Returns**: adding more of one factor of production **holding all others constant** will result in successively lower increases in output

- In order to increase output, need to increase use of *all* factors!





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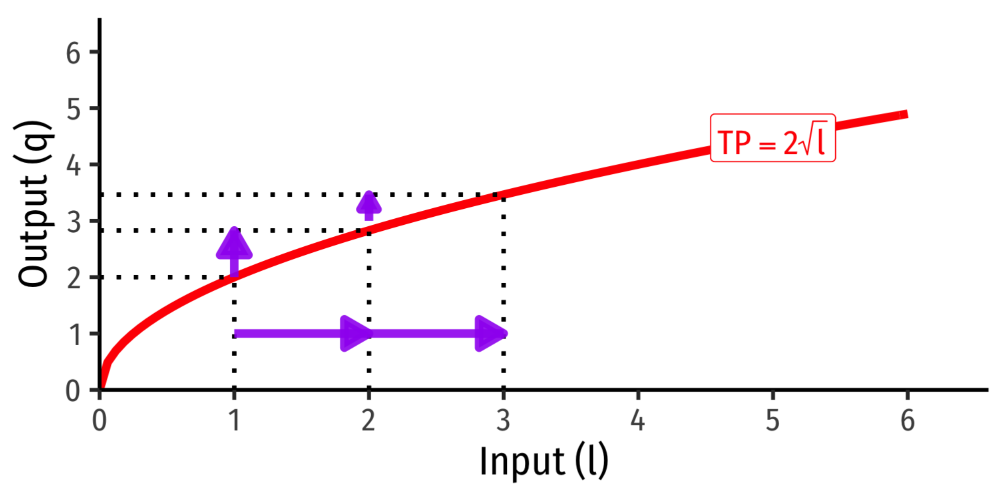
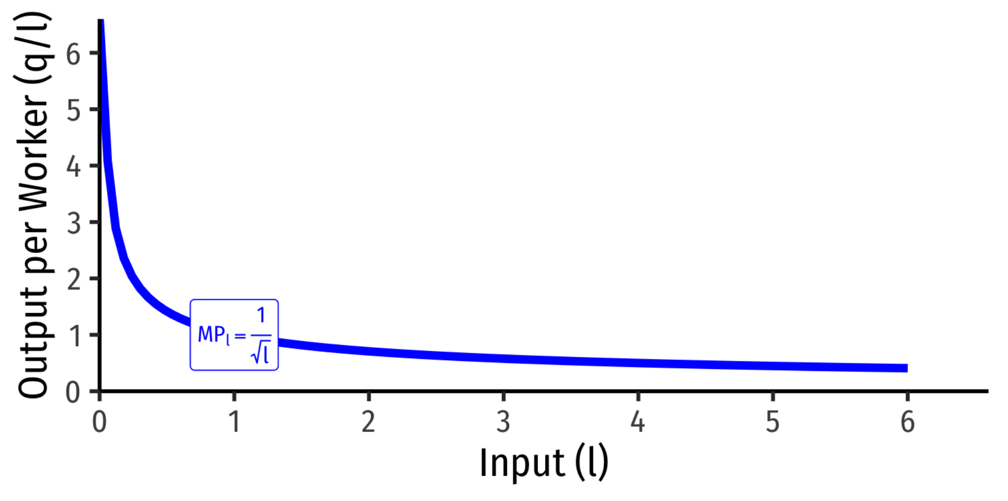




Competitive Markets and Factor Switching

- We still assume output markets and factor markets (for land, labor, capital) are perfectly competitive
- Firms hire resources up to the point where marginal cost of one more unit of l or k is equal to its marginal benefit in production ("marginal revenue product")
- Implies that in equilibrium, each factor of production is paid its marginal revenue product:

$$p_l = p_y * MP_l$$
$$p_k = p_y * MP_k$$

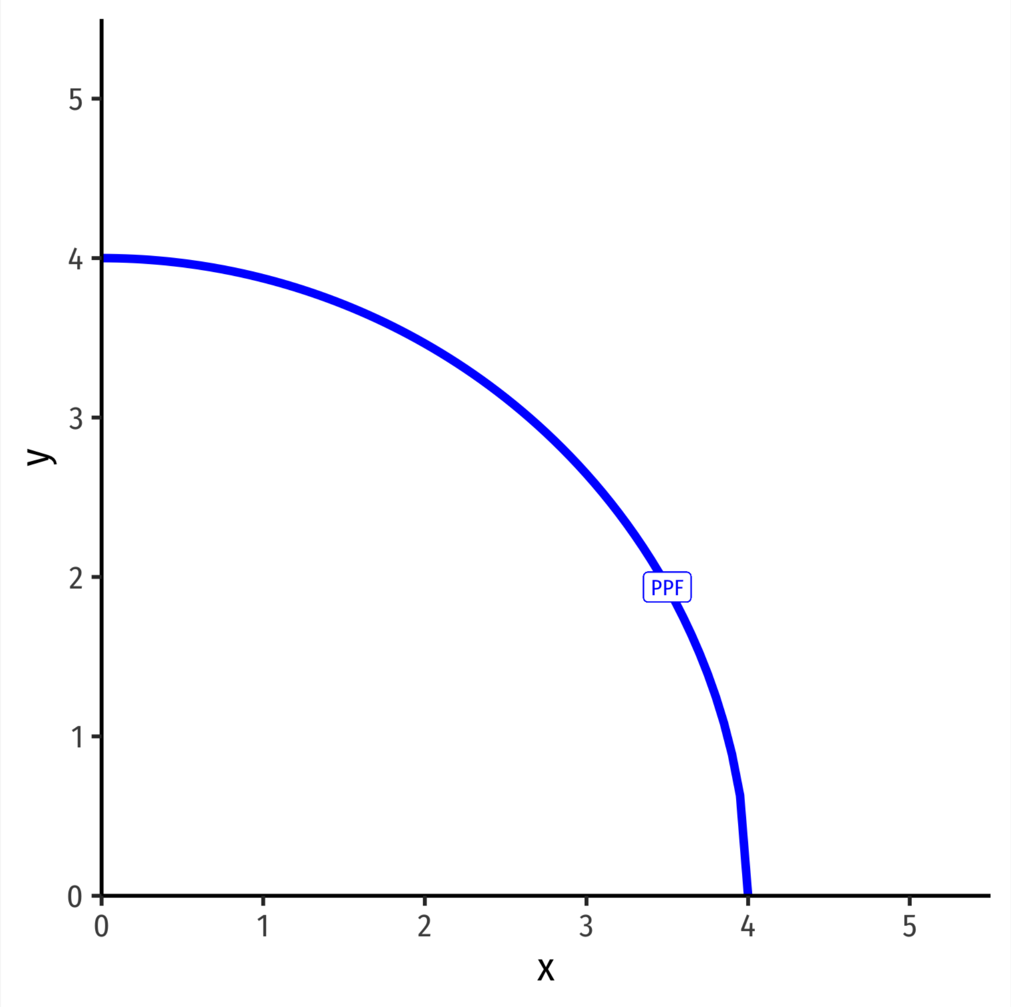
  - Where p_l and p_k are prices of labor and capital, and p_y is the price of some output

- If you want to remember why, see my slides on Factor Markets
- Multiple combinations of l and k can produce equivalent output y
- **Takeaway: producers will substitute between labor and capital depending on relative prices and technology**

PPF: Increasing Costs

- **Marginal rate of transformation (MRT)** *increases* as we produce more of a good
  - Again: **"slope"**, **"relative price of x"**, **"opportunity cost of x"**
  - Amount of y given up to get 1 more x

$$-\frac{p_x}{p_y}$$



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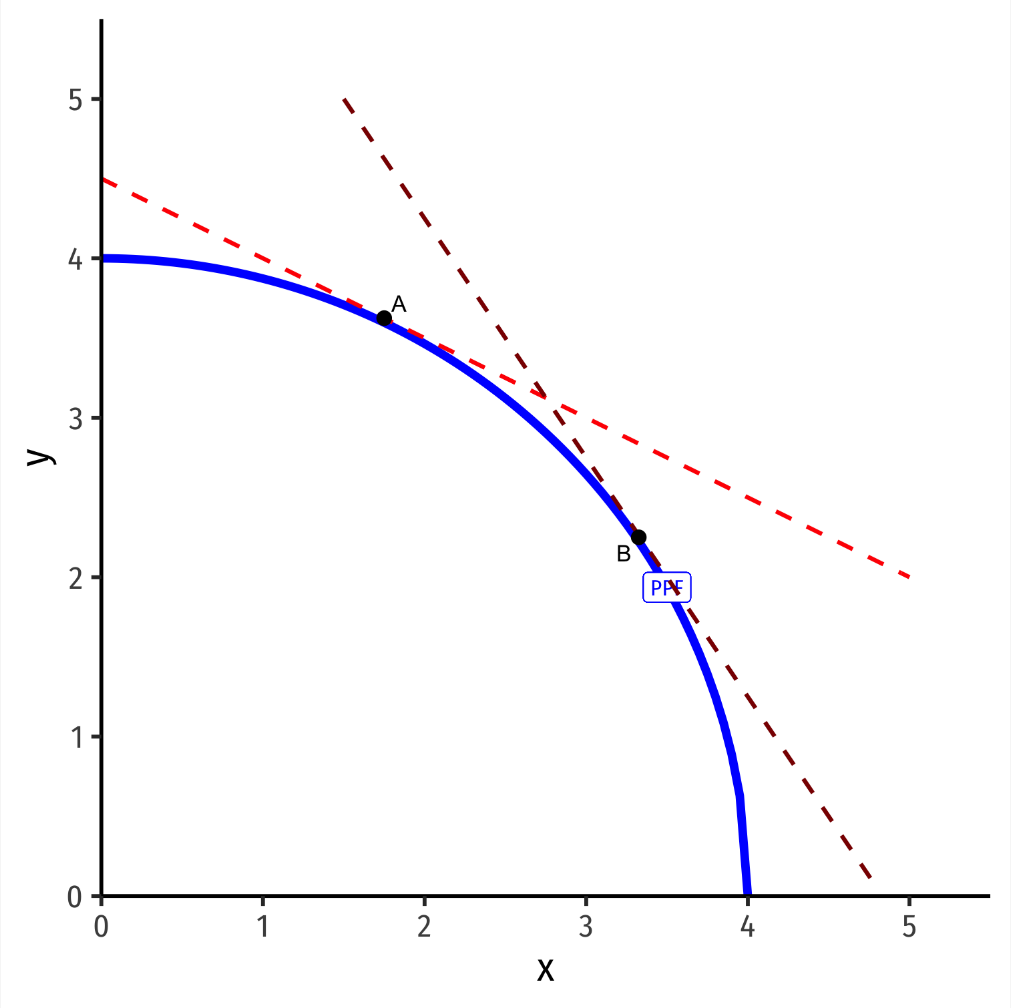

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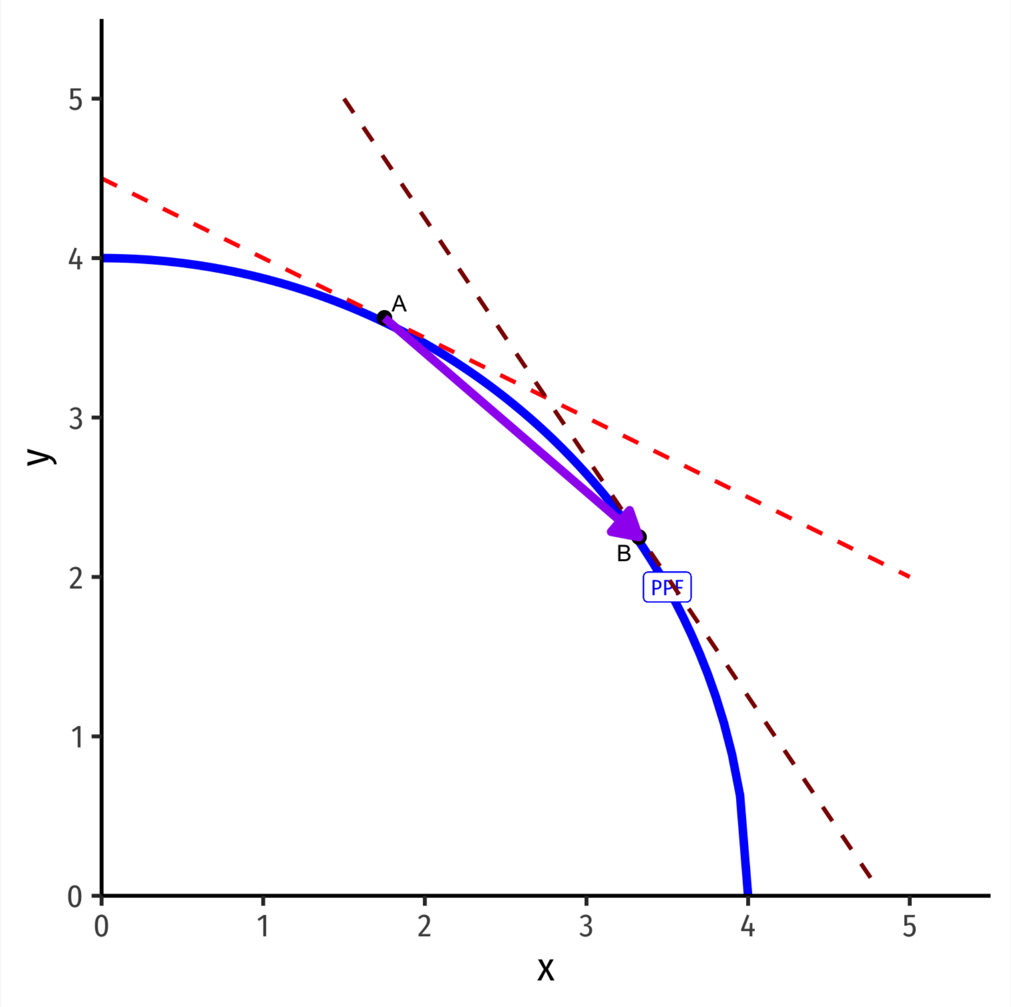

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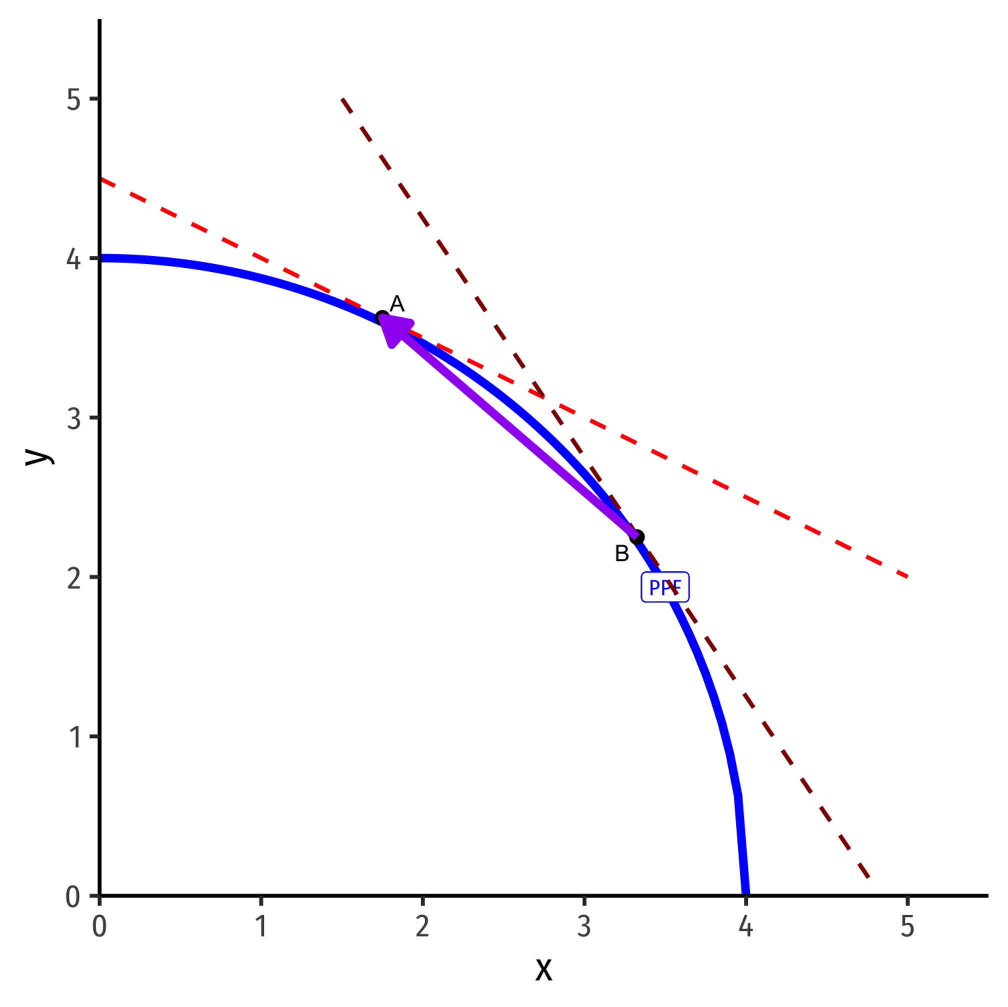
- $A \rightarrow B$ raises opportunity cost of producing x
- $A \leftarrow B$ raises opportunity cost of producing y

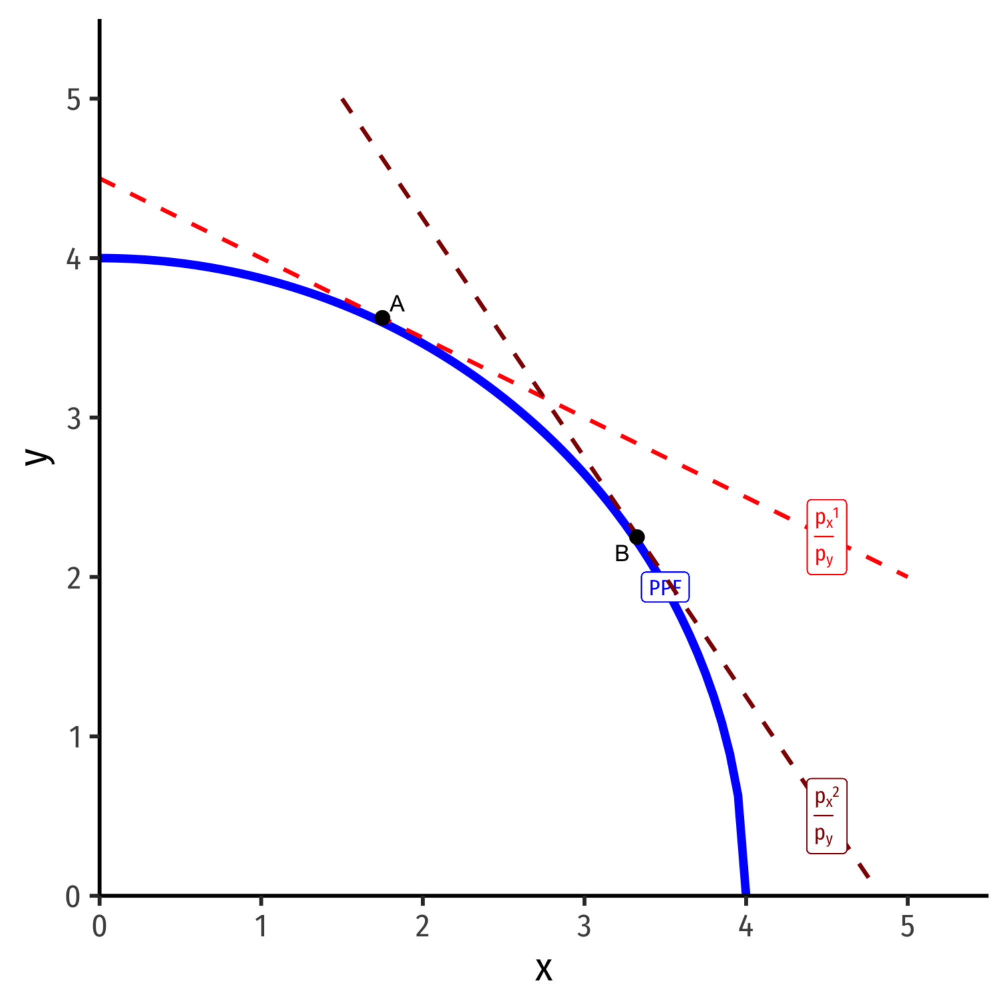


What Causes a Curved PPF?

- Diminishing returns to each factor of production ($\downarrow MP_L, MP_K, MP_T$) (holding others constant)
- Substitution of factors of production and combinations based on relative factor prices
- Moving Left/Right $\implies$ changes in relative prices between x and y

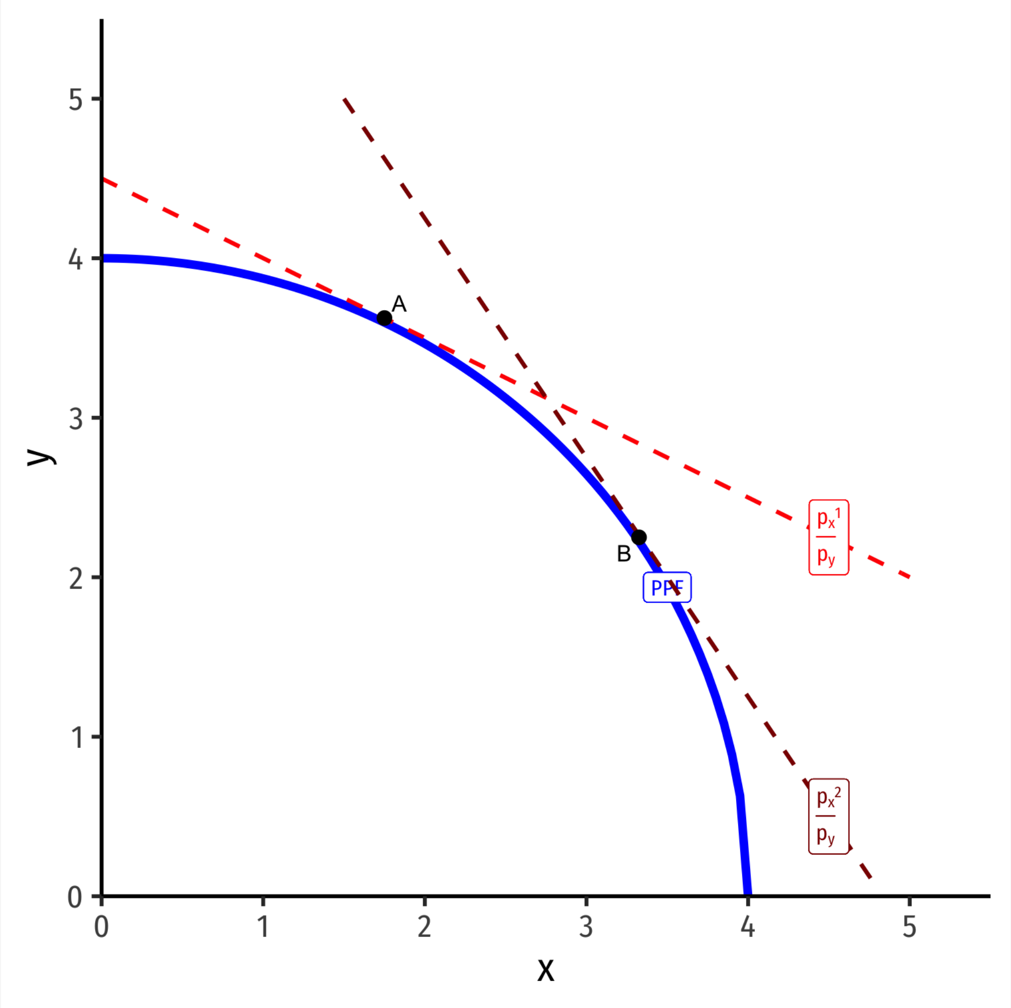
$$\left(\frac{p_x}{p_y}\right)^1 \rightarrow \left(\frac{p_x}{p_y}\right)^2$$

- We dive deeper into these issues in the next model



Optimal Production Choice in Autarky

- A country begins in **autarky** with no international trade
- Where on its PPF should it produce? It should find an **optimum** combination of (x,y)
- Every point on its PPF is determined by relative prices $\frac{p_x}{p_y}$
  - As a curve, each point has a different slope (derivative)



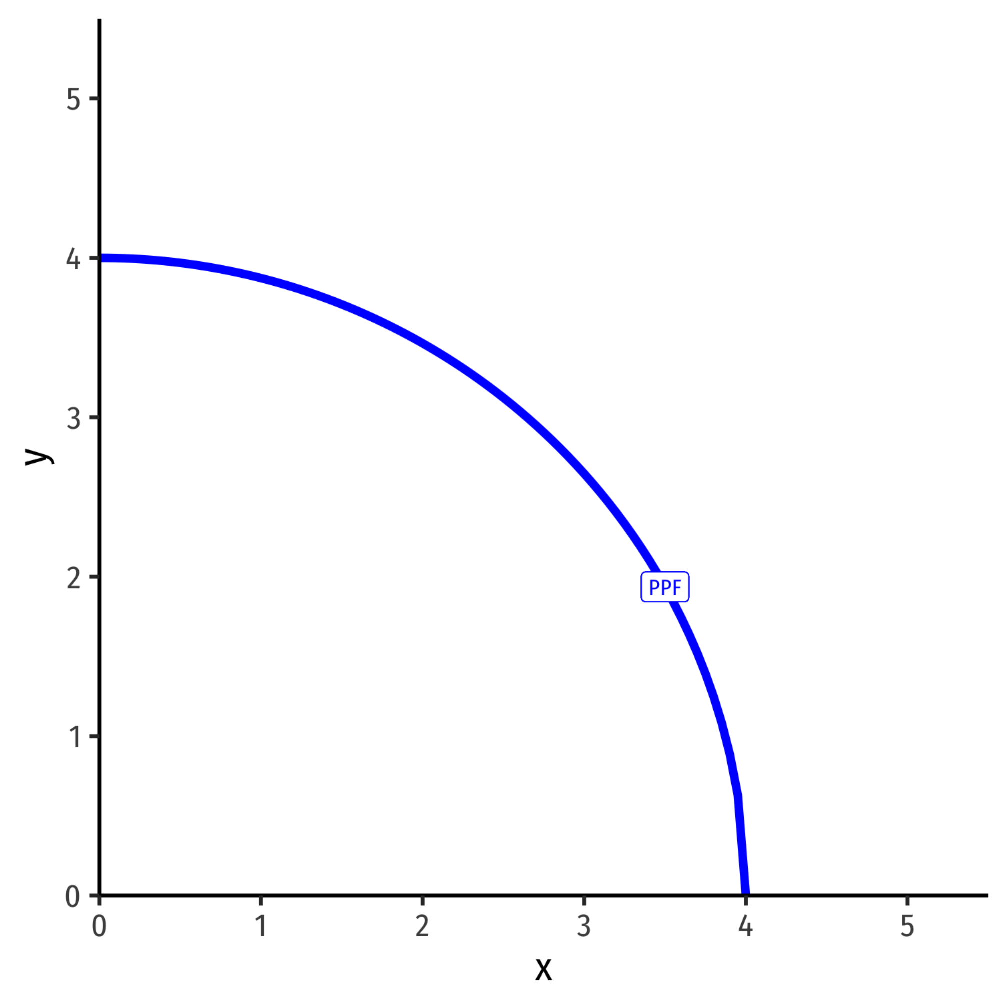
Optimal Production Choice in Autarky

- Assume: country will produce to maximize the market value of its production

1. **Choose:** **< a production & consumption bundle >**

2. **In order to maximize:** **< market value >**

3. **Subject to:** **< technology and market prices >**

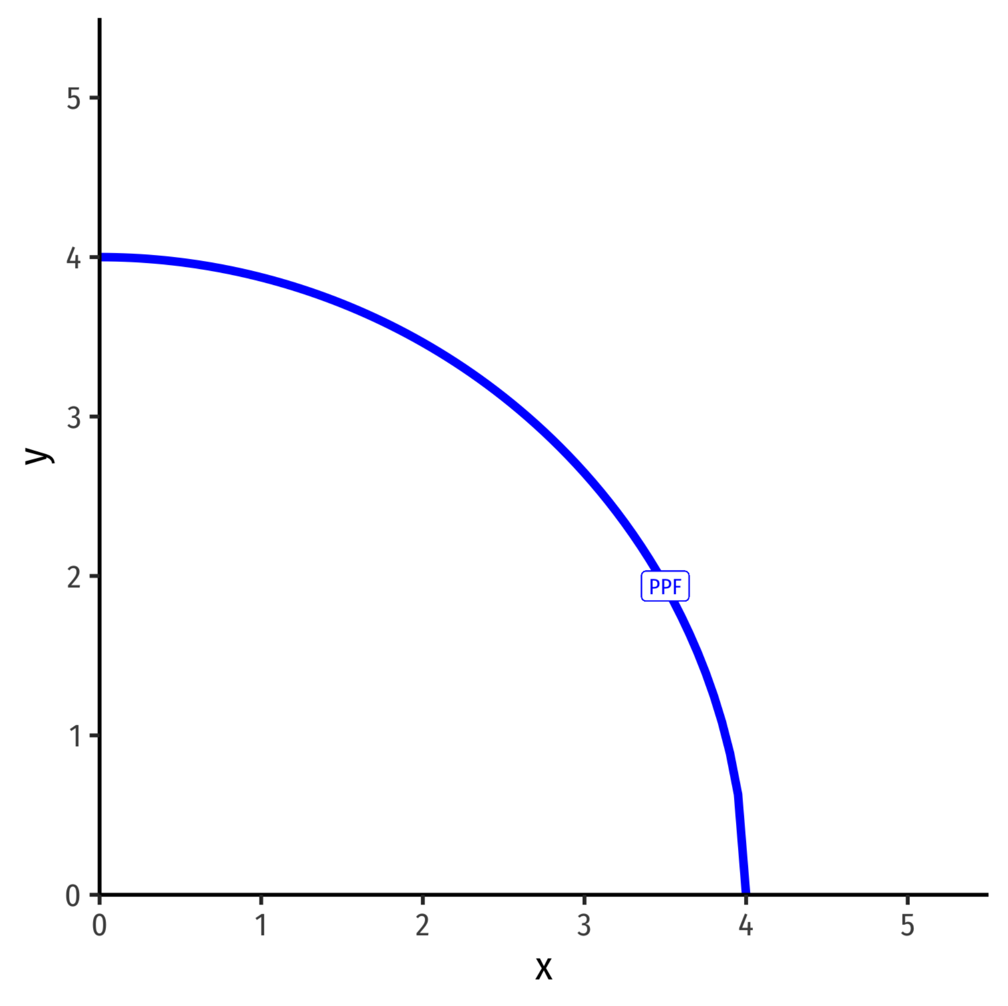


Optimal Production Choice in Autarky

- For some *given* autarky prices, p_x and p_y:

$$p_x x + p_y y = V$$

- Describes the equation of **"isovalue lines"**
  - Each line: set of combinations of x and y worth the same total market value
  - Higher lines $\implies$ higher market value



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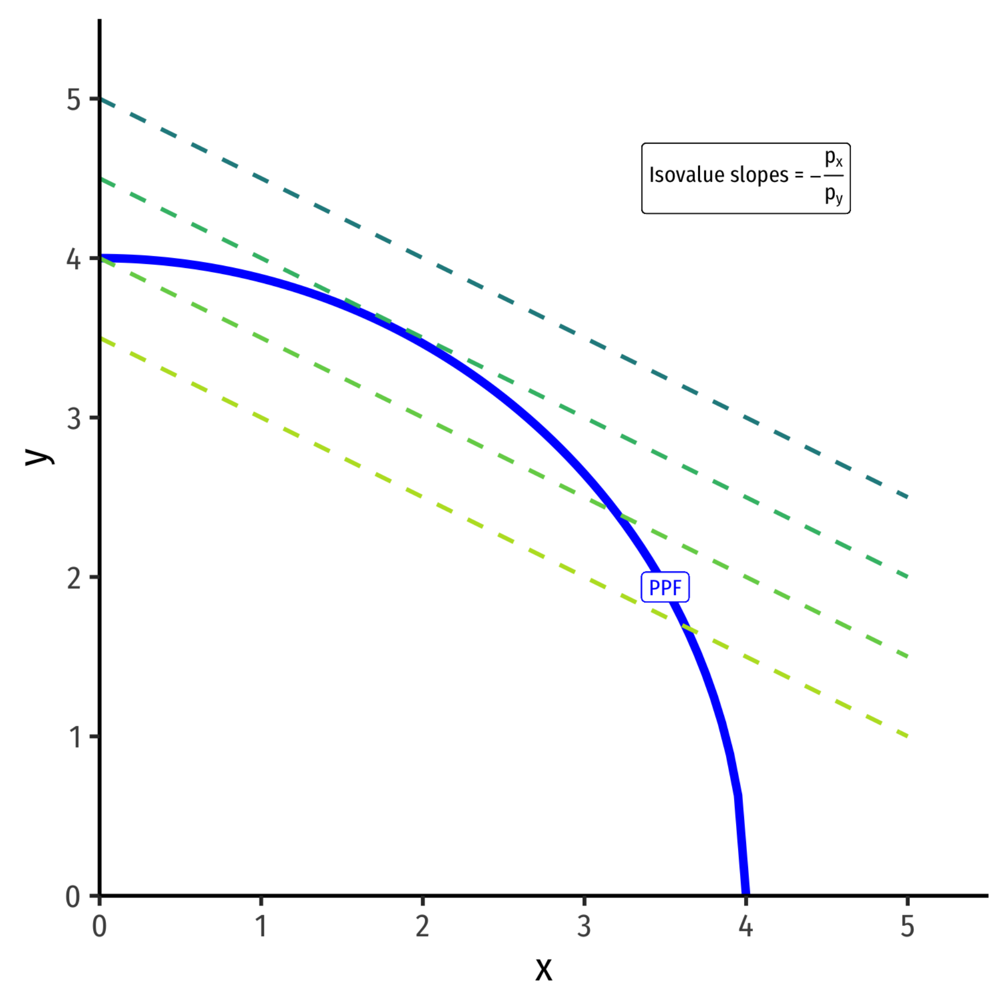
- Describes the equation of **"isovalue lines"**
    - Each line: set of combinations of x and y worth the same total market value
    - Higher lines $\implies$ higher market value
- Solved for y to graph:

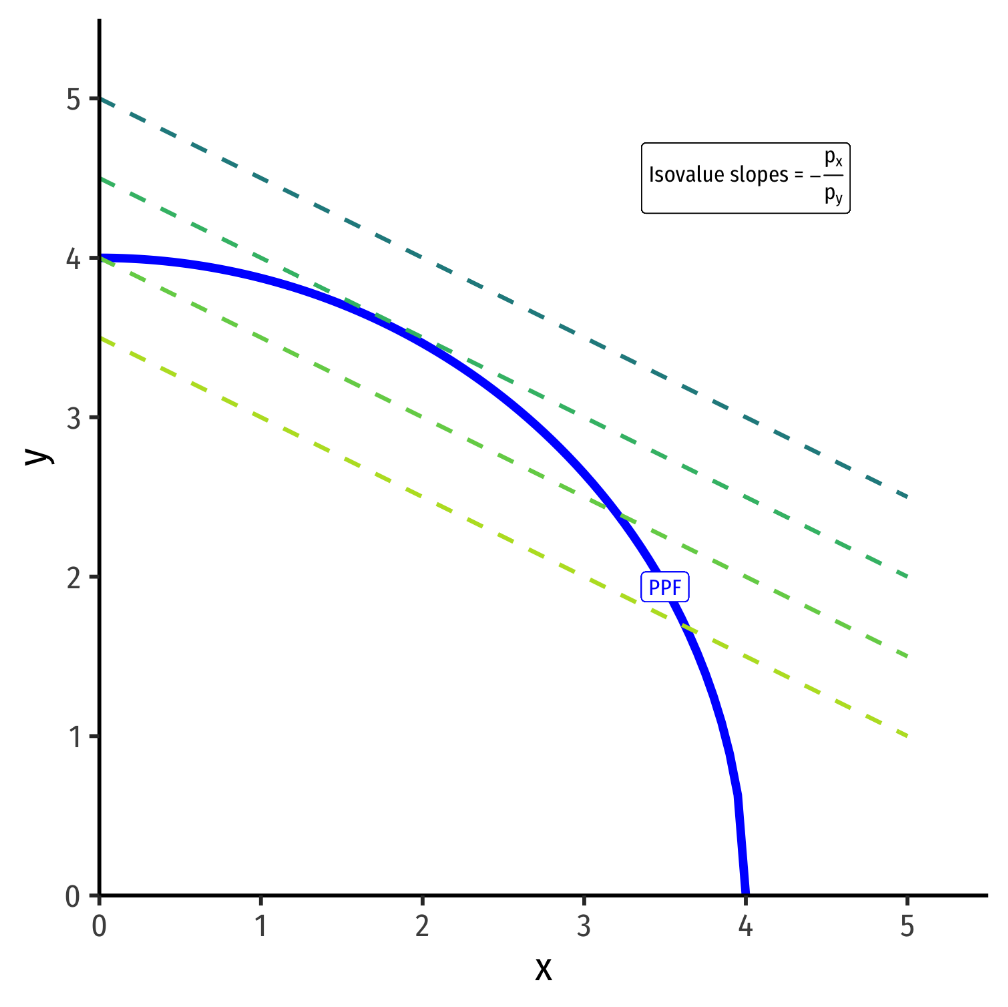
$$y = \frac{V}{p_y} - \frac{p_x}{p_y} x$$



Optimal Production Choice in Autarky

$$y = \frac{V}{p_y} - \frac{p_x}{p_y}x$$

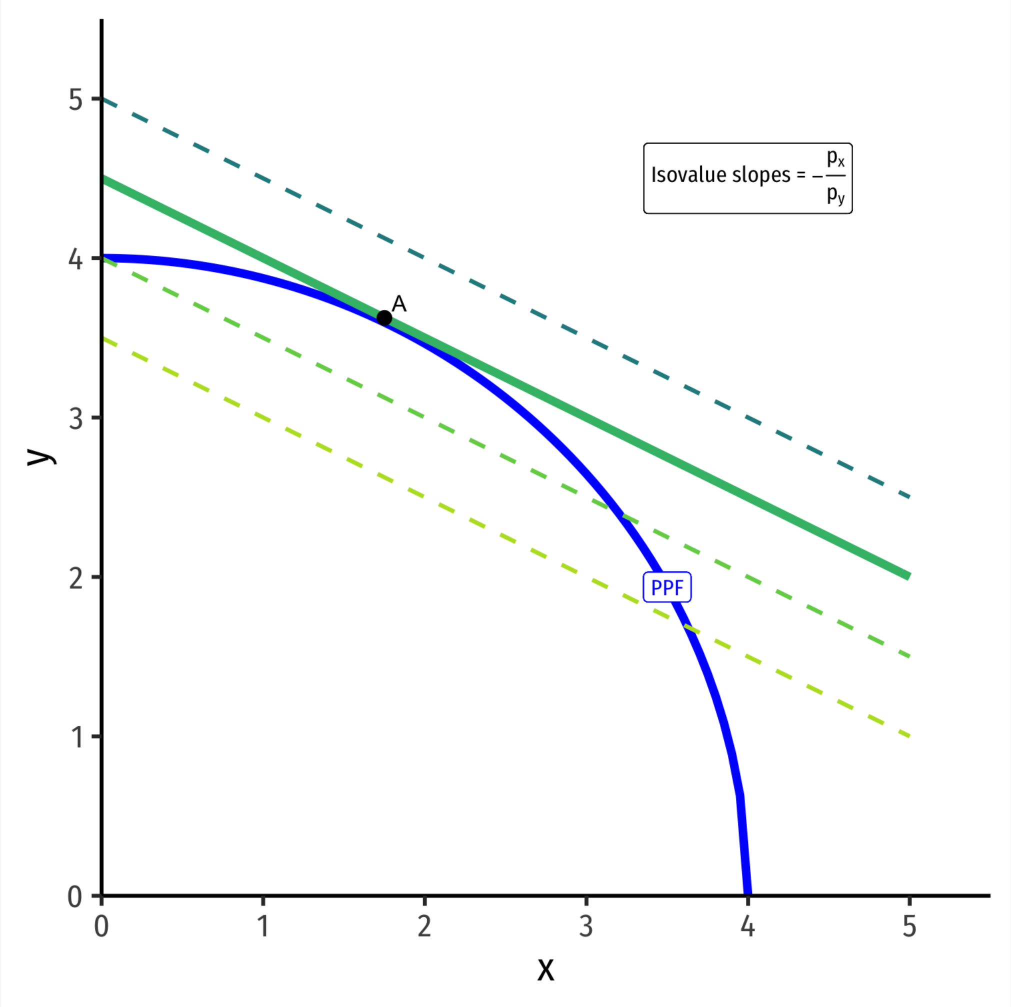
- Again, **slope** is the **relative price of x**



Optimal Production Choice in Autarky

$$y = \frac{V}{p_y} - \frac{p_x}{p_y}x$$

- Again, **slope** is the **relative price of x**
- Given p_x and p_y, pick the point on PPF **tangent** to **highest** line
- **Point A**: maximized market value of output under current constraints



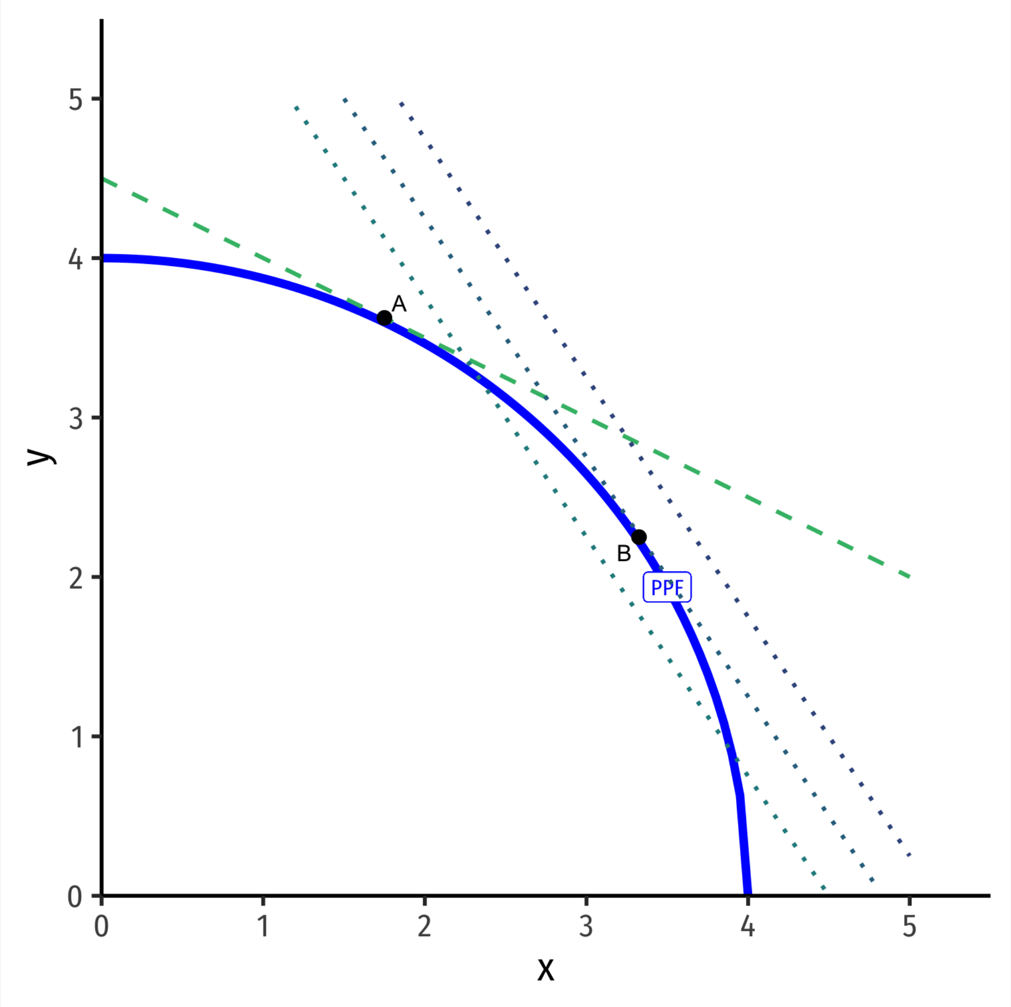
Isovalue Lines depend on Relative Prices in Autarky

$$y = \frac{V}{p_y} - \frac{p_x}{p_y}x$$

- If relative prices were to **change** (in autarky)

$$\left(\frac{p_x}{p_y}\right)^1 \rightarrow \left(\frac{p_x}{p_y}\right)^2$$

there would be a new set of isovalue lines with a **different slope**.



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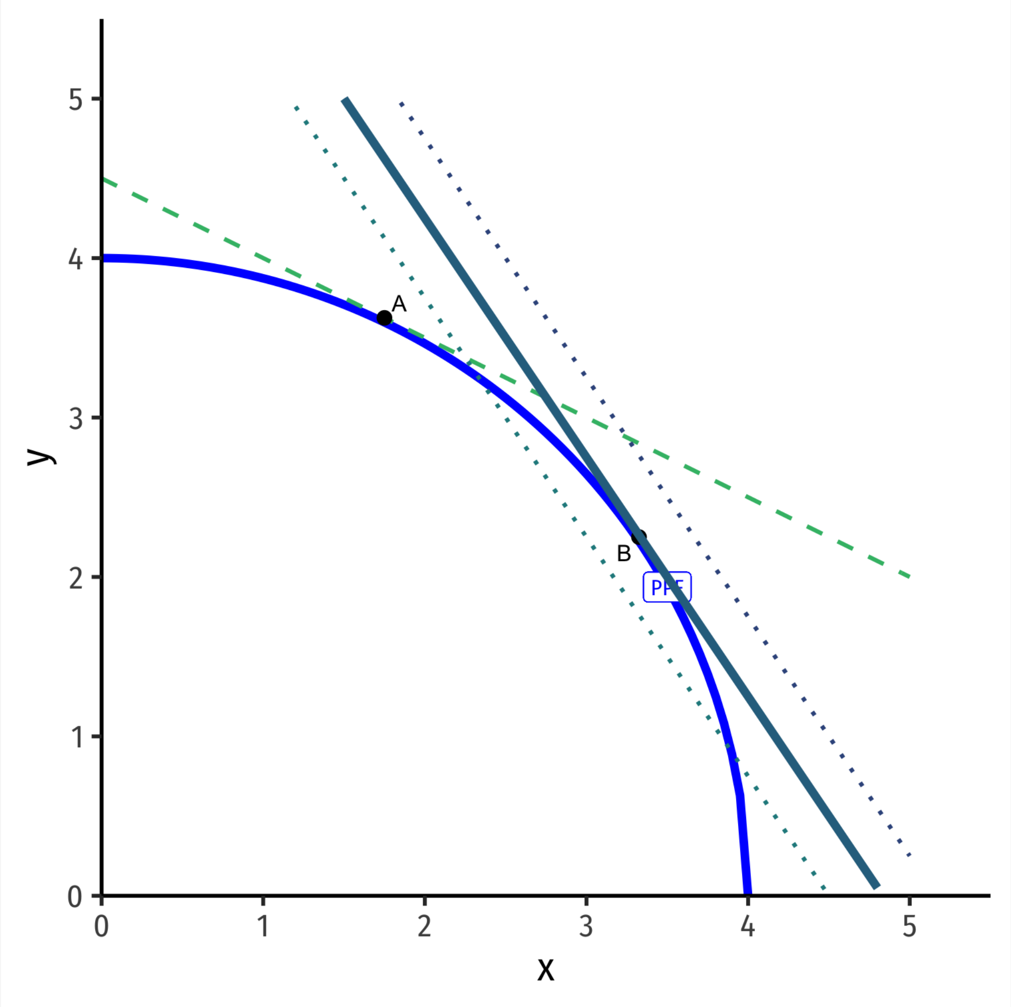
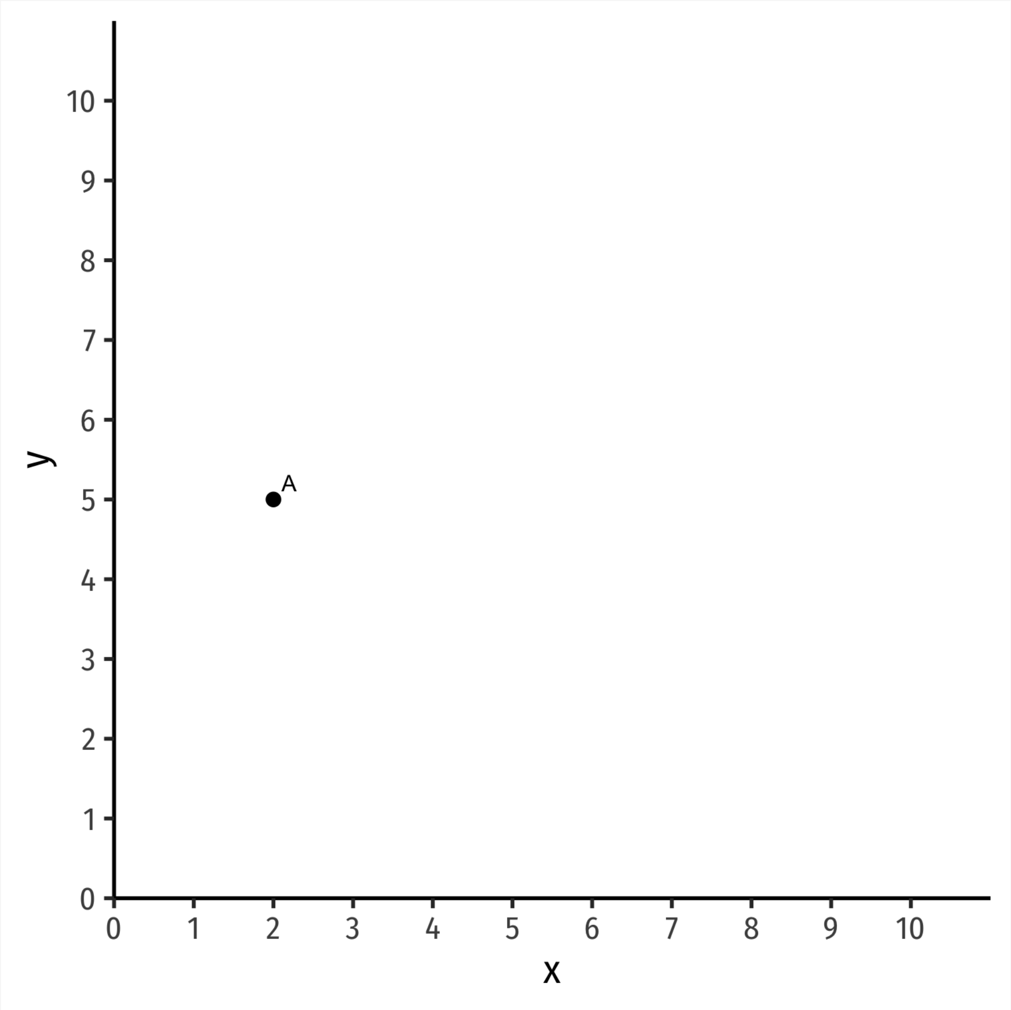
- Optimum in autarky would be different point tangent to highest isovalue line of new slope: **Point B**



Indifference Curves

Indifference Curves

- Consider a bundle of goods x and y: A = (2,5)

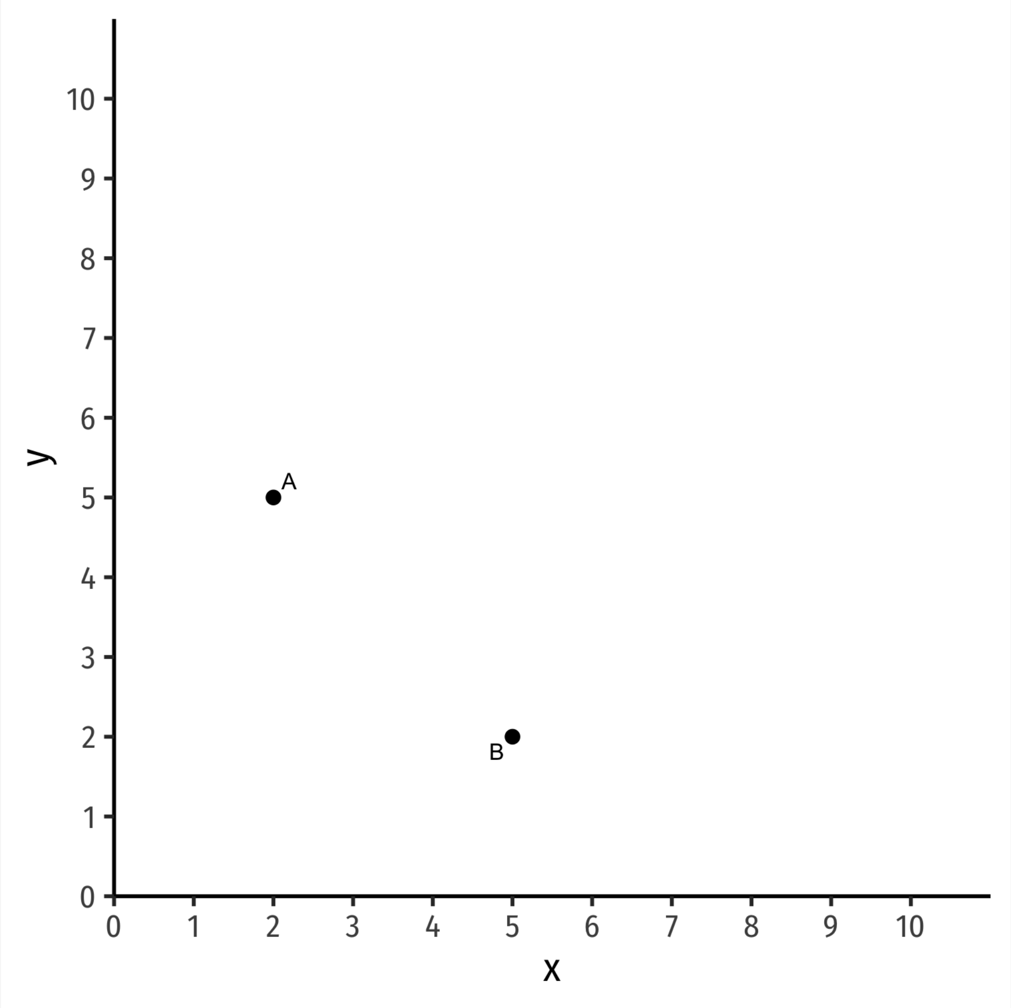


Indifference Curves

- Consider a bundle of goods x and y: A = (2,5)

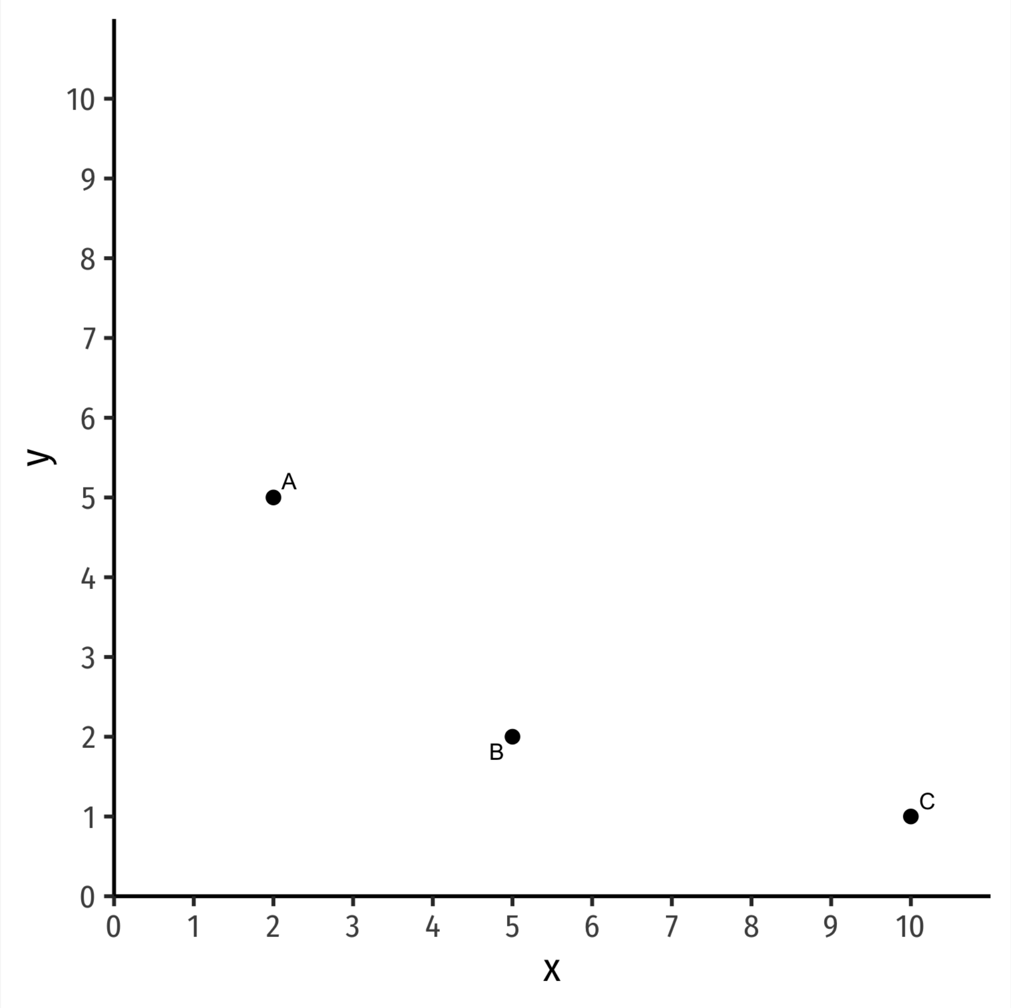
- Consider another bundle: B = (5,2)

  - More x but less y



Indifference Curves

- Consider a bundle of goods x and y: A = (2,5)
- Consider another bundle: B = (5,2)
  - More x but less y
- Consider a third bundle: C = (10,1)
  - Even more x but even less y



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- Consider a bundle of goods x and y: A = (2,5)

- Consider another bundle: B = (5,2)

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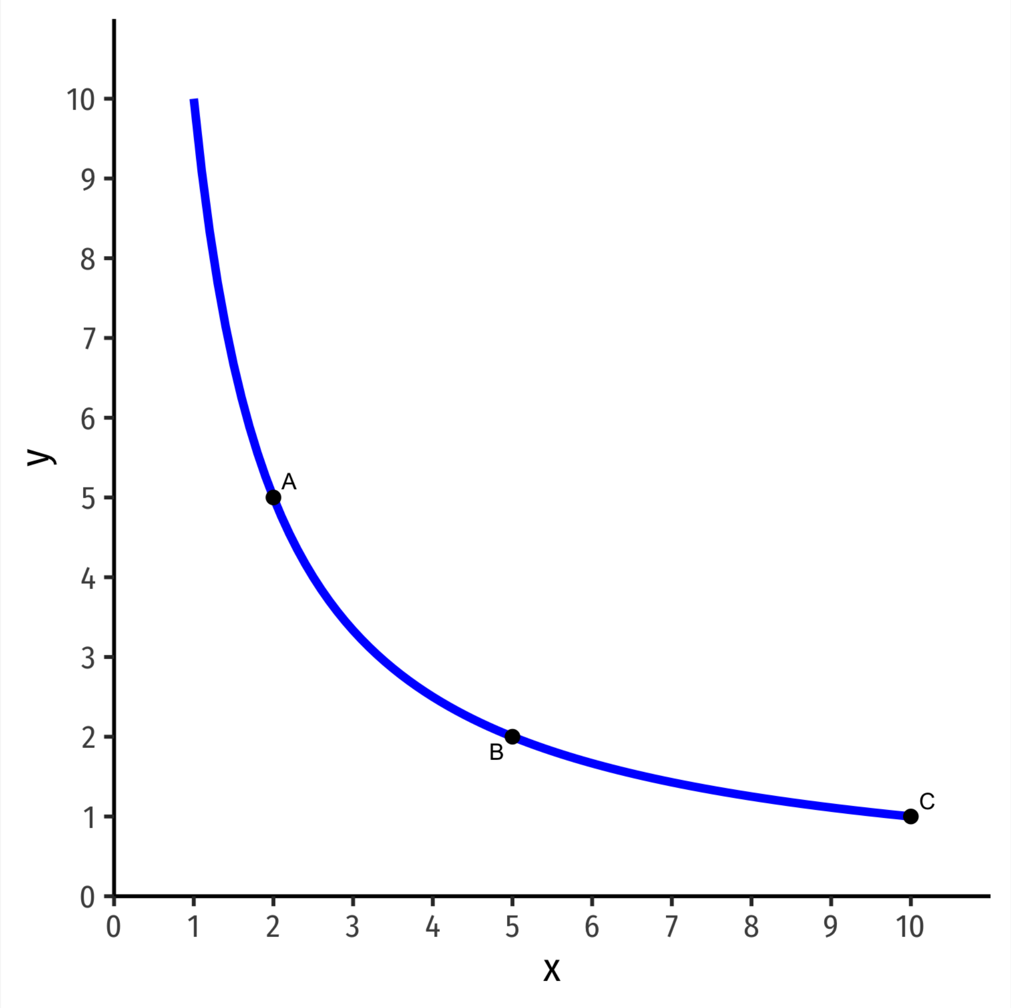
- Consider a third bundle: C = (10,1)

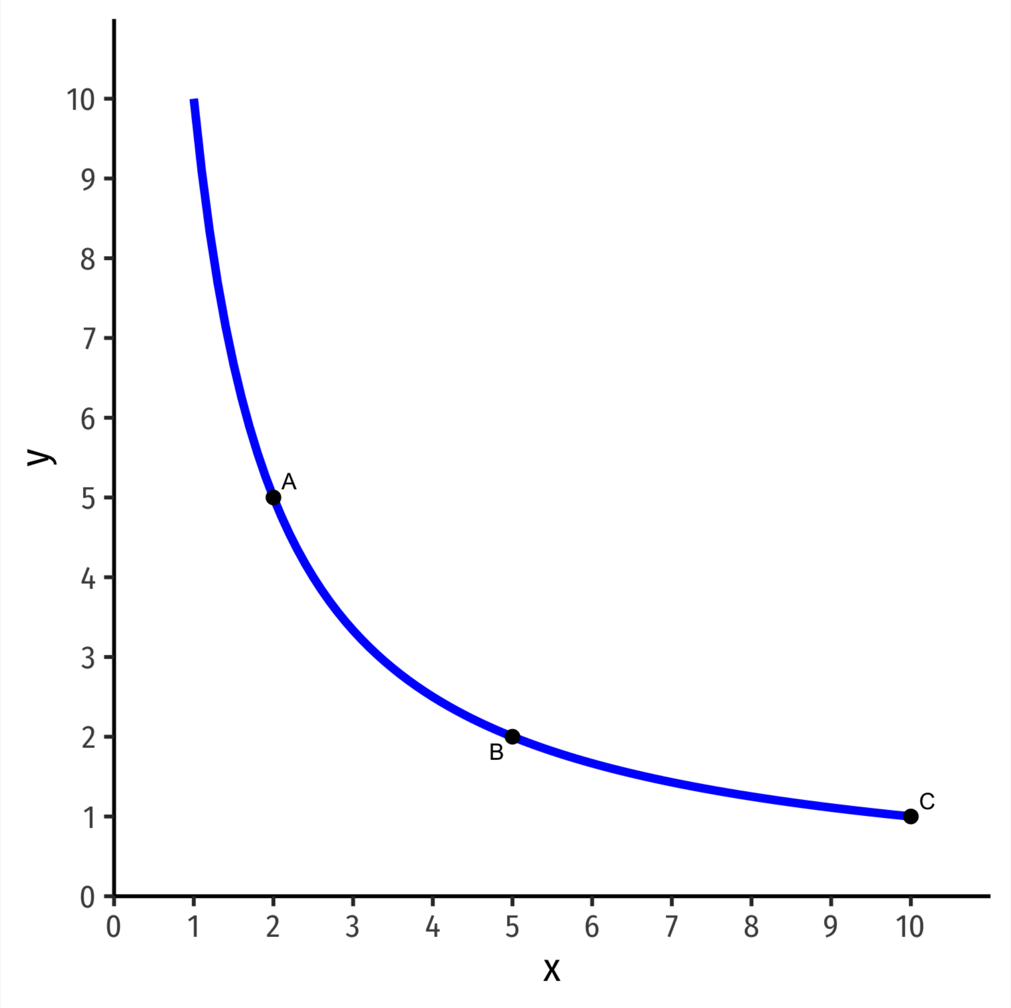
  - Even more x but even less y

- Suppose you are indifferent between $A \sim B \sim C$: these bundles are on the same **indifference curve**



Indifference Curves

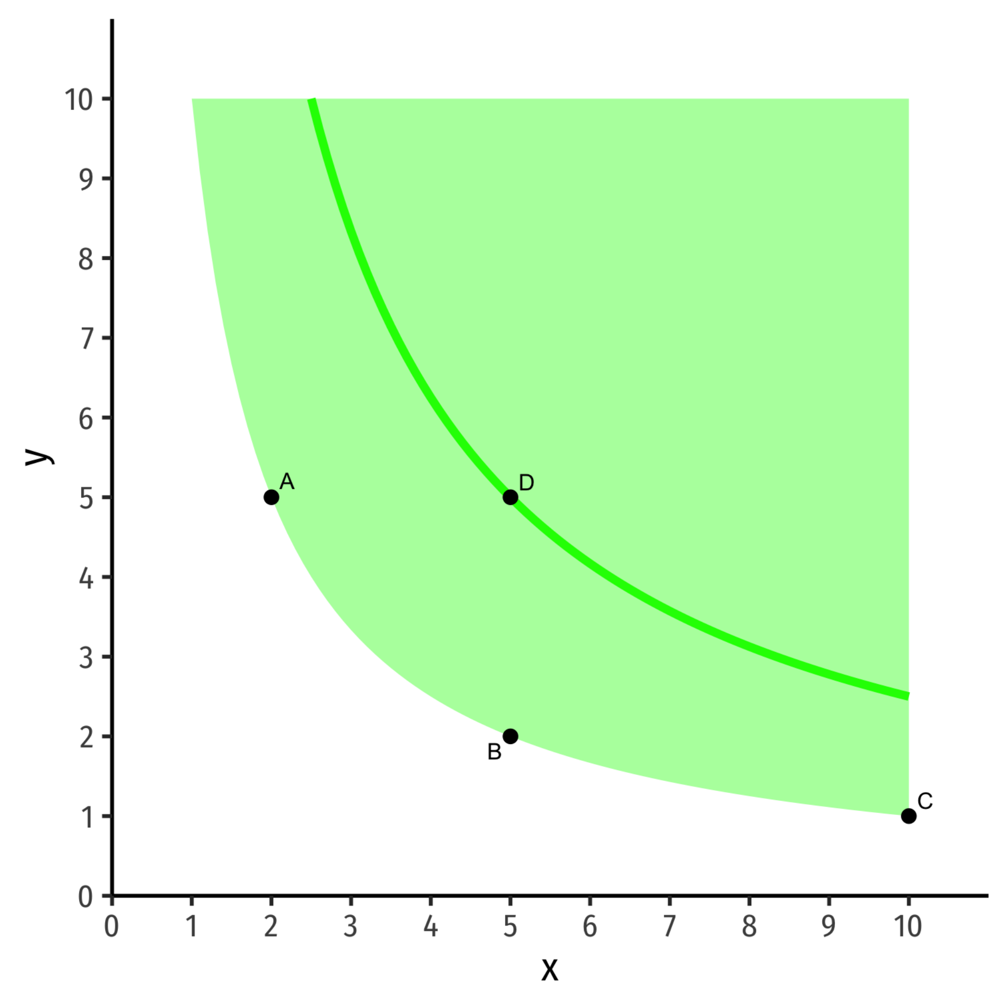
- Country is **indifferent** between all bundles on the same indifference curve



Indifference Curves

- Country is **indifferent** between all bundles on the same indifference curve

- Bundles *above* curve are **preferred over** bundles on curve
  - $D \succ A \sim B \sim C$
  - On a **higher curve**



Indifference Curves

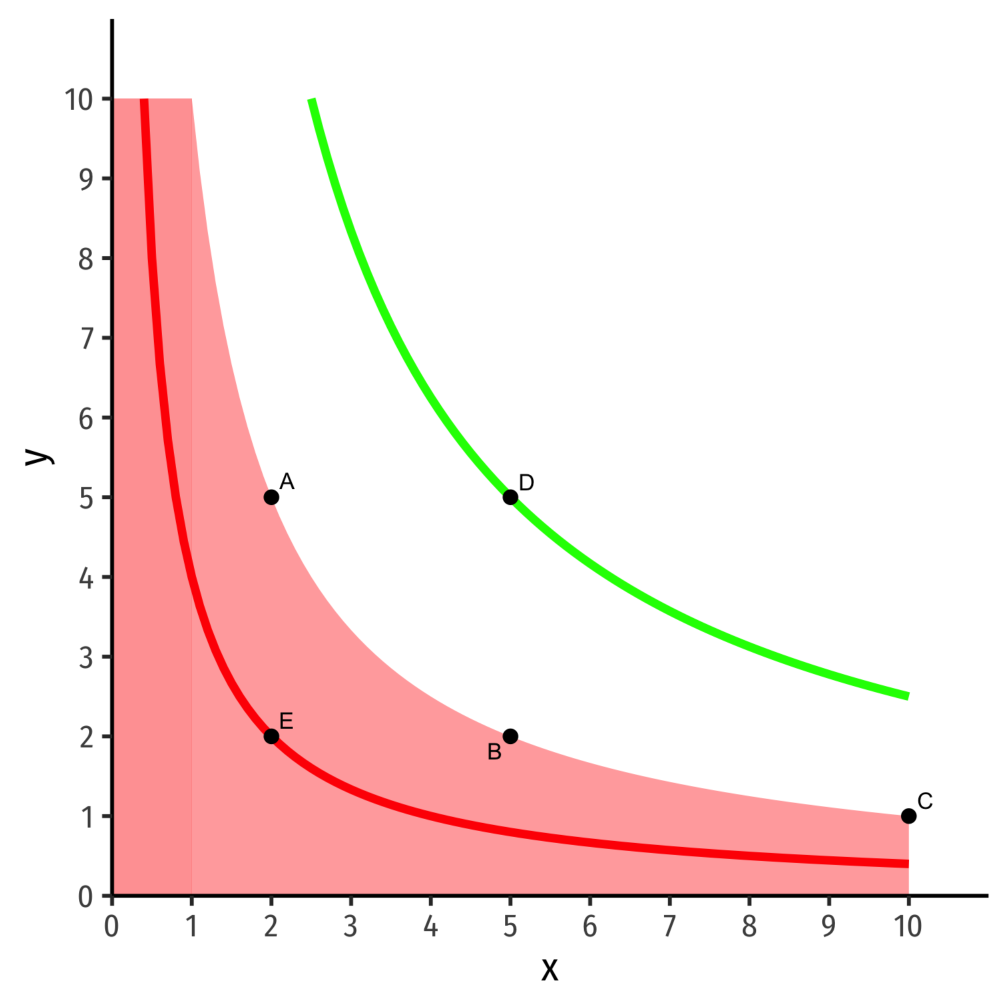
- Country is **indifferent** between all bundles on the same indifference curve

- Bundles *above* curve are **preferred over** bundles on curve

  - $D \succ A \sim B \sim C$
  - On a **higher curve**

- Bundles **below** curve are **less preferred** than bundles on curve

  - $E \prec A \sim B \sim C$
  - On a **lower curve**



Marginal Rate of Substitution

- To aquire 1 more unit of x, how many units of y are you willing to give up to remain indifferent?

Marginal Rate of Substitution I

- To aquire 1 more unit of x, how many units of y are you willing to give up to remain indifferent?

- Marginal Rate of Substitution (MRS): rate at which you trade off one good for the other and remain *indifferent*

- Again: **opportunity cost**: # of units of y you need to give up to acquire 1 more x

MRS vs. Other Slopes

- Isovalue lines (slope) & MRT (PPF slope) measured the **production** tradeoff between x and y based on market prices

- **MRS** measures **consumption** tradeoff between x vs. y based on preferences

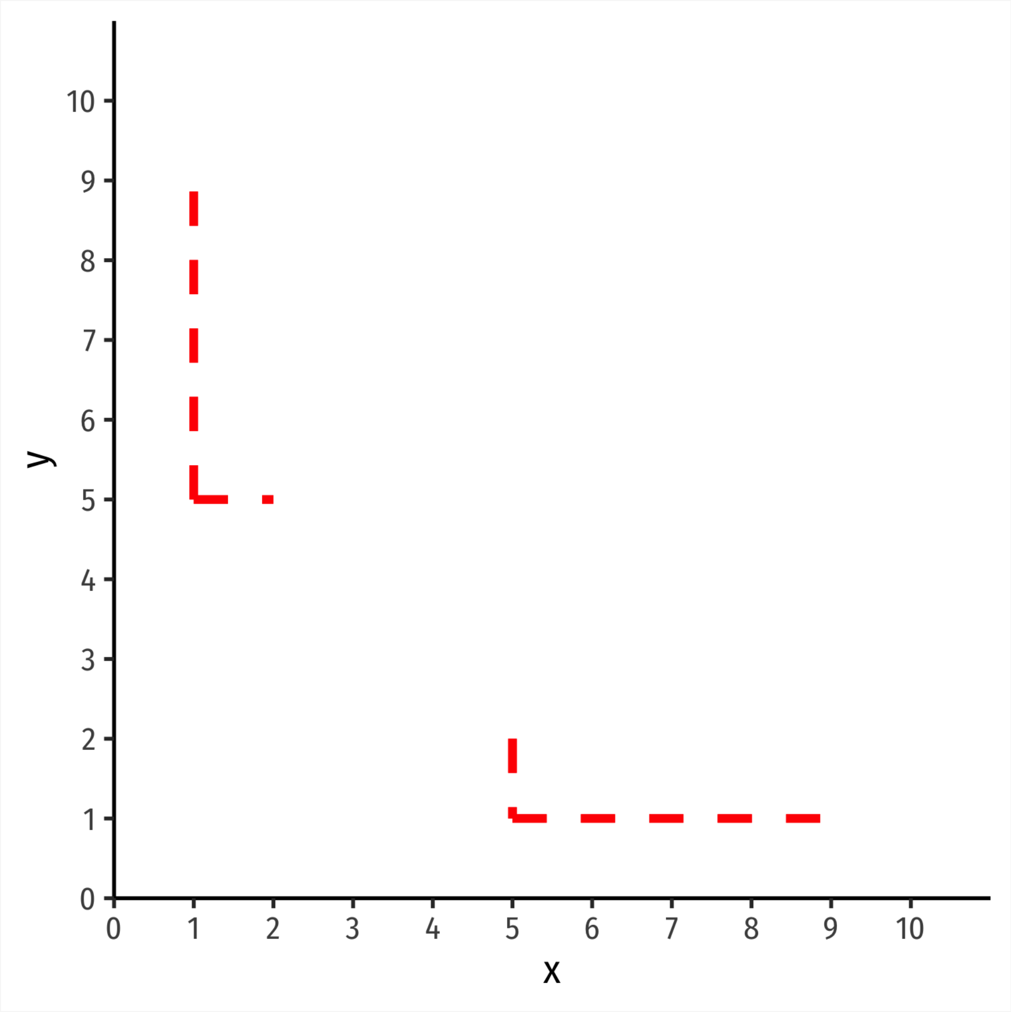
Marginal Rate of Substitution

- MRS is the slope of the indifference curve

$$MRS_{x,y} = -\frac{\Delta y}{\Delta x} = \frac{rise}{run}$$

- Amount of y given up for 1 more x

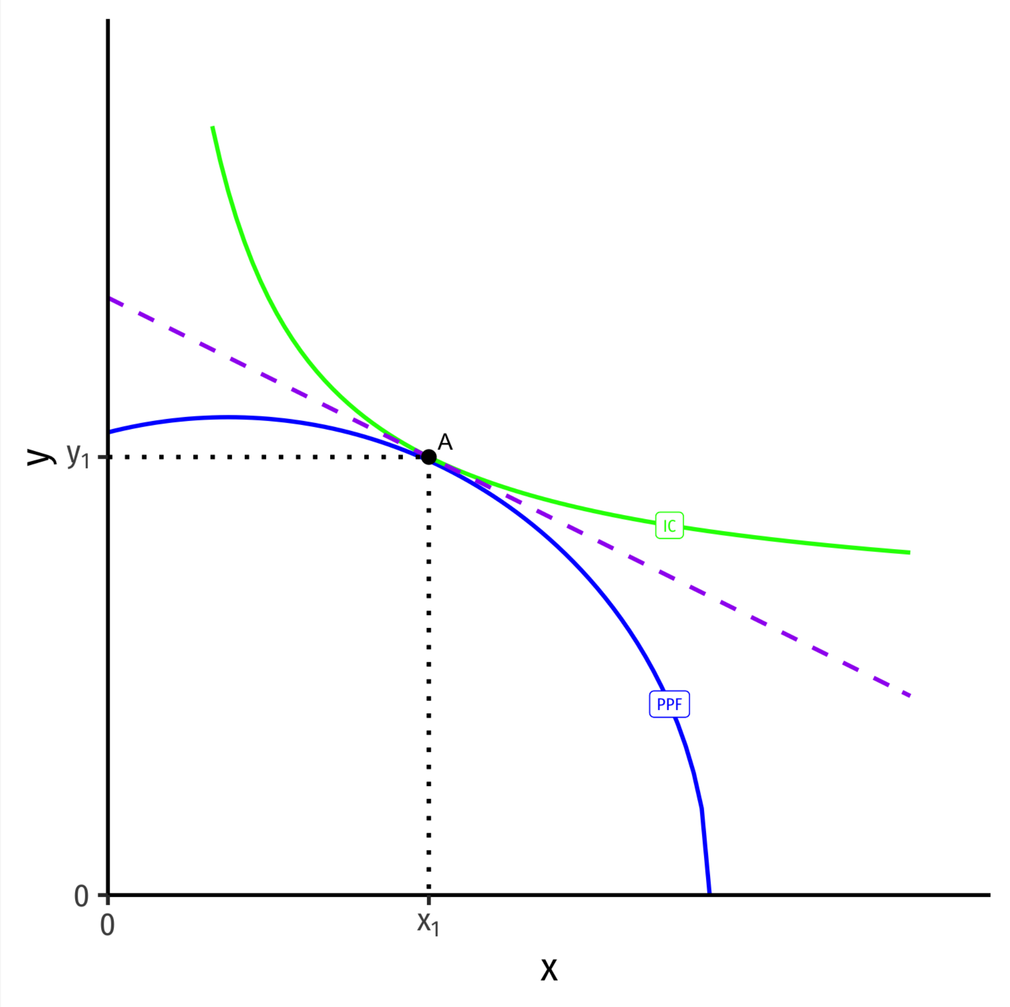
- Note: slope (MRS) changes along the curve!



Autarky Optimum

Home's Autarky Optimum

- Home produces and consumes at highest indifference curve tangent to its PPF



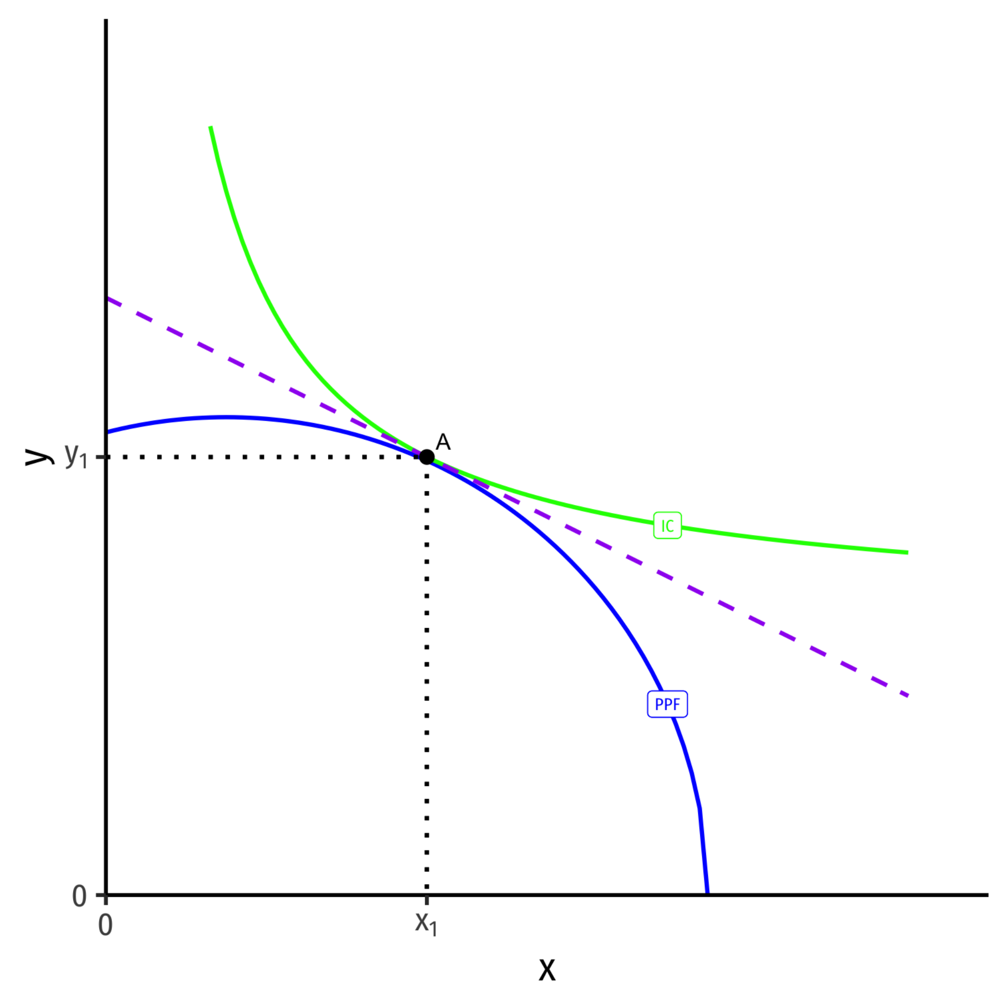
Home's Autarky Optimum

- Home produces and consumes at highest indifference curve tangent to its PPF

- At Home's autarky optimum:

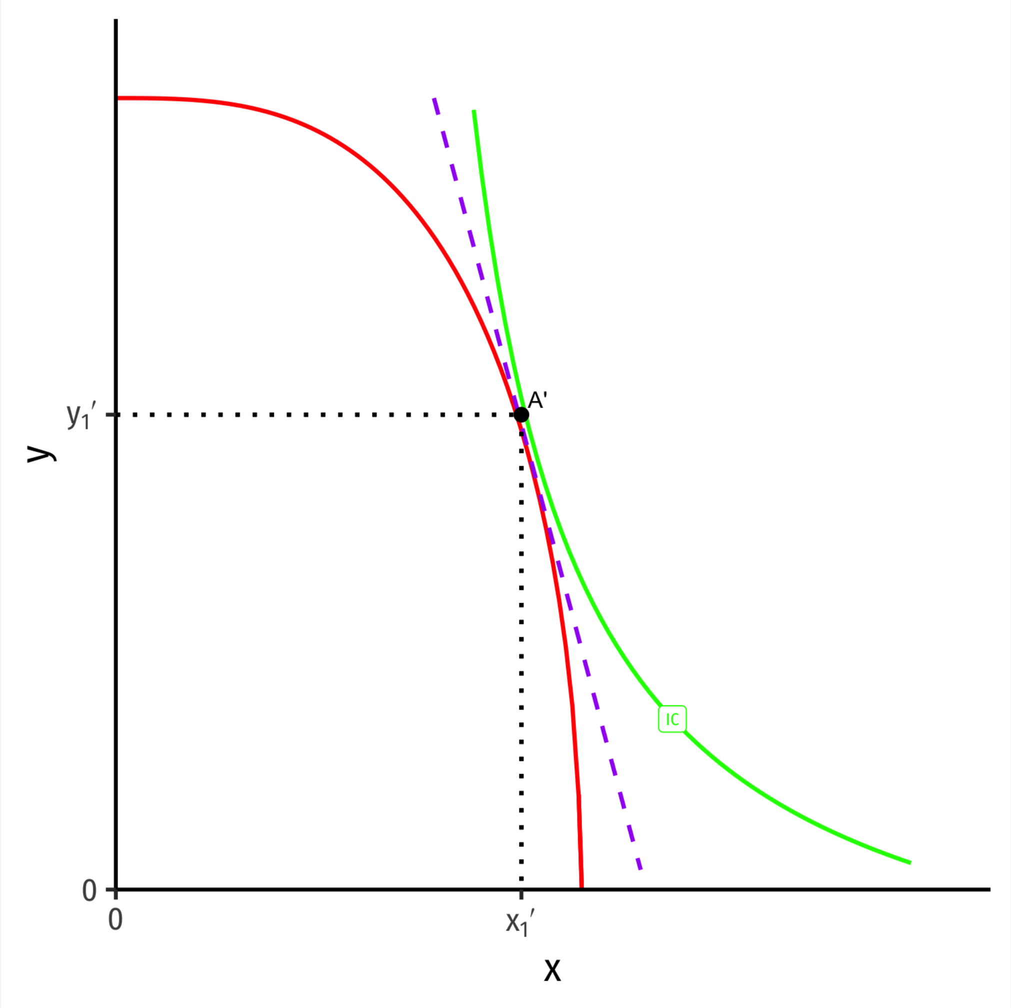
$$\underbrace{MRT}_{\text{PPF Slope}} = \underbrace{MRS}_{\text{I.C. Slope}} = \underbrace{\left(\frac{p_x}{p_y}\right)}_{\text{price line}}$$

- This is Home's **relative price in autarky**: the relative price (of x) where nation is maximizing its welfare in autarky



Foreign's Autarky Equilibrium

- Foreign (with different PPF) also produces and consumes at highest indifference curve tangent to its PPF



Foreign's Autarky Equilibrium

- Foreign (with different PPF) also produces and consumes at highest indifference curve tangent to its PPF

- At Foreign's autarky optimum:

$$\underbrace{MRT'}_{\text{PPF Slope}} = \underbrace{MRS'}_{\text{I.C. Slope}} = \underbrace{\left(\frac{p_x}{p_y}\right)'}_{\text{price line}}$$

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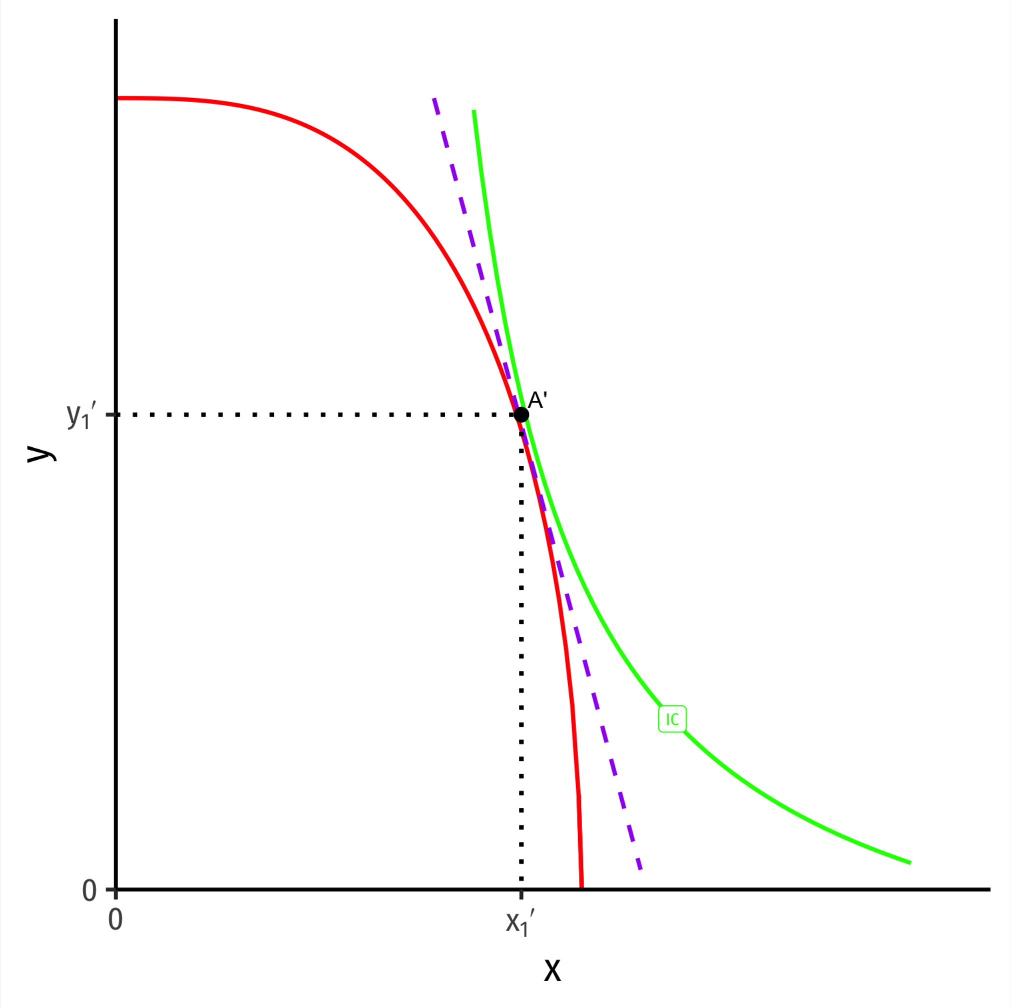
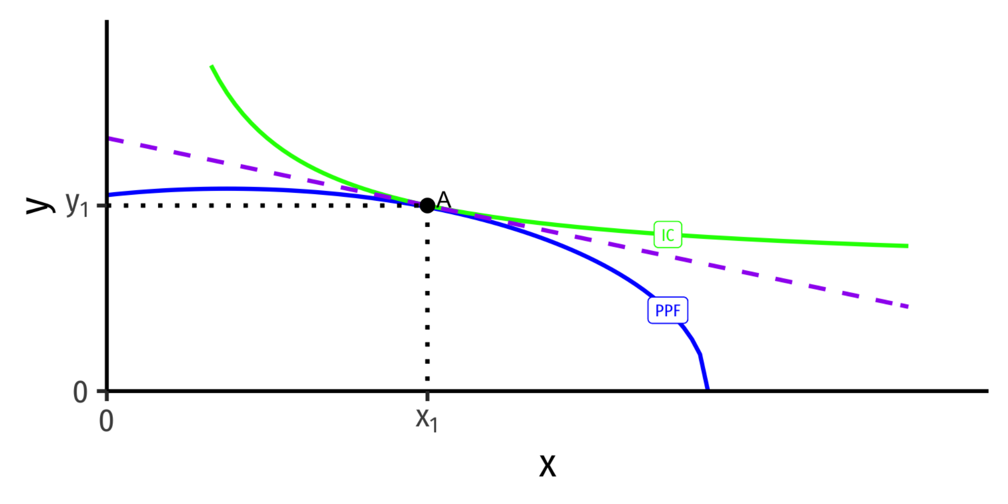
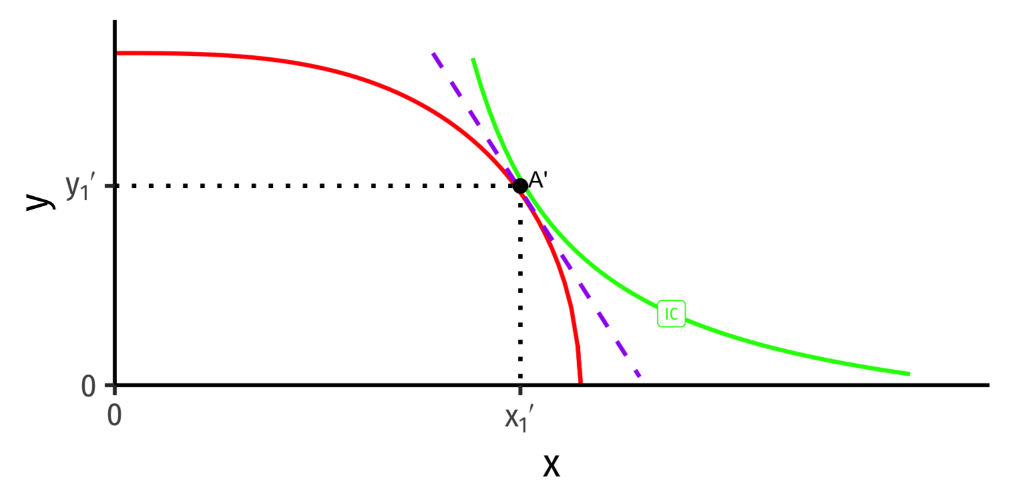


Relative Prices in Autarky Equilibrium

Home



Foreign



- Home and Foreign have **different relative prices in autarky**

Relative Prices in Autarky Equilibrium

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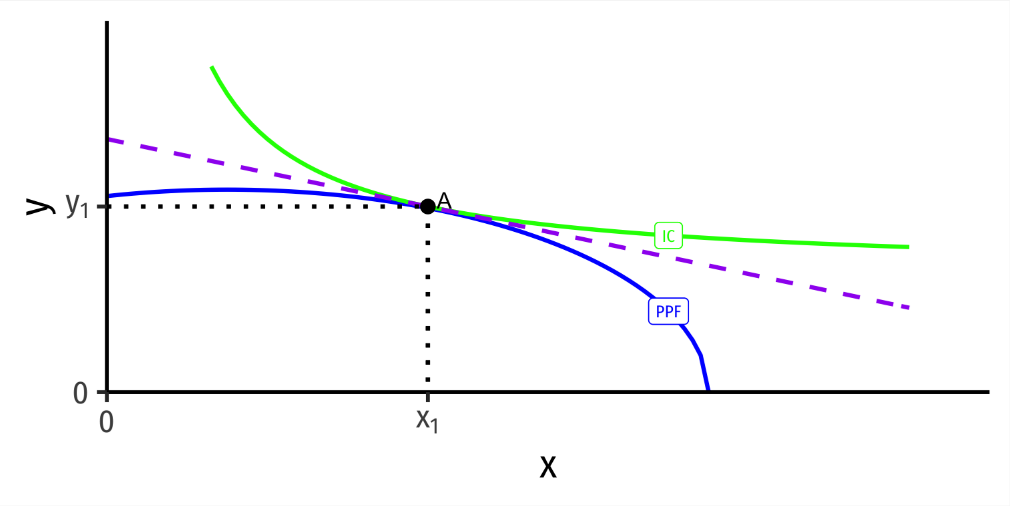
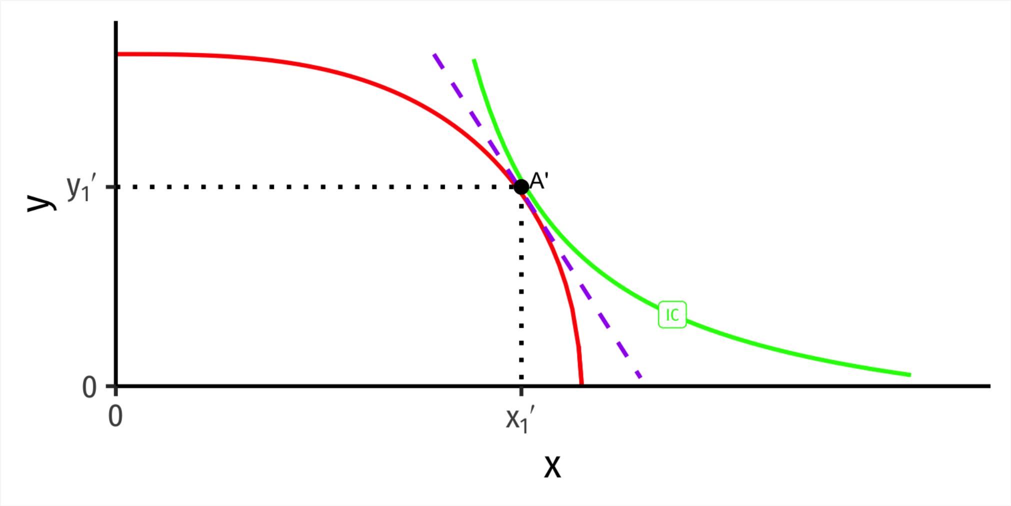


Foreign

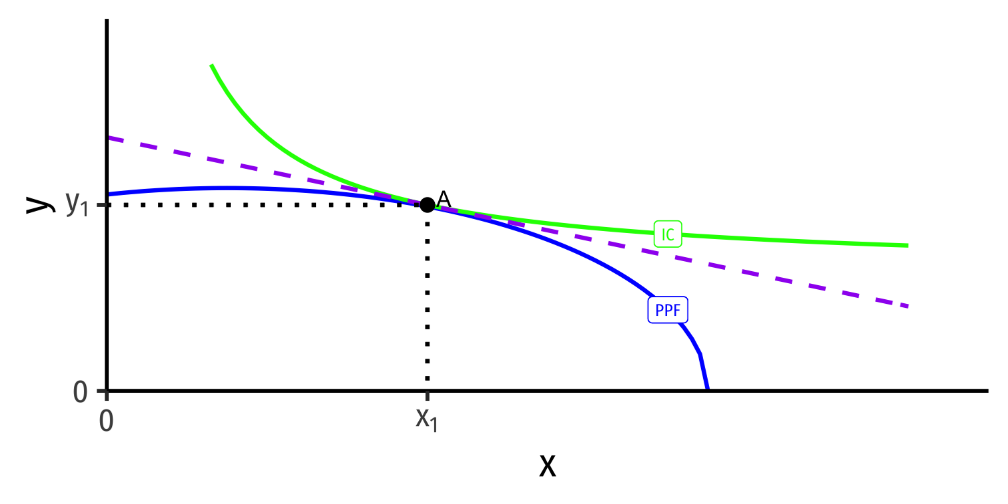


- Home and Foreign have **different relative prices in autarky**
- Relative price of x (slope of PPF) is lower (flatter) in Home than Foreign

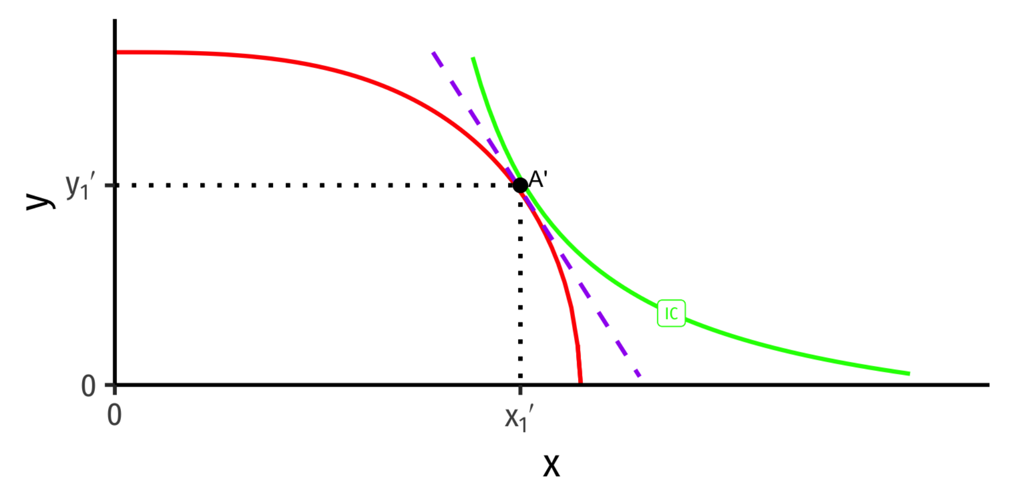
$$\left(\frac{p_x}{p_y}\right) < \left(\frac{p_x}{p_y}\right)'$$

Comparative Advantage

Home



Foreign



- Home has a comparative advantage in x; will export x
- Foreign has a comparative advantage in y; will export y

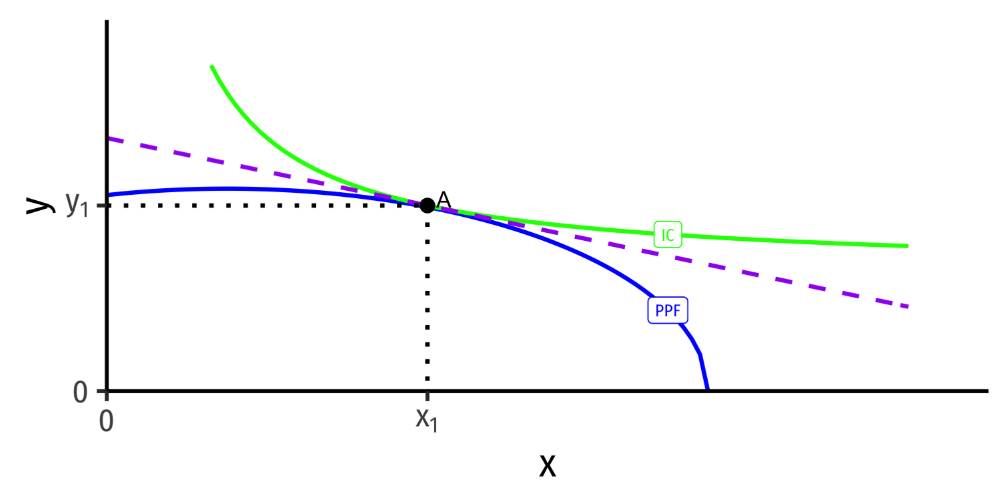
Recall from Ricardian Model: Price Adjustments

- Home exports x $\implies$ *less* x sold in Home $\implies$ $\uparrow p_x$ in Home
- As x arrives in Foreign $\implies$ *more* x sold in Foreign $\implies$ $\downarrow p_x$ in Foreign
- Foreign exports y $\implies$ *less* y sold in Foreign $\implies$ $\uparrow p_y$ in Foreign
- As y arrives in Home $\implies$ *more* y sold in Home $\implies$ $\downarrow p_y$ in Home

Global Market for x

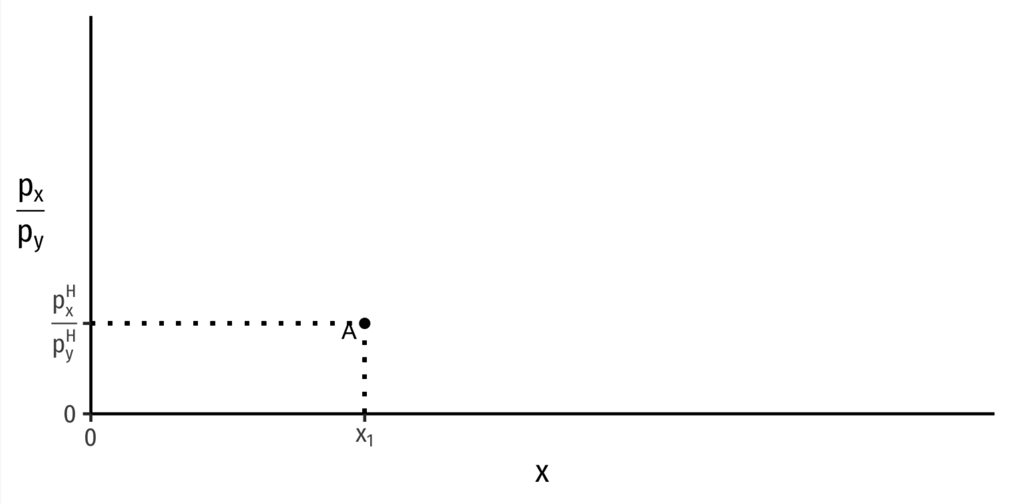
Global Market for x: Home

Home



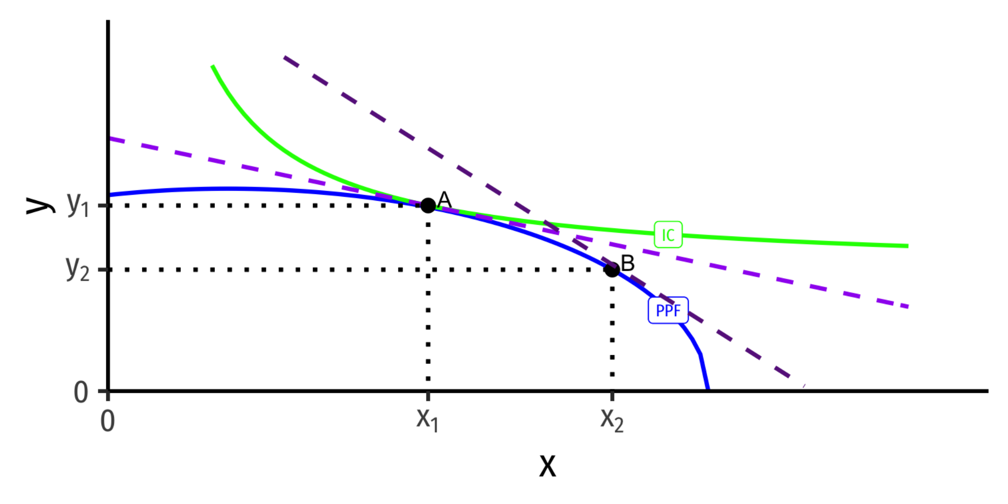
- Home is exporting x

Home's Supply of x

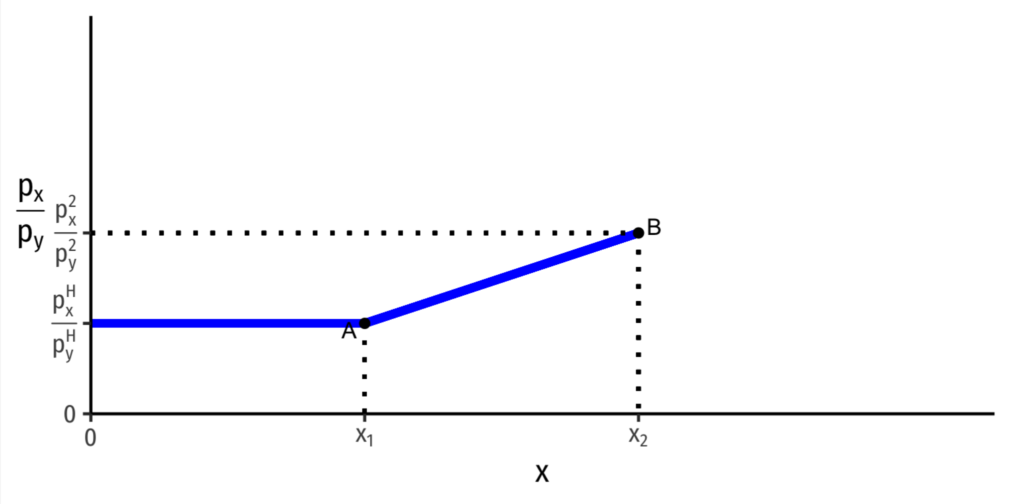


Global Market for x: Home

Home



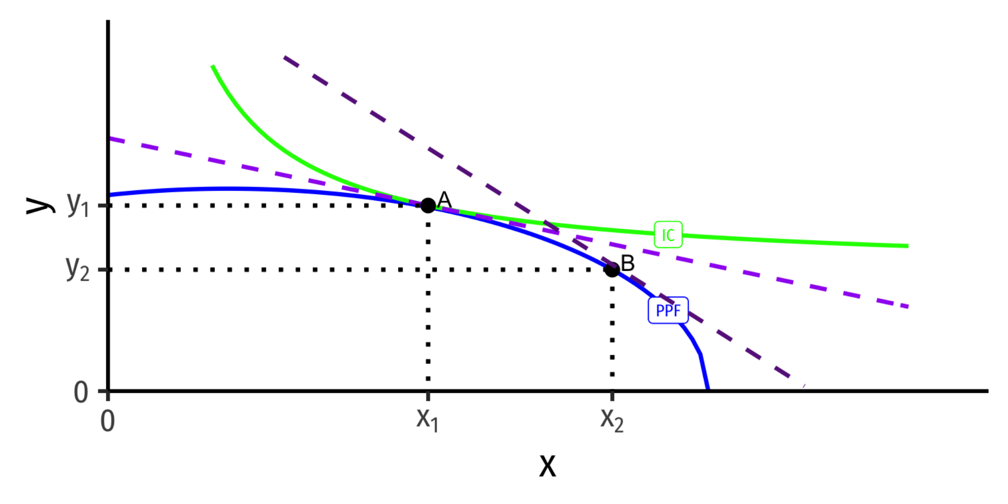
Home's Export Supply of x



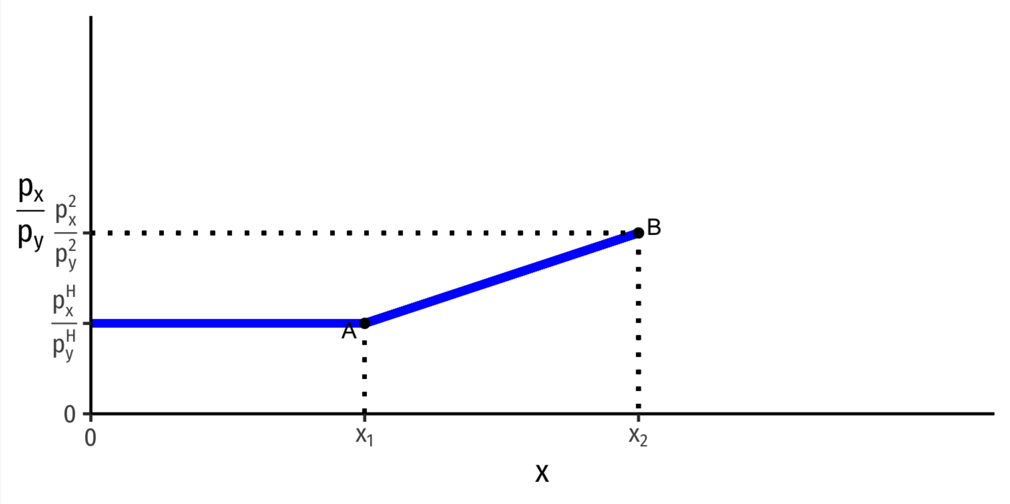
- Home is exporting x
- As relative price of x (slope) ↑ from $\left(\frac{p_x}{p_y}\right)^H \rightarrow \left(\frac{p_x}{p_y}\right)^2$, Home exports more x

Global Market for x: Home

Home



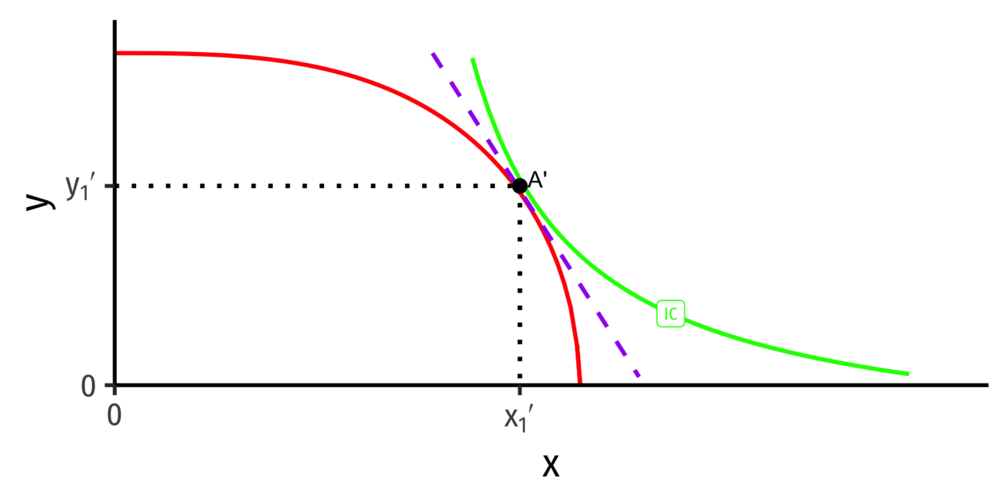
Home's Export Supply of x



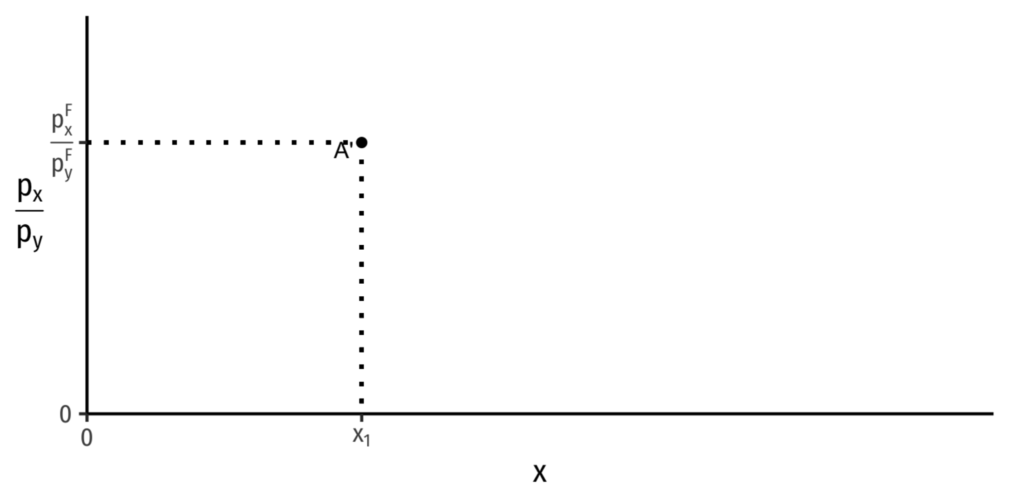
- Home is exporting x
- As relative price of x (slope) ↑ from $\left(\frac{p_x}{p_y}\right)^H \rightarrow \left(\frac{p_x}{p_y}\right)^2$, Home exports more x
- Trace Home's **export supply curve for x** upward as relative price of x increases

Global Market for x: Foreign

Foreign



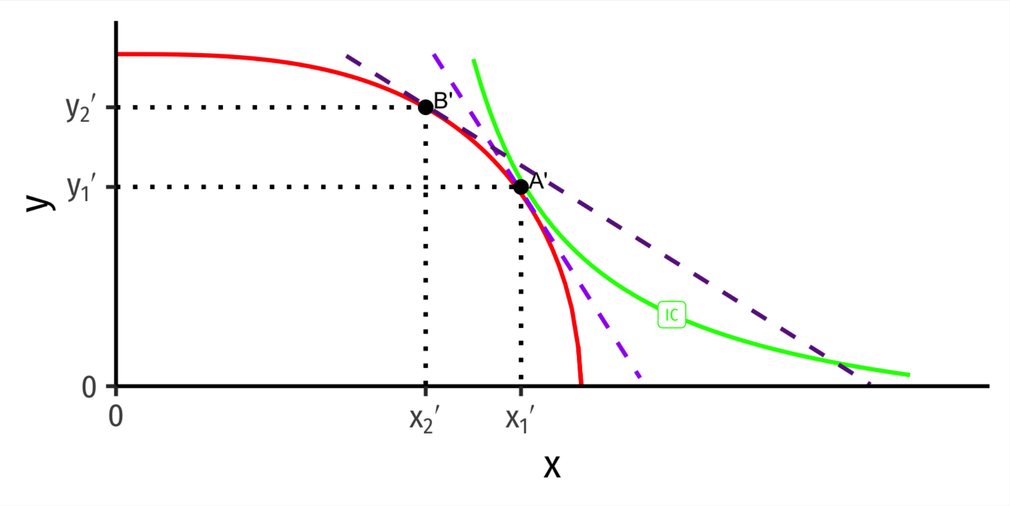
Foreign's Import Demand for x



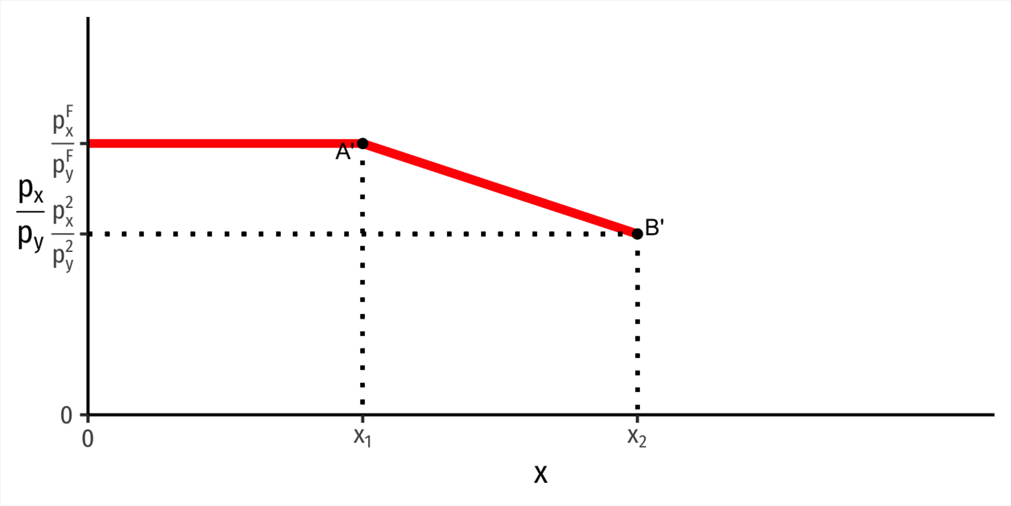
- Foreign is importing x

Global Market for x: Foreign

Foreign



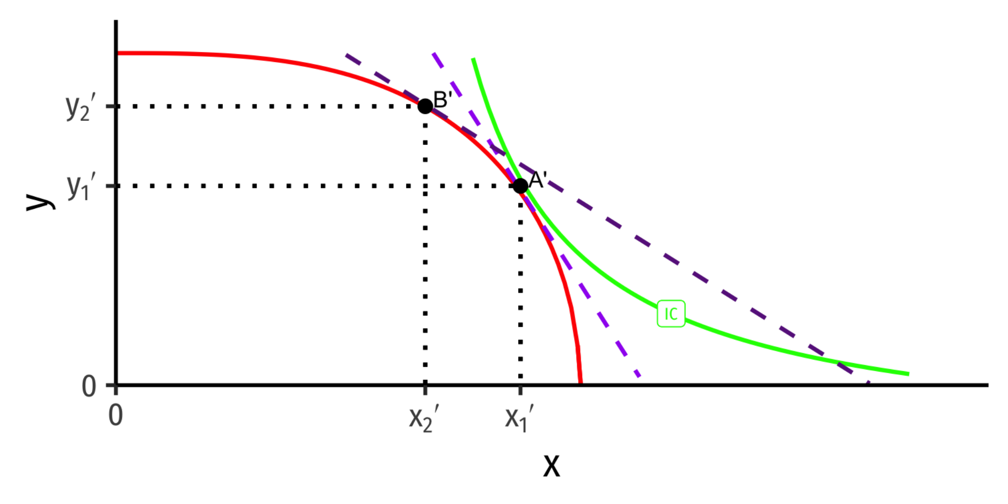
Foreign's Import Demand for x



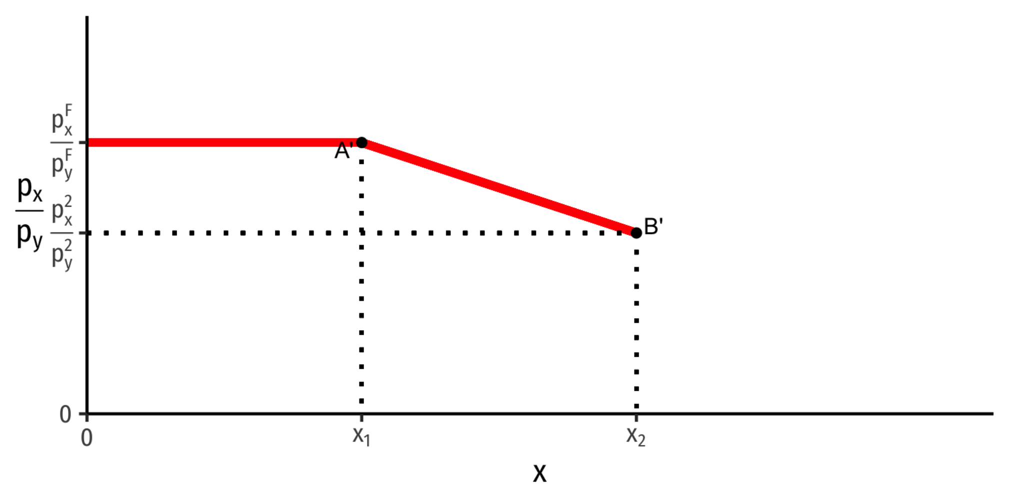
- Foreign is exporting x
- As relative price of x (slope) ↓ from $\left(\frac{p_x}{p_y}\right)^F \rightarrow \left(\frac{p_x}{p_y}\right)^2$, Foreign imports more x

Global Market for x: Foreign

Foreign



Foreign's Import Demand for x

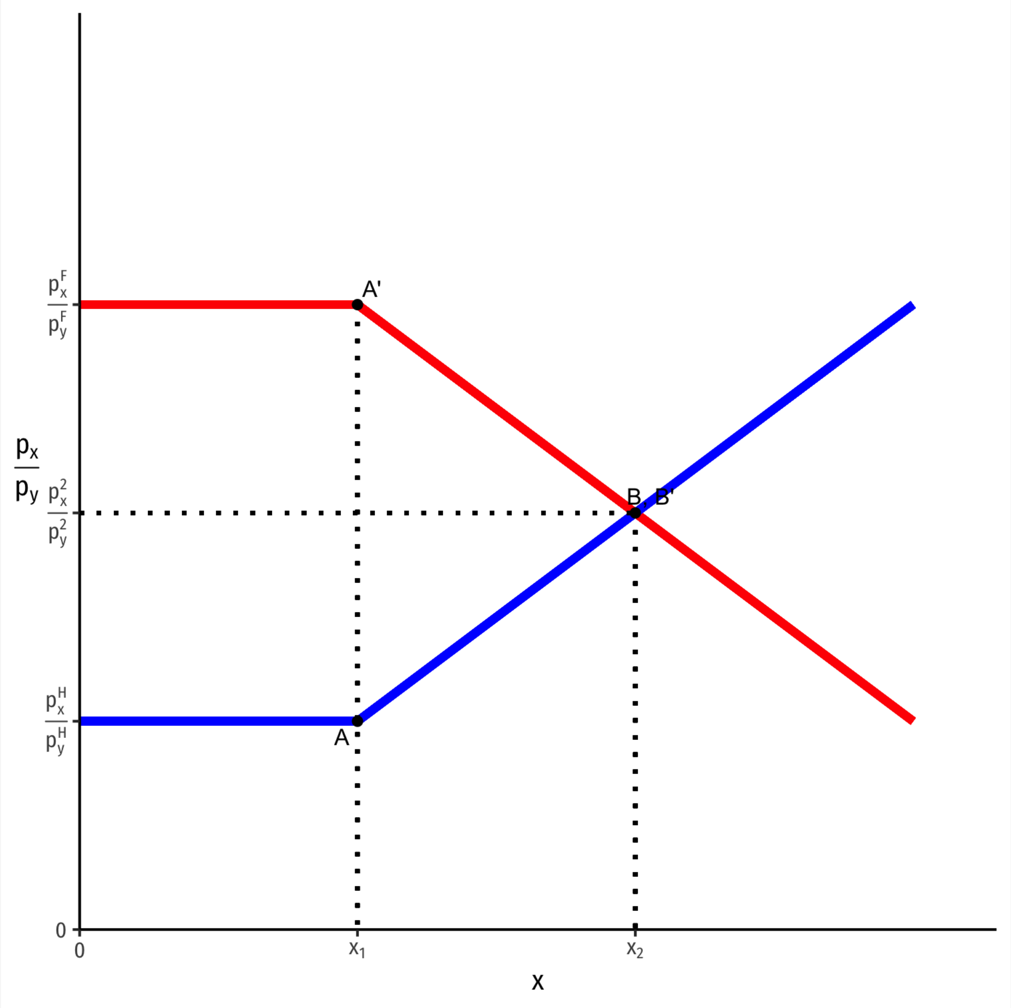


- Foreign is exporting x
- As relative price of x (slope) ↓ from $\left(\frac{p_x}{p_y}\right)^F \rightarrow \left(\frac{p_x}{p_y}\right)^2$, Foreign imports more x
- Trace Foreign's **import demand curve for x** upward as relative price of x decreases

The Global Market for x

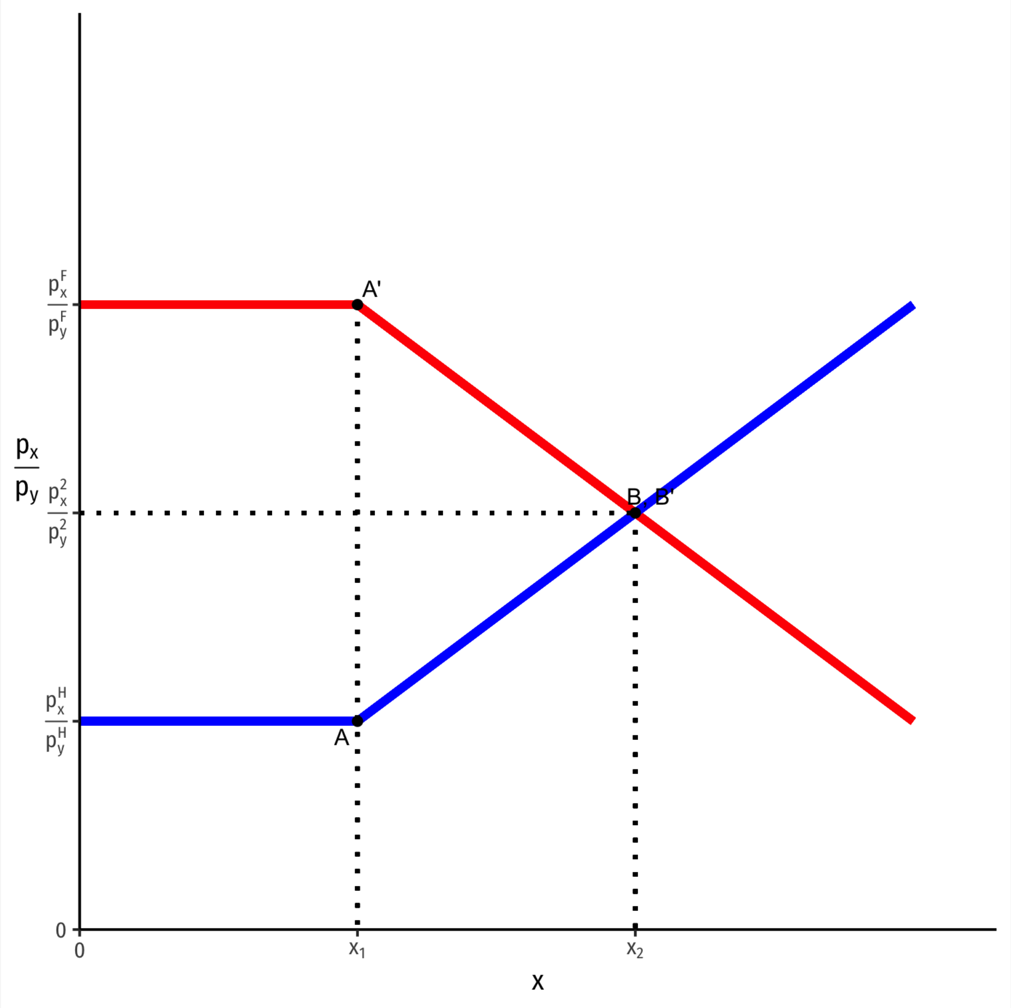
- Put together Home's export supply and Foreign's import demand for x

- **World equilibrium relative price of x**: $\left(\frac{p_x}{p_y}\right)^2$ balances Home's exports and Foreign's imports of x



The Global Market for x

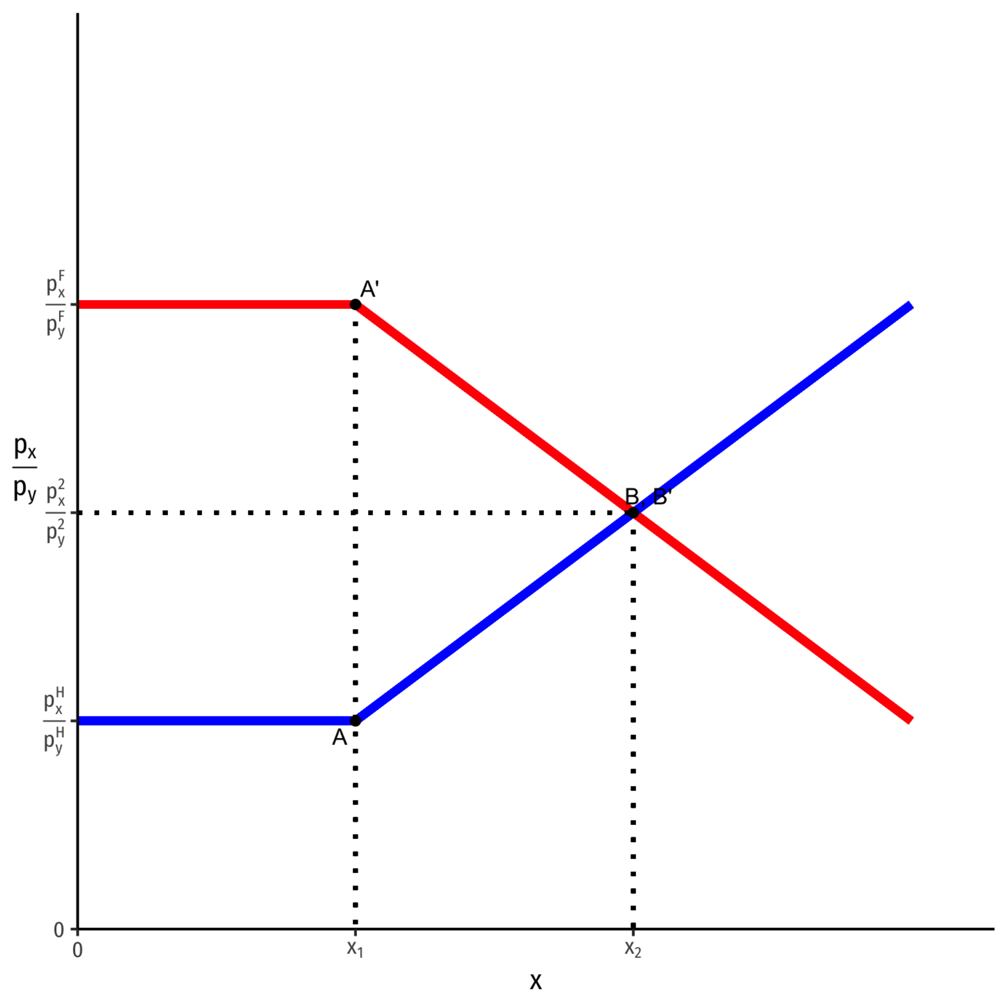
- Both countries began in autarky (A, A') with very different relative prices of x
  - Cheaper in Home (has comparative advantage)
  - More expensive in Foreign (comparative disadvantage)



The Global Market for x

- Both countries began in autarky (A, A') with very different relative prices of x
    - Cheaper in Home (has comparative advantage)
    - More expensive in Foreign (comparative disadvantage)
- As countries trade, changes relative price of x in each country until both reach equilibrium world relative price (B,B'), where both countries have same relative price:

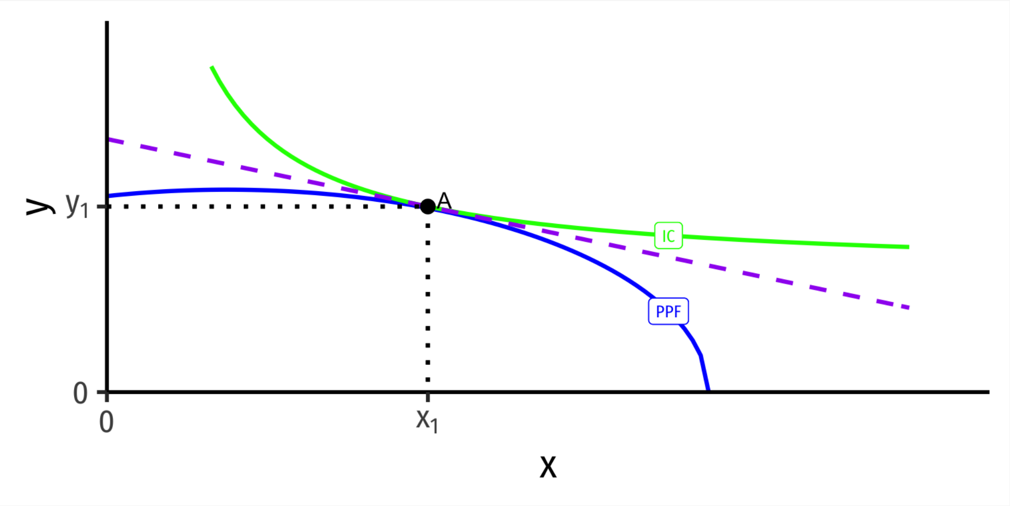
$$\left(\frac{p_x}{p_y}\right)^H < \left(\frac{p_x}{p_y}\right)^2 < \left(\frac{p_x}{p_y}\right)^F$$



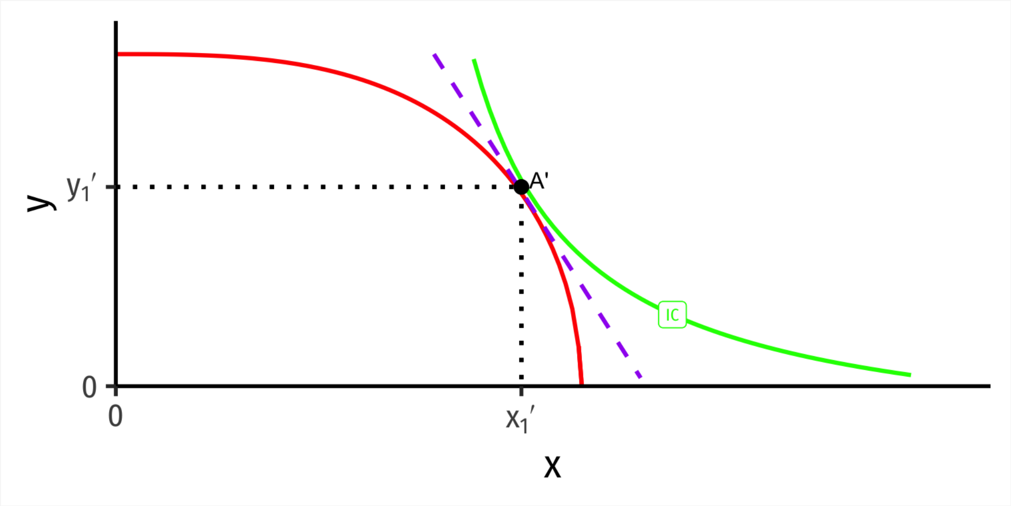
The Complete Picture

Autarky Equilibrium

Home



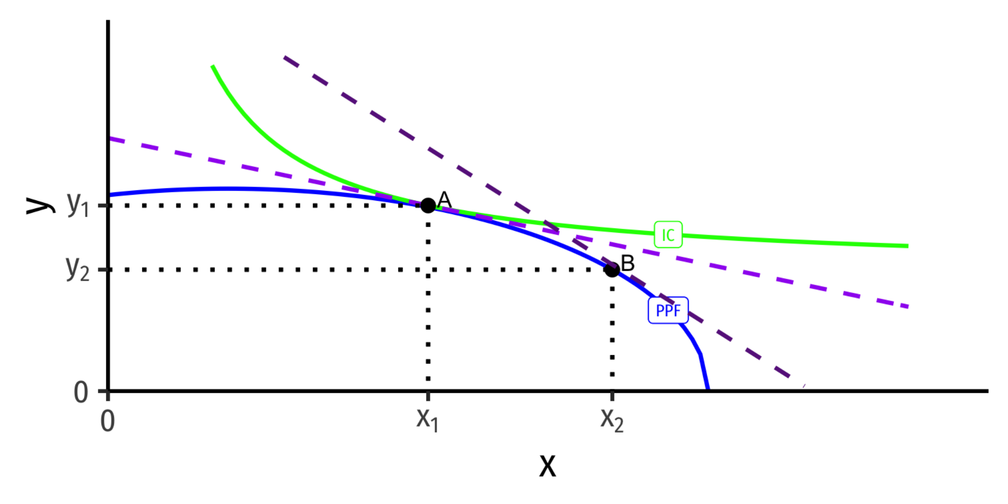
Foreign



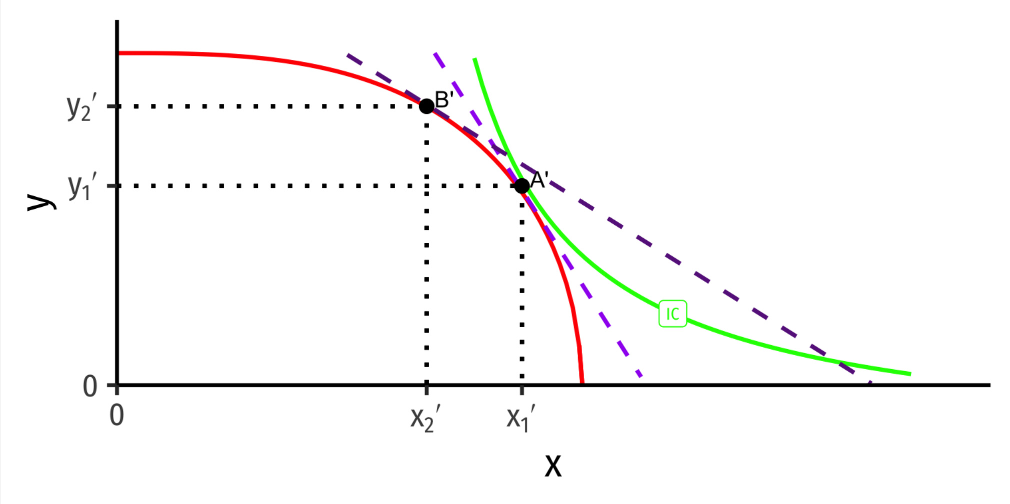
- Countries begin in **autarky** optimum with different relative prices
  - A is optimum for Home
  - A' is optimum for Foreign

Specialization

Home



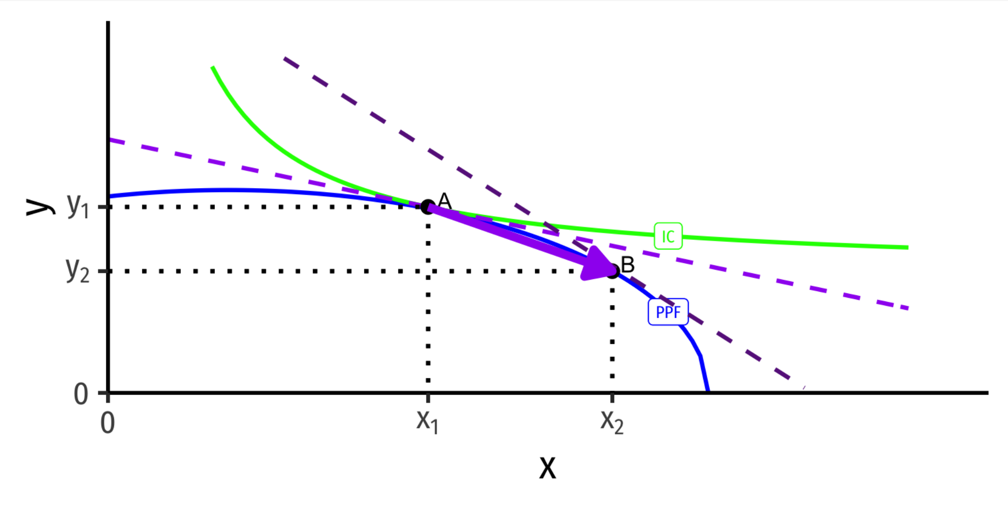
Foreign



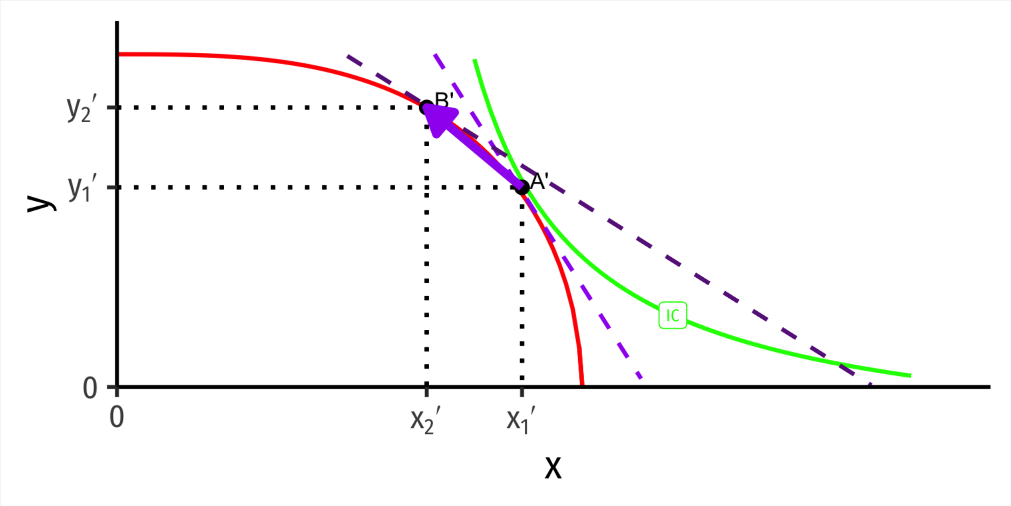
- International trade changes the relative price of x (↑ for Home, ↓ for Foreign)
- **With international trade, countries face same world relative prices** (slope of dark purple dashed line)

Specialization

Home



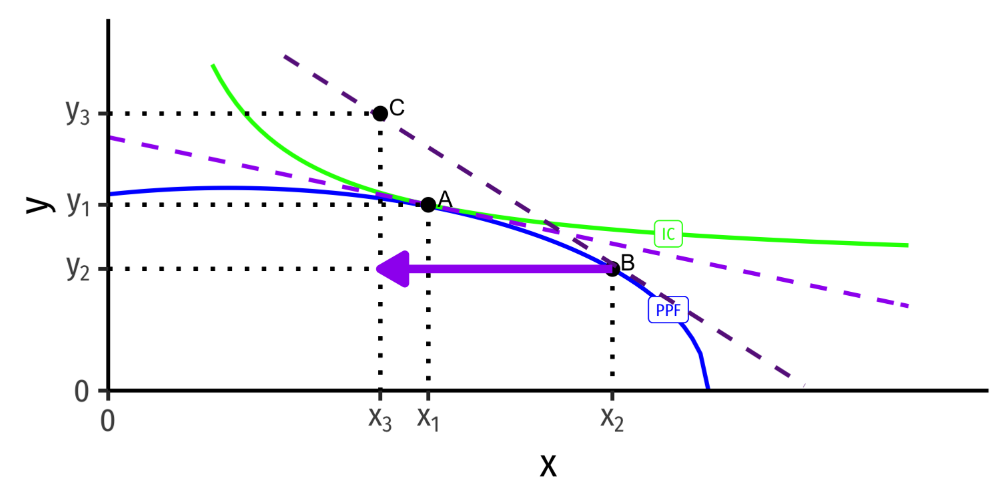
Foreign



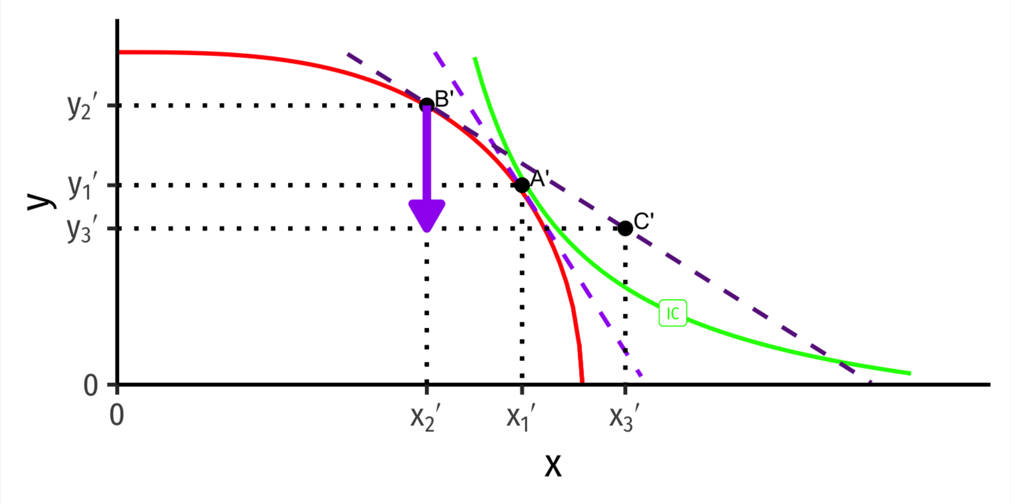
- Countries **specialize**: produce *more* of comparative advantaged good, *less* of disadvantaged good
  - Home: A $\longrightarrow$ B: produces more x, less y
  - Foreign: A' $\longrightarrow$ B': produces less x, more y
- Note this is **incomplete specialization**: countries still produce both goods!

Trade Triangles

Home



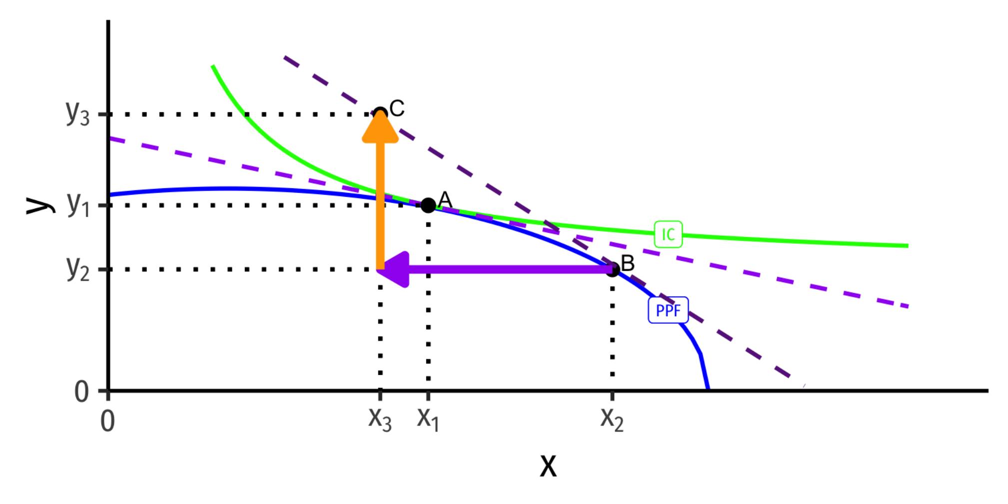
Foreign



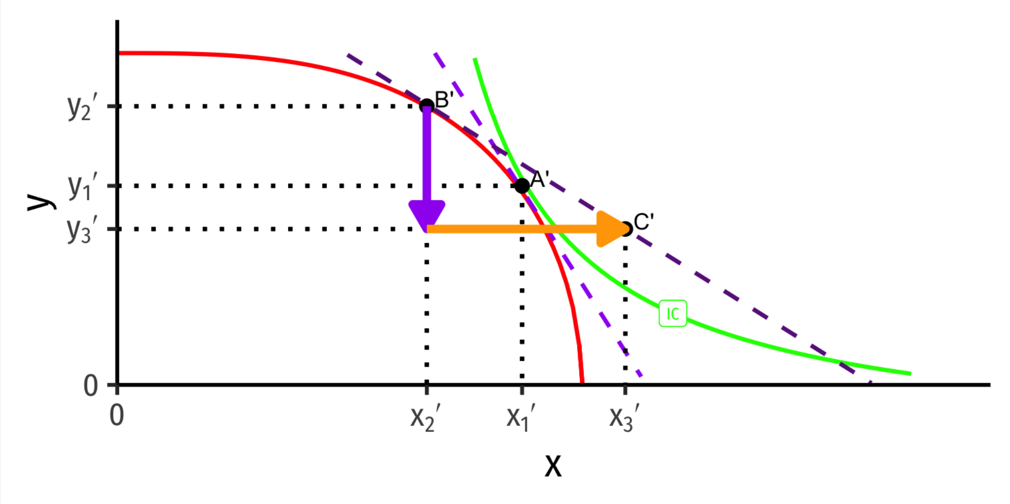
- Home → x → Foreign

Trade Triangles

Home



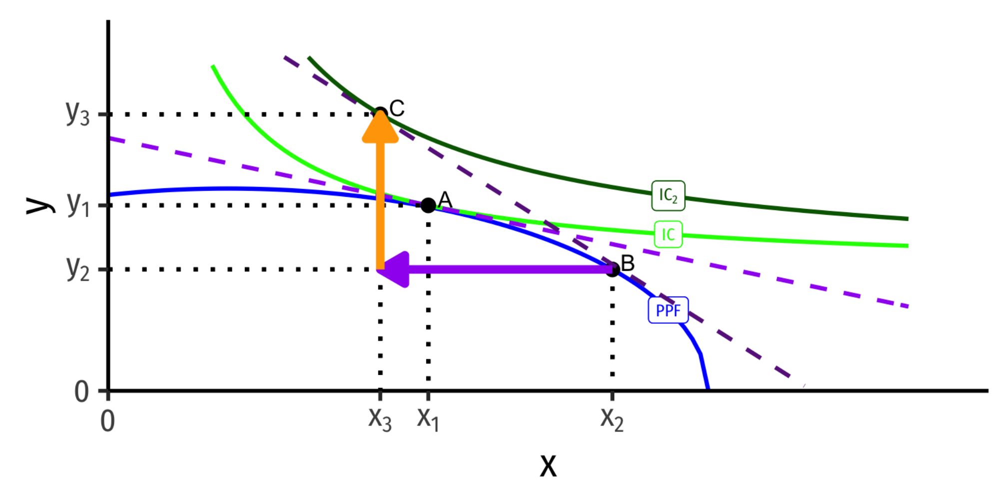
Foreign



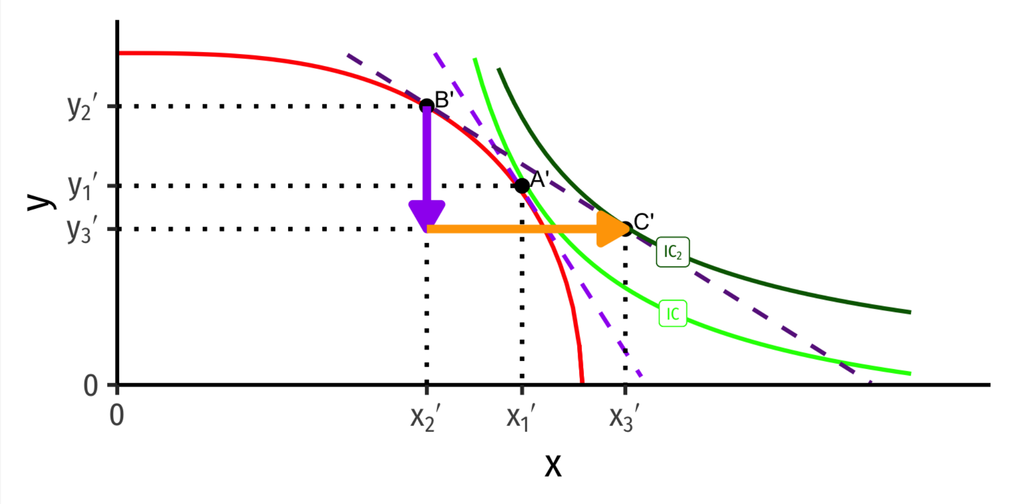
- Home → x → Foreign
- Home ← y ← Foreign

Gains from Trade

Home



Foreign



- Both countries exchange their imports & exports and consume at C and C'
- Both reach a higher indifference curve with trade, well beyond their PPFs!