

International Economics I

The Neoclassical Framework: The Specific Factor Model

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Introduction

- **Main question:** Why countries trade?
 - ▶ What is needed for trade to be beneficial?
 - ▶ What are the gains from trade?
 - ▶ Who gains and who loses from trade in each country?
- Use a general equilibrium **neoclassical model** to answer.
- Simple starting point: **Specific Factors Model**.

Introduction

- 2 goods: manufactures, M , (clothes, computers, etc) and agricultural goods, A (food).
- 3 factors of production:
 - ▶ labor, L , used to produce A and M (mobile between sectors).
 - ▶ land, T , used to produce A (specific factor).
 - ▶ capital, K , used to produce M (specific factor).
- Technology with decreasing marginal productivity of factors.
- Convex and homothetic preferences.
- Perfect competition and full employment.
- First study the closed economy, then open to trade.

Outline

1. Closed Economy

2. Open Economy

3. Gains From Trade and Redistributive Effects

Eq. in a closed economy

- Let's first study the **closed economy**.
- Equilibrium in a closed economy occurs when supply equals demand.
 - ▶ **Firms:** demand labor, produce goods.
 - ▶ **Workers:** supply labor, consume goods.
- Since the economy is closed, everything consumed nationally should be produced within borders.

Production

- How the economy produces M and A ? Combining labor with its specific factors.
- Production function of manufactures: $Q_M = F_M(K, L_M)$
 - ▶ Q_M = quantity of M produced.
 - ▶ L_M = labor employed in manufactures.
 - ▶ K = capital.
- Production function of agricultural goods: $Q_A = F_A(T, L_A)$
 - ▶ Q_A = quantity of A produced.
 - ▶ L_A = labor employed in agriculture.
 - ▶ T = land.
- decreasing marginal productivity of labor, MPL_M and MPL_A :

Production

Assumptions about the production functions.

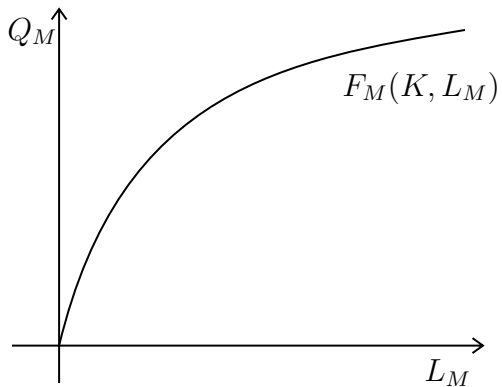
(i) Increasing in labor (Mg. product of labor is positive):

- ▶ $\frac{\partial F_M}{\partial L_M} = MPL_M > 0$ and $\frac{\partial F_A}{\partial L_A} = MPL_A > 0$.
- ▶ $\uparrow \text{labor} \Rightarrow \uparrow \text{production}$

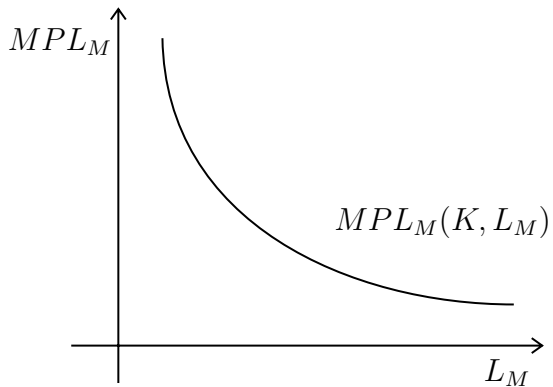
(ii) Decreasing marginal product of labor, MPL_M and MPL_A :

- ▶ $\frac{\partial MPL_M}{\partial L_M} < 0$ and $\frac{\partial MPL_A}{\partial L_A} < 0$.
 - ▶ Every additional worker produces less than the previous ones.
- **Example:** Cobb-Douglas: $Q_M = K^\alpha L_M^{1-\alpha}$ where $0 < \alpha < 1$.

Production



Increasing in Labor



Decreasing MPL

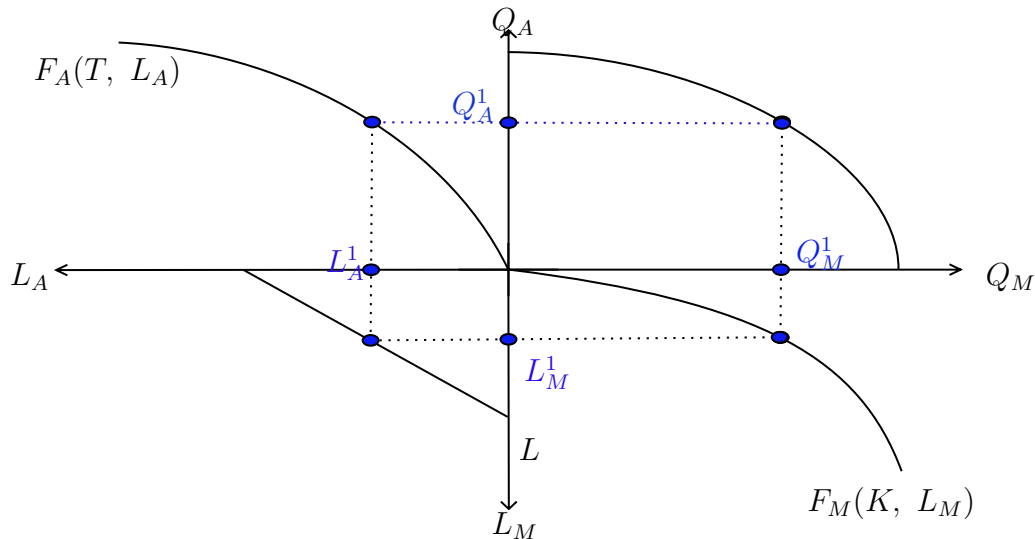
Production Possibility Frontier (PPF)

- How much of each good can the economy produce?
- The labor endowment, L , is allocated between the production of M and A :

$$L = L_A + L_M \quad (1)$$

- For a given labor allocation, (L_M^1, L_A^1) , the economy produces:
 - ▶ $Q_M^1 = F_M(K, L_M^1)$ units of manufactures.
 - ▶ $Q_A^1 = F_A(T, L_A^1)$ units of agricultural goods.
- If we move 1 worker from A to M:
 - ▶ How much the quantities Q_M^2 and Q_A^2 change?
 - ▶ The **Production Possibility Frontier (PPF)** curve tells us.

Production Possibility Frontier (PPF)



PPF: Explanation and Analytical Expression

What the PPF really represents?

- The **technological feasibility** of the economy.
- Movements in the PPF $\Rightarrow$ reallocation of inputs from M to A .
- It represents the **opportunity cost** of producing one good in terms of the other good.
- Decreasing $MPL \Rightarrow$ PPF is concave.
 - ▶ The more M we produce, the higher is the production cost in terms of the other good (A).

PPF: Explanation and Analytical Expression

- Imagine Q_A is **much larger** than Q_M .
- Given decreasing returns, a small reallocation of workers from A to M increases Q_M more than Q_A falls.
- Since the abundance of A relative to M implies a low opportunity cost increasing the production of M .
- This is why the PPF is concave!

PPF: Explanation and Analytical Expression

- Analytically, shifting one hour of work from A to M :
 - ▶ $\uparrow Q_M$ by the marginal product of labor, MPL_M .
 - ▶ $\downarrow Q_A$ by the marginal product of labor, MPL_A .
- The *opportunity cost* of M relative to A is equal to the slope of the PPF:

$$-\frac{MPL_A}{MPL_M} \quad (2)$$

- This is called the **Marginal Rate of Transformation**.

The Relative Supply: Optimal Production

- The PPF gives the feasible production of the economy, but exactly how much of A and M the economy will produce?
- Recall that in **perfectly competitive markets** firms maximize profits given prices and wage:

$$\max_{L_i} \pi_i = p_i F_i(L_i, F) - w_i L_i \quad \text{for } i = M, A \quad \text{and } F = K, T \quad (3)$$

- Taking derivatives with respect to L_i and equalizing to zero:

$$p_i \underbrace{\frac{\partial F_i(L_i, F)}{\partial L_i}}_{MPL_i} - w_i = 0 \quad (4)$$

The Relative Supply: Optimal Production

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- Taking derivatives with respect to L_i and equalizing to zero:

$$p_i \underbrace{\frac{\partial F_i(L_i, F)}{\partial L_i}}_{MPL_i} - w_i = 0 \quad (6)$$

Optimal Production

- **Optimality condition:** marginal cost equal marginal revenue in each sector:

$$w_M = p_M \times MPL_M \quad \text{and} \quad w_A = p_A \times MPL_A \quad (7)$$

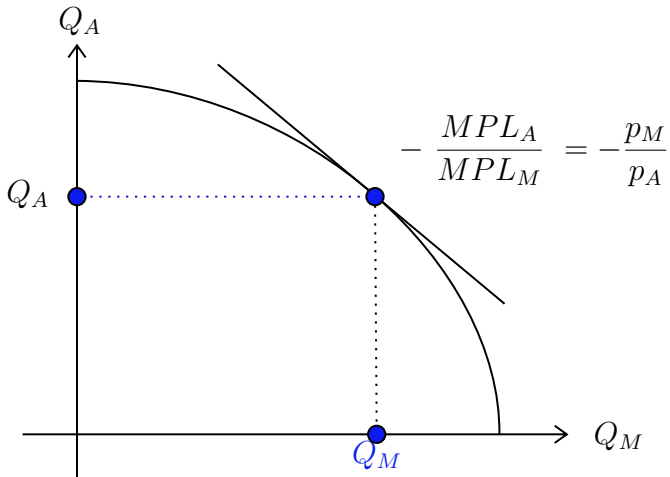
- But wages must be equal in both sectors since labor is **mobile** between M and A !
- $\Rightarrow w_M = w_A = w$.

$$p_M \times MPL_M = p_A \times MPL_A \Rightarrow \frac{p_M}{p_A} = \frac{MPL_A}{MPL_M}. \quad (8)$$

- Equilibrium production of M and A is determined by the relative price that lies at the tangency between the PPF and the line of the relative price!

Equilibrium Production

Figure: Opportunity cost of M = Relative price of M



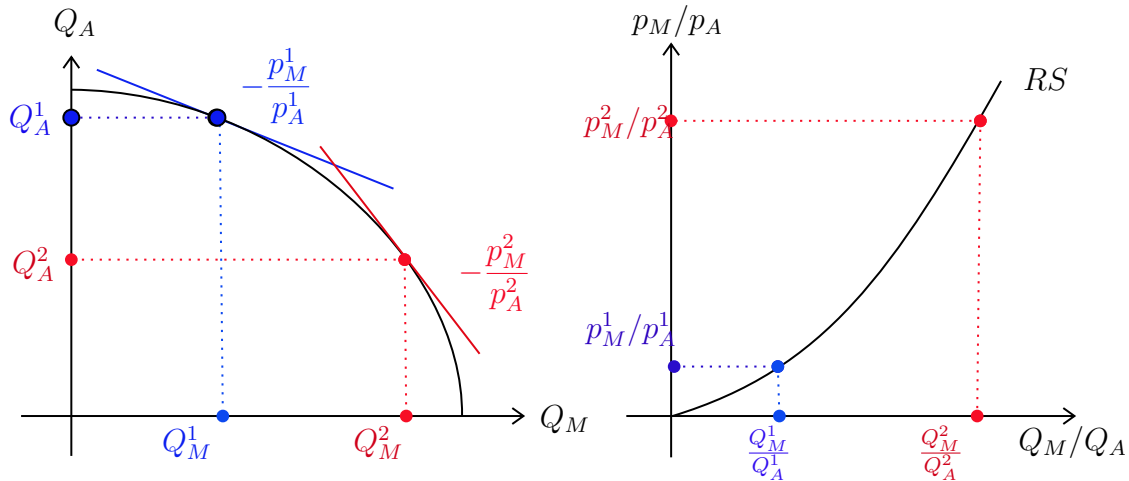
Equilibrium Production

- If the price of M increases ($p'_M > p_M$):
 - ▶ Firms in M want to increase production and demand more labor: $\uparrow w_M$.
 - ▶ As L moves from A to M , $MPL_A \uparrow$ and $MPL_M \downarrow \Rightarrow \uparrow w_A$ and $\downarrow w_M$.
 - ▶ The reallocation of L goes on until $w_M = w_A = w$ and $MPL_A/MPL_M = p'_M/p_A$.
- Note that w increases less than p_M !
 - ▶ Recall: $w = p_M \times MPL_M$.
 - ▶ $\uparrow p_M$, but $\downarrow MPL_M$ due to diminishing marginal returns.

Relative Supply

- Overall, **positive relationship** between relative price, p_M/p_A , and relative quantity, Q_M/Q_A .
- $\uparrow p_M/p_A \Rightarrow \uparrow L_M, \downarrow L_A \Rightarrow \uparrow Q_M/Q_A$.
- **Relative Supply Curve**: the higher is the price of a good, the higher are incentives to produce that good (relative to the other good).

Relative Supply



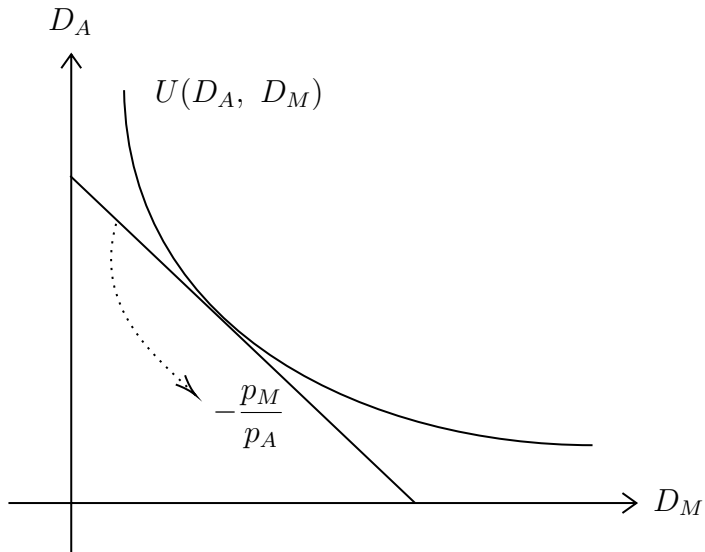
Consumers and Relative Demand

- To close the model we need to specify the **Relative Demand**.
- A consumer will demand the quantities of M and A that maximizes utility subject to the budget constraint.
- The utility function, $U = U(D_A, D_M)$.
- The budget constraint: $p_M D_M + p_A D_A \leq V$, where V is the income level of the consumer.

Utility Function

- Assumptions on the utility function, $U = U(D_A, D_M)$:
 - ▶ is increasing in the quantities consumed: $\partial U / \partial D_i = M g U D_i > 0$.
 - ▶ has decreasing marginal utilities ($\partial M g U D_i / \partial D_i < 0$).
 - ▶ is described by convex indifference curves in the space of (D_M, D_A)
 - ★ Consumers prefer consuming a bit of both goods rather than a lot of one and a little of the other.
 - ▶ is homogenous of degree one.
 - ★ Rich people have the same relative demand as the poor. They just consume more of both goods.
- **Example:** Cobb-Souglas $U = D_A^\beta D_M^{1-\beta}$.

Utility Function



Optimal Consumption

- Consumer problem:

$$\max_{D_A, D_M} U(D_A, D_M) \quad \text{subject to} \quad p_M D_M + p_A D_A \leq V \quad (9)$$

- We can solve the problem using the Lagrange:

$$L(D_A, D_M, \lambda) = U(D_A, D_M) + \lambda(V - p_M D_M + p_A D_A). \quad (10)$$

- Taking the first order conditions:

$$\frac{\partial U()}{\partial D_M} = M g U D_M = \lambda p_M \quad \text{and} \quad \frac{\partial U()}{\partial D_A} = M g U D_A = \lambda p_A \quad (11)$$

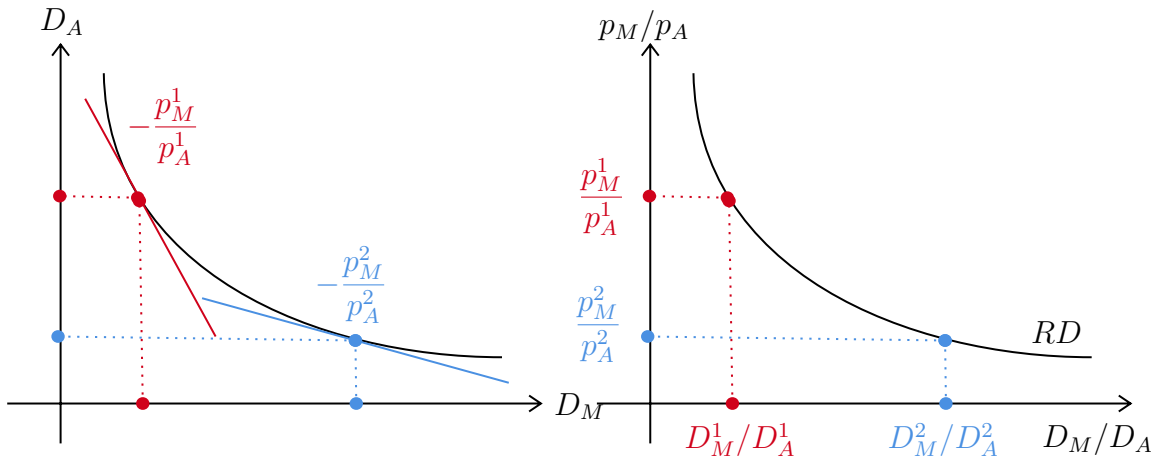
Relative Demand

- Equalizing the FOCs:

$$-\frac{MgUD_M}{MgUD_A} = -\frac{p_M}{p_A} \quad (12)$$

- The **Marginal Rate of Substitution** is equal to the relative price (indifference curve tangent to the line of the relative price).
- Recall that the Marginal Rate of Substitution is the amount of M the consumer is willing to trade for one unit of A .
- In short, the **Relative Demand**, D_M/D_A , is decreasing on prices!
 - ▶ $\uparrow p_A \Rightarrow$ Consumer demand less of A and more of M .

Relative Demand



Equilibrium in a Closed Economy

- In equilibrium, a closed economy (autarky) must consume all the quantities produced:

$$Q_M = D_M \quad \text{and} \quad Q_A = D_A \quad (13)$$

- Equilibrium would be the relative price, p_M/p_A , that equalizes Relative Demand to Relative Supply, $RD = RS$.
 - ▶ This is possible only if the PPF and the indifference curve are tangent to the relative price line **in the same point**.

Equilibrium

- Note that we can compute GDP in our economy using various equations.
- GDP using production approach:

$$V = p_M Q_M + p_A Q_A \quad (14)$$

- GDP using expenditure approach:

$$V = p_M D_M + p_A D_A \quad (15)$$

- GDP using income approach:

$$V = \pi_A + \pi_M + w \times L \quad (16)$$

where $\pi_i = p_i Q_i - w L_i$ are the profits of firms in sector $i = M, A$.

Equilibrium in a Closed Economy

- Therefore, equilibrium in a **closed economy**, two conditions must hold:

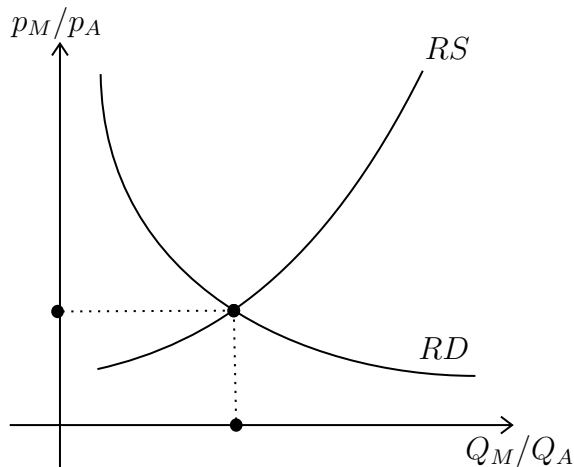
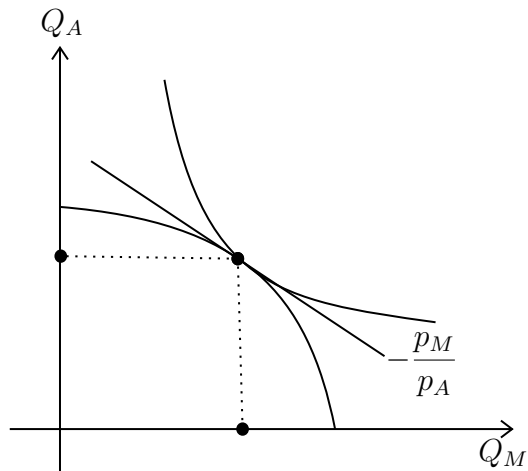
- (i) Produced value equals consumed value (or income equals expenditure):

$$V = p_M D_M + p_A D_A = p_M Q_M + p_A Q_A \quad (17)$$

- (ii) Produced quantities equal consumed quantities of each good:

$$Q_M = D_M \quad \text{and} \quad Q_A = D_A \quad (18)$$

Equilibrium in a Closed Economy



Outline

1. Closed Economy
2. Open Economy
3. Gains From Trade and Redistributive Effects

Equilibrium in an Open Economy

- Let's suppose now that the economy is **open to trade** with the rest of world.
- In an open economy, good prices are determined in **equilibrium with the international markets**.
- p_M^I and p_A^I make international demand equal international supply.
- Our economy can be **large** or **small** relative to the rest of world.
 - (i) **Small Open Economy**: Our economy take international prices as given.
 - (ii) **Large Open Economy**: The national demand/supply of goods affect international prices.
- For simplicity, let us assume that we are in Small Open Economy. In the future, we will relax this assumption.

Equilibrium in an Open Economy

- In an open economy, a country can consume different quantities from the produced ones.

$$D_M \begin{matrix} \leq \\ \geq \end{matrix} Q_M \quad \text{and} \quad D_A \begin{matrix} \geq \\ \leq \end{matrix} Q_A \quad (19)$$

- The only condition that must hold is that produced value equals consumed value:

$$V = p_M^I Q_M + p_A^I Q_A = p_M^I D_M + p_A^I D_A \quad (20)$$

- The imported A goods, $(D_A - Q_A)$, must be bought using the exports of M , $(Q_M - D_M)$.

$$\Rightarrow D_A - Q_A = (p_M^I / p_A^I) \times (Q_M - D_M) \quad (21)$$

Equilibrium in an Open Economy

- What determines whether the country will **export** or **import** a given good?
- The international price!
- If the international relative price is different from the closed economy, production and demand will not be equal.

$$\frac{p_M^I}{p_A^I} \neq \frac{p_M}{p_A} \Rightarrow D_M \neq Q_M \quad \text{and} \quad D_A \neq Q_A \quad (22)$$

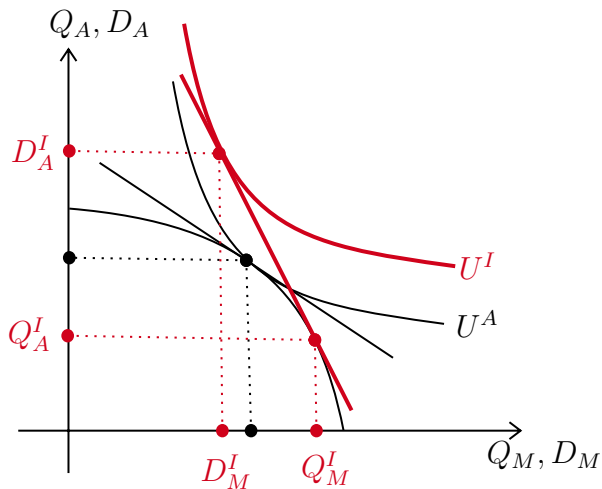
- For now, suppose that the price of M in the international markets are higher than the local price in autarky, $\frac{p_M^I}{p_A^I} > \frac{p_M}{p_A}$.

Equilibrium in an Open Economy

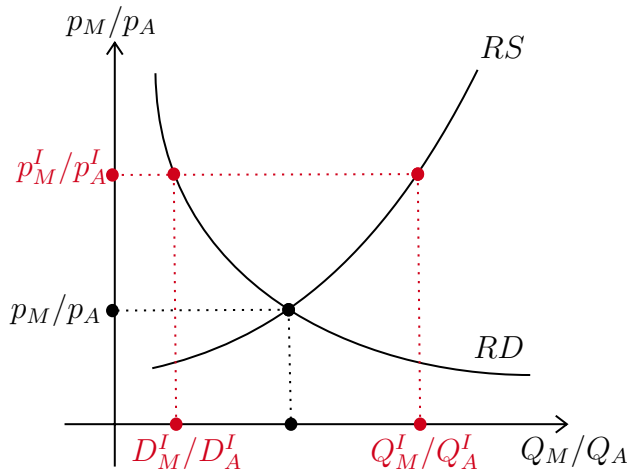
- If $p_M^I/p_A^I > p_M/p_A$:
- Incentives to reallocate labor from the production of A to the production of M .
 - ▶ Firms choose the new equilibrium production (PPF tangent to the relative price line).
- Consumers decrease demand of M and substitute for A .
 - ▶ New equilibrium demand (indifference curve tangent to the relative price line), given the value of production (i.e., income).

Equilibrium in a Closed and Open Economy

- If $p_M^I/p_A^I > p_M/p_A$:
- $Q_M^I > Q_M = D_M > D_M^I$
- $Q_A^I < Q_A = D_A < D_A^I$
- Higher utility! $U^I > U^A$.



Equilibrium in a Closed and Open Economy



Comparative Advantage and Pattern of Trade

- We say that there is **comparative advantage** in the production of a good (e.g., M) if its **relative price** in closed economy is lower than in open economy.

$$\frac{p_M^I}{p_A^I} > \frac{p_M}{p_A} \quad (23)$$

- Pattern of trade:

- ▶ a country exports its good of comparative advantage (e.g., M):

$$X_M = Q_M^I - D_M^I > 0.$$

- ▶ a country imports its good of comparative disadvantage (e.g., A):

$$M_A = D_A^I - Q_A^I > 0.$$

- If their relative prices in open and closed economy coincide, there is no comparative advantage for any country and there are no gains from trade.

Comparative Advantage and Absolute Advantage

- We say that there is **absolute advantage** in the production of a good (e.g., M) if its **price** in closed economy is lower than in open economy.
 - ▶ a country with absolute advantage in both goods ($p_M^I > p_M$ and $p_A^I > p_A$) may have comparative advantage in only one.
 - ▶ a country with absolute disadvantage in both goods ($p_M^I < p_M$ and $p_A^I < p_A$) may have comparative advantage in only one.
- Trade requires **comparative advantage**, not necessarily absolute advantage.
- There is comparative advantage if countries are different.

Comparative Advantage

- What are the **sources** of comparative advantages?
- Think about what determines the prices in a closed economy...
- Technology ($F_M(K, L_M)$, $F_A(T, L_A)$).
 - ▶ A country more productive in $Q_M = F_M(K, L_M)$, would be able to produce more M (lower p_M/p_A).
- Factor endowment, K , T , L .
 - ▶ An economy with more capital, K , would be able to produce more M (lower p_M/p_A).
- Preferences of consumers, $U(D_M, D_A)$ (not really CA, but might affect relative prices).
 - ▶ A country that likes more M than A , would have higher relative price p_M/p_A .

Outline

1. Closed Economy
2. Open Economy
3. Gains From Trade and Redistributive Effects

Gains From Trade

- What are the **Gains From Trade**?
- The economy move to a higher indifference curve $\Rightarrow$ A representative consumer of this economy achieves higher utility!
- Without trade, the economy is **constrained** to consume at the PPF.
- Trade expands the economy's choice!

Gains From Trade and Terms of Trade

- A direct way to assess the economy's gains from trade is to look at the **Terms of Trade**.
- **Terms of Trade** $\Rightarrow$ relative price of exports in terms of imports.
 - ▶ In an economy that exports M and imports A : $ToT = \frac{p_M^I}{p_A^I}$.
- What if our terms of trade deteriorate?
 - ▶ The value of our production drops $\Rightarrow$ Produce less M and more A .
 - ▶ Partly stop exporting M and importing $A \Rightarrow$ Welfare drops as the economy is closer to autarky.
- $\uparrow ToT \Rightarrow \uparrow$ Welfare.
 - ▶ Note: no fall in the ToT is able to push U below autarky level!

Terms of Trade and Tariffs

- The terms of Trade also help us to do a simple analysis of tariffs.
- Suppose a tariff of $\tau\%$ of the value of imports $\Rightarrow$ price for the domestic consumer is now: $p_A^I(1 + \tau)$.
- This deteriorates the terms of trade! $ToT = \frac{p_M^I}{p_A^I(1+\tau)}$.
- The tariff incentivizes production of more A and less M .
- The economy produces **less** of the good it has comparative advantage $\Rightarrow$ welfare decreases.
- **Very simplistic analysis!** Other issues to consider: the revenue of the tariff, dynamic gains, redistributive motives, etc.

The Redistributive Effects of Trade

- Overall, trade increases welfare for the “representative consumer” of this economy.
- Let's now imagine there are three different agents in the economy:
 - ▶ **Workers:** own L , supply labor and earn w .
 - ▶ **Capitalists:** own K , produce M and earn $\pi_M = p_M Q_M - w L_M$.
 - ▶ **Landowners:** own T , produce A and earn $\pi_A = p_A Q_A - w L_A$.
- Who wins and who loses from trade?
- We use as a measure of welfare: real income in terms of both goods.

The Redistributive Effects of Trade

- Consider workers real income first: w/p_A and w/p_M .
- Recall from profit maximization:

$$\frac{w}{p_M} = MPL_M \quad \text{and} \quad \frac{w}{p_A} = MPL_A \quad (24)$$

- Trade: $\frac{p_M^I}{p_A^I} > \frac{p_M}{p_A} \Rightarrow \uparrow Q_M/Q_A \Rightarrow \uparrow L_M$ and $\downarrow L_A$.
- Since MPL_M and MPL_A are decreasing in labor: $\uparrow \frac{w}{p_A}$ and $\downarrow \frac{w}{p_M}$.
- **Ambiguous Effect** $\Rightarrow$ Workers gain in terms of A and lose in terms of M .

The Redistributive Effects of Trade

- Capitalists real income (profit from M):

$$\frac{\pi_M}{p_M} = Q_M - \frac{w}{p_M} L_M \quad \text{and} \quad \frac{\pi_M}{p_A} = \frac{p_M}{p_A} \frac{\pi_M}{p_M} \quad (25)$$

- We know that $\uparrow Q_M$, $\downarrow w/p_M$, and $\uparrow L_M$. Net effect on π_M/p_M ?
 - ▶ **Intuitively:** Production increases precisely because firms want to maximize profits from additional demand of M .
 - ▶ Recall that capitalist take p_M and w as given, they hire workers until the “last one” equalizes marginal revenue to marginal cost.
 - ▶ Hence, their profits increase ($\uparrow \pi_M/p_M$) from the decrease in real wages ($\downarrow w/p_M$) but also from the hiring in of additional workers ($\uparrow L_M$).
- Because $\uparrow p_M/p_A$ and $\uparrow \pi_M/p_M$, then $\uparrow \pi_M/p_A$.
- Capitalists gain with respect to both goods.

The Redistributive Effects of Trade

- Using an analogous argument, we can show that Landowners lose with respect to both goods ($\downarrow \pi_A/p_M$ and $\downarrow \pi_A/p_A$).
- Therefore, in the **Specific Factors Model**:
 - ▶ The factor specific of the exporting sector **gains**.
 - ▶ The factor specific of the import-competing sector **loses**.
 - ▶ The welfare change for the mobile factor is ambiguous.

The Redistributive Effects of Trade

- Does it mean that trade is detrimental?
- No! Trade makes the “pie” bigger.
- That means we can always design a policy that redistributes the gains from trade to the losers so **everybody benefits**.
- In practice, implementing such policies is hard because it involves a lot of political negotiation.
- Some groups of winners/losers are more organized, better politically connected, etc.

Taking Stock

- We study the implications of trade in a neoclassical model with specific factors.
- If the domestic relative price is different than the international prices, trade occurs.
- Trade expands the consumption possibility of the economy and increase overall welfare.
- Nevertheless, gains from trade are heterogeneous: owner of the factor that produces exporting good gains, owner of factor that produces importing goods loses.
- The effect on the mobile factor is ambiguous.