ECBS 6060: International Trade
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Lecture 1: Gains from trade

Structure of the course

- What can we learn from trade theory?
    1. Every country gains from trade.
    2. We trade too little.
    3. Someone always loses from trade.

What trade theory is about

What trade theory is about

- Trade theory is applied general equilibrium theory.
- The agents are countries, represented by production functions (sets), endowments, and preferences.
- These lead to *excess demand* functions that tell us the pattern and volume of trade at given world prices.
- World prices will be such that *world markets* clear (world net trade is zero).

Where we depart from basic GE

- We will introduce some important modifications to standard GE.
  - Trade/transport costs.
  - Increasing returns to scale.
  - Imperfect competition.
  - Heterogeneity within countries.

Why countries trade

- Agents trade because they want to exchange goods.
- Countries will exchange goods if they are *different*.
- Countries may differ in
    1. Technology
    2. Endowments
    3. Preferences
    4. Income

Different preferences?

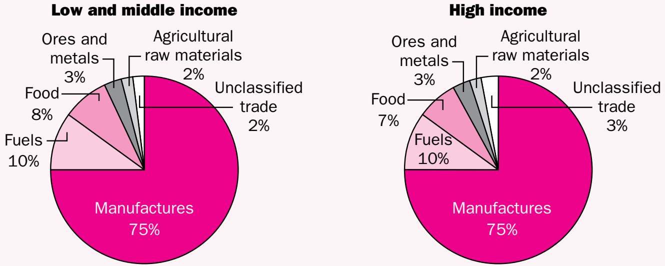
- Across countries, there is much less variation in demand than in supply.
- For these reasons, we focus on trade models around supply differences.
  - But see discussion of trade costs.

Rich and poor countries import similar goods

4.6a

Manufactures account for the biggest share of merchandise imports

% of merchandise imports, 2001



Developing and high-income economies have similar import structures.

Source: United Nations Conference on Trade and Development.

Production theory recap

Technology

- Production technology represent the set of feasible transformations of goods into one another.
- In trade, we focus on a restricted setup.
- Vector of goods $\mathbf{x}$
- Vector of primary inputs $\mathbf{v}$
- Production function

$$\mathbf{x} = f(\mathbf{v})$$

Production function

We assume the following properties of $f(v)$

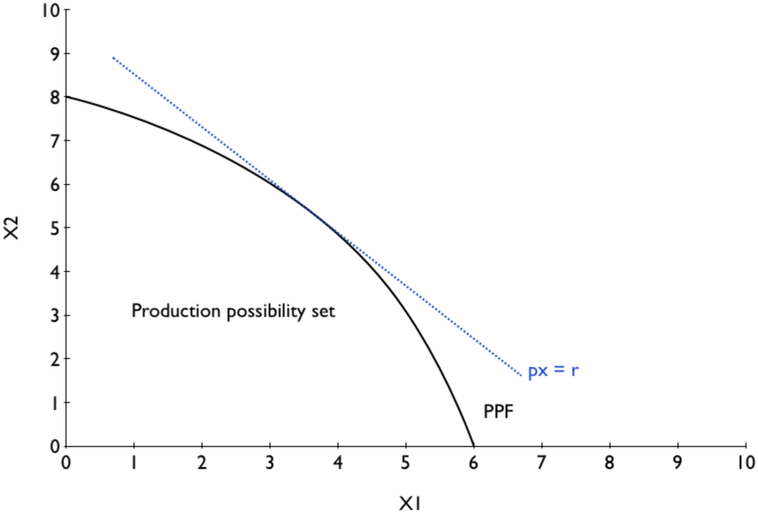
- constant return to scale
- quasi-concave
- (twice continuously differentiable)

Profit maximization

$$\max_{\mathbf{x},\mathbf{v}} p\mathbf{x} - w\mathbf{v}$$

$$\text{s.t. } \mathbf{x} = f(\mathbf{v})$$

Maximizing revenue given inputs



Cost minimization

- The dual side of the problem is equivalent.

$$\min_{\mathbf{v}} w\mathbf{v}$$

$$\text{s.t. } \mathbf{x} = f(\mathbf{v})$$

- The solution to this problem gives us a cost function

$$C(w, \mathbf{x}) = c(w)\mathbf{x},$$

  where the last eq follows from CRS.
- $c(w)$ is the *unit cost function*.

Properties of the unit cost function

We will use a number of properties:

1. homogeneous of degree one
2. concave in w
3. derivatives wrt w give unit input requirements

Graphical representation

The revenue function

- Suppose you have access to many technologies (f is vector-valued).
- Maximize total revenue subject to a limited amount of inputs.

$$\max_{x} p\mathbf{x}$$

$$\text{s.t. } \mathbf{x} = f(\mathbf{v})$$

- The solution gives the *revenue function*:

$$r(p, \mathbf{v}).$$

Properties of the revenue function

We will use a number of properties:

1. homogeneous of degree one in p
2. convex in p
3. concave in $\mathbf{v}$
4. derivatives wrt p give supply

Consumer choice recap

Utility maximization

$$\max_{\mathbf{x}} u(\mathbf{x})$$
$$\text{s.t. } p\mathbf{x} = e$$

Expenditure minimization

- The dual side of the problem is equivalent.

$$\min_{\mathbf{x}} p\mathbf{x}$$

$$\text{s.t. } u(\mathbf{x}) = u$$

- The solution to this problem gives us an expenditure function

$$e(p, u).$$

- For homothetic preferences, we have

$$e(p, u) = e(p)g(u).$$

Properties of the expenditure function

We will use a number of properties:

1. homogeneous of degree one in p
2. concave in p
3. derivatives wrt p give demand

Gains from trade

Setup

The country has

- endowments (vector) $\mathbf{v}$
- production $\mathbf{x}$
- consumption $\mathbf{c}$
- prices p

Technology and tastes

- Technology is represented by the revenue function

$$r(p, \mathbf{v}) = \max_{\mathbf{x}} p\mathbf{x} : (\mathbf{x}, \mathbf{v}) \text{ feasible.}$$

- Tastes are represented by the expenditure function

$$e(p, u) = \min_{\mathbf{c}} p\mathbf{c} : u(\mathbf{c}) = u.$$

Supply and demand

- Supply of goods (production)

$$\mathbf{x} = r_p(p, \mathbf{v}).$$

- Demand for goods (consumption)

$$\mathbf{c} = e_p(p, u).$$

Autarky equilibrium

- *Autarky*: the economy is closed, markets have to clear *within* the country.
- In equilibrium, each product market clears,

$$r_p(p, v) = e_p(p, u).$$

- Expenditure equals revenue

$$r(p, v) = e(p, u).$$

Autarky equilibrium

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- What about factor markets?
- What about profit maximization?
- What about utility maximization?

Trading equilibrium

- We start with the small open economy.
- The world price is p^w (arbitrary).
- At this price, the world buys and sells any amount.
- Net import of goods:

$$\mathbf{m}(p^w) = \mathbf{c}(p^w) - \mathbf{x}(p^w).$$

Equilibrium conditions

- Balanced trade:

$$0 = p^w \mathbf{m} = p^w(\mathbf{c}^w - \mathbf{x}^w) = p^w[e_p(p^w, u^w) - r_p(p^w, \mathbf{v})].$$

- Use Euler's theorem:

$$r(p, \mathbf{v}) = e(p, u).$$

Equilibrium conditions

- Goods market are now global, so local markets do not have to clear.

$$\mathbf{m}(p^w) = e_p(p, u) - r_p(p, \mathbf{v}).$$

- What about factor markets?

Gains from trade

- Let p^a denote the vector of autarky prices.

$$\begin{aligned} e(p^w, u^a) &\leq p^w \mathbf{c}^a \\ &= p^w \mathbf{x}^a \\ &\leq r(p^w, \mathbf{v}) \\ &= e(p^w, u^w) \end{aligned}$$

Gains from trade

- Let p^a denote the vector of autarky prices.

$$\begin{aligned} e(p^w, u^a) &\leq p^w \mathbf{c}^a \\ &= p^w \mathbf{x}^a \\ &\leq r(p^w, \mathbf{v}) \\ &= e(p^w, u^w) \end{aligned}$$

1. Definition of the expenditure function.
2. Autarky equilibrium.
3. Definition of the revenue function.
4. Open-economy equilibrium.

Gains from trade

- Since $e(p, u)$ is increasing in u,
$$u^w \geq u^a.$$
- Welfare is higher under trade than under autarky.
- Note that this holds for any p^w.

Graphical illustration with PPS

Discussion

- Moving from autarky to free trade always improves *aggregate welfare*.
- What we assumed:
  1. representative consumer/producer
  2. constant returns to scale technologies
  3. perfect competition
  4. no externalities / market failures

The equivalence of trade and technology

- Trade is a "technology" to transform export goods into import goods.
- As long as technology use is voluntary, having access to it is welfare improving.
- There may be important distributional consequences (to be discussed later).
  - Attitudes toward trade should be similar to attitudes toward technical progress.

Welfare effects of a new technology

- Take a linear technology $\mathbf{A}$ that defines the production set
$$\mathcal{A} = \{\mathbf{x} : \mathbf{A}\mathbf{x} \leq 0\}.$$
- Let $\mathcal{X}$ denote the set of existing technologies.
- How does welfare change with the invention of this new technology?

Welfare effects of a new technology

- Let $\mathbf{x} \in \mathcal{X}$ denote the old equilibrium, $\mathbf{x}' \in \mathcal{X} \bigcup \mathcal{A}$ the new one.
- By revenue maximization,
$$p'\mathbf{x} \leq p'\mathbf{x}'.$$
(If $\mathbf{x} \in \mathcal{X}$ then $\mathbf{x}' \in \mathcal{X} \bigcup \mathcal{A}$.)
- For consumers, the old consumption vector x is still attainable at the new prices.
- The fact that they chose a new basket implies that they are better off (weak axiom of revealed preference).

The equivalence of trade and technology

- Clearly, this problem is identical to opening up to trade if $\mathbf{A} \equiv p^w$.
- Even in a large economy, where p^w depends on $\mathbf{m}$, the same equivalence holds. (We have not used the linearity of $\mathbf{A}$ anywhere.)

2-country case

- Because the country gains for any p^w, when two countries open up to trade, *both gain*.

Patterns of trade

Patterns of trade

- How much can we say about the patterns of trade without talking about technologies, endowments, and tastes?
- Quite a lot. These are all summarized in the *autarky equilibrium price*.
- Deardorff (1980, JPE) derived the law of comparative advantage.

The law of comparative advantage

- Balanced trade:
$$p^w \mathbf{m} = 0.$$
- Autarky consumption is affordable at world prices,
$$p^w \mathbf{c}^a \leq p^w \mathbf{c}^w.$$

  Why?

The law of comparative advantage

- Balanced trade:
$$p^w \mathbf{m} = 0.$$
- Autarky consumption is affordable at world prices,
$$p^w \mathbf{c}^a \leq p^w \mathbf{c}^w.$$

Why?

1. $p^w \mathbf{x}^a \leq p^w \mathbf{x}^w$ by revenue maximization. ($\mathbf{x}^a$ is still feasible to produce, but brings less revenue.)
2. $p^w \mathbf{x}^a = p^w \mathbf{c}^a$ by market clearing.
3. $p^w \mathbf{x}^w = p^w \mathbf{c}^w$ by balanced trade.

The law of comparative advantage

- Autarky consumption is affordable under free trade, yet not chosen.
- By the *weak axiom of revealed preference*:

$$p^a \mathbf{c}^w > p^a \mathbf{c}^a.$$

- By revenue maximization,

$$p^a \mathbf{x}^w \leq p^a \mathbf{x}^a.$$

- Subtract the value of production, $p^a x$:

$$p^a(\mathbf{c}^w - \mathbf{x}^a) = p^a \mathbf{m} > p^a(\mathbf{c}^a - \mathbf{x}^a) = 0.$$

- *The autarky cost of the net import vector is positive.*
- Equivalently,

$$(p^a - p^w)\mathbf{m} > 0.$$

The 2-good case

- For two goods, this means $m_i > 0$ if and only if $p_i^a > p_i^w$.
- The country exports the product which has a low autarky price relative to the world price.
- The country imports the product which has a high autarky price relative to the world price.
- (How does this relate to "Buy cheap, sell dear?")
- There is no such strong conclusion for the n-good case. We only have a correlation of prices and trade patterns.

The 2-country case

- In a 2-country world, net imports of country 1 are net exports of country 2:

$$\mathbf{m} = -\mathbf{M}.$$

- (We use uppercase letters for country 2.)
- The law of CA holds in both countries

$$p^a \mathbf{m} > 0,$$
$$P^a \mathbf{M} > 0.$$

- Summing the two

$$(p^a - P^a)\mathbf{m} > 0.$$

The 2×2 case

- Goods flow from the low autarky price country to the high autarky price country.

$$(p^a - P^a)\mathbf{m} > 0.$$

- Balanced trade

$$p^w m = 0.$$

- With two goods, this implies

$$\frac{p_1^a}{p_2^a} < \frac{p_1^w}{p_2^w} < \frac{P_1^a}{P_2^a}$$

  if good 1 is exported and the reverse if good 2..
- We can narrow down the prices in trade equilibrium.
- Again, no such strong conclusion for the n-good case.