

14.581 International Trade
— Lecture 1 —
Comparative Advantage and Gains from Trade

Today's Plan

- 1 Course logistics
- 2 A Brief History of the Field
- 3 Neoclassical Trade: Standard Assumptions
- 4 Neoclassical Trade: General Results
 - 1 Gains from Trade
 - 2 Law of Comparative Advantage

- Recitations: TBA
- No required textbooks, but we will frequently use:
 - Dixit and Norman, Theory of International Trade (DN)
 - Feenstra, Advanced International Trade: Theory and Evidence (F)
 - Helpman and Krugman, Market Structure and Foreign Trade (HKa)
- Relevant chapters of all textbooks will be available on Stellar

- **Course requirements:**

- Four problem sets: 50% of the course grade
- One referee report: 15% of the course grade
- One research proposal: 35% of the course grade

- **Course outline:**

- ① Ricardian and Assignment Models (4 weeks)
- ② Factor Proportion Theory (2 weeks)
- ③ Firm Heterogeneity Models (2 weeks)
- ④ Gravity Models (1 week)
- ⑤ Topics:
 - ① Economic Geography (1 week)
 - ② Offshoring (1 week)
 - ③ Trade Policy (2 weeks)

A Brief History of the Field

Two hundred years of theory

① 1830-1980: Neoclassical trade theory

⇒ Ricardo

⇒ Heckscher-Ohlin-Samuelson

⇒ Dixit-Norman

② 1980-1990: New trade theory

⇒ Krugman-Helpman

⇒ Brander-Krugman

⇒ Grossman-Helpman

A Brief History of the Field

The discovery of trade data

- 1 **1990-2000: Empirical trade**
 - ⇒ Leamer, Trefler, Davis-Weinstein
 - ⇒ Bernard, Tybout
- 2 **2000-2010: Firm-level heterogeneity**
 - ⇒ Melitz
 - ⇒ Eaton-Kortum
- 3 **Where are we now?**

International Trade: Standard Assumptions

- What distinguishes trade theory from abstract general-equilibrium analysis is the existence of a **hierarchical market structure**:
 - 1 “**International**” good markets
 - 2 “**Domestic**” factor markets
- Typical asymmetry between “**goods**” and “**factors**”:
 - Goods enter consumers’ utility functions directly, are elastically supplied and demanded, and can be freely traded internationally
 - Factors only affect utility through the income they generate, they are in fixed supply domestically, and they cannot be traded at all
- **Central Issues**:
 - How does the integration of good markets affect good prices?
 - How do changes in good prices, in turn, affect factor prices, factor allocation, production, and welfare?

International Trade: Standard Assumptions (Cont.)

- While these assumptions are less fundamental, we will also often assume that:
 - Consumers have identical homothetic preferences in each country (representative agent)
 - Model is static (long-run view)
- Many of these assumptions look very strong, but they can be dealt with by clever reinterpretations of the model:
 - Transport costs could be handled by interpreting one of the good as transportation services
 - Factor mobility could be dealt with by defining as a good anything that can be traded
 - Goods and factors can be distinguished by locations, time, and states of nature

Neoclassical Trade: Standard Assumptions

- **“Neoclassic trade models”** characterized by three key assumptions:
 - ① *Perfect competition*
 - ② *Constant returns to scale (CRS)*
 - ③ *No distortions*
- **Comments:**
 - We could allow for decreasing returns to scale (DRS) by introducing hidden factors in fixed supply
 - Increasing returns to scale (IRS) are a much more severe issue addressed by “New” trade theory

Neoclassical Trade: General Results

- Not surprisingly, there are few results that can be derived using only Assumptions 1-3
- In future lectures, we will derive sharp predictions for special cases: Ricardo, Assignment, Ricardo-Viner, and Heckscher-Ohlin models
- Today, we'll stick to the general case and show how simple revealed preference arguments can be used to establish two important results:
 - 1 *Gains from trade* (Samuelson 1939)
 - 2 *Law of comparative advantage* (Deardorff 1980)

- Consider a world economy with $n = 1, \dots, N$ countries, each populated by $h = 1, \dots, H_n$ households
- There are $g = 1, \dots, G$ goods:
 - $y^n \equiv (y_1^n, \dots, y_G^n) \equiv$ Output vector in country n
 - $c^{nh} \equiv (c_1^{nh}, \dots, c_G^{nh}) \equiv$ Consumption vector of household h in country n
 - $p^n \equiv (p_1^n, \dots, p_G^n) \equiv$ Good price vector in country n
- There are $f = 1, \dots, F$ factors:
 - $v^n \equiv (v_1^n, \dots, v_F^n) \equiv$ Endowment vector in country n
 - $w^n \equiv (w_1^n, \dots, w_F^n) \equiv$ Factor price vector in country n

Supply

The revenue function

- We denote by Ω^n the set of combinations (y, v) feasible in country n
 - CRS $\Rightarrow \Omega^n$ is a convex cone
- **Revenue function** in country n is defined as

$$r^n(p, v) \equiv \max_y \{py \mid (y, v) \in \Omega^n\}$$

- Comments (see Dixit-Norman pp. 31-36 for details):
 - Revenue function summarizes all relevant properties of technology
 - Under perfect competition, y^n maximizes the value of output in country n :

$$r^n(p^n, v^n) = p^n y^n \quad (1)$$

Demand

The expenditure function

- We denote by u^{nh} the utility function of household h in country n
- **Expenditure function** for household h in country n is defined as

$$e^{nh}(p, u) = \min_c \{pc \mid u^{nh}(c) \geq u\}$$

- Comments (see Dixit-Norman pp. 59-64 for details):
 - Here factor endowments are in fixed supply, but easy to generalize to case where households choose factor supply optimally
 - Holding p fixed, $e^{nh}(p, u)$ is increasing in u
 - Household's optimization implies

$$e^{nh}(p^n, u^{nh}) = p^n c^{nh}, \quad (2)$$

where c^{nh} and u^{nh} are the consumption and utility level of the household in equilibrium, respectively

Gains from Trade

One household per country

- In the next propositions, when we say “*in a neoclassical trade model,*” we mean in a model where equations (1) and (2) hold in any equilibrium
- Consider first the case where there is just one household per country
- Without risk of confusion, we drop h and n from all variables
- Instead we denote by:
 - (y^a, c^a, p^a) the vector of output, consumption, and good prices under autarky
 - (y, c, p) the vector of output, consumption, and good prices under free trade
 - u^a and u the utility levels under autarky and free trade

Gains from Trade

One household per country

- **Proposition 1** *In a neoclassical trade model with one household per country, free trade makes all households (weakly) better off.*
- Proof:

$$\begin{aligned} e(p, u^a) &\leq pc^a, && \text{by definition of } e \\ &= py^a && \text{by market clearing under autarky} \\ &\leq r(p, v) && \text{by definition of } r \\ &= e(p, u) && \text{by equations (1), (2), and trade balance} \end{aligned}$$

Since $e(p, \cdot)$ increasing, we get $u \geq u^a$

Gains from Trade

One household per country

- **Comments:**

- Two inequalities in the previous proof correspond to consumption and production gains from trade
- Previous inequalities are weak. Equality if kinks in IC or PPF
- Previous proposition only establishes that households always prefer “free trade” to “autarky.” It does **not** say anything about the comparisons of trade equilibria

Gains from Trade

Multiple households per country (I): domestic lump-sum transfers

- With multiple-households, moving away from autarky is likely to create winners and losers
 - How does that relate to the previous comment?
- In order to establish the Pareto-superiority of trade, we will therefore need to allow for policy instruments. We start with *domestic* lump-sum transfers and then consider
- We now reintroduce the index h explicitly and denote by:
 - c^{ah} and c^h the vector of consumption of household h under autarky and free trade
 - v^{ah} and v^h the vector of endowments of household h under autarky and free trade
 - u^{ah} and u^h the utility levels of household h under autarky and free trade
 - τ^h the lump-sum transfer from the government to household h ($\tau^h \leq 0 \Leftrightarrow$ lump-sum tax and $\tau^h \geq 0 \Leftrightarrow$ lump-sum subsidy)

Gains from Trade

Multiple households per country (I): domestic lump-sum transfers

- **Proposition 2** *In a neoclassical trade model with multiple households per country, there exist domestic lump-sum transfers such that free trade is (weakly) Pareto superior to autarky in all countries*
- **Proof:** We proceed in two steps
Step 1: For any h , set the lump-sum transfer τ^h such that

$$\tau^h = (p - p^a) c^{ah} - (w - w^a) v^h$$

Budget constraint under autarky implies $p^a c^{ah} \leq w^a v^h$. Therefore

$$p c^{ah} \leq w v^h + \tau^h$$

Thus c^{ah} is still in the budget set of household h under free trade

Gains from Trade

Multiple households per country (I): domestic lump-sum transfers

- **Proposition 2** *In a neoclassical trade model with multiple households per country, there exist domestic lump-sum transfers such that free trade is (weakly) Pareto superior to autarky in all countries*

- **Proof (Cont.):**

Step 2: By definition, government's revenue is given by

$$\begin{aligned} -\sum \tau^h &= (p^a - p) \sum c^{ah} - (w^a - w) \sum v^h && : \text{definition of } \tau_h \\ &= (p^a - p) y^a - (w^a - w) v && : \text{mc autarky} \\ &= -py^a + wv && : \text{zp autarky} \\ &\geq -r(p, v) + wv && : \text{definition } r(p, v) \\ &= -(py - wv) = 0 && : \text{eq. (1) + zp free trade} \end{aligned}$$

Gains from Trade

Multiple households per country (I): domestic lump-sum transfers

- **Comments:**

- Good to know we don't need *international* lump-sum transfers
- Domestic lump-sum transfers remain informationally intensive (c^{ah} ?)

Gains from Trade

Multiple households per country (II): commodity and factor taxation

- With this last comment in mind, we now restrict the set of instruments to commodity and factor taxes/subsidies
- More specifically, suppose that the government can affect the prices faced by all households under free trade by setting τ^{good} and τ^{factor}

$$\begin{aligned}p^{\text{household}} &= p + \tau^{\text{good}} \\w^{\text{household}} &= w + \tau^{\text{factor}}\end{aligned}$$

Gains from Trade

Multiple households per country (II): commodity and factor taxation

- **Proposition 3** *In a neoclassical trade model with multiple households per country, there exist commodity and factor taxes/subsidies such that free trade is (weakly) Pareto superior to autarky in all countries*
- **Proof:** Consider the two following taxes:

$$\begin{aligned}\tau^{\text{good}} &= p^a - p \\ \tau^{\text{factor}} &= w^a - w\end{aligned}$$

By construction, household is indifferent between autarky and free trade. Now consider government's revenues. By definition

$$\begin{aligned}-\sum \tau^h &= \tau^{\text{good}} \sum c^{ah} - \tau^{\text{factor}} \sum v^h \\ &= (p^a - p) \sum c^{ah} - (w^a - w) \sum v^h \geq 0,\end{aligned}$$

for the same reason as in the previous proof.

Gains from Trade

Multiple households per country (II): commodity and factor taxation

- **Comments:**

- Previous argument only relies on the existence of *production gains* from trade
- If there is a kink in the PPF, we know that there aren't any...
- Similar problem with “moving costs”. See Feenstra p.185
- Factor taxation still informationally intensive: need to know endowments per efficiency units, may lead to different business taxes

Law of Comparative Advantage

Basic Idea

- The previous results have focused on normative predictions
- We now demonstrate how the same revealed preference argument can be used to make positive predictions about the pattern of trade
- **Principle of comparative advantage:**
Comparative advantage—meaning differences in relative autarky prices—is the basis for trade
- Why? If two countries have the same autarky prices, then after opening up to trade, the autarky prices remain equilibrium prices. So there will be no trade....
- **The law of comparative advantage (in words):**
Countries tend to export goods in which they have a CA, i.e. lower relative autarky prices compared to other countries

Law of Comparative Advantage

Dixit-Norman-Deardorff (1980)

- Let $t^n \equiv (y_1^n - \sum c^{nh}, \dots, y_G^n - \sum c^{nh})$ denote net exports in country n
- Let u^{an} and u^n denote the utility level of the representative household in country n under autarky and free trade
- Let p^{an} denote the vector of autarky prices in country n
- Without loss of generality, normalize prices such that:

$$\sum p_g = \sum p_g^{an} = 1,$$

- Notations:

$$\begin{aligned} \text{cor}(x, y) &= \frac{\text{cov}(x, y)}{\sqrt{\text{var}(x) \text{var}(y)}} \\ \text{cov}(x, y) &= \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) \\ \bar{x} &= \frac{1}{n} \sum_{i=1}^n x_i \end{aligned}$$

Law of Comparative Advantage

Dixit-Norman-Deardorff (1980)

- **Proposition 4** *In a neoclassical trade model, if there is a representative household in country n , then $\text{cor}(p - p^a, t^n) \geq 0$*

Proof: Since $(y^n, v^n) \in \Omega^n$, the definition of r implies

$$p^a y^n \leq r(p^a, v^n)$$

Since $u^n(c^n) = u^n$, the definition of e implies

$$p^a c^n \geq e(p^a, u^n)$$

The two previous inequalities imply

$$p^a t^n \leq r(p^a, v^n) - e(p^a, u^n) \quad (3)$$

Since $u^n \geq u^{an}$ by Proposition 1, $e(p^a, \cdot)$ increasing implies

$$e(p^a, u^n) \geq e(p^a, u^{an}) \quad (4)$$

Law of Comparative Advantage

Dixit-Norman-Deardorff (1980)

- **Proposition 4** *In a neoclassical trade model, if there is a representative household in country n , then $\text{cor}(p - p^a, t^n) \geq 0$*
Proof (Cont.): Combining inequalities (3) and (4), we obtain

$$p^a t^n \leq r(p^a, v^n) - e(p^a, u^{na}) = 0,$$

where the equality comes from market clearing under autarky.
Because of balanced trade, we know that

$$p t^n = 0$$

Hence

$$(p - p^a) t^n \geq 0$$

Law of Comparative Advantage

Dixit-Norman-Deardorff (1980)

- **Proposition 4** *In a neoclassical trade model, if there is a representative household in country n , then $\text{cor}(p - p^a, t^n) \geq 0$*

Proof (Cont.): By definition,

$$\text{cov}(p - p^a, t^n) = \sum_g (p_g - p_g^a - \bar{p} + \bar{p}^a) (t_g^n - \bar{t}^n),$$

which can be rearranged as

$$\text{cov}(p - p^a, t^n) = (p - p^a) t^n - G(\bar{p} - \bar{p}^a) \bar{t}^n$$

Given our price normalization, we know that $\bar{p} = \bar{p}^a$. Hence

$$\text{cov}(p - p^a, t^n) = (p - p^a) t^n \geq 0$$

Proposition 4 derives from this observation and the fact that

$$\text{sign}[\text{cor}(p - p^a, t^n)] = \text{sign}[\text{cov}(p - p^a, t^n)]$$

Law of Comparative Advantage

Dixit-Norman-Deardorff (1980)

• Comments:

- With 2 goods, each country exports the good in which it has a CA, but with more goods, this is just a correlation
- Core of the proof is the observation that $p^a t^n \leq 0$
- It directly derives from the fact that there are gains from trade. Since free trade is better than autarky, the vector of consumptions must be at most barely attainable under autarky ($p^a y^n \leq p^a c^n$)
- For empirical purposes, problem is that we rarely observe autarky...
- In future lectures, we will look at models which relate p^a to (observable) primitives of the model: technology and factor endowments

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