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

Course Logistics

- **Lecture**: Mondays, Wednesdays 09:00am-10:30am, E51-151
- **Instructor**: Arnaud Costinot
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Course Logistics

- **TA**: Masao Fukui
  - Email: fukui@mit.edu
  - Office hours: by appointment
- Recitations: Wednesdays 12:00pm-1:00pm, E51-151
- 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
- Relevant papers can be downloaded on Dropbox (link in the syllabus)

Course Logistics

- **Course requirements**:
  - Four problem sets: 40% of the course grade
  - One referee report: 15% of the course grade
  - One presentation: 15% of the course grade (second week of December)
  - One research proposal: 30% of the course grade (due January 14th, 2019)
- There will be **no lecture** on Wednesday Nov. 21 (Thanksgiving)

Course Logistics

- **Course outline:**
  1. Law of CA (1 week)
  2. Technology (2 weeks)
  3. Factor Endowments (2 weeks)
  4. Increasing Returns and Imperfect Competition (3 weeks)
  5. Counterfactual and Welfare Analysis (1.5 week)
  6. Trade Policy and Other Impediments to Trade (2.5 weeks)

A Brief History of the Field

Two hundred years of theory

1. **1830-1980: Neoclassical trade theory**
   - $\Rightarrow$ Ricardo
   - $\Rightarrow$ Heckscher-Ohlin-Samuelson
   - $\Rightarrow$ Dixit-Norman
2. **1980-1990: New trade theory**
   - $\Rightarrow$ Krugman-Helpman
   - $\Rightarrow$ Brander-Krugman
   - $\Rightarrow$ Grossman-Helpman

A Brief History of the Field

The discovery of trade data

1. **1990-2000: Empirical trade**
   $\Rightarrow$ Leamer, Trefler, Davis-Weinstein
   $\Rightarrow$ Bernard, Tybout
2. **2000-2010: Firm-level heterogeneity**
   $\Rightarrow$ Melitz
   $\Rightarrow$ 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:
  - Goods can be distinguished by locations, time, and states of nature
    - So even if trade is "free", goods that are sold abroad may be subject to transportation costs, whereas goods that are sold locally are not
    - In an Arrow-Debreu sense, goods sold in different locations are just different goods that require different "production" costs
  - Factor mobility could be dealt with by defining as a good anything that can be traded etc.

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 can always allow for decreasing returns to scale (DRS) by introducing extra 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)

Basic Environment

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

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

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

- 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:

$$r^n(p^n, v^n) = p^n y^n \tag{1}$$

- 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

$$e^{nh}(p, u) = \min_{c} \left\{ pc | u^{nh}(c) \geq u \right\}$$

- 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

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

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

- **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 $u \geq u^a$

- **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 commodity taxes
- 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)

- **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

- **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

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

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 taxes

- With this last comment in mind, we now restrict the set of instruments to commodity 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}

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

- **Proposition 3** *In a neoclassical trade model with multiple households per country, there exist commodity 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.

- **Comments:**
  - Proof only relies on the existence of *production gains* from trade
    - Closely related to Diamond and Mirrlees' (1971) production efficiency
    - When only commodity taxes are available, DM show that production should remain efficient at a social optimum
    - Thus, trade, which acts as an expansion of PPF, should remain free (ignoring issues of market power)
  - If there is a kink in the PPF, there are no production gains...
    - Similar problem with "moving costs". See Feenstra p.185
  - Factor taxation still informationally intensive: need to know endowments in 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 $t^n \equiv \left(y_1^n - \sum c^{nh}, ..., y_G^n - \sum c^{nh}\right)$ 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:

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

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 cor* $(p - p^a, t^n) \geq 0$
  Proof: Since $(y^n, v^n) \in \Omega^n$, the definition of r implies

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

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

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

The two previous inequalities imply

$$p^a t^n \leq r\left(p^a, v^n\right) - e\left(p^a, u^n\right) \tag{3}$$

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

$$e(p^a, u^n) \geq e(p^a, u^{na}) \tag{4}$$

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

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

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

$$pt^n = 0$$

  Hence

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

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* $cor\left(p - p^a, t^n\right) \geq 0$
  Proof (Cont.): By definition,

$$cov\left(p - p^a, t^n\right) = \sum\nolimits_g \left(p_g - p_g^a - \overline{p} + \overline{p}^a\right)\left(t_g^n - \overline{t}^n\right),$$

which can be rearranged as

$$cov\left(p - p^a, t^n\right) = \left(p - p^a\right) t^n - G\left(\overline{p} - \overline{p}^a\right)\overline{t}^n$$

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

$$cov\left(p - p^a, t^n\right) = \left(p - p^a\right) t^n \geq 0$$

Proposition 4 derives from this observation and the fact that

$$sign\left[cor\left(p - p^a, t^n\right)\right] = sign\left[cov\left(p - p^a, t^n\right)\right]$$

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