14.581 MIT International Trade —Lecture 1: Gains from Trade and the Law of Comparative Advantage (Theory)—

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Spring 2011

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

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Course Logistics

- **Lecture**: Monday, Wednesday 2:30PM-4:00PM, E52-398
- **Instructor**: Dave Donaldson
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  - Office hours: by appointment

Course Logistics

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

Course Logistics

- **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 Logistics

- **Course outline:**
  1. Neoclassical Trade (4 weeks)
     1. General Model
     2. Special Cases: Ricardo, Ricardo-Viner, Heckscher-Ohlin
  2. "New" trade (4 weeks)
     1. Increasing Returns and Monopolistic Competition
     2. Monopolistic Competition with Firm Heterogeneity
     3. Gravity models and gravity equations.
  3. Topics:
     1. Trade and Growth (1 week)
     2. Trade and Labor Markets (1 week)
     3. International Organization of Production (outsourcing, fragmentation of production, multinational firms) (2 weeks)
     4. Trade Policy (political economy, WTO) (1 week)
- Under every topic we will have one lecture on the theory and then one on the empirics; the goal is to learn as much as possible about each, and about their interaction.

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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; tighter integration of theory and empirics

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?**

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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, which was (partially) addressed by "New" trade theory.

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Neoclassical Trade: General Results

- Not surprisingly, there are few results that can be derived using only Assumptions 1-3.
- In the next three classes, we will derive sharp predictions for special cases of the neoclassical trade: Ricardo, Ricardo-Viner, and Heckscher-Ohlin.
- 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

Supply

The revenue function

- 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:

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

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

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

- 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.

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 more general policies.
- 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

$$pc^{ah} \leq wv^h + \tau^h.$$

  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

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

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 (where to find data on 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} according to:

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

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.

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Law of Comparative Advantage

Basic Idea

- The previous results have focused on normative predictions.
- We now demonstrate how the same revealed preference argument can also 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

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

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 (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,

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

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.