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

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

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)

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:**
  - Neoclassical Trade (4 weeks)
    - General Model
    - Special Cases: Ricardo, Ricardo-Viner, Heckscher-Ohlin
  - "New" trade (4 weeks)
    - Increasing Returns and Monopolistic Competition
    - Monopolistic Competition with Firm Heterogeneity
    - Gravity models and gravity equations.
  - Topics:
    - Trade and Growth (1 week)
    - Trade and Labor Markets (1 week)
    - International Organization of Production (outsourcing, fragmentation of production, multinational firms) (2 weeks)
    - 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

- **1830-1980: Neoclassical trade theory**
  - $\Rightarrow$ Ricardo
  - $\Rightarrow$ Heckscher-Ohlin-Samuelson
  - $\Rightarrow$ Dixit-Norman
- **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

- **1990-2000: Empirical trade**
  $\Rightarrow$ Leamer, Trefler, Davis-Weinstein
  $\Rightarrow$ Bernard, Tybout
- **2000-2010: Firm-level heterogeneity**
  $\Rightarrow$ Melitz
  $\Rightarrow$ Eaton-Kortum
- **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**:
  - **"International"** good markets
  - **"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:
  - *Perfect competition*
  - *Constant returns to scale (CRS)*
  - *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:
  - *Gains from trade* (Samuelson 1939)
  - *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

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

  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

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

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* $cor\left(p - p^a, t^n\right) \geq 0$.

  Proof: Since $\left(y^n, v^n\right) \in \Omega^n$, 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.

14.581 International Economics I

Spring 2011