14.582 International Trade
— Lecture 1: Monopolistic Competition —

Today's Plan

1. "New" Trade Theory
2. Trade Theory Goes Dixit-Stiglitz
    1. Krugman (1979)
    2. Krugman (1980)
3. Unifying "Old " and "New" Trade Theory
    1. Helpman and Krugman (1985)

"New" Trade Theory

What's wrong with neoclassical trade theory?

- In a neoclassical world, differences in relative autarky prices—due to differences in technology, factor endowments, or preferences—are the only rationale for trade
- This suggests that:
  1. "Different" countries should trade more
  2. "Different" countries should specialize in "different" goods
- In the real world, however, we observe that:
  1. A substantial amount of world trade is between "similar" countries
  2. These countries tend to trade "similar" goods

"New" Trade Theory

Why Increasing Returns to Scale (IRS)?

- "New" Trade Theory proposes IRS as an alternative rationale for international trade and a potential explanation for the previous facts
- **Basic idea:**
  1. Because of IRS, similar countries will specialize in different goods to take advantage of large-scale production, thereby leading to trade
  2. Because of IRS, countries may exchange goods with similar factor content
- In addition, IRS may provide new source of gains from trade if it induces firms to move down their average cost curves

"New" Trade Theory

How to model increasing returns to scale?

1. **External economies of scale**
   - Under perfect competition, multiple equilibria and possibilities of losses from trade (Ethier 1982)
   - Under Bertrand competition, many issues can be resolved (Grossman and Rossi-Hansberg 2009)
2. **Internal economies of scale**
   - Under perfect competition, average cost curves need to be U-shaped, but in this case:
     - firms can never be on the downward-sloping part of their average cost curves (so no efficiency gains from trade liberalization)
     - there still are CRS at the sector level
   - Under imperfect competition, many predictions seem possible depending on the market structure

Monopolistic Competition

Trade economists' most preferred market structure

- Monopolistic competition, formalized by Dixit and Stiglitz (1977), is the most common market structure among "new" trade models
- It provides a very mild departure from imperfect competition, but opens up a rich set of new issues
- **Classical examples:**
  - Krugman (1979): IRS as a new rationale for international trade
  - Krugman (1980): Home market effect in the presence of trade costs

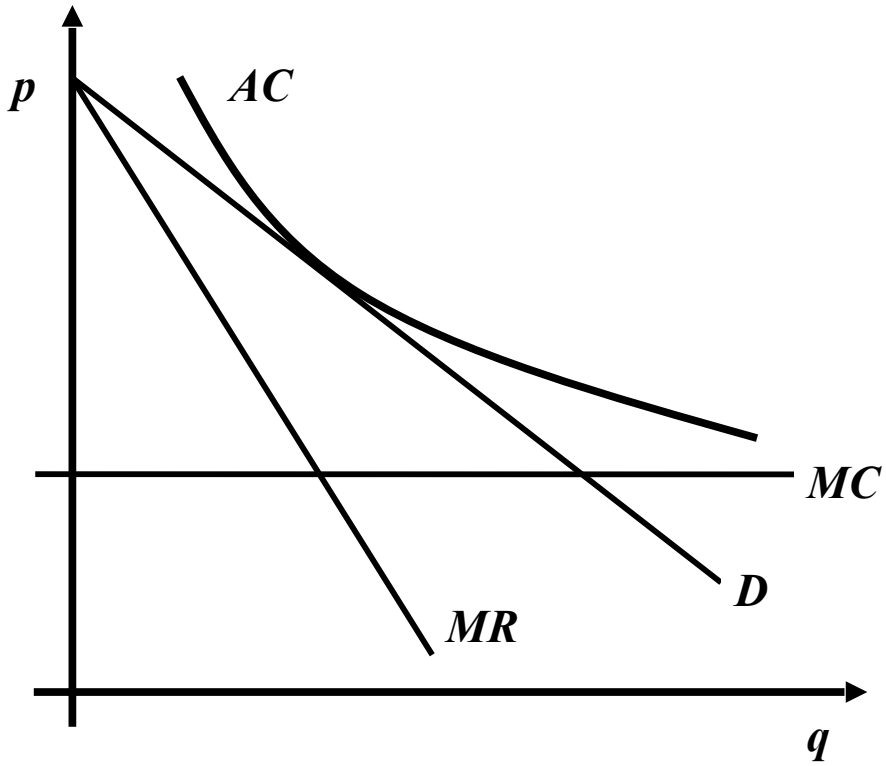
Monopolistic Competition

Basic idea

- **Monopoly pricing:**
  Each firm faces a downward-sloping demand curve
- **No strategic interaction:**
  Each demand curve depends on the prices charged by other firms
  - but since the number of firms is large, each firm ignores its impact on the demand faced by other firms
- **Free entry:**
  Firms enter the industry until profits are driven to zero for all firms

Monopolistic Competition

Graphical analysis



Krugman (1979)

Endowments, preferences, and technology

- **Endowments:** All agents are endowed with 1 unit of labor
- **Preferences:** All agents have the same utility function given by

$$U = \int_0^n u\left[c_i\right] di$$

where:

  - $u(0) = 0$, $u' > 0$, and $u'' < 0$ (love of variety)
  - $\sigma(c) \equiv -\frac{u'}{cu''} > 0$ is such that $\sigma' \leq 0$ (why?)

- **IRS Technology:** Labor used in the production of each "variety" is

$$l_i = f + q_i / \varphi$$

where $\varphi \equiv$ *common* productivity parameter

Krugman (1979)

Equilibrium conditions

1. **Consumer maximization:**

$$p_i = \lambda^{-1} u'(c_i)$$

2. **Profit maximization:**

$$p_i = \left[\frac{\sigma(c_i)}{\sigma(c_i) - 1}\right] \cdot \left(\frac{w}{\varphi}\right)$$

3. **Free entry:**

$$\left(p_i - \frac{w}{\varphi}\right) q_i = wf$$

4. **Good and labor market clearing:**

$$\begin{aligned} q_i &= Lc_i \\ L &= nf + \int_0^n \frac{q_i}{\varphi} di \end{aligned}$$

Krugman (1979)

Equilibrium conditions rearranged

- Symmetry $\Rightarrow p_i = p$, $q_i = q$, and $c_i = c$ for all $i \in [0, n]$
- c and p/w are simultaneously characterized by

$$\text{(PP):} \qquad \frac{p}{w} = \left[\frac{\sigma(c)}{\sigma(c)-1}\right]\frac{1}{\varphi}$$

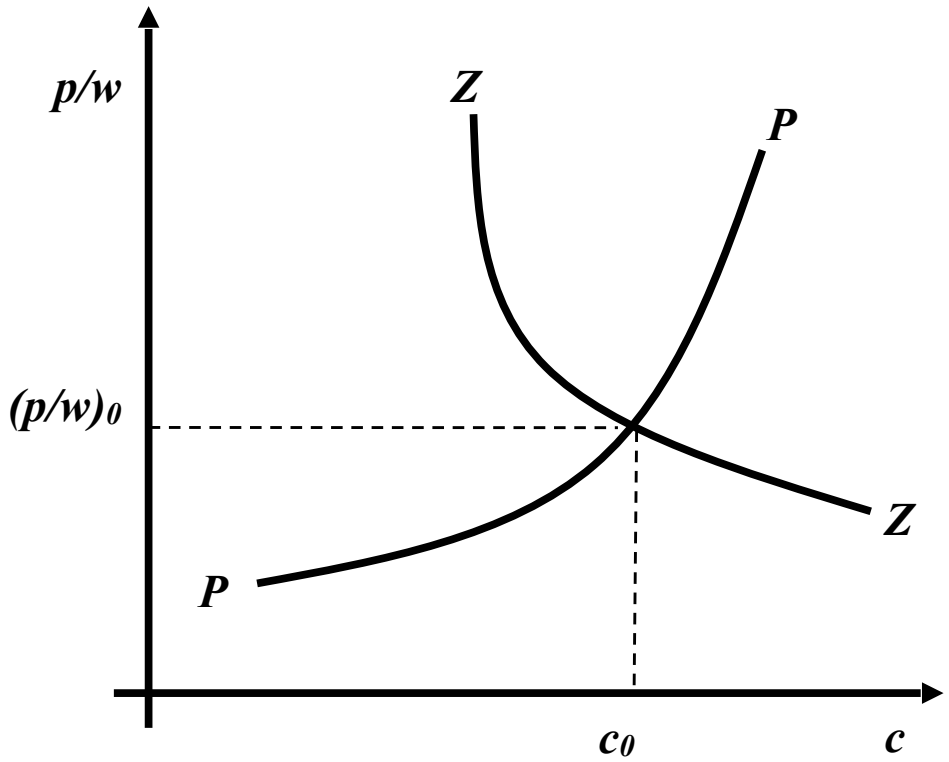
$$\text{(ZP):} \qquad \frac{p}{w} = \frac{f}{q} + \frac{1}{\varphi} = \frac{f}{Lc} + \frac{1}{\varphi}$$

- n can then be computed using market clearing conditions

$$n = \frac{1}{f/L + c/\varphi}$$

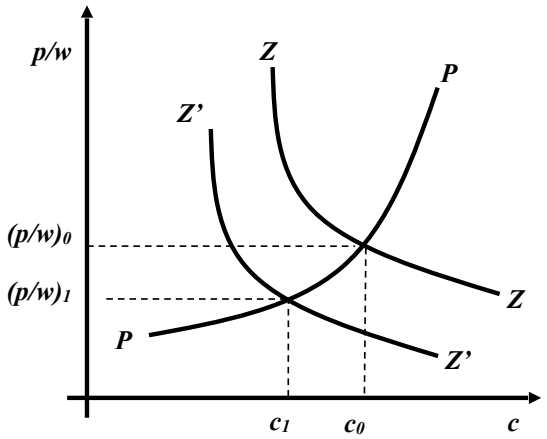
Krugman (1979)

Graphical analysis



Krugman (1979)

Gains from trade revisited



- Suppose that two identical countries open up to trade
  - This is equivalent to a doubling of country size (which would have no effect in a neoclassical trade model)
- Because of IRS, opening up to trade now leads to:
  - **Increased product variety**: $c_1 < c_0 \Rightarrow \frac{1}{f/2L+c_1/\varphi} > \frac{1}{f/L+c_0/\varphi}$
  - **Pro-competitive/efficiency effects**: $(p/w)_1 < (p/w)_0 \Rightarrow q_1 > q_0$

CES Preferences

Trade economists' most preferred demand system

- Constant Elasticity of Substitution (CES) preferences correspond to the case where:

$$U = \int_0^n (c_i)^{\frac{\sigma-1}{\sigma}} di,$$

  where $\sigma > 1$ is the elasticity of substitution between pair of varieties
- What is it to like about CES preferences?
  - Homotheticity ($u(c) \equiv (c)^{\frac{\sigma-1}{\sigma}}$ is actually the *only* functional form such that U is homothetic)
  - Can be derived from discrete choice model with i.i.d extreme value shocks (See Feenstra Appendix B)
- Is it empirically reasonable?

CES Preferences

Special properties of the equilibrium

- Because of monopoly pricing, CES $\Rightarrow$ constant markups:

$$\frac{p}{w} = \left[\frac{\sigma}{\sigma - 1}\right] \frac{1}{\varphi}$$

- Because of zero profit, constant markups $\Rightarrow$ constant output per firm:

$$\frac{p}{w} = \frac{f}{q} + \frac{1}{\varphi}$$

- Because of market clearing, constant output per firm $\Rightarrow$ constant number of varieties per country:

$$n = \frac{L}{f + q/\varphi}$$

- So, gains from trade **only** come from access to Foreign varieties
  - IRS provide an intuitive reason why Foreign varieties are different
  - But consequences of trade would now be the same if we had maintained CRS with different countries producing different goods

CES Utility

Special properties of the equilibrium

- Decentralized equilibrium is efficient (Dhingra and Morrow 16)
- Decentralized equilibrium solves:

$$\max_{q_i,n} \int_0^n p_i\left(q_i\right) q_i di$$

$$\text{subject to} \quad : \quad nf + \int_0^n \frac{q_i}{\varphi} di \leq L.$$

- A central planner would solve:

$$V(L) = \max_{q_i,n} \left(\int_0^n \left(q_i\right)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}$$

$$\text{subject to:} \quad nf + \int_0^n \frac{q_i}{\varphi} di \leq L.$$

- Under CES, $p_i\left(q_i\right) q_i \propto q_i^{1-\frac{1}{\sigma}} \Rightarrow$ Two solutions coincide
  - This is unique to CES (in general, entry is distorted)
  - This implies that many properties of perfectly competitive models will carry over to this environment

CES Utility

External versus internal economies of scale redux

- Consider the value function associated with the planner's problem
- At the solution of the planner's problem:

$$q_i = f(\sigma - 1)\phi$$
$$n = L/(\sigma f)$$

- The value function therefore satisfies:

$$V(L) = f(\sigma - 1)(L/(\sigma f))^{\frac{\sigma}{\sigma-1}} \propto L(L)^{\frac{1}{\sigma-1}}$$

- It is as if we had external economies scale w/ elasticity $1/(\sigma - 1)$
  - Aggregate TFP, $V(L)/L$, is an increase function of L
  - With external economies of scale, physical productivity goes up with L
  - Here, higher L implies more varieties, which also lowers the price index
- Key for home-market effect in Krugman (1980)
  - Also central in economic geography models

Krugman (1980)

The role of trade costs

- Trade costs were largely absent from neoclassical trade models (pre 1980)
- We now explore the implications of trade costs in the presence of IRS
- **Main result**: *"Home-market effect"*
  - Countries will tend to export those goods for which they have relatively large domestic markets
- **Basic idea:**
  - Because of trade costs, countries produce relatively more of the goods for which they have relatively higher demand
  - Because of IRS, these goods are relatively cheaper (lower price index)
  - Because prices are lower, exports are larger
    - Formalization of Linder's (1961) Hypothesis
- Logic is very different from neoclassical trade theory in which larger demand tends to be associated with *imports* rather than *exports*

Krugman (1980)

Starting point: one factor-one industry-two-country

- There are two countries: Home (H) and Foreign (F)
- There is one differentiated good produced under IRS by monopolistically competitive firms, as in Krugman (1979)
- Preferences over varieties are CES:

$$U = \int_0^n (c_i)^{\frac{\sigma-1}{\sigma}} di,$$

- There are iceberg trade costs between countries:
  - In order to sell 1 unit abroad, domestic firms must ship $\tau > 1$ units

Krugman (1980)

Equilibrium conditions (Home Country)

1. **Consumer maximization:**

$$q^{H,H} = \frac{w^H L^H}{P^H}\left(p^{HH}/P^H\right)^{-\sigma},\ q^{F,H} = \frac{w^H L^H}{P^H}\left(p^{F,H}/P^H\right)^{-\sigma} \quad (1)$$

where $P^H = \left[n^H\left(p^{H,H}\right)^{1-\sigma} + n^F\left(p^{F,H}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$.

2. **Monopoly pricing:**

$$p^{H,H} = \left[\frac{\sigma}{\sigma-1}\right]\cdot\left(w^H/\varphi\right),\ p^{H,F} = \left[\frac{\sigma}{\sigma-1}\right]\cdot\left(\tau w^H/\varphi\right) \quad (2)$$

3. **Free entry:**

$$\left(p^{H,H} - w^H/\varphi\right)q^{H,H} + \left(p^{H,F} - w^H/\varphi\right)q^{H,F} = w^H f, \quad (3)$$

4. **Labor market clearing:**

$$L^H = n^H\left(f + q^{H,F}/\varphi + \tau q^{H,F}/\varphi\right) \quad (4)$$

- **Proposition** $w^H \geq w^F$ *if and only* $L^H \geq L^F$
- **Proof:** Monopoly pricing and free entry, (2) and (3), imply

$$q^{H,H} + \tau q^{H,F} = (\sigma - 1) f \varphi$$

Combining this with labor market clearing (4), we get

$$n^H = L^H / \sigma F \tag{5}$$

Relative wage, w^H / w^F, is determined by trade balance

$$n^H p^{H,F} q^{H,F} = n^F p^{F,H} q^{F,H} \tag{6}$$

- **Proof (Cont.):** Combining (6) with (1) and (5) (and their Foreign counterparts), we obtain

$$\left(w^H/w^F\right)^{\sigma} = \frac{\tau^{1-\sigma} + \left(L^H/L^F\right)\left(w^H/w^F\right)^{1-\sigma}}{1 + \tau^{1-\sigma}\left(L^H/L^F\right)\left(w^H/w^F\right)^{1-\sigma}}$$

  Since $\tau^{1-\sigma} < 1$, this implies $w^H/w^F \nearrow$ in L^H/L^F. Proposition derives from this observation and $w^H/w^F = 1$ if $L^H/L^F = 1$

- **Intuition:**
  - In a neoclassical world, increase in relative labor supply would be associated with a decrease in relative wage
  - Here, increase in relative labor supply also shifts relative labor demand
    - It is as if we had external economies of scale that exactly compensate for the increase in supply
  - Without trade costs, wages are equal across countries. With trade costs, extra demand for labor from larger market leads to higher wages

Krugman (1980)

Home-Market Effect

- Now suppose that we add a second industry, $k = 1, 2$
- Upper-level preferences are Cobb-Douglas, but **differ across countries**
  - β_k^j = share of expenditure on industry k in country $j = H, F$
- For simplicity, two countries are mirror-image of each other:
  - $\beta_1^H = \beta_2^F = \beta$
  - $L^H = L^F = 1$
- Under these assumptions, wages are equalized: $w^H = w^F = 1$
  - See Matsuyama (2015) for a recent model with home-market effects that dispenses with mirror image restriction

Krugman (1980)

Home-market effect

- **Proposition** *Home is a net exporter of good* 1 *if and only* $\beta > 1$
- **Proof:** Good market clearing condition in industry 1:

$$\begin{aligned} n_1^H (p_1^{HH} q_1^{HH} + p_1^{HF} q_1^{HF}) &= \beta \frac{n_1^H}{n_1^H + \tau^{1-\sigma} n_1^F} + (1-\beta) \frac{\tau^{1-\sigma} n_1^H}{\tau^{1-\sigma} n_1^H + n_1^F} \\ n_1^F (p_1^{FH} q_1^{FH} + p_1^{FF} q_1^{FF}) &= \beta \frac{\tau^{1-\sigma} n_1^F}{n_1^H + \tau^{1-\sigma} n_1^F} + (1-\beta) \frac{n_1^F}{\tau^{1-\sigma} n_1^H + n_1^F} \end{aligned}$$

Under the mirror image assumption (also assuming $n_1^H, n_1^F > 0$)

$$p_1^{HH} q_1^{HH} + p_1^{HF} q_1^{HF} = p_1^{FH} q_1^{FH} + p_1^{FF} q_1^{FF}$$

This leads to

$$\frac{n_1^H}{n_1^F} = \frac{\frac{\beta}{(1-\beta)} - \tau^{1-\sigma}}{1 - \frac{\beta}{(1-\beta)} \tau^{1-\sigma}}$$

- **Proof (Cont.):** If parameters such that $\tau^{1-\sigma} < \frac{\beta}{1-\beta} < \tau^{\sigma-1}$, previous expression implies $\frac{n_1^H}{n_1^F} > 1$ if and only $\beta > 1$. Home's net exports in sector 1 are given by

$$NX_1^H = (1-\beta)\frac{\tau^{1-\sigma} n_1^H}{\tau^{1-\sigma} n_1^H + n_1^F} - \beta \frac{\tau^{1-\sigma} n_1^F}{n_1^H + \tau^{1-\sigma} n_1^F}$$
$$= \frac{(1-\beta)\tau^{1-\sigma}(n_1^H - n_1^F)}{\tau^{1-\sigma} n_1^H + n_1^F}$$

  Thus Home is also a net exporter of good 1. If parameters such that $\tau^{1-\sigma} < \frac{\beta}{1-\beta} < \tau^{\sigma-1}$ does not hold, one can check that equilibrium must have Home completely specialized in 1. So result still holds.
- **Intuition:** Since wages are necessarily equal, firms will only be active in the smaller market if they face softer competition there. This requires relatively less local competitors ($\frac{n_1^H}{n_1^F} > 1$ if and only $\beta > 1$).

Krugman (1980)

Home-Market Effect Redux

- Suppose that we again add a second industry in which a homogeneous good is produced one-for-one for labor in both countries
- Here, key difference between the two goods is **not demand**. It is that one is subject to **IRS** whereas other is subject to **CRS**.
  - Similar to model with external economies of scale in Ethier (1982)
- In such an environment, one can ask whether **large** countries should export good subject to **IRS** and **small** countries those subject to **CRS**
  - Krugman (1980) discusses that issue in his conclusion. Helpman and Krugman (1985) offer a proof and refer to result as home-market effect.
  - Source of confusion in the subsequent empirical literature in which tests of "the" home-market effect may refer to both:
    - Cross-country differences in demand, as in Krugman (1980)
    - Cross-country differences in size, as in Helpman and Krugman (1985)

Krugman (1980)

Home-Market Effect Redux

- Preferences over two types of goods are Cobb-Douglas
- Homogeneous good is freely traded, but differentiated goods are not
  - This is not innocuous, as discussed in Davis (1998)
- Under the previous assumptions:
  - wages again are equalized across countries: $w^H = w^F = 1$
  - Adjustments across countries may only come from number of varieties n^H and n^F (labor supply in the differentiated sector is endogenous)

Krugman (1980)

Home-market Effect Redux

- **Proposition** *Home is a net exporter of the differentiated good if and only if* $L^H \geq L^F$
- **Proof:** Focusing on good market clearing condition in the differentiated sector, same algebra as before implies (again assuming $n^H, n^F > 0$) that:

$$\frac{n^H}{n^F} = \frac{L^H/L^F - \tau^{1-\sigma}}{1 - \left(L^H/L^F\right)\tau^{1-\sigma}}$$

  Rest of the argument is unchanged.
- **Comment:** Math is identical, but economics behind equal wages is very different: mirror image vs. freely traded outside good.
- Note that $\partial\left(n^H/n^F\right)/\partial\tau^{1-\sigma} > 0$ if $L^H/L^F > 1$: home-market effect is larger if trade costs are small or elasticity of substitution is large

Helpman and Krugman (1985)

Inter- and intra-industry trade united

- Helpman and Krugman (1985), chapters 7 and 8, offer a unified theoretical framework to analyze inter- and intra-industry trade
- **Basic Strategy:**
  1. Start from the integrated equilibrium, but allow IRS in some sectors
  2. Provide conditions such that integrated equilibrium can be replicated under free trade
  3. Build on the observation that each variety is only produced in one country, but consumed in both, to make new predictions about the structure of trade flows when free trade replicates integrated eq.

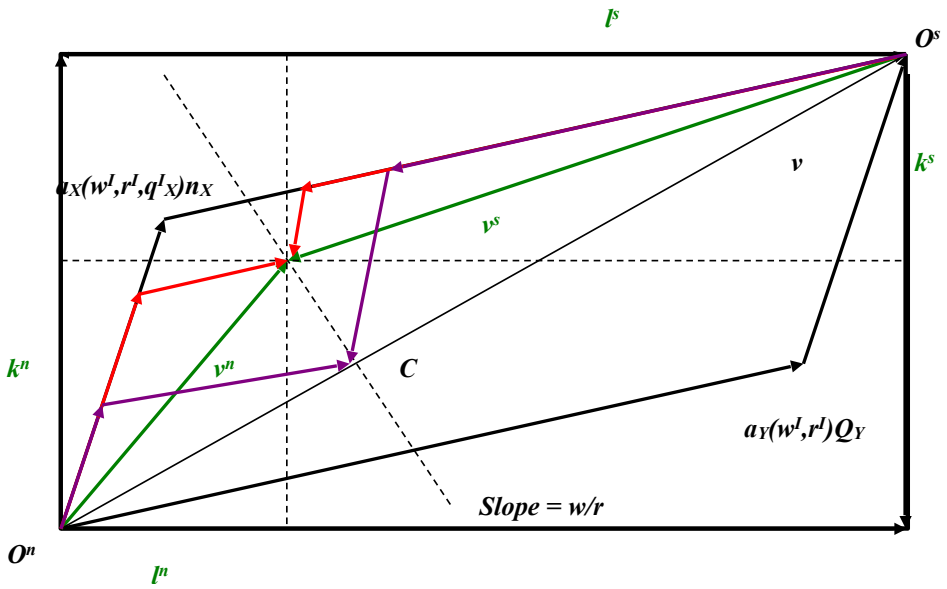
Helpman and Krugman (1985)

Back to the two-by-two-by-two world

- Compared to Krugman (1979), suppose now that there are:
  - 2 industries, $i = X, Y$
  - 2 factors of production, $f = l, k$
  - 2 countries, North and South
- Y is a "homogeneous" good produced under CRS:
  - $a_{fY}\left(w^l, r^l\right) \equiv$ (constant) unit factor requirements in integrated eq.
- X is a "differentiated" good produced under IRS:
  - $a_{fX}\left(w^l, r^l, q_X^l\right) \equiv$ (average) unit factor requirements in integrated eq.
  - $q_X^l a_{fX}\left(w^l, r^l, q_X^l\right) \equiv$ factor demand per firm in integrated eq.
  - W.l.o.g, we can set units of account s.t. $q_X^l = 1$ for all firms

Helpman and Krugman (1985)

The Integrated Equilibrium Revisited

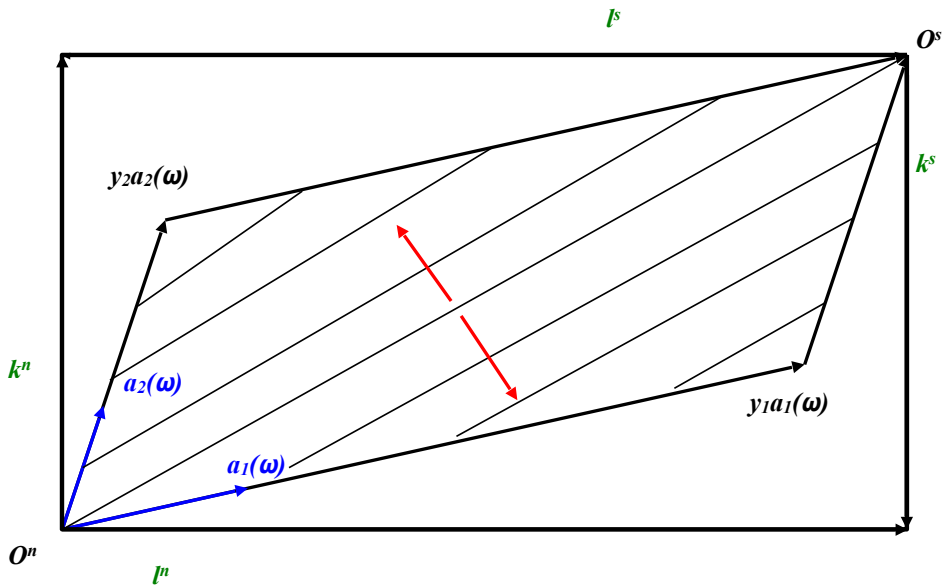


- Taking q^I_X as given, integrated eq. is isomorphic to HO integrated eq.
- Pattern of inter-industry trade (and so net factor content of trade) is the same as in HO model
- But product differentiation + IRS lead to intra-industry trade in Y

Helpman and Krugman (1985)

Trade Volumes

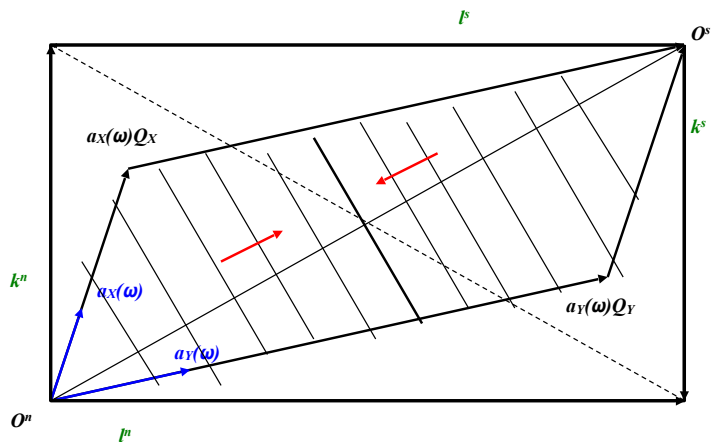
- Intra-industry trade has strong implications for trade volumes
- In HO model (with FPE), we have seen that trade volumes do not depend on country size



Helpman and Krugman (1985)

Trade Volumes

- In this model, by contrast, countries with similar size trade more



- Should this be taken as evidence in favor of New Trade Theory?
  - If we think of IRS as key feature of New Trade Theory, then no
  - Pattern is consistent with any model with complete specialization and homotheticity, regardless of whether we have CRS or IRS

Thinking Outside the Parallelogram

"Gravity" redux

- **Proposition** *Suppose that countries have identical homothetic preferences and that any good is only produced in one country. Then bilateral trade flows between countries i and j satisfy "gravity"*

$$X_{ij} = \frac{Y_i Y_j}{Y^W}$$

- **Proposition** *If bilateral trade flows satisfy gravity, then trade volumes are maximized when countries are of equal size*