

14.581 MIT PhD International Trade  
— Lecture 9: Increasing Returns to Scale and  
Monopolistic Competition (Theory) —

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# Today's Plan

- 1 Introduction to “New” Trade Theory
- 2 Monopolistically Competitive Models
  - 1 Krugman (JIE, 1979)
  - 2 Helpman and Krugman (1985 book)
  - 3 Krugman (AER, 1980)
- 3 From “New” Trade Theory to Economic Geography

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# “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 The bulk of world trade is between “similar” countries.
  - ② These countries tend to trade “similar” goods.

# “New” Trade Theory

## Why Increasing Returns to Scale (IRTS)?

- “New” Trade Theory proposes IRTS as an alternative rationale for international trade and a potential explanation for the previous facts.
- **Basic idea:**
  - ① Because of IRTS, similar countries will specialize in different goods to take advantage of large-scale production, thereby leading to trade.
  - ② Because of IRTS, countries may exchange goods with similar factor content.
- In addition, IRTS 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, Etca 1982).
- Under Bertrand competition, many of these features disappear (Grossman and Rossi-Hansberg, QJE 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 CRTS at the sector level.
- Under imperfect competition, many predictions seem possible depending on the market structure.

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# Monopolistic Competition

Trade economists' preferred assumption about market structure

- Monopolistic competition, formalized by Dixit and Stiglitz (1977), is the most common market structure assumption 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): IRTS as a new rationale for international trade.
  - Helpman and Krugman (1985): Inter- and intra-industry trade united.
  - Krugman (1980): Home market effect in the presence of trade costs.

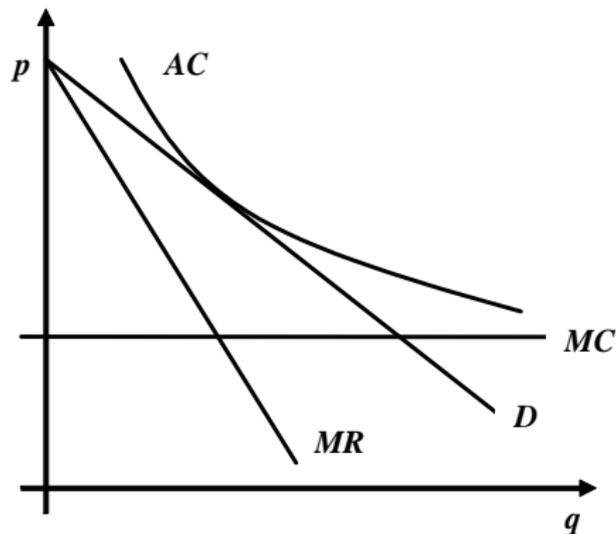
# Monopolistic Competition

## 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

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

where:

- $u(0) = 0$ ,  $u' > 0$ , and  $u'' < 0$  (love of variety).
  - $\sigma(c) \equiv -\frac{u'}{cu''} > 0$  is such that  $\sigma' \leq 0$  (by assumption).
  - $n$  is the number/mass of varieties  $i$  consumed.
- **IRTS Technology:** Labor used in the production of each “variety”  $i$  is

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

where  $\varphi \equiv$  common productivity parameter (firms/plants are homogeneous).

# 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:

$$q_i = Lc_i$$

$$L = nf + \int_0^n \frac{q_i}{\varphi} di$$

# 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 (see graph):

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

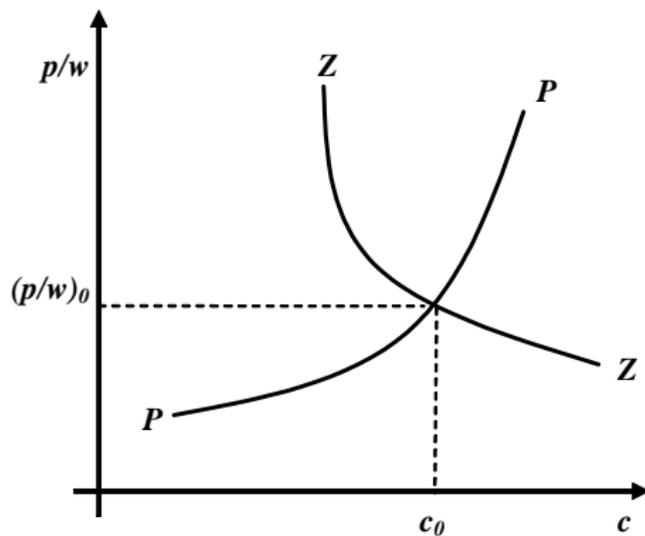
$$\text{(ZP):} \quad \frac{p}{w} = \frac{f}{q} + \frac{1}{\varphi} = \frac{f}{Lc} + \frac{1}{\varphi}$$

- Given  $c$ , the number of varieties  $n$  can then be computed using market clearing conditions:

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

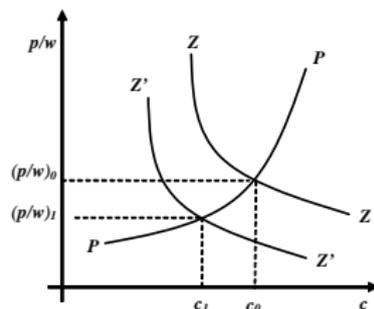
# Krugman (1979)

Graphical analysis; PP is upward sloping thanks to assumption that elasticity of substitution is falling



# 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:**  $(p/w)_1 < (p/w)_0 \Rightarrow q_1 > q_0$  (thanks to falling elasticity of substitution).

# CES Preferences

Trade economists' 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 (constant) elasticity of substitution between any pair of varieties.

- What is there 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, Anderson et al, 1992).
- Is it empirically reasonable?
  - Rejected in field of IO long ago (independence of irrelevant alternatives property, constant markups, and other features we deemed just too unattractive).

# 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 come **only** from access to Foreign varieties.
  - IRTS provide an intuitive reason for why Foreign varieties are different.
  - But consequences of trade would now be the same if we had maintained CRTS with different countries producing different goods (the so-called “Armington assumption”).

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# Helpman and Krugman (1985)

## Inter- and intra-industry trade united

- Helpman and Krugman (1985), chapters 7 and 8, offer a unified theoretical framework in which to analyze inter- and intra-industry trade.
- **Basic Strategy:**
  - ① Start from the integrated equilibrium, but allow IRTS 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 equilibrium.

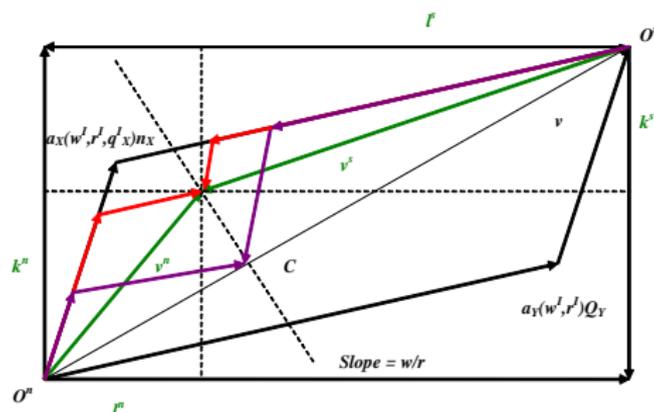
# Helpman and Krugman (1985)

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 CRTS:
  - $a_{fY} (w^l, r^l) \equiv$  (constant) unit factor requirements in integrated eq.
- $X$  is a “differentiated” good produced under IRTS:
  - $a_{fX} (w^l, r^l, q_X^l) \equiv$  (average) unit factor requirements in integrated eq.
  - $q_X^l a_{fX} (w^l, r^l, q_X^l) \equiv$  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

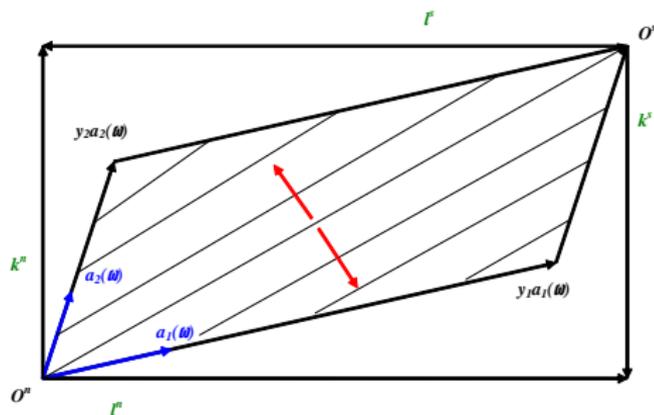


- Taking  $q^l_X$  as given, integrated eq. is isomorphic to HO integrated eq.
- Pattern of inter-industry trade (and so net factor content of trade) is the same as in HO model.
- But product differentiation + IRS lead to intra-industry trade in  $Y$ .

# Helpman and Krugman (1985)

## Trade Volumes

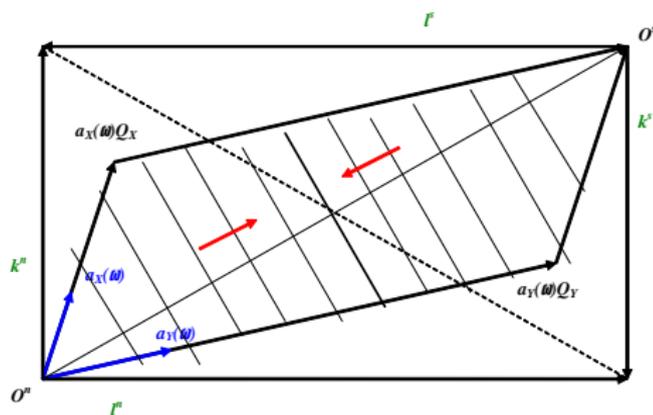
- Intra-industry trade has strong implications for trade volumes.
- In HO model (with FPE), we have seen that trade volumes do not depend on country size.



# Helpman and Krugman (1985)

## Trade Volumes

- In this model, by contrast, countries with similar size trade more (figure drawn for extreme case where both  $X$  and  $Y$  are differentiated goods):



- 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.

## A First Look at “Gravity”

- **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*

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# Krugman (1980)

## The role of trade costs

- Trade costs were largely absent from neoclassical trade models.
  - Solving for the pattern of international specialization in the presence of trade costs is hard.
- We now explore the implications of trade costs in the presence of IRTS.
  - Thanks to Dixit-Stiglitz product differentiation, solving for international specialization is easy (each firm is deliberately the only firm in the world to make its own variety), and is not substantially complicated by trade costs (especially ad valorem trade costs that don't require factors of production or generate income—so called 'iceberg' trade costs).

# Krugman (1980)

## The role of trade costs

- **Main result:** “*Home-market effect*”
  - Countries will tend to export those goods for which they have relatively large domestic markets.
- **Basic idea:**
  - Because of IRS, firms will locate in only one market.
  - Because of trade costs, firms prefer to locate in larger markets.
- 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 IRTS 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:

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

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

## 2 Monopoly pricing:

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

## 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:

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

# Krugman (1980)

## A First Step: Market size and wages

- **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

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

# Krugman (1980)

## Market size and wages

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

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

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:**

- Everything else being equal, demand is larger in larger markets
- Firms will only be active in the smaller market if they have to pay lower wages or face softer competition, i.e. smaller number of domestic firms
- Labour supply is **perfectly inelastic**  $\Rightarrow$  number of domestic firms is fixed
- Smaller market has to be associated with lower wages

# Krugman (1980)

## Home-Market Effect

- What would happen if labor supply was **perfectly elastic** instead?
- Suppose that we add a second industry in which a homogeneous good is produced one-for-one for labor in both countries.
- Preferences over two goods are Cobb-Douglas.
- Suppose, in addition, that homogeneous good is freely traded.
- Under these assumptions, wages are equal across countries:  
 $w^H = w^F$ .
  - So 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

- **Proposition**  $n^H / L^H \geq n^F / L^F$  if and only if  $L^H \geq L^F$ .
- “Home-market effect”: larger market has a disproportionately large share of differentiated good firms (and so will export that good).
- Since wages are necessarily equal, firms will only be active in the smaller market if they face softer competition there.
- With a little bit of algebra, one can show that:

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

- Note that  $\partial (n^H / n^F) / \partial \tau^{1-\sigma} > 0$  if  $L^H / L^F > 1$ : home-market effect is larger when trade costs are small or elasticity of substitution is large.

# From New Trade Theory To Economic Geography

## Basic Idea

- Krugman (JPE 1991) added one additional assumption to Krugman (1980), which was that some workers are perfectly mobile across the two countries/“regions” .
  - Mobile workers move to where their real wage is highest.
  - These workers are attracted to the already larger region because of the higher nominal wages they earn there (HME) and the wider array of varieties for sale there (lower price index).
  - Extent of agglomeration depends (very naturally) on the relative importance of the IRTS good in tastes, and the share of workers who are mobile.

# From New Trade Theory To Economic Geography

## Basic Idea

- The result was an extremely influential model of ‘economic geography’, ie a model in which the distribution of economic activity across space (ie agglomeration) is endogenous.
- Previous modeling approaches had emphasized non-pecuniary, positive externalities (eg spatially-decaying knowledge spillovers or thick-market search externalities) to explain agglomeration. Krugman (1991) emphasized instead the pecuniary externalities in the Krugman (1980) model.
- Time doesn't permit further diversions into this literature in 14.581. But if you're interested, in Spring 2010 we held a ‘Spatial Economics Reading Group’ about Krugman (1991) and other key papers in this literature and slides from student presentations are here: <http://econ-www.mit.edu/faculty/ddonald/spatial>.