International Trade: Lecture 8

Increasing Returns and Monopolistic Competition

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Fall 2024

Introduction

- Models of international trade considered so far have been concerned with,
    - **Inter**-industry trade - trade in **different** commodities (e.g., bread and cheese, cloth and steel)
    - Trade between **dissimilar** economies (e.g., dissimilar in terms offactor endowments)
- Two important unexplained empirical regularities
    - Large amount of **intra**-industry trade - trade in **similar** products within an industry (e.g., different brands of consumer goods)
    - Large amount of trade among **similar** economies

Trade with Scale Economies and Monopolistic Competition

- Production side with scale economies:
  - Firms face entry costs and sell differentiated products
  - Monopolistic competition
- Implications for trade:
  - Intra-industry trade
  - Gains from trade through product diversity
  - Extensive margin vs. intensive margin
  - Competitive effects of trade (markups)
  - Market size effects on specialization and welfare
- Contrast with neoclassical models, where
  - Gross exports equal net exports
  - Gains from trade only through relative price changes
  - No market size effects (or opposite market size effects)
  - No concept of firm, markups

This Lecture

- Monopolistic competition, market size, and scale economies
  - Dixit and Stiglitz (1977): Monopolistic competition market structure and efficiency
  - Krugman (1979 JIE), Zhelobodko et al. (2013): role of market size with VES
- Monopolistic competition with trade costs and home market effects
  - Krugman (1980 AER): home market effects
  - Venables (1987 EJ): firm reallocations
- Helpman and Krugman (1985) integrated model

Monopolistic Competition

- Reminder of the market structure:
  - M homogeneous firms
  - Profits: $\pi(q, M) = R(q; M) - C(q)$
  - Firms behave as monopolists on their local demand
  - But do not affect market aggregates (so Bertrand=Cournot)
    - i.e., inverse demand (price) elasticity equals inverse of demand elasticity
  - Equilibrium $\left(M^*, q^*\right)$ such that:
    - $q^* = \arg\max_q \pi(q, M^*)$
    - $\pi\left(q^*, M^*\right) = 0$
- Typical equilibrium features:
  - Markups: $\frac{p(q,M)}{C'(Q)} > 1$
  - Generally, socially inefficient (M, q)
  - Equilibrium $\rightarrow$ Perfect competition as $M \rightarrow \infty$
- See e.g. chapter 6 of Vives (2001) book "Oligopoly Pricing."

Preferences

- Explicitly additive preferences over varieties:

$$U = \sum_i u(c_i),$$

with $u(0) = 0$, $u'(c) > 0$, $u''(c) < 0$

- "Love for variety":
    - Suppose total production is Q, population equal to 1
    - Concavity of u implies $Mu(c) = Mu\left(\frac{Q}{M}\right)$ increasing with M: $u(Q) < Mu\left(\frac{Q}{M}\right)$
    - Conditional on output Q, a welfare gain due to more firms

Demand

- Consumer optimization yields demand for good i,

$$p_i = \frac{1}{\lambda} u'(c_i),$$

  where the multiplier λ captures substitution and income effects

$$\lambda = \frac{\sum_i u'(c_i) c_i}{y},$$

  where y is per-capita income
- Assume: L homogeneous workers and no equilibrium profits
  - Then y equals labor income $Ew \equiv E$ (=efficiency units of labor)

CES

- CES preferences are the case with $u(c) = \kappa c^{\frac{\sigma-1}{\sigma}}$
- In this case, U is homothetic:
  - Remember, homothetic $\equiv$ monotone in a homogenous function
  - Here, let $W(x) = x^{\frac{\sigma}{\sigma-1}}$, then $W(U(c))$ is homogeneous of degree 1
  - This is the only explicitly additive homothetic utility function
- CES demand:

$$c_i = \frac{E}{P}\left(\frac{p_i}{P}\right)^{-\sigma}$$

  - Price index: $P = \left(\sum_i p_i^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$
  - Love for variety: $p_i = p \rightarrow W = M^{\frac{1}{\sigma-1}}\frac{E}{P}$
- Equivalent: discrete choice model with random utility
  - Extreme-value distributed draws
  - More draws make it more likely that a consumer will find ideal match
  - See Anderson, De Palma and Thisse, *Discrete Choice Models of Product Differentiation*

Technology and Firm Optimization

- Large number of potential entrants. Each firm:
  - Enters with a unique differentiated product
  - Needs $C(q) = F + V(q)$ units of labor to produce q units of output
  - Implies increasing returns
- If a firm produces q, it faces inverse demand $p(\frac{q}{L})$ such that

$$p(c) \equiv \frac{1}{\lambda} u'(c)$$

- Perceived inverse demand elasticity *keeping λ constant*

$$\varepsilon_p(x) \equiv -\frac{p'(x)}{p(x)} x = -\frac{u''(x)}{u'(x)} x > 0$$

  - Approximation as $M \to \infty$, each firm is negligible relative to market size
  - $\varepsilon_p(x)$ is a primitive of the model

Technology and Firm Optimization

- Work with representative firm
- Firm optimization:

$$\max_{q} \pi(q) = p\left(\frac{q}{L}\right) q - C(q)$$

- Standard monopoly pricing condition:

$$p'\left(\frac{q}{L}\right)\frac{q}{L} + p = C'(q)$$

- FOC:

$$p = \frac{1}{1 - \varepsilon_p(\frac{q}{L})} C'(q)$$

General Equilibrium (Closed Economy)

- Symmetric outcomes across firms; $\{q, M\}$ such that
  - Firms optimize + there are zero profits:

$$\underbrace{\frac{1}{1-\varepsilon_p(\frac{q}{L})}C'(q)}_{p} = \frac{C(q)}{q} \tag{1}$$

  - Labor market clears: $\sum_j C(q_j) = EL$ implies

$$M = \frac{EL}{C(q)} \tag{2}$$

General Equilibrium (Closed Economy) (cont'd)

- Note: labor market clearing implied by budget constraint and zero profits
  - BC: $pqM = yL$; ZP: $pq = C(q)$; and $y = E$
- From (1), break-even sales q determined "independently" from number of firms
  - In the background, λ is adjusting for zero profits through entry of firms
- Uniqueness if $\varepsilon_C(q) \equiv \frac{C'(q)q}{C(q)}$ increases faster $1 - \varepsilon_p(\frac{q}{L})$
  - Holds with concavity of profit function

Equilibrium with Constant Marginal Cost

- Typically studied case. Assume:

$$C(q) = \frac{q}{z} + F$$

- Optimal pricing and consumption per capita:

$$p = \frac{\sigma(c)}{\sigma(c) - 1}\frac{1}{z},$$

  where $\sigma(c) \equiv \varepsilon_p(c)^{-1}$ is the demand elasticity (a primitive of the model)

- Firm size:

$$q = \left(\sigma\left(\frac{q}{L}\right) - 1\right) zF$$

- Number of firms:

$$M = \frac{1}{F}\frac{EL}{\sigma\left(\frac{q}{L}\right)}$$

- CES case: $\sigma(c) = \sigma$

Effect of International Trade

- Suppose two economies trade
- Assume they are identical in all parameters, except perhaps size $\text{EL} \equiv \text{L}$
- No traditional (neoclassical) reason for trade
- Same wages and prices in both countries
- However, there is (intra-industry) trade as each variety is (endogenously) only produced in one country
    - Indeterminate which variety is produced where

Effect of International Trade: Constant Marginal Cost and $\sigma'(c) \leq 0$

- $\sigma'(c) \leq 0$ is "Marshall's Second Law of Demand"
  - Intuitive case?
  - Empirically reasonable?
- Competitive pressure through market size lowers prices compared to autarky:

$$p = \frac{\sigma\left(\frac{q}{L^W}\right)}{\sigma\left(\frac{q}{L^W}\right) - 1}\frac{1}{z}$$

- Lower markups imply larger firms:

$$q = \left(\sigma\left(\frac{q}{L^W}\right) - 1\right) zF$$

- Number of firms in each country?

Effect of International Trade: Constant Marginal Cost and $\sigma'(c) \leq 0$ (cont'd)

- Utility:

$$U = Mu\left(\frac{1}{Mp}\right)$$

- Welfare increases through both higher M (love of variety) and lower p
- CES case: only effect is access to imported varieties (no allocative changes)
  - Consumers gain by trading some of each local variety for new varieties
  - Similar as perfect-competition model with constant-elasticity scale effect
    - i.e., real income $W \equiv U^{\frac{\sigma}{\sigma-1}} = AL^{\frac{\sigma}{\sigma-1}}$ where $A \equiv \frac{\sigma-1}{\sigma} z \left(F\sigma\right)^{\frac{1}{1-\sigma}}$
    - Abdel-Rahman and Fujita (1990): "Product variety, Marshallian externalities, and city sizes"
- Volume of trade: gravity-like prediction
  - Country 1 import share of expenditures = income: $\frac{M_2}{M_1+M_2} = \frac{L_2}{L^W}$
  - Hence volume of trade is $\frac{L_1 L_2}{L^W}$

Effect of International Trade: General Case

- Zhelobodko et al. (ECMA 12), general case with general $C(q)$ and $\sigma(c)$
- Under standard regularity condition ($\varepsilon_C(q)$ steep enough), market size leads to $\downarrow$ c, hence to $\uparrow$ M
  - Follows from FOC+ZP: $\frac{\sigma(c)-1}{\sigma(c)} = \varepsilon_C(cL)$
- Elasticity with respect to L

	$\sigma'(c) < 0$ (Krugman '79)	$\sigma'(c) = 0$ (CES)	$\sigma'(c) > 0$ (Anti-Competitive)
p	< 0	$= 0$	> 0
M	$\in (0, 1)$	$= 1$	> 1
c	$\in (-1, 0)$	$= -1$	< -1
q	$\in (0, 1)$	$= 0$	< 0

- With $\sigma'(c) > 0$, more firms (more than 1-1 with size) and higher prices. Welfare effect ambiguous.

Effect of International Trade: General Case

- Efficiency trade-off: intensive vs. extensive margin
- Welfare:

$$U = \underbrace{\frac{LE}{C(cL)}}_{=N} u(c)$$

  - Planner's FOC: $\varepsilon_u(c) = \varepsilon_C(cL)$
  - Market FOC can be written $\varepsilon_R(c) \equiv 1 - \varepsilon_p(c) = \varepsilon_C(cL)$
  - Inefficiency because marginal utility $\neq$ marginal revenue
- $\varepsilon_u(x) = 1 - \varepsilon_p(x)$ if $u(x)$ is CES, hence CES is efficient
- With constant marginal costs, too many firms if $1 - \varepsilon_u(x)$ is increasing
  - Interpretation: $1 - \varepsilon_u(x) \equiv \frac{\partial Mu(c)}{\partial M}$ is a measure of love for variety (Vives, 2001)

Krugman (1980)

- **First point:** we would like a theoretical framework capable of explaining these empirical regularities
- **Second point:** throughout the analysis so far, we assumed constant returns to scale and perfect competition. What happens if we relax these assumptions?
- This Chapter considers the **Krugman (1980)** model of trade
- Combines (i) Internal increasing returns to scale and (ii) imperfect competition (product differentiation)
- (i) and (ii) provide a theoretical explanation for intra-industry trade

Krugman (1980) (cont'd)

- **Note:** we consider a particularly tractable form of imperfect competition where no strategic interaction: monopolistic competition
- **Note:** increasing returns to scale and/or imperfect competition is not necessary to explain intra-industry trade. As argued by Davis (1995), one can explain intra-industry trade in a constant returns to scale, perfect competition model, which introduces elements of Ricardian trade theory within the Heckscher-Ohlin model
- Davis, D. (1995) "Intra-industry Trade: A Heckscher-Ohlin-Ricardo Approach," *Journal of International Economics*, 39, 201-226.

Krugman (1980) Model: Assumptions

- Two identical economies (home and foreign*)
- **Commodities**
  - single nontraded factor of production (labour)
  - many varieties consumer goods $j \in [0, n]$
- **Consumer preferences:** identical across economies and homothetic

$$U = \sum_{j=1}^{n} c_j^{\theta}, \qquad 0 < \theta < 1, \tag{3}$$

- **Note: 'Dixit-Stiglitz preferences'** (i) Diminishing marginal utility to the consumption of extra units of each good j, (ii) **Love of variety** - in a symmetric equilibrium ($c_j = c_k = c$ for all j, k),

$$U = n \cdot c^{\theta}$$

Krugman (1980) Model: Assumptions (cont'd)

- **Endowments**
  - $(L = L^*)$ agents in each economy, each endowed with one unit of (nontradeable) labour
- **Production technologies:** identical in two economies and same for each variety
  - Fixed cost of producing each variety j of $\alpha > 0$ units of labour
  - Constant marginal cost of $\beta > 0$ units of labour
- So employment needed to produce x_j units of good j

$$l_j = \alpha + \beta \cdot x_j, \tag{4}$$

  and total cost of producing these x_j units is $w \cdot l_j$
- **Note:** production technologies exhibit **increasing returns to scale**

Krugman (1980) Model: Assumptions (cont'd)

- **Market mechanism:** monopolistic competition
  - fixed cost of production $\Rightarrow$ in equilibrium only one firm produces each variety
  - monopoly producer of each variety of consumer goods faces a downward sloping demand curve
  - each firm takes the behavior of other firms as given (no strategic interaction)

Closed Economy: Profit Maximization

- **Firms max profits** subject to a downward sloping demand $x_j(p_j)$

$$\max \; p_j \cdot x_j(p_j) - w(\alpha + \beta \cdot x_j(p_j)) \tag{5}$$

- First-order condition wrt p_j,

$$x_j(p_j) + p_j \cdot \frac{\partial x_j(p_j)}{\partial p_j} = \beta w \cdot \frac{\partial x_j(p_j)}{\partial p_j} \tag{6}$$

- Define the elasticity of demand facing the producer of variety j:

$$\varepsilon_j = -\frac{p_j}{x_j} \cdot \frac{\partial x_j}{\partial p_j} \tag{7}$$

Closed Economy: Profit Maximization (cont'd)

- Divide through by $x_j(p_j)$ in the first-order condition (6), multiply both sides by p_j, and rearrange using (7)

$$p_j = \frac{\varepsilon_j}{\varepsilon_j - 1} \cdot \beta w \qquad \forall\ j \tag{8}$$

- In equilibrium prices are a mark-up over marginal cost, with size of mark-up determined by elasticity of demand ε_j

Closed Economy: Utility Maximization

- **Consumers maximize utility:** first-order condition,

$$p_j = \frac{\theta}{\lambda}\left(\frac{x_j}{L}\right)^{\theta-1}, \qquad \forall\ j, \tag{9}$$

where λ is the Lagrange multiplier on representative consumer's budget constraint, and use fact that with a representative consumer,

$$c_j = \frac{x_j}{L}$$

- **Assume:** number of goods produced is large, so each firm's pricing policy negligible effect on marginal utility of income λ

Closed Economy: Utility Maximization (cont'd)

- That is, assume firms take λ as given. Differentiate wrt p_j in equation (9),

$$\frac{\partial x_j}{\partial p_j} = \frac{\lambda L}{\theta(\theta - 1)} \cdot \left(\frac{x_j}{L}\right)^{2-\theta} \tag{10}$$

- Substitute for p_j and $\partial x_j / \partial p_j$ in definition of ε_j using (9) and (10),

$$\varepsilon_j = \frac{1}{1 - \theta} \tag{11}$$

- Hence,

$$p_j = p = \frac{\beta}{\theta} \cdot w, \qquad \forall\ j \tag{12}$$

Closed Economy: Utility Maximization (cont'd)

- With Dixit-Stiglitz preferences, price is constant mark-up over marginal cost and we assume $0 < \theta < 1$
- Have symmetric equilibrium with $\mathsf{p_j = p_k = p} \ \forall \ \mathsf{j, k}$. From representative consumer's budget constraint,

$$c_j = c = \frac{w}{np}, \qquad \forall \ j$$

Closed Economy: Equilibrium Profits

- Monopolistic competition implies equilibrium profits are zero,

$$\pi_j = px_j - (\alpha + \beta x_j)w = 0 \tag{13}$$

- Using (12) and (13), solve for equilibrium output,

$$x_j = x = \frac{\alpha\theta}{\beta(1-\theta)}, \qquad \forall\ j \tag{14}$$

Closed Economy: Labor Market Clearing

- Equilibrium number of varieties produced determined by labour market clearing,

$$
\begin{aligned}
L &= \sum_{j=1}^{n} l_j = \sum_{j=1}^{n} (\alpha + \beta x) \\
\Rightarrow \qquad n &= \frac{L(1-\theta)}{\alpha} \qquad (15)
\end{aligned}
$$

Effects of International Trade

- Now suppose that the two economies trade with one another
- Two economies are **identical** — *identical tastes* and *technology*, while with only one factor of production are *no differences in factor endowments*
- **None of the conventional reasons for international trade**
- Trade will still occur because, with increasing returns to scale, each variety will only be produced in one country

Effects of International Trade (cont'd)

- Because the economies are identical, wages and prices of all goods will be the same
- Number of varieties produced in each economy in the free trade equilibrium is,

$$n = \frac{L(1-\theta)}{\alpha}, \qquad n^* = \frac{L^*(1-\theta)}{\alpha} \tag{16}$$

- Equilibrium consumption of each variety by representative consumer in home and foreign is,

$$c = c^* = \frac{w}{p(n+n^*)} \tag{17}$$

- Real wage remains constant,

$$w/p = \theta/\beta$$

Effects of International Trade (cont'd)

- Nonetheless, **gains from trade** because the world economy produces a **greater diversity of goods** and representative consumer's preferences are increasing in number of variety consumed
- Trade is **intra**-industry
- **Direction** of trade is indeterminate
- **Volume** of trade is determinate. From (17), representative consumer in each economy spends fraction of income $n^*/(n + n^*)$ on foreign goods. Choose real wage for the numeraire in each country. Then, value of home country's imports is,

$$M = \frac{Ln^*}{n + n^*} = \frac{LL^*}{L + L^*} \tag{18}$$

- **Note:** Gravity equation type prediction

Transport Costs

- Introduce **iceberg transportation costs**
  - Only a fraction g, where $0 < g < 1$, of any good shipped arrives
- 'Cost inclusive of freight' (cif) price of foreign varieties in home becomes

$$\hat{p}^* = \frac{p^*}{g},$$

  where p^* is the 'Free on board' (fob) price prior to transport costs
- From first-order condition (9), can determine the ratio of total demand by home residents for each foreign variety relative to total demand by home residents for each domestic variety, $\sigma = c^*/c$:

$$gc^* = \left(\frac{\lambda}{\theta}\right)^{\frac{1}{\theta-1}} \left(\frac{p^*}{g}\right)^{\frac{1}{\theta-1}}$$

$$c = \left(\frac{\lambda}{\theta}\right)^{\frac{1}{\theta-1}} (p)^{\frac{1}{\theta-1}}$$

Transport Costs (cont'd)

- (if a home resident consumes one unit of a foreign variety, his combined direct demand and indirect demand used up in transportation is for $1/g$ units)

$$\sigma = \frac{c^*}{c} = \left(\frac{p}{p^*}\right)^{\frac{1}{1-\theta}} g^{\frac{\theta}{1-\theta}} \tag{19}$$

- Similarly, for foreign:

$$\sigma^* = \frac{c}{c^*} = \left(\frac{p}{p^*}\right)^{\frac{-1}{1-\theta}} g^{\frac{\theta}{1-\theta}} \tag{20}$$

- Home consumers' budget constraint implies that their expenditure equals their income:

$$\left(np + \sigma n^* p^*\right) d = w,$$

where d is the consumption of a representative domestic variety

Transport Costs (cont'd)

- Since firms face the same elasticity of demand in both domestic and export markets, the free on board pricing rule is the same (cif prices will be fob prices adjusted for transport costs):

$$\mathsf{p} = \frac{\mathsf{w}\beta}{\theta}, \qquad \mathsf{p}^* = \frac{\mathsf{w}^*\beta}{\theta}$$

- Combining the free on board pricing rule and free entry, the equilibrium output of each variety remains the same and hence so does the equilibrium number of varieties produced:

$$\mathsf{n} = \frac{\mathsf{L}(1-\theta)}{\alpha}, \qquad \mathsf{n}^* = \frac{\mathsf{L}^*(1-\theta)}{\alpha}$$

Transport Costs (cont'd)

- However, introducing transport costs has implications for **relative wages**
- If countries are of unequal size, the country with the larger market (larger L) will have the higher wage w
  - Large market advantage when production is subject to **economies of scale** and the world economy is imperfectly integrated due to **transport costs**

Home Market Effect

- In a world of increasing returns to scale and transport costs, strong domestic demand will other things equal tend to make a country an exporter of a good
- **Economic intuition**
  - Increasing returns to scale imply that firms wish to concentrate production
  - Transport costs imply that firms wish to concentrate production close to large markets
- Contrasts with a world of constant returns to scale, where strong domestic demand will other things equal tend to make a country an importer of a good

Home Market Effect (cont'd)

- Consider a two-industry version of the above model
  - There are two industries, alpha and beta industries, each of which consists of many different varieties (in Krugman's notation alpha $\neq \alpha$ and beta $\neq \beta$!)
  - Demand for the two industries output arises from the presence of two groups in the population, L of whom demand alpha varieties and $\tilde{L}$ of whom demand beta varieties

$$U = \sum_{i=1}^{n} c_i^{\theta}, \qquad \tilde{U} = \sum_{j=1}^{n} \tilde{c}_j^{\theta} \qquad 0 < \theta < 1$$

- Production technologies for the two classes of varieties are identical:

$$l_i = \alpha + \beta x_i, \qquad \tilde{l}_j = \alpha + \beta \tilde{x}_j$$

Closed Economy Equilibrium

- Demand for the two classes of varieties depends on the shares of the two groups in the population
- Since consumers are identical within each group

$$x_i = Lc_i, \qquad \tilde{x}_j = \tilde{L}\tilde{c}_j$$

- Full employment in the labour market applies to the economy as a whole

$$\sum_{i=1}^{n} l_i + \sum_{j=1}^{\tilde{n}} \tilde{l}_j = L + \tilde{L} = \bar{L}$$

- The equilibrium pricing rule remains exactly as before
- Equilibrium pricing and free entry imply that equilibrium output of each of the two types of varieties is the same as before

Closed Economy Equilibrium (cont'd)

- Since the two types of varieties have the same production technology, the total number of the two groups of varieties taken together $(n + \tilde{n})$ can be determined in the same way as before using the labour market clearing condition
- The share of the two types of varieties in the total can be determined from the requirement that the sales of each industry equal the income of the relevant group of the population

$$npx = wL, \qquad \tilde{n}\tilde{p}\tilde{x} = \tilde{w}\tilde{L}$$

$$\Rightarrow \qquad \frac{n}{\tilde{n}} = \frac{L}{\tilde{L}}$$

Trade Equilibrium with Transport Costs

- Assume the home and foreign country are mirror images of one another:

$$L = f\bar{L}, \qquad L^* = \left(1 - f\right)\bar{L}$$

$$\text{where} \qquad \bar{L} = L + \tilde{L} = L^* + \tilde{L}^*$$

- Since the two economies are completely symmetric, apart from the size of the two groups, and the production technology is identical for the two industries it follows that output, prices of all varieties and wages will be the same in the two countries

Trade Equilibrium with Transport Costs (cont'd)

- It follows from equations (19) and (20), that ratio of demand for an imported product relative to demand for a domestic product is the same in both countries and equal to:

$$\sigma = \sigma^* = g^{\frac{\theta}{1-\theta}} < 1$$

- Since prices and output are the same in the two countries, home's share of expenditure on home goods is:

$$\frac{npd}{npd + \sigma n^* pd} = \frac{n}{n + \sigma n^*}$$

- And home's share of expenditure on foreign goods is:

$$\frac{\sigma n^* pd}{npd + \sigma n^* pd} = \frac{\sigma n^*}{n + \sigma n^*}$$

Trade Equilibrium with Transport Costs (cont'd)

- In equilibrium, we require for each industry that the value of production in a country equals the value of expenditure on varieties produced in that country:

$$\begin{aligned} npx &= \frac{n}{n+\sigma n^*}wL + \frac{\sigma n}{\sigma n + n^*}wL^* \\ n^*px &= \frac{\sigma n^*}{n+\sigma n^*}wL + \frac{n^*}{\sigma n + n^*}wL^* \end{aligned} \tag{21}$$

- With analogous relationships holding for the other industry
- We can use these relationships to prove the home market effect
- Suppose that both countries are incompletely specialized: $n > 0$, $n^* > 0$, $\tilde{n} > 0$, $\tilde{n}^* > 0$

Home Market Effect

- Dividing equations (21) through by n and n^* and rearranging, we obtain:

$$\frac{L}{L^*} = \frac{n + \sigma n^*}{\sigma n + n^*} \qquad \Rightarrow \qquad \frac{n}{n^*} = \frac{L/L^* - \sigma}{1 - \sigma L/L^*}$$

- **Home market effect**: implications for production
  - If $L/L^* = 1$, so does n/n^*
  - For $\sigma < L/L^* < 1/\sigma$ (the range of incomplete specialization), a rise in the relative size of a country's home market (L/L^*) leads to a rise in its share of production in the industry (n/n^*)
  - Can also analyze complete specialization, where the country with the larger home market for an industry specializes in that industry

Implications for Trade

- The home country's balance of trade (exports minus imports) for alpha products may be written as:

$$\begin{aligned} B_{\text{alpha}} &= \frac{\sigma n}{\sigma n + n^*} wL^* - \frac{\sigma n^*}{n + \sigma n^*} wL \\ &= wL^* \left[\frac{\sigma n}{\sigma n + n^*} - \frac{\sigma n^*}{n + \sigma n^*} \frac{L}{L^*} \right] \\ &= \frac{\sigma w L^*}{\sigma n + n^*} \left[n - n^* \right], \end{aligned}$$

  where we have seen that $L > L^*$ implies $n > n^*$
  - The country with a larger home market for an industry is a net exporter in that industry
- With increasing returns to scale and transport costs, idiosyncracies of demand play a strong role in determining trade patterns
  - Increases in demand for a good lead to a more than proportionate increase in production so that net exports of the good rise

Implications for Trade (cont'd)

- Contrasts with a world of constant returns to scale, where increases in domestic demand can at most lead to a proportionate increase in domestic production, and when they lead to a less than proportionate increase in domestic production, they will raise net imports
- This home market effect prediction is used as the basis for an empirical test of models of constant returns to scale and transport costs against those of increasing returns to scale and transport costs by Davis and Weinstein (1999, 2003)

Subsequent Empirical Work

- Davis, D and Weinstein, D (1999) "Economic Geography and Regional Production Structure: An Empirical Investigation," *European Economic Review*, 43, 379-407.
- Davis, D and Weinstein, D (2003) "Market Access, Economic Geography, and Comparative Advantage: An Empirical Assessment," *Journal of International Economics*, 59(1), 1-23.
- Redding, Stephen J. and Anthony J. Venables (2004) "Economic Geography and International Inequality," *Journal of International Economics*, 62(1), 53-82.
- Redding, Stephen J. and Daniel M. Sturm (2008) "The Costs of Remoteness: Evidence from German Division and Reunification," *American Economic Review*, 98(5), 1766-1797.

Subsequent Theoretical Work

- Donald R. Davis (1998) “The Home Market, Trade, and Industrial Structure,” American Economic Review, 88(5), 1264-1276.
- Fujita, Masahisa, Paul Krugman and Anthony Venables (2001) *The Spatial Economy: Cities, Regions and International Trade*, Cambridge (MA): MIT Press.
- Holmes, Thomas J. and John J. Stevens (2005) “Does Home Market Size Matter for the Pattern of Trade?,” *Journal of International Economics*, 65, 489-505.
- Kristian Behrens, Andrea R. Lamorgese, Gianmarco I.P. Ottaviano, Takatoshi Tabuchi (2009) “Beyond the Home Market Effect: Market size and Specialization in a Multi-country World,” *Journal of International Economics*, 79(2), 259-265.

Venables (1987)

- Study welfare and policy implications in a 2-sector model.
  - A homogeneous sector, used both in final consumption and as an input;
  - A differentiated Krugman (1980) sector.
- In the Krugman model:
  - The number of firms is pinned down by factors, and terms of trade are endogenous.
  - Foreign productivity growth is welfare enhancing.
- Here,
  - The number of firms changes with demand, and terms of trade are fixed.
  - Foreign productivity growth reduces welfare.

Setup

- Aggregate utility: Cobb-Douglas with a share α_i in the differentiated sector.
  - Country n's income = stock of numeraire Z_n.
  - Country-specific productivity z_i, trade cost τ, and fixed cost f_i.
  - Expenditures on each variety from i in n: $p_{ni} c_{ni} = \alpha_n Z_n \left(\frac{p_{ni}}{P_n}\right)^{1-\sigma}$
- Optimal pricing rule: $p_{ni} = \frac{\sigma}{\sigma - 1} \tau z_i$, can be treated as a primitive
  - We can't use factor market clearing to determine # of varieties
  - Must use demand side

Equilibrium

- Zero profits and optimal pricing imply:

$$\sum_n p_{ni} c_{ni} = p_{ii} c_{ii} + \left(\frac{z_i}{z_n \tau} \right)^{\sigma - 1} p_{nn} c_{nn} = \sigma f_i$$

- Yields solution for domestic market size:

$$p_{ii} c_{ii} = \sigma \frac{f_i - \left(\frac{z_i}{z_n \tau} \right)^{\sigma - 1} f_n}{1 - \tau^{2(1-\sigma)}}$$

  - Assume $f_i - \left(\frac{z_i}{z_n \tau} \right)^{\sigma - 1} f_n > 0$
  - This gives the solution for the price index.

Incomplete Specialization

- Suppose both countries produce in the industrial sector
- Assuming only demand differences:

$$p_{ii}c_{ii} = p_{nn}c_{nn} = \sigma \frac{f}{1+\tau^{1-\sigma}},$$

which implies

$$\frac{P_n}{P_i} = \left(\frac{\alpha_i Z_i}{\alpha_n Z_n}\right)^{\frac{1}{\sigma-1}} \text{ suppose } > 1$$

- Larger market $\rightarrow$ Lower price index $\rightarrow$ Relatively more firms ($\frac{M_i}{M_n} > \frac{\alpha_i Z_i}{\alpha_n Z_n} > 1$)
  - Larger country: higher welfare per worker and net exporter of differentiated sector

$\rightarrow$ Home market effect in industry specialization: domestic market for a product draws more exports

  - Contrast with neoclassical models

Complete Specialization

- When will industry agglomerate in one country?
- Normalize $p_{ii} = 1$. Definition of price index:

$$P_n^{1-\sigma} = M_n + M_i \tau^{1-\sigma}$$
$$P_i^{1-\sigma} = M_n \tau^{1-\sigma} + M_i$$

  Given the intensive margin (pinned down by P), entry in one market linked to exit in the other
- Solution for number of firms: $M_i = \frac{\alpha_i Z_i - \tau^{1-\sigma}\alpha_n Z_n}{1-\tau^{1-\sigma}}$
  - As trade costs fall, entry in larger market (and exit in smaller market!): $\frac{\partial M_i}{\partial \tau^{1-\sigma}} > 0 \Leftrightarrow \alpha_i Z_i > \alpha_n Z_n$
  - Interior equilibrium ($M_1 > 0$ and $M_2 > 0$) holds if: $\frac{1}{\tau} < \frac{P_i}{P_n} = \left(\frac{\alpha_i Z_i}{\alpha_n Z_n}\right)^{\frac{1}{\sigma-1}} < \tau$
- "Globalization" leads to agglomeration of industry in the large market
  - What happens when $\tau = 1$?

Impacts of Trade

- Gains from trade (around interior equilibrium):

$$\mathrm{GFT}_i = \left(\frac{P_i^{\text{trade}}}{P_i^{\text{autarky}}}\right)^{-\alpha_1} = \left(\frac{p_{ii}^{\text{trade}} c_{ii}^{\text{trade}}}{p_{ii}^{\text{autarky}} c_{ii}^{\text{autarky}}}\right)^{\frac{\alpha_1}{1-\sigma}} = \left(\frac{1-\left(\frac{z_i}{z_n\tau}\right)^{\sigma-1}\frac{f_n}{f_i}}{1-\tau^{2(1-\sigma)}}\right)^{\frac{\alpha_1}{1-\sigma}}$$

- With exports, domestic sales must fall to preserve zero profits.
  - So domestic price index must fall $\rightarrow$ gains from trade
- Market size $\alpha_i Z_i$ affects welfare but not gains from trade.
- Lower f_n or higher z_n reduces welfare in country 1
  - Losses from foreign growth!
  - Contrast with Ricardian model
- Export subsidy (to fixed or marginal costs) and import tariffs are welfare improving

Fajgelbaum, Grossman and Helpman (2011)

- Trade data reveal systematic patterns of vertical specialization.
  - Richer countries export goods with higher unit values: Schott, Hummels and Klenow (2005), Hallak and Schott (2008).
  - Higher quality goods are directed disproportionately to higher-income markets: Hallak (2006).
  - Income distribution affects the composition of import baskets:
    - Dalgin, Mitra and Trindade (2008): Imports of luxuries increase with inequality
    - Choi, Hummels and Xiang (2009): More similar income distribution $\Rightarrow$ more similar import price distributions
- This paper: tractable framework to study link between income distribution and patterns of vertical specialization.
  - Focus on demand-driven specialization à la Linder.
  - Non-homothetic preferences and home-market effects generate a link between the distribution of income and trade patterns.
  - Complements supply-side explanations (Ricardian, H-O, Melitz).
  - Explore implications of globalization for specialization and distributional outcomes

Home Market Effects in Other Contexts

- Two industries, with aggregate preferences in country j $\left(U^A\right)^{\alpha_j}\left(U^B\right)^{1-\alpha_j}$
  - Assume that each industry is Krugman-like with elasticity σ_A and σ_B.
  - If $\alpha_H = \alpha_F = \alpha$ but $L_H > L_F$ and $\sigma_B > \sigma_A$, then H specializes in A (more differentiated industry drawn to larger market).
  - If $L_H = L_F = L$ but $\alpha_H > \alpha_F$ and $\sigma_B = \sigma_A$, then H specializes in A (industry localized where there is more demand).
- Trade costs in all sectors play a role in driving the home market advantage.
  - Davis (AER 1998): upper-level Cobb-Douglas between a homogeneous and a Dixit-Stiglitz sector
    - With same trade costs in all sectors, industry size again proportional to population (why?)
  - Hanson and Xiang (AER 2004): a continuum of sectors with the same σ but different τ
    - Sectors with sufficiently small trade costs concentrate in the smaller country.

Other Models: Helpman and Krugman (1985)

Helpman and Krugman (1985), *Market Structure and Foreign Trade*

- Heckscher-Ohlin economy with Krugman (1980) structure in manufacturing.
- Patterns of trade are preserved: capital-abundant countries export capital-intensive manufacturing.
- Volume of trade: increasing with differences in factor endowments (H-O), decreasing with differences in relative country size.
  - Helpman (1987): consistent with the evidence from OECD countries
  - Hummels and Levinsohn (1995): also holds for non-OECD countries
  - Evenett and Keller (2002): when intra-industry trade is low, factor endowments explain differences in trade

Other Models: Krugman and Venables (1995)

Krugman and Venables (1995), "Globalization and the Inequality of Nations"

- Agriculture and manufacturing, only labor as the primary input.
  - Manufacturing also used as input
- Globalization leads to divergence (as one country fully specializes in manufacturing), then convergence (as manufacturing grows in the periphery)

Other Models: Romalis (2004)

Romalis (2004), "Factor Proportions and the Structure of Commodity Trade"

- DFS (1980) model with Krugman (1980) structure in all sectors
- "Smooth" predictions compared to DFS (1980)
- Derive tests of Heckscher-Ohlin and Rybczynski with multiple sectors

Some Tests of Home Market Effects

- Davis and Weinstein (2003), "Market Access, Economic Geography and Comparative Advantage: An Empirical Test," JIE
  - Test home market effects in OECD manufacturing, using residual demand from gravity regressions as demand shifters
- Hanson and Xiang (2004), "The Home Market Effect and Bilateral Trade Patterns," AER
  - Test prediction that large economies are relative exporters of large $\tau^{1-\sigma}$ sectors
- Costinot, Donaldson, Kyle, and Williams (2019), "The More We Die, The More We Sell? A Simple Test of the Home-Market Effect," QJE
  - Test that countries with larger demand for specific pharmaceutical drugs (due to demographics) are larger exporters

Helpman and Krugman (1985)

- Two countries, home and foreign, $i \in \{H, F\}$
- Preferences and technologies identical across countries
- Countries only differ in terms of *factor endowments*
- Two factors of production : labour, L, and capital, K. Home is *capital abundant*
- Two production sectors
- Homogenous agricultural good, A
- Differentiated varieties of manufacturing goods, m(i)
- Agriculture assumed to be *labour intensive* (Manufacturing assumed to be *capital intensive*)

Consumer Preferences

- Consumer preferences defined over consumption of Agricultural good, A, and of composite of manufacturing varieties, M,

$$U = M^{\mu} A^{1-\mu} \tag{22}$$

$$M = \left[\int_0^n m(i)^{\rho} di \right]^{1/\rho}, \qquad 0 < \rho < 1 \tag{23}$$

- Analyse patterns of trade in free trade equilibrium
- Begin by solving for integrated equilibrium

Consumer's Problem

- Consumer's problem is:

$$\max \quad U = M^{\mu} A^{1-\mu} \tag{24}$$

$$\text{s.t.} \qquad p^A A + \int_0^n p_i m_i di = \Omega \tag{25}$$

- Since utility function is separable between agriculture and manufacturing, and since M is homothetic in m_i, consumer maximisation problem can be solved in two stages
- First, solve for equilibrium consumption of Agriculture and Manufacturing,

$$M = \frac{\mu \Omega}{p_M} \tag{26}$$

$$A = \frac{(1-\mu)\Omega}{p_A}, \tag{27}$$

where p_M is a price index for the manufacturing composite M (to be defined below)

Consumer's Problem (cont'd)

- Second, for any given value of M, m_i for all i is chosen to minimise the cost of attaining M,

$$\min \quad \int_0^n p_i m_i di \quad \text{s.t.} \quad \left[\int_0^n m_i{}^{\rho} di\right]^{1/\rho} = M \tag{28}$$

- From first-order conditions,

$$m_i = \left[\frac{p_i}{p_j} m_j{}^{\rho-1}\right]^{1/(\rho-1)} \qquad \text{for any pair } i, j \tag{29}$$

- Substitute into constraint in (28), obtain Hicksian demand function for manufacturing variety j,

$$m_j = \frac{M \cdot p_j{}^{1/(\rho-1)}}{\left[\int_0^n p_i{}^{\rho/(\rho-1)} di\right]^{1/\rho}} \tag{30}$$

Price Index

- Therefore the minimum expenditure required to obtain a value of the consumption index M is:

$$\int_0^n p_j m_j dj = \left[\int_0^n p_i^{\rho/(\rho-1)} di \right]^{(\rho-1)/\rho} M \tag{31}$$

- Thus the price index p_M dual to the consumption index M is:

$$p_M = \left[\int_0^n p_i{}^{\rho/(\rho-1)} di \right]^{(\rho-1)/\rho} = \left[\int_0^n p_i^{1-\sigma} di \right]^{1/(1-\sigma)} \tag{32}$$

Producer's Problem : Manufacturing

- Producer of manufacturing variety i chooses price to max profits subject to a downward sloping demand function (30)
- Manufacturing production technology is increasing returns to scale. Define cost function,

$$\Gamma(w, r, x), \qquad \Gamma_x(\cdot) > 0, \qquad \Gamma_{xx}(\cdot) < 0, \tag{33}$$

- Producer of manufacturing variety i solves,

$$\max_{p_i} \qquad p_i \cdot x_i(p_i) - \Gamma(w, r, x_i(p_i)) \tag{34}$$

- The first-order condition is:

$$x_i(p_i) + p_i \cdot \frac{\partial x_i(p_i)}{\partial p_i} - \Gamma_x(w, r, x_i) \cdot \frac{\partial x_i(p_i)}{\partial p_i} = 0 \tag{35}$$

Equilibrium Pricing Rule

- Rearranging this first-order condition, we obtain the standard result that price is a mark-up over marginal cost:

$$p_i = \left(\frac{\varepsilon_i}{\varepsilon_i - 1}\right) \Gamma_x(w, r, x_i) \tag{36}$$

- With Dixit-Stiglitz preferences, the elasticity of demand $\varepsilon_i = \sigma \equiv 1/(1-\rho)$
- With the same elasticity of demand and production technology for all varieties, we have a symmetric equilibrium:

$$\textbf{(GE1)} \qquad p_i = p = \frac{1}{\rho}\Gamma_x(w, r, x) \tag{37}$$

Free Entry

- Free entry implies that equilibrium profits are zero if a variety is produced,

$$p_i x_i - \Gamma(w, r, x_i) = 0 \quad \text{if} \quad x_i > 0 \tag{38}$$

- In a symmetric equilibrium, this implies,

$$\textbf{(GE2)} \qquad p = \gamma(w, r, x), \tag{39}$$

  where $\gamma(w, r, x)$ is the average cost function

- Equilibrium aggregate output of manufacturing varieties is,

$$\textbf{(GE3)} \qquad X = nx, \tag{40}$$

  where care needs to be taken in the interpretation of X

Producer's Problem : Agriculture

- Agricultural good produced under conditions of constant returns to scale and perfect competition

$$\max \qquad p_A Y - \eta(w, r) Y, \tag{41}$$

where $\eta(w, r)$ is average (equals marginal) cost function in Agriculture

- The first-order condition for profit maximization implies,

$$\textbf{(GE4)} \qquad p_A = \eta(w, r) \tag{42}$$

Factor Market Clearing

- Factor market clearing conditions

$$\textbf{(GE5)} \qquad a_L^A(w,r)Y + a_L^x(w,r,x)nx = L \tag{43}$$

$$\textbf{(GE6)} \qquad a_K^A(w,r)Y + a_K^x(w,r,x)nx = K \tag{44}$$

$$\text{where} \qquad a_L^A(\cdot) = \frac{\partial \eta(w,r)}{\partial w}, \qquad a_L^x = \frac{\partial \Gamma(w,r,x)}{\partial w}/x.$$

Goods Market Clearing

- Consumers' optimal demands for manufacturing variety i are already incorporated into the equilibrium pricing relationship **(GE1)**
- If equation (27) is satisfied and the consumer's budget constraint binds, equation (26) is redundant
- Imposing goods market clearing in the integrated equilibrium, consumer equilibrium may be represented with the single equation,

$$\textbf{(GE7)} \qquad \frac{p_A Y}{p_A Y + pnx} = (1-\mu) \tag{45}$$

- Choose Agricultural good as numeraire, $p_A = 1$.

Conditions for Integrated Equilibrium

$$\textbf{(GE1)} \qquad p_i = p = \frac{1}{\rho}\Gamma_x(w, r, x)$$

$$\textbf{(GE2)} \qquad p = \gamma(w, r, x)$$

$$\textbf{(GE3)} \qquad X = nx$$

$$\textbf{(GE4)} \qquad 1 = \eta(w, r)$$

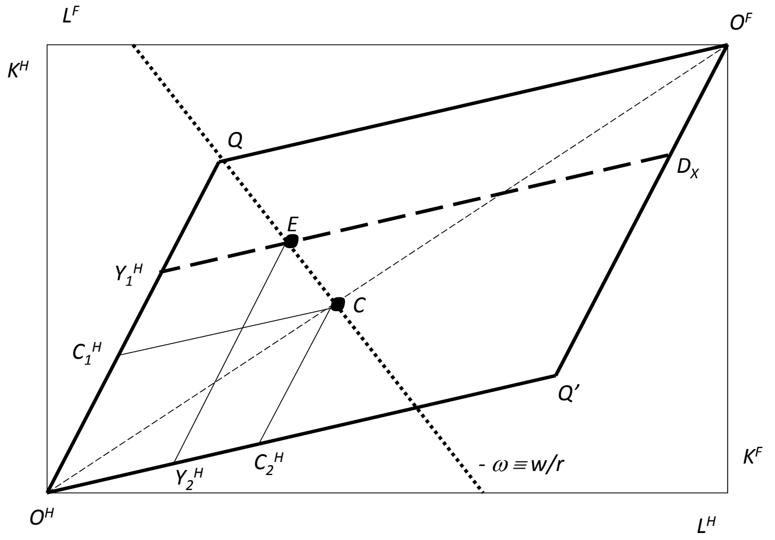
$$\textbf{(GE5)} \qquad a_L^A(w, r)Y + a_L^x(w, r, x)X = L$$

$$\textbf{(GE6)} \qquad a_K^A(w, r)Y + a_K^x(w, r, x)X = K$$

$$\textbf{(GE7)} \qquad \frac{Y}{Y + pnx} = (1 - \mu)$$

Seven equations (GE1)-(GE7) implicitly define integrated equilibrium values of $\{\hat{p}_i, \hat{w}, \hat{r}, \hat{x}, \hat{n}, \hat{Y}, \hat{X}\}$

Figure 1



Factor Price Equalization Equilibrium

- Shown diagrammatically in **Figure 1**
- $O^H Q$ (determines $\hat{X}$) is integrated equilibrium employment of capital and labour in Manufacturing
- QO^F (determines $\hat{Y}$) is integrated equilibrium employment of capital and labour in Agriculture
- As drawn, Manufacturing is the more capital intensive sector
- Home and foreign endowments indicated by point E. As drawn, home is capital abundant
- $\{OY_1^H, OY_2^H\}$ are home's employment of capital and labour in Manufacturing and Agriculture in the FPE equilibrium
- Foreign's employment of capital and labour in the two sectors in the FPE equilibrium can be shown analogously

Factor Price Equalization

- We have constructed an equilibrium allocation of resources that,
  - Uses exactly same techniques of production as in integrated equilibrium
  - Exactly exhausts each country's endowment of factors of production
  - Produces same level of output of each good as in integrated equilibrium
  - Characterised by same equilibrium factor rewards $\{\hat{w}, \hat{r}\}$, commodity prices $(\hat{p})$, and output per firm in the manufacturing sector $(\hat{x})$
- Home and foreign produce the range of manufacturing varieties

$$\hat{n}^H = \frac{\hat{X}^H}{\hat{x}}, \qquad \hat{n}^F = \frac{\hat{X}^F}{\hat{x}}$$

$$\text{where} \qquad \hat{n}^H + \hat{n}^F = \hat{n} = \frac{\hat{X}}{\hat{x}}$$

Inter-industry Trade

- The integrated equilibrium and factor price equalization equilibrium are shown diagrammatically in Figure 1; Draw a line passing through the endowment point (E) with slope equilibrium relative factor prices $(\hat{w}/\hat{r})$
- Distance $O^H C / O^H O^F$ proportional to home's share of world GDP
- With identical and homothetic preferences, the representative consumer in each country consumes the Manufacturing and Agricultural goods in the same proportions as the representative consumer in the integrated world economy
- The factor content of consumption in each country is the same as the factor content of consumption in the integrated world economy
- The vectors $\{O^H C_1^H, O^H C_2^H\}$ denote the factor content of home's consumption of Manufacturing and Agriculture
- **Inter-industry trade:** Capital-abundant home is a *net* exporter of capital-intensive Manufacturing goods and a *net* importer of labour-intensive Agricultural goods

Intra-industry Trade

- **Intra-industry trade :** *love of variety* implies that representative consumer in each country consumers both *home* and *foreign* manufacturing varieties
- *Identical* and *homothetic* preferences imply that home consumes a proportion of the output of each variety equal to its share of world income, s

$$D_X^H = s\left(n^H x + n^F x\right)$$

- Similarly, for foreign we have,

$$D_X^F = (1-s)\left(n^H x + n^F x\right)$$

- Implies that, although home is a net exporter of Manufacturing goods, it imports a quantity $sn^F x$ from foreign
- That is, although foreign is a net importer of Manufacturing goods, it exports some Manufacturing varieties to home