ECON 357

Lecture 2: the Krugman model of trade

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Ricardian model of trade (1817)

- Countries differ in their technology.
- Motive for trade: comparative advantages.
- Key assumption: it is easier to move goods than technologies.

Heckscher-Ohlin model of trade (1933)

- Countries differ in their factor endowments.
- Motive for trade: endogenous differences in technology.
- Key finding: trade alone may equalize factor prices.
- Key assumption: it is easier to trade goods than factors of production.

Empirical challenges

- Countries with seemingly similar technologies trade.
- Countries with seemingly similar factor endowments trade.
- A large fraction of trade is two-way trade within industry.

Krugman model of trade (1979-80)

- Countries have identical technologies, factor endowments, preferences...
- Differentiated goods (love for variety) $\Rightarrow$ consumers want to consume all possible goods.
- Increasing returns to scale $\Rightarrow$ countries specialize in producing a subset of goods.

Key assumptions

- Love for variety preferences.
- Increasing returns to scale.
- Imperfect competition.

Key *simplifying* assumptions

- Iso-elastic preferences.
- Fixed cost + constant marginal cost technology.
- Monopolistic competition with many firms.
- Multiplicative trade costs.

Preferences

$$\max_{q(\omega)} U \equiv \left(\int_{\Omega} q\left(\omega\right)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

$$\text{s.t.} \int_{\Omega} p\left(\omega\right) q\left(\omega\right) d\omega = wL$$

Demand

$$q(\omega) = \left(\frac{p(\omega)}{P}\right)^{-\sigma} \frac{wL}{P}$$

$$\text{with } P = \left(\int_{\Omega} p(\omega)^{1-\sigma} d\omega\right)^{\frac{1}{1-\sigma}}$$

Technology and pricing

- Increasing returns to scale technology:

$$l(q) = f + \frac{q}{\varphi}$$

- Iso-elastic demand $\Rightarrow$ constant mark-up over marginal cost:

$$p(\omega) = \frac{\sigma}{\sigma - 1}\frac{w}{\varphi}, \ \forall \omega$$

Profits and free entry

- Gross profits proportional to size,

$$\pi(p,P) + wf = pq(p,P) - \frac{wq(p,P)}{\varphi}$$
$$= w\frac{q(p,P)}{(\sigma-1)\varphi}$$

- Free entry drives down profits to zero,

$$\pi = 0 \Rightarrow q = (\sigma-1)\varphi f \qquad (FE)$$

- Note 1: key assumption, fixed cost in units of labor (not of goods).
- Note 2: entry of new firms drives down P,

$$P = \left(\int_{\Omega} p(\omega)^{1-\sigma} d\omega\right)^{\frac{1}{1-\sigma}} = n^{\frac{1}{1-\sigma}} p$$

Number of firms and welfare

- Number of firms pinned down by aggregate ressource constraint (labor market clearing),

$$n\left(f+\frac{q}{\varphi}\right)=L\Rightarrow n=\frac{L}{\sigma f} \qquad (LMC)$$

- Welfare increases with size,

$$P=\frac{\sigma w}{(\sigma-1)\,\varphi}\left(\frac{L}{\sigma f}\right)^{\frac{1}{1-\sigma}}$$

$$W=\frac{w}{P}=(\sigma-1)\,\varphi\left(\frac{L}{\sigma f}\right)^{\frac{1}{\sigma-1}}$$

Trade

- 2 countries, only differ in size (L, L^*).
- Icerberg transportation costs $\tau > 1$.
- Segmented markets:

$$\begin{cases} \text{domestic price} = p = \frac{\sigma-1}{\sigma}\frac{w}{\varphi} \\ \text{export price (c.i.f.)} = \tau p \end{cases}$$

- Note: this is not "pricing-to-market."

Aggregate prices

- Both trade barriers and relative abundance of varieties affect trade,

$$P^{1-\sigma} = np^{1-\sigma} + n^* \left(\tau p^*\right)^{1-\sigma}$$
$$P^{*1-\sigma} = n \left(\tau p\right)^{1-\sigma} + n^* p^{*1-\sigma}$$

- Novel intuition: trade enhances welfare through added varieties.
- Note: in Krugman, trade barriers $(< +\infty)$ do not affect available varieties.

Production and profits

- Firms produce both for domestic and foreign consumers,

$$q\left(p, P, P^*\right) = q^D\left(p, P\right) + \tau q^X\left(\tau p, P^*\right)$$

- Profits derived from global sales,

$$\pi\left(p, P, P^*\right) = \frac{w}{\left(\sigma - 1\right)\varphi} q\left(p, P, P^*\right) - wf$$

- Free entry drives down global profits to zero,

$$\pi = 0 \Leftrightarrow q = \left(\sigma - 1\right)\varphi f$$

- Note: scale of production unaffected by trade (due to constant mark-ups, fixed costs in labor and free entry).

Number of firms

- Number of firms pinned down by aggregate ressource constraint (labor market clearing),

$$\begin{cases} n\left(f+\frac{q}{\varphi}\right)=L \\ n^*\left(f+\frac{q^*}{\varphi}\right)=L^* \end{cases} \Rightarrow \begin{cases} n=\frac{L}{\sigma f} \\ n^*=\frac{L^*}{\sigma f} \end{cases} \qquad (LMC)$$

- Note: number of firms same as in autarky (due to constant mark-ups).
- Corrolary: number of products unaffected by changes in trade barriers.

Gains from trade *do not* come from increased variety

- Welfare depends on number of goods and prices,

$$W = \frac{w}{P} = w\left(np^{1-\sigma} + n^*\left(\tau p^*\right)^{1-\sigma}\right)^{1/(\sigma-1)}$$

- Number of varieties and local prices are constant,

$$\begin{cases} n = \frac{L}{\sigma f} \\ n^* = \frac{L^*}{\sigma f} \end{cases}$$

$$\begin{cases} p = \frac{\sigma-1}{\sigma}\frac{w}{\varphi} \\ p^* = \frac{\sigma-1}{\sigma}\frac{w^*}{\varphi} \end{cases}$$

- Gain from trade only comes from *cheaper* foreign goods, not from *more* foreign goods.
- Note: only true "on average", because relative wages adjust.

Aggregate trade

- Define the relative wage, $\omega = \frac{w}{w^*}$, and normalize $w^* = 1$.
- Aggregate trade flows,

$$X_{f.o.b.} = \lambda \times L \times L^* \times \left(\frac{\tau\omega}{P^*}\right)^{1-\sigma}$$

- Foreign price index,

$$P^{*1-\sigma} = \lambda \left((\tau\omega)^{1-\sigma} L + L^* \right)$$

Wages and market size (Economic Geography)

- Trade balance, $X_{f.o.b.} = X^*_{f.o.b.}$, gives,

$$\left(L + \left(\frac{\tau}{\omega}\right)^{1-\sigma} L^*\right) \omega^{2(1-\sigma)} = (\omega\tau)^{1-\sigma} L + L^*$$

$$\Rightarrow \begin{cases} \text{if } L = L^*, \ \omega = 1 \\ \text{if } L > L^*, \ \omega > 1 \end{cases}$$

- In a large market:
  - More cheap (domestic) varieties
    $\Rightarrow$ lower price index.
    $\Rightarrow$ consumers are less willing to import (expensive) foreign varieties.
    $\Rightarrow$ to restore trade balance, "currency appreciates".
    $\Leftrightarrow$ relative wage increases.
- Note: a larger market has higher *nominal* wages and a lower *price index*, so higher *real* wages.

Home market effect

Definition

Increasing returns to scale industries tend to locate in larger markets, and export their goods to other countries.

Simple set-up in Helpman-Krugman.

- Cobb-Douglas preferences over 2 sectors.
- 1 differentiated good sector: CES (σ), share μ.
- 1 homogenous goods sector: share $(1-\mu)$, CRS, freely tradable

$$\Rightarrow \frac{w}{w^*} = 1$$

- Note: only true if both countries produce homogenous good.

Labor market clearing

- As in Krugman, free entry pins down scale of production: $q = q^* = (\sigma - 1)\,\varphi f$.
- Simplifying assumption: $w = w^* \Rightarrow p = p^*$ (all normalized to 1).
- Goods market clearing,

$$\begin{cases} nq = \frac{n}{n+n^*\tau^{1-\sigma}}\mu L + \frac{n^*\tau^{1-\sigma}}{n\tau^{1-\sigma}+n^*}\mu L^* \\ n^*q^* = \frac{n\tau^{1-\sigma}}{n+n^*\tau^{1-\sigma}}\mu L + \frac{n^*}{n\tau^{1-\sigma}+n^*}\mu L^* \end{cases}$$

Home market effect

- $s_n = n/\left(n+n^*\right)$, $s_L = L/\left(L+L^*\right)$, and $s_n = \frac{\left(1+\tau^{1-\sigma}\right)s_L - \tau^{1-\sigma}}{1-\tau^{1-\sigma}}$.

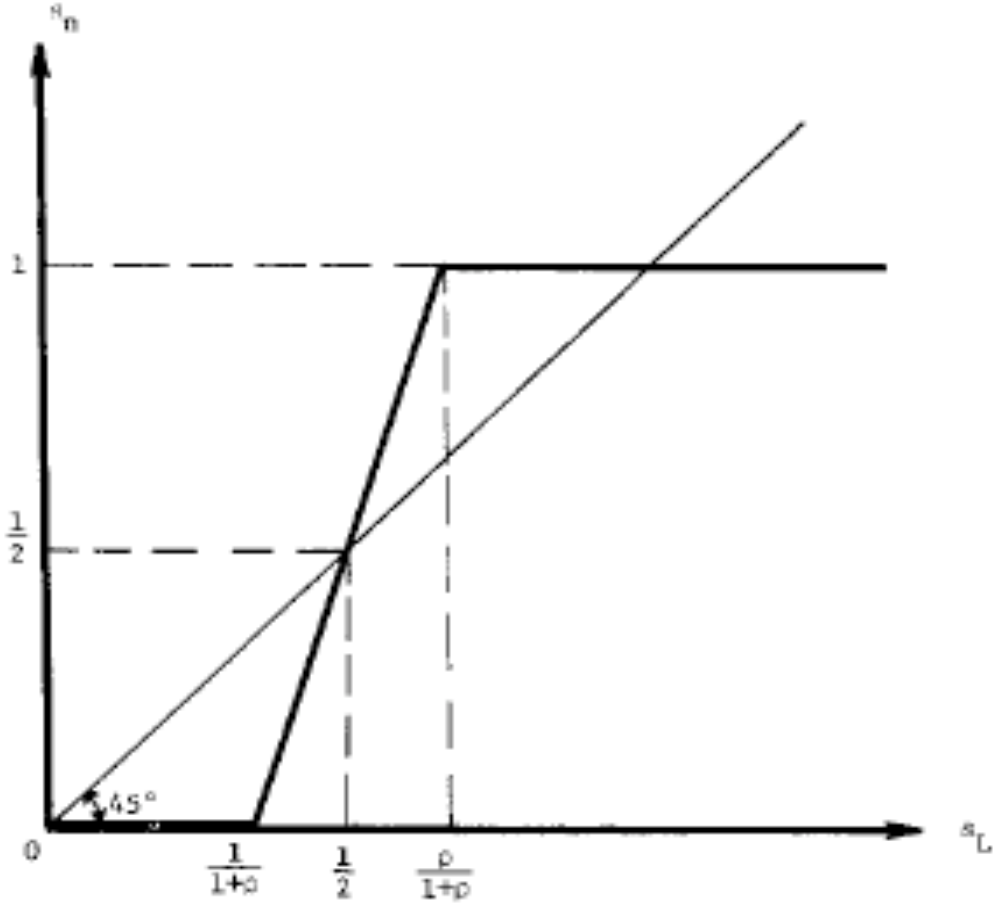

Figure: Home market effect

Home market effect: intuition

- Intuition: from a symmetric equilibrium, increase size of home,
  - more demand/profits for home firms.
  - to restore free entry, entry of domestic firms.
- When $\tau < +\infty$, markets are shared by domestic and foreign firms.
- Firm entry has a lower impact on profits than consumer entry.
- Firm entry must respond *more* than proportionally to size.

Home market effect: intuition

- Note: $\searrow \tau \Rightarrow$ steeper line $\Rightarrow$ stronger home market effect.
- τ high: most competitors to domestic firms are also domestic.
  - domestic firms lose a lot from entry of domestic firms.
  - to restore zero profits, entry must move a little.
- τ low: many competitors to domestic firms are foreign.
  - domestic firms lose little from entry of domestic firms.
  - to restore zero profits, entry must move a lot.