Lecture 9: Trade, External Scale Economies and Oligopoly

14.581: International Economics I

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Motivation

- Some uncomfortable features about neoclassical trade model:
  - stresses country asymmetries, while the bulk of trade flows is between similar countries and it involves little net factor trade (70-80% of trade is intraindustry trade – see Grubel-Lloyd);
  - hard (though not impossible) to generate predictions for bilateral trade flows, while evidence suggests strong patterns (gravity equation);
  - misses important aspects of the effects of trade liberalization (heterogeneity);
  - hard to think about firms in the model (intrafirm trade, multinational activity)
- In the next few lectures we will discuss models with scale economies, imperfect competition and product differentiation, which have proved to be very useful in dealing with these caveats.
- These models do not attempt to replace neoclassical trade theory – effort to embed new features in standard integrated equilibrium frameworks (see Helpman and Krugman, 1985).
- We will introduce scale economies, imperfect competition and product differentiation sequentially.
- A natural first step is to study external (or Marshallian) economies of scale, which are consistent with perfect competition and homogenous products.

External Economies of Scale

- We now modify the neoclassical model in a straightforward way. The unit cost function is now
$$c_i\left(w^k,\xi\right), \tag{1}$$
where ξ is a vector of external effects that affect the productivity of firms in sector i and country k.
- An important distinction is between national external effects vs. international external effects.
  - We will come back to this distinction in the section of the course on growth.
- The standard assumption is $\xi = X_i^k$ and $\partial c_i\left(w^k, X_i^k\right)/\partial X_i^k < 0$, which implies positive domestic and within-industry external effects.
- Because (infinitessimal) firms do not internalize the effect of their output levels on ξ, these firms perceive the cost function in (1) as featuring constant returns to scale.
- The equilibrium conditions under autarky and free trade are then analogous to those in the neoclassical model, except for the fact that both the cost functions as well as the unit factor requirements will depend on ξ^{aut} and ξ^T.
- What are the effects of this modification?

External Economies of Scale: Some Implications

- If external effects are global in nature, equilibrium is not much affected by external effects (analogous FPE set, comparative advantage uniquely defined,...).
- With local external effects matters become more complicated:
  - replication of the integrated equilibrium requires that industry with external effects be concentrated in one country;
  - as a result, FPE set may look quite different from standard model and may not include 45 degree line (see figure below);
  - equilibrium will in general not be unique (even when FPE is attained!);
  - countries with identical relative factor endowments may feature positive trade flows and H-O theorem may fail even in $2 \times 2 \times 2$ case;
  - gains from trade are not ensured unless each country's GDP (evaluated at post-trade prices) is higher under the vector ξ^T than under the vector ξ^{aut}.
- Still, when FPE (or conditional FPE) is attained, the Vanek equation will still hold:
  - Antweiler and Trefler (2002) use these facts to estimate the size of economies of scale.

External Economies of Scale: Integrated Equilibrium

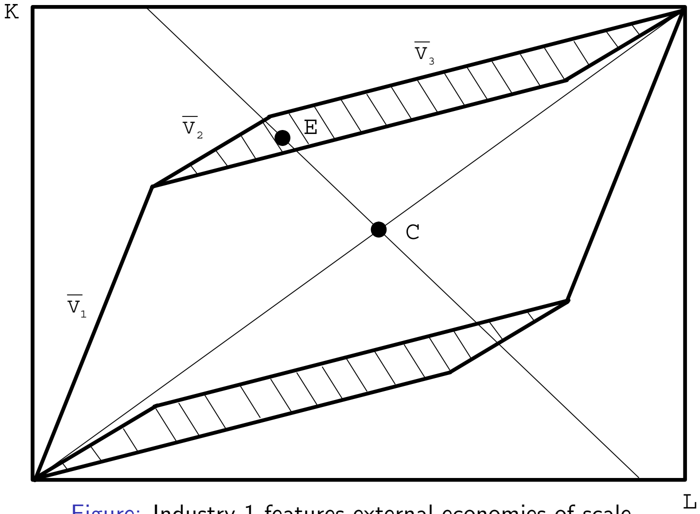

Figure: Industry 1 features external economies of scale

External Economies of Scale: Example #1

- Assume 2 goods $(1, 2)$, 2 countries (H, F), and one factor (labor).
- Cost functions are
$$c_1\left(w^k\right) = w^k\left(X_1^k\right)^{-1/2};\ c_2\left(w^k\right) = w^k.$$
- Preferences are Cobb-Douglas with a share α going to sector 1.
- Autarkic equilibrium (with $w^{k,aut} = 1$) has
$$\begin{aligned} p_1^k &= \left(X_1^k\right)^{-1/2};\ p_2^k = 1 \\ \left(X_1^k\right)^{-1/2} X_1^k + X_2^k &= L^k \\ X_2^k &= (1-\alpha) L^k \end{aligned}$$
- This yields:
$$X_1^k = \left(\alpha L^k\right)^2;\ p_1^k = \left(\alpha L^k\right)^{-1};\ Welfare = \alpha^\alpha (1-\alpha)^{1-\alpha}\left(\alpha L^k\right)^\alpha.$$
- Note the presence of scale effects.

External Economies of Scale: Example #1 (cted.)

- Now consider a potential trading equilibrium in which Home specializes in good 1:

$$\begin{aligned} p_1 &= w^H \left(X_1^k\right)^{-1/2}; \, p_2 = w^F \\ \left(X_1^H\right)^{-1/2} X_1^H &= L^H; \, X_2^H = 0; \\ X_1^F &= 0; \, X_2^F = L^F \\ p_2 X_2^F &= (1-\alpha)\left(w^F L^F + w^H L^H\right) \end{aligned}$$

- This yields:

$$p_1 = w^H \left(L^H\right)^{-1}; \; p_2 = w^F.$$

- Note that for this to be an equilibrium, we need that $p_2 = w^F \leq w^H$, or

$$\frac{\alpha}{1-\alpha}\frac{L^F}{L^H} > 1. \tag{2}$$

External Economies of Scale: Example #1 (cted.)

- Welfare levels under free trade are then:

$$W^H = \alpha^\alpha (1-\alpha)^{1-\alpha} \left(L^H\right)^\alpha \left(\frac{\alpha}{1-\alpha}\frac{L^F}{L^H}\right)^{1-\alpha}$$

$$W^F = \alpha^\alpha (1-\alpha)^{1-\alpha} \left(L^H\right)^\alpha \left(\frac{\alpha}{1-\alpha}\frac{L^F}{L^H}\right)^{-\alpha}$$

- Using condition (2), it is clear that Home is better off. But Foreign will be worse off whenever:

$$\frac{L^H}{L^F} < \frac{\alpha}{\sqrt{1-\alpha}},$$

that is when Home is small enough.

- Graham (1923): Foreign is worse off because it loses the IRS technology to a country that exploits it less efficiently (see Ethier, 1982 for fuller treatment).

External Economies of Scale: Example #2

- Assume I goods (possibly a continuum), 2 countries (H, F), and one factor (labor).
- Cost function is

$$c_i\left(w^k, X_i^k\right) = a_i^k \left(X_i^k\right)^{-\varepsilon_i} w^k.$$

- When $\varepsilon_i = 0$, we can rank goods and get the standard chain of comparative advantage:

$$\underbrace{\frac{a_1^H}{a_1^F} < \frac{a_2^H}{a_2^F} < \ldots <}_{\text{Home exports}} \frac{w^F}{w^H} < \underbrace{\ldots < \frac{a_{I-1}^H}{a_{I-1}^F} < \frac{a_I^H}{a_I^F}}_{\text{Foreign exports}}.$$

- But with $\varepsilon_i > 0$ (no matter how small) any pattern of specialization is an equilibrium.
- What determines equilibrium? In the presence of adjustment costs to moving factors, there is a tension between "History" (path-dependence) and "Expectations" (see Krugman, 1991)

Oligopoly: Segmented Markets

- We begin our study of internal economies of scale and imperfect competition with a specific model developed by Brander (1981) and Brander and Krugman (1983).
- Consider a two country (H, F), one good (A), partial equilibrium setup.
- By assumption, there are only two firms in the world economy, one in each country.
- By assumption, firms compete in quantities in each market separately.
- By assumption, any price differences across markets are not arbitraged away.
- Demand for good A is given by the following inverse demand function
$$p^j = p^j\left(X_A^{H,j} + X_A^{F,j}\right),$$
where $X_A^{H,j}$ is sales of the Home firm in market j.
- There is a constant marginal cost of production c plus a fixed cost F^j (decreasing average cost curves).
- There exist transport costs $\tau > 1$ when selling abroad.

Segmented Markets: Firm Behavior

- Firm in H solves

$$\max_{X_A^{H,H}, X_A^{H,F}} \pi^H = \left[p^H\left(X_A^{H,H}+X_A^{F,H}\right)-c\right]X_A^{H,j} + \left[p^F\left(X_A^{H,F}+X_A^{F,F}\right)-\tau c\right]X_A^{H,F}-F^H.$$

- Firm in F solves

$$\max_{X_A^{F,H}, X_A^{F,F}} \pi^F = \left[p^F\left(X_A^{H,F}+X_A^{F,F}\right)-c\right]X_A^{F,F} + \left[p^H\left(X_A^{H,H}+X_A^{F,H}\right)-\tau c\right]X_A^{F,H}-F^F.$$

- It is clear that each market can be studied in isolation.
- Standard first-order condition (assume SOC are satisfied):

$$MR \equiv p + p'X^j = \left(1-\frac{s^j}{\varepsilon}\right)p = MC,$$

where s^j is the market share of firm from j ($s^j \equiv X^j/(X^H+X^F)$) and ε is price elasticity of demand.

Segmented Markets: Firm Behavior

- Consider the case of the domestic market (drop unnecessary subscripts):

$$p\left(1 - s^H/\varepsilon\right) = c;$$
$$p\left(1 - \left(1 - s^H\right)/\varepsilon\right) = \tau c.$$

  from which we can solve:

$$p = \frac{c\varepsilon\left(1+\tau\right)}{2\varepsilon - 1}$$
$$s^H = \frac{\left(\tau - 1\right)\varepsilon + 1}{1+\tau}$$

- It is straightforward to show that $s^H > 1/2$, while $s^H < 1$ (Foreign penetration) provided that $\tau < \varepsilon / \left(\varepsilon - 1\right)$ – satisfied for $\tau \rightarrow 1$.
  - Intuition: transport cost $<$ markup.
- An analogous analysis in the Foreign market reveals that the model delivers two-way trade in identical commodities.
- Notice also that $s^H > 1/2$ implies that firms charge a higher markup in their domestic market: reciprocal dumping.

Segmented Markets: Welfare and Extensions

- Because we are in a second-best world, it is no longer clear that trade is Pareto optimal:
  - if countries are identical, we do not have any of the standard gains from trade;
  - but there is a competition gain, since we move from monopoly to duopoly (cf. Markusen, 1981);
  - but cross-hauling of identical with transport costs generates waste.
- When $\tau \longrightarrow 1$, trade is good (only competition effect), but when $\tau \longrightarrow \varepsilon / (\varepsilon - 1)$, trade is bad (only cross-hauling effect).
- Brander and Krugman (1981) also extend the model to allow for free entry and thus an endogenous number of firms in each market.
  - Surprisingly, this is sufficient to ensure that trade is welfare-improving.
  - The intuition is that, with free entry, price is driven down to average cost, and the latter will fall with increased export opportunities.

Segmented Markets: Limitations

- Segmented market models have been criticized for their ad hoc assumptions.
- If firms could commit to service only their domestic market, this would be profit maximizing (similar to Prisoner's Dilemma).
- More importantly, Cournot behavior does not seem to realistic. Price competition seems to better describe reality.
- Kreps and Scheinkman (1983) showed that in a two-stage game in which firms choose capacity in stage 1 and prices in stage 2, the subgame perfect equilibrium looks like a Cournot equilibrium.
  - What happens when apply Kreps-Scheinkman to multi-market environment?
- Ben-Zvi and Helpman (1992) show that it dramatically changes conclusions:
  - three-stage game with overall capacity decided in stage 1, prices in both markets in stage 2, and sales in each market in stage 3;
  - it is shown that two-way trade in identical goods disappears.
- This suggests that an analysis of oligopolistic behavior in an integrated world market may be a more promising approach
  - this approach is developed in HK, sections 5.1 through 5.4 – can still describe FPE set and Vanek equation holds within this set.