International Economics B
5. International oligopoly 2: Reciprocal market model

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The Reciprocal markets model

- **Seminal papers:**
  - **Brander, James A. (1981), Intra-industry trade in identical commodities,** *Journal of International Economics* **11, pp.1–14.**
  - **Brander, James and Paul Krugman (1983), A 'reciprocal dumping' model of international trade,** *Journal of International Economics* **15, pp.313–321.**
- **Motivation: To explain intra-industry trade (i.e., trade in similar products) between similar countries.**
  - **Cannot explained by classical (i.e., Ricardian) or neoclassical (i.e., Heckscher–Ohlin) trade models**

- **Findings:**
  - **There is no comparative advantage but still trade occurs. (cf. classical and neoclassical trade models)**
  - **There is two-way trade in absolutely identical products. (i.e., intra-industry trade)**
  - **Trade can be mutually beneficial to the two countries because of increased competition if the transport costs are not too large. (i.e., gains from trade)**

Setup of the model

- **Two identical countries (domestic & foreign), each of which has one firm producing commodity Z**
- **Transport costs incurred in exporting goods from one country to the other $\Rightarrow$ Each firm regards each country as a separate market and therefore chooses the profit-maximizing quantity for each country separately.**

- **Cournot duopoly in homogeneous products when trade occurs**
  - **Domestic firm: output x for domestic consumption and output x^* for foreign consumption**
  - **Foreign firm: output y for domestic consumption and output y^* for foreign consumption**
- **Marginal cost: $c > 0$**
  - **Transport costs of the 'iceberg' type $\Rightarrow$ MC of export is c/g, $0 \leq g \leq 1$**

- **Profits**
  - **Domestic firm:**

$$\pi = p(Z)x + p^*(Z^*)x^* - c \cdot \left(x + \frac{x^*}{g}\right) - F$$

  - **Foreign firm:**

$$\pi^* = p(Z)y + p^*(Z^*)y^* - c \cdot \left(\frac{y}{g} + y^*\right) - F^*$$

- **Assumption of constant MC $\Rightarrow$ Profit maximizing choice of x is independent of x^* and similarly for y and y^*.**
  - **Each country can be considered separately.**
- **$\Rightarrow$ Focus on the domestic country.**

- **FOCs in the domestic market**
  - **Domestic firm:**

$$\pi_x = p(Z) + p'(Z)x - c = 0$$

  - **Foreign firm:**

$$\pi_y^* = p(Z) + p'(Z)y - \frac{c}{g} = 0$$

- **Solving the above 'best-reply' functions in implicit form $\Rightarrow$ Trade equilibrium**
- **These implicit best-reply functions can be rewritten as:**

$$p = \frac{c\epsilon}{\epsilon + \sigma - 1}, \qquad p = \frac{c\epsilon}{g(\epsilon - \sigma)}$$

  - $\sigma \equiv y/Z$: **foreign share in the domestic market**
  - $\epsilon \equiv -p/(Zp')$: **elasticity of domestic demand**

- **Second-order conditions are assumed to be satisfied:**

$$\pi_{xx} = xp'' + 2p' < 0; \quad \pi^*_{yy} = yp'' + 2p' < 0$$

- **The following conditions are also assumed to be satisfied:**

$$\pi_{xy} = xp'' + p' < 0; \quad \pi^*_{yx} = yp'' + p' < 0$$

  - **Own marginal revenue declines when the other firm increases its output.**
  - **Reaction functions are downward sloping.**

Two-way trade equilibrium

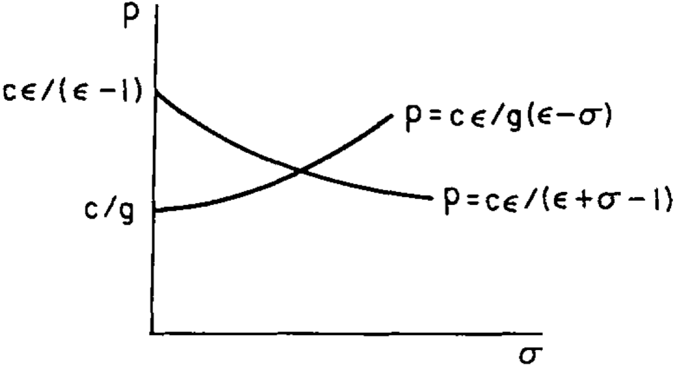
- **Equilibrium conditions $\Rightarrow$ Existence, stability, and uniqueness of an equilibrium:**

$$p = \frac{c\epsilon(1+g)}{g(2\epsilon-1)}, \qquad \sigma = \frac{\epsilon(g-1)+1}{1+g}$$

- **If $1/2 < \epsilon < 1/(1-g)$ at the equilibrium, a positive solution $(p, \sigma > 0)$, which implies a two-way trade equilibrium will arise.**

- **Properties of trade equilibrium:**
  - $g \leq 1 \Rightarrow \sigma \leq 1/2$ **holds; each firm has a smaller market share of its export market than of its domestic market.**
  - $c \leq c/g \Rightarrow$ **Each firm has a a smaller markup over cost in its export market than at home; there is reciprocal dumping.**

- **Special case of constant elasticity demand**



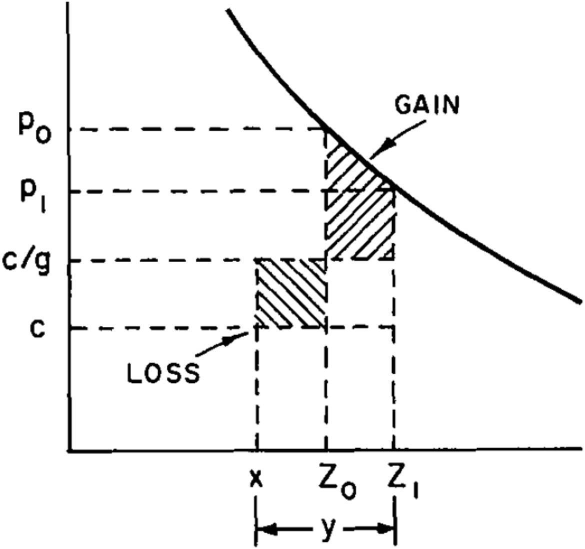
  - **Domestic firm's profit-maximizing price is decreasing in σ and the intercept on the p–axis is $c\epsilon/(\epsilon - 1)$.**
  - **Foreign firm's profit-maximizing price is increasing in σ and the intercept on the p–axis is c/g.**

- **If $c\epsilon/(\epsilon - 1) > c/g$, the intersection must be at a positive foreign market share; reciprocal dumping will occur if monopoly markups in its absence were to exceed transport costs.**
  - **$c\epsilon/(\epsilon - 1)$: price which would prevail if there were no trade**
  - **c/g: marginal cost of exports**

Trade and welfare

- **Reciprocal dumping solution is not Pareto efficient.**
  - **Some monopoly distortion persists even after trade**
  - **There are socially pointless transportation costs incurred in cross-hauling.**
- **Is free trade superior to autarky? $\Rightarrow$ Uncertain answer because there are two effects:**
  1. **Allowing trade in this model leads to waste in transport, tending to reduce welfare.**
  2. **International competition leads to lower prices, reducing the monopoly distortion.**

- **Conflicting effects on welfare**
  - Z_0: **pre-trade output,** p_0: **pre-trade price**
  - Z_1: **after-trade output,** p_1: **after-trade price**
  - $Z_1 = x + y$, **where** x: **output for domestic consumption,** y: **imports**
- **After trade consumption rises and price falls, but output for domestic consumption falls** $\Rightarrow$ **Whether free trade enhances welfare depends on:**
  - **Gain from the 'consumption creation'** $Z_1 - Z_0$; **versus**
  - **Loss from the 'production diversion'** $Z_0 - x$
- **If transport costs are not too high, the gain outweighs the loss and there will be gains from trade.**


GAIN
p_0
p_1
c/g
c
LOSS
x
Z_0
Z_1
y

- **Example with linear demand: $p(Z) = A - Z$**
  - **Autarkic equilibrium:**

$$Z_0 = \frac{A-c}{2}, \quad p_0 = \frac{A+c}{2}$$

  - **Free trade equilibrium:**

$$x = \frac{A - \frac{2g-1}{g}c}{3}, \quad y = \frac{A - \frac{2-g}{g}c}{3},$$
$$Z_1 = \frac{2A - \frac{1+g}{g}c}{3}, \quad p_1 = \frac{A + \frac{1+g}{g}c}{3}$$

- **Comparison of welfare**
  - **Gain:** $\dfrac{5\left(A - \frac{2-g}{g}c\right)^2}{72}$
  - **Loss:** $\dfrac{\left(A - \frac{2-g}{g}c\right)\frac{1-g}{g}c}{6}$

$\Rightarrow$ **If $g > (<) \dfrac{22}{\frac{5A}{c} + 17}$, trade enhances (reduces) welfare.**

Extension: Trade policy

- **Assume:**
  - **No transport costs (i.e., $g = 1$)**
  - **Government in each country imposes a specific tariff on its import.**
- **Profits**
  - **Domestic firm:**

$$\pi = p(Z)x + p^*(Z^*)x^* - cx - (c + t^*)x^* - F$$

  - **Foreign firm:**

$$\pi^* = p(Z)y + p^*(Z^*)y^* - (c + t)y - cy^* - F^*$$

- **FOCs in the domestic market**
  - **Domestic firm:**

$$\pi_x = p(Z) + p'(Z)x - c = 0$$

  - **Foreign firm:**

$$\pi_y^* = p(Z) + p'(Z)y - (c + t) = 0$$

- **Cournot–Nash equilibrium output depends on t.**

$$\begin{bmatrix} \pi_{xx} & \pi_{xy} \\ \pi_{yx}^* & \pi_{yy}^* \end{bmatrix} \begin{bmatrix} dx \\ dy \end{bmatrix} = \begin{bmatrix} 0 \\ dt \end{bmatrix}$$

$$\Rightarrow \quad \frac{dx}{dt} = -\frac{\pi_{xy}}{\Delta} > 0, \quad \frac{dy}{dt} = \frac{\pi_{xx}}{\Delta} < 0,$$

$$\Delta \equiv \pi_{xx}\pi_{yy}^* - \pi_{xy}\pi_{yx}^* > 0$$

- **Domestic welfare:**

$$W = \underbrace{\int_0^Z p(\zeta)d\zeta - p(Z)Z}_{\text{consumer surplus}} + \underbrace{\pi}_{\text{firm profit}} + \underbrace{ty}_{\text{tariff revenue}}$$

- **Welfare effect of a change in t:**

$$\begin{aligned}\frac{dW}{dt} &= -\frac{dp}{dt}Z + \left[\frac{dp}{dt}x + (p-c)\frac{dx}{dt}\right] + \left[y + t\frac{dy}{dt}\right] \\ &= \left(1 - \frac{dp}{dt}\right)y + (p-c)\frac{dx}{dt} + t\frac{dy}{dt}\end{aligned}$$

- **Optimal level of t:**

$$t^o = \frac{\left(1 - \frac{dp}{dt}\right) y + (p - c) \frac{dx}{dt}}{-\frac{dy}{dt}}$$

- **If demand is not too convex, $1 - dp/dt > 0$ and hence $t^o > 0$, i.e., optimal policy is an import tariff.**

Extension: Many firms

- n domestic firms and n^* foreign firms $\Rightarrow$ Inverse demand functions:
  - Domestic market: $Z = \sum_{i=1}^{n} x_i + \sum_{j=1}^{n^*} y_j$
  - Foreign market: $Z^* = \sum_{i=1}^{n} x_i^* + \sum_{j=1}^{n^*} y_j^*$
- FOCs in the domestic market
  - Domestic firms:

$$\frac{\partial \pi_i}{\partial x_i} = p(Z) + p'(Z)x_i - c = 0, \quad i = 1, \cdots, n$$

  - Foreign firms:

$$\frac{\partial \pi_j^*}{\partial y_j} = p(Z) + p'(Z)y_j - \frac{c}{g} = 0, \quad j = 1, \cdots, n^*$$

- **Symmetry within each country $\Rightarrow$ In a Cournot–Nash equilibrium, the following equations hold:**

$$p = \frac{c\epsilon n}{\epsilon n + \sigma - 1}, \quad p = \frac{c\epsilon n^*}{g(\epsilon n^* - \sigma)}$$

  - $\sigma \equiv n^* y / Z$: **foreign market share**

- **Solving for p and σ:**

$$p = \frac{c\epsilon(ng + n^*)}{g[(n + n^*)\epsilon - 1]}, \quad \sigma = \frac{n^*[n\epsilon(g-1)+1]}{ng + n^*}$$

- Suppose there is free entry and exit of oligopolists.
- In equilibrium, n and n^* are endogenously determined by zero-profit conditions $\pi_i = 0$, $i = 1, \cdots, n$, and $\pi_j^* = 0$, $j = 1, \cdots, n^*$.
- Under free entry, opening international trade unambiguously improves welfare.
  - Profits are zero under free entry equilibrium $\Rightarrow$ Welfare = consumer surplus
  - Since CS is negatively dependent on price, it suffices to show that price must fall with the opening of trade.

- **Proof that price must fall with the opening of trade:**
  - **Each domestic firm maximizes profit so that $x_i = -(p-c)/p'$ from the FOC, from which**

$$\frac{dx_i}{dp} = -\frac{p' - (p-c)p''\frac{dZ}{dp}}{(p')^2} = -\frac{p' + x_i p''}{(p')^2} > 0,$$

    i.e., x_i must rise if p rises.
  - **Under autarky, it holds that**

$$\pi_i = (p-c)x_i - F = 0.$$

  - **Domestic firm's profit under free trade:**

$$\pi_i = (p-c)x_i - F + (p^* - c/g)x_i^*$$

  - **If price (and quantity) were to rise or remain constant under free trade, $(p-c)x_i - F \geq 0$, and $p^* > c/g$ must hold if trade is to take place $\Rightarrow \pi_i > 0$, a contradiction.**