Two-factor trade model with monopolistic competition

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Main questions

- Impact of differences in factor endowments on product and capital prices
- Liberalization of trade
- Dumping & reverse-dumping
- Relative number of firms and relative value added

Stylized facts

- Firms operating in bigger markets have lower markups (Syverson, 2007)
- Firms price discriminate across countries (Martin, 2009; Manova and Zhang, 2009)
- Dumping (reverse-dumping) means that export price is lower (higher) than domestic price increased by trade cost (Bernard et al., 2007)
- Firms located in capital- and labor-abundant countries set higher prices than import prices from other countries (Schott, 2004; Hummels and Klenow, 2005; Hallak, 2006; Hallak and Schott, 2006)

Related literature

- Helpman and Krugman (1987): disparities in factor endowments are the main point to understanding international trade patterns
- Krugman (1979); Ottaviano, Tabuchi, Thisse (2002); Behrens and Murata (2012): models with non-CES preferences to study price effects
- Brander and Krugman (1983): dumping in oligopoly
- Greenhut et al. (1987): reverse dumping in spatial monopoly

Specific cases

- CES predicts constant mark-up and price w.r.t. number of firms and market size
- CES predicts constant firm size w.r.t market size
- CES predicts same mill-prices for domestic and foreign markets
- Quadratic-utility function "OTT"(Ottaviano, Tabuchi, Thisse, 2002) is still specific case
- Berliant (2006): "How can we draw general conclusions... from these models if the conclusions change when the utility functions or functional form of transport cost change? Certainly, examples are a first step in a research program. But they are usually not the last."

Trade model

Monopistic competition assumptions

- There is a continuum of firms each of them produces **a single variety** and chooses its price.

- **Free entry and exit**, hence firms' profits are zero

Assumptions

- Economy involves **two sectors** - manufacture and agriculture
- "Agricultural" firms produce **homogeneous** good under perfect competition and constant returns
- "Manufacturing" firms produce **differentiated** good under monopolistic competition and increasing returns
- L workers own each one unit of labor and K capitalists own each one unit of capital
- Workers and capital-owners share **the same** preferences
- World economy includes **two countries** - Home and Foreign

Assumptions (continued)

- Agricultural good requires **zero** trade cost
- $\tau > 1$ is the **iceberg-type** trade cost for manufactured good
- There are $L = s_L L + (1 - s_L)L$ workers, s_L is the share of workers in Home
- There are $K = s_K K + (1 - s_K)K$ capital-owners, s_K is the share of capital-owners in Home and $s_K > \frac{1}{2}$
- Let x^{ij} be the individual consumption of each variety produced in country i and consumed in country j, p^{ij} is the price for x^{ij}
- Let N^H and N^F denote number of firms in Home and Foreign

Consumer's problem

Follow Krugman (1979) and Zhelobodko et al. (2012) we assume nonspecific utility function, so

Consumer's problem in Home:

$$\max_{X,A}\left[V\left(\int_0^{N_H} u(x_i^{HH})di + \int_{N_H}^{N_H+N_F} u(x_i^{FH})di\right) + A\right];$$

budget constraint:

$$\int_0^{N_H} p_i^{HH}x_i^{HH}di + \int_{N_H}^{N_H+N_F} p_i^{FH}x_i^{FH}di + Ap_a \leq E$$

Here p_a- agricultural good price; A - consumption of agricultural good; E - income of consumer

Equilibrium of consumer's problem

- FOC for the consumer problem implies the inverse demand function for varieties:

$$\mathbf{p}(x_k^{HH}, \mu^H) = \frac{u'(x_k^{HH})}{\mu^H}, \ \mathbf{p}(x_k^{FH}, \mu^H) = \frac{u'(x_k^{FH})}{\mu^H}$$

$$\mathbf{p}(x_k^{FF}, \mu^F) = \frac{u'(x_k^{FF})}{\mu^F}, \ \mathbf{p}(x_k^{HF}, \mu^F) = \frac{u'(x_k^{HF})}{\mu^F},$$

which are the same for both agents types under quasi-linear preferences

$$\mu^H = \frac{1}{V'(\int_0^{N_H} u(x_k^{HH})di + \int_{N_H}^{N_H+N_F} u(x_k^{FH})di)} > 0$$

- μ can interpreted the **marginal utility** of expenditure on manufacturing but it's not a Lagrange multiplier

Producer's problem

- Agriculture sector produces homogeneous good with marginal cost of one unit of labor, so price $p_a \equiv 1$. Without loss of generality we normalized wage in Agriculture to $w_a = 1$
- Each manufacturing firm has a fixed requirement of **one unit of capital** and a marginal requirement of **one unit of labor**
- Labor is intersectorally mobile $\Rightarrow$ **same wages in both sectors**. Agricultural good requires zero trade cost $\Rightarrow$ **same wages in both countries**. So, $w = w_a = 1$
- Total **production cost** of output q

$$C(q) = \pi + q,$$

where π is the capital price (interest rate); q is output

- So, income of **workers** is $E = 1$ and income of **capital owners** $E = \pi$

Producer's problem (continued)

- **Producer's problem** in Home:

$$(p_i^{HH}(x_i^{HH})-1)(s_K K+s_L L)x_i^{HH}+(p_i^{HF}(x_i^{HF})-\tau)((1-s_K)K+(1-s_L)L)x_i^{HF}-\pi_i^H \to \max_{x_i^{HH},x_i^{HF}},$$

$q_i^H \equiv (s_K K+s_L L)x_i$ - output of firm in Home

- Since firms have the same product cost they are symmetric

Equilibrium of producer's problem

Using the FOC we characterize the symmetric profit-maximizing prices:

$$p^{HH} = \frac{1}{1 - r_u(x^{HH})}, \qquad p^{FH} = \frac{\tau}{1 - r_u(x^{FH})}$$

$$p^{FF} = \frac{1}{1 - r_u(x^{FF})}, \qquad p^{HF} = \frac{\tau}{1 - r_u(x^{HF})},$$

where

$$r_u(x) \equiv |\mathscr{E}_{u'}(x)| \equiv -\frac{xu''(x)}{u'(x)}$$

is the **elasticity of the inverse-demand** function for variety i and r_u is the **relative love for variety** (RLV)

Mark-up is:

$$M = \frac{p - c}{p} = r_u(x)$$

Equilibrium

Proposition 1

Individual consumptions are such that

$$\frac{u'(x^{HH})}{u'(x^{FH})} = \frac{1}{\tau} \cdot \frac{1 - r_u(x^{FH})}{1 - r_u(x^{HH})}$$

$$V'\left[sKu(x^{HH}) + (1-s)\,Ku(x^{FH})\right] u'(x^{HH}) = \frac{c}{1 - r_u(x^{HH})}$$

The same equations for individual consumptions in Foreign.

Capital balance in each country yields:

$$N^H = s_K K; \qquad N^F = (1 - s_K)K$$

Individual consumption

- There is **at most one solution** $(x^{HH}, x^{FH}, x^{HF}, x^{FF})$ to the equilibrium system
- Individual consumption of any domestic variety is **higher** than the consumption of any imported variety, i.e. $(x^{HH} > x^{FH},\ x^{FF} > x^{HF})$
- Consumption of a domestic variety is **smaller** in the country with the higher capital endowment $(x^{FF} > x^{HH})$
- $\hat{s}_K \in (0.5, 1]$ exists such that individual consumptions satisfy:
- $$x^{FF} > x^{HF} > x^{HH} > x^{FH} \text{ when } s_K > \hat{s}_K \text{ (very asymmetric countries)}$$
- $$x^{FF} > x^{HH} > x^{HF} > x^{FH} \textit{ when } s_K < \hat{s}_K \textit{ (fairly similar countries)}$$

Prices

- Behavior of prices and mark-ups are identical and characterized by $r_u(x) = -\frac{xu''(x)}{u'(x)}$
- If $r'_u(x) > 0$, the equilibrium price decreases with number of firms in a country - **price-decreasing competition**
- If $r'_u(x) < 0$, the equilibrium price increases with number of firms in a country - **price-increasing competition**
- So, $r_u(x)$ **determines the type of competition**
- CES is the border-line case

Prices

- Decreasing trade costs decreases the price of any imported variety when RLV decreases (the impact is ambiguous in the opposite case), whereas price p^{ii} of any domestic variety decreases (increases) under increasing (decreasing) RLV
- A larger world capital makes prices of domestic and imported varieties decreasing (increasing) under increasing (decreasing) RLV
- A larger share of a country's capital decreases (increases) prices of domestic and imported varieties in this country under increasing (decreasing) RLV

Dumping

Dumping means that export price is lower than domestic price increased by trade cost

Proposition 2

Under weak asymmetry:

$$x^{FF} > x^{HH} > x^{HF} > x^{FH}$$

- under price-decreasing competition firms use dumping in each country:

$$p(x^{FF}) > p(x^{HH}) > \frac{p(x^{HF})}{\tau} > \frac{p(x^{FH})}{\tau}$$

- under price-increasing competition firms use reverse-dumping in each country:

$$p(x^{FF}) < p(x^{HH}) < \frac{p(x^{HF})}{\tau} < \frac{p(x^{FH})}{\tau}$$

Dumping (continued)

Proposition 3

Under strong asymmetry:

$$x^{FF} > x^{HF} > x^{HH} > x^{FH}$$

- price-decreasing competition yields dumping by firms located in the smaller country and reverse-dumping by those in the bigger country:

$$p(x^{FF}) > \frac{p(x^{HF})}{\tau} > p(x^{HH}) > \frac{p(x^{FH})}{\tau}$$

- price-increasing competition yields dumping by firms located in the bigger country and reverse-dumping by those in the smaller country:

$$p(x^{FF}) < \frac{p(x^{HF})}{\tau} < p(x^{HH}) < \frac{p(x^{FH})}{\tau}$$

Value of export

- The **impact of difference in capital endowment**. To separate this effect from the impact of population size, we consider the *same* populations in both countries: $(s_K K + s_L L = (1 - s_K)K + (1 - s_L)L)$, but still $s_K > \frac{1}{2}$
- The value of export from Home:

$$e^H = s_K K((1 - s_K)K + (1 - s_L)L)p^{HF} x^{HF}$$

- Export from Foreign:

$$e^F = (1 - s_K)K(s_K K + s_L L)p^{FH} x^{FH}$$

Then:

$$e^H > e^F$$

Proposition 4

The country with bigger endowment of capital is a net exporter of the manufacturing good.

Capital returns

Proposition 5

Capital price is smaller in country with the bigger endowment of capital:

$$\pi^H < \pi^F$$

Relative number of firms and value added

Since population is decomposed into workers and capital-owners, we use the value added in manufacturing (M^i, $i = H, M$) as the measure of the industry size:

$$M^H = s_K K \left[x^{HH}(s_K K + s_L L) + x^{HF} \tau((1 - s_K)K + (1 - s_L)L) + \pi^H \right],$$

Then:

$$\frac{M^H}{N^H} < \frac{M^F}{N^F}$$

Trade equilibrium

Proposition 6

The trade equilibrium displays:

1) the country with advantage in capital (Home) has disproportionally lower added value per firm;

2) firm's output located in Home is less than firm output in Foreign;

3) total value of trade increases with trade liberalization.

Thank you for your attention!