

## PC5: Location Choice

### Exercise #1. Horizontal foreign direct investment

The model<sup>1</sup>

Consider a country  $j$  where consumers have a CES utility function over differentiated varieties of the same product, each variety being produced in a different country ( $i = 1$  to  $C$ ). The demand for each variety  $i$  is given by:

$$c_{ij} = \left( \frac{p_{ij}}{P_j} \right)^{-\sigma} \frac{Y_j}{P_j}$$

where  $p_{ij}$  is the price of product  $i$  in country  $j$ ,  $Y_j$  is the exogenous nominal income of country  $j$ ,  $\sigma > 1$  is the elasticity of substitution across varieties and  $P_j$  is the price index:

$$P_j = \left[ \sum_{i=1}^C N_i (p_{ij})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

$N_i$  being the number of varieties of product  $i$ . The production function of the exporter is given by:

$$L_i = \beta_i y_i$$

where  $L_i$  denotes labor input,  $y_i$  is the production volume and  $1/\beta_i$  is labor productivity. We assume that plant-specific costs are already covered by home sales of the product. The unit cost of labor is  $w_i$ .

As in PC3, international transportation involves a proportional, ‘iceberg-type’ cost  $T_{ij} > 1$ , meaning that the production shipped by country  $i$  to country  $j$  is:

$$y_i = c_{ij} T_{ij}$$

The corresponding CIF price for country  $i$ 's consumer is:

$$p_{ij} = p_i T_{ij}$$

where  $p_i$  is the producer's FOB price.

1. Show that maximization of the exporter's profit  $\pi_i$  given the demand function yields the following pricing policy:

$$p_i = \frac{\sigma}{\sigma - 1} \beta w_i$$

Express the corresponding profit  $\pi_i$  as a function of this optimal price. Comment.

2. Rather than exporting to country  $j$ , the firm can instead establish a subsidiary in country  $j$  and sell locally. In this case, it faces a production cost  $L_i = \alpha_j + \beta y_i$ , where  $\alpha_j$  is the plant-specific fixed cost paid abroad, and  $y_j$  is the production carried out in country  $j$ . There are no transport costs when producing in country  $j$  and selling locally, so with the price  $p_j$ , the quantity sold is:

<sup>1</sup> Adapted from Feenstra (2004), pp. 386-390.

$$c_{ij} = \left( \frac{P_{ij}}{P_j} \right)^{-\sigma} \frac{Y_j}{P_j}$$

Derive the new optimal price  $p_j$  of the foreign subsidiary and the corresponding profit. Comment. What happens under perfect competition?

3. For which values of  $T_{ij}$  will exporters of country  $i$  switch to local production in country  $j$ ? For which values of  $T_{ji}$  will exporters of country  $j$  switch to local production in country  $i$ ?
4. For which values of  $T_{ij} T_{ji}$  will a multinational operate in both countries? When are horizontal multinationals more likely to materialize?
5. Denoting  $Y = Y_i + Y_j$  and defining  $s_i$  (resp.  $s_j$ ) as the share of country  $i$  (resp. country  $j$ ) in total income  $Y$ , show that horizontal multinational are more likely if countries are of similar sizes.
6. Comment the following table:

**Conditional logit estimation of investments abroad and in France by French multinationals (1992-2002)**

Model :	Dependent Variable: Chosen Country						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln market access	0.44 <sup>a</sup> (0.02)	0.36 <sup>a</sup> (0.03)	0.37 <sup>a</sup> (0.03)	0.34 <sup>a</sup> (0.03)	0.35 <sup>a</sup> (0.03)	0.36 <sup>a</sup> (0.03)	0.35 <sup>a</sup> (0.03)
ln distance	-0.44 <sup>a</sup> (0.07)	-0.26 <sup>a</sup> (0.08)	-0.26 <sup>a</sup> (0.08)	-0.27 <sup>a</sup> (0.09)	-0.27 <sup>a</sup> (0.09)	-0.23 <sup>a</sup> (0.08)	-0.27 <sup>a</sup> (0.09)
common language	0.05 (0.07)	-0.27 <sup>a</sup> (0.08)	-0.23 <sup>a</sup> (0.08)	-0.19 <sup>b</sup> (0.09)	-0.17 <sup>c</sup> (0.09)	-0.21 <sup>a</sup> (0.09)	-0.18 <sup>c</sup> (0.09)
ex colony	0.19 (0.12)	0.38 <sup>a</sup> (0.12)	0.36 <sup>a</sup> (0.12)	0.21 (0.14)	0.21 (0.14)	0.35 <sup>a</sup> (0.12)	0.21 (0.14)
ln GDP per capita	-0.28 <sup>a</sup> (0.03)	-0.27 <sup>a</sup> (0.03)	-0.27 <sup>a</sup> (0.03)	-0.24 <sup>a</sup> (0.04)	-0.25 <sup>a</sup> (0.04)	-0.26 <sup>a</sup> (0.03)	-0.24 <sup>a</sup> (0.04)
France	2.37 <sup>a</sup> (0.07)	2.20 <sup>a</sup> (0.08)	0.97 <sup>a</sup> (0.09)	3.97 <sup>a</sup> (0.29)	4.47 <sup>a</sup> (0.17)	5.16 <sup>a</sup> (0.39)	1.32 <sup>a</sup> (0.10)
ln (# of same ind. firms -1)	0.88 <sup>a</sup> (0.01)	0.87 <sup>a</sup> (0.01)	0.85 <sup>a</sup> (0.02)	0.87 <sup>a</sup> (0.02)	0.82 <sup>a</sup> (0.02)	0.82 <sup>a</sup> (0.02)	0.87 <sup>a</sup> (0.02)
ln (supply access -1)		0.14 <sup>a</sup> (0.01)	0.12 <sup>a</sup> (0.01)	0.10 <sup>a</sup> (0.02)	0.10 <sup>a</sup> (0.02)	0.12 <sup>a</sup> (0.01)	0.10 <sup>a</sup> (0.02)
ln (financial network -1)			0.86 <sup>a</sup> (0.03)	0.79 <sup>a</sup> (0.03)	0.82 <sup>a</sup> (0.03)	1.70 <sup>a</sup> (0.08)	0.79 <sup>a</sup> (0.03)
France × ln productivity				-0.49 <sup>a</sup> (0.05)			
France × ln employment					-0.58 <sup>a</sup> (0.03)		
France × ln financial network						-0.86 <sup>a</sup> (0.08)	
France × ln advertising							-1.53 <sup>a</sup> (0.29)
Region fixed effects	yes	yes	yes	yes	yes	yes	yes
Investments × countries	1266123	1183772	1183772	1131094	1138197	1183772	1136625
Investments	14966	14960	14960	14294	14384	14960	14364
French Investments	12321	12321	12321	12238	12321	12321	12306
Pseudo R <sup>2</sup>	0.784	0.783	0.796	0.830	0.834	0.797	0.830

Note: Standard errors in parentheses with <sup>a</sup>, <sup>b</sup> and <sup>c</sup> respectively denoting significance at the 1%, 5% and 10% levels.

Source: Mayer, Méjean and Nefussi (2007).

## Exercise #2. Foreign direct investment: proximity or concentration?

An aircraft producer considers locating its assembly lines in France, in Germany, or in both countries. The assumptions are the following:

- France is the main market: French demand is 40 planes whereas it is only 5 planes in Germany. However Germany has a lower production cost of 6 million euros per plane instead of 7 million euros per plane in France;
  - Planes are sold the same price in both countries, *i.e.* 10 million euros;
  - A fixed cost of 30 million euros per location is incurred by the firm;
  - There is a trade cost of  $t$  per plane sold abroad and zero when selling locally.
1. What is the total profit when an assembly line is established in each country to cover the country's local market?
  2. What is total profit if all production is located in France? In Germany?
  3. If Germany and France were not in a custom union, a tariff  $t = 6$  million euros per plane would be incurred. What would the best strategy? Comment.
  4. Being both members of the European Union, Germany and France do not impose tariffs vis-à-vis each other, so that trade cost  $t$  boils down to transportation costs worth 2 million euros per plane. What is the best strategy? Comment.
  5. Due to improvements in transport infrastructures, trade costs fall to  $t = 1$  million euros per plane. What is the best strategy? Comment.