



**::Solutions::**

Problem Set #4: Due end of class November 2, 2017

You may discuss this problem set with your classmates, but everything you turn in must be your own work. Please read the "problem set guidelines" on the course web page before beginning.

1. Use the two-country model of vertical FDI we developed in class to answer the following questions. Assume that  $\theta_{au} = 5$ ,  $\theta_{as} = 1$ ,  $\theta_{bu} = 1$ ,  $\theta_{bs} = 10$ ,  $w_u^1 = 10$ ,  $w_s^1 = 20$ ,  $w_u^2 = 2$ ,  $w_s^2 = 30$ ,  $\tau_b = 0.06$ , and  $\tau = 0.05$ .
  - a. What is the optimal firm structure? Show your calculations.

Country 1 export, partial fragmentation, and HFDI

$$c^1 = 5 * 10 + 1 * 20 + 1 * 10 + 10 * 20 = 280$$

Country 1 complete fragmentation

$$c^1 = [5 * 2 + 1 * 30 + (1 * 10 + 10 * 20)(1.06)](1.05) = 275.73$$

Country 2 complete fragmentation, partial fragmentation

$$c^2 = 5 * 2 + 1 * 30 + (1 * 10 + 10 * 20)(1.06) = 262.6$$

Country 2 exporting

$$c^2 = (5 * 10 + 1 * 20 + 1 * 10 + 10 * 20)(1.05) = 294$$

Country 2 HFDI

$$c^2 = 5 * 2 + 1 * 30 + 1 * 2 + 10 * 30 = 342$$

**Complete fragmentation** delivers the lowest cost final good to each country.

- b. Suppose economic development in country 2 increases the unskilled wage rate to  $w_u^2 = 4$ . What is the optimal firm structure? Show your calculations.

Country 1 export, partial fragmentation, and HFDI

$$c^1 = 5 * 10 + 1 * 20 + 1 * 10 + 10 * 20 = 280$$

Country 1 complete fragmentation

$$c^1 = [5 * 4 + 1 * 30 + (1 * 10 + 10 * 20)(1.06)](1.05) = 286.23$$

Country 2 complete fragmentation, partial fragmentation

$$c^2 = 5 * 4 + 1 * 30 + (1 * 10 + 10 * 20)(1.06) = 272.6$$

Country 2 exporting

$$c^2 = (5 * 10 + 1 * 20 + 1 * 10 + 10 * 20)(1.05) = 294$$

Country 2 HFDI

$$c^2 = 5 * 4 + 1 * 30 + 1 * 4 + 10 * 30 = 354$$

**Partial fragmentation** delivers the lowest cost final good to each country.

- c. How large does  $w_u^2$  need to be for the firm to prefer exporting to partial fragmentation? Show your calculations.

Set the cost in country 2 in the export case equal to the cost in country 2 in the partial fragmentation case.

$$c_{pt}^2 = c_{ex}^2$$

$$c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1 + \tau_b) = [c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)](1 + \tau)$$

$$5 * w_u + 1 * 30 + (1 * 10 + 10 * 20) * (1.06) = [5 * 10 + 1 * 20 + 1 * 10 + 10 * 20] * (1.05)$$

$$5 * w_u + 252.6 = 294$$

$$w_u = 8.28$$

If the wage in country 2 is greater than 8.28, it is optimal to produce the entire good in country 1 and export the final good to country 2.

- d. Would your answer to part c. increase or decrease if, leaving all the other parameters unchanged,  $\tau$  decreases 0.02? Explain your reasoning. You do not have to recalculate part c., but you may if it helps.

The break-even  $w_u^2$  would decrease. Lowering  $\tau$  makes exporting less costly, so the unskilled wage in country 2 needs to be lower to make the partial fragmentation case less costly as well.

2. Since 2001, Chinese wages have been growing at about 12 percent per year. How would you expect the types of foreign direct investment into China to change? Use the model of vertical FDI to frame your answer.

Our calculations in question 1 shed some light on this question. As the price of the “cheap” input in China increase, the gain from fragmentation shrinks. In China, the cheap input is labor, but this input is rapidly increasing in cost. We would expect to see less vertical FDI in China that is based on low-price labor.

This is already happening: Clothing firm H&M, for example, recently moved sweater production from China to Myanmar.

3. In 1997, chipmaker Intel opened a microprocessor testing and assembly facility in Costa Rica. Fabrication plants in other countries produce the extremely capital and skilled-labor intensive silicon wafers and other parts, which are shipped to Costa for assembly and testing. Once complete, the microprocessors are exported to the world market. How are other firms in Costa Rica likely to be affected by productivity spillovers from Intel's investment? Explain your answer.

Spillovers from Intel's production in Costa Rica are weak.

The backward linkages that create spillovers to suppliers are not very strong: most of the part assembled and tested in Costa Rica come from Intel operations in other countries.

The forward linkages that create spillovers to downstream firms are not very strong either: almost all of the production is exported to the global market.

**True/False-Explain.** Respond to the following statements by *explaining why they are true or false*. No partial credit will be awarded for stating TRUE or FALSE without explanation.

4. The fixed-proportions (or Leontief) production function, with unit requirements  $\theta_k$  for capital and  $\theta_\ell$  for labor, has the cost function

$$c(r, w) = \frac{r}{\theta_k} + \frac{w}{\theta_\ell},$$

where  $r$  is the rental price of capital and  $w$  is the wage.

FALSE. The cost function is

$$c(r, w) = r\theta_k + w\theta_\ell.$$

5. In February 2016, Indonesia announced plans to open its waste management industry to foreign investment; Waste management firms may now be 100 percent foreign owned. Even if foreign direct investment does not bring "spillovers" we would expect to see the Indonesian waste management industry become more productive.

TRUE. The appearance of larger, more productive multinational corporations in Indonesia will increase the level of competition in the waste management industry, which will drive less efficient firms out of the market. This will increase the average productivity level in the Indonesian waste management industry.

This is an example of the composition effect of MNEs on the host country.