::Solutions::

Exam 2

Do not open this exam until instructed to do so.

- You have 75 minutes to complete this exam
- You may use a calculator; you may **not** use any other device (cell phone, etc.)
- You may consult one page of notes (both sides); you may not use books, notebooks, etc.
- Show your work

I will not lie, cheat, or steal to gain an academic advantage, nor will I tolerate those who do.

_____

Signature

_____

Printed Name

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.

1. (10 pts.) Consider the two country model of vertical FDI that we developed in class. When the cost of trading the first-stage good is zero ($\tau_b = 0$), the firm will choose either complete fragmentation or exporting as its production structure.

   FALSE. When there are no cost to trading intermediate goods, the firm will **partially fragment** if the cost of trading the final good is high, or **completely fragment** if the cost of trading the final good is low.

2. (10 pts.) When evaluating the impact of a foreign investment on the local labor market, the analysis needs to consider the ease with which workers can move within the country.

   TRUE. The effect of FDI on the labor market depends on the elasticity of labor supply. If workers are mobile, then the "local" labor market is includes the surrounding areas as well. How easily the workers can move about the country is a factor in determining the size and the elasticity of labor supply.

3. (10 pts.) Goods x and y are produced using electricity (e) and labor (ℓ). The production function for good x is $x = \min\{\frac{\ell}{2}, \frac{e}{3}\}$. The production function for good y is $y = \min\{\frac{\ell}{1}, \frac{e}{3}\}$. Electricity prices in countries 1 and 2 are $p_e^1 = 5$ and $p_e^2 = 8$. Wages in countries 1 and 2 are $w^1 = 10$ and $w^2 = 3$. If trade costs for both x and y are zero, then country 1 specializes in good x and country 2 specializes in good y.

   FALSE. Good x is labor intensive and good y is electricity intensive. Electricity is cheaper in country 1, so that is where good y is produced and wages are cheaper in country 2, so that is where x is produced.

4. (10 pts.) The *productivity composition effect* is the increase in aggregate productivity in the host country that results from the fact that foreign affiliates operating in the host country are larger than local firms.

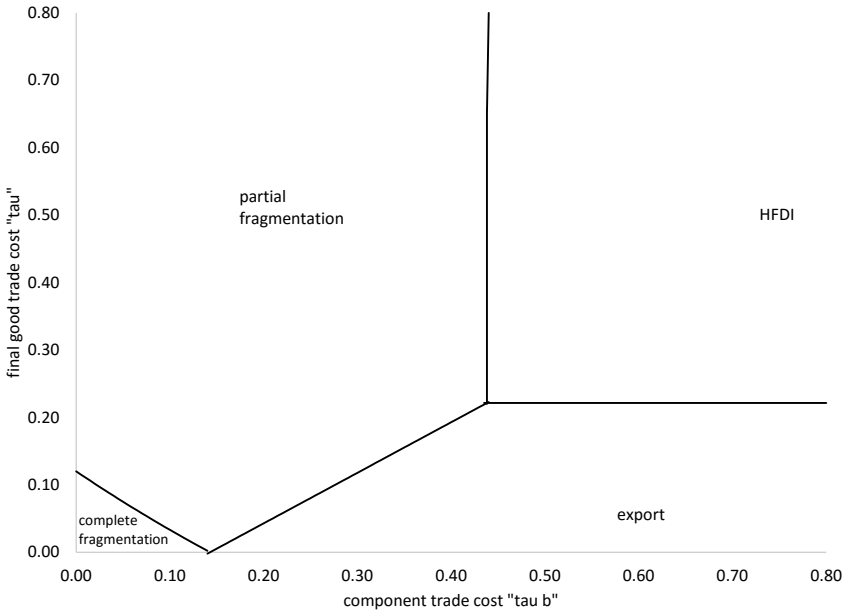
   FALSE. The composition effect results from the fact that foreign affiliates are **more productive** than local firms. Even if nothing else changes, MNEs will increase the number of more productive firms, increasing aggregate productivity.

5. (10 pts.) Country 2 is interested in increasing its inward direct investment. Currently, firms from country 1 are serving country 2 by exporting. There are two proposals under consideration:

   1. To increase foreign investment in country 2, *increase* tariffs on imports into country 2.
   2. To increase foreign investment in country 2, *decrease* tariffs on imports into country 2.

   Explain how both of these proposals could be successful. Your answer should discuss what tariffs should be changed, and what kinds of foreign direct invest the proposals would attract. You may want to use the figure below to help frame your answer.

Figure 1



This figure summarizes the optimal firm configuration in the model of vertical FDI developed in class, when $\theta_{au} = 5$, $\theta_{as} = 1$, $\theta_{bu} = 1$, $\theta_{bs} = 10$, $w_u^1 = 10$, $w_s^1 = 20$, $w_u^2 = 2$ and $w_s^2 = 30$.

The country is currently in the "export" zone in figure 1. To increase FDI, it either needs to move into the fragmentation zone or the HFDI zone. How does it do it?

Proposal 1: Increase tariffs on final goods and, if need be, components. This moves the country to the HFDI zone, which will lead to FDI in both components and assembly.

Proposal 2: Decrease tariffs on components goods. Depending on the final good trade cost, this moves the country to either partial or full fragmentation. This will increase FDI in the assembly sector.

6. Carrier air conditioners are made in two stages. First, skilled and unskilled labor are used to design the air conditioning units. Second, skilled and unskilled labor use the designs to manufacture the air conditioning units. The production functions for design (d) and assembly (a) are

$$d = \min\left\{\frac{\ell_s}{10}, \frac{\ell_u}{1}\right\}$$
$$a = \min\left\{\frac{\ell_s}{1}, \frac{\ell_u}{3}\right\},$$

where ℓ_s are the number of skilled labor units used and ℓ_u are the number of unskilled labor units used. An air conditioning unit requires one unit of design services and one unit of assembly. In the United States, wages are $w_s^U = 25$ and $w_u^U = 15$ and in Mexico they are $w_s^M = 35$ and $w_u^M = 2$.

Use the model of vertical FDI that we developed in class to answer the following questions.

a. (10 pts.) There are no trade costs for using the air conditioner designs in another country ($\tau_d = 0$). The cost of trading the finished air conditioner is $\tau = 0.05$. What is the optimal firm structure? Explain your answer.

Carrier chooses complete fragmentation: design occurs in the US and assembly occurs in Mexico.

US HFDI, Export, and P.F

$$C^U = (10 * 25 + 1 * 15) + (1 * 25 + 3 * 15) = 335$$

US C.F.

$$C^U = [(10 * 25 + 1 * 15) + (1 * 35 + 3 * 2)]1.05 = 321.3$$

MX HFDI

$$C^U = (10 * 35 + 1 * 2) + (1 * 35 + 3 * 2) = 393$$

MX Export

$$C^M = 335 * 1.05 = 351.75$$

MX C.F., P.F.

$$C^M = (10 * 25 + 1 * 15) + (1 * 35 + 3 * 2) = 306$$

b. (6 pts.) Suppose the US government can control τ. What value of τ would make Carrier indifferent between assembling air conditioners in Mexico and exporting them to the United States (~~partial fragmentation~~ complete fragmentation) and producing the entire air conditioner in the United States? Call this value $\hat{\tau}$.

$$\begin{aligned}\left[c_d(w_s^U, w_u^U) + c_a(w_s^M, w_u^M)\right](1+\hat{\tau}) &= c_d(w_s^U, w_u^U) + c_a(w_s^U, w_u^U)\\ 306\,(1+\hat{\tau}) &= 335\\ \hat{\tau} &= 0.095\end{aligned}$$

c. (3 pts.) If the US government chooses $\tau = \hat{\tau} + 0.1$, by how much does the cost of an air conditioner in the United States increase?

If τ is raised to 0.195, Carrier will do design and assembly in the United States. The cost of an air conditioner for the US market will now be 335, **an increase of 13.7 dollars from 321.3 to 335**.

I did not make it clear in the question what base level to compare the new price to so full credit for computing the new price of 335.

d. (3 pts.) If the US government chooses $\tau = \hat{\tau} + 0.1$, how do Carriers' Mexican assembly operations change?

Since it is costless to trade the designs, the firm will choose partial fragmentation with the new, higher trade cost. Mexico's assembly operations shrink. Mexico was assembling air conditioners for both markets, but now only assembles for the Mexican market.

e. (3 pts.) Suppose that Carrier, for political reasons, will continue to design and assemble air conditioners in the United States, but is considering changing the way it assembles air conditioners. After some research, Carrier devises an assembly method described by

$$a = \min\left\{\frac{\ell_s}{1.5}, \frac{\ell_u}{1}\right\}.$$

The design production function stays unchanged.

How does the new technology change the cost of producing an air conditioner in the United States? Compute the new price.

> The new price is 317.5. The new technology requires fewer unskilled workers to operate, but more skilled workers.

f. (4 pts.) How does the new technology change Carrier's relative demand for skilled versus unskilled workers?

> Carrier will now demand more skilled workers and fewer unskilled workers.
>
> [To the extent that forcing Carrier to assemble air conditioners in the United States was meant to increase the demand for unskilled labor, this policy may have a limited effect once Carrier changes its production technology to use less unskilled labor. This kind of factor substitution happens all the time, for many reasons. Example: Wendy's is rolling out order-by kiosk to save on labor costs.]

7. Consider a model in which two countries compete for an FDI project. The project will generate variable profits of $50 million for the firm, but the firm must make a $60 million investment to create the project. If the project is placed in country 1, the country receives $30 million worth of spillovers and if the project is placed in country 2, the country receives $30 million worth of spillovers. Each country is allowed to make a take-it-or-leave it subsidy offer to the multinational.

   a. (8 pts.) Suppose the two countries make sealed subsidy offers to the firm. If the firm's after-subsidy profit for locating the project in each country is the same, the firm will randomly choose a country to locate the project. Write out the payoff matrix for this game.

cty 1 \cty 2	subsidy	no subsidy
subsidy	(0,0)	(19.99,0)
no subsidy	(0,19.99)	(0,0)

   b. (5 pts.) What is the outcome of this model: where does the firm locate? How large is the subsidy that the firm actually receives? What is the after-subsidy benefit in each country?

The Nash equilibrium is that each country will offer a subsidy of $30 mil. The firm will randomly choose to place the project into either country 1 or country 2.

The country that does not receive the project has a benefit of zero and pays nothing in subsidies — its net benefit is zero.

The country that receives the project has a benefit of $30 mil. and pays a subsidy of $30 mil., so the net benefit is zero.

c. (8 pts.) Suppose the two countries can make a deal before choosing their subsidy payments. Is there a transfer that country 2 can make to country 1 that would make both countries better off than if they both competed for the project as in parts a. and b.? Describe the arrangement between the two countries.

Yes, an arrangement exists that makes both countries better off. Country 2 can agree to pay country 1 $1 mil. and country 1 can agree to not bid for the project.

Under this arrangement, country 2 will offer a subsidy of $10.01 mil. and win the project. Country 2 will receive a net benefit of $30 - $10.01 mil. - $1 mil. = $18.99 mil.

Country 1 earns $1 mil. rather than zero, and country 2 earns $18.99 mil. rather than zero. Both countries are better off.

[Note that any positive payment from country 2 to country 1 will make this arrangement work.]

Extra Space

Clearly label the question number, and leave a reference to this page near the question.