Econ/EEP 181: International Trade
Assignment # 2 Solutions

Luosha Du, Shanthi Nataraj, and Robert Santillano
University of California, Berkeley
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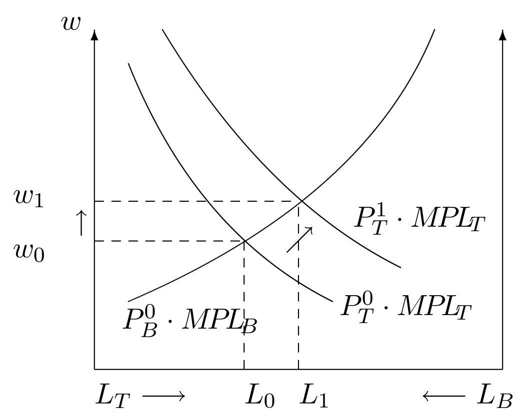
1. *Specific Factors and Trade. Finland is capital abundant relative to potential trading partners in the rest of the world. Telecommunications is a capital intensive sector relative to the business services sector. Businesses in Finland have made investment in both industries, creating stocks of capital that are devoted to either telecommunications or business services. The mobile factor of production in labor.*

   (a) *Suppose that Finland is not trading. Draw the specific factors diagram for Finland, indicating how labor is divided between the two industries, and showing the prevailing wage w_o.*

Figure 1: Domestic Labor Market



Let us begin by listing all of the products and factors in this model:
T=telecommunications sector
B=business services sector
K_T=capital specific to telecom sector
K_B=capital specific to business services sector
L=labor, mobile between industries
P_T= price of 1 units of telecom services
P_B=price of 1 unit of business services
r_t=rate of return on capital in telecom sector
r_b=rate of return on capital in business services sector
w=wage rate of labor
Figure 1 shows how labor is divided between the two industries. Labor is paid according to the value of the marginal product of labor (VMPL), which is equal to $P_T MPL_T$ in the telecom

sector and $P_B MPL_B$ in the business services sector. Since labor is mobile between sectors, and there is no unemployment, the intersection of these two curves tells us the allocation of labor in each sector, and the equilibrium wage rate w_0, as shown above. The labor to the left of L_0 is in the telecom sector, while the labor to the right of L_0 is in the business services sector.

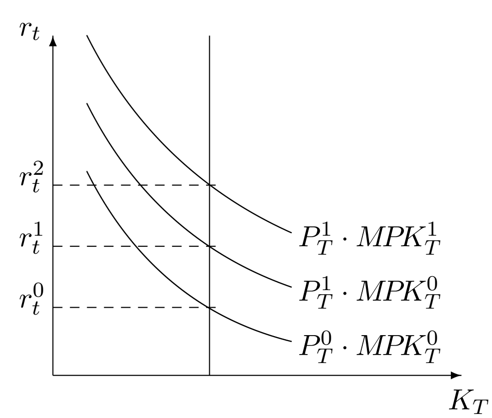
(b) *Modify your diagram to show how Finland's labor allocation and wage change when it opens trade with the rest of the world.*

To answer this question, we need to know what will happen to relative output prices after Finland allows trade. Since Finland is capital–abundant relative to its trading partners, and telecoms are relatively capital-intensive, Finland's relative supply curve of telecom services to business services must be shifted to the right relative to its trading partners (it's willing to provide more telecom services at any given price than its trading partners are). Therefore, when Finland opens up to trade, the relative price of telecom services will rise. For simplicity, we will assume that P_B is unchanged and P_T rises. This means that $P_T MPL_T$ shifts up, as shown in Figure 1, so the equilibrium wage rises, and workers move out of the business sector into the telecom sector.

(c) *How does the opening of trade affect capital owners in Finland's telecommunications industry? Describe and show on your graph.*

Figure 2 shows the market for telecom-specific capital. The vertical line is the supply of capital in this sector. The demand for capital is given by the value of the marginal product of capital, or $P_T MPK_T$, as shown by the downward-sloping line. The equilibrium rental rate of capital, prior to trade, is given by the intersection of capital supply and demand, r_0. After trade, the demand for capital shifts up since P_T increases, which increases the return to owners of capital in Finland's telecom industry from r_t^0 to r_t^1. Also, since labor moves out of the business sector into the telecom sector, this increases MPK_T, so the demand for capital shifts up again, further increasing the return to telecom capital from r_t^1 to r_t^2.

Figure 2: Telecom-Specific Capital Market



(d) *Are Finnish workers likely to benefit or lose from the opening of trade?*

Figure 1 showed that the wage rate rises when Finland opens to trade. However, the increase in wage is less than the increase in P_T. We can see this from Figure 1; the vertical distance between $P_T^0 MPL_T$ and $P_T^1 MPL_T$ is the increase in P_T, but w rises by less than this amount. The real returns to Finland's workers are given by the ratio of wages to output prices. Since P_B has not changed, w/P_B increases. Since $\Delta P_T > \Delta w$, w/P_T decreases. Therefore, the overall effect of trade on Finnish workers is ambiguous.

(e) *Suppose Finnish workers consume as much telecommunications as they can, while they buy very few business services. How does this affect the magnitude of worker gains or losses?*
As shown above, the real wage in terms of telecom services decreases, while the real wage in terms of business services increases, with trade. If Finnish workers consume a lot of telecom services, they are more likely to gain less, or lose more, from trade, than they would if they bought more business services.

2. The HO Framework.

	USA	Canada
Capital	40 machines	10 machines
Labor	200 workers	60 workers

(a) *Suppose that the United States and Canada have the factor endowments in the above table. Suppose further that the production requirements for a unit of steel is two machines and eight workers, and the requirement for a unit of bread is one machine and eight workers. Which good, bread or steel, is relatively capital intensive? Labor intensive? Explain how you know. Which country exports bread with trade? Why?*
The steel industry is relatively capital intensive because the ratio of capital to labor required in the steel industry is higher than the ratio of capital to labor required in the bread industry:

$$\frac{a_{KS}}{a_{LS}} = \frac{2}{8} > \frac{1}{8} = \frac{a_{KB}}{a_{LB}}$$

The bread industry is relatively labor intensive because the ratio of labor to capital required in the bread industry is higher than the ratio of labor to capital required in the steel industry:

$$\frac{a_{LB}}{a_{KB}} = \frac{8}{1} > \frac{8}{2} = \frac{a_{LS}}{a_{KS}}$$

According to the Hecksher-Ohlin theorem, a country exports the good that uses its abundant factor intensively. The USA is relatively more abundant in capital, because

$$\frac{K_{US}}{L_{US}} = \frac{40}{200} > \frac{10}{60} = \frac{K_C}{L_C}$$

Therefore, the USA will export steel, since its relatively more abundant factor is capital, and steel uses capital more intensively.

(b) *What does the term factor price equalization mean?*

The term factor price equalization (FPE) means that IF the following conditions are met:

(1) Same technology across countries

(2) Prices of goods are the same across countries (ie free trade, no trade barriers) and

(3) Countries continue to produce both goods when they start trading

then returns to the factors of production (in this example, capital and labor) will equalize across countries when there is free trade in goods, even if factors cannot move freely between countries. This does not mean payments to capital will be the same as payments to labor; rather, than capital will be paid the same in the USA and in Canada; and labor will be paid the same in the two countries as well. FPE means that the returns will be the same across countries in nominal terms; since prices must also equalize across countries due to free trade, real returns will be the same as well (as long as workers and owners of capital have the same demand patterns in both countries).

3. *Another HO Problem: Suppose there is only one technique that can be used in clothing production and food production. To produce a unit of clothing requires four labor-hours and one unit of capital; in food production each unit requires a single labor-hour and one unit of capital. At an initial equilibrium suppose that the wage rate and capital rental are each valued at 2 dollars. If both goods are produced, what must be their prices? Now keep the price of food constant and raise the price of clothing to $15. Trace through the effects on the distribution of income. Rank the relative changes in the wage rate, the price of clothing, the price of food (unchanged by assumption), and the rent on capital. Assuming that the country is relatively well endowed with labor, relate your results to the Stolper-Samuelson theorem.*

   We know that (by assumption) firms in both the cloth industry and the food industry must make zero profits. This means that the price of one unit of cloth or steel must equal the cost to make it:

$$P_C = wa_{LC} + ra_{KC} = \$2 * 4 + \$2 * 1 = \$10$$

$$P_F = wa_{LF} + ra_{KF} = \$2 * 1 + \$2 * 1 = \$4$$

   When P_C rises, the zero profit conditions must still hold in both industries (as long as both goods are still produced, which we assume). Therefore, since we are told that the production techniques are fixed (we cannot change the factor inputs), the nominal factor returns w and r must change. We can solve for the new w and r:

$$P_C = 15 = w * 4 + r * 1$$

$$P_F = w * 1 + r * 1$$

   Solving these two equations gives us $w = 11/3, r = 1/3$. The nominal wage rate has increased by \$1.67 and the nominal return to capital has decreased by \$1.67. The relative changes in prices and returns to factors are therefore:

$$\Delta P_C = 5 > \Delta w = \frac{5}{3} > \Delta P_F = 0 > \Delta r = -\frac{5}{3}$$

Note: you could also rank by percent changes, in which case

$$\%\Delta w = 83.3\% > \%P_C = 50\% > \%\Delta P_F = 0\% > \%\Delta r = -83.3\%$$

So what do we know about the real returns to labor and capital? In the HO framework, as long as we only change the price of one good, nominal and real returns move in the same direction. Therefore, since r decreased and w increased, owners of capital lose from trade, and owners of labor gain. These results are consistent with the Stolper-Samuelson theory, which says that trade leads to an increase in the return to a country's abundant factor (labor) and a fall in the return to its scarce factor (capital).

4. *Hecksher-Ohlin Trade Theory and Endowments. At current goods and thus factor prices, cloth is produced using 20 hours of labor for each acre of land, while food is produced using only 5 hours of labor per acre of land.*

   (a) *The economy's total resources are 600 hours of labor and 60 acres of land. Use an Edgeworth box to determine the allocation of resources.*

Figure 3: EDGEWORTH BOX

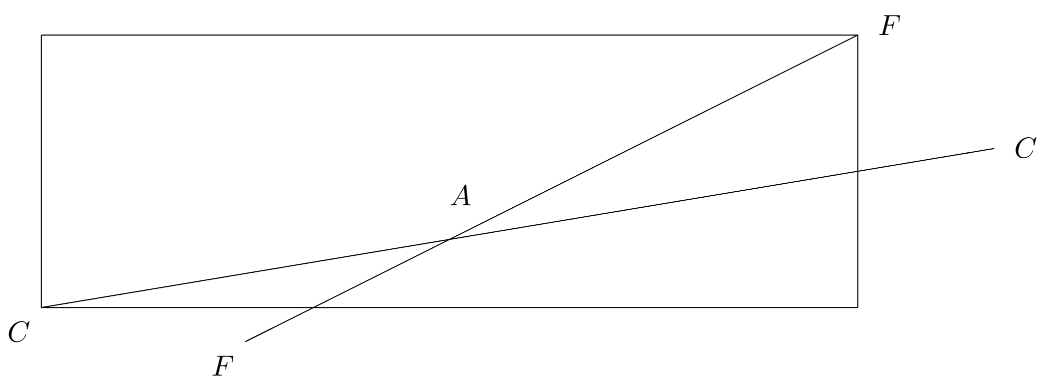


Figure 3 shows an Edgeworth box of the economy. The horizontal dimension represents 600 hours of labor, and the vertical dimension represents 60 acres of land (NOTE: THE FIGURE IS NOT TO SCALE!) Inputs into cloth production are measured from the lower left; inputs into food production are measured from the upper right. Inputs into the cloth industry must lie along line CC, which has a slope of 1T/20L. Inputs into the food industry must lie along line FF, which has a slope of 1T/5L (measured from the origin at the upper right). The economy must therefore be at point A, where the two lines meet.

We can figure out what this point is numerically using one of two methods.

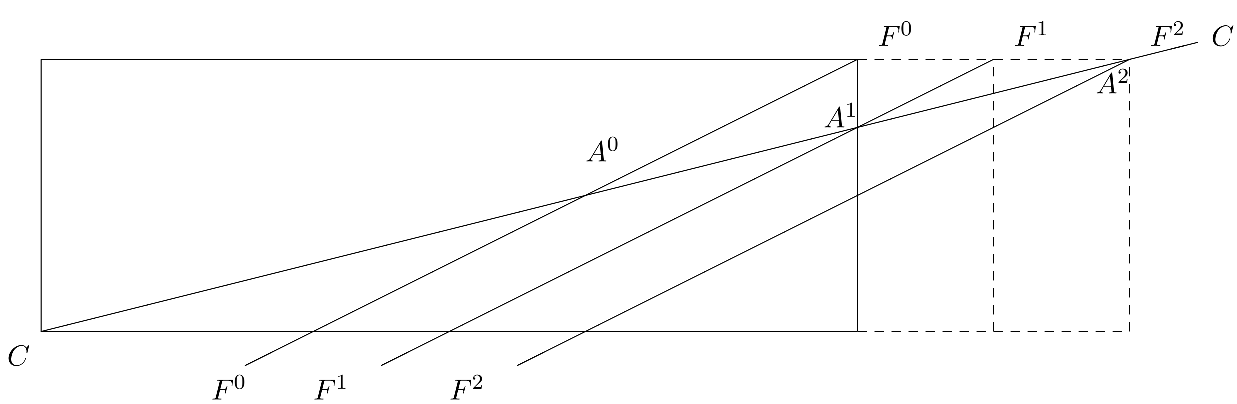
i. If you prefer to think in terms of finding the intersection of two lines, then you can solve for the equations of the two lines CC and FF, in terms of the same origin. We will use the lower left origin, and let that point by $(T, L) = (0, 0)$. Let's start by finding the equation of CC. Two points on this line are (0,0) and (600,30). This means that the slope is $m = \frac{30-0}{600-0} = 1/20$. To solve for the equation of the line, we can use point (0,0) to get $T - 0 = \frac{1}{20}(L - 0)$. This gives us an equation of $T = \frac{1}{20}L$. Similarly, two points on the line FF (using the lower left corner as the origin) are (600,60) and (300,0). Using the same method as above, the equation of FF is $T = \frac{1}{5}L - 60$. Solving for the intersection of these two lines gives us $L^* = 400, T^* = 20$. Since we are working from the lower left origin, this means the the economy allocates 400 hours of L and 20 acres of T to cloth, and 600-400=200 hours of L and 60-20=40 acres of land to food.

ii. If you prefer to think about satisfying two constraints - the labor and land constraints - then you can solve for how much cloth and food are produced, and use those quantities to determine the amount of inputs used in each sector. We know that the cloth and food sectors must use exactly 600 units of labor, and that each unit of cloth takes 20 units of labor, while each unit of food takes 5 units, so 20C+5F=600. Similarly, there are 60 units of land, and producing either a unit of cloth or of food takes 1 unit of land, so 1C+1F=60. Solving these two equations, we get C=20, F=40. Since each unit of cloth takes 20 units of L and 1 unit of T, $T_C = 20x1 = 20$ and $L_C = 20x20 = 400$. Since each unit of food takes 5 units of L and 1 unit of land, $T_F = 40x1 = 40$ and $L_F = 40x5 = 200$.

(b) *Labor supply increases from 600 to 900 to 1200 hours. Using an Edgeworth box, trace out the changing allocation of resources.*

When the labor supply increases, we simply expand the horizontal dimension of the Edgeworth box and re-calculate the allocation. Figure 4 shows the larger box(es).

Figure 4: Edgeworth Box with Increase in Labor Supply



How does the increase in labor supply change the allocation of land and labor to cloth and food? Qualitatively, Figure 4 shows us that we allocate more land and more labor to cloth, and less land and labor to food. Since less of both land and labor are being used in food, some of those factors must have shifted to the cloth industry, so the increase in cloth output must be in greater proportion than the increase in labor. This is consistent with the Rybczynski theorem, which tells us that an increase in the supply of a factor (labor) raises the output of the good which uses this factor relatively more intensively (cloth) by an even greater proportion, and actually reduces the supply of the other good (food).

We can calculate the exact allocations of land and labor in each industry by similar calculations as above.

i. Method 1. If there are 900 units of L, then the line F^1F^1 contains the two points (900,60) and (600,0), so the equation of this line is $T = \frac{1}{5}L - 120$, which gives us $L^* = 800, T^* = 40$. Since we are working from the lower left origin, this means the the economy allocates 800 hours of L and 40 acres of T to cloth, and 900-800=100 hours of L and 10-40=20 acres of land to food. If there are 1200 units of L, then the line F^2F^2 contains the two points (1200,60) and (900,0), so the equation of this line is $T = \frac{1}{5}L - 180$, which gives us $L^* = 1200, T^* = 60$. Since we are working from the lower left origin, this means the the economy allocates 1200 hours of L and 60 acres of T to cloth, and does not produce food at all.

ii. Method 2. If there are 900 unit of L, then the labor constraint becomes 20C+5F=900, and the land constraint is unchanged. This gives us F=20, C=40, so $T_C = 40$, $L_C = 800$, $T_F = 20$, and $L_F = 100$. If there are 1200 unit of L, then the labor constraint becomes 20C+5F=1200, and the land constraint is unchanged. This gives us F=0, C=60, so $T_C = 60$, $L_C = 1200$, $T_F = 0$, and $L_F = 0$. The economy is completely specialized in cloth.