ECONOMICS 181: INTERNATIONAL TRADE
ASSIGNMENT # 1 SOLUTIONS

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1. We are given the following labor input requirements:

	Cloth	Wheat
UK	2 hours	6 hours
USA	3 hours	2 hous

(a) What is the relative price of cloth in terms of wheat in the UK? In the USA?

In autarky, relative prices are equal to the opportunity cost of production. This is because, if a positive amount of both goods are demanded, in equilibrium, the cost of purchasing a good must equal the cost to produce the good. Letting the USA be home and UK be foreign, we have:

$$\frac{P_c}{P_w} = \frac{a_c}{a_w} = \frac{3}{2}\frac{\text{wheat}}{\text{cloth}} \qquad\qquad \frac{P_c^*}{P_w^*} = \frac{a_c^*}{a_w^*} = \frac{2}{6} = \frac{1}{3}\frac{\text{wheat}}{\text{cloth}}$$

Notice, we wrote in the units for the relative price and opportunity cost.

(b) Where will the free trade price settle post trade? Who will export which good?

If positive amounts of both goods are demanded in each country, then the post trade price must either be equal to, or rest in between the two autarkic relative prices. This gives:

$$\left(\frac{P_c}{P_w}\right)^w \in \left[\frac{1}{3}, \frac{3}{2}\right]$$

A country will trade whichever good for which they have a comparative advantage. From the above calculations, since the UK has a lower opportunity cost of cloth in terms of wheat, they will export cloth and the US will export wheat.

(c) If the post-trade relative price of cloth in terms of wheat is equal to 2/3, show what happens to consumption of cloth and wheat in the US and UK pre- and post-trade. Use this information to calculate the wage in the USA relative to the UK post-trade.

We answer this question by asking: "How much can we consume with one unit of labor pre- and post-trade?" Before trade, a country can only consume what it can produce itself, so it depends on technology (i.e. ULRs). With trade, however, a country will produce the good for which it has a comparative advantage and can then either consume it, or trade it at world prices for the other good. We therefore, get the following:

Table 1: Consumption with 1 Unit of Labor

	Before Trade		After Trade with $\left(\frac{P_c}{P_w}\right)^w = \frac{2}{3}\frac{\text{wheat}}{\text{cloth}}$	
	Cloth	Wheat	Cloth	Wheat
UK	1/2	1/6	1/2	1/3
USA	1/3	1/2	3/4	1/2

In the table above, the goods for which a country has a comparative advantage are underlined in the "Before Trade" columns. We know those amounts are produced post trade in each of the countries after trade, and then we convert them into the other good using the relative price of 2/3. This is easily done when we notice the units on the relative price of cloth in terms of wheat. For example, if the US produces 1/2 units of wheat, we perform the following calculation to determine how much cloth they can consume:

$$\frac{1}{2}\text{wheat} \times \frac{3}{2}\frac{\text{cloth}}{\text{wheat}} = \frac{3}{4}\text{cloth}$$

Now, looking at the "After Trade" column, it is easy to verify that the USA is wealthier because they can consume more of either good with one unit of labor when compared to the UK. To know by how much, we just have to ask the question: "What do I have to multiply the UK consumption by in order to get the equivalent amount in the US?" We find this by the following calculation:

$$\frac{1}{3} \cdot x = \frac{1}{2} \Rightarrow$$

$$x = \frac{3}{2}$$

Therefore, we can see that the US is 3/2 wealthier than the UK, which implies $\frac{w}{w^*} = \frac{3}{2}$.

(d) Show that unit labor costs post-trade are consistent with the pattern of trade.

Post-trade, a country should be producing the good for which they have the lower unit labor cost(ULC). Recall, the ULC for good i is given by $a_i \cdot w$. From the previous problem we know that $\frac{w}{w^*} = \frac{3}{2}$. Therefore, if we let $w^* = 1$, then $w = \frac{3}{2}$. We can then calculate the ULCs for each good in each country.

Table 2: Unit Labor Costs After Trade

	Cloth	Wheat		Cloth	Wheat
UK	$2 \cdot 1$	$6 \cdot 1$	$\Rightarrow$	2	6
USA	$3 \cdot \frac{3}{2}$	$3 \cdot \frac{3}{2}$	$\Rightarrow$	$\frac{9}{2}$	3

Indeed, the table confirms the pattern of trade identified in the previous parts of the problem.

2. We are given the following labor input requirements for Uruguay and Chile:

	Uruguay	Chile
Insulation	5	2.5
Grain	15	30
Beef	30	30
Video Tape	2	3

(a) What is the order of products from greatest to least comparative advantage for Uruguay relative to Chile?

Recall, in the multiple good context, a country has a comparative advantage when they have a lower ULC. Therefore, for any good i, we want to make the following comparison:

$$a_i^u \cdot w^u \quad \bigcirc \quad a_i^c \cdot w^c \qquad \Rightarrow$$
$$\frac{w^u}{w^c} \quad \bigcirc \quad \frac{a_i^c}{a_i^u}$$

The open circles are supposed to represent potential inequalities that we have yet to fill in. However, notice what we are comparing: the relative wage of Uruguay to Chile, to the relative ULR of Chile to Uruguay. The higher these relative ULRs, the more of an advantage Uruguay has at producing that good. We can therefore list the goods for which Uruguay has the greatest to least comparative advantage as:

Table 3: Greatest to Least Comparative Advantage for Uruguay.

	a_i^c/a_i^u
Grain	2
Video Tape	$\frac{3}{2}$
Beef	1
Insulation	$\frac{1}{2}$

(b) Use the numbers provided to draw the relative demand for labor. The $y-$axis of the diagram should display the relative wage of Uruguay to Chile (w_u/w_c).
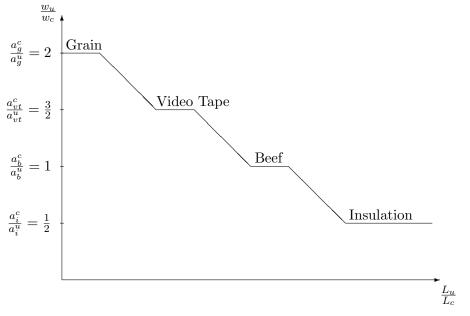
Figure 1: RELATIVE DEMAND FOR LABOR

(c) In equilibrium both Uruguay and Chile produce Video Tapes. What other products are produced by Uruguay, and what other products are produced by Chile?

First note that if both Uruguay and Chile produce video tapes, then they must have the same unit labor cost for producing video tapes. From part (a) we know that Uruguay has a greater comparative advantage at grain, and so Uruguay must have higher unit labor costs for producing beef and insulation when compared to Chile. We therefore have:

Uruguay: *Grain*

Chile: *Beef and Insulation*

(d) What is the relative wage (w_u/w_c) for Uruguay to Chile when the equilibrium results in both countries producing Video Tapes?

Again, if both countries produce video tapes, we know both countries must have the same unit labor costs for producing video tapes. We therefore have:

$$
\begin{aligned}
a_{vt}^u \cdot w_u &= a_{vt}^c \cdot a_w \Rightarrow \\
\frac{w_u}{w_c} &= \frac{a_{vt}^c}{a_{vt}^u} \Rightarrow \\
\frac{w_u}{w_c} &= \frac{3}{2}.
\end{aligned}
$$

4

3. Home (no asterisk) and Foreign (asterisk) produce cheese and wine with the following unit labor requirements:

$$
\begin{array}{ccc}
 & \text{Home} & \text{Foreign} \\
\text{Cheese} & alc = 5 & alc^* = 6 \\
\text{Wine} & alw = 2 & alw^* = 6
\end{array}
$$

Home and Foreign have total labor forces of $L = 100$ and $L^* = 200$ workers.

Before we begin this problem, we should already organize the information we are given into a single table. This will help us identify all necessary information with relative ease.

Table 4: ORGANIZING INFORMATION

	Unit Labor Requirements			Total Feasible Production				
	Cheese	Wine	Labor Force	Cheese		Wine	$\frac{a_c}{a_w}$	$\frac{a_w}{a_c}$
Home	5	$\underline{2}$	100	20	or	$\underline{50}$	$\frac{5}{2}$	$\frac{2}{5}$
Foreign	$\underline{6}$	6	200	$\underline{\frac{100}{3}}$	or	$\frac{100}{3}$	1	1

Notice, we have underlined the good for which each country has a comparative advantage.

(a) Graph each country's production possibility frontier and calculate the opportunity cost of cheese in terms of wine. Which country has an absolute advantage in cheese produciton, which in wine production? Which country has a comparative advantage in cheese produciton, which in wine production?

From the above table, since home has lower unit labor requirements for both goods, it has an absolute advantage at the production of both goods. However, when comparing the opportunity cost of cheese in terms of wine, we see that foreign has a comparative advantage at cheese, and home has a comparative advantage in wine. Each countries' production possibility frontier is given below. Note the slope is given by the opportunity cost of cheese in terms of wine.
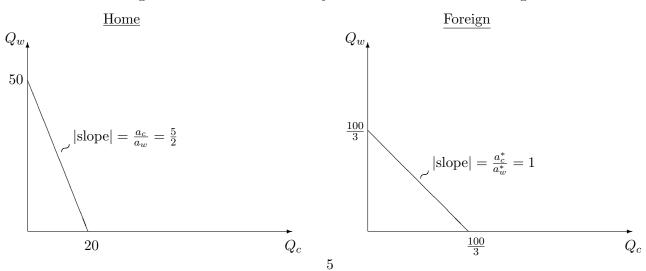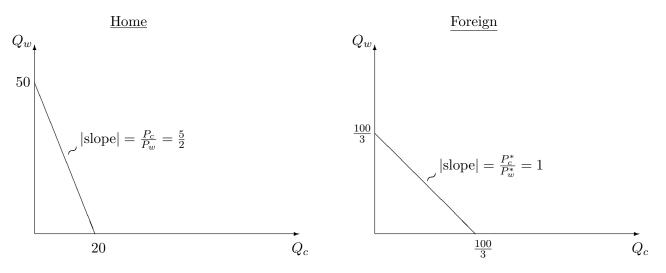
Figure 2: Production Possibility Frontiers for Home and Foreign

Home — Foreign

$|\text{slope}| = \frac{a_c}{a_w} = \frac{5}{2}$

$|\text{slope}| = \frac{a_c^*}{a_w^*} = 1$

(b) Using the graph from your precedingg answer, draw each country's consumption possibilities in the absence of trade. Calculate the relative prices of cheese in terms of wine in autarky.

We should first recognize that, in the absence of trade, a country's consumption possibilities are the same as its production possibilities. Therefore, the consumption possibilities are given directly by the PPF. Further, if we assume there is a positive demand for both goods in autarky, the relative prices will be given by the opportunity cost. The autarkic consumption possibilities and prices are given below.

Figure 3: Consumption Possibilities for Home and Foreign

(c) Both countries open up to free trade. Graph the relative world supply of cheese to wine and its response to the relative world price of cheese P_c/P_w base on the unit labor requirements. Provide specific values on the axes.

We can again refer to the initial table we created in order to draw the relative supply curve. Knowing that foreign has a comparative advantage at cheese production, we can use the table to list all specific values. The graph is given below.
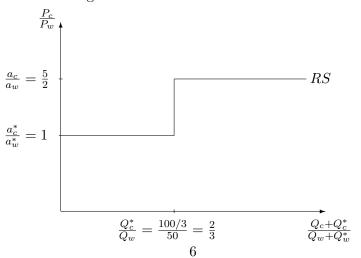
Figure 4: RELATIVE WORLD SUPPLY

(d) **EXTRA CREDIT:** World consumer demand for cheese relative to wine depends on the relative price of the two goods: $(Q_c + Q_c^*)/(Q_w + Q_w^*) = 6 - 5(P_c/P_w)$.

Graph the relative demand curve. Calculate the relative price P_c/P_w of cheese in world trade equilibrium. Calculate the production of Q_c, Q_c^*, Q_w, Q_w^*. Calculate the equilibrium wage rates w and w^* under free trade.
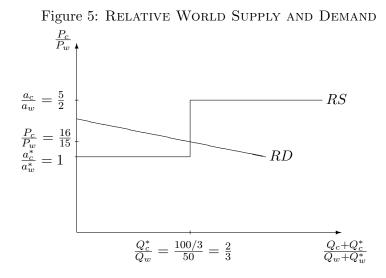
To simplify this problem, we will first manipulate relative world demand to a more user-friendly form. Then we will find the equilibrium and finally graph relative world demand with relative world supply. Rearranging the demand curve, we get:

$$\frac{P_c}{P_w} = -\frac{1}{5}\frac{Q_c^w}{Q_w^w} + \frac{6}{5}$$

Then, plugging in the specialization production ratio of 2/3, we get:

$$
\begin{aligned}
\frac{P_c}{P_w} &= -\frac{1}{5} \cdot \frac{2}{3} + \frac{6}{5} \\
&= \frac{16}{15}
\end{aligned}
$$

Notice that the equilibrium price is in between the two autarkic prices, or $\frac{16}{15} \in \left(1, \frac{5}{2}\right)$. Therefore, we know that both countries specialize and the relative demand curve crosses the relative supply curve on the vertical portion. Graphically we have the following:

Figure 5: RELATIVE WORLD SUPPLY AND DEMAND

Given that they both specialize, we know $Q_c = 0$, $Q_c^* = 100/3$, $Q_w = 50$, $Q_w^* = 0$. Now, to calculate the equilibrium relative wage rates under free trade, we employ the same technique as in problem 1. We ask ourselves: "what can be consumed with one-unit of labor under free trade?"

Table 5: Consumption with 1 Unit of Labor

	Before Trade		After Trade with $\left(\frac{P_c}{P_w}\right)^w = \frac{16}{15}\frac{\text{wine}}{\text{cheese}}$	
	Cheese	Wine	Cheese	Wine
Home	1/5	1/2	15/32	1/2
Foreign	1/6	1/6	1/6	8/45

From the above calculations, we can see that Home is wealthier, and to find out be how much, we ask ourselves: "what do I have to multiply foreign's consumption by to get home's consumption?"

$$\frac{8}{45} \cdot x = \frac{1}{2} \Rightarrow$$
$$x = \frac{45}{16}.$$

Therefore, $w/w^* = 45/16$.