EC3355 International Trade
Problem Set 3: Ricardo's model of comparative advantage

Consider two countries: the United Kingdom (UK) and China. Each country can produce two types of goods, textile (T) and food (F). Assume that the UK has 200 workers and China 600 workers. Labour productivity in each country, in terms of output per day, is:

Table 1: Labour productivity (units/day) by country and good

	UK	China
Textile	6	4
Food	18	3

1. Which country has the absolute advantage in producing textile and which in food?

   Answer: The UK has the absolute advantage in both goods as marginal labour productivity is higher.

2. What are the opportunity costs of producing food and textile in the UK and China?

   Answer: For the UK the opportunity costs of producing food is $\frac{6}{18}=\frac{1}{3}$ units of textile for units of food. Subsequently this means that in order to produce one more unit of textile, the UK has to give up 3 units of food.

   In China the opportunity cost of food production is $\frac{4}{3}$ units of textile for units of food. I.e. the UK has lower opportunity costs of producing food. Which means that China has the lower opportunity costs of producing textile: $\frac{3}{4}$ units of food per units of textile.

3. Derive the production probability frontier for each country.

   Answer: For the UK: Units of textile$= Q_t = 6L_t = 6(200 - L_f)$.
   Since $L_f = Q_f/18$ we get: $1,200 - 6 * \frac{Q_f}{18} = 1,200 - \frac{Q_f}{3}$

   For China: Units of textile $= Q_t^* = 4L_t^* = 4(600 - L_f^*)$.
   Since $L_f^* = Q_f^*/3$ we get: $2,400 - 4 * \frac{Q_f^*}{3} = 2,400 - \frac{4}{3}Q_f^*$

4. Prior to trade the UK produces 600 T and 1,800 F while China produces 1,200 T and 900 F. Show that by altering the production in each country that it is possible to increase world output for each good.

   Answer: Each country will alter its production to produce more of the good in which it has a comparative advantage. So the UK will increase food production by F units, whereas China will increase textile production by T units.
   As a result textile production in the UK will fall by $F/3$ and food production in China by $3T/4$.
   From a world perspective:

   Change food production: $= F - (3T/4) > 0$ if $F > 3T/4$
   Change textile production: $= T - F/3 > 0$ if $F < 3T$

   So for any change in the two countries such that $3T > F > 3T/4$, world output for both goods will increase.

5. What are the autarky relative prices and real wages in each country?

   Answer: In the absence of trade the autarky relative prices are:

$$\frac{p_t}{p_f} = 3\frac{F}{T}$$
$$\frac{p_t^*}{p_f^*} = \frac{3}{4}\frac{F}{T}$$

   Real wages are simply the productivity in each sector so:

$$\frac{W}{p_f} = 18\ units/day\ ;\ \frac{W}{p_t} = 6\ units/day$$
$$\frac{W*}{p_f^*} = 3\ units/day\ ;\ \frac{W*}{p_t^*} = 4\ units/day$$

6. Opening up to trade, what will the trade pattern be and how does this affect real wages in each country? (analytical answer is enough here)

   Answer: If trade is allowed, each country will export the good in which it has a comparative advantage. So the UK will export food and China will export textile.
   According to the Ricardian model each country will end up fully specialised which means that the world trade relative prices will become:

$$\frac{3}{4} < \frac{p_t}{p_f} < 3$$

   For the UK the relative price of textile will decrease which means an increase in real wage in terms of textile while the real wage in terms of food doesn't change.
   In China, the relative price of food falls and as a result the real wage in terms of food increases. The real wage in terms of textile remains unaltered.
   For both countries we see that there is an increase in real wages in terms of the imported good, i.e. the goods that can now be obtained more cheaply due to trade.

7. Given the demand for food D_F and textile D_T, assume that people spend half of their income on each good. Under free trade, what are the world equilibrium relative prices and how do real wages change in each country as a result of free trade?

   Answer: Two types of equilibrium could occur: one where both countries specialise and the other where one country produces both goods. For this problem we assume that the Ricardian of complete specialisation holds and that each country exports the good in which it has a comparative advantage. We get the following in terms of wages, income, and production:

   UK: $w = 18p_f$, $I = w * L = 18p_f * 200 = 3600p_f$, $Q_f = 18L = 3600$
   China: $w^* = 4p_t$, $I^* = w^*L^{=}4p_t * 600 = 2400p_t$, $Q_t = 4L^* = 2400$

   We assume that people have the same taste across countries, so for demand we get:

   $D_f = \frac{I+I^*}{2p_f}$, $D_t = \frac{I+I^*}{2p_t}$

   Assuming specialisation, we set $D_f = S_f$:

   $D_f = \frac{I+I^*}{2p_f} = \frac{3600p_f+2400p_t}{2p_f} = 3600$

$\frac{1}{2}(3600p_f + 2400p_t) = 3600p_f$
$1200p_t = 1800p_f$
$\frac{p_t}{p_f} = \frac{3}{2}$

Relative price is between $\frac{3}{4}$ and 3 so this is the equilibrium and the assumption that countries specialise is valid.

Now need to find out how real wages changes:
Real wages in terms of exported goods remain the same, so we have to look at changes in terms of the imported goods:

UK before trade: $\frac{w}{p_t} = 6$, UK after trade: $\frac{w}{p_t} = \frac{18p_f}{p_t}$.
Since $p_f = \frac{2}{3}p_t$ we get: $\frac{18*\frac{2}{3}p_t}{p_t} = 12$

China before trade: $\frac{w^*}{p_f^*} = 3$, China after trade: $\frac{w^*}{p_f} = \frac{4p_t}{p_f}$.
Since $p_f = \frac{2}{3}p_t$ we get: $\frac{4*\frac{3}{2}p_f}{p_t} = 6$

Shows that there is a clear increase in real wages in terms of the imported goods in each country.

8. Suppose that a third country, South Africa, joins the free trade area and that labour productivity is given as 2 units of textile/day and 1/2 units food/day.
How will the addition of South Africa affect which goods the UK and China export and which good will the UK export? (analytical answer is enough here)

Answer: Again we have to look at the relative prices under autarky in order to determine the comparative advantage of each country. We have:
$\frac{p_t}{p_f} = 3$ $\frac{p_t^*}{p_f^*} = \frac{3}{4}$, $\frac{p_t^\dagger}{p_f^\dagger} = \frac{1}{4}$

The UK remains the lowest cost supplier of food, but now South Africa is the lowest cost supplier of textile. If trade occurs among the three countries the UK would export food and South Africa would export textile. China's trade pattern is uncertain since its prices are intermediate between that of the UK and South Africa.
It has a comparative advantage in producing textile relative to the UK, and in food relative to South Africa but given the information we cannot be sure which good it would export.

9. How does the joining of South Africa affect the relative price of textile? (analytical answer is enough here)

Answer: Before South Africa joined the free trade areas the relative price of textile was above 1/4 so South Africa will want to specialise in textile after joining. When South Africa joins we will see an increase in the supply of textile as well as an increase in the demand for food. So the world relative price of food will will rise and that of textile will fall.

10. Does the welfare in the UK and China change because of the South Africa joining and will South Africa benefit by joining the free trade area?

    Answer: If South Africa joins this will lower the price of textile which benefits the UK as it is a UK import. South Africa will benefit of course since it can get export its comparative advantage good and import more cheaply the good in which it has a comparative disadvantage.
    That leaves the case of China. If it continues to export textile it will lose as the world price falls. It could change from being a textile exporter to food exporter, exporting food to South Africa in which case it is ambiguous whether it looses or gains.