



1.1. Identify each country's comparative and absolute advantages in the production of goods. Justify your answer.

To identify the countries comparative and absolute advantage we use the unit labor requirements, which we derive based on the MPL given in the table.

For Botswana the unit labor requirements are:

$$a_{lc}^B = \frac{1}{MPL_C^B} = \frac{1}{1} = 1$$

$$a_{lu}^B = \frac{1}{MPL_U^B} = \frac{1}{1} = 1$$

And for Zambia they are:

$$a_{lc}^Z = \frac{1}{MPL_C^Z} = \frac{1}{0.5} = 2$$

$$a_{lu}^Z = \frac{1}{MPL_U^Z} = \frac{1}{0.25} = 4$$

Analyzing who has absolute advantage in Copper:

$$a_{lc}^Z = 2 > a_{lc}^B = 1$$

Since the unit labor requirements are lower for Botswana ($a_{lc}^B = 1$) than for Zambia ($a_{lc}^Z = 2$) when producing Copper, Botswana has absolute advantage in the production of copper.

Analyzing who has absolute advantage in Uranium:

$$a_{lu}^Z = 4 > a_{lu}^B = 1$$

Since the unit labor requirements are lower for Botswana ($a_{lu}^B = 1$) than for Zambia ($a_{lu}^Z = 4$) when producing Uranium, Botswana has absolute advantage in the production of Uranium.

Analyzing who has comparative advantage in Copper in terms of Uranium:

$$OC_{c,u}^B = \frac{a_{lc}^B}{a_{lu}^B} = \frac{1}{1} = 1 > OC_{c,u}^Z = \frac{a_{lc}^Z}{a_{lu}^Z} = \frac{2}{4} = 0.5$$

Since the opportunity cost of producing Copper in terms of Uranium is lower for Zambia ($OC_{c,u}^Z = 0.5$), than for Botswana ($OC_{c,u}^B = 1$), we know Zambia has comparative advantage in the production of Copper.

And thus, we also know that Botswana has comparative advantage in the production of Uranium, since they will have lower opportunity costs of producing Uranium in terms of copper. For good measure, this can be seen below where $OC_{u,c}^B = 1$ which is lower than $OC_{u,c}^Z = 2$.

$$OC_{u,c}^B = \frac{a_{lu}^B}{a_{lc}^B} = \frac{1}{1} = 1 < OC_{u,c}^Z = \frac{a_{lu}^Z}{a_{lc}^Z} = \frac{4}{2} = 2$$

1.2 Suppose the free-trade equilibrium implies $P_U / P_C = 1$. Illustrate diagrammatically the free trade equilibrium. Denote the relevant quantities on the vertical and horizontal axes. At the free-trade equilibrium, which country produces/imports/exports which good? Hint: On the plot the variable denoted on the vertical axis is P_U / P_C .

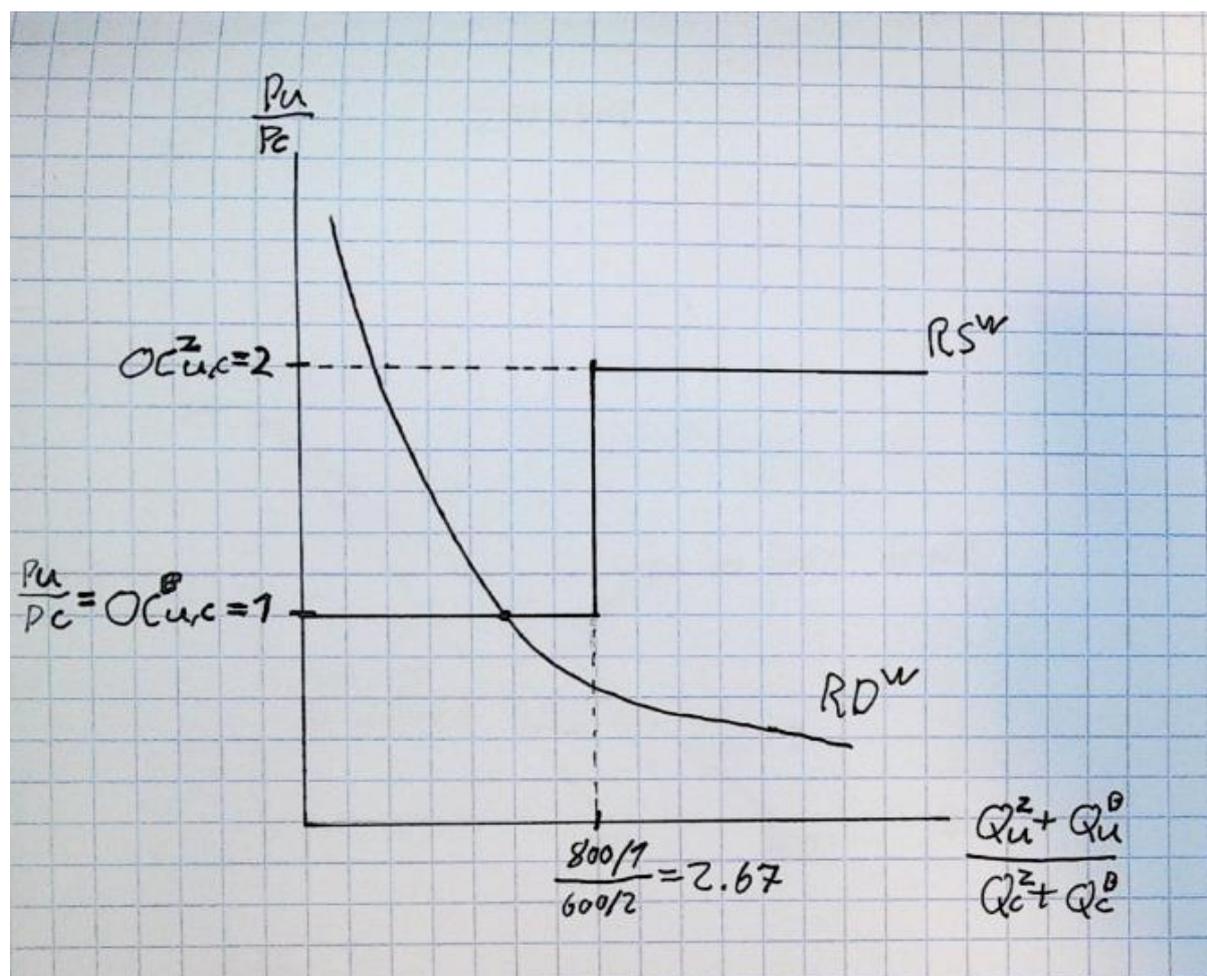
We know Botswana has comparative advantage in the production of Uranium, and their opportunity cost of producing Uranium in terms of Copper is:

$$OC_{u,c}^B = \frac{a_{lu}^B}{a_{lc}^B} = \frac{1}{1} = 1$$

And the opportunity cost for Zambia of uranium in terms of copper is:

$$OC_{u,c}^Z = \frac{a_{lu}^Z}{a_{lc}^Z} = \frac{4}{2} = 2$$

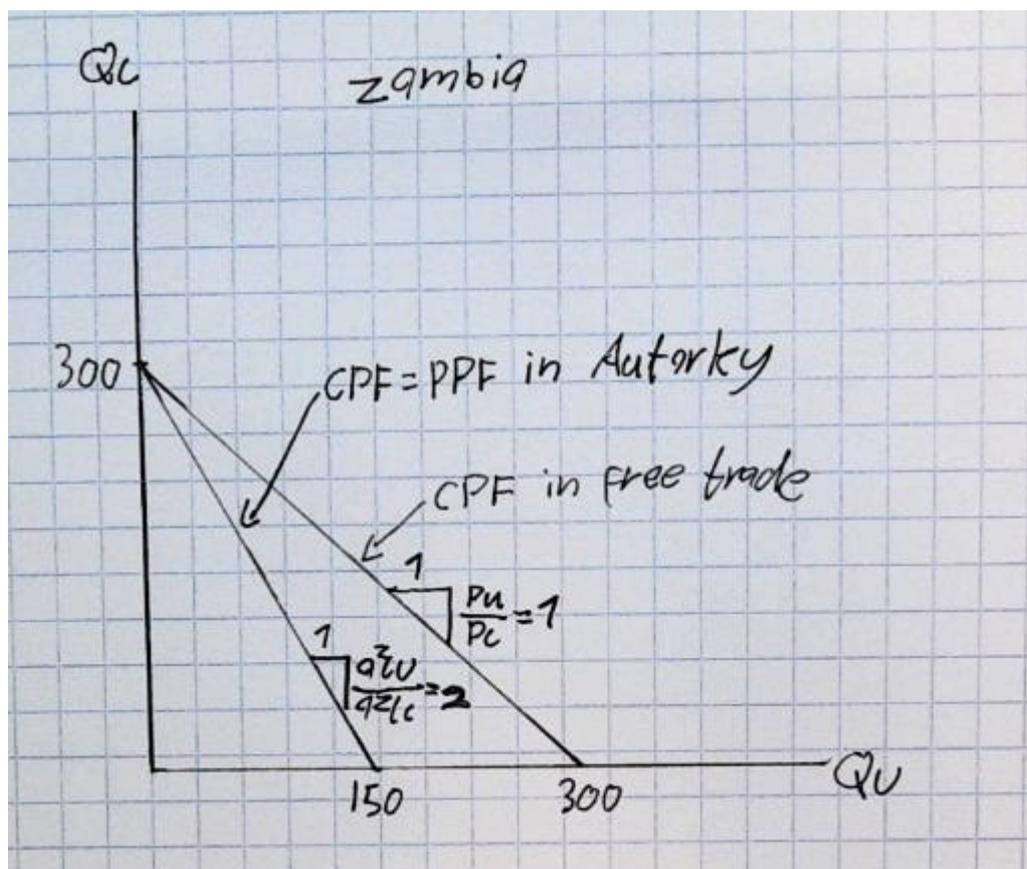
Now we plot the graph and mark the opportunity costs as seen on the Y-axis. We are told that at the free-trade equilibrium $\frac{P_U}{P_C} = 1$. We thus see the world relative demand intersects the world relative supply ($RD^W = RS^W$) where $OC_{u,c}^B = 1$



At the free-trade equilibrium, Zambia will be specialized in the production of Copper, where it has comparative advantage. Therefore, Zambia produces and exports Copper. They then import Uranium from Botswana.

Botswana will produce any relative amount of Copper and Uranium subject to its labor constraint, $L^B = 800$. They will import Copper from Zambia, and they will export Uranium to Zambia.

1.3 Illustrate diagrammatically, and explain in words, the effects on Zambia's consumption possibility frontier (CPF) of moving from autarky to the free-trade equilibrium. Hint: Denote the slope and intercept of each CPF. The scale of the plot does not need to be accurate.



In Autarky, the PPF is equal to the CPF, such that the country consumes what it produces.

The Y-intercept here (In Autarky) is equal to the maximum production of Copper (Q_C) for Zambia which is: $\frac{L^Z}{a_{Lc}^Z} = \frac{600}{2} = 300$ units.

And the X-intercept here (In Autarky) is equal to the maximum production of Uranium for Zambia which is: $\frac{L^Z}{a_{Lu}^Z} = \frac{600}{4} = 150$ units.

The slope in autarky is equal to the negative value of the opportunity cost of producing uranium in terms of copper which is:

$$OC_{u,c}^Z = \frac{a_{Lu}^Z}{a_{Lc}^Z} = \frac{4}{2} = 2. \text{ Thus, the slope is } -2$$

In free-trade the maximum consumption of Copper is unchanged (the good where Zambia has comparative advantage). However, the CPF expands in the direction of the imported good. Now, the maximum consumption of Uranium is:

$$\frac{\frac{L^Z}{a_{lc}^Z} * P_C}{P_U} = 300 * \frac{1}{1} = \mathbf{300}$$

This is since that Zambia will produce Copper. But its CPF is also constrained by its income from selling Copper. We thus calculate that the maximum amount of Uranium that Zambia can consume in free-trade is 300 units. Thus, the slope is equal to the negative value of the free-trade equilibrium relative prices of $\frac{P_U}{P_C} = 1$. Thus the slope is **-1**. See drawing above.

We thus see that the consumption possibilities for Zambia expands in the direction of the good they import, which is uranium. Thus, the drawing reflects that there are gains from trade for Zambia (when we are assuming they consume both goods).

1.4 What is the effect on Botswana's consumption possibility frontier of moving from autarky to the free-trade equilibrium? Explain in words.

For Botswana, since the free trade equilibrium relative price of $\frac{P_U}{P_C} = 1$ is the same as Botswana's opportunity cost ($OC_{u,c}^B = 1$) there are no gains from trade. Thus, the CPF for Botswana is equal to its PPF (production possibilities frontier) in **both the autarky and free trade equilibrium**.

2.1 Define external economies of scale (or external increasing returns), and explain how the equilibrium market price and quantity are determined in industries that exhibit external economies of scale.

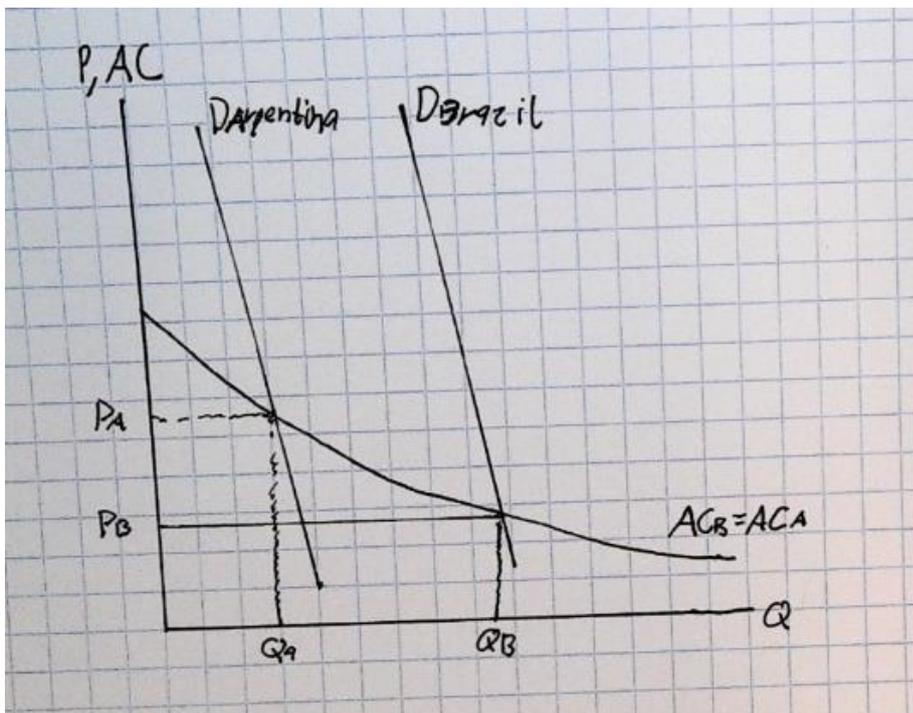
External economies of scale occurs when the average costs (AC) decrease as the number of firms in the industry increases. In industries characterized by external economies of scale we often see many smaller firms operating in the market that are geographically located close to each other such that they benefit from for example specialized suppliers, labor market pooling and knowledge spillovers.

The market price and quantities are determined by the intersection of demand and the average costs of firms, such that in equilibrium $P = AC$. The reasoning is that in external economies of scale, we assume perfect competition such that firms will continue to enter the market if there are profits (which increases production), and they will enter until $P = AC$.

2.2 Consider two countries (Brazil and Argentina). Both produce home appliances, whose production technology exhibits external economies of scale. The average cost curve of producing home appliances is the same in both countries, but the demand for home appliances is larger in Brazil. If both countries operate in autarky, in which country are home appliances cheaper? If later the two countries decide to engage in free trade, how would the free-trade equilibrium price relate to the autarky equilibria prices in Argentina and Brazil? Illustrate graphically and explain in words.

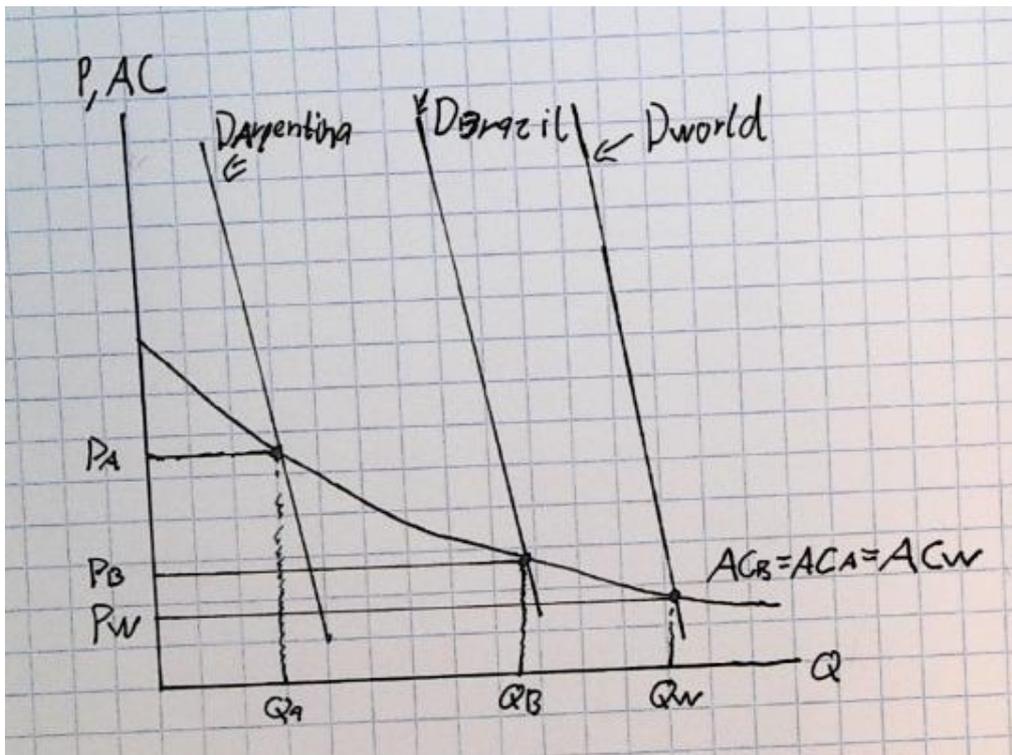
The demand for home appliances is larger in Brazil such that the demand curve for Brazil is further to the right. We also see that the average cost curves are the same such that $AC_B = AC_A$.

Therefore, in autarky, the demand of Brazil will intersect the AC-curve at a lower price point, since the AC-curve is downwards sloping. Home Appliances are therefore cheaper in Brazil than in Argentina in autarky. See illustration below:



When the 2 countries engage in free trade, it leads to an expansion of the demand curve (as seen from the plot below) compared to the 2 autarky's demand. Additionally, we see that there are no changes to the AC-curve such that $AC_A = AC_B = AC_W$.

In the free trade equilibrium, the world price of home appliances (P_W) is lower than both of the 2 autarky prices (P_A and P_B). This is since the market expands such that the external economies of scale allows for a further cost reduction in firms average costs. The largest decrease in prices is for Argentina, since their demand was initially lower than for Brazil, which led to higher prices in Argentina compared to Brazil.



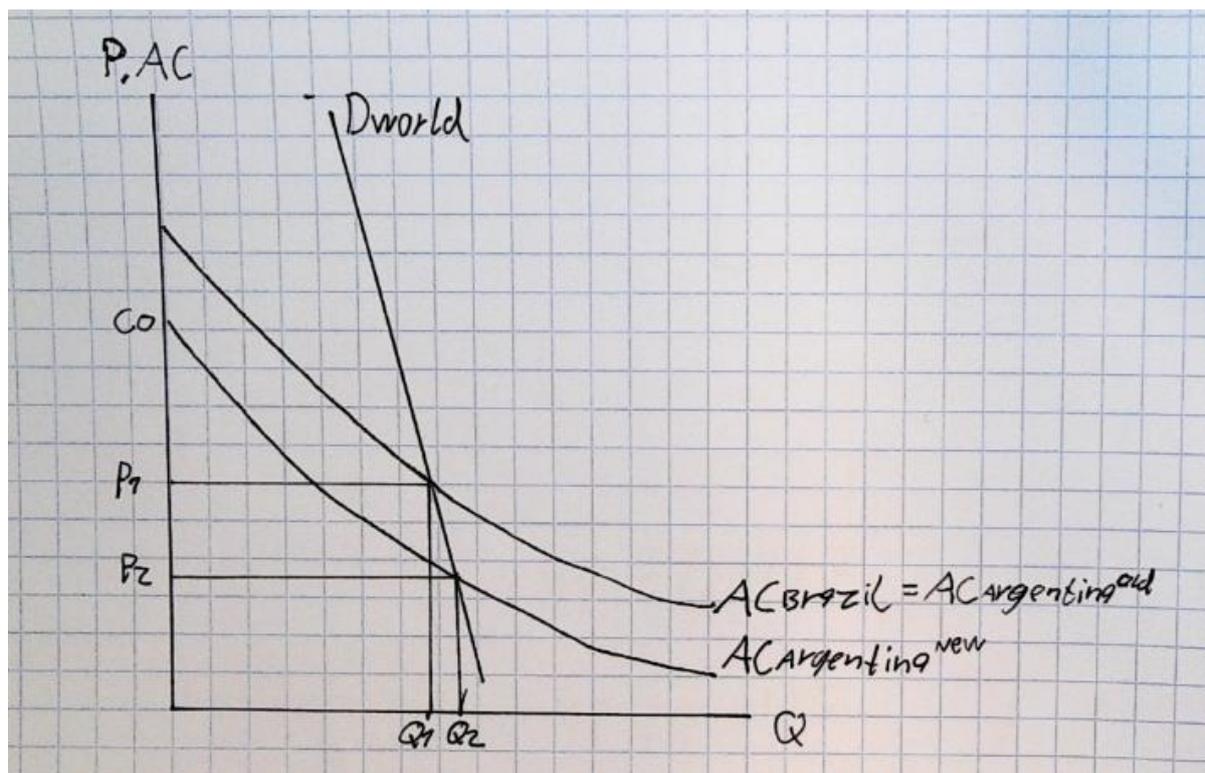
2.3 Suppose the world is currently operating in a free-trade equilibrium where the Brazilian industry is serving the whole world market for home appliances. Some decades later Argentina develops a new technology to produce home appliances that leads to a reduction in its average cost curve. However, the free-trade equilibrium remains unchanged (i.e. the Argentinian home appliance industry is not able to displace its Brazilian counterpart). Intuitively explain in words how that outcome is possible and illustrate it graphically.

Since the production is initially at Brazil, this has allowed Brazil to take advantage of the external economies of scale, through for example specialized suppliers, labor market pooling and knowledge spillovers. This has allowed the Brazilian producers to obtain **lower average costs** as they benefit from external economies of scale.

Thus, even though, Argentina could be more efficient in production of home appliances (reflected by a lowered average cost curve in the graph below), it would not be beneficial for the first Argentinian producers to enter the market, since the world market price is below their average costs (reflected

by C_0 being higher than P_1). They will therefore not enter the market, and will thus not be able to displace the Brazilian producers in the world market. In such a market, we thus see a 'lock-in' effect, where the fact that the production is initially at Brazil, 'locks-in' their production and gives them a cost advantage.

See graphical illustration below, where we see that the AC-curve of Argentina has shifted down (since before it was equal to Brazil's). Even though the average cost curve of Argentina is below the average cost curve of Brazil, the world market price, P_1 , is lower than C_0 which would be the initial average costs for the first Argentinian producers that enters the market. Thus, it would not be economically beneficial for them to enter, and the production remains in Brazil.



2.4 Continuing with the example described in 2.3, in theory, can an intervention by the Argentinian government alter the free-trade equilibrium and allow its home appliance industry to displace the Brazilian industry? Provide an example of an infant-industry protection policy that would allow the Argentinian government to attain that goal, and explain in words how the policy would achieve its goal.

Yes, an intervention by the Argentinian government can alter the free-trade equilibrium and allow its home appliance industry to displace the Brazilian industry.

An example of an infant-industry protection policy would be introducing an import tariff on Brazilian-produced home appliances, such that the domestic price in Argentina of these Brazilian goods increases to a level above the average costs of the Argentinian producers. In such a scenario, it would be beneficial for Argentinian producers to produce. This would allow the Argentinian Home appliance industry to serve its home market and build scale, which would decrease the Argentinian firms' average costs as the number of firms increases.

Once the Argentinian producers have reached an average cost below the average cost of Brazilian producers (without the tariff), the import tariff can be removed, and then, in theory, the Argentinian producers would now serve both the world market and the domestic market and have displaced the Brazilian industry.

3.1. Find the autarky equilibria prices and quantities of cherries produced in Georgia and Moldova.

Firstly, we find the autarky equilibria prices and quantities of cherries produced in Georgia.

$$Q_S = 10 + 2P$$

$$Q_D = 600 - 8P$$

We set $Q_S = Q_D$

$$10 + 2P = 600 - 8P$$

$$10P = 590$$

$$P = \mathbf{59}$$

The quantity consumed and produced will be the same in autarky and equal to:

$$Q_D = Q_S = 10 + 2(59) = \mathbf{128}$$

The autarky price in Georgia for cherries is thus $P = 59$ and the quantity produced and consumed is $Q = 128$.

Now for Moldova. Their demand and supply are:

$$Q_S^* = 20 + 2P^*$$

$$Q_D^* = 200 - 2P^*$$

We set $Q_D^* = Q_S^*$ to find the autarky price:

$$20 + 2P^* = 200 - 2P^*$$

$$4P^* = 180$$

$$P^* = \mathbf{45}$$

The quantity consumed and produced will be the same in autarky and equal to:

$$Q_D^* = Q_S^* = 20 + 2(45) = \mathbf{110}$$

3.2 Calculate the import-demand and export-supply curves of cherries in the world. Then, find the free-trade equilibrium price, and the quantity of cherries traded in the world market.

Since the autarky price of cherries is lower in Moldova than in Georgia, we know that Moldova will export. We calculate the excess supply:

$$\begin{aligned}XS^* &= S^* - D^* \\XS^* &= 20 + 2P^* - (200 - 2P^*) \\XS^* &= -180 + 4P^*\end{aligned}$$

And following the same logic, we know that Georgia will import and thus calculate the import demand curve based on their demand and supply:

$$\begin{aligned}MD &= D - S \\MD &= 600 - 8P - (10 + 2P) \\MD &= 590 - 10P\end{aligned}$$

Now we find the free-trade equilibrium prices and quantities traded in the world market by setting $MD = XS^*$:

$$\begin{aligned}590 - 10P^W &= -180 + 4P^W \\770 &= 14P^W \\P^W &= 55\end{aligned}$$

And the quantity of cherries traded in the world market is equal to 40 units, as calculated below:

$$\begin{aligned}MD &= 590 - 10P^W \\MD &= 590 - 10(55) = \mathbf{40}\end{aligned}$$

3.3 Do Georgian consumers of cherries gain from trade? Calculate the change in consumer surplus that results from moving from autarky to free trade in Georgia, and intuitively explain your result. Without making any calculations, do Georgian cherry producers gain or lose from trade? What about Georgia as a whole? Briefly explain in words.

Yes, the Georgian consumers gain from trade. In autarky the price of cherries was $P_A = 59$ whereas in the free-trade equilibrium, the world market price is $P_W = 55$.

To calculate the change in consumer surplus, we firstly calculate the quantity demanded and supplied at the world market price ($P_W = 55$) in the Georgian market:

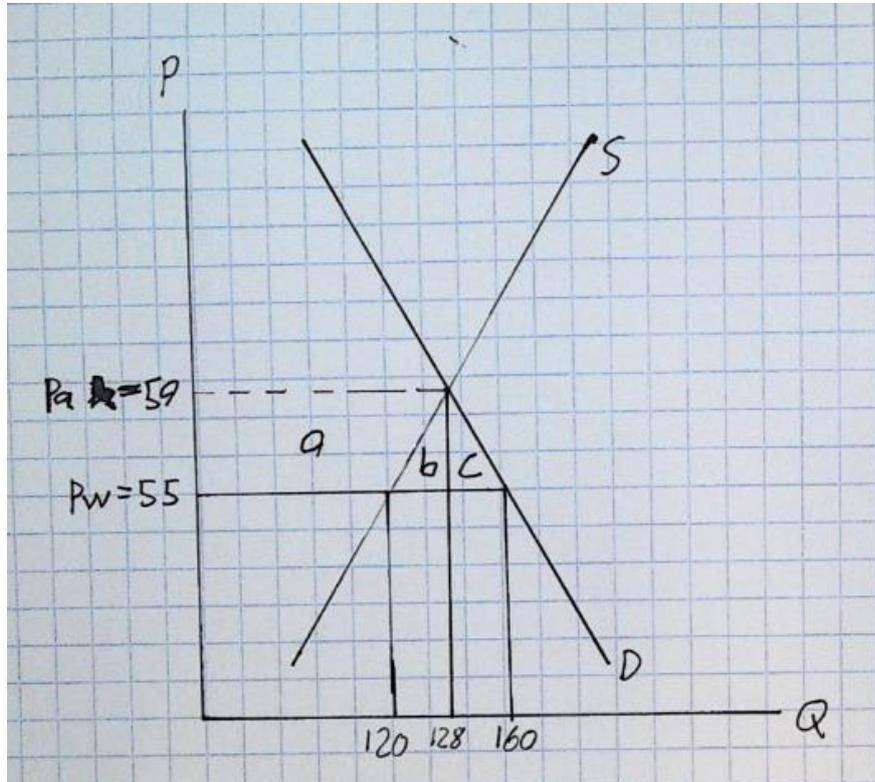
$$\begin{aligned}Q_S &= 10 + 2P_W \\Q_S &= 10 + 2(55) = \mathbf{120}\end{aligned}$$

And the quantity demanded is:

$$Q_D = 600 - 8P_W$$

$$Q_D = 600 - 8(55) = \mathbf{160}$$

We calculate the consumer gain, which is the area of $a + b + c$ in the graph below (which is made for illustrative purposes):



Firstly, we calculate the area of $a + b$ above as:

$$\text{Area } a + b = (P_A - P_W) * Q_A^D$$

$$\text{Area } a + b = (59 - 55) * 128$$

$$\text{Area } a + b = 512$$

Then we calculate the area of c (see above,) which is:

$$\text{Area } c = (P_A - P_W) * (Q_W^D - Q_A^D)$$

$$\text{Area } c = (59 - 55) * (160 - 128) = 128$$

Thus, the total change in consumer surplus is positive and equal to:

$$\text{Change in consumer surplus} = 512 + 128 = \mathbf{640}$$

Intuitively, this increase in consumer surplus results from the price for consumers falling in free trade compared to autarky, such that consumers are able to consume more at lower prices.

For Georgian producers, they lose from trade, since that they are now producing a lower quantity (from producing 128 units in autarky to producing 120 units in free trade) and they do so at lower prices. For illustrative purposes, the area of the producer loss for Georgian producers is equal to the area a in the graph made above.

Georgia as a whole gain from trade, since that the increase in consumer surplus as a result of free trade is larger than the producer loss. Specifically, their gain can be quantified as the area of b+c in the graph above. This gain is equal to the sum of production and consumption distortions that arise in Autarky from not being in free trade.

3.4 Suppose the Moldovan government adopts an export subsidy of 7 euros for each exported cherry. Write the algebraic expression of Moldova's export-supply curve with the export subsidy. Then, calculate the new equilibrium price with the export subsidy. How does the export subsidy affect Georgia's terms of trade? Briefly explain in words.

The algebraic expression of Moldova's export-supply curve with the export subsidy is calculated below:

$$XS^* = -180 + 4P$$

$$XS^* = -180 + 4(P + S)$$

$$XS^* = -180 + 4(P + 7)$$

$$XS^* = -152 + 4P$$

Thus, the export subsidy will expand the excess supply curve to the right in the world market (when graphing the inverse excess supply), since it is now more attractive for Moldova's producers to export.

The new equilibrium price is calculated below by setting the new excess supply equal to the imported demand function:

$$XS^* = MD$$

$$-152 + 4P_W^S = 590 - 10P_W^S$$

$$14P_W^S = 742$$

$$P_W^S = 53$$

We thus see that $P_W^S = 53$ which reflects a lower world market price than before the subsidy was introduced, where $P_W = 55$.

Terms of trade is defined as the world market price(s) of the good that the country exports over the world market price(s) that the country imports.

Since that Georgia **imports** cherries from Moldova, a decrease in the price of cherries will improve Georgia's terms of trade. This is since the price of imports fall, and there are no changes to the price of exports.