1. Import tariffs increase domestic production of importables, hence they reduce production of exportables. Import tariffs decrease domestic consumption of importables, hence they raise consumption of exportables. Export subsidies do the opposite – by encouraging exports (more production of export good), they discourage domestic production of importables. Hence, import tariffs and export subsidies of the same magnitude – *on all imports and for all exports* – should essentially negate each other.

Given the production functions:

\[ Q_f = 2 \left( L_f \right)^{1/2} K^{1/2}; \quad Q_c = L_c; \quad \text{implies:} \quad TC_c = WL_c = WQ_c, \quad TC_f = WL_f = W \left( Q_f^2 / 4K \right) \]

Since profit maximization implies price equals marginal cost:

\[ P_c = MC_c = W \quad \text{and} \quad P_f = MC_f = W \left( Q_f / 2K \right) \quad \text{or:} \quad Q_f^* = \left( 2P_f K / W \right) \]

If good \( C \) is to be produced, we must have \( P_c = W \) (if \( P_c < W \), then good \( C \) will not be produced; it is not possible to have \( P_c > W \) since there will be excess profits in producing \( C \), and \( C \) producers will want to hire more labor. But this will bid up the wage until \( P_c = W \)).

Concentrating on an interior solution (where both goods are produced) we have:

**Supply:** \( Q_f^* = \left( 2P_f K / W \right) = \left( 2P_f K / P_c \right) = 2\rho K = 4\rho \) where: \( \rho \equiv \left( P_f / P_c \right) \) and \( K = 2 \)

\[ Q_c^* = \left( L - Q_f^* \right) = \left( L - \left( Q_f^2 / 4K \right) \right) = \left( L - \left( 4\rho^2 K^2 / 4K \right) \right) = \left( 2000 - 2\rho^2 \right), \]

since \( L = 2000, \ K = 2 \)

This solution requires \( \rho^2 \leq 1000 \implies \rho \leq 10\sqrt{10} \approx 31.6 \); if \( \rho > 10\sqrt{10} \) only good \( F \) is produced.

**For preferences: \( U = D_c + 30D_f - \left( D_f^2 / 4 \right) \); demands** are found by setting MRS = price ratio:

\[ \left( \frac{\partial U / \partial D_f}{\partial U / \partial D_c} \right) = \left( P_f / P_c \right) \rightarrow \left( 30 - \frac{D_f}{2} \right) = \rho \rightarrow D_f = 60 - 2\rho, \rho \leq 30; \quad D_f = 0, \quad \rho > 30. \]

Thus, **demands** are: \( D_f = 60 - 2\rho; \quad P_c D_c = I - P_f D_f \rightarrow D_c = \frac{\left( I - 2P_f \left( 30 - \rho \right) \right)}{P_c}; \quad \rho \leq 30 \)

(Note that if the relative price of \( F \) is too high, demand for \( F \) will be zero; and if income is too low, demand for \( C \) will be there. For simplicity, we focus on cases where both goods are consumed).

The autarky equilibrium thus satisfies:
\[ Q_f = D_f \rightarrow 4\rho = 60 - 2\rho, \text{ and hence the autarky price: } \rho^d = 10. \quad \text{ } W = P_c \text{ or } (W/P_c) = 1, \]
\[ (W/P_f) = (W/P_c,\rho) = (1/10) \]

Only relative price matters because doubling output prices will double the wage rate. Hence, marginal cost and price both double, so supply is unchanged. On the demand side, income doubles, but prices also double, so demand is unchanged. The real question is: what does a price of “10” mean. There is no absolute standard for prices: rather it is “10 units of good C per unit of good F”.

b) As given in the question, the world prices are such that: \( P^w_c = 1, \quad P^w_f = 20 \), and hence \( \rho^w = 20 \).

Thus, under free trade the country would export good \( F \). Under free trade, with domestic prices equal world prices, we have:

\[ Q^*_f = 4\rho = 80, \quad Q^*_c = (2000 - 2\rho^2) = 1200, \quad D_f = 60 - 2\rho = 20 \] so:

Exports of good \( F \): \( X_f = Q_f - D_f = 60 \).

Balance of trade equilibrium implies: \( P_f X_f = P_c M_c \rightarrow M_c = \rho X_f = 20 \cdot 60 = 1200 \),

Hence, domestic consumption of \( C \) (production plus imports) is: \( 1200 + 1200 = 2400 \)

c) A 25% import tariff results in the following domestic prices:

\( P^d_f = P^w_f = 20; \quad P^d_c = P^w_c (1.25) = 1.25 \) hence: \( \rho^d = (20/1.25) = 16 \)

As long as good \( M \) is still produced (as it will be) the domestic wage – **in terms of good C** - is unchanged \((W = P_c^d)\), but the “nominal” wage goes up (to \( W = 1.25 \) ) which means the real wage in terms of good \( F \) increases. Since the domestic price of \( F \) is unchanged, but the “nominal” wage increases, this means the real return to capital, must fall (as in the specific factor model where we are lowering the relative price of the sector in which capital is specific). More formally:

\[ R = P_f^d \left( \frac{\partial Q_f}{\partial K} \right) = P_f \left( L_f/K \right)^{1/2} \text{. From earlier: } L_f = \left( Q_f^2 / 4K \right) \text{ and supply of F is given by:} \]

\[ Q^*_f = 2\rho^d K; \quad \text{hence: } L_f^* = \left( 4 \rho^d / 4K \right) \text{ and } \left( L_f^* / K \right) = \left( \rho^d \right)^2 \text{ implying: } R = P_f^d \rho^d \]

and: \( R/P_f^d = \rho^d, \quad R/P_c^d = \left( \rho^d \right)^2 \)

Thus, decreasing the domestic relative price of \( F \) lowers the real return to capital, whether measured in terms of the import or export good. Finally, domestic production and consumption are found by substitution with \( \rho^d = 16 \):

\[ Q^*_f = 4\rho = 64; \quad Q^*_c = (2000 - 2\rho^2) = 1488 \quad D_f = 60 - 2\rho = 28 \text{ and thus: } X_f = 64 - 28 = 36. \]

From the balance of trade, since world price is unchanged:

\( M_c = \rho^w X_f = 20 \cdot 36 = 720; \text{ domestic consumption of } C: \quad D_c = Q_c + M_c = 2208 \)

d) If the import tariff is removed, but an export subsidy of 25%, based on the world price, is imposed we have:

\[ P^d_f = P^w_f + s = (1.25) \cdot 20 \rightarrow 25, \quad P^d_c = 1 \text{ or: } \rho^d = 25 \]

then results opposite to (c) hold: domestic production of \( F \) rises, production of \( C \) falls, etc.
\[ Q^*_f = 4 \rho = 100; \quad Q_c^* = \left(2000 - 2 \rho^2\right) = 750 \quad D_f = 60 - 2 \rho = 10 \quad \text{and thus:} \quad X_f = 100 - 10 = 90. \]

Also: \[ M = \rho X_f = 20 \cdot 90 = 1800; \quad D_c = Q_c + M = 2550 \]

e) Finally, with an import tariff of 25% and an export subsidy of 25%, both based on the world price, we have:

\[ P_f^d = P_f^w + \text{subsidy} = 20 \times (1.25) = 25; \quad P_c^d = P_c^w + \text{tariff} = P_c^w \times (1 + .25) = 1.25 \quad \text{and:} \]

\[ \rho^d = \left( P_f^d / P_c^d \right) = (25/1.25) = 20. \]

So, these policies raise the nominal prices of all goods by 25%, and hence will increase the nominal wage by 25%, but relative prices will be unaffected and there will be no real effect (on consumption, production, trade) of these policies. In essence, they are like a devaluation of the country’s currency.

2. **Free Trade Area.** Consider the computer industry; Mexico has following Supply and Demand:

\[ S = \left( p^d - 200 \right); \quad D = 1900 - 2 p^d \]

Mexico can import (identical) computers from US at \( p^w = 400 \) or from Japan at \( p^j = 300 \)

Mexico is small and does not affect world prices.

Mexican tariff is originally \( 150 \) on all computers.

a) Initially, with \( t = 150 \) regardless of origin of imported computers:

Mexico imports from Japan; \( P^\text{mex} = P^j + 150 = 450 \)

Hence: \( Q^\text{mex} = (p^d - 200) = 250; \quad D = 1900 - 2 p^d = 1000; \quad M = D - S = 750 \)

b) Mexico forms FTA with US. Since there are no taxes on US computers, imports from US cost Mexican consumer 400, those from Japan 450. **Hence, imports come from US.**

\( P^d = P^\text{mex} = 400; \quad S^m = 200; \quad D^m = 1100; \quad M^m = 900 \)

**Mexican production falls, consumption increases, imports increase. Volume trade increases by 150 (from 750 to 900) – this is trade creation;** but all imports come from US rather than Japan – this is trade diversion. To see welfare, consider diagram:
Consumers gain: Area \{400,B*,B,450\} = 52,500
Producers lose Area \{400,A*,A,450\} = 11,250
Government loses tariff revenue = 150*750 = 112,500 (Area ABHJ)
Net Loss = 71,250

This net loss is the gain from trade creation (triangles \{A*,A,V\} and \{B,B*,W\}) minus the loss due to trade diversion (area \{V,W,H,J\}) - which reflects the higher costs paid for the original level of imports (750) from the US rather than from Japan.

(c) If the tariff were originally $300 per unit (instead of $150 per unit), then before the FTA the price of Japanese imports in Mexico would be $600, and all imports would come from Japan. So:

Pre-FTA: \(P^{mex} = 600; \ Q = 400; \ D = 700; \) Imports = 300; tariff revenue = 90,000 (see figure below)

After the FTA, the tariff on US goods is eliminated and imports come from US. The post-FTA situation is the same as in (b):

Post-FTA \(P^{mex} = 400; \ Q = 200; \ D = 1100; \) Imports = 900

Thus, the amount of trade creation is much larger than in (b), and the amount of trade diversion is smaller. Hence, the net loss should be smaller (or the net gain larger). To measure it, see figure below:

Consumers gain: Area \{400,B*,T,600\} = 180,000
Producers lose: Area \{400,A*,S,600\} = 60,000
Government loses tariff revenue = 90,000 (Area STLM)
Net welfare gain = 30,000
This welfare gain equals the gains from trade creation (the triangles \{A^*,S,J\} and \{K,T,B^*\}) less the loss from trade diversion (area \{J,K,M,L\}) due to the fact higher priced imports from the US replace imports from Japan.

So, joining the FTA benefits Mexico in case (c), but not in (b). Explanation: trade creation in (c) is larger as imports increase from 300 to 900 than in (b), where imports increase only by 150. In both cases trade diversion occurs, as imports from Japan that previously cost $300 to the country (remember the tariff revenue goes to the Mexican government) are diverted to imports from the US, which cost $400. This trade diversion is much larger in (b), where imports are originally 750 because of the lower tariffs, than in (c), where imports are only 300. Moral: even if lowering all tariffs is good, it does not automatically follow that lowering some tariffs will improve welfare.

3. The Current Account Balance measures the difference between exports and imports (including goods and services, net investment income and unilateral transfers). A deficit signifies that imports exceed exports and means that there is net foreign borrowing by domestic residents; a surplus indicates net foreign lending. As an identity:

\[ X-M = Y-(C+I+G) = S^p + (T-G) - I \]

where symbols were defined in class. In particular, a balance of trade surplus (deficit) indicates that domestic saving (the sum of private saving \(S^p\) and government saving \(T-G\)) exceeds (is less than) investment.

a) A Current Account deficit is neither bad nor good, per se. As noted above, a deficit implies low current savings or high current investment, and hence borrowing. What it does mean is that Net Foreign Indebtedness will increase (Net Foreign Wealth decrease), and this debt will (probably) have to be repaid in the future. However, sometimes it makes sense to borrow against future income
- for example, a poor country that knows its oil revenue will increase in the future due to current exploration or, by analogy, a college student who knows her (his) income will increase in future years. Furthermore, if the current borrowing is used to increase investment and if this investment has a higher return than the interest rate on the borrowing, then both current and future consumption could be increased. Thus, the issue is not whether there is a deficit, but whether the funds are being spent “wisely”.

b) A US Current Account deficit occurs, as an identity, when US absorption \((C+I+G)\) is high relative to income, or savings \((S^p+T-G)\) is low relative to investment. An increase in government spending, without a change in taxes, means that net government saving falls (or government borrowing rises) and hence the government \textbf{budget deficit} increases. \textit{If private savings do not increase} (consumption does not decrease) and investment does not decrease, then this increased government spending must lead to a (higher) current account deficit. It is possible the higher government spending might reduce private consumption, but the details depend on a specific theory. It is certainly reasonable to expect, in the short run at least, that the higher government purchases lead to an increased trade deficit. \textit{Something called Ricardian equivalence predicts that a government tax cut – raising the deficit – would be offset by an equal increase in private saving because people realize that taxes will have to be increased in the future to repay the deficit and hence will increase saving in anticipation of the future taxes. Not all economists believe this “theory” to hold and empirical evidence is mixed, at best).}

c) Impact on the current account of:

i. \textbf{A discovery of oil reserves; oil extraction occurs after 3 years}. The discovery will increase people’s expectations of future income, and hence should stimulate current consumption (through an economic theory that predicts individuals’ current spending depends on current income and wealth, and expectations of future income). Thus, we would predict that the discovery would lead to a Current Account deficit in the years before extraction starts, and a Current Account surplus (to repay the borrowing) once extraction reaches its maximum potential.

ii. \textbf{A temporary increase in oil prices for an oil exporter}. Since this increased income is assumed to be transitory, the economic prediction is that only a fraction of it will be spent today. Hence, current consumption should rise by less than current income, and the temporary oil price increase should lead to a (temporary) current account surplus.

Extra Credit Problem.

4. \{Strategic Trade Policy\} A European firm (Phillips) and a Japanese firm (Sony) are the only firms to sell HDTVs in the US. Each firm realizes that US market price depends on total sales. Demand in the US, and costs for each firm are as follows:

\[ D^{us} = 4000 - 5p^{us} \rightarrow p^{us} = 800 - \left[\left(q^e + q^j\right)/5\right]; \quad TC^e = 200q^e; \quad TC^j = 200q^j \]

where \(q^e, q^j\) are the output of the European and Japanese firm, respectively, and \(TC^e, TC^j\) are their costs (implying equal constant marginal costs of 200). Profits for each firm are:

\[ \pi^e = (p^{us} - 200)q^e = \left[800 - \left(\left(q^e + q^j\right)/5\right)\right] - 200q^e \]
\[ \pi^j = (p^{us} - 200)q^j = \left[800 - \left(\left(q^e + q^j\right)/5\right)\right] - 200q^j \]
a) Find the profit-maximizing output level for each firm, given the other firm’s output level:

\[
\pi^e = \left[800 - \left(\frac{[q^e + q^j]}{5}\right)\right] - 200 \quad q^e \rightarrow \frac{d\pi^e}{dq^e} = 600 - \frac{q^j}{5} - \frac{2q^e}{5} = 0 \rightarrow q^e = 1500 - \frac{q^j}{2}
\]

\[
\pi^j = \left[800 - \left(\frac{[q^e + q^j]}{5}\right)\right] - 200 \quad q^j \rightarrow \frac{d\pi^j}{dq^j} = 600 - \frac{q^e}{5} - \frac{2q^j}{5} = 0 \rightarrow q^j = 1500 - \frac{q^e}{2}
\]

Solving these two equations simultaneously (for example, use the first equation for \(q^e\) to substitute out and solve for \(q^j\)):

\[
q^j = 1500 - \frac{q^e}{2} = 1500 - \frac{1}{2} \left(1500 - \frac{q^j}{2}\right) = 750 + \frac{q^j}{4} \rightarrow \hat{q}^j = 1000, q^e = 1000
\]

At these output levels, \(P^{eq} = 800 - \left(\frac{q^j + q^e}{5}\right)\) = 400; \(\hat{\pi}^e = \hat{\pi}^j = 200 \cdot 1000 = 200,000\)

Since the equilibrium price is 400, and marginal cost is 200, each firm is making a 100% profit on each item sold and would love to sell more if it could do so without driving down price (too much).

b) Suppose the Japanese government subsidizes Sony. How will this affect the equilibrium?

Sony’s profits become:

\[
\pi^j = (p^{as} + s - 200)q^j = \left[800 + s - \left(\frac{[q^e + q^j]}{5}\right)\right] - 200 \quad q^j
\]

Maximizing its profits yields:

\[
\frac{d\pi^j}{dq^j} = (600 + s) - \frac{q^e}{5} - \frac{2q^j}{5} = 0 \rightarrow q^j = (1500 + 2.5s) - \frac{q^e}{2}
\]

**Though not asked, for symmetry suppose Europe uses an export subsidy of \(\theta\); we can always set this equal to zero for part b.** Then for the European firm:

\[
\pi^e = (p^{as} + \theta - 200)q^e = \left[600 + \theta - \left(\frac{[q^e + q^j]}{5}\right)\right]q^e \quad \text{and:}
\]

\[
\frac{d\pi^e}{dq^e} = (600 + \theta) - \frac{q^j}{5} - \frac{2q^e}{5} = 0 \rightarrow q^e = (1500 + 2.5\theta) - \frac{q^j}{2}
\]

Solving these two equations simultaneously (e.g., as above substitute) yields:

\[
q^j = (1500 + 2.5s) - \frac{q^e}{2} = (1500 + 2.5s) - \frac{1}{2} \left(1500 + 2.5\theta - \frac{q^j}{2}\right) = 750 + 2.5s - 1.25\theta + .25q^j
\]

Solving: \(\hat{q}^j = 1000 + \left(\frac{10s}{3}\right) - \left(\frac{5\theta}{3}\right) = 5\left(200 + \left(\frac{2s - \theta}{3}\right)\right); \quad \hat{q}^e = 5\left(200 + \left(\frac{2\theta - s}{3}\right)\right)\)

Note that the Japanese subsidy increases the equilibrium output of the Japanese firm but reduces the output of the European firm; a European subsidy has a symmetric impact.

Price and profits, and the subsidy cost, are:
Clearly, the Japanese subsidy increases the output, and profits, of the Japanese firm; decreases the output, and profits, of the European firm; lowers the US price and hence benefits the US. The Japanese subsidy clearly hurts Europe. To determine its impact on Japan, take the profits to the Japanese firm and subtract the cost of the subsidy to the government:

$$W^j = \pi^j - s\tilde{q}^j = 5\left(200 + \frac{2s-\theta}{3}\right)^2 - s5\left(200 + \frac{2s-\theta}{3}\right) = 5\left(200 + \frac{2s-\theta}{3}\right)\left(200 - \frac{s+\theta}{3}\right)$$

At $s = 0, \theta = 0, W^j = \pi^j = 200,000$ as above;

At $s = 150, \theta = 0, W^j = 5 \cdot (300) \cdot (150) = 225,000$ so Japan gains from this export subsidy.

Not asked, but if you calculate Europe’s loss (lower profits for the firm) Europe loses more than Japan gains.  

Also not asked, but you can calculate the optimal export subsidy, from Japan’s perspective:

$$W^j = 5 \cdot \left(200 + \frac{2s-\theta}{3}\right)\left(200 - \frac{s+\theta}{3}\right); \quad \frac{dW^j}{ds} = \frac{10}{3} \left(200 - \frac{s+\theta}{3}\right) - 5 \left(200 + \frac{2s-\theta}{3}\right) = 0$$

Solving this yields the optimal Japanese subsidy (in terms of the European subsidy):

$$s^* = 150 - \frac{\theta}{4} \quad \{\text{Turns out 150 is the best Japanese subsidy, if there is no European subsidy}\}.$$  

c) Clearly, Europe has the same incentives as Japan – if subsidizing exports benefits Japan (because of the monopoly profits) then subsidizing exports can benefit Europe. However, if both subsidize exports, it is possible (inevitable, in the symmetric case) that both exporters will lose. On the other hand, the US benefits – as they say, it laughs all the way to the bank!

Not asked, but to find the equilibrium when both countries subsidize exports you would take European welfare (profits of the European firm less the cost of the subsidy), and maximize over $\theta$, the European choice variable:

$$W^c = \tilde{\pi}^c - s\tilde{q}^c = 5 \cdot \left(200 + \frac{2\theta-s}{3}\right)^2 - 5\cdot \left(200 + \frac{2\theta-s}{3}\right) = 5\left(200 + \frac{2\theta-s}{3}\right)\left(200 - \frac{s+\theta}{3}\right)$$

Maximizing yields:

$$\frac{dW^c}{d\theta} = \frac{10}{3} \left(200 - \frac{s+\theta}{3}\right) - 5 \left(200 + \frac{2\theta-s}{3}\right) = 0 \quad \theta^* = 150 - \frac{s}{4}$$

(the fact this looks like the Japanese rule should be obvious since the firms are identical and the governments have the same policy objectives). Solving:

$$\theta^* = 150 - \frac{s}{4}, \quad s^* = 150 - \frac{\theta}{4} \rightarrow \tilde{s} = \tilde{\theta} = 120. \quad \text{At this solution:}$$

$$\tilde{W}^c = \tilde{W}^j = \tilde{\pi}^c - s\tilde{q}^c = 5\cdot \left(200 + \frac{2\theta-s}{3}\right)\left(200 - \frac{s+\theta}{3}\right) = 5 \cdot 240 \cdot 120 = 144,000. \quad \text{Both countries lose because of the (joint) export subsidies but the US obviously gains.}$$