Exercises

Trade Policy

1. Home demand for good X is:

$$D(p) = 40 - 10p.$$

The supply curve is

$$S(p) = 10 + 10p.$$

Find the autarky equilibrium and the demand for imports.

Solution: Equating supply and demand yields:

$$D(p^A) = S(p^A) \implies p^A = 1.5, q^A = D(p^A) = S(p^A) = 25.$$

To obtain the demand for imports, we subtract supply from demand (always verify that we compare quantities)

$$D^i(p) = D(p) - S(p) = 40 - 10p - (10 + 10p) = 30 - 20p$$

The following curve represents Foreign's inverse of exports:

$$S^e(p) = 1 + 5p.$$

Find the international equilibrium price and the quantity exchanged.

Solution: Equating the demand for imports and the supply of exports:

$$D^i(p^w) = S^e(p^w) \implies 30 - 20p^w = 1 + 5p^w \implies p^w = 1.16.$$

Note that the international price is lower than the autarky price. At this price level, the quantity exchanged equals

$$q^w = D^i(1.16) = S^e(1.16) = 6.8.$$

If Home is a small open economy and imposes a specific tariff of $\tau = 0.1$ on imports, what price will consumers at home pay? How much will local producers receive? How does the tariff affect the government?

Solution: Because Home is small, the tariff does not affect international prices. Note: I am simplifying here because with only two countries, any tariff will have an effect, but let's pretend this is not the case.

Hence, the entire tariff will be passed on to consumers. After all, international sellers have other markets to which they could sell their products and get paid the international price. For this reason, international sellers are not willing to sell at Home and receive less than the international price. Consequently, they ask the international price plus the tariff. Consumers

pay this amount, the tariff goes to the government and international sellers receive the international price. Hence, the price paid by consumers is

$$p^w + \tau = 1.16 + 0.1.$$

Local producers know this, so they charge exactly the same price: if their price is higher, they sell zero, if the price is lower, they could gain more by charging more. Hence, local producers receive $1.16 + 0.1$. At this price level, local demand is:

$$D(p^w + \tau) = 40 - 10 \times (1.16 + 0.1) = 27.4.$$

Local supply is

$$S(p^w + \tau) = 10 + 10 \times (1.16 + 0.1) = 22.6.$$

Therefore, imports are $27.4 - 22.6 = 4.8$ We obtain the same result using the equation for the demand for imports:

$$D^i(p^w + \tau) = 30 - 20(1.16 + 0.1) = 4.8.$$

The government earns $\tau = 0.1$ for each imported unit, thus generating a revenue of

$$\tau D^i(p^w + \tau) = 0.1 \times 4.8 = 0.48.$$

Suppose now that Home is a large economy. Repeat the previous exercise.

Solution: if Home is a large economy, it influences the world price. To solve for the new international prices, we suppose that exporters pay the tariff (using any other method yields the same result). In particular, we know that the supply curve indicates willingness to sell, this is, the minimum amount of money at which a seller is willing to sell ζ units. First, it is useful to work with the inverse supply of exports curve, this is,

$$P^e(Q) = \frac{Q-1}{5}.$$

Because we assumed that exporters pay the tariff, an exporter will increase the price he asks to compensate the tariff. This is, according to the function, sellers were willing to sell 6 units at a price of $P^e(6) = \frac{6-1}{5} = 1$. In order to obtain 1 monetary unit after the transaction, an exporter will be willing to sell the 6 units at $1 + 0.1$: the tariff 0.1 goes to the government, and he keeps 1 as desired. Hence, after the introduction of the tariff, supply is now

$$P^e_\tau(Q) = \frac{Q-1}{5} + \underbrace{0.1}_{\tau} \implies S^e_\tau(p) = 1 + 5(p - \underbrace{0.1}_{\tau}).$$

Solving for the equilibrium level:

$$D^i(p^c) = S^e_\tau(p^c) \implies 30 - 20p^c = 1 + 5(p^c - 0.1) \implies p^c = 1.18.$$

This is the price paid by consumers. International sellers obtain $1.18 - 0.1 = 1.08$. This is, the world price falls from $p^w = 1.16$ to $p^c - \tau = 1.08$ and this is the amount exporters will obtain by selling the product in any country. Local producers sell their production at a price $p^c = 1.18$ for the same reason a before. Finally, imports are $D^i(p^c) = 30 - 20 \times 1.18 = 6.4$ and the government collects

$$\tau D^i(p^c) = 6.4 \times 0.1 = 0.64.$$

2. Under what conditions can a tariff or a tax on exports increase wellbeing?

   Solution: Trade instruments always represent a deadweight loss for small economies. However, large economies can benefit from the introduction of such instruments. The reason is that, by being large, they can influence the world price. For instance, a tariff on imports effectively reduces world demand, which pushes the international price down. Therefore, part of the burden of the tariff is passed to international sellers, who now obtain a lower price for their product.

   At the same time, the introduction of the tariff increases the local price of the product: local consumers pay more for the imports, which reduces the demand for imports. Simultaneously, the greater local price incentivizes local producers to enter the market, which further reduces the need to import from abroad (more local producers sell). Thus, consumers loss and producers gain.

   Finally, and crucially, the government earns the entire value of the tariff on each imported item. Because part of the price change accrued to international sellers, the distortion the tariff imposes on the local market is not as big as it would be for a small economy. It is possible that what the government earns compensates the losses introduced in the economy. We can also relate this discussion to the terms of trade: by manipulating international prices, a tariff can improve the terms of trade, reducing the price of the imports.

   Note 1: although local producers benefit from the tariff (they can sell at a higher price) this is bad for the economy because it encourages inefficient producers to serve the market, replacing efficient international sellers. It would be better if only the most efficient ones produced.

   Note 2: there is a limit on how large a tariff can be. In reality, the increase in wellbeing generated by a tariff has an inverse U-shape. For a small tariff, the gains are small. They increase up until a maximum and decrease afterwards. Moreover, once the tariff becomes too large, the economy is better off not trading at all and entering autarky. Since it is always possible not to trade, welfare under a tariff has a minimum: the welfare level that would prevail in autarky.

Note 3: part of the burden generated by a tariff is passed to exporters from foreign countries. The exact share depends on the elasticity of the demand for imports and the supply of exports.

Export taxes are similar, but operate in the reverse. In that case, they discourage local producers (who now export abroad) from selling abroad, effectively reducing the world supply and increasing the international price that foreign consumers pay. In that case, this measure benefits local consumers, who enjoy a lower price at the expenses of local producers making less money. As before, the government earns the tax on each item shipped abroad. Because the tax effectively changes international prices, part of the burden is suffered by foreign consumers, who now pay a higher international price (we do not care about them). As a consequence, the local price does not fall by as much as it would if the country were small. As before, we can relate that to a change in the terms of trade.

Note 4: Technically (and mathematically), all countries benefit from such instruments. However, gains are in general infinitesimal because a country can only affect international supply or demand by a small amount (as mentioned, the effect depends on elasticities). Only large economies can influence international supply or demand enough as to benefit from tariffs or export taxes.

3. In general, barriers to trade worsen economic wellbeing (except for large countries). However, many countries implement some protectionism under the argument of infant industry protection. In other cases, they are put in place because of political economy. Provide some examples and explain.

   Solution: The protection of infant industries argues that, before an industry becomes competitive internationally, it requires some protection to permits its development. Without the initial protection, producers at Home will never invest in the industry because international imports from mature countries are cheaper and of better quality. Therefore, if the industry has the potential to become internationally competitive, for instance because of a competitive advantage, then it makes sense to afford it protection from international competition, allowing it to grow. Once the infant industry has developed, it can compete at the international level.

   For instance, during the 80s, Brazil imposed tariffs on computers to protect this industry. As expected, tariffs increase the local price, hurting Brazilian consumers. At the same time, it allowed Brazilian computer manufacturers to earn more, because of the higher price. Ideally, import tariffs should have stimulated the development of a computer industry in Brazil. However, the policy was a fiasco: computer technology in Brazil stagnated and consumers had to pay a large premium for copies of low-tech foreign computers. In contrast, Canada protected its manufacturing industry during 1890 by imposing large tariffs. This allowed this industry to develop and become competitive with the US. A similar argument holds

for South Korea.

In contrast, rent-seeking within the frame of political economics tends to be harmful. This typically involves a small group of local producers that lobby politicians to protect their industry, for instance, sugar production in the USA. If a tariff on the import of sugar is imposed, this benefits local sugar producers, who can now sell at a higher price. At the same time, the effect of the tariff on the general population tends to be very small: the increase in the price consumers pay is insignificant. Thus, it is unlikely for the general population to protest against such a measure. Yet, the effect it has on sugar producers is large and, because they benefit from the protectionist measure, they campaign in favor of such tariffs.

However, at the aggregate level, we know that tariff protectionism tends to be harmful. In that sense, once we consider the additional price that each consumer pays, the total effect is larger than what sugar producers gain (this is what we do when we compute the change in consumers' and producers' surplus). Yet, because producers are few and very well organized, they can convince politicians to keep tariffs in place.

4. The World Trade Organization recommends against the use of import quotas and suggests these to be replaced by tariffs. Explain why quotas may have worse effects than an equivalent tariff.

   Solution: in general, tariffs and quotas are equivalent, this is, for a given tariff it is possible to compute the equivalent quota and vice-versa. However, this is only true under ideal conditions. Two cases provide a rationale in favor of tariffs.

   1: A growing economy. When an economy grows, its demand increases. After a quota is in place, local producers serve the residual demand, this is, the part of the demand that is not covered with imports. For instance, if local demand is $Q(p) = 10-p$ and a quota ϕ is in place, the residual demand is $Q^r(p, \phi) = 10-p-\phi$. This residual demand determines the equilibrium price. Hence, when a country grows, demand increases and so does the residual demand. If we assume that neither local supply nor the quota changes, the increase in residual demand is not matched by an increase in supply and the equilibrium price rises. This reduces consumers surplus. At the same time, because of the increase in price (and in demand), some local producers that before could not participate in the market now find this profitable. So, we are replacing efficient foreign producers for inefficient local producers: remember that they could not compete against the foreign suppliers. Instead, with a tariff, the increase in demand would translate as an increase in imports, with no further effects on prices.

   Note: the negative effect of the quota can be offset if we allow the quota to adapt to the demand increase. Alternatively, if local supply is also growing, the negative impact is also mitigated.

2: Imperfect competition at home. If the local market at home is served by a monopoly, it will maximize profits by equating marginal income to marginal cost.

First, we note that when the monopoly faces international competition, it loses its monopoly power. In fact, when foreign producers can sell at Home, the monopoly is no longer a monopoly. To see this, suppose that world price is p^w, and for the moment, let's assume free trade. Local consumers can: a) buy from the monopoly, or b) import the good at price p^w. If the monopoly charges more than p^w, it sells zero and makes zero profits. The reason is simple: consumers will prefer to import the good from abroad. At the same time, if the monopoly sold at a price lower than p^w, it could gain more by increasing its price until p^w. In that sense, international competition is competition for the monopoly, and it must adjust its behavior. This implies that it no longer holds any power: deviating from the international price means no profits.

Next, let's assume that a tariff is in place and that Home is a small, open economy. Essentially, nothing changes with respect to the free trade situation. We know that the price at home will increase to $p^w + \tau$, and thus the monopoly will be forced to sell at the price $p^w + \tau$. As before, deviating from it implies lower profits. In reality, the monopoly prefers the situation with the tariff, because the price increases. However, it still bears no monopoly power whatsoever.

In contrast, when a quota is in place, the residual demand can only be satisfied with local production. In this case, the monopoly retains its power on this part of the demand. To see why, imagine the situation of a consumer: if his demand is not covered from imports, he must buy from the monopoly. Hence, the monopoly will maximize its profits on this part of the demand. In a sense, the introduction of the quota creates a captive demand: either it buys from the monopoly, or it does not buy at all. Thus, in fact, the monopoly is can behave as a monopoly for the residual demand. Notice how, under free trade or tariffs, the monopoly operated, instead, under perfect competition. Finally, we shall mention that quotas are typically attributed to some local firms that can import from abroad. These firms will buy cheaply from abroad and sell at the same price as the monopoly, cashing the price difference.

5. Suppose that Home is a large economy that **exports** a good. Local demand and supply are given by:

$$D_h(p) = 10 - p$$

and

$$S_h(p) = 30 + 2p.$$

Compute Home's supply of exports.

Assuming that world demand for imports is

$$D^i(p) = 25 - p,$$

compute the equilibrium price and the quantity traded.

Solution: the supply of exports is given by

$$S_h^e(p) = S_h(p) - D_h(p) = 30 + 2p - (10 - p) = 20 + 3p.$$

Equating it to the demand for imports yields the equilibrium world price.

$$S_h^e(p^w) = D^i(p^w) \implies 20 + 3p^w = 25 - p^w \implies p^w = 1.25.$$

At this price level, exports are equal to

$$S_h^e(p^w) = 20 + 3 \times 1.25 = 23.75.$$

We can also compute exports by comparing local supply and demand:

$$S_h(p^w) = 30 + 2 \times 1.25 = 32.5, \quad D_h(p^w) = 10 - 1.25 = 8.75$$

and exports are $32.5 - 8.75 = 23.75$

If the government introduces an export subsidy of $s = 0.1$, how does it affect the prices received by Home exporters and the price paid by Home consumers?

Solution: Because the country is large, the introduction of a subsidy affects world supply. With the subsidy, exporters from Home are willing to accept a lower international price: the difference will be covered by the subsidy. This is, before the introduction of the subsidy, they were willing to sell at the price indicated by the inverse supply of exports function:

$$P^e(Q) = \frac{Q - 20}{3}.$$

For instance, Home producers will sell $Q = 50$ units at a price of 10. With the subsidy of $s = 0.1$ in place, this producer is ready to accept $10 - 0.1 = 9.9$ from a foreign customer because the government offers 0.1 for each exported unit. Thus, with the subsidy, the price at which Home exporters are willing to sell is:

$$P_s = \frac{Q - 20}{3} - \underbrace{0.1}_{s} \implies S_s^e = 20 + 3(p + \underbrace{0.1}_{s}).$$

Hence, the equilibrium price solves

$$S_w^e(p^f) = D^i(p^f) \implies 20 + 3(p^f + 0.1) = 25 - p^f \implies p^f = 1.175.$$

This is the price level that foreign consumers pay. However, Home exporters obtain $1.175 + 0.1 = 1.275$. Because exporters should be indifferent

between selling at home or exporting (gaining 1.275), consumers at Home pay $p^c = 1.175 + 0.1 = 1.275$. Thus, demand at Home is $D_h(p^c) = 8.725$, production at home is $S_h(p^c) = 32.55$ and exports are 23.825. The government thus pays $sS^e(p^c) = 23.825 \times 0.1 = 2.3825$ as subsidies. Overall, there is a reduction in surplus.

6. Suppose that Home is a small, open economy. Supply and demand for a good are

$$D(p) = 20 - p$$

and

$$S(p) = 1 + p.$$

Furthermore, assume that the international price p^w for this good is 3. The government has in place a specific tariff of value equal to $\tau = 0.5$. Compute the equivalent quota.

Solution: With the tariff in place, the price faced by Home consumers is $p^w + \tau = 3.5$ because the country is small. At this price level, demand is $D(3.5)20 - 3.5 = 16.5$. Home producers also earn 3.5, and they supply $S(3.5) = 1 + 3.5 = 4.5$ units. Thus, imports are $D(3.5) - S(3.5) = 16.5 - 4.5 = 12$. Consequently, a quota $\phi = 12$ will have the same effects as the tariff. Let's analyze it. With the quota, the residual demand is $D^r(p, \phi) = 20 - p - \phi$. Because $\phi 12 \implies D^r(p, 12) = 20 - p - 12 = 8 - p$. This residual demand will be satisfied by local producers. The equilibrium price solves:

$$D^r(p^\phi, 12) = S(p^\phi) \implies 8 - p^\phi = 1 + p^\phi \implies p^\phi = 3.5.$$

As we can see, the price level coincides with the one prevailing under the tariff. Hence, all distortions are the same (you can compute them or check graphically). Notice that holders of quota rights import the good at the international price $p^w = 3$ and sell it at the local price $p^\phi = 3.5$, gaining 0.5 per unit. Because the quota is 12 units, they import this amount and thus make $12 \times 0.5 = 6$.

Suppose now that the local producer at home is a monopoly. Compute the equilibrium price at home after the quota $\phi = 12$ is introduced.

Solution: The monopoly maximizes its profits by equating marginal revenue to marginal cost (the supply curve). Marginal revenue can be computed as the derivative of revenue with respect to quantity.

$$\text{Rev} = qP(q) = q(8 - q) = 8q - q^2$$

$$\text{MR} = \frac{\partial \text{Rev}}{\partial q} = 20 - 2q$$

Hence, the quantity the monopoly sells solves:

$$8 - 2q^M = q^N - 1 \implies q^M = 3$$

The corresponding price is $p^M = 8 - 3 = 5$. Clearly, this price is higher than the one prevailing under the tariff. Moreover, quota holders obtain higher profits because they still import goods at price 3 and sell at the price of 5. We can also check that, at a price 5 demand is $20 - 5 = 15$. This is covered by the imports the quota allows (12) and locally produced goods (3).

How should the quota change to have the same equilibrium price under the monopoly as under the tariff?

Solution: For a given quota level θ, the residual demand satisfied by the monopoly is

$$Q^r(p, \theta) = 20 - p - \theta \implies P(Q, \theta) = 20 - Q - \theta.$$

Hence, we can compute a generic version of the marginal revenue for any value θ.

$$\text{MR}(\theta) = \frac{\partial(20 - Q - \theta)Q}{\partial Q} = 20 - 2Q - \theta.$$

Therefore, the monopoly solves:

$$20 - 2Q - \theta = Q - 1 \implies Q^M(\theta) = \frac{21 - \theta}{3}.$$

The price level associated to this quantity is given by the inverse residual demand: $P^r(q, \theta) = 20 - \theta - q$. In particular, the quantity $\frac{21-\theta}{3}$ will be priced at

$$P^r\left(\frac{21 - \theta}{3}, \theta\right) = 20 - \theta - \frac{21 - \theta}{3} = 13 - \frac{2}{3}\theta.$$

Since we want the price to be equal to 3.5, we thus have

$$3.5 = 13 - \frac{2}{3}\theta \implies \theta = 14.25.$$

So, a quota of 14.25 will have the same effects as the tariff. Note how we need a larger quota to induce the monopoly to decrease its price level. Effectively, a larger quota reduces the residual demand, and as usual, a demand reduction implies a lower price.

7. Exercises relative to the Standard Trade Model. Discuss how the following events could affect the terms of trade and the wellbeing.

   a) Egypt exports cotton. A severe drought in Benin, another country that exports cotton, reduces its production.

Solution: The event reduces the world supply of cotton, thus its relative price with respect to any other good will increase. Because Egypt exports cotton, the rise in its relative price improves its terms of trade, and it will be positive for its economy. For Benin, the conclusions are not as straightforward. The economy certainly benefits from the increase in the relative price. However, it also produces and sells less cotton, so the total effects are ambiguous.

b) The USA exported oil. Recent technological improvements make exploiting shale oil feasible, increasing its supply.

Solution: For the US economy, this represents export-biased technological growth at Home (the US). The exploitation of shale oil increases its supply and the relative price of oil falls. Depending on the magnitudes, the event may be positive or negative for the economy. On the one side, the US economy will be able to export more oil. On the other, they will do so at a lower price. The net effect is likely to be positive, but we cannot be sure.

For other countries exporting oil, the US exporting shale oil is equivalent to export-biased growth at Home. After all, it is as if, let's say, Saudi Arabia was producing more oil. However, different from above, the implications are negative for the remaining oil producing countries: the price of the good they sell falls, but they are *not* producing more. Hence, this will reduce their terms of trade and negatively impact their economies.

Finally, for oil importers, the exploitation of shale oil in the US represents that the rest of the world is export-biased growing: they are growing in the sector they export. This has positive consequences on the economy because the relative price of the good we import decreases, improving our terms of trade.

c) France imports rubber to produce tires. The German company Bayer discovers synthetic rubber.

This represents export-biased growth in the rest of the world: foreign countries are growing in a sector they export. This will decrease the relative price of rubber, improving French terms of trade and raising wellbeing.

Note: the effect is also positive for Germany. Before synthetic rubber, the German economy did not produce nor sell any rubber. Hence, now it is able to export a previously non-exported product. This is perhaps surprising, because in general we would think that Germany experienced export-biased at home, but in fact it did not export anything before.

d) Great Britain exported textiles. The invention of the steam engine in the UK makes textile production much more efficient.

Solution: For the UK, Home is growing export-biased: it is possible to produce more of the goods it sells. This entails a decrease in the relative price of textiles, which reduces the UK's terms of trade. The total effect may be positive or negative, depending on whether the higher production or the lower price dominates.

e) Italy imports cars from abroad. Ferrari decides to produce affordable cars in Italy.

Solution: Home (Italy) is import-based growing because it produces more of the goods it imported. This will have positive effects on its economy:

the world relative demand of cars decreases, reducing its relative price and improving Italy's terms of trade. The effect on the Italian economy will be positive.