

Econ/EEP 181: International Trade
ASSIGNMENT #4 SOLUTIONS
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1. *The nation of Bermuda is “small” and assumed to be unable to affect world prices. It imports strawberries at the price of 10 dollars per box. The Domestic Supply and Domestic Demand curves for boxes are:*

$$S = 60 + 20P$$
$$D = 1160 - 15P$$

a) *Assume Bermuda is completely open to trade. What is equilibrium price and quantity consumed? How much is produced domestically, and how much is imported?*

ANSWER: When Bermuda is completely open up to trade, it will import strawberries because its autarky price of a box of strawberries is higher than the world price of a box of strawberries. Since Bermuda is a small country and is unable to affect world prices, it will import strawberries at the world equilibrium price, 10 dollars per box. The quantity consumed domestically is $D=1160-15*10=1010$. And domestic production will be $S=60+20*10=260$. Therefore, the quantity imported of the nation of Bermuda is $D-S=1010-260=750$.

b) *Now consider the effect of an import quota of 400 boxes. What happens to the price of strawberries and quantity consumed? How much is produced domestically, and how much is imported?*

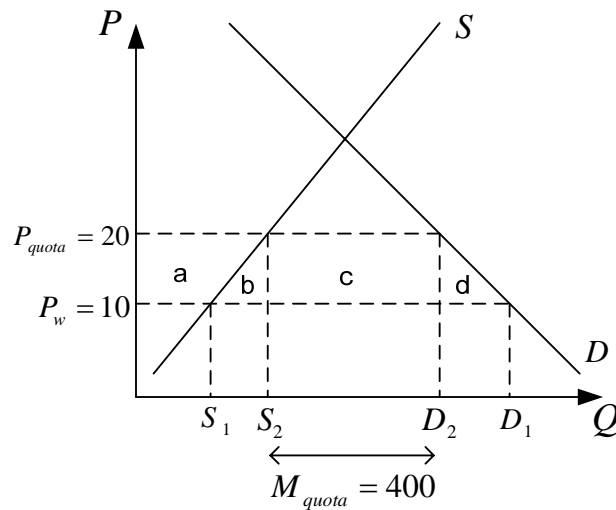
ANSWER: To figure out the effect of an import quota on the domestic price of strawberries, it is helpful to derive the import demand (ID) function for this small economy. We write ID as follows:

$$ID = D - S = 1160 - 15P - 60 - 20P = 1100 - 35P$$

Now, since there is an import quota of 400 boxes, the excess demand will decrease from 750 to 400. So, we have $ID = 400 = 1100 - 35P$. Solving for P, we will get the new domestic price of a box of strawberries which is 20. With $P = 20$, the quantity consumed is $D = 1160 - 15*20 = 860$ and quantity produced is $S = 60 + 20*20 = 460$. And the quantity imported of this country is $D - S = 860 - 460 = 400$, which is equal to the quantity allowed by the import quota.

c) *Who wins or who loses? Discuss consumers, domestic producers and importers (Be sure to compute quantitatively with numbers the change in their welfare).*

ANSWER: Since the introduction of an import quota increases the domestic price of strawberries from 10 dollars per box to 20 dollars, producers will gain but consumers will lose. If the government doesn't auction off the quota licenses, the quota rents will belong to distributors (in this case, importers). Please see the graph shown in the next page for the welfare analysis.



Welfare analysis:

Notice that the domestic price has gone up from 10 to 20 because of the import quota. D_1 and S_1 are representing the demand and supply when the domestic price is 10 dollars while D_2 and S_2 are representing the demand and supply when the domestic price increases to 20 dollars per box of strawberries.

Producer surplus: + a

Consumer surplus: - (a+b+c+d)

The quota rents belong to importers: +c

Net effect on Bermuda's welfare: - (b+d)

Now, we need to measure the areas of a, b, c, and d numerically. The areas of the boxes can be calculated using the formulas for parallelograms: Area = $\frac{1}{2}(\text{Base1} + \text{Base2}) \times (\text{Height})$, and Triangles: Area = $\frac{1}{2} \text{Base} \times \text{Height}$.

$$a = \frac{1}{2} * (S_1 + S_2) * (P_{quota} - P_w) = \frac{1}{2} * [S(P_w) + S(P_{quota})] * 10 = \frac{1}{2} * [(60 + 20 * 10) + (60 + 20 * 20)] * 10 = 3,600$$

$$b = \frac{1}{2} * (S_2 - S_1) * (P_{quota} - P_w) = \frac{1}{2} * [S(P_{quota}) - S(P_w)] * 10 = \frac{1}{2} * [(60 + 20 * 20) - (60 + 20 * 10)] * 10 = \frac{1}{2} * 200 * 10 = 1,000$$

$$c = (D_2 - S_2) * (P_{quota} - P_w) = 400 * 10 = 4,000$$

$$d = \frac{1}{2} * (D_1 - D_2) * (P_{quota} - P_w) = \frac{1}{2} * [D(P_w) - D(P_{quota})] * 10 = \frac{1}{2} * [(1160 - 15 * 10) - (1160 - 15 * 20)] * 10 = \frac{1}{2} * 150 * 10 = 750$$

Therefore, the producer surplus increase by 3,600 dollars; the consumer surplus decreases by 9,350 dollars; and importers' revenues increase by 4,000 dollars. The national welfare of Bermuda therefore decreases by 1750 dollars (the sum of the areas of b and d).

2. Assume California's supply and demand for beef is

$$D_C = 800 - 10P$$

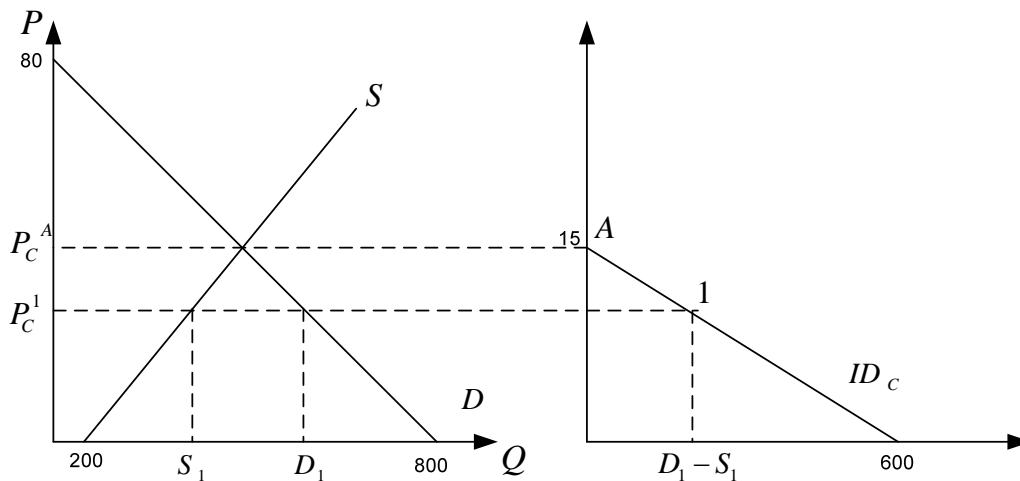
$$S_C = 200 + 30P$$

a) Derive and graph California's import demand schedule. If California's agricultural department outlawed purchasing out of state beef to prevent the slaughter of unhappy cows, what would the price of beef be (ie what is the price of beef in autarky)?

ANSWER:

California's import demand function (ID_C): $ID_C = D_C - S_C = 800 - 10P - (200 + 30P) = 600 - 40P$.

The figure below shows how to derive the import demand function graphically (Note: the figure is NOT to Scale).



If California's agricultural department outlawed purchasing out of state beef to prevent the slaughter of unhappy cows, the price of beef would be the autarky price. By equating D_C and S_C , we get

$$P_C^* = 15.$$

b) Now consider Nebraska, with the following demand and supply schedules for beef:

$$D_n = 100 - 5P$$

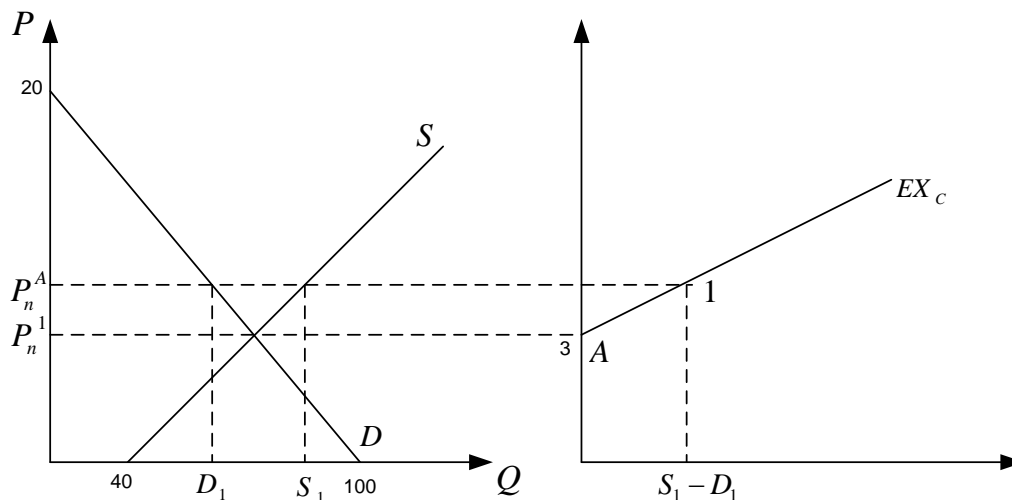
$$S_n = 40 + 15P$$

Derive Nebraska's export supply schedule and graph it. If Nebraska's agricultural department outlaws selling beef out of state, what would be the price of beef in the absence of trade?

ANSWER:

Nebraska's export supply function (EX_n): $EX_n = S_n - D_n = 40 + 15P - (100 - 5P) = -60 + 20P$.

The figure on the next page shows how to derive the excess supply function graphically.



If Nebraska's agricultural department outlawed selling beef out of state, the price of beef would be the autarky price. By equating D_n and S_n , we get $P_n^* = 3$.

c) Suppose that interstate sale of beef is permitted between California and Nebraska. What is the world price? What is the volume of trade?

ANSWER: If interstate trade is allowed, the world price is obtained by equating California's import demand function and Nebraska's export supply function. So,

$$\begin{aligned} ID_C &= EX_n \\ \Rightarrow 600 - 40P &= -60 + 20P \\ \Rightarrow P_w &= 11 \text{ and } Q_w = 160 \end{aligned}$$

Therefore, the world price is 11 dollars and quantity traded is 160.

d) What happens if California limits beef imports from Nebraska by adding a 15 percent tax? Calculate the effect of the tariff on (1) the price of beef in each state (2) the quantity of beef supplied and demanded in each state and (3) the volume of trade. Calculate the impact on the welfare of California consumers, producers, government revenue, and total welfare.

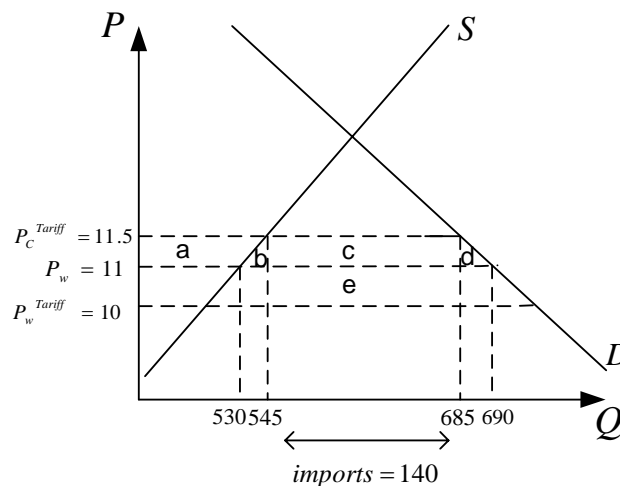
ANSWER: Let's look at what would happen to the world market first if California imposes a 15% ad valorem import tariff. With this import tariff, the import demand curve will shift in while the export supply will stay the same. Therefore, the new world equilibrium price will be driven down. To obtain the new world price and the new volume of trade, we equate the new import demand curve (ID_C^{Tariff}) and the previous export supply curve (EX_n).

$$\begin{aligned} ID_C^{Tariff} &= 600 - 40P(1 + 0.15) \\ EX_n &= -60 + 20P \\ \Rightarrow ID_C^{Tariff} &= EX_n \\ \Rightarrow P_w^{Tariff} &= 10 \text{ and } Q_w^{Tariff} = 140 \end{aligned}$$

Then, since there is a 15% ad valorem import tariff in California, the price of beef in California is $10(1+15\%) = 11.5$. The price of beef in Nebraska is just the new world price ($P_w^{Tariff} = 10$). To decide the quantity of beef supplied and demanded in each state, we need to plug the new prices in each state into their original demand and supply curves respectively. For California, $D_C^{Tariff} = 800 - 10 * 11.5 = 685$ and $S_C^{Tariff} = 200 + 30 * 11.5 = 545$. For Nebraska, $D_n^{Tariff} = 100 - 5 * 10 = 50$ and $S_n^{Tariff} = 40 + 15 * 10 = 190$. To summarize the results when there is a 15% ad valorem import tariff before preceding the welfare analysis,

	Price of beef	Quantity demanded	Quantity supplied	Volume of trade
California	11.5	685	545	140 (imports)
Nebraska	10	50	190	140 (exports)

Now, let's do the welfare analysis for California.



Since the domestic price increases from 11 to 11.5 because of the tariff, producers and the government gain while consumers lose. Producer surplus increases by the area of “a”, consumer surplus decreases by the sum of the areas of “a+b+c+d” and the government revenues increase by the sum of the areas of “c+e”. Then the net effect of the import tariff on the California’s welfare is the area of (e-b-d). Now, we need to measure these effects numerically.

$$a = 1/2 * (530 + 545) * (11.5 - 11) = 268.75$$

$$b = 1/2 * (545 - 530) * (11.5 - 11) = 3.75$$

$$c = 140 * (11.5 - 11) = 70$$

$$d = 1/2 * (690 - 685) * (11.5 - 11) = 1.25$$

$$e = 140 * (11 - 10) = 140$$

Therefore, producer surplus increases by 268.75 dollars, consumer surplus decreases by 343.75 dollars and the government revenues increase by 210 dollars. The net effect on welfare is positive (135 dollars).

3. Import Tariff in Partial Equilibrium

Home's demand and supply for cars are given by: $D = 130 - 30 \cdot P$ and $S = 10 + 30 \cdot P$, while Foreign's demand and supply for cars are: $D^* = 60 - 30 \cdot P$ and $S^* = 40 - 30 \cdot P$ (P is thousands of US\$). Assume both Home and Foreign are large countries.

a) Home imposes a specific tariff of $t=0.4$ per car. Calculate and depict the price that Home consumers pay. Show domestic consumption, production and the trade volume.

Answer: We have already found the Import Demand (for home) and Export Supply (for foreign) from Problem Set 3, as well as the equilibrium in trade with no commercial policies. These are given by,

$$MD(P) = 120 - 60P \text{ and } XS(P) = -20 + 60P$$

$$P = 7/6 = 1.1\bar{6} \text{ and } D(1.1\bar{6}) = 95, S(1.1\bar{6}) = 45, MD(1.1\bar{6}) = 50$$

When solving for equilibrium with the tariff we still set $MD=XS$, except we now have to recognize that the two countries will make decisions based on different prices. Since Home imports cars, the price they see, P_h , is the price in MD , while Foreign's price, P_f , is the price in XS , and a tariff implies that $P_h = P_f + 0.4$. Solving for P_h gives,

$$MD(P_h) = XS(P_h - 0.4)$$

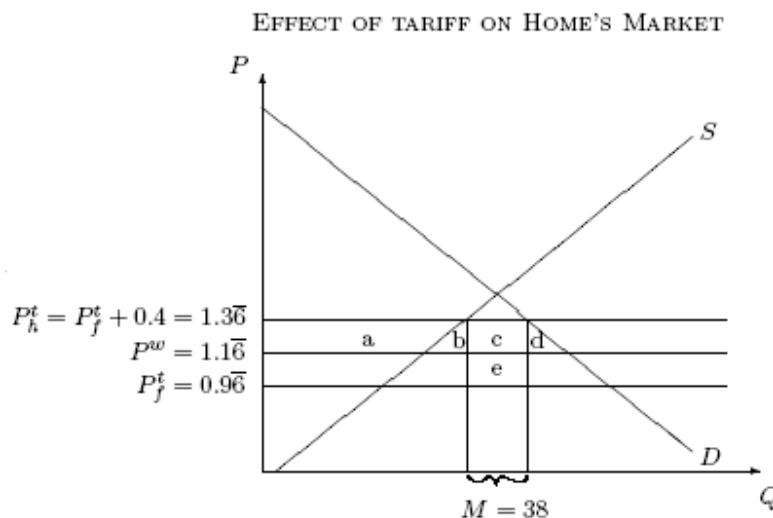
$$120 - 60(P_h) = -20 + 60(P_h - 0.4) \Rightarrow$$

$$\Rightarrow P_h = 41/30 = 1.3\bar{6}, P_f = 29/30 = 0.9\bar{6}, D(1.3\bar{6}) = 89, S(1.3\bar{6}) = 51, MD(1.3\bar{6}) = 38.$$

Notice, because both countries are large, there was a TOT gain for home (the price of Home's imports, and Foreign's exports fell), and total imports fell.

b) Show graphically how the tariff affects Home welfare. Distinguish Home consumer surplus, producer surplus and government revenue providing exact numeric amounts.

Answer: The effect on Home's welfare can be seen in the following diagram.



We can calculate the welfare effects by using the numbers for demand, supply, and imports in the initial equilibrium and the new numbers from trade. The areas of the boxes can be calculated using the formulas for parallelograms: Area = $\frac{1}{2}(\text{Base1} + \text{Base2}) \times (\text{Height})$, and Triangles: Area = $\frac{1}{2} \text{Base} \times \text{Height}$, and are given alongside the welfare analysis in the following table.

Areas		Welfare Analysis		
a	$\frac{1}{2}(45+51)(1.36-1.16)=9.6$	Cons. Surp.	-a-b-c-d	(-18.4)
b+d	$\frac{1}{2}(1.36-1.16)(50-38)=1.2$	Prod. Surp.	+a	(+9.6)
c	$38(1.36-1.16)=7.6$	Govt. Rev	c+e	(+15.2)
e	$38(1.16-0.96)=7.6$	Welfare Change:	e-b-d	(+6.4)

c) Did the tariff improve efficiency? Show the net efficiency gain or loss graphically.

The final welfare change is determined by the difference between the TOT gain, area e, minus the efficiency losses, areas b+d. In this case, we see the overall welfare change is positive at +6.4.

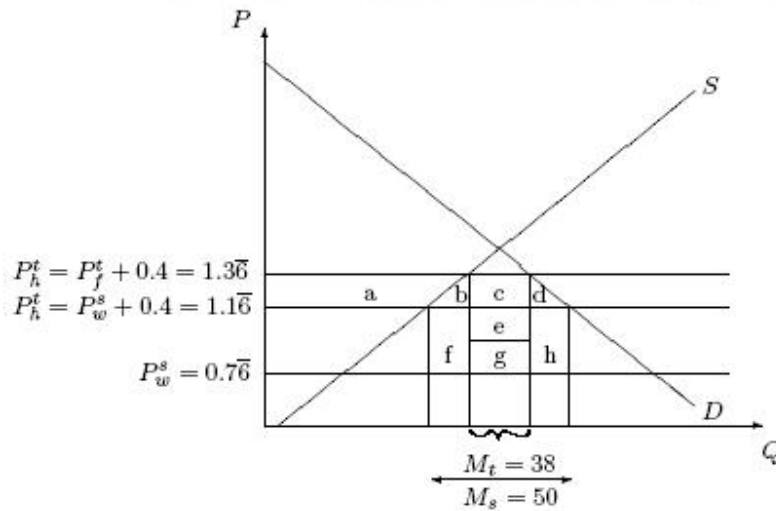
4. Export Promotion in Partial Equilibrium

Consider the two countries from the previous question. Home has a tariff of $t=0.4$ per car in place. The Foreign government decides to grant an export subsidy of $t=0.4$ per exported car.

a) How does this subsidy affect Home welfare, providing specific amounts of consumer surplus, producer surplus, government revenue, and the change in welfare?

Answer: Since both countries are large, the subsidy will cancel out the effect of the tariff. To see this, imagine there is a world price, P_w , at which Home and Foreign exchange cars. However, at Home, consumers and producers actually face the price $P_h = P_w + t$. In Foreign, consumers and producers actually face the price $P_f = P_w + s$, where s is the size of the export subsidy. Since $t=s$, $P_h = P_f$. So, we return to the initial trade equilibrium of $P_h = P_f = 1.16$, and $MD(1.16) = XS(1.16) = 50$. Note, the world price at which goods are traded is $P_w = 0.76$. The graphical effect on Home's welfare can be seen in the following diagram.

EFFECT OF TARIFF AND SUBSIDY ON HOME'S MARKET



To do the analysis, notice that the areas, a, b, c, d, and e are the same from the previous problem, but we now have the new areas f, g, and h. Calculating these new values, and using the old values from the previous problem, the welfare effects for Home are given in the following table.

Areas	Welfare Analysis
f+h (50-38)(0.4)=4.8	Cons. Surp. +a+b+c+d (+18.4)
g (38)(0.96-0.76)=7.6	Prod. Surp. -a (-9.6)
h	Govt. Rev -c+f+g+h (4.8)
	Welfare
	Change: b+d+f+g+h (+13.6)

So, we see that Home is much better off with a Foreign subsidy. From the initial equilibrium of no commercial policies, it is as if Home is getting government revenue of $e+f+g+h$, which is like a direct transfer from the foreign country's government of the amount imported times the tax, or $50 \times 0.4 = 20$.

b) Show the changes to surpluses and tax revenues for Foreign

For this problem, we are simply going to look at the change in welfare from the initial equilibrium with no commercial policies. Since the price that Foreign faces is the same as the initial equilibrium, there is no effect on consumer and producer surplus. The only difference is that the Foreign government now has to pay a subsidy on the amount of exports. We know that $X_S = 50$, which means the government pays $50 \times 0.4 = 20$, without affecting consumer or producer surplus. Note the gain in the Home country from no commercial policies (+6.4 from the tariff and +13.6 from the subsidy) is given by this exact amount.