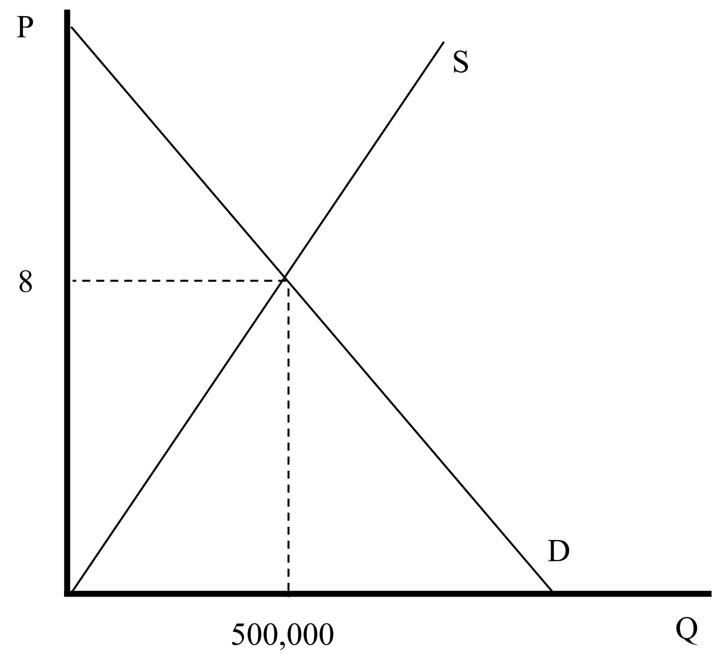
# Lecture # 11 – Case #1: Rice Imports in Pacifica

The calculations for this case combine two tools that we developed in class. To begin, you will use supply and demand diagrams to illustrate each policy and identify the areas that represent consumer surplus, producer surplus, subsidy, and deadweight loss. These will show you the changes between each policy. However, the diagrams by themselves will not provide the numbers needed to analyze the case. To get these numbers, you will use the elasticity formulas. The illustrations will help you determine which calculations you need to do.

Let's begin with the simplest case: *simply removing the trade ban*.

Before the trade ban, the country's demand and supply curve are as drawn below.

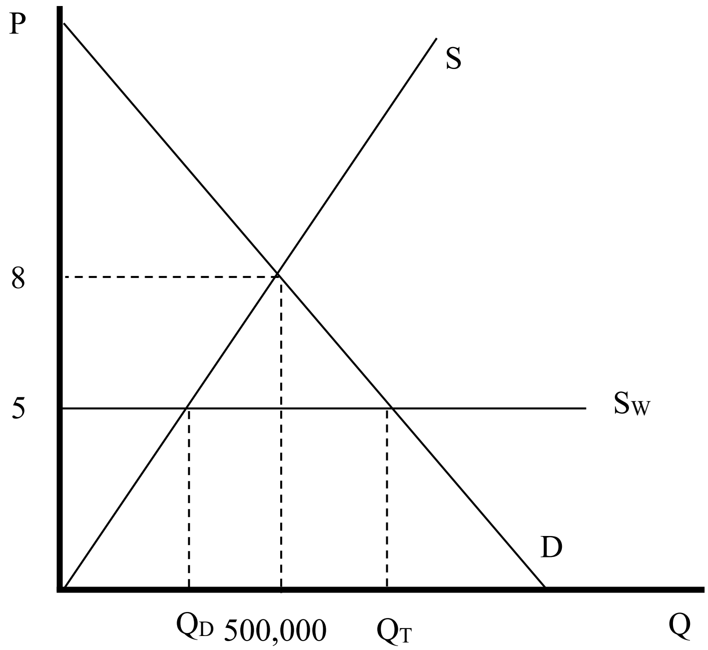
**Figure 1**




Based on the data we are given, both supply and demand are inelastic. Thus, I have drawn both supply and demand as rather steep curves. Here, the supply curve represents only the rice that local farmers are able to produce.

Because this is a small open economy, we can treat the country as a price taker. Thus, once the trade ban is removed, the country becomes a price taker of rice. It faces a horizontal supply curve ($S_W$) at $5, the world price of rice.

**Figure 2**




The total quantity of rice demanded by farmers at a price of \$5 is $Q_T$. Local farmers will produce as much rice as possible at the world price ($Q_D$), and imports from other countries will provide the remaining demand. Thus, imports equal $Q_T - Q_D$.

To find these values, we need to apply the elasticity formula. Let's first find the total quantity of rice purchased by consumers ($Q_T$). Consumers move down the demand curve from their initial consumption of 500,000 bags of rice at a price of \$8 to the new total at the price of \$5. Begin with the standard elasticity formula:

$$\varepsilon_D = \frac{\%\Delta Q}{\%\Delta P} = \frac{\Delta Q / Q}{\Delta P / P} = \frac{\Delta Q}{\Delta P}\frac{P}{Q}$$

We know the initial price (\$8), the change in price (\$3), the initial quantity (500,000) and the price elasticity of demand (-0.5). Thus, we need to solve for $\Delta Q$:

$$\Delta Q = \frac{\varepsilon_D (Q)(\Delta P)}{P} = \frac{-0.5(500{,}000)(-3)}{8} = 93{,}750$$

This tells us that quantity will increase by 93,750 bags. Adding this to the original 500,000 bags consumed gives us a new total of **593,750**.

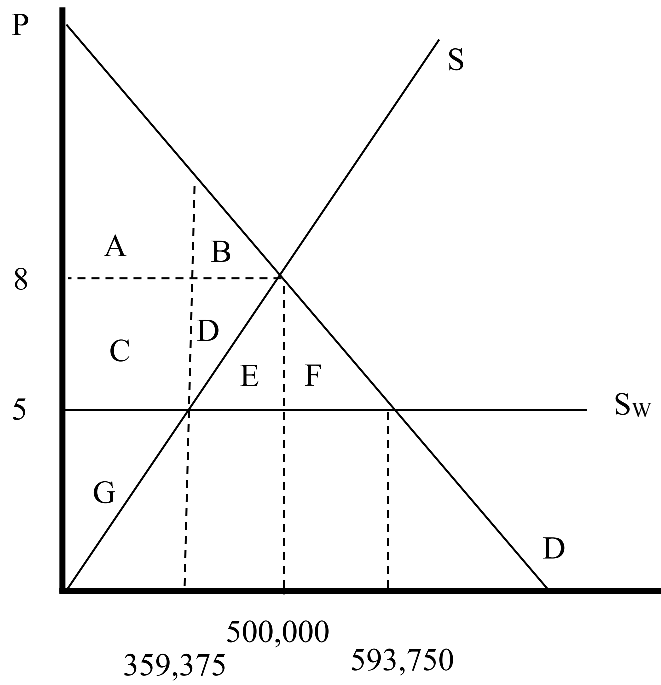
To find the amount of rice produced by local farmers, we need to find $Q_D$. Here, suppliers move down the supply curve to the new price of \$5. Thus, we use the elasticity of supply. As before, we solve for $\Delta Q$:

$$\Delta Q = \frac{\varepsilon_S (Q)(\Delta P)}{P} = \frac{0.75(500{,}000)(-3)}{8} = -140{,}625$$

Since the change in quantity is -140,625, we subtract this from 500,000 to find the total rice produced by local farmers, which are **359,375** bags of rice.

We now have the information we need to find the change in consumer and producer surplus, as well as the net change in total welfare.

**Figure 3**




We'll begin by finding the areas that represent consumer and producer surplus before and after the policy change:

| | **With import ban** | **With free trade** | **Change** |
|---|---|---|---|
| consumer surplus: | AB | ABCDEF | CDEF |
| producer surplus: | CDG | G | -CD |
| TOTAL | ABCDG | ABCDEFG | EF |

Since we don't know the y-intercept of the demand curve, we will not calculate the total consumer and producer surplus for each case. Rather, we will just calculate the changes, which is all we are asked for in the case.

The gain to consumers is areas CDEF. This is the area of a rectangle (CDE) plus the area of a triangle (F):
$\Delta$CS = area(CDE)+ area(F) = 3 x 500,000 + 0.5 x 3 x (593,750 – 500,000) = 1,640,625

The loss to producers is areas CD. This is the area of a rectangle (C) plus the area of a triangle (D):
$\Delta$PS = area(C)+ area(D) = 3 x 359,375 + 0.5 x 3 x (500,000 – 359,375) = 1,289,062.50

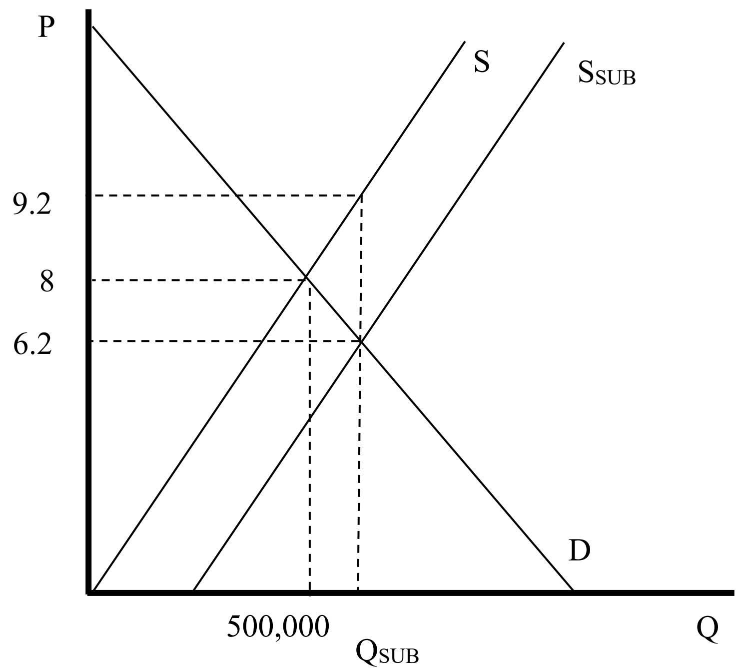
The welfare gain is the difference between these, or $351,562.50. As a check, notice that this is also the area of the triangle EF:
net welfare change = area(EF) = 0.5 x 3 x (593,750 – 359,375) = 351,562.50.

To summarize:

| | Plan A: remove import ban | Plan B: $3 subsidy per bag | Plan C: remove import ban & $3 subsidy/bag |
|---|---|---|---|
| Quantity purchased by consumers | 593,750 | | |
| Quantity produced by local farmers | 359,375 | | |
| Total quantity of rice imported | 234,375 | | |
| Change in consumer surplus | $1,640,625 | | |
| Change in producer surplus | -$1,289,062.5 | | |
| Revenue for subsidy | N/A | | |
| Net welfare gain | $351,562.50 | | |

The next policy to consider is the *$3 subsidy per bag of rice*. Under this plan, imports would still be banned, so it is only domestic supply that matters. Because the subsidy will be paid to farmers, the subsidy shifts out their supply curve, as shown below.

**Figure 4**




We are told that consumers pay $6.20 per bag of rice under the subsidy with the import ban. Thus, farmers must receive $3 more, or $9.20. The only number that we need to calculate is the new quantity, $Q_{SUB}$. Once again, we use an elasticity formula. I use the elasticity of demand formula below:

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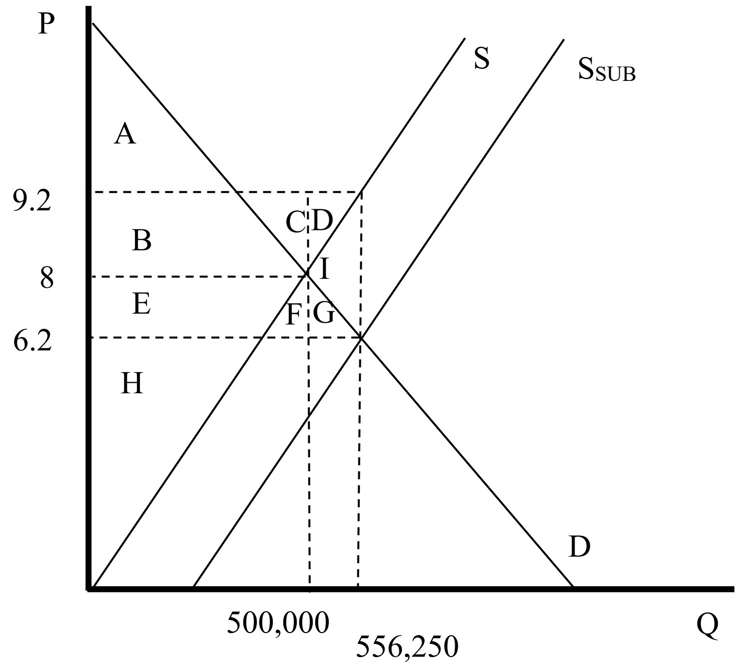
$$\Delta Q = \frac{\varepsilon_D(Q)(\Delta P)}{P} = \frac{-0.5(500{,}000)(-1.8)}{8} = 56{,}250$$

The only change from our earlier calculation is that the change in price is lower. You would get the same answer if you used the elasticity of supply and the price change faced by suppliers:

$$\Delta Q = \frac{\varepsilon_S(Q)(\Delta P)}{P} = \frac{0.75(500{,}000)(1.2)}{8} = 56{,}250$$

Thus, the total quantity of rice consumed and produced by local farmers is **556,250**. We now have enough information to calculate the changes in welfare:

**Figure 5**




| | **Before subsidy** | **After subsidy** | **Change** |
|---|---|---|---|
| consumer surplus: | AB | ABEFG | EFG |
| producer surplus: | EH | BCDEH | BCD |
| cost to government: | -- | -BCDEFGI | -BCDEFGI |
| TOTAL | ABEH | ABEH - I | -I |

As before, we simply calculate the areas in the last column. The change in consumer surplus is the area of a rectangle (EF) plus the area of a triangle (G):
$\Delta$CS = area(EF)+ area(G) = 1.8 x 500,000 + 0.5 x 1.8 x (556,250 – 500,000) = \$950,625

Similarly, the gain of producer surplus is the area of a rectangle (BC) plus the area of a triangle (D):
$\Delta$PS = area(BC)+ area(D) = 1.2 x 500,000 + 0.5 x 1.2 x (556,250 – 500,000) = \$633,750

Notice that some of the areas of consumer and producer surplus overlap. This is because those welfare gains come from revenue paid by the government. This is just a transfer, rather than a true welfare gain, as it is money that comes from taxpayers. The subsidy payment equals \$3 times the total rice purchased. This is a rectangle with area BCDEFGI:
cost to government = area(BCDEFGI) = 3 x 556,250 = \$1,668,750.

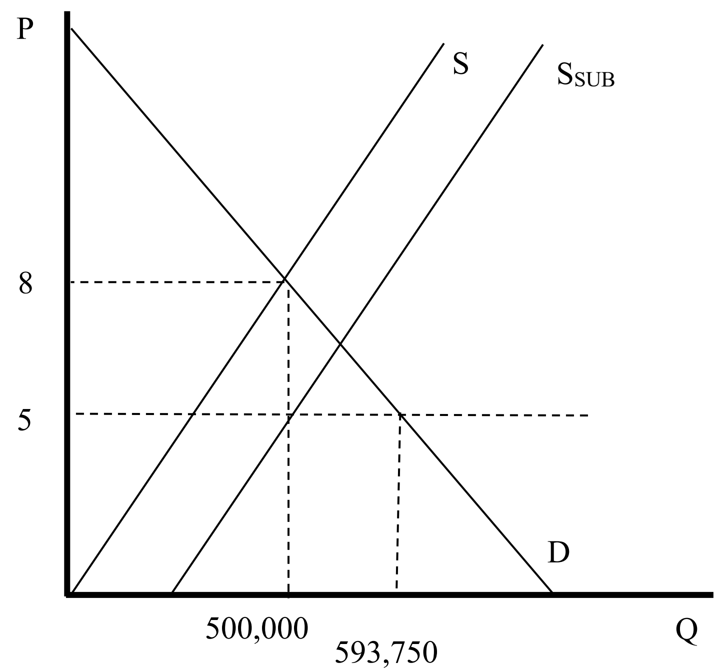
The net welfare gain or lost is the sum of consumer and producer surplus minus the revenue payments. Note that the gain to consumers and producers is just $1,584,375. This is less than the cost of the subsidy to taxpayers. Thus, there is a net welfare loss of $84,375. To check your work, note that is the same as area I on the diagram (= 0.5 x 3 x 56,250).

To summarize:

| | Plan A: remove import ban | Plan B: $3 subsidy per bag | Plan C: remove import ban & $3 subsidy/bag |
|---|---|---|---|
| Quantity purchased by consumers | 593,750 | 556,250 | |
| Quantity produced by local farmers | 359,375 | 556,250 | |
| Total quantity of rice imported | 234,375 | 0 | |
| Change in consumer surplus | $1,640,625 | $950,625 | |
| Change in producer surplus | -$1,289,062.5 | $633,750 | |
| Revenue for subsidy (cost to taxpayers) | N/A | -$1,668,750 | |
| Net welfare gain | $351,562.50 | -$84,375 | |

The final policy combines *removing the import ban with the $3 subsidy per bag of rice*. Here, the analysis is a bit more complicated. The subsidy still shifts the supply curve out. However, once the country opens rice markets to free trade, rice will sell at the world price of $5 per bag. Thus, consumers pay $5 per bag of rice. Because of the subsidy, farmers receive $8 per bag of rice. Since this is the same price as before, they continue to produce the same 500,000 bags that they sold when the import ban was in place.

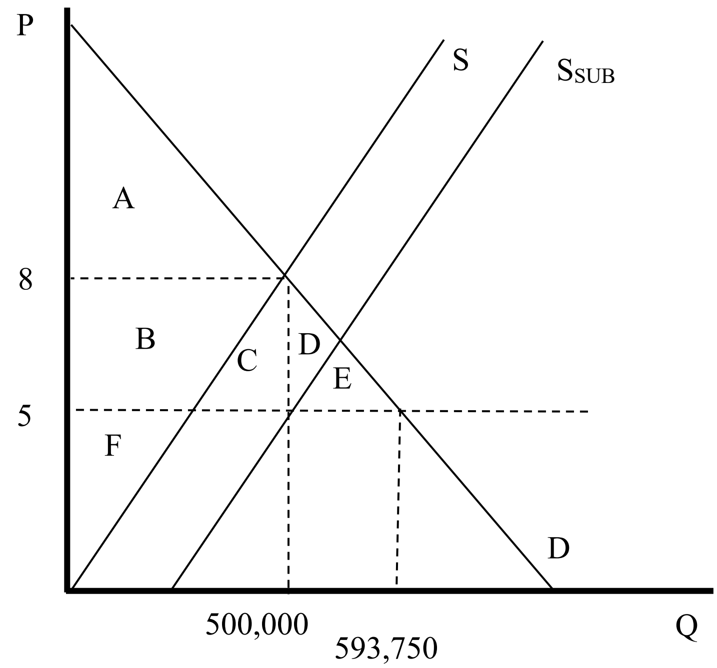
**Figure 6**




There are no new quantities to solve for in this case. We already know, from analyzing the first policy option, that consumers will purchase 593,750 bags of rice when the price is $5. What is different in this case is that farmers continue to produce 500,000 bags of rice. Thus, just 93,750 bags of rice are imported.

As before, we can use this graph to analyze the changes in welfare:

**Figure 7**




| | Import ban | Free trade & subsidy | Change |
|---|---|---|---|
| consumer surplus: | A | ABCDE | BCDE |
| producer surplus: | BF | BF | -- |
| cost to government: | -- | -BC | -BC |
| TOTAL | ABF | ABDEF | DE |

Compare this result to the graph where the import ban is lifted, but there is no subsidy. In that case, the total welfare gain is larger (area C from this graph would be included). However, removing the import ban made producers worse off. Here, the subsidy counteracts the producers' losses. However, because of the costs of transferring revenues to the farmers, the total welfare gain is smaller than with free trade only.

We can calculate the value of these welfare changes as before. The gain to consumers is a rectangle (areas BC) plus a triangle (areas DE). This value is the same as their gains with free trade only:
$\Delta$CS = area(BC)+ area(DE) = 3 x 500,000 + 0.5 x 3 x (593,750 – 500,000) = $1,640,625

There is no change in producer surplus. However, there is a cost to taxpayers from the transfer to producers. This cost is a rectangle (areas BC), and represents $3 paid to producers for each of the 500,000 bags of rice they produce:
cost to government = area(BCDEFGI) = 3 x 500,000 = $1,500,000.

Since domestic farmers grow less under this policy than they do with the subsidy alone, the cost of the subsidy is slightly smaller. However, this cost does negate part of the gains to consumers, so that the net welfare gain is only $140,625. This is just 40% of the welfare gain achieved by free trade alone.

To summarize:

| | Plan A: remove import ban | Plan B: $3 subsidy per bag | Plan C: remove import ban & $3 subsidy/bag |
|---|---|---|---|
| Quantity purchased by consumers | 593,750 | 556,250 | 593,750 |
| Quantity produced by local farmers | 359,375 | 556,250 | 500,000 |
| Total quantity of rice imported | 234,375 | 0 | 93,750 |
| Change in consumer surplus | $1,640,625 | $950,625 | $1,640,625 |
| Change in producer surplus | -$1,289,062.5 | $633,750 | 0 |
| Revenue for subsidy (cost to taxpayers) | N/A | -$1,668,750 | -$1,500,000 |
| Net welfare gain | $351,562.50 | -$84,375 | $140,625 |

Thus, we observe a tradeoff between these policies. The most efficient policy (e.g. the one with the largest welfare gain) is plan A: simply removing the import ban. However, the welfare gain is not shared by everyone. Consumers benefit greatly, while producers suffer a loss that is just slightly smaller.

Plan B, subsidizing rice while maintaining the import ban, makes things worse. More rice is produced, so that both consumers and producers are better off. However, this comes at the expense of taxpayers, who must pay the cost of the subsidy. The loss occurs because for the last bags of rice sold, the true value to consumers (measured by the demand curve) is less than the true marginal cost to producers (measured by the *original* supply curve). It is only because of the subsidy that these bags are produced. This loss is shown as area I in Figure 5.

Plan C, lifting the import ban and subsidizing rice, improves welfare, but not as much as Plan A. However, because it subsides farmers, it compensates them for the losses that they incur under Plan A. Thus, some of the gains from trade are used to compensate farmers for their losses, so that they are made no worse off by opening markets to trade.