Agricultural markets throughout the world are often subject to intervention by government policies with the purpose of raising the prices farmers receive for their product. Typically, this new price is above the equilibrium price that would have occurred in an unregulated market, which we know causes an excess supply and market forces will want to push the prices back down to the equilibrium level. There are generally two ways that government policies work against these market forces. One approach operates on the demand side, while the second approach is on the supply side.

- **Demand Side** - This approach attempts to somehow raise demand so that the excess supply is bought by someone. One example that we talked about in detail during class was the use of subsidies while an alternative demand-side approach is for the government to directly buy the excess supply and thereby add to the demand. In the United States farm policies typically operate on the demand side which cost United States taxpayers billions upon billions of dollars each year.

- **Supply Side** - Policies which operate on the supply side are called *supply management* policies because they limit how much each farmer can produce, thus preventing the excess demand from ever being made. The remainder of this case study explains how the policy works for the dairy industry, specifically the Canadian dairy industry quota system.

In order to sell milk in Canada, a farmer needs to own *quota* which is a legal right created by the government to produce the product, in this case milk, which limits the supply. Therefore, the more milk a farmer wants to sell, the more quota a farmer needs. To exposit the idea of the quota system we will use the following simple numerical example.

- The equilibrium price of the unregulated market is $P^* = $5 which corresponds to $Q^* = 5$ units of milk production. The numbers of this example are not realistic but make for simple calculations, also note that I have not defined the units for the quantity of milk, but you can make it gallons for simplicity.

- The government has a goal of raising the price received by dairy farmers to $P^S = $7. Then looking at Figure 1 on the following page it should be clear the the quantity supplied would then be $Q^S = 7$ while the quantity demanded is $Q^D = 3$ which would result in an excess supply of 4 units.
Figure 1. Market for Milk

NOTE: As you look at the figure above you should be able to explain how much of a subsidy would need to be paid by the government in order to assure that the producers of milk receive $P^S = $7.

Now continuing with our numerical example lets suppose that the government limits the amount of the quota to $Q^{Quota} = 3$. This means that the quantity of milk produced in the market is now $Q^S = 3$. In order to determine the price we look at the demand curve and evaluate demand at the quota quantity. The price of milk on the demand curve when the quantity of milk is $Q^{Quota} = 3$ is $P^{Quota} = $7. So $7 is the price of milk under this quota system.

When the supply management system was set up in Canada 40 years ago, the quota rights were initially distributed for free to the dairy farmers in the industry at the time. The rights became an asset that the dairy farmers could buy and sell amongst themselves. Quota are traded in a Quota Exchange, a market organized by the farmers themselves. Click here, for more information on the exchange operated by the Dairy Farmers of Ontario.

The price of a quota unit on the Ontario quota exchange is currently $25,000 (in Canadian dollars). This quota entitles the holder to sell each day an amount of milk with one kilogram of butterfat in it. This is approximately 7 gallons of milk which is the amount one cow can produce each day. The price of this amount of milk at the “farm gate” in Ontario is currently about $10 (Canadian), or about $1.40 a gallon. At the “farm gate” means what the farmer gets paid, not the retail price. Supply management policies in Canada have been successful in keeping milk prices high. Canada’s farm-gate prices are more than twice ”the world price,” the price Canada would pay if they imported milk.

The $25,000 cost of quota per cow is the most expensive part of being in the dairy business in Canada. One can get a sense of this by looking at farm real estate listings. Click here for a description of a farm for sale in Ontario that comes with everything: land, modern dairy barn, the milking herd and a living residence. Importantly, also included with the deal are 282.9 units of quota. The
purchase price listed for this farm is $18 million. But the quota itself is worth $7.1 million (or $25,000 times 282.9 units of quota). So 40% of the entire farm is the quota, which gives them the right to produce milk.

At this point I hope that everyone sees that we now have the following two markets:

- *The market for milk.* This is the market where the dairy farmer can sell the milk which he has produced.
- *The market for quota.* This is the market where the dairy farmer can sell quota or the right that he owns to produce.

Now let’s return to our numerical example. We have chosen the quota amount, $Q = 3$ such that the price of milk is $7. Our next step is to figure out the price of a unit of quota that need to sell a unit of milk. I will first explain the rule to use for determining the price of the quota, then I will give some motivation on why this rule makes sense. To calculate the price of the quota, draw a vertical line at the quota quantity (The orange line in Figure 1). Take the point where it intersects the demand curve, $7$, and subtract this from the point where it intersects the supply curve, $3$. The difference is the equilibrium quota price

$$\text{P}_{\text{Quota}} = \text{P}_{\text{Demand}} - \text{P}_{\text{Supply}} = 7 - 3 = 4$$

Let’s use the notation $C_{\text{Marginal}}$ to represent the cost of the last producer in when the quantity of milk is 3. Then another way to state the rule is that the equilibrium quota price equals the price of milk minus $C_{\text{Marginal}}$.

To explain why this works, we first need to make an argument about how profit-maximizing farmers will behave in this industry. The economic idea of *opportunity cost* plays a big role in this argument. Consider a farmer who is thinking about being in the dairy business. If the farmer did not inherit any quota from her parents, then she will naturally factor the cost of the quota into her decision of whether to be in the industry. But even a farmer who inherited a quota must consider the opportunity cost of using the quota for herself rather than selling the quota in the quota exchange. In this context we would calculate the profit received from selling milk as the price that milk sells for minus the price of the quota on the quota exchange, because this is the opportunity cost of using the quota for her business. Then the profit received from selling quota is the price of the quota on the quota exchange if she was lucky enough to inherit some quota.

Hopefully, we now have an understanding of why the quota market exists, but now we want to further discuss why the price of the quota is equal to $4. To do this we will want to look at the *marginal producer* in the industry who has a production cost of $C_{\text{Marginal}} = 3$. This is her cost of feeding cows and maintaining equipment necessary in the production of milk. As I stated above the opportunity cost of using the quota should also be factored in which brings her total cost to $7 = 4 + 3$ and this exactly offsets the milk price of $7$. So this producer would just break even. Now let’s look at the two cases where the price of the quota is greater than $4 and less than $4.
• The quota price is greater than $4
If this was the case then the marginal producer who had production costs of $C_{\text{Marginal}} = 3$ would no longer want to produce milk because now her total cost would exceed $7$ which is the price milk is selling for. She would prefer to sell her quota and the number of quota that people would want would be less than three. This means that the supply of 3 units of quota would exceed the demand for quota causing a surplus which causes the price of the quota to decrease.

• The quota price is less than $4$
If this was the case then the marginal producer who had production costs of $C_{\text{Marginal}} = 3$ would produce milk at a positive profit because now her total cost would be less than $7$ which is the price milk is selling for. Since she is now making a profit so would another farmer with production costs that are just a little bit higher than the marginal producer’s production costs. This means that the demand for quota would exceed the supply of 3 units of quota causing a shortage of quota which causes the price of the quota to increase.

Table 1 and Figure 2 analyzes the impact which occurs when the government imposes a quota system on the Total Surplus in the economy and the division of this surplus among producers, consumers and the owners of the quota. In constructing the table, I have divided the farmers profit into two categories, profit from selling milk (denoted $PS^{\text{Milk Business}}$) and the profit from owning quota (denoted $PS^{\text{Quota Business}}$). Profit in the quota business equals the number of quota units times the price of each quota unit, $4 \times 3 = 12$.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Free Market</th>
<th>Quota Policy</th>
<th>Change from Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P^{\text{Milk}}$</td>
<td>5</td>
<td>7</td>
<td>+2</td>
</tr>
<tr>
<td>$Q^{\text{Milk}}$</td>
<td>5</td>
<td>3</td>
<td>-2</td>
</tr>
<tr>
<td>$P^{\text{Quota}}$</td>
<td>0</td>
<td>4</td>
<td>+4</td>
</tr>
<tr>
<td>$CS$</td>
<td>12.5</td>
<td>4.5</td>
<td>-8</td>
</tr>
<tr>
<td>$PS^{\text{Milk Business}}$</td>
<td>12.5</td>
<td>4.5</td>
<td>-8</td>
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<tr>
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<td>12</td>
<td>+12</td>
</tr>
<tr>
<td>$PS^{\text{Combined}}$</td>
<td>12.5</td>
<td>16.5</td>
<td>+4</td>
</tr>
<tr>
<td>$TS$</td>
<td>25</td>
<td>21</td>
<td>-4</td>
</tr>
</tbody>
</table>

Having a quota policy reduces total surplus from $25$ in the free market to $21$ under the quota system. The source of the inefficiency is due to the fact that we are not producing the efficient quantity which is 5 units of milk.
As you look at Figure 2 you might be thinking, "This looks a lot like a tax." If you are think this then you are absolutely right! You can think of what is happening here as being just like a tax of $4. The only difference is that instead of the tax money going to the government it is now going to the holders (owners) of the quota.

While the quota system makes the overall pie smaller, it should be clear why it is popular among farmers. There producer surplus, $PS_{combined}$ is $16.5$ which is much larger then the return in the free market of $12. Moreover, if the quota policies were ever discontinued, the owners of the quota would suffer huge capital losses. If quotas were discontinued, the owners of dairy property would lose a huge sum of money, which make it no surprise that dairy farmers of Canada are fighting hard to preserve this system.