

# 39 | SUBSIDIES AND WELFARE

Purpose: To show the effects of crop subsidies on prices, quantities, and on social welfare.

Computer file: **crop\_sub.xls** or **crop\_sub\_mac.xlsm**

Instructions and background information:

In an earlier problem set you showed that competitive markets ordinarily maximize the welfare from a good or service. The reason markets have this remarkable and desirable characteristic is that when we're in a free market equilibrium the sum of consumer and producer surplus is as large as possible.

A corollary to this result is that interference with the operation of a free market, if it changes price and quantity, must reduce welfare as measured by the sum of producer and consumer surplus. In this problem set you will explore the effects of crop subsidies in a market for apples – the fruit, not the computer. Your main result will be that subsidies cause welfare to decrease, even taking into account the benefits farmers and consumers seem to get from lower apple prices and increased production. This decrease in welfare is usually referred to as the *deadweight loss* due to the subsidy.

The deadweight loss due to a subsidy is a form of economic inefficiency. It's a reduction in consumer and producer surplus, and is a result of the fact that the subsidy causes more than the socially best amount of the good is produced. And what is produced is sold at too low a price. Another way economists describe this result is to say that subsidies distort the allocation of resources. It's just another way of saying that when the subsidy is granted, too much of society's resources will be devoted to the good.

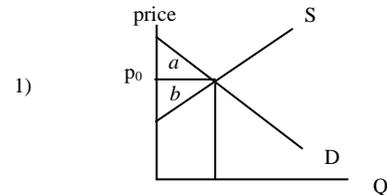
This is not to say that government should never use taxes and subsidies to influence a market. In many cases people are prepared to accept the deadweight loss due to subsidies if the government can provide services that the market would otherwise fail to provide. For example, if firms producing a good or service provide significant external benefits (neighborhood effects) for which they are not compensated, then the firms will under produce, leaving a role for government in removing the inefficiency.

Open the file **crop\_sub.xls** or **crop\_sub\_mac.xlsm**. What you see are demand and supply curves for apples in a hypothetical market. You're asked to compute the total surplus in the market for apples in the absence of any tax or subsidy. Then you introduce a subsidy, and explore the consequences for consumer surplus, producer surplus, and total welfare. The subsidy is presumed to be collected by apple farmers in this case, so the granting of the subsidy shows up as a shift in the supply curve for apples.

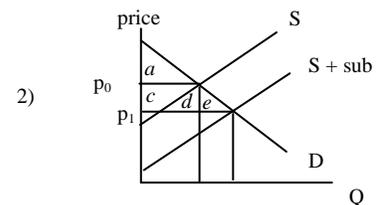
How do crop subsidies work? A per unit subsidy paid to farmers lowers their costs, and therefore their supply curves, by an amount exactly equal to the subsidy per unit of output. It's just like a per unit tax, but while the per unit tax raises costs and the supply curve by the amount of the tax, a subsidy works exactly the opposite way.

Let's proceed exactly as we did to analyze a per unit tax, and compute the consumer and producer surplus before the subsidy. We then compare that to the surplus after the subsidy. The trick, of course, will be that when the government pays a subsidy the cost of that subsidy has to be included in the final calculations of surplus.

Figure 1) at the right shows the supply and demand curve for apples. The consumer surplus in a free market, before-subsidy, world is the area  $a$ , while the producer surplus is area  $b$ .

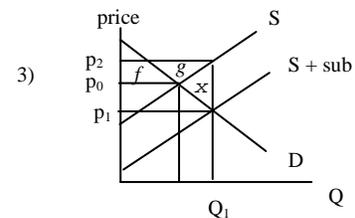


When the subsidy is granted, the supply curve falls, as in Figure 2), and the market price falls to  $p_1$ . (Note that the supply curve shifts down by the exact amount of the subsidy.) There is an increase in consumer surplus by  $c + d$  +  $e$ . So consumers become better off.



When the subsidy is granted, producers become better off as well, and their surplus increases by  $f + g$  in Figure 3).

Finally, we come to the government, who, after all is paying the bill for this. The cost to the government is the area of the rectangle  $(p_2 - p_1)$  times  $Q_1$ . Notice that this area is larger than the combined gain to producers and consumers by the amount  $x$ . In other words, there is a deadweight loss in welfare equal to  $x$ .



Here is your learning check list to come back to at the end of answering the questions:

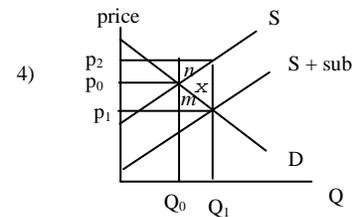
- 1) Total welfare (consumer plus producer surplus) is maximized in the free market equilibrium.
- 2) The subsidy lowers the market price of apples to consumers, and they gain consumer surplus. Their welfare increases.
- 3) The subsidy raises the revenues of apple farmers, and causes their producer surplus to increase.
- 4) The cost to the government of the program is the amount of the subsidy per unit of output times the after-subsidy equilibrium output level.

- 5) The cost to the government is *always* greater than the increased benefits to consumers and producers, and therefore there is a deadweight loss in social welfare.

Here are some hints to help you get the answers quicker:

- 1) You'll need a calculator to do the computations. The area of a right triangle is  $(1/2) \times \text{base} \times \text{height}$ . Double check tip 4), below.
- 2) Drawing a sketch of the graphs on a piece of scrap paper will help. Label the crucial points in your sketch by referring to the worksheet display of the graph. You'll need to know where the supply and demand curves intersect the price axis. Set quantity to zero to find these numbers.
- 3) You'll need to find the equilibrium price and quantity in the market. Use Goal Seek (or experimentation) to find the quantity of apples that makes the difference between the buyer's price and seller's price equal to zero.

- 4) You'll need to find the loss in welfare due to the subsidy. In the diagram at the right, the loss due to the subsidy is the triangle  $x$ . The easiest way to find  $x$  is to notice that it is one-half of the area  $x + n + m$ . The area  $x + n + m$  is easy to compute. It's just the rectangle that is  $(Q_1 - Q_0)$  wide by  $(p_2 - p_1)$  wide.



## LEARNING ABOUT CROP SUBSIDIES ANSWERS

### Questions

Set all variables to their baseline values.

- 1) What is the market equilibrium quantity?
- 2) What is the market equilibrium price?
- 3) What's the amount of consumer surplus at the baseline market equilibrium?
- 4) What's the amount of producer surplus at the baseline market equilibrium?
- 5) With all variables at their baseline values, and with the market in equilibrium, what's the total surplus (consumer plus producer)?

With variables starting from their baseline values, set the subsidy to \$2 per bushel of apples.

Tip: Do this by setting the amount of the tax to  $-2$  dollars.

- 6) What's the new equilibrium price of apples?
- 7) With the subsidy in place, what's the new equilibrium quantity of apples?
- 8) After the sellers get their subsidy, what's the new consumer surplus?
- 9) After the subsidy, what's the gain in consumer surplus?
- 10) After sellers get the subsidy, what's their new amount of producer surplus?
- 11) What's the gain in surplus for producers?
- 12) What's the total (consumer plus producer) surplus?
- 13) What's the total gain in surplus for producers and consumers?
- 14) What's the total subsidy payment the government makes to apple farmers?
- 15) What's the deadweight loss to society of the apple subsidy program?
- 16) Now be sure to go back and confirm the learning objectives from this exercise!