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Economics 201

## Who pays the tax?

In this handout, we look at how taxes contribute to changes in the price paid by consumers and price received by sellers. This handout assumes knowledge of how imposing a commodity tax on suppliers will affect that market, as a commodity tax on suppliers is a shift variable for the supply curve. Below, we'll consider the effect of imposing a per unit commodity tax on a good sold in Louisville, but will then extend that analysis to a setting where we have 2 different markets.

### A. The Louisville market for good X:

Assume we have a good we'll call good X that is sold within Louisville. The demand and supply curves for that good are provided below.

$$\begin{array}{ll} \text{Demand:} & P = 3 - 0.5Q_D \quad (\text{where } P = \text{price, } Q_D = \text{quantity demanded}) \\ \text{Supply:} & P = 1 + 0.5Q_S \quad (\text{where } Q_S = \text{quantity demanded}) \end{array}$$

Basic algebra allows us to take these equations and determine the values of our equilibrium price and equilibrium quantity. When we do this, we find that the equilibrium price is \$2 per unit and that the equilibrium quantity is 2 units (where we'll assume each unit is 1000).

Now, let's assume that the government decides to impose a tax of 50¢ per unit on suppliers. Let's use our understanding for how this tax would affect the Supply curve in this market to determine how the Supply curve equation will change. Once we do that, we can use the post-tax Supply curve and the Demand curve to determine our new equilibrium point.

First, we know that this tax will decrease the Supply curve for good X. Given that this is a per unit tax, we also know that this shift will be parallel. I.e., the tax does not affect higher priced units any differently than lower priced units, each unit is taxed by the same amount. This implies that the per unit tax doesn't affect the slope of our Supply curve equation, just the intercept. We also know that the vertical distance between the pre-tax Supply curve and post-tax Supply curve is the amount of the tax on each unit, which implies that the intercept of the Supply curve will rise by the amount of the tax on each unit. Therefore, the way that we determine the effect of this per unit tax on the Supply curve equation is by adding the tax to the Supply curve equation. I.e., the post-tax Supply curve would be  $P = 1 + 0.5Q_S + 0.5$  (or  $P = 1.5 + 0.5Q_S$ ).

That gives us the following post-tax Demand and Supply curves (in Louisville):

$$\text{Demand:} \quad P = 3 - 0.5Q_D$$

$$\text{Supply:} \quad P = 1.5 + 0.5Q_S$$

Once again, some really cool algebra allows us to determine that the post-tax equilibrium price is \$2.25 and post-tax equilibrium quantity is 1.5 units.

If we take the additional step of asking who pays for this tax, then we need to provide a few definitions – that of the Consumer Burden (CB) and Producer Burden (PB) from this tax. CB represents the increase in price faced by consumers from the tax (i.e. the change in price paid by consumers). PB represents any additional amount of tax that consumers don't cover, something that must then be paid by producers (suppliers). I.e., if a tax causes the price of a good to increase by 50% of the amount of the tax, then half of the tax will be paid by consumers in the form of higher prices, and half will be paid by producers in the form of a lower price received with each unit sold (the price that producers can use to determine their post-tax total revenue).

Comparing our pre-tax equilibrium price to the post-tax equilibrium price to determine CB, and then using the tax and CB to find PB, we get  $CB = 0.25$  and  $PB = 0.25$  (i.e. the 50¢ per unit tax gives us  $CB = 25¢$  and  $PB = 25¢$ ). This result tells us that producers do not simply pass the entire tax on to consumers and that the burden of the tax in this situation is shared equally. Of course, that's just what we get here. Given that  $CB + PB = \text{Per unit tax}$ , we know that as  $CB \uparrow$ , we get  $PB \downarrow$  (and as  $CB \downarrow$ , we get  $PB \uparrow$ ). What changes would allow producers to pass along more of this tax, rather than share it?

To answer this question, let's consider a second market, the Lexington market for good X, where the only difference between this market and the Louisville market is that consumers in the Louisville market are obviously smarter and better looking, and that this leads to a different demand curve within the Lexington market (but the same Supply curve).

### **B. The Lexington market for good X:**

$$\text{Demand:} \quad P = 5 - 1.5Q_D$$

$$\text{Supply:} \quad P = 1 + 0.5Q_S$$

Once again, we turn to our friend basic algebra to find a pre-tax equilibrium price of \$2 and pre-tax equilibrium quantity of 2 units. If the government imposes a per unit tax of 50¢ on Lexington area suppliers, then we end up with the same post-tax Supply curve as that of the

Louisville market, namely  $P = 1.5 + 0.5Q_s$ . That gives us the following post-tax Demand and Supply curves (in Lexington):

Demand:  $P = 5 - 1.5Q_D$

Supply:  $P = 1.5 + 0.5Q_S$

As before, re-solving for our equilibrium gives us a post-tax equilibrium price of \$2.375 and post-tax equilibrium quantity of 1.75 units. Comparing the pre-tax equilibrium price to the post-tax equilibrium price, we get  $CB = 0.375$ , which means that  $PB = 0.125$  (i.e. the 50¢ per unit tax gives us  $CB = 37.5¢$  and  $PB = 12.5¢$ ). Once again, producers do not pass the entire tax on to consumers, but unlike our result from the Louisville market, the burden of this tax is not shared equally. Producers in Lexington are able to pass more of this tax on to consumers than producers in Louisville were able to do. I.e. consumers in Lexington bear a higher per unit tax burden than consumers in Louisville, and producers in Lexington bear a lower per unit tax burden than producers in Louisville.

What did this analysis demonstrate? In our example, the demand for good X in Lexington was more inelastic than the demand for good X in Louisville. The more inelastic demand curve in Lexington gave those consumers a greater per unit tax burden than consumers in Louisville (i.e.  $CB$  in Lexington  $>$   $CB$  in Louisville). As the consumer burden in Lexington rises, relative to Louisville, then the producer burden in Lexington falls. Therefore, within the context of a per unit tax being placed on the suppliers of a good or service, as the demand for that good or service gets more inelastic, we observe that tax being associated with a greater consumer burden (and lower producer burden).