8 APPLICATION: THE COSTS OF TAXATION

Questions for Review

1. The greater the elasticities of demand and supply, the greater the deadweight loss of a tax. Because elasticity measures the response of quantity to a change in price, higher elasticity means the tax induces a greater reduction in quantity, and therefore, a greater distortion to the market.

2. Experts disagree about whether labor taxes have small or large deadweight losses because they have different views about the elasticity of labor supply. Some believe that labor supply is inelastic, so a tax on labor has a small deadweight loss. But others think that workers can adjust their hours worked in various ways, so labor supply is elastic, and thus a tax on labor has a large deadweight loss.

3. Figure 2 illustrates the deadweight loss and tax revenue from a tax on the sale of a good. Without a tax, the equilibrium quantity would be Q_1, the equilibrium price would be P_1, consumer surplus would be A + B + C, and producer surplus would be D + E + F. The imposition of a tax places a wedge between the price buyers pay, P_B, and the price sellers receive, P_S, where $P_B = P_S$ + tax. The quantity sold declines to Q_2. Now consumer surplus is A, producer surplus is F, and government revenue is B + D. The deadweight loss of the tax is C+E, because that area is lost due to the decline in quantity from Q_1 to Q_2.

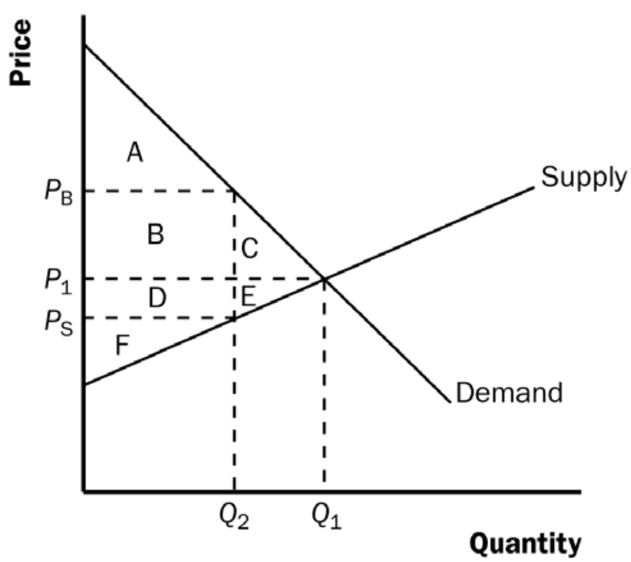

Figure 2

4. The deadweight loss of a tax rises more than proportionally as the tax rises. Tax revenue, however, may increase initially as a tax rises, but as the tax rises further, revenue eventually declines.

5. When the sale of a good is taxed, both consumer surplus and producer surplus decline. The decline in consumer surplus and producer surplus exceeds the amount of government revenue that is raised, so society's total surplus declines. The tax distorts the incentives of both buyers and sellers, so resources are allocated inefficiently.

Problems and Applications

1. a. Figure 7 illustrates the market for socks and the effects of the tax. Without a tax, the equilibrium quantity would be Q_1, the equilibrium price would be P_1, total spending by consumers equals total revenue for producers, which is P_1 x Q_1, which equals area B + C + D + E + F, and government revenue is zero. The imposition of a tax places a wedge between the price buyers pay, P_B, and the price sellers receive, P_S, where $P_B = P_S$ + tax. The quantity sold declines to Q_2. Now total spending by consumers is P_B x Q_2, which equals area A + B + C + D, total revenue for producers is P_S x Q_2, which is area C + D, and government tax revenue is Q_2 x tax, which is area A + B.

   b. Unless supply is perfectly elastic or demand is perfectly inelastic, the price received by producers falls because of the tax. Total receipts for producers fall, because producers lose revenue equal to area B + E + F.

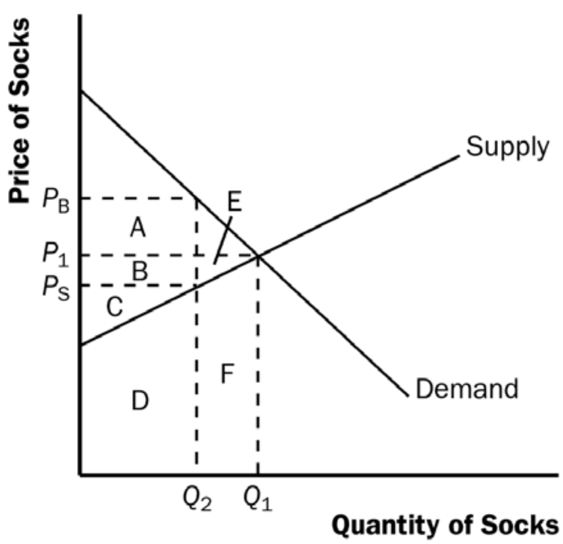

Figure 7

   c. The price paid by consumers rises, unless demand is perfectly elastic or supply is perfectly inelastic. Whether total spending by consumers rises or falls depends on the price elasticity of demand. If demand is elastic, the percentage decline in quantity exceeds the percentage increase in price, so total spending declines. If demand is inelastic, the percentage decline in quantity is less than the percentage increase in price, so total spending rises. Whether total consumer spending falls or rises, consumer surplus declines because of the increase in price and reduction in quantity.

2. a. As Figure 6 shows, an increase in the demand for land will raise the price of land, but leave the equilibrium quantity unchanged. Thus, the revenue of land owners will rise.

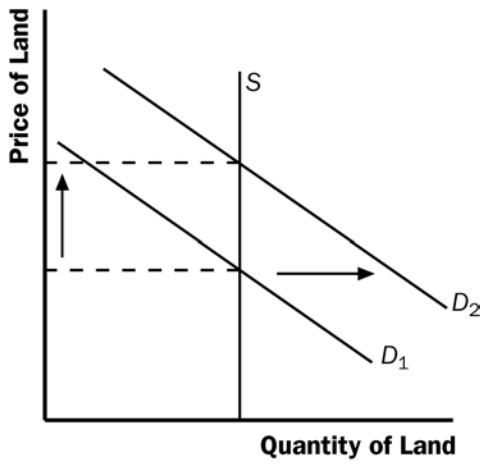

Figure 6

b. Because the supply of land is perfectly inelastic, sellers (land owners) will bear the entire burden of the tax.

c. There is no deadweight loss of this tax. The equilibrium quantity of land is unchanged.

d. Land has alternative uses. Therefore, its supply may not be perfectly inelastic.

3. a. This tax has such a high rate that it is not likely to raise much revenue. Because of the high tax rate, the equilibrium quantity in the market is likely to be at or near zero.

b. Senator Moynihan's goal was probably to ban the use of hollow-tipped bullets. In this case, the tax could be as effective as an outright ban.

4. a. With very elastic supply and very inelastic demand, the burden of the tax on rubber bands will be borne largely by buyers. As Figure 4 shows, consumer surplus declines considerably, by area A + B, but producer surplus does not fall much at all, just by area C + D.

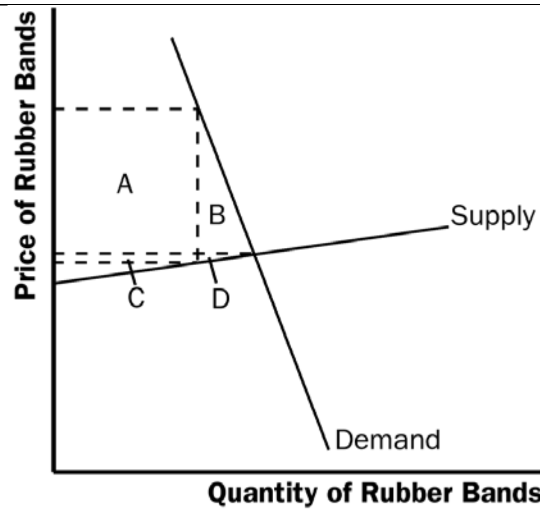

Figure 4

b. With very inelastic supply and very elastic demand, the burden of the tax on rubber bands will be borne largely by sellers. As Figure 5 shows, consumer surplus does not decline much, just by area A + B, while producer surplus falls substantially, by area C + D. Compared to part (a), producers bear much more of the burden of the tax, and consumers bear much less.

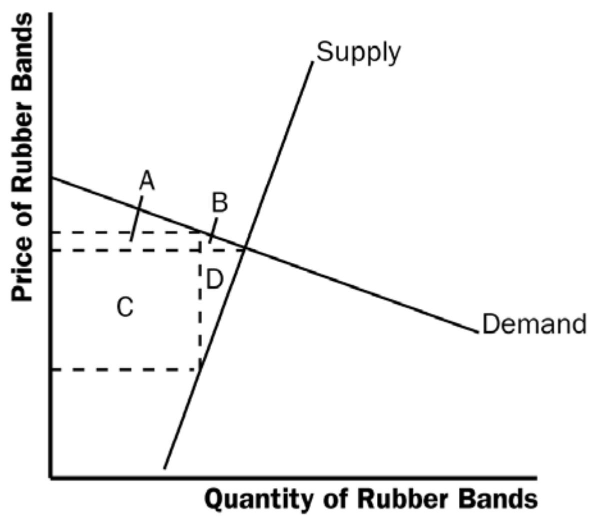

Figure 5

5. Because the demand for food is inelastic, a tax on food is a good way to raise revenue because it does not lead to much of a deadweight loss; thus taxing food is less inefficient than taxing other things. But it is not a good way to raise revenue from an equity point of view, because poorer people spend a higher proportion of their income on food. The tax would hit them harder than it would hit wealthier people.

6. a. The statement, "A tax that has no deadweight loss cannot raise any revenue for the government," is incorrect. An example is the case of a tax when either supply or demand

is perfectly inelastic. The tax has neither an effect on quantity nor any deadweight loss, but it does raise revenue.

b. The statement, "A tax that raises no revenue for the government cannot have any deadweight loss," is incorrect. An example is the case of a 100% tax imposed on sellers. With a 100% tax on their sales of the good, sellers will not supply any of the good, so the tax will raise no revenue. Yet the tax has a large deadweight loss, because it reduces the quantity sold to zero.

7. a. The deadweight loss from a tax on heating oil is likely to be greater in the fifth year after it is imposed rather than the first year. In the first year, the elasticity of demand is fairly low, as people who own oil heaters are not likely to get rid of them right away. But over time they may switch to other energy sources and people buying new heaters for their homes will more likely choose gas or electric, so the tax will have a greater impact on quantity. Thus, the deadweight loss of the tax will get larger over time.

b. The tax revenue is likely to be higher in the first year after it is imposed than in the fifth year. In the first year, demand is more inelastic, so the quantity does not decline as much and tax revenue is relatively high. As time passes and more people substitute away from oil, the quantity sold declines, as does tax revenue.

8. a. Figure 3 illustrates the market for pizza. The equilibrium price is P_1, the equilibrium quantity is Q_1, consumer surplus is area A + B + C, and producer surplus is area D + E + F. There is no deadweight loss, as all the potential gains from trade are realized; total surplus is the entire area between the demand and supply curves: A + B + C + D + E + F.

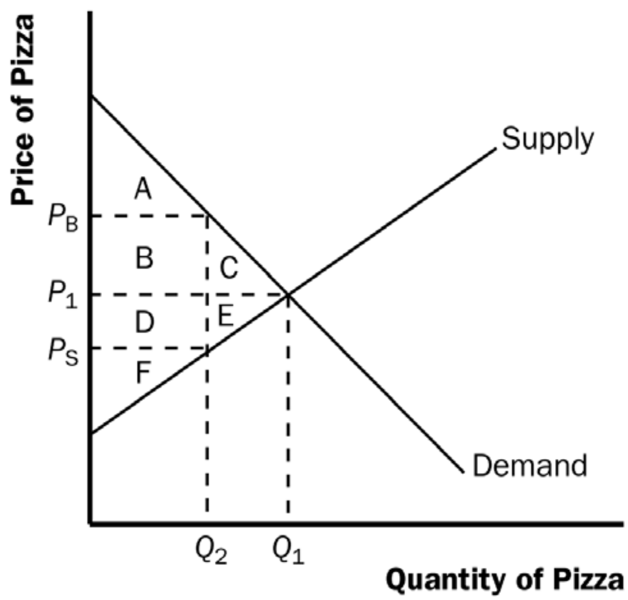

Figure 3

b. With a $1 tax on each pizza sold, the price paid by buyers, P_B, is now higher than the price received by sellers, P_S, where $P_B = P_S + \$1$. The quantity declines to Q_2, consumer surplus is area A, producer surplus is area F, government revenue is area B + D, and deadweight loss is area C + E. Consumer surplus declines by B + C, producer surplus declines by D + E, government revenue increases by B + D, and deadweight loss increases by C + E.

c. If the tax were removed and consumers and producers voluntarily transferred B + D to the government to make up for the lost tax revenue, then everyone would be better off than without the tax. The equilibrium quantity would be Q_1, as in the case without the tax, and the equilibrium price would be P_1. Consumer surplus would be A + C, because consumers get surplus of A + B + C, then voluntarily transfer B to the government. Producer surplus would be E + F, because producers get surplus of D + E + F, then voluntarily transfer D to the government. Both consumers and producers are better off than the case when the tax was imposed. If consumers and producers gave a little bit more than B + D to the government, then all three parties, including the government, would be better off. This illustrates the inefficiency of taxation.

9. Because the tax on gadgets was eliminated, all tax revenue must come from the tax on widgets. The tax revenue from the tax on widgets equals the tax per unit times the quantity produced. Assuming that neither the supply nor the demand curves for widgets are perfectly elastic or inelastic and because the increased tax causes a smaller quantity of widgets to be produced, then it is impossible for tax revenue to double—multiplying the tax per unit (which doubles) times the quantity (which declines) gives a number that is less than double the original tax revenue from widgets. So the government's tax change will yield less money than before.

10. Figure 8 illustrates the effects of the $2 subsidy on a good. Without the subsidy, the equilibrium price is P_1 and the equilibrium quantity is Q_1. With the subsidy, buyers pay price P_B, producers receive price P_S (where $P_S = P_B + \$2$), and the quantity sold is Q_2. The following table illustrates the effect of the subsidy on consumer surplus, producer surplus, government revenue, and total surplus. Because total surplus declines by area D + H, the subsidy leads to a deadweight loss in that amount.

	OLD	**NEW**	**CHANGE**
Consumer Surplus	A + B	A + B + E + F + G	+(E + F + G)
Producer Surplus	E + I	B + C + E + I	+(B + C)
Government Revenue	0	–(B + C + D + E + F + G + H)	–(B + C + D + E + F + G + H)
Total Surplus	A + B + E + I	A + B – D + E – H + I	–(D + H)

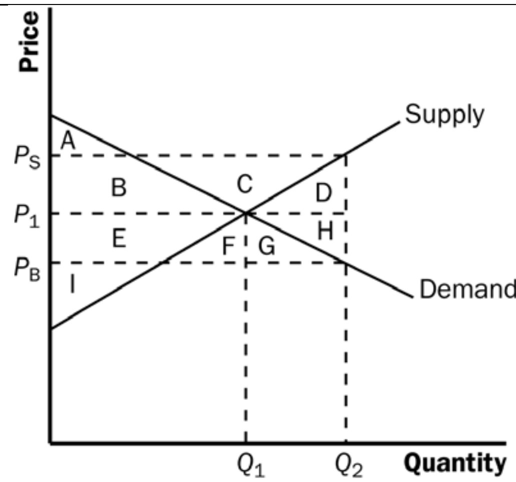

Figure 8

11. a. Figure 9 shows the effect of a \$10 tax on hotel rooms. The tax revenue is represented by areas A + B, which are equal to (\$10)(900) = \$9,000. The deadweight loss from the tax is represented by areas C + D, which are equal to (0.5)(\$10)(100) = \$500.

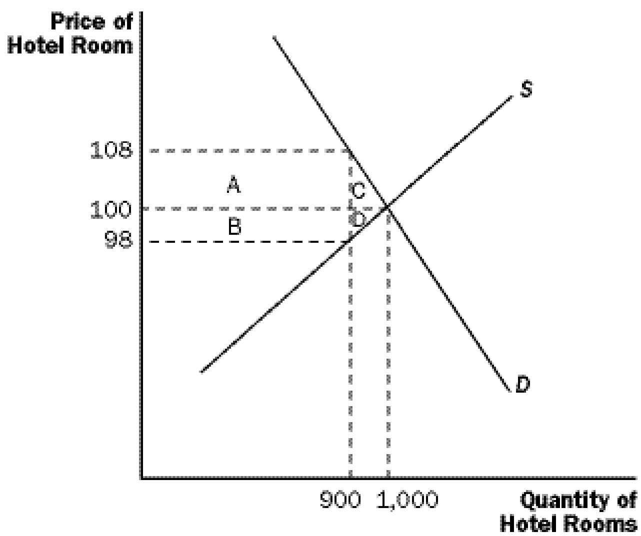

Figure 9

b. Figure 10 shows the effect of a \$20 tax on hotel rooms. The tax revenue is represented by areas A + B, which are equal to (\$20)(800) = \$16,000. The deadweight loss from the tax is represented by areas C + D, which are equal to (0.5)(\$20)(200) = \$2,000.

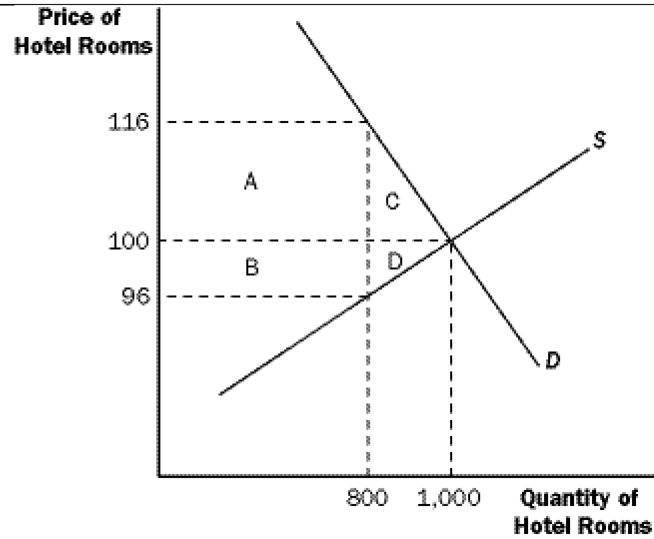

Figure 10

When the tax is doubled, the tax revenue rises by less than double, while the deadweight loss rises by more than double.

12. a. Setting quantity supplied equal to quantity demanded gives $2P = 300 - P$. Adding P to both sides of the equation gives $3P = 300$. Dividing both sides by 3 gives $P = 100$. Plugging $P = 100$ back into either equation for quantity demanded or supplied gives $Q = 200$.

b. Now P is the price received by sellers and $P + T$ is the price paid by buyers. Equating quantity demanded to quantity supplied gives $2P = 300 - (P+T)$. Adding P to both sides of the equation gives $3P = 300 - T$. Dividing both sides by 3 gives $P = 100 - T/3$. This is the price received by sellers. The buyers pay a price equal to the price received by sellers plus the tax ($P + T = 100 + 2T/3$). The quantity sold is now $Q = 2P = 200 - 2T/3$.

c. Because tax revenue is equal to $T \times Q$ and $Q = 200 - 2T/3$, tax revenue equals $200T - 2T^2/3$. Figure 11 shows a graph of this relationship. Tax revenue is zero at $T = 0$ and at $T = 300$.

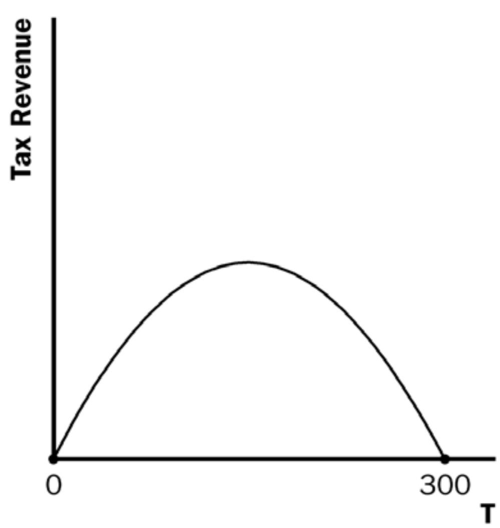

Figure 11

d. As Figure 12 shows, the area of the triangle (laid on its side) that represents the deadweight loss is 1/2 x base x height, where the base is the change in the price, which is the size of the tax (T) and the height is the amount of the decline in quantity ($2T/3$). So the deadweight loss equals 1/2 x T x $2T/3 = T^2/3$. This rises exponentially from 0 (when $T = 0$) to 45,000 when $T = 300$, as shown in Figure 13.

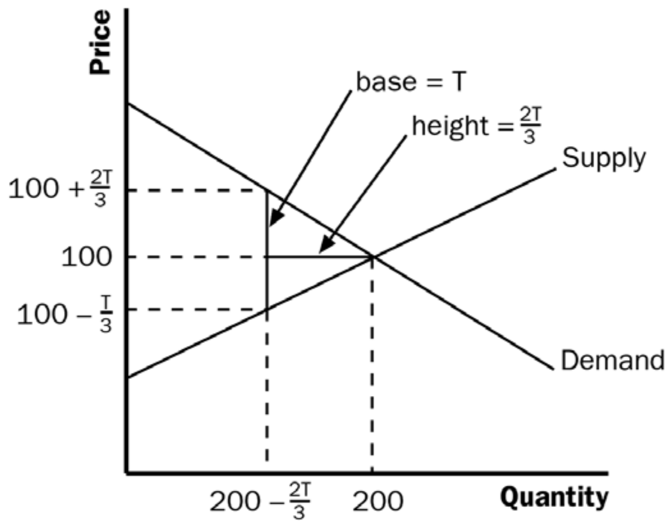

Figure 12

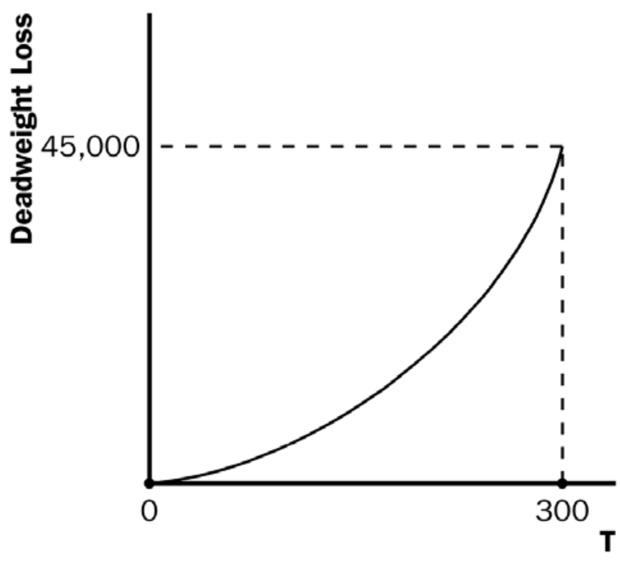

Figure 13

e. A tax of $200 per unit is a bad idea, because it is in a region in which tax revenue is declining. The government could reduce the tax to $150 per unit, get more tax revenue

($15,000 when the tax is $150 versus $13,333 when the tax is $200), and reduce the deadweight loss (7,500 when the tax is $150 compared to 13,333 when the tax is $200).