The following questions practice these skills:

- Compute the effects of an excise tax on price, quantity, and tax revenue.
- Show how the tax burden is divided between consumers and producers according to demand and supply elasticity.
- Compute the effects of an excise tax on consumer and producer surplus.

Question: The United States imposes an excise tax on the sale of domestic airline tickets. Let's assume that in 2006 the total excise tax was $5.80 per airline ticket (consisting of the $3.30 flight segment tax plus the $2.50 September 11 fee). According to data from the Bureau of Transportation Statistics, in 2006, 656 million passengers traveled on domestic airline trips at an average price of $389.08 per trip. The accompanying table shows the supply and demand schedules for airline trips. The quantity demanded at the average price of $389.08 is actual data; the rest is hypothetical.

<table>
<thead>
<tr>
<th>Price of trip</th>
<th>Quantity of trips demanded (millions)</th>
<th>Quantity of trips supplied (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$389.17</td>
<td>655</td>
<td>1,100</td>
</tr>
<tr>
<td>$389.08</td>
<td>656</td>
<td>1,000</td>
</tr>
<tr>
<td>$384.00</td>
<td>685</td>
<td>685</td>
</tr>
<tr>
<td>$383.28</td>
<td>700</td>
<td>656</td>
</tr>
<tr>
<td>$383.27</td>
<td>701</td>
<td>655</td>
</tr>
</tbody>
</table>

a. What is the government tax revenue in 2006 from the excise tax?
b. On January 1, 2007, the total excise tax increased to $5.90 per ticket. What is the equilibrium quantity of tickets transacted now? What is the average ticket price now? What is the 2007 government tax revenue?
c. Does this increase in the excise tax increase or decrease government tax revenue?

Answer to Question:
a. Tax revenue is $5.80 per trip x 656 million trips $3,804.8 million.
b. The equilibrium quantity now falls to 655 million, with the price rising to $389.17. Tax revenue rises to $5.90 per trip x 655 million trips $3,864.5 million.
c. The increase in the excise tax increases government tax revenue.

Question: All states impose excise taxes on gasoline. According to data from the Federal Highway Administration, the state of California imposes an excise tax of $0.18 per gallon of gasoline. In 2005, gasoline sales in California totaled 15.6 billion gallons. What was California's tax revenue from the gasoline excise tax? If California doubled the excise tax, would tax revenue double? Why or why not?

Answer to Question: Tax revenue is $0.18 per gallon × 15.6 billion gallons = $2.8 billion. Doubling the excise tax would reduce the amount of gasoline bought and sold, and tax revenue would less than double. The exception would be a case in which either demand or supply is perfectly inelastic; only in that special case would the quantity transacted not change as a result of the imposition of the excise tax, and tax revenue would—in this special case only—double as a result of a doubling in the excise tax rate.

Question: In the United States, each state government can impose its own excise tax on the sale of
cigarettes. Suppose that in the state of North Texarkana, the state government imposes a tax of $2.00 per pack sold within the state. In contrast, the neighboring state of South Texarkana imposes no excise tax on cigarettes. Assume that in both states the pre-tax price of a pack of cigarettes is $1.00. Assume that the total cost to a resident of North Texarkana to smuggle a pack of cigarettes from South Texarkana is $1.85 per pack. (This includes the cost of time, gasoline, and so on.) Assume that the supply curve for cigarettes is neither perfectly elastic nor perfectly inelastic.

a. Draw a diagram of the supply and demand curves for cigarettes in North Texarkana showing a situation in which it makes economic sense for a North Texarkananan to smuggle a pack of cigarettes from South Texarkana to North Texarkana. Explain your diagram.

b. Draw a corresponding diagram showing a situation in which it does not make economic sense for a North Texarkananan to smuggle a pack of cigarettes from South Texarkana to North Texarkana. Explain your diagram.

c. Suppose the demand for cigarettes in North Texarkana is perfectly inelastic. How high could the cost of smuggling a pack of cigarettes go until a North Texarkananan no longer found it profitable to smuggle?

d. Still assume that demand for cigarettes in North Texarkana is perfectly inelastic and that all smokers in North Texarkana are smuggling their cigarettes at a cost of $1.85 per pack, so no tax is paid. Is there any inefficiency in this situation? If so, how much per pack? Suppose chip-embedded cigarette packaging makes it impossible to smuggle cigarettes across the state border. Is there any inefficiency in this situation? If so, how much per pack?

**Answer to Question:**

a. In the accompanying figure, the demand for cigarettes in North Texarkana is relatively inelastic. So most of the $2.00 tax is borne by consumers, who pay an aftertax price of $2.95. Since it would cost $2.85 to purchase and smuggle a pack from South Texarkana ($1.00 price per pack + $1.85 smuggling cost per pack), this diagram illustrates a situation in which a North Texarkananan would be better off smuggling rather than purchasing cigarettes in North Texarkana.

![Diagram of supply and demand curves for cigarettes in North Texarkana.](attachment:image.png)

a. In the accompanying diagram, the demand in North Texarkana is less inelastic. As a result, consumers pay an after-tax price of $2.50. In this case, it does not make economic sense to smuggle.
Practice Questions and Answers from Lesson I-8: Taxes

3.

**c.** As shown in the accompanying diagram, if the demand for cigarettes in North Texarkana is perfectly inelastic, the demand curve is a vertical line and all of the tax is borne by consumers. In that case, the after-tax price paid by North Texarkanans is $3.00. So the cost of smuggling could go as high as $1.99, and North Texarkanans would still be better off smuggling; at a cost of $2.00 to smuggle, they would be indifferent between smuggling and purchasing their cigarettes in their home state.

**d.** Since demand is perfectly inelastic, the same number of cigarettes are transacted after the tax is imposed compared to before the tax is imposed. But there is still an inefficiency incurred in this situation despite the fact that no tax is paid and no transactions are discouraged: it is the $1.85 that is spent to smuggle a pack of cigarettes. This is the value of resources spent to evade the tax that consumers would have preferred to spend on other goods and activities. If technology eliminates smuggling altogether, there is no inefficiency. Because demand is perfectly inelastic, no transactions are discouraged by the tax, and all of the surplus lost by consumers is captured by the government as tax revenue.

**Question:** In each of the following cases involving taxes, explain: (i) whether the incidence of the tax falls more heavily on consumers or producers, (ii) why government revenue raised from the tax is not a good indicator of the true cost of the tax, and (iii) how deadweight loss arises as a result of the tax.

**a.** The government imposes an excise tax on the sale of all college textbooks. Before the tax was imposed, 1 million textbooks were sold every year at a price of $50. After the tax is imposed, 600,000 books are sold yearly; students pay $55 per book, $30 of which publishers receive.

**b.** The government imposes an excise tax on the sale of all airline tickets. Before the tax was imposed, 3 million airline tickets were sold every year at a price of $500. After the tax is imposed, 1.5 million tickets are sold yearly; travelers pay $550 per ticket, $450 of which the airlines receive.

**c.** The government imposes an excise tax on the sale of all toothbrushes. Before the tax, 2 million toothbrushes were sold every year at a price of $1.50. After the tax is imposed, 800,000 toothbrushes are sold every year; consumers pay $2 per toothbrush, $1.25 of which producers receive.
Answer to Question:
a. After the imposition of the tax, consumers pay $5 more per book than before; publishers receive $20 less per book than before. Producers (publishers) bear more of the tax. The tax is $55 \ - \ $30 = $25 per book, and 600,000 books are bought and sold. So government revenue is $15 million. This, however, is a poor estimate of the cost of the tax, since it does not take into account the fact that, in addition to the higher price, there are now 400,000 potential consumers who would have bought the books without the tax but no longer will buy them. Deadweight loss arises because consumers and producers lose surplus that is not captured as government revenue. That loss in surplus is accounted for by the 400,000 potential consumers and publishers who would have made transactions without the tax but do not once the tax is levied.

b. After the imposition of the tax, travelers pay $50 more per ticket than before; airlines receive $50 less than before. The tax is split evenly between consumers and producers. The tax is $550 \ - \ $450 = $100 per ticket, and 1.5 million tickets are bought and sold. So government revenue is $150 million. This, however, is a poor estimate of the cost of the tax, since it does not take into account the fact that, in addition to 1.5 million travelers paying higher prices, there are now 1.5 million potential consumers who would have bought tickets without the tax but no longer buy tickets. Deadweight loss arises because consumers and producers lose surplus that is not captured as government revenue. That loss in surplus is represented by the 1.5 million tickets that would have been transacted at the pre-tax price but are not transacted once the tax is levied.

c. After the imposition of the tax, consumers pay $0.50 more per toothbrush than before; producers receive $0.25 less than before. The incidence of the tax falls mainly on consumers. The tax is $2.00 \ - \ $1.25 = $0.75 per toothbrush, and 800,000 toothbrushes are bought and sold. So government revenue is $600,000. This, however, is a poor estimate of the cost of the tax, since it does not take into account the fact that, in addition to 800,000 toothbrushes now being more expensive, there are 1.2 million toothbrushes that would have been transacted without the tax but are no longer transacted. Inefficiency arises because consumers and producers lose surplus that is not captured as government revenue. That loss in surplus is represented by the 1.2 million toothbrushes that would have been transacted at the pre-tax price but are not transacted once the tax is levied.

Question: The accompanying diagram shows the market for cigarettes. The current equilibrium price per pack is $4, and every day 40 million packs of cigarettes are sold. In order to recover some of the health care costs associated with smoking, the government imposes a tax of $2 per pack. This will raise the equilibrium price to $5 per pack and reduce the equilibrium quantity to 30 million packs.

The economist working for the tobacco lobby claims that this tax will reduce consumer surplus for smokers by $40 million per day, since 40 million packs now cost $1 more per pack. The economist working for the lobby for sufferers of second-hand smoke argues that this is an enormous overestimate.
and that the reduction in consumer surplus will be only $30 million per day, since after the imposition of
the tax only 30 million packs of cigarettes will be bought and each of these packs will now cost $1 more.
They are both wrong. Why?

**Answer to Question:** The economist working for the tobacco lobby is overestimating the change in
consumer surplus. She is assuming that there will be no change in the quantity demanded and that
consumers will continue to smoke 40 million packs of cigarettes per day even when the price has risen
by $1 per pack. The economist working for the secondhand smoke lobby is underestimating the loss of
consumer surplus. He expects that the quantity demanded will be reduced to 30 million packs per day.
He is then looking at the loss of consumer surplus experienced by the consumers of those 30 million
packs per day. The loss is $1 per pack, the increase in the price per pack. He is not counting the loss of
consumer surplus experienced by those who are no longer smoking 10 million packs per day because
consumption dropped from 40 million to 30 million packs per day.

The reduction in consumer surplus resulting from the new tax is the $30 million reduction
experienced by the smokers of the 30 million packs plus the $5 million reduction in consumer surplus
experienced by those smokers who are smoking 10 million fewer packs. The total reduction in
consumer surplus is $35 million.

One way of calculating this answer is to look at the total consumer surplus before and after the new
tax. Before the tax the consumer surplus was \( \frac{1}{2} \times (8 - 4) \times 40 \text{ million} = 80 \text{ million} \). After the tax, the
consumer surplus is \( \frac{1}{2} \times (8 - 5) \times 30 \text{ million} = 45 \text{ million} \). The reduction in consumer surplus is $80
million \(- $45 million \( = $35 million. (Recall that the area of a triangle is \( \frac{1}{2} \times \text{the base of the triangle} \times \text{the
height of the triangle.})

**Question:** Consider the original market for pizza in Collegetown, illustrated in the accompanying table.
Collegetown officials decide to impose an excise tax on pizza of $4 per pizza.

<table>
<thead>
<tr>
<th>Price of pizza</th>
<th>Quantity of pizza demanded</th>
<th>Quantity of pizza supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>$9</td>
<td>1</td>
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<td>0</td>
</tr>
<tr>
<td>$1</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

a. What is the quantity of pizza bought and sold after the imposition of the tax? What is the price paid by
consumers? What is the price received by producers?
b. Calculate the consumer surplus and the producer surplus after the imposition of the tax. By how
much has the imposition of the tax reduced consumer surplus? By how much has it reduced producer surplus?
c. How much tax revenue does Collegetown earn from this tax?
d. Calculate the deadweight loss from this tax.

**Answer to Question:**
a. The tax drives a wedge between the price paid by consumers and the price received by producers. Consumers now pay $9, and producers receive $5. So after the imposition of the tax, the quantity bought and sold will be one pizza.
b. Consumer surplus is now zero (the one consumer who still buys a pizza at $9 has a willingness to pay of just $9, so that the consumer surplus is $9 – $9 = $0). Compared to the situation before the imposition of the tax, where the equilibrium price was $7, consumer surplus has been reduced by $3. Similarly, the producer of the one pizza has a cost of $5, and this is the price he receives, so producer surplus is also zero: compared to the situation before, it has decreased by $3.
c. Collegetown earns a tax of $4 per pizza sold, which is a total tax revenue of $4.
d. Total surplus has been decreased by $6. Of that $6, the town earns $4 in revenue, but $2 of surplus is lost. That is the deadweight loss from this tax.

Question: The state needs to raise money, and the governor has a choice of imposing an excise tax of the same amount on one of two previously untaxed goods: the state can tax sales of either restaurant meals or gasoline. Both the demand for and the supply of restaurant meals are more elastic than the demand for and the supply of gasoline. If the governor wants to minimize the deadweight loss caused by the tax, which good should be taxed? For each good, draw a diagram that illustrates the deadweight loss from taxation.

Answer to Question: The tax should be imposed on sales of gasoline. Since both demand for and supply of gasoline are less elastic, changes in the price of gasoline will result in smaller reductions in the quantity demanded and quantity supplied. As a result, fewer transactions are discouraged by the tax—in other words, less total surplus (consumer and producer surplus) is lost. Panel (a) of the accompanying diagram illustrates a tax imposed on sales of gasoline, for which both demand and supply are less elastic; panel (b) illustrates a tax imposed on sales of restaurant meals, for which both demand and supply are more elastic. As you can see, deadweight loss, the shaded triangle, is larger in panel (b) than in panel (a).

Question: You work for the Council of Economic Advisers, providing economic advice to the White House. The president wants to overhaul the income tax system and asks your advice. Suppose that the current income tax system consists of a proportional tax of 10% on all income and that there is one person in the country who earns $110 million; everyone else earns less than $100 million. The president proposes a tax cut targeted at the very rich so that the new tax system would consist of a proportional tax of 10% on all income up to $100 million and a marginal tax rate of 0% (no tax) on income above $100 million. You are asked to evaluate this tax proposal. Would this tax system create more or less tax revenue, other things equal? Is this tax system more or less efficient than the current tax system? Explain.
Answer to Question: This tax system would raise almost the same amount of tax revenue, since for all individuals, except for the one richest individual, it is identical to the current tax system. The richest individual pays $10 million in taxes, except the new tax system now creates an incentive for that individual to work to raise his or her income: an additional dollar of income is now worth exactly one additional dollar. Under the current system, an additional dollar of income for the top earner would only be worth an additional 90 cents. So this tax system is more efficient than the current tax system.