

Elasticity, Taxation, and Consumer Choice

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- PRICE ELASTICITY OF DEMAND AND OF SUPPLY
- INCOME ELASTICITY OF DEMAND
- CROSS-PRICE ELASTICITY OF DEMAND
- BURDEN OF TAXES ON CONSUMERS AND SUPPLIERS
- TRADE, TARIFFS, AND QUOTES

INTRODUCTION

The law of demand states that consumers will buy more of a product when the price falls and less when the price increases. In the real world, however, people may still buy a product when the price of a product increases. How much more or less will people buy with price changes? Why do people still heat their homes in the winter when energy costs rise but buy less Pepsi when it goes up in price? These questions can be addressed by studying **elasticity**, which shows how sensitive consumers and producers are to changes in price.

We will also learn how markets affect the welfare of society, and when a market fails to produce an optimal output, known as a **deadweight loss**. Finally, we will look at how taxes and tariffs affect total welfare, and how consumers make choices to maximize their utility or satisfaction.

ELASTICITY OF DEMAND

Elasticity of demand measures how consumers respond to changes in price. When the price of a good increases, will consumers still buy it, or leave the market? When demand is inelastic, consumers are insensitive to changes in price; the change in quantity demanded is small relative to the change in price, and the price elasticity of demand is less than one. With elastic demand, a price change leads to a large change in quantity demanded relative to the price change and the price elasticity is greater than one.

Calculating Price Elasticity of Demand

Use the formula below for calculating price elasticity of demand. Use absolute values for this formula, and ignore the negative sign.

$$\text{Price Elasticity of Demand (Ed)} = \frac{\% \text{ Change in Quantity Demanded (Qd)}}{\% \text{ Change in Price (P)}}$$

ONLINE

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Also you need to know how to calculate a percentage change in price and quantity to use the elasticity formula.

$$\% \text{ Change in Price or } Qd = \frac{\text{Change in } P \text{ or } Qd}{\text{Initial } P \text{ or } Qd}$$

Or for another way to calculate a percentage change, you can just take the new number minus the old divided by the old number. The acronym for that is **N - OOO** (or **New Minus Old Over Old**).

Refer to Table 5.1 to make sure you get the elasticity of demand classifications correct.

Table 5.1 Elasticity Coefficient Value

Type of Elasticity	Elasticity Value
Perfectly Inelastic	= 0
Relatively Inelastic	< 1
Unit Elastic	= 1
Relatively Elastic	> 1
Perfectly Elastic	∞ (Infinity)

EXAMPLE 1

Suppose the price of designer blue jeans increases from \$100 to \$120 and the quantity demanded decreases from 10 to 9. First, calculate the percentage change for both price and quantity demanded: $(\$120 - \$100)/\$100 = 0.2 = 20\%$ increase in price. $(9 - 10)/10 = -0.1 = 10\%$ decrease in the quantity demanded.

$$Ed = (-10\%)/(20\%) = 0.5$$

The price elasticity is 0.5, or relatively inelastic. (Note that the negative sign is dropped!)

EXAMPLE 2

Suppose the price of apples decreases by 10% and the quantity demanded increases by 20%.

$$Ed = (20\%)/(-10\%) = 2$$

The price elasticity is 2, or relatively elastic.

EXAMPLE 3

The price of eating at fast food restaurants has increased 5%, and the quantity demanded has decreased by 5%.

$$Ed = (-5\%)/(5\%) = 1$$

The price elasticity is 1, or unit elastic.

TOTAL REVENUES TEST TO DETERMINE ELASTICITY

A simple and easy way to check for elasticity is the **total revenues test**. Total revenue is merely price multiplied by quantity. As you can see in Table 5.2, if price increases and total revenue decreases, price elasticity is relatively elastic (greater than one). If price increases and total revenue increases, price elasticity is relatively inelastic (less than one) and if price changes and total revenue stays the same, price elasticity is unit elastic (equal to one).

TIP

Be sure to memorize the elasticity values on Figure 5.1. They will show up on the test.

Table 5.2 Total Revenues Test ($P \times Q = \text{Total Revenue}$) and Elasticity

Type of Elasticity	Relationship between price (P) and total revenues (TR)
> 1, Relatively Elastic	P and TR are inversely related
< 1, Relatively inelastic	P and TR have a direct relationship
= 1, Unit Elastic	TR does not change when P changes

PERFECT ELASTICITY

If demand is **perfectly elastic**, the price elasticity of demand is infinity. As price changes, the change in quantity demanded is infinite. For example, in Figure 5.1, at a price of P_1 buyers will buy any quantity. At any price above P_1 , quantity demanded is zero and, at price P_1 and below, quantity demanded is infinite. (An easy way to remember the slope of a perfectly elastic demand curve is to call it "Mr. Flat.")

TIP

To remember the slope of perfectly inelastic or elastic curves, inelastic starts with an i which is a vertical letter, just like the perfectly inelastic curve. Perfectly elastic's curve is horizontal, just like the three dashes in the letter E. Here's another: inelastic products are *insensitive* to changes in price.

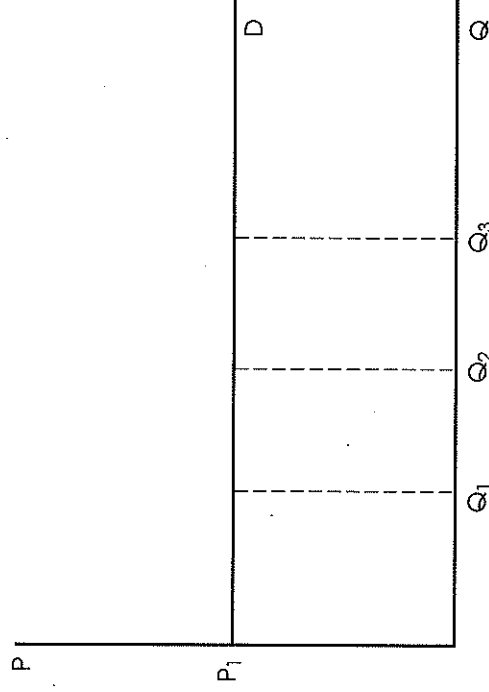


Fig. 5.1 Perfectly Elastic Demand

If demand is **perfectly inelastic**, the price elasticity of demand is zero. As price changes, the change in quantity demanded is zero. For example, in Figure 5.2, at either P_1 , P_2 , or any price, the quantity demanded remains unchanged at Q_3 . (An easy way to remember the slope of a perfectly inelastic demand curve is to call it "Mr. Stick.")

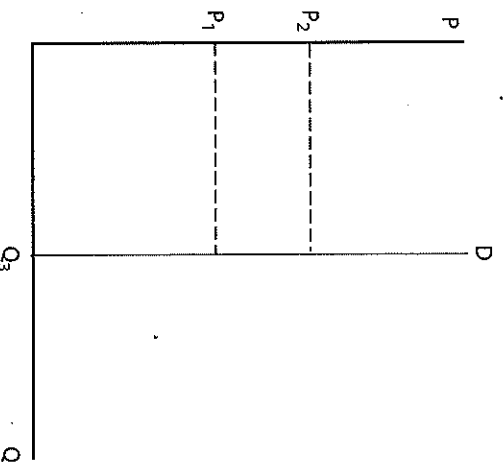


Fig. 5.2 Perfectly Inelastic Demand

ELASTICITY ALONG A DEMAND CURVE

On a typical demand curve, the price elasticity of demand varies along the curve. Think of measuring elasticity as looking at a specific point on the demand curve. In general, the top left of the demand curve is the elastic range, the lower right section is the inelastic range, and the midpoint of the curve is unit elastic. As you can see in Figure 5.3, as the price decreases in the elastic range, total revenue increases. However, as price decreases in the inelastic range, total revenue falls. (You will see this concept again later. *A monopoly always produces in the elastic range of the demand curve.*)

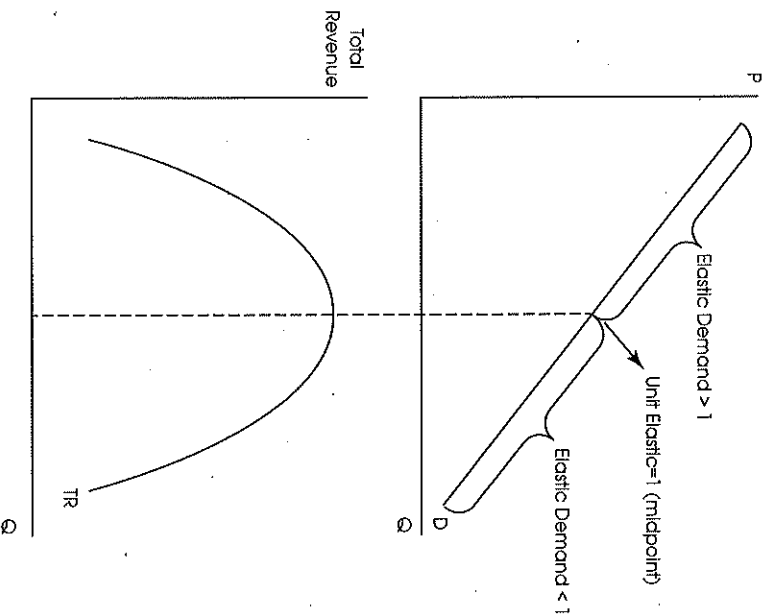


Fig. 5.3

Three Questions to Determine Demand Elasticity

- 1. ARE THERE ADEQUATE SUBSTITUTES AVAILABLE, OR IS THE GOOD A NECESSITY?** If a good is a necessity without any close substitutes, a consumer is likely to purchase the same quantity as the price changes. A diabetic who needs a shot of insulin to survive does not have adequate substitutes; their demand for insulin is inelastic. If the price of Toyota cars increases, buyers likely can find a close substitute and buy a different brand. Hence, demand would be relatively elastic for new cars.
- 2. CAN THE PURCHASE BE DELAYED?** If consumers have a longer time to make a buying decision, the demand for the product is generally more price elastic. If the purchase cannot be delayed, demand is more inelastic. For example, given a huge increase in the price of gasoline, demand for gas in the short-term is unlikely to change much. In the longer term, consumers have time to shop for more fuel-efficient cars or arrange other forms of transportation, leading to more elastic demand with more time. Emergency medical care is another example of a purchase that cannot be delayed, and has inelastic demand.
- 3. DOES THE PURCHASE REQUIRE A LARGE PERCENTAGE OF INCOME?** If a good is a large part of one's budget, the good tends to be more price elastic. If a luxury boat increases in price by 10%, that amount can be several thousand dollars, a significant part of one's budget leading to less quantity demanded. However, if the price of salt increases by 10%, that is likely a very small amount of one's monthly spending, making demand for salt relatively inelastic.

CROSS-PRICE ELASTICITY OF DEMAND

Cross-price elasticity of demand measures how a price change in one product affects the quantity demanded of another product. Calculating this determines if products are complementary or substitute goods. Here is the formula of calculating cross-price elasticity:

Cross-Price Elasticity of Demand = CPED

$$\text{CPED} = \frac{\% \Delta \text{ Quantity Demanded of Product X}}{\% \Delta \text{ Price of Product Y}}$$

(where Δ = change in)

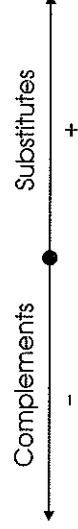


Fig. 5.4 Cross-Price Elasticity of Demand

EXAMPLE

SUBSTITUTE GOODS

Suppose the price of plastic wrap increases by 20%, and the quantity demanded of waxed paper increases by 50%. $(50\%)/(20\%) = 2.5$. Since the answer is a positive number, these two goods are substitutes (see Figure 5.4).

TIP

Use absolute values (positive numbers) when calculating normal elasticity. However, pay attention to positives and negatives when using cross-price and income elasticity of demand.

TIP

Here's an acronym to remember the elasticity of different sections of the demand curve. From top left to bottom right of the curve is **EUJ**: Elastic, Unit Elastic, Inelastic. To remember **EUJ**, just think **Eat Up Idiots**.

EXAMPLE

COMPLEMENTARY GOODS

Suppose the price of hot dogs increases by 20%, and the quantity demanded of hot dog buns decreases by 10%. $(-10\%)/(20\%) = -0.5$. Since the answer is a negative number, these two goods are complements (see Figure 5.4).

INCOME ELASTICITY OF DEMAND

In addition to consumers being constrained by prices in their purchasing decisions, they are also constrained by their budgets or incomes. Thus, we consider consumers' sensitivity in terms of their responses to changes in both prices and incomes. Income elasticity of demand shows how changes in income affect the quantity demanded of a good, and can be determined using this formula:

$$\text{Income Elasticity of Demand} = \frac{\% \Delta \text{Quantity Demanded}}{\% \Delta \text{Consumer Income}}$$

This formula shows whether a good is an inferior or a normal good. Remember that goods can be normal—where quantity demand increases as income increases, and inferior goods—where quantity demand decreases as income increases. The ratio for normal goods will have a positive sign, and the ratio for inferior goods will have a negative sign. (See Figure 5.5.)

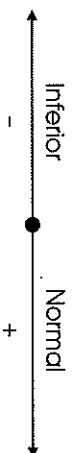


Fig. 5.5 Income Elasticity of Demand

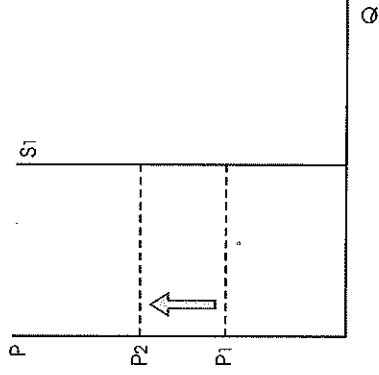
PRICE ELASTICITY OF SUPPLY

Elasticity also applies to the supply curve. Price elasticity of supply considers how a change in price affects the quantity supplied. The elasticity values for supply are exactly the same as demand. Timing is important when considering the elasticity of supply. The longer firms have to adjust, the more elastic their supply curves are, as it's difficult for many firms to significantly increase production in the short term. In the long run, a market or industry supply curve is usually perfectly elastic (remember this when studying perfect competition).

In Figure 5.6, the left part of the figure (the supply) is perfectly inelastic, where a change in price leaves the quantity supplied unchanged. The right part shows perfectly elastic supply, where at a price of P_1 or higher, producers will produce an infinite quantity, and there will be no production below P_1 .

$$\text{Price Elasticity of Supply} = \frac{\% \Delta \text{Quantity Supplied}}{\% \Delta \text{Price}}$$

Perfectly Inelastic Supply



Perfectly Elastic Supply

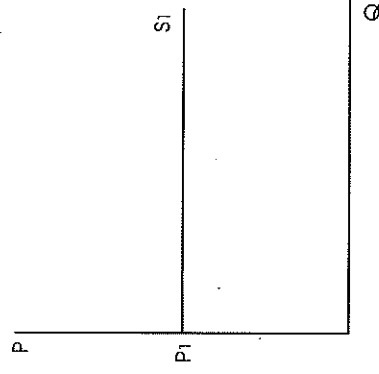


Fig. 5.6 Price Elasticity of Supply

CONSUMER AND PRODUCER SURPLUS

An important way economics measures the effectiveness of markets is to highlight and calculate consumer and producer surplus. When both consumer and producer surplus are maximized, economists consider this an efficient outcome. The **consumer surplus** is the difference between the highest price a consumer would pay for a product and the actual price paid.

For example, if you bought a concert ticket for \$20, but you would have paid as much as \$50, the consumer surplus is $\$50 - \$20 = \$30$. The demand curve displays the maximum price each consumer will pay, so this can be easily calculated and displayed graphically using the supply and demand graph. For example, in Figure 5.7, the market for a bag of peanuts, the area of consumer surplus is the triangular area below the demand and above the equilibrium price of \$5, or area ABC. To calculate the exact value of the consumer surplus, use the formula $\frac{1}{2}$ (base \times height) by taking the difference between \$9 and \$5 on the price axis times the quantity sold, and multiply by $\frac{1}{2}$. Or, $\frac{1}{2} \times (\$9 - \$5) \times 30 = \$60$.

The **producer surplus** is the difference between the lowest price a producer would sell a product and the actual price received.

TIP

The area of consumer surplus can be located on a graph as the area below the demand curve, above price, and left of quantity. For producer surplus, find it above the supply curve, below price, and left of quantity.

EXAMPLE

If you have an old cell phone that you sell on the Internet for \$100, but you would have sold it for as low as \$50, your producer surplus is $\$100 - \$50 = \$50$. In Figure 5.7, the equilibrium price for a bag of peanuts is \$5, but many sellers would have sold it for less than that, and receive producer surpluses. The area of producer surplus is above the supply curve and below the equilibrium price of \$5, or area CDB. To calculate the exact total value of the producer surplus, take the difference between \$5 and \$1 on the price axis times the quantity sold, and multiply by $\frac{1}{2}$. Or, $\frac{1}{2} \times 4 \times 30 = \60 . Adding the consumer and producer surplus together gives you the total surplus of \$120.

TIP

If a demand curve is perfectly elastic, there is no consumer surplus. Likewise, if a supply curve is perfectly elastic, there is no producer surplus.

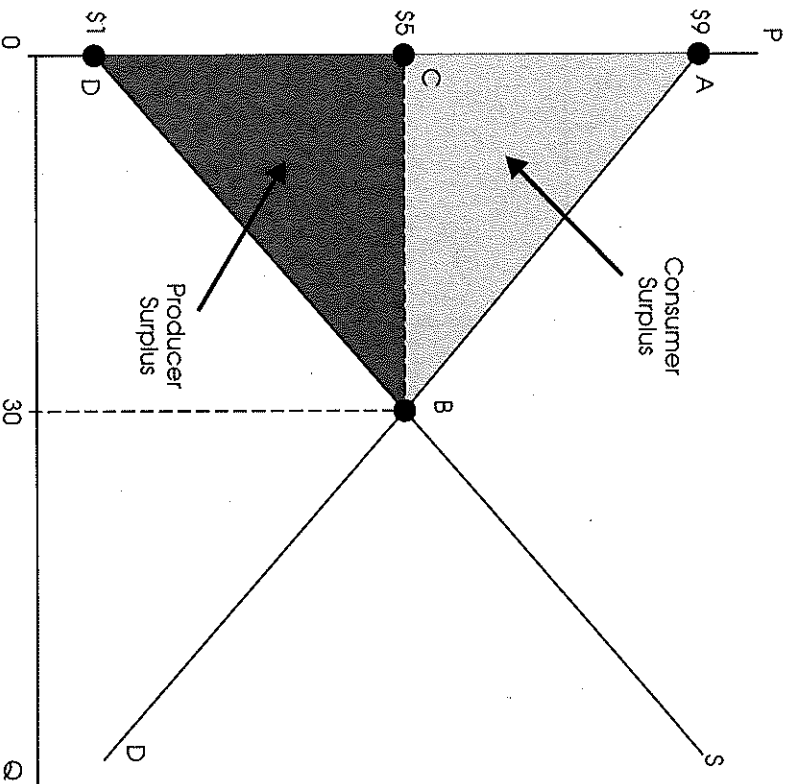


Fig. 5.7 Consumer and Producer Surplus in the Peanut Market

Table 5.3 Consumer and Producer Surplus (from Figure 5.7)

Equilibrium price and quantity	\$5, 30
Consumer surplus	Area: A B C $\frac{1}{2} \times (\$9 - \$5) \times 30 = \$60$
Producer surplus	Area: C B D $\frac{1}{2} \times (\$5 - \$1) \times 30 = \$60$
Total surplus	$\$60 + \$60 = \$120$

Deadweight Loss with a Price Ceiling

When a market fails to maximize total surplus, a deadweight loss is present. A **deadweight loss** is the loss of total surplus when a market fails to reach a competitive equilibrium. Recall a binding price ceiling from Chapter 4, where a minimum price is set below the competitive market price. If a price ceiling is imposed on the peanut market from the previous graph, the new quantity in the market is 15, not 30. Note the loss of total surplus that arises, a deadweight loss, shown by the area **DBF**. Producer surplus is now area **CEF**, and consumer surplus is area **ADFE**. (See Figure 5.8.)

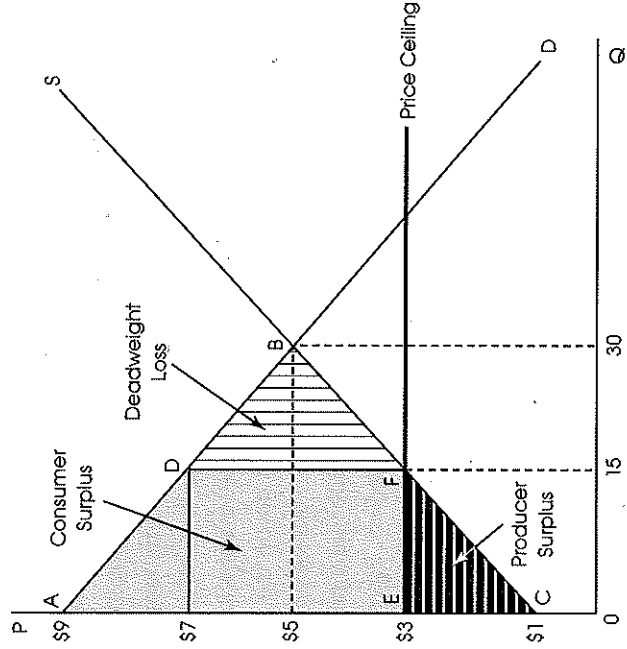


Fig. 5.8 Price Ceiling with a Deadweight Loss

Deadweight Loss with a Price Floor

With a binding price floor, a minimum price is set above the competitive market price. If a price floor is imposed on the peanut market as in Figure 5.9, the new quantity in the market is 15, not 30. Note the loss of total surplus that arises, a deadweight loss, shown by the area **DBF**. Producer surplus is now area **CEDE**, and consumer surplus is area **ADE**.

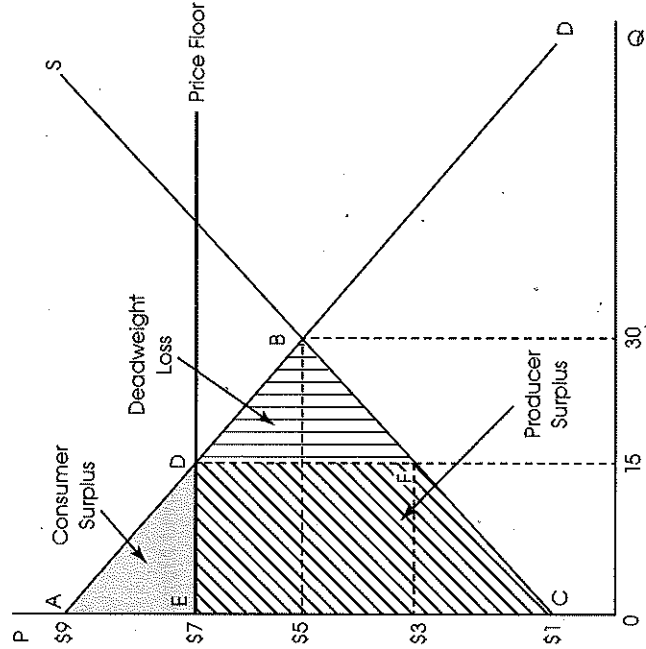


Fig. 5.9 Price Floor with a Deadweight Loss

IMPACT OF TAXES ON CONSUMER AND PRODUCER SURPLUS

While all governments need tax revenue to provide public services, taxation does result in a reduction of total surplus (a deadweight loss). Taxes can have varying impacts on consumers and producers depending on their respective price elasticities of demand or supply. In Figure 5.10, the equilibrium price of a pound of beef is \$5. Suppose, however, that the government places an excise tax of \$4 on the production of beef, measured graphically by the vertical distance between the supply curves. An **excise tax** is a per-unit tax on the production or sale of a good. After the tax, the consumers pay a price of \$7 for beef, but sellers only get \$3 from the sale; the other \$4 goes to the government as tax revenue. While many people think producers will pay all the \$4 tax, in reality it is split between buyers and sellers. Buyers are also paying the tax in the form of higher prices.

TIP

The tax revenue portion of a tax graph (tax paid by consumers and producers) is not part of the deadweight loss. This money is spent by the government to provide public services.

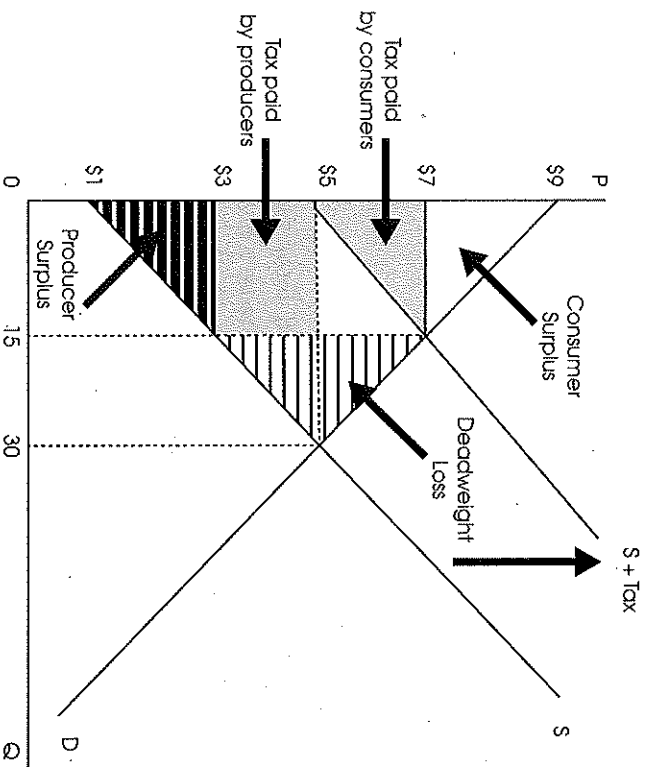


Fig. 5.10 Incidence of the Tax on the Beef Market

Also note in Figure 5.10 the reduction in producer and consumer surplus. As buyers pay a higher price, you can note how both consumer and producer surpluses have decreased. Part of this surplus goes to the government as tax revenue, but another part has disappeared. Consumers wanted to buy a quantity of 30 and producers wanted to sell 30, but only 15 units were bought and sold. The total deadweight loss in this case is \$30 as seen in the calculations in Table 5.4.

Consumers and producers are usually both partially responsible for the paying the tax (the tax incidence), but often one pays a greater percentage of the tax. The tax incidence is directly related to the price elasticity of supply and demand. If supply is more price elastic than demand (e.g., demand is more inelastic), consumers bear a greater burden tax than suppliers. Conversely, if demand is more price elastic than supply, sellers pay more of the tax. In fact, governments like placing taxes on items that have relatively inelastic demand, such as cigarettes or gasoline, as many people still buy them as price increases, placing a greater burden of the tax on consumers (and providing revenue for the government).

Table 5.4 Before and After Tax Analysis of Figure 5.10

Before Tax		After Tax
Price and quantity	\$5, 30	Total size of tax \$4
Consumer surplus	$\frac{1}{2} \times (\$9 - \$5) \times 30 = 60$	Price for consumers \$7
Producer surplus	$\frac{1}{2} \times (\$5 - \$1) \times 30 = 60$	Price received by sellers \$3
Total surplus	$\$60 + \$60 = \$120$	Consumer surplus $\frac{1}{2} \times (\$9 - \$7) \times 15 = 15$
		Producer surplus $\frac{1}{2} \times (\$3 - \$1) \times 15 = 15$
		Total tax revenue $(\$7 - \$3) \times 15 = 60$
		Tax paid by consumers $(\$7 - \$5) \times 15 = 30$
		Tax paid by producers $(\$5 - \$3) \times 15 = 30$
		Deadweight loss $\frac{1}{2} \times (\$7 - \$3) \times (30 - 15) = \$30$

Table 5.5 summarizes who is responsible for paying a tax, or the tax incidence.

Table 5.5 Tax Incidence

Elasticities	Tax Incidence: Who pays the tax, consumers or producers?
Elasticity of demand > elasticity of supply	Producers pay more of the tax than consumers.
Elasticity of demand < elasticity of supply	Consumers pay more of the tax than producers.
Perfectly inelastic demand ($E_d = 0$)	Consumers pay all the tax.
Perfectly elastic demand ($E_d = \infty$)	Consumers pay none of the tax.
Perfectly inelastic supply ($E_s = 0$)	Producers pay all of the tax.
Perfectly elastic supply ($E_s = \infty$)	Producers pay none of the tax.

TIP

Regarding the tax incidence (who pays the tax), the curve that is more price inelastic pays more of the tax. Conversely, the more price elastic curve pays less.

A Tax Paid Mainly by Consumers

Now we will graphically show the tax incidence between consumers and producers in Figure 5.11, with consumers paying most of the tax. The equilibrium price and quantity is at Q_1 and P_1 , but after the tax is imposed and the supply curve shifts up by the amount of the tax. P_T and Q_T are the after-tax price and quantity, with P_s the price received by sellers. Here you can see demand is more inelastic than supply, resulting in buyers paying a greater amount of tax.

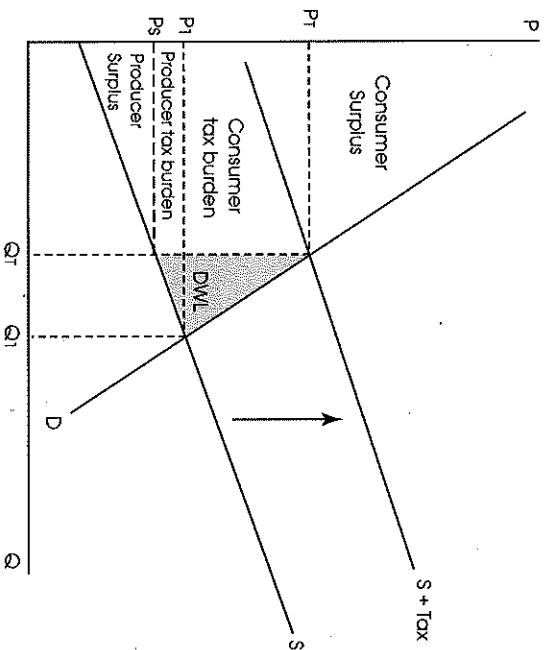


Fig. 5.11 Consumers Paying a Larger Portion of a Tax

A Tax Paid Mainly by Producers

Now we will graphically show producers paying most of the burden of the tax in Figure 5.12. The equilibrium price and quantity is at Q_1 and P_1 , but after the tax is imposed and the supply curve shifts up by the amount of the tax, P_T and Q_T are the after-tax price and quantity, with P_S the price received by sellers. Here you can see supply is more inelastic (steeper) than demand, resulting in sellers paying a greater amount of tax.

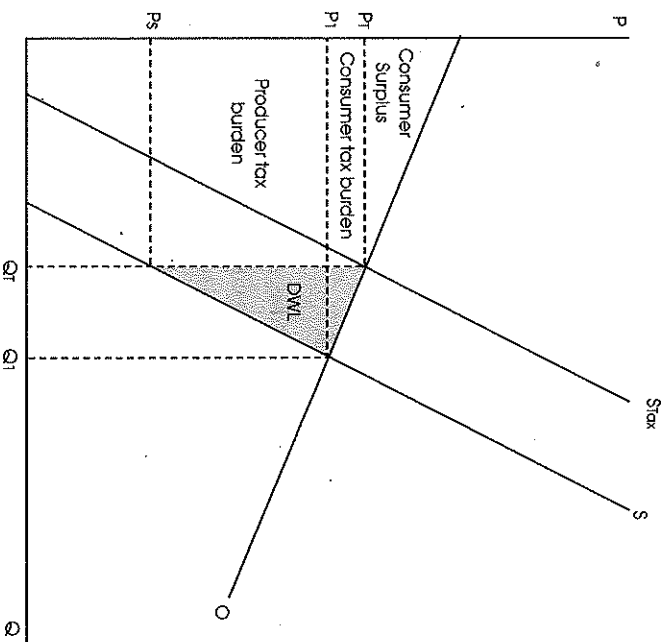


Fig. 5.12 Producers Paying a Larger Portion of a Tax

TRADE, TARIFFS, AND QUOTAS

If you have taken Macro in addition to Microeconomics, you likely have learned about international trade in detail. However, for the purposes of Micro, you should understand the effects of international trade on total surpluses, and how tariffs and quotas affect total welfare.

World Price with No Tariff or Quota

Let's look at the market for bananas in Figure 5.13. Here you can see the price and quantity before (\$4, 40) and after (\$2, 60) trade at the world price. Note at the world price consumer surplus is ABDE because 60 were consumed, and producer surplus is C because only 20 were produced. Therefore, the total surplus (area ABCDE) is greater than before trade (area ABC). At the world price, consumers receive huge gains from the lower prices, but a peculiarity is that producer surplus shrinks from area BC to C. Despite the fact that the producer surplus decreases in size, there is still a large net positive gain in total surplus, from the large increase in consumer surplus. The amount of domestic consumption increases from 40 to 60 after trade, and the total amount of imports is $60 - 20 = 40$. See Table 5.6 for more details from the graph.

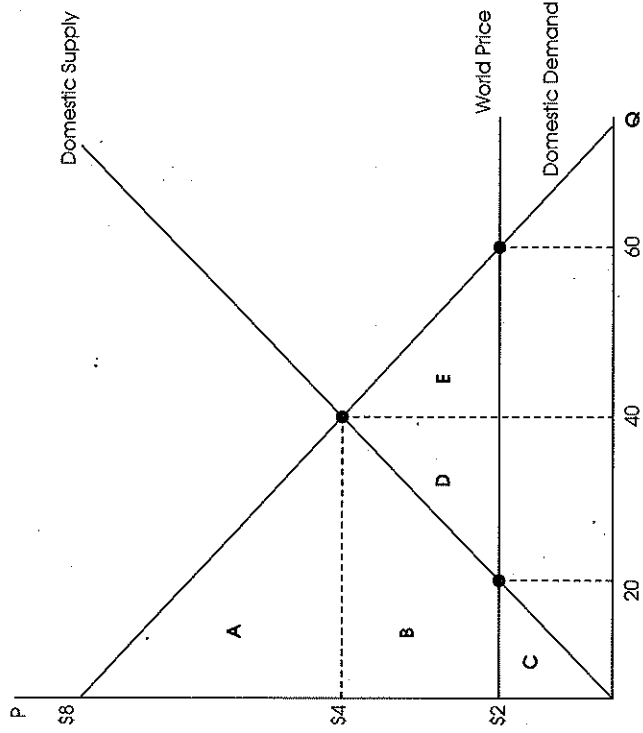


Fig. 5.13 International Trade

Table 5.6 Before and After Trade Analysis of Figure 5.13

Before World Trade		After Trade @ World Price	
Equilibrium price and quantity	\$4, 40	Equilibrium price and quantity	\$2, 60
Consumer surplus	A	Consumer surplus	A B D E
Producer surplus	B C	Producer surplus	C
Total surplus	A B C	Total surplus	A B C D E
Quantity of imports	—	Quantity of imports	$60 - 20 = 40$
Net gains from trade	—	Net gains from trade	D E

World Price with a Tariff

Recall that all taxes create a deadweight loss. A tariff is a tax on imports or exports, and a quota has a similar effect on trade that sets a limit on the quantity of goods imported or exported. To better understand the effect of tariffs on total surplus, look at Figure 5.14. At the world price, P_W , there is no deadweight loss and the amount of imports is from Q_1 to Q_4 . After a tariff, the new price is P_T , and the quantity of imports has decreased to the quantity from Q_2 to Q_3 . Areas that were consumer surplus before trade are now tax revenue from the tariff and deadweight loss.

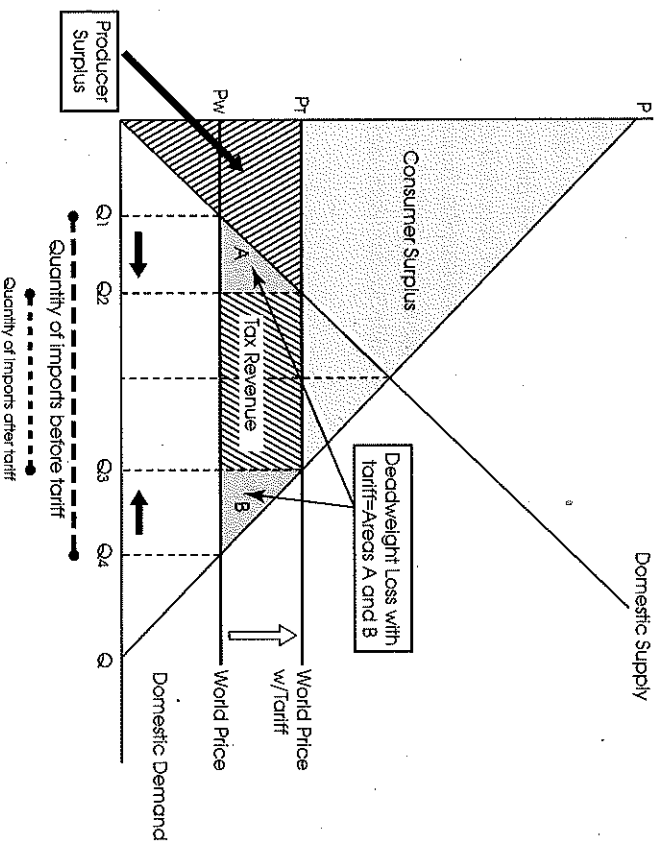


Fig. 5.14 Trade at the World Price with Tariff

Trade at the World and Tariff Prices

Let's assume that domestic suppliers successfully lobby the government for a tariff on imported bananas because of a decline in producer surplus and international trade. As shown in Figure 5.15, the imposition of a \$1 tariff on imported bananas increases the price of bananas to \$3 and reduces the quantity of domestic consumption from 60 to 50. Domestic producers are happy as their production increases from 20 to 30 and their producer surplus increases from C to CH. However, the tariff has an undesirable effect on total surplus, and brings back a deadweight loss (areas D and G). A similar effect would take place if a quota was set as opposed to a tariff, except a quota will not provide tax revenue for the government like a tariff (areas F_1 and F_2 are the tax revenue). See Table 5.7 for further analysis of the impact of the tariff.

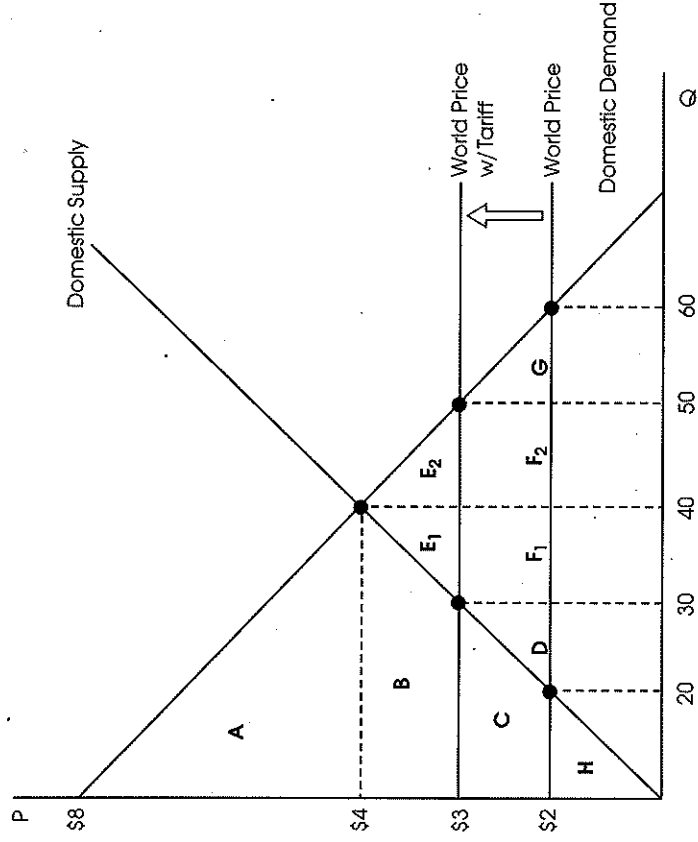


Fig. 5.15 World Trade Before and After a Tariff

Table 5.7 An Analysis of Trade Before and After a Tariff

World Price Before Tariff	World Price After Tariff
Equilibrium price and quantity	\$2, 60
Consumer surplus	\$3, 50
Producer surplus	Consumer surplus
Total surplus	Producer surplus
Net gains from trade	Total surplus
Quantity supplied (domestic)	Net gains from trade
Quantity of imports	Quantity supplied (domestic)
	Quantity of imports
	Deadweight loss (net loss from tariff)
	Tax revenue

CONSUMER CHOICE THEORY

How does a consumer allocate a scarce income among a wide variety of choices for goods and services? Economists use consumer choice theory to help us understand consumption decisions. **Diminishing marginal utility** means that at some point in the consumption pattern of a good, each additional unit consumed yields less additional satisfaction or utility. Think of the first scoop of ice cream on a summer day. The first scoop of ice cream gives you lots of satisfaction. However, with each additional scoop, your utility will marginally decrease, and at some point you will even stop eating ice cream. **Marginal utility** is the change in total satisfaction. Also, keep in mind that when your marginal utility decreases, you would not pay as much for each additional scoop.

Table 5.8 shows both the total and marginal utility for each scoop of ice cream. Note that while total utility is increasing for scoops 1 to 4, marginal utility is falling, yet is positive. Eventually at scoop 5 both total and marginal utility are decreasing. Total utility is maximized where marginal utility is zero.

Table 5.8 Scoops of Ice Cream

Quantity	Total Utility	Marginal Utility
0	0	—
1	20	20
2	35	15
3	45	10
4	50	5
5	45	-5

THE UTILITY-MAXIMIZATION RULE

While economics assumes people face scarcity through unlimited wants, but also scarce resources (or in this case limited budgets or a budget constraint), how do they decide what to buy? The consumer will want to get as much extra satisfaction (measured by utility) as possible given budget constraints. The consumer will want to buy the product with the most utility per dollar. One way to think of marginal utility is to consider it “satisfaction points” and you want the most happiness per dollar spent. The utility-maximization rule helps solve the problem when multiple items are being considered for purchase. For example, if you are at a theme park and you need to decide how much money to spend on souvenirs vs. playing games, you can use the utility-maximization formula:

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

TIP On FRGs regarding the utility-maximization question like that in Table 5.9, the question will change the prices and then ask how the consumer will change the consumption pattern. When this happens, just make another table listing the new marginal utility/new price and you will ace it.

By applying this formula, one spends money until the marginal utility of good X (souvenirs) divided by the price of good X (souvenirs) equals the marginal utility of good Y (games) divided by the price of good Y (games) given your budget constraint. If marginal utility needs to increase, buy less, and if it needs to decrease, buy more. When the utility formula equals out, you have reached the optimal combination.

SAMPLE QUESTION

Maria has \$52 to spend at an amusement park, and wants to spend her limited budget on souvenirs or playing games. Souvenirs cost \$8 each and games cost \$4 each. Help her find the optimal combination of these items to maximize her utility using Table 5.9. Note the utility numbers are total, not marginal.

Table 5.9 Total Utility: Souvenirs vs. Games

Total Units	Total Utility (Souvenirs \$8)	Total Utility (Games \$4)
1	56	32
2	104	60
3	136	84
4	160	104
5	180	116
6	196	126
7	208	134

The utility-maximization formula $MU_x/P_x = MU_y/P_y$ uses marginal utility, but on an AP test question you are often only initially given total utility. To solve this problem, look at the total utility data and make your own table of the marginal utility and the marginal utility/price for each product (done for you in Table 5.10). Start circling the highest marginal utilities per dollar and continue until you have spent all the income.

Table 5.10 Marginal Utility and Marginal Utility/Price

Total Units	Marginal Utility of Souvenirs	Marginal Utility S/Price S (\$8)	Marginal Utility of Games	Marginal Utility G/Price G (\$4)
1	56	7	32	8
2	48	6	28	7
3	32	4	24	6
4	24	3	20	5
5	20	2.5	12	3
6	16	2	10	2.5
7	12	1.5	8	2

This gives you the correct utility-maximization combination for Maria that is: **4 souvenirs and 5 games given the budget constraint of \$52.**



SUMMARY

- Price elasticity of demand or the percentage of change in the quantity demanded of a particular good divided by the price of the same good demonstrates the sensitivity of consumers to price changes. $P \times Q = TR$ allows a revenue test, i.e., whether a price change will increase or decrease total revenue.
- Price elasticity of supply shows the sensitivity of producers or firms to price changes for their products.
- Price elasticity of demand or supply that has a numerical value > 1 is elastic, $= 1$ is unit elastic, or < 1 is inelastic.
- Cross-price elasticity of demand is the percentage change in the quantity demanded of one product in response to the percentage change in the price of a second product. If this ratio produces a positive sign, the two products are good substitutes. If this ratio produces a negative sign, then the two products are complements.
- Income elasticity of demand measures the responsiveness of consumers to changes in their income. A positive income elasticity is a normal good while a negative income elasticity is an inferior good.
- Consumer surplus is the difference between the highest price a consumer would pay and the actual price paid.
- Producer surplus is the difference between the lowest price a producer would sell for and the actual price of a sale.
- A tax on a good creates a deadweight loss, and the burden or incidence of the tax falls more on the person with the more inelastic demand or supply.
- A tariff does provide the government with tax revenue but also causes a deadweight loss.
- The theory of consumer choice includes understanding diminishing marginal utility, facing budget constraints, and making consumption choices with the utility-maximization rule.



TERMS

- Consumer Surplus** the difference between the highest price a consumer would pay for a product and the actual price paid
- Cross-Price Elasticity** the percentage change in demand for good X if there is a price change for good Y. If the number is negative, they are complements, and if it is positive, they are substitutes.
- Deadweight Loss** the loss of total surplus for society when a market fails to reach a competitive equilibrium due to market distortion, like a tax
- Diminishing Marginal Utility** at some point in the consumption pattern of a good, each additional unit consumed yields less additional satisfaction (utility)
- Elasticity** a measure of how producers and consumers respond to changes in price
- Excise Tax** a per-unit tax on production
- Income Elasticity of Demand** how a change in income affects the quantity demanded for a product. If income goes up and the quantity demanded goes down, it is an inferior good. If the quantity demanded increases with income, it is a normal good.
- Marginal Utility** the change in total utility
- Price Elasticity of Demand** measures how consumers respond to changes in price

Producer Surplus the difference between the lowest price a producer would sell a product and the actual price received

Total Revenue the amount of money taken in by a firm from its sales, which is the price of a product multiplied by the quantity sold

Total Revenues Test a way to determine elasticity by multiplying the price of a good times the quantity sold. If price and total revenues are directly related, a good is inelastic; if inversely related, a good is elastic; and if they equal each other, the good is unit elastic.

Total Utility the total satisfaction a consumer receives from the consumption of a good or service

FORMULAS

Price Elasticity of Demand:

$$E_d = \frac{\% \Delta \text{ Quantity Demanded}}{\% \Delta \text{ Price}}$$

Cross-Price Elasticity of Demand:

$$\text{CPED} = \frac{\% \Delta \text{ Quantity Demanded of Product X}}{\% \Delta \text{ Price of Product Y}}$$



Income Elasticity of Demand:

$$E_i = \frac{\% \Delta \text{ Quantity Demanded}}{\% \Delta \text{ Consumer Income}}$$



Price Elasticity of Supply:

$$E_s = \frac{\% \Delta \text{ Quantity Supplied}}{\% \Delta \text{ Price}}$$

Utility-Maximization Rule:

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

Calculating a Percentage Change:

$$\% \text{ Change in Price} = \frac{\text{Change in P}}{\text{Initial P}}$$

$$\% \text{ Change in } Q_d = \frac{\text{Change in } Q_d}{\text{Initial } Q_d}$$

MULTIPLE-CHOICE REVIEW QUESTIONS

- When the price elasticity of demand coefficient ratio is 2, demand is
 - unit elastic.
 - relatively elastic.
 - perfectly elastic.
 - relatively inelastic.
 - perfectly inelastic.
- Price times quantity measures
 - the international trade gap.
 - the budget deficit.
 - total revenue.
 - price elasticity of demand.
 - price elasticity of supply.
- A positive sign on cross-price elasticity of demand indicates that the two products are
 - luxuries.
 - necessities.
 - substitutes.
 - complements.
 - independent.
- If the quantity demanded of good X increases 25% while the price decreases 25%, this means the price elasticity of demand is
 - unit elastic.
 - relatively elastic.
 - perfectly elastic.
 - relatively inelastic.
 - perfectly inelastic.
- If an excise tax is imposed on a supplier, the tax incidence will fall more heavily on consumers if
 - demand and supply are both unit elastic.
 - the price elasticity of demand is more inelastic than supply.
 - the price elasticity of supply is more inelastic than demand.
 - the price elasticity of demand is more elastic than supply.
 - the price elasticity of supply is perfectly elastic.
- Suppose a 10% decrease in the price of ice cream leads to a 15% increase in the quantity demanded of ice cream. What type of elasticity does this show?
 - Perfectly elastic
 - Relatively elastic
 - Unit elastic
 - Relatively inelastic
 - Perfectly inelastic
- A 20% increase in the price of milk leads to a 10% decrease in the quantity of cereal purchased. The cross-price elasticity of demand between milk and cereal is
 - 0.5 and the two goods are substitutes
 - 0.5 and the two goods are complements
 - 0.5 and the two goods are complements
 - 2 and the two goods are substitutes
 - 2 and the two goods are complements
- If the cross-price elasticity of demand between goods X and Y is positive, and the income elasticity of demand for good Y is negative, which of the following is correct?
 - Good Y is an inferior good and good X is a normal good
 - Good Y is an inferior good and goods X and Y are complements
 - Good Y is a normal good and goods X and Y are substitutes
 - Good Y is an inferior good and goods X and Y are substitutes
 - Good Y is an inferior good and goods X and Y are complements
- The area above a supply curve, below the equilibrium price, and left of equilibrium quantity is the
 - deadweight loss.
 - consumer surplus.
 - producer surplus.
 - price ceiling.
 - price floor.

10. If the demand for gasoline is price inelastic in a competitive market, an increase in the price of gasoline will
- (A) result in a deadweight loss in the gasoline market.
 (B) cause an increase in the consumer surplus.
 (C) decrease the total revenue of gasoline producers.
 (D) increase the total revenue of gasoline producers.
 (E) decrease the total spending on gasoline by consumers.

11. A tariff that is imposed on a good that is imported to the United States will result in which of the following to consumer surplus, domestic producer surplus, and tax revenue?

	<u>Consumer Surplus</u>	<u>Domestic Producer Surplus</u>	<u>Tax Revenue</u>
(A)	Increase	Decrease	Decrease
(B)	Decrease	Increase	Decrease
(C)	Decrease	Increase	Increase
(D)	Increase	Increase	Increase
(E)	Decrease	No change	Decrease

12. Jane is shopping online and is spending \$48 on T-shirts and music downloads. Given her budget constraint of \$48 she is at her utility-maximization combination of spending. T-shirts cost \$10. In addition, her marginal utility of T-shirts is 40 and for music downloads it's 8. What then is the price of music downloads?

- (A) 50¢
 (B) \$1
 (C) \$2
 (D) \$3
 (E) \$4

Use this chart for Questions 13 and 14.

Quantity of Pizza	Marginal Utility from Pizza	Quantity of Music Downloads	Marginal Utility from Music Downloads
1	10	1	8
2	8	2	6
3	6	3	4
4	4	4	2
5	2	5	1

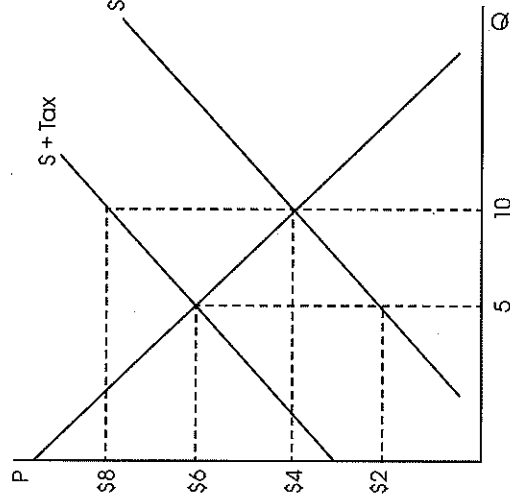
13. Samantha consumes both pizza and music downloads. The table above shows her marginal utility from these. What is her total utility from purchasing four music downloads?
- (A) 4
 (B) 14
 (C) 18
 (D) 20
 (E) 21
14. Now assume Samantha's weekly income is \$12, the price of a pizza is \$2, and the price of a music download is \$1. What is the utility-maximization quantity of pizza and music downloads if she spends her entire \$12 on these two goods?

	<u>Pizza</u>	<u>Music Downloads</u>
(A)	2	2
(B)	2	3
(C)	4	4
(D)	5	4
(E)	5	5

15. The utility-maximization rule is to choose the basket of goods that
- (A) has the highest marginal utility of each good in the basket.
 - (B) has the lowest prices for the goods.
 - (C) has the highest value of marginal utility to price for each good.
 - (D) the marginal utility to price ratio is equal for all goods in the basket.
 - (E) the marginal utility to price ratio is equal for all goods in the basket subject to the budget constraint.
16. According to the principle of diminishing marginal utility,
- (A) marginal utility stays the same.
 - (B) total utility stays the same.
 - (C) marginal utility decreases with each additional unit of a good that is consumed.
 - (D) marginal utility and total utility both decrease.
 - (E) total utility declines.

FREE-RESPONSE REVIEW QUESTIONS

1. Analyze the following graph of the sugar market and how a per-unit excise tax affects the following.



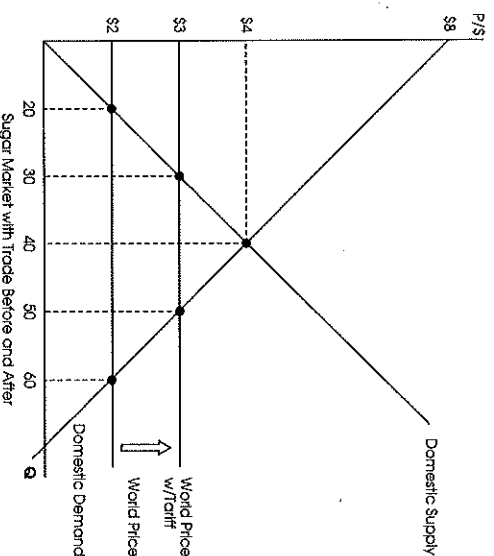
Sugar Market with Tax

- What is the size of the tax per unit on the sugar market?
- What is the total amount of tax revenue from the tax?
 - Is the tax incidence between consumers and producers equal, do consumers pay more of the tax than producers, or do producers pay more of the tax than consumers?
- What is the price that consumers pay for sugar after the tax?
 - What is the after tax, per-unit price received by producers for each sale?
- What was the equilibrium price and quantity before the tax?
- Now assume the price elasticity of demand becomes more inelastic, while supply remains constant. Who will now pay more of the burden of the tax? Consumers? Producers? Or will the burden of the tax be equal? Explain.

2. Assume Micah spends \$14 on burgers and slices of pizza every week. A burger costs \$4 and a slice of pizza is \$2. Using the chart, answer the following questions.

Total Units	Marginal Utility of a Burger	Marginal Utility of a Slice of Pizza
1	20	12
2		16
3		12
4		8
5		6
	4	4

- (a) What is the total utility of consuming 4 burgers?
- (b) What is the quantity of burgers and slices of pizza that will maximize Micah's utility given that he spends \$14?
- (c) Now suppose a 10% increase in the price of a burger leads to a 5% increase in the quantity of slices of pizza purchased. Calculate the cross-price elasticity between burgers and pizza, and note if burgers and pizza are complements, substitutes, or inferior goods. Show your work.
3. Analyze the following graph of the price of sugar in the United States before and after a tariff is imposed.



Sugar Market with Trade Before and After Tariff

- (a) What is the price of sugar if there is no trade?
- (b) Calculate the total consumer surplus both without trade *and* at the world price without a tariff. Show your work.
- (c) Calculate the total tariff revenue at the world price with a tariff. Show your work.
- (d) What is the quantity of domestic supply at the world price both with and without a tariff?

Multiple-Choice Review Answers

1. (B) 5. (B) 9. (C) 13. (D)
 2. (C) 6. (B) 10. (D) 14. (C)
 3. (C) 7. (B) 11. (C) 15. (E)
 4. (A) 8. (D) 12. (C) 16. (C)

Free-Response Review Answers

1. (a) \$4
 (b) \$20. $(\$6 - \$2) \times 5 = \$20$
 (i) The tax burden is equally shared by producers and consumers. Both pay \$10 in tax.
 (c) \$6, where the demand curve and supply + tax curves meet
 (i) \$2. The tax of \$4 is subtracted from the sale price of \$6, leaving producers with \$2.
 (d) \$4, quantity of 10
 (e) Consumers will now pay more of the tax, or have a higher tax incidence. The more inelastic curve pays more of the tax. Here the demand curve is now more price inelastic than the supply curve.
 2. (a) 56. $(20 + 16 + 12 + 8 = 56)$
 (b) 2 burgers and 3 slices of pizza. As you can see with the new columns of both products' utility per dollar, circle the highest utility per dollar until both sides equal out and the budget constraint of \$14 is met.

Total Units	Marginal Utility of a Burger	Marginal Utility of B/Price B (\$4)	Marginal Utility of Pizza	Marginal Utility P/Price P (\$2)
1	20	5	12	6
2	16	4	10	5
3	12	3	8	4
4	8	2	6	3
5	4	1	4	2

- (c) Substitutes. The formula to calculate cross-price is the percentage change in the quantity demanded of good X/percent change in the price of good Y. $5\%/10\% = 0.5$. Since that is positive, they are substitutes. If the number were negative, the two goods would be complements.

3. (a) \$4
- (b) $\frac{1}{2} \times (\$8 - \$4) \times 40 = \$80$ consumer surplus at the price before trade
 $\frac{1}{2} \times (\$8 - \$2) \times 60 = \$180$ consumer surplus with trade at the world price
- (c) $(\$3 - \$2) \times (50 - 30) = \$20$
- (d) 20 at the world price without a tariff and 30 at the world price with the tariff