Elasticity and Its Application

In a competitive market, the demand and supply curve represent the behaviour of buyers and sellers. The demand curve shows how buyers respond to price changes whereas the supply curve shows how sellers response to the price changes. And we know from our earlier discussion that demand is negatively related to price whereas supply is positively related. However from our earlier discussion, we do not know how much the quantity changes as a result of a price change. We only know the direction of the change from our discussion but not the magnitude. In order to get more precision into our analysis we need to discuss the concept of elasticity, which is what we will do in this session.

Elasticity is one of the most readily available measures and its uses include:

Pricing.

Managing cash flows.

Impact of changes in competitors' prices.

Impact of economic booms and recessions.

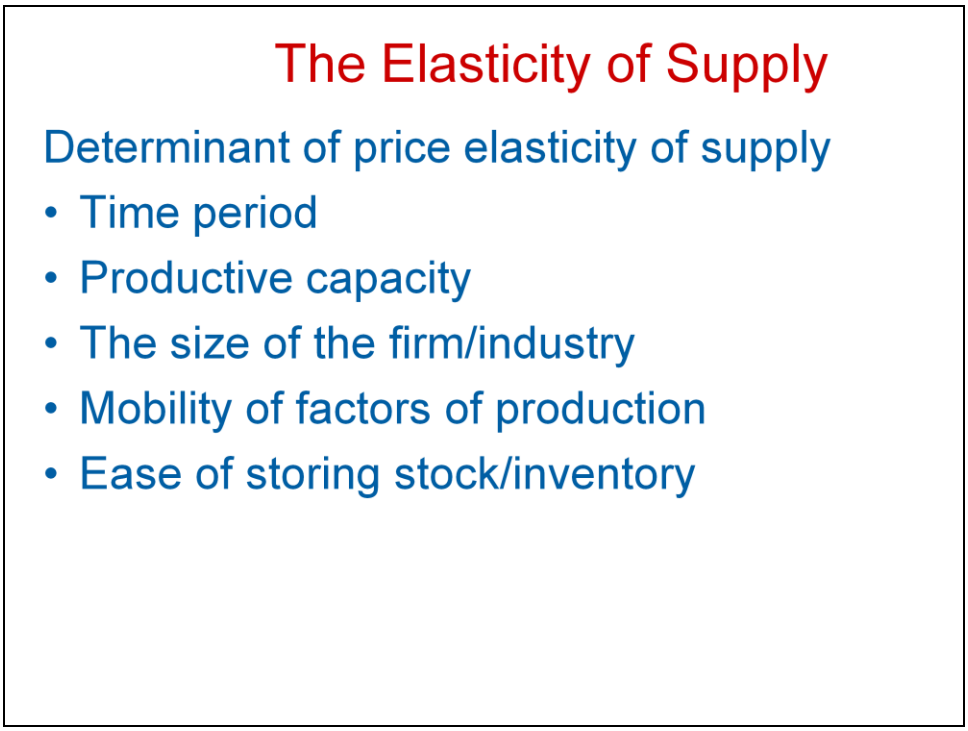
Impact of advertising campaigns.

And lots more!

The Elasticity of Supply

- Elastic supply
  - Quantity supplied responds substantially to changes in the price
- Inelastic supply
  - Quantity supplied responds only slightly to changes in the price

The law of supply states that higher prices raise the quantity supplied. The price elasticity of supply measures **how much** the quantity supplied responds to changes in the price. Supply of a good is said to be elastic (or price sensitive) if the quantity supplied responds substantially to changes in price. Supply is said to be inelastic (or price insensitive) if the quantity supplied responds only slightly to changes in the price. The elasticity of supply can be zero or greater. The measure of elasticity of supply is closer to zero then it is considered to be inelastic and if it is closer to infinity then it is more elastic. Different goods have different elasticity of supply. For example, beachfront house will be more inelastic than books. Firstly, the land on which beachfront houses are built is limited and secondly it takes time to build the house even if we find the land. However, more books can be relatively easily printed.



This brings us to our next point about the determinants of price elasticity of supply. The main determinants of price elasticity can be classified as:

Time period: In a number of markets time period is a fundamental determinant of the price elasticity of supply. In the short run supply is usually more inelastic than in the long run. In most situations firms have limited capacity. They cannot increase the goods produced as easily in the short run as in the long run. So if price increases then the supply is likely to be more responsive in the long run rather than immediately.

Productive capacity: The responsiveness of the firm to changes in prices is also going to depend on the state of the economy. For example, when the economy is experiencing recession most business will not be operating to their full capacity and will be able to respond relatively quickly to changes in market condition and hence supply will be more elastic. On the other hand in times of boom most firms will be operating near full capacity and will find it much more difficult to respond to any price changes and hence price will be less elastic.

The Size of the Firm/Industry: The price elasticity of supply may be more inelastic for bigger firms than smaller firms. For example, if a small furniture

company gets an unexpected order then it might be able to buy extra raw material at a short notice and produce more. A small increase in purchases of raw material is unlikely to impact the unit costs of the firm. However, for a big steel manufacturing firm buying iron ore in large quantities on the commodity markets is likely to be a more difficult decision impacting the firms unit costs and hence profitability. So the elasticity of supply is likely to be more elastic for the furniture company than the steel firm.

Mobility of factors of production: If factors of production can be switched relatively easily to produce a particular good then supply will be more elastic. For example, wheat and rye can be produced using very similar resources. If price of wheat goes up, farmers may switch from producing rye and supply wheat instead. Thus, the supply of wheat will be elastic. However, if there is a shortage of heart specialists then that does not mean that other doctors can suddenly become heart surgeons. The supply of heart specialists is therefore going to relatively inelastic.

Ease of storing stock/inventory: Ease of storing stock/inventory: Industries such as light fittings or car parts are easier to store and therefore firms can easily supply more if there is an increase in price. However, the same is not true for fresh fruit. Mangoes are only available for instance in certain time periods and a price hike in the off season period does not guarantee readily available mangoes. Thus, price elasticity of supply of fresh fruit may be more inelastic.

The Elasticity of Supply

- Computing price elasticity of supply
  - Percentage change in quantity supplied divided by percentage change in price
  - Always positive
- Midpoint method
  - Two points: (Q_1, P_1) and (Q_2, P_2)

$$\text{Price elasticity of supply} = \frac{(Q_2 - Q_1) / [(Q_2 + Q_1) / 2]}{(P_2 - P_1) / [(P_2 + P_1) / 2]}$$

Elasticity is measured as percentage change in quantity supplied divided by percentage change in price. It is very important to remember the ceteris paribus assumption. We can calculate the price elasticity of supply only if other things are held constant. The relationship between price and quantity is always positive and so is the slope of the supply curve. This implies the price elasticity of supply will always be a positive number.

The standard method of computing the percentage (%) change is: (end value – start value /start value) x 100%. However, in the case of supply curve we are interested in finding the elasticity between two points where the distinction between start and end values is less meaningful.

For example take the following points:

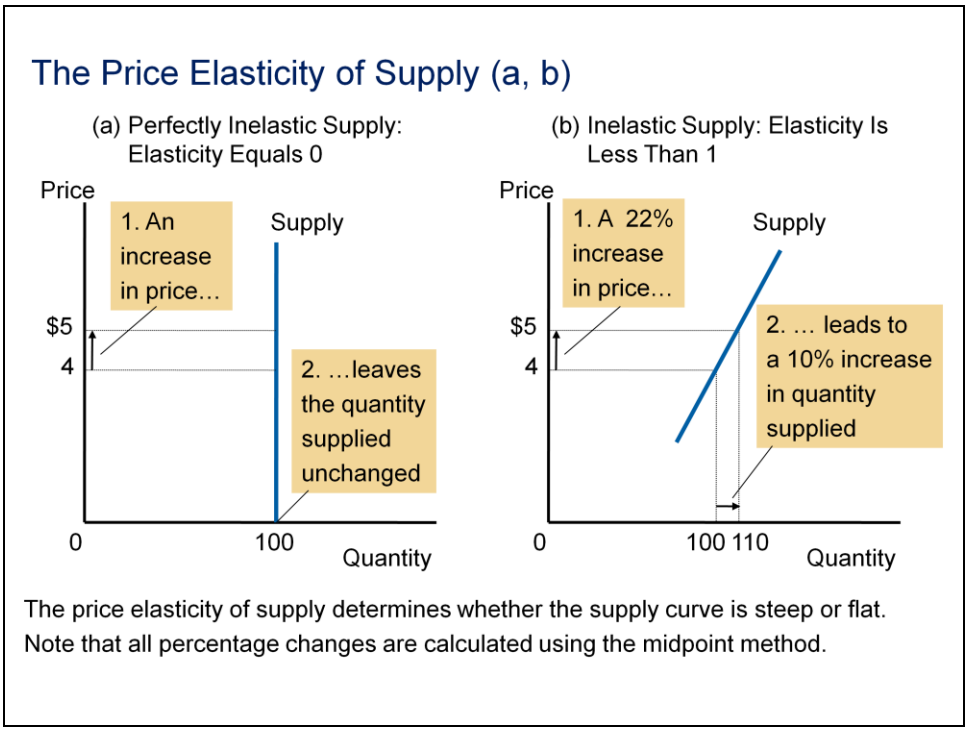
Point A : Price = €4 Quantity Supplied = 80

Point B : Price = €6 Quantity Supplied = 125

If we use the standard method of calculating elasticity and use point A as the

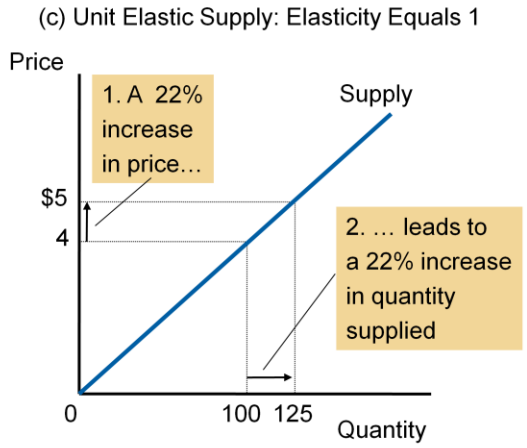
starting point then price rise should comes to 50%. However, if we use the point B as the starting point then the price fall should be 33%. Using these numbers for elasticity calculations will provide very different estimates. To avoid this problem we will use the midpoint method.

The midpoint is the number halfway between the start and end values, the average of those values. It doesn’t matter which value you use as the start and which as the end—you get the same answer either way!



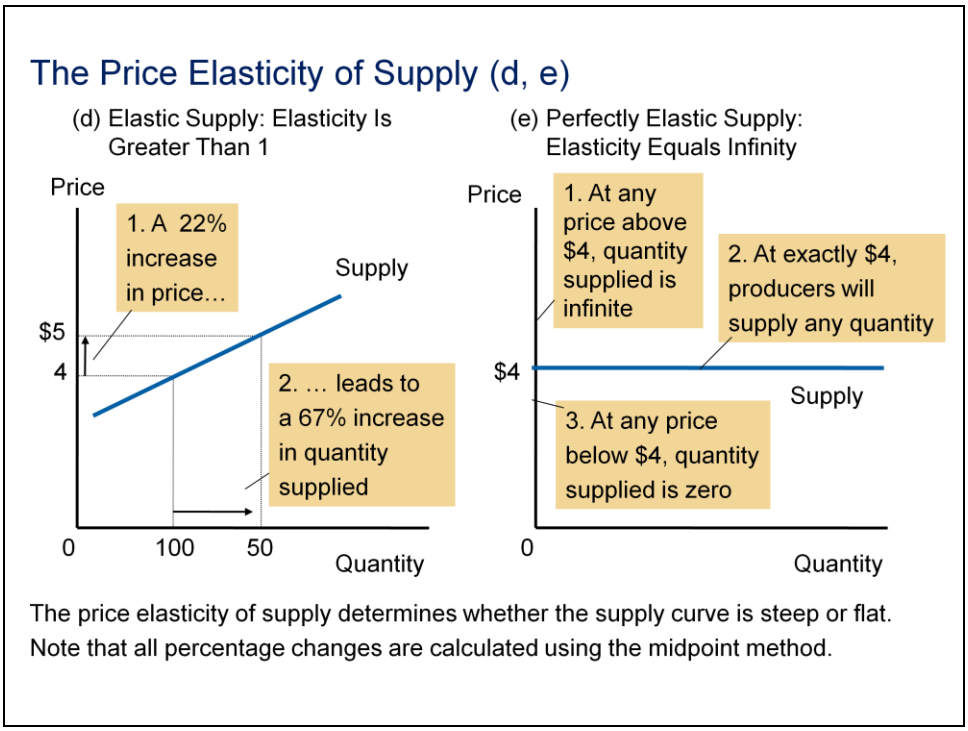
Price elasticity of supply measures the seller's responsiveness to price. If the scales on the axes of the diagrams used are the same then supply curves can be visually compared for elasticity. The diagram in panel a shows perfectly inelastic supply: Elasticity=0. If we think about this then it is fairly straightforward. If the price increases then the quantity supplied does not change. Thus supply is completely insensitive to price changes and hence this is represented as the vertical line. An example of this can be fresh fruit in the short run. The capacity of the mango farms cannot be changed overnight and once mangoes are harvested they are available in a fixed stock. Panel b shows the supply curve where elasticity is less than one. The curve captures the fact that in this case the change in price is proportionately greater than change in quantity supplied.

The Price Elasticity of Supply (c)



The price elasticity of supply determines whether the supply curve is steep or flat. Note that all percentage changes are calculated using the midpoint method.

If price elasticity of supply is equal to one then it is referred to as unit elastic. On this slide we have a diagram of supply curve that is unit elastic, where percentage change in quantity supplied is equal to the percentage change in price.



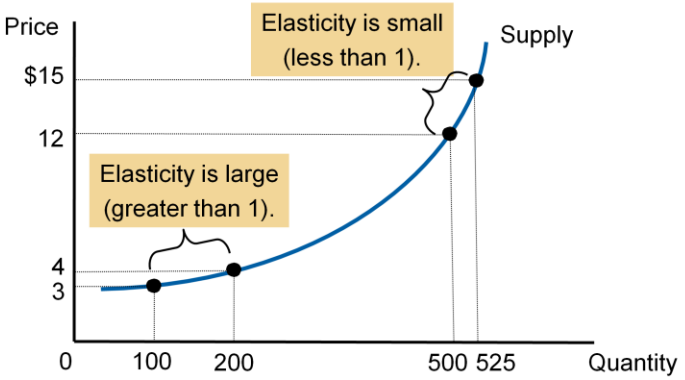
Elasticity of supply can be greater than one as depicted on the slide in panel d and e. As elasticity rises the supply curve gets flatter. In the case of panel d the elasticity is greater than one. The supply curve becomes horizontal in the case of perfectly elastic supply as illustrated on the slide.

The Elasticity of Supply

- Supply curve
  - Different price elasticities
    - Points with low price and low quantity
      - Elastic supply
      - Capacity for production not being used
    - Points with high price and high quantity
      - Inelastic supply

In some markets the price elasticity of supply is not constant and varies along the curve. In some cases points with low price and low quantity tend to elastic due to unused capacity. Small increases in prices increase the quantity substantially in order to capitalize on the potential for profit. As firms continue increasing production, firms begin to reach full capacity. Thus points with high price and high quantity may be inelastic.

How the Price Elasticity of Supply Can Vary

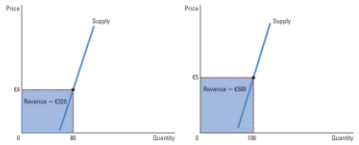


Because firms often have a maximum capacity for production, the elasticity of supply may be very high at low levels of quantity supplied and very low at high levels of quantity supplied. Here an increase in price from $3 to $4 increases the quantity supplied from 100 to 200. Because the 67% increase in quantity supplied (computed using the midpoint method) is larger than the 29% increase in price, the supply curve is elastic in this range. By contrast, when the price rises from $12 to $15, the quantity supplied rises only from 500 to 525. Because the 5% increase in quantity supplied is smaller than the 22% increase in price, the supply curve is inelastic in this range.

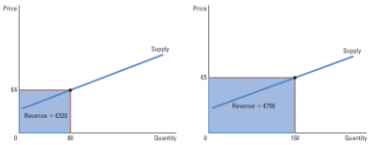
Because firms often have a maximum capacity for production, the elasticity of supply may be very high at low levels of quantity supplied and very low at high levels of quantity supplied. Here an increase in price from $3 to $4 increases the quantity supplied from 100 to 200. Because the 67% increase in quantity supplied (computed using the midpoint method) is larger than the 29% increase in price, the supply curve is elastic in this range. By contrast, when the price rises from $12 to $15, the quantity supplied rises only from 500 to 525. Because the 5% increase in quantity supplied is smaller than the 22% increase in price, the supply curve is inelastic in this range.

The **total revenue (TR)** received by sellers is **P x Q**, the price of the good times the quantity of the good sold

The change in **TR** as one moves along the supply curve depends on the elasticity of a supply



- If supply is inelastic, then an increase in the price causes an increase in TR that is proportionately less than the price change



- If the supply is elastic, then an increase in price leads to a much greater increase in TR

The total revenue (TR) received by sellers is P x Q, the price of the good times the quantity of the good sold

The change in TR as one moves along the supply curve depends on the elasticity of a supply

If supply is inelastic, then an increase in the price causes an increase in TR that is proportionately less than the price change

If the supply is elastic, then an increase in price leads to a much greater increase in TR

The Elasticity of Demand

- Elasticity
  - Measure of the responsiveness of quantity demanded or quantity supplied
  - To a change in one of its determinants
- Price elasticity of demand
  - How much the quantity demanded of a good responds to a change in the price of that good

The law of demand states that higher prices consumers reduce quantity demanded. The price elasticity of demand measures how much the quantity demanded responds to changes in the price. Demand of a good is said to be elastic (or price sensitive) if the quantity demanded responds substantially to changes in price. Demand is said to be inelastic (or price insensitive) if the quantity demanded responds only slightly to changes in the price.

The Elasticity of Demand

- Price elasticity of demand
  - Percentage change in quantity demanded divided by the percentage change in price
- Elastic demand
  - Quantity demanded responds substantially to changes in price
- Inelastic demand
  - Quantity demanded responds only slightly to changes in price

Price elasticity of demand measures the responsiveness of quantity demanded to its own price. There is an inverse relationship between price and quantity demanded, hence price elasticity of demand is always negative. For reasons of convention, we drop the minus sign and speak of price elasticity in absolute terms. The absolute value of own price elasticity can be greater than one in which case the demand is said to be elastic. This means an increase in the price of good will reduce the consumption considerably. Or a reduction in price will increase the consumption substantially. It is very important to remember the ceteris paribus assumption. We can calculate the own price elasticity of demand only if other things are held constant.

The Elasticity of Demand

- Determinants of price elasticity of demand
  - Availability of close substitutes
    - Goods with close substitutes: more elastic demand
  - Necessities vs. luxuries
    - Necessities: inelastic demand
    - Luxuries: elastic demand

Like supply a number of factors impact the elasticity of demand. We as consumers do not respond to the change in prices of different goods in the same fashion. For example, if the price of salt doubles- would you change your consumption patterns? Alternatively is the price of the house you want to buy doubles then you are unlikely to ignore it as you probably do for salt. Some of the factors affecting the own price elasticity include:

Available Substitutes: The more substitutes available for the good, the more elastic the demand. For example, butter and margarine can be easily substituted for each other. If there is a small in the price of butter, assuming the price of margarine is held fixed, causes a big drop in quantity of butter demanded as people start to consume margarine instead.

Necessities versus Luxuries: Necessities will have a more inelastic demand as compared to luxuries. For example, food is a necessity whereas a owning a sailing boat is a luxury for most people. If the price of food increases, people will still buy food. They may buy less of and avoid wastage but the demand of food will largely stay intact. However, people are going to be more responsive to the change in the price of a luxury such as a sailing boat. Thus, sailing boat will have a more elastic demand curve.

The Elasticity of Demand

- Determinants of price elasticity of demand
  - Definition of the market
    - Narrowly defined markets: more elastic demand
  - Time horizon
    - Demand is more elastic over longer time horizons
  - Proportion of income devoted to the product
    - Demand is more elastic for goods that take up a higher proportion of our income

Definition of the market: Narrowly defined markets have a greater price elasticity of demand than a broadly defined market. For example, the demand for beverages is more inelastic than the demand for coke.

Time: Demand tends to be more inelastic in the short term than in the long term. Time allows consumers to seek out available substitutes.

Proportion of income devoted to the product: Goods that comprise a small share of consumer's budgets tend to be more inelastic (e.g salt) than goods for which consumers spend a large portion of their incomes (e.g house).

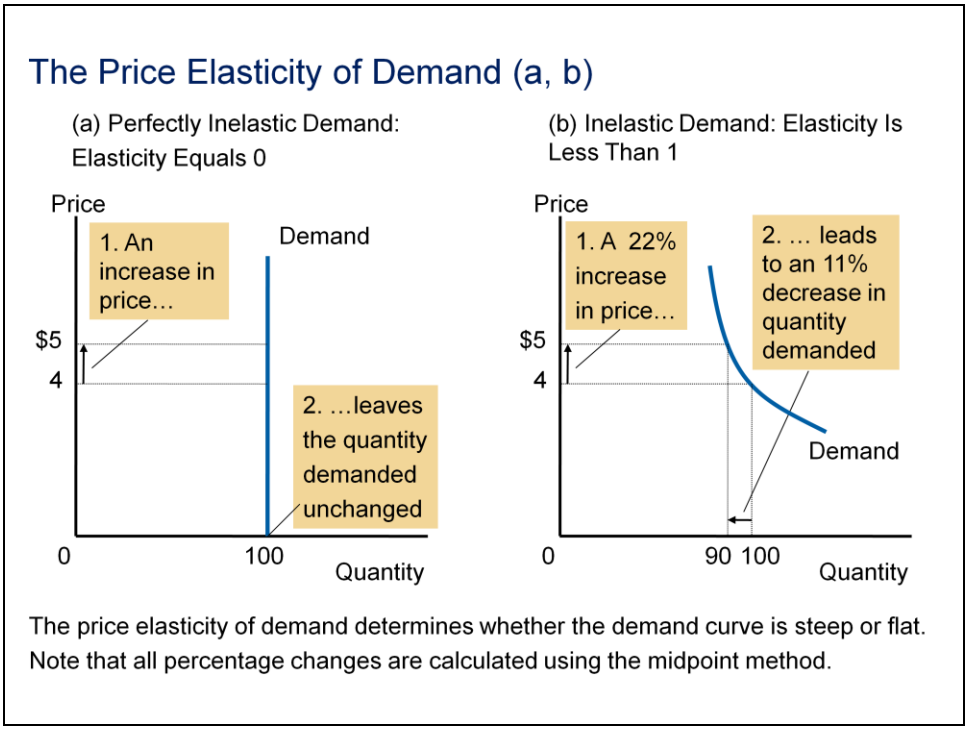
The Elasticity of Demand

- Computing the price elasticity of demand
  - Percentage change in quantity demanded divided by percentage change in price
  - Use absolute value (drop the minus sign)
- Midpoint method
  - Two points: (Q_1, P_1) and (Q_2, P_2)

$$\text{Price elasticity of demand} = \frac{(Q_2 - Q_1)/[(Q_2 + Q_1)/2]}{(P_2 - P_1)/[(P_2 + P_1)/2]}$$

Elasticity of demand is measured as percentage change in quantity demanded divided by percentage change in price. It is very important to remember the ceteris paribus assumption. We can calculate the price elasticity of demand only if other things are held constant. There is an inverse relationship between price and quantity demanded, hence own price elasticity of demand is always negative. For reasons of convention, we drop the minus sign and speak of own price elasticity in absolute terms.

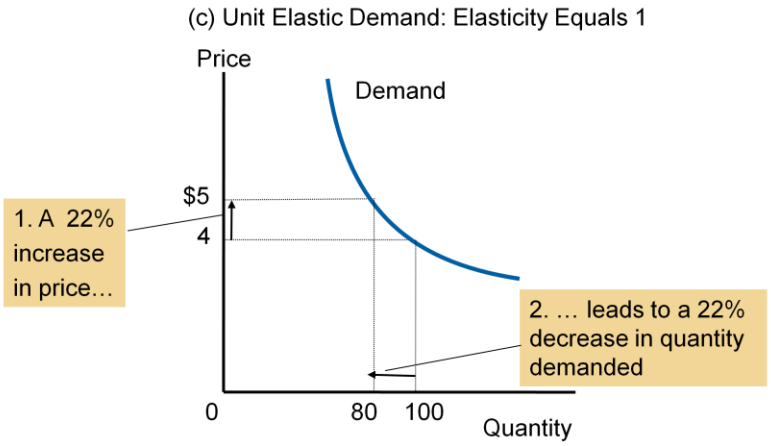
As with supply, we use the midpoint method for calculating price elasticity of demand- for the same reasons discussed earlier while calculating elasticity of supply.



As with supply, demand curves can be classified according to their elasticity.

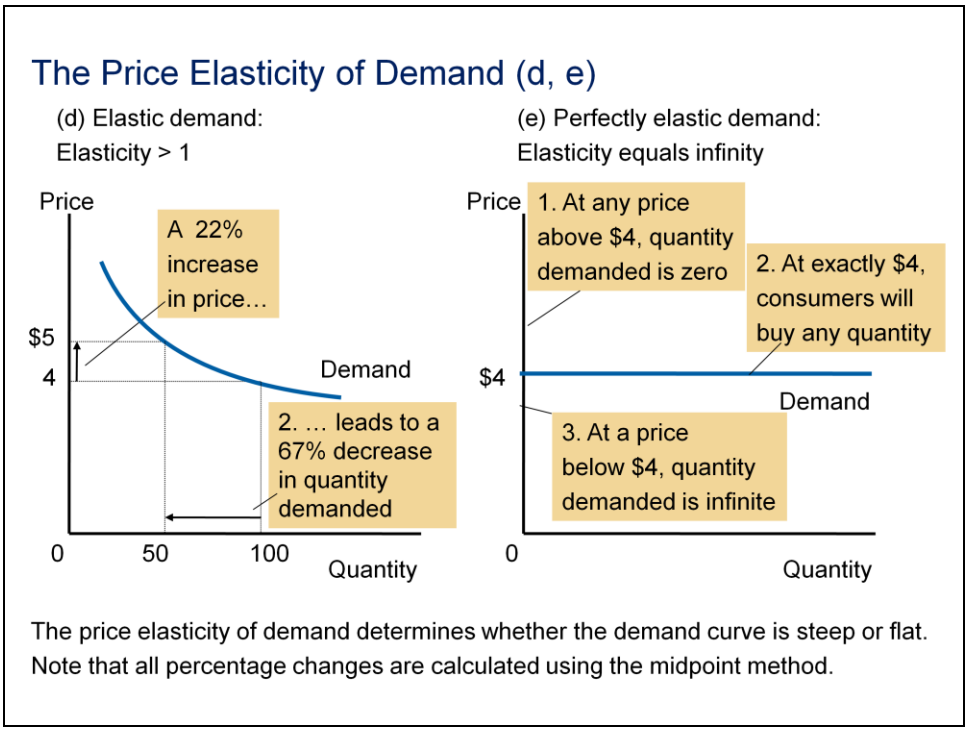
Demand is perfectly inelastic if price elasticity of demand = 0. In this case demand curve is vertical as depicted in panel a. An example of a vertical demand curve may include medication for diabetes where the consumer is entirely dependent on the medication and therefore not responsive to price. Demand is inelastic if price elasticity of demand < 1 as depicted in panel b. Here an increase in price has a relatively small affect on demand. An example of this would be a commodity like cigarettes that are highly addictive.

The Price Elasticity of Demand (c)



The price elasticity of demand determines whether the demand curve is steep or flat. Note that all percentage changes are calculated using the midpoint method.

Demand has unit elasticity if price elasticity of demand = 1. This is an intermediate case where demand is neither highly price-sensitive or completely unresponsive.



Demand is elastic if price elasticity of demand > 1 as depicted in panel d. A number of goods with a variety of substitutes will fit this case. Demand is perfectly elastic if price elasticity of demand = infinite. In this case demand curve is horizontal, shown in panel e.

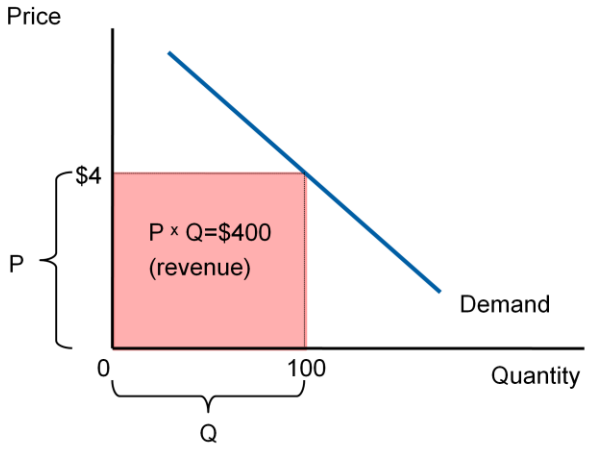
As a rule of thumb the flatter the demand curve, the greater is the price elasticity of demand. However, please note that this will only work if the measurement scales across different demand curves are comparable especially if demand curves are not perfectly elastic or inelastic.

The Elasticity of Demand

- Total revenue, TR
  - Amount paid by buyers and received by sellers of a good
  - Price of the good times the quantity sold ($P \times Q$)
- For a price increase
  - If demand is inelastic, TR increases
  - If demand is elastic, TR decreases

The expenditure on a good or the total revenue received by the seller ultimately depends on the purchasing habits of buyers. A producer therefore has to be mindful of the consumer's sensitivity to price changes in any decisions as it has a direct impact on the total revenue received. The consumer response to price changes in turn depends on elasticity. If demand is inelastic, a price increase will cause TR to go up. If demand is elastic, a price increase will cause TR to go down. In the next few slides we will analyse the reason behind this step by step.

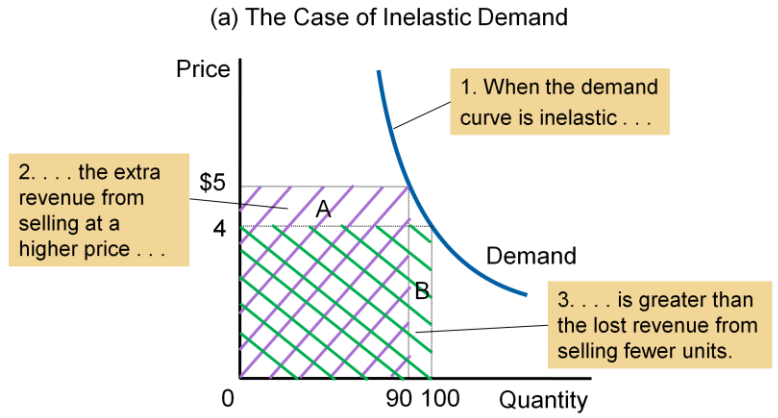
Total Revenue



The total amount paid by buyers, and received as revenue by sellers, equals the area of the box under the demand curve, $P \times Q$. Here, at a price of $4, the quantity demanded is 100, and total revenue is $400.

The total amount paid by buyers, and received as revenue by sellers, equals the area of the box under the demand curve, $P \times Q$. Here, at a price of $4, the quantity demanded is 100, and total revenue is $400. This is illustrated by the pink rectangle in the slide above.

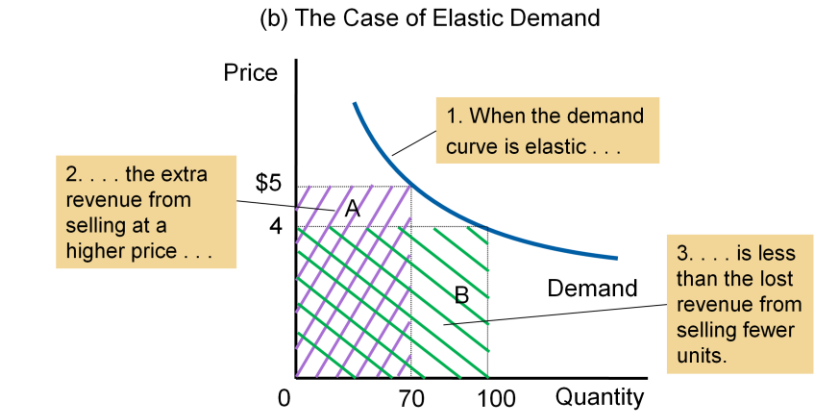
How Total Revenue Changes When Price Changes (a)



The impact of a price change on total revenue (the product of price and quantity) depends on the elasticity of demand. In panel (a), the demand curve is inelastic. In this case, an increase in the price leads to a decrease in quantity demanded that is proportionately smaller, so total revenue increases. Here an increase in the price from $4 to $5 causes the quantity demanded to fall from 100 to 90. Total revenue rises from $400 to $450.

The impact of a price change on total revenue (the product of price and quantity) depends on the elasticity of demand. In panel (a), the demand curve is inelastic. In this case, an increase in the price leads to a decrease in quantity demanded that is proportionately smaller, so total revenue increases. Here an increase in the price from $4 to $5 causes the quantity demanded to fall from 100 to 90. Total revenue rises from $400 to $450.

How Total Revenue Changes When Price Changes (b)



The impact of a price change on total revenue (the product of price and quantity) depends on the elasticity of demand. In panel (b), the demand curve is elastic. In this case, an increase in the price leads to a decrease in quantity demanded that is proportionately larger, so total revenue decreases. Here an increase in the price from $4 to $5 causes the quantity demanded to fall from 100 to 70. Total revenue falls from $400 to $350.

The impact of a price change on total revenue (the product of price and quantity) depends on the elasticity of demand. In panel (b), the demand curve is elastic. In this case, an increase in the price leads to a decrease in quantity demanded that is proportionately larger, so total revenue decreases. Here an increase in the price from $4 to $5 causes the quantity demanded to fall from 100 to 70. Total revenue falls from $400 to $350.

The Elasticity of Demand

- When demand is inelastic (elasticity < 1)
  - P and TR move in the same direction
    - If P ↑, TR also ↑
- When demand is elastic (elasticity > 1)
  - P and TR move in opposite directions
    - If P ↑, TR ↓
- If demand is unit elastic (elasticity = 1)
  - Total revenue remains constant when the price changes

To summarise our discussion on price elasticity of demand and TR, we have two opposing forces when price changes. On one hand an increase in price increases total revenue. However, a price increase also causes a fall in quantity demanded. Elasticity helps us determine which of these opposing effects dominate and whether the total revenue will increase or decrease.

When demand is inelastic (elasticity < 1)

-P and TR move in the same direction

If P ↑, TR also ↑

When demand is elastic (elasticity > 1)

-P and TR move in opposite directions

If P ↑, TR ↓

If demand is unit elastic (elasticity = 1)

-Total revenue remains constant when the price changes

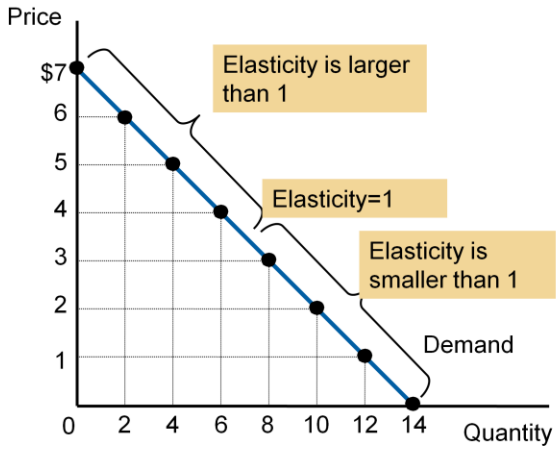
The Elasticity of Demand

- Linear demand curve
  - Constant slope
    - Rise over run
  - Different price elasticities
    - Points with low price and high quantity
      - Inelastic demand
    - Points with high price and low quantity
      - Elastic demand

The demand curves we have analysed so far have an elasticity that is same along the whole curve. This, however, is not always the case. Most of the times we will work with linear demand curve, which has a constant slope but varying elasticity figures along the curve. Slope is defined as the ratio of changes in two variables (rise over run), whereas the elasticity is the ratio of percentage changes in the two variables.

The linear demand curve tends to be inelastic at points with low price and high quantity. Whereas points with high price and low quantity tend to lie in the elastic region of the linear demand curve.

Elasticity of a Linear Demand Curve (graph)



The slope of a linear demand curve is constant, but its elasticity is not. The demand schedule in the table was used to calculate the price elasticity of demand by the midpoint method. At points with a low price and high quantity, the demand curve is inelastic. At points with a high price and low quantity, the demand curve is elastic.

The diagram above shows the elasticity at various points along a linear demand curve. Unlike slope, elasticity is not constant along the linear demand curve. As price increase demand becomes more elastic. The elastic area on the demand curve shows the region where Elasticity>1, followed by region of unit elasticity and then the area of where Elasticity<1. According to the formula price elasticity, elastic area means that a percent fall in price increases the quantity demanded by more than a percent. Connecting this to Total revenue or revenue implies that if we are in the elastic region and we reduce the price then total revenue will increase. On the other hand in the inelastic region a percent reduction in price will lead to less than a percent increase in quantity, causing the total revenue to fall. Total revenue is maximized at the point of unit elasticity. The unit elastic point lies in the middle of the curve.

The Elasticity of Demand

- Income elasticity of demand
  - How much the quantity demanded of a good responds to a change in consumers' income
  - Percentage change in quantity demanded
    - Divided by the percentage change in income

In addition to price elasticity, economists also rely on other elasticities to describe consumer behaviour in the market. Income elasticity provides a useful measure of how the quantity demanded changes as consumer income changes. Income elasticity is equal to percentage change in quantity demanded divided by the percentage change in income.

The Elasticity of Demand

- Normal goods
  - Positive income elasticity
  - Necessities
    - Smaller income elasticities
  - Luxuries
    - Large income elasticities
- Inferior goods
  - Negative income elasticities

Most goods such as shoes, clothes, computers are normal good, which implies that higher income leads to more demand. However, some goods such as bus rides tend to be inferior goods. As income goes up we tend to use less of public transport and therefore income elasticity tends to be negative. Necessities such as food tend have small income elasticities because we all rely on food regardless of income. On the other hand luxuries such as diamonds have a high income elasticity because people can do without these goods in times of income reductions.

The Elasticity of Demand

- Cross-price elasticity of demand
  - How much the quantity demanded of one good responds to a change in the price of another good
  - Percentage change in quantity demanded of the first good (Good X)
    - Divided by the percentage change in price of the second good (Good Y)

As we know the demand for a good is also affected by change in prices of related goods. For example the demand for bananas gets affected by the price of apples/oranges etc. So we can calculate the effect of price changes of related goods using cross price elasticity of demand. The same principles that we discussed previously apply here. All you do is calculate the percentage change of quantity demanded of good X and the percentage change of price of good Y. Dividing the two gives us the cross price elasticity. Here the sign is extremely important. If the sign is positive, it means that when the price of good Y increases, the demand for good X goes up. Hence, the two goods are substitutes (goods typically used in place of one another

). If the sign is negative, it means that when the price of good Y increases, the demand for good X goes down. Implying that the two goods are complements (Goods that are typically used together).

Applications

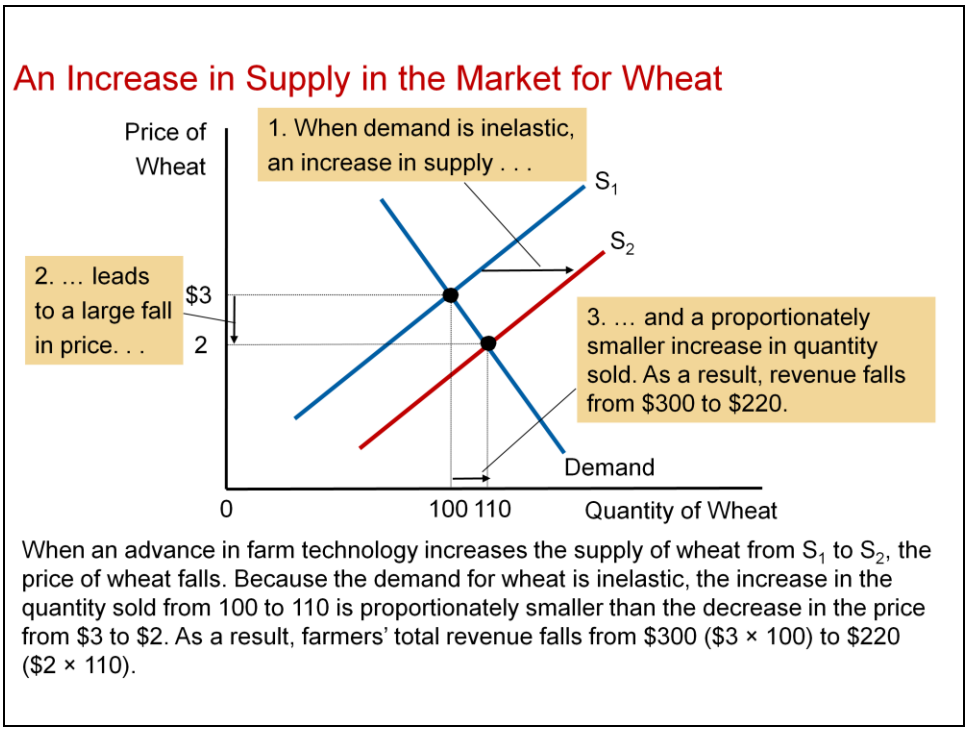
- Can Good News for Farming Be Bad News for Farmers?
  - New hybrid of wheat – increase production per acre 20%
    - Supply curve shifts to the right
    - Higher quantity and lower price
    - Demand is inelastic: total revenue falls

Imagine a situation where you are a wheat farmer and a new crop variety increases the production per acre by 20%. This causes:

Supply curve shifts to the right

Higher quantity and lower price

Demand is inelastic: total revenue falls



When an advance in farm technology increases the supply of wheat from S_1 to S_2, the price of wheat falls. Because the demand for wheat is inelastic, the increase in the quantity sold from 100 to 110 is proportionately smaller than the decrease in the price from $3 to $2. As a result, farmers' total revenue falls from $300 ($3 × 100) to $220 ($2 × 110).

In this example we see the two opposing factors impacting the total revenue. Since the quantity sold is now more than before TR increases. But at the same time the price for each unit sold goes down. Since in this case demand is inelastic, overall the revenue goes down.

Applications

- Can Good News for Farming Be Bad News for Farmers?
  - Paradox of public policy
    - Induce farmers not to plant crops

The paradox of public policy arises from the fact that what may be good news for the economy may not be good news for individual farmers. This may also explain why despite the improvements in technology many farmers have left the farm for jobs in the city.