Chapter 5 Elasticity

Elasticity

- is a measure of how much buyers and sellers respond to changes in market conditions.
- measures how responsive Qd or Qs is to changes in price, income or prices of related goods.
- allows us to analyze supply and demand with greater precision.

Elasticity of Demand

- Price elasticity of demand is a measure of how much the quantity demanded of a good responds to a change in the price of that good.

- Price elasticity of demand is the percentage change in quantity demanded given a percent change in the price.

- The price elasticity of demand is computed as the percentage change in the quantity demanded divided by the percentage change in price.
- We'll denote price elasticity by Ep.

- $$Ep = \frac{\text{percentage change in Qd}}{\text{percentage change in P}}$$

$$= \frac{\%\ \triangle \text{ in Qd}}{\%\triangle \text{ in P}}$$

- The number we get from our calculations is called the coefficient of elasticity.
- The size of the coefficient, Ep, will tell us how elastic the good is – how responsive demand is to a change in price.
- Since elasticity will vary, we can define different types of elasticity.

Types of Price Elasticity

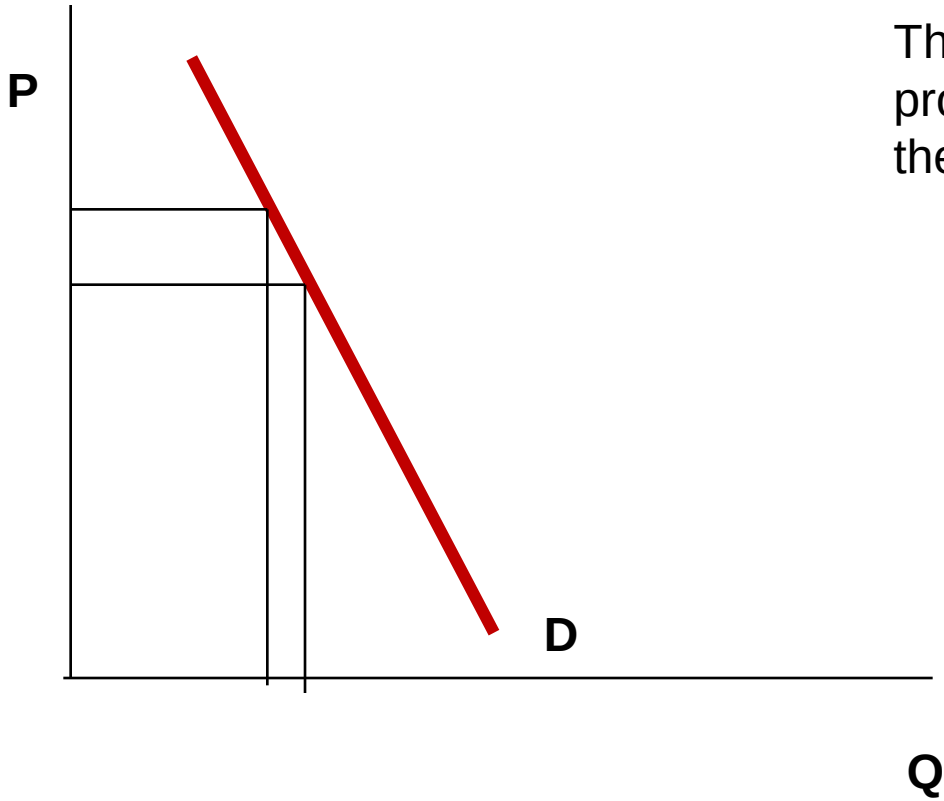
- People respond to changes in price differently depending on various factors.

- Are there a large number of substitutes?
- Is the good a luxury or a necessity?
- How narrowly defined is the market?
- What about the time period?

Inelastic Demand

- Quantity demanded does not respond strongly to price changes.
- The % change in Qd < % change in P
- Ep < 1
- The demand curve would be fairly steep.
- Example: required textbooks. Your only option to buying a new book is to find a used copy, which may be difficult.

- Inelastic Demand

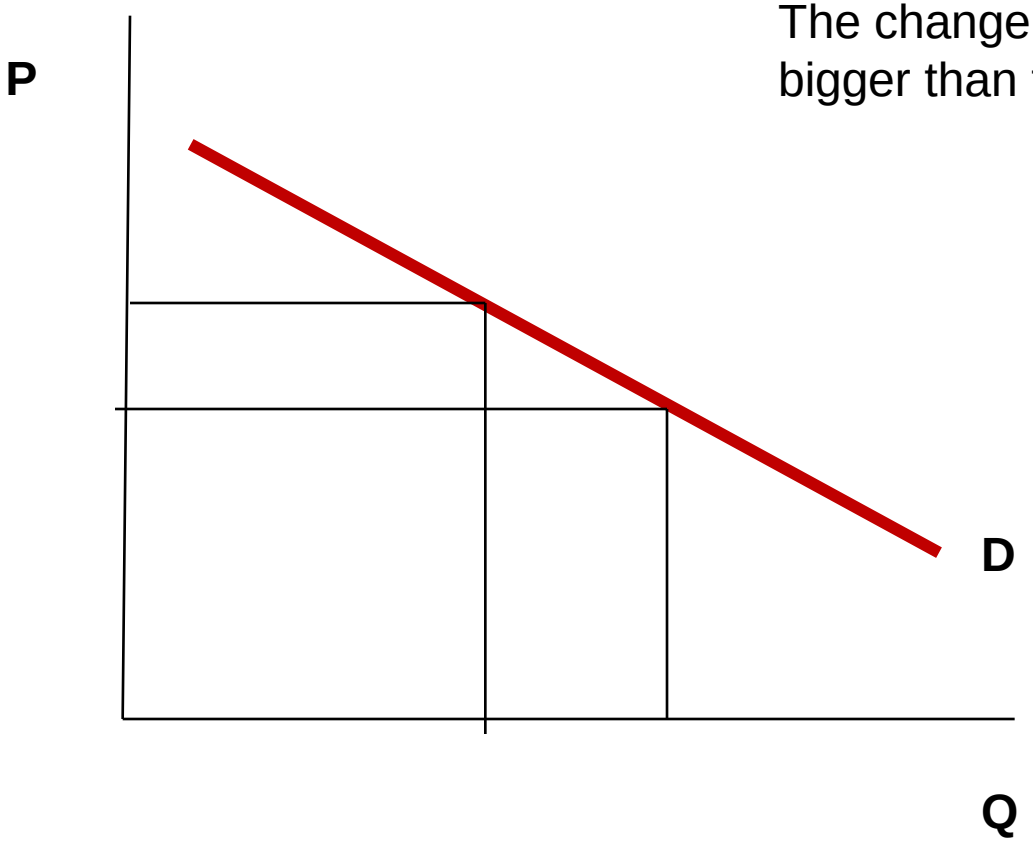


The change in P is proportionally bigger than the change in Q.

Elastic Demand

- Quantity demanded responds strongly to changes in price.
- The % change in Qd > % change in P
- Ep > 1
- The demand curve would be fairly flat.
- Example: most manufactures.

- Elastic Demand

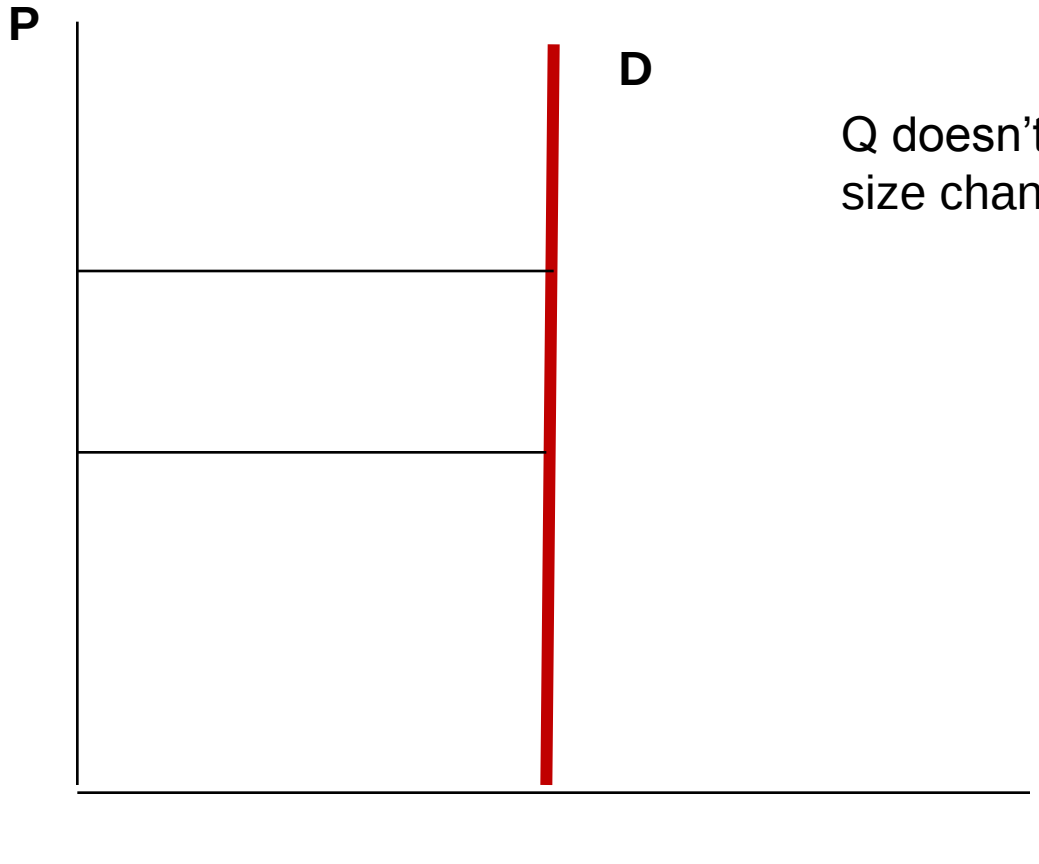


The change in Q is proportionally bigger than the change in P.

Perfectly Inelastic Demand

- Quantity demanded does not respond to price changes at all.
- Ep = 0
- The demand curve is vertical.
- Example: prescription heart medication. If you need it to stay alive, price is not even an issue.

- Perfectly Inelastic Demand

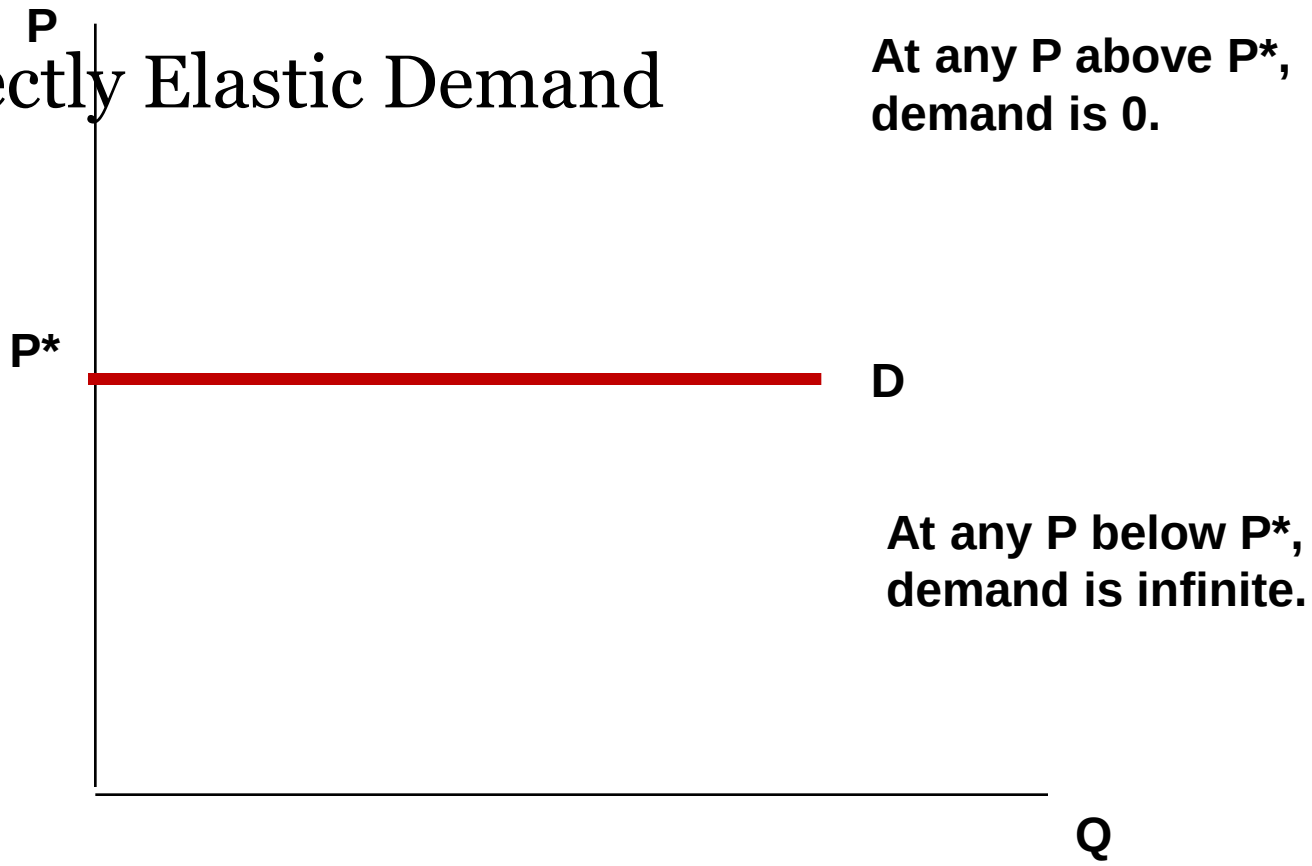


Q doesn't change for any size change in P.

Perfectly Elastic Demand

- Quantity demanded changes infinitely with any change in price.
- Ep => infinity
- The demand curve is horizontal.
- Example: wheat. If a supplier raises her price, you'll find a cheaper supplier because wheat is wheat – she won't sell any wheat, so she faces a perfectly elastic demand for her wheat .

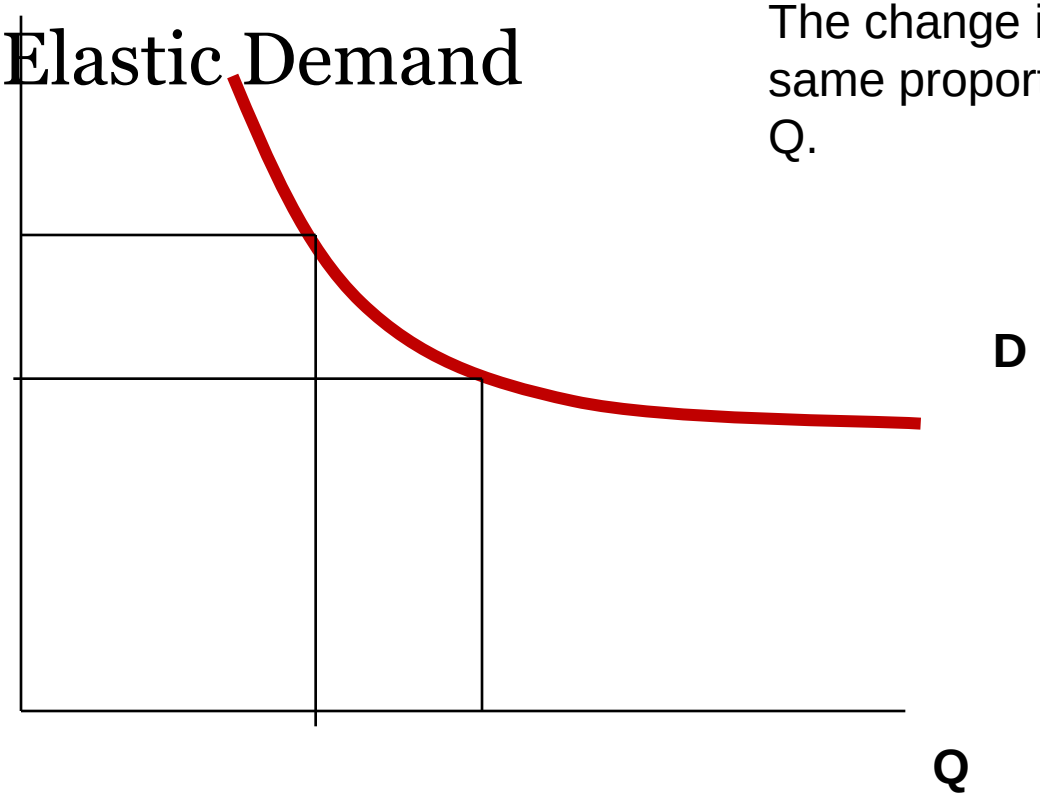
- Perfectly Elastic Demand



Unit Elastic

- Quantity demanded changes by the same percentage as the price
- Ep = 1
- The demand curve is non-linear.
- Example: none really exist, so think of unit elasticity as simply a dividing point between elastic and inelastic.

- Unit Elastic Demand



The change in P leads to the same proportionate change in Q.

- NOTE: The more price - elastic the demand for a good, the flatter the demand curve will be.

Calculating Elasticity

- If we are given percentage changes in price and the corresponding changes in Qd, we use the formula

$$Ep = \frac{\%\triangle \text{ in Qd}}{\%\triangle \text{ in P}}$$

- For example,

  The price of milk increases by 2% and Qd decreases by .5%

  Ep = -.5/2 = -.25

- Another formula we use is the midpoint formula.
- The midpoint formula is preferable when calculating the price elasticity of demand because it gives the same answer regardless of the direction of the change.
- We use it when we are given two prices and their corresponding Qd values.

- The midpoint formula is:

$$Ep = \frac{(Q_2 - Q_1) / ([Q_2 + Q_1] / 2)}{(P_2 - P_1) / ([P_2 + P_1] / 2)}$$

- Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand would be calculated as:

- $P_1 = 2.00$
- $P_2 = 2.20$
- $Q_1 = 10$
- $Q_2 = 8$

$$Ep = \frac{(8 - 10) / (8 + 10) /2}{(2.20 - 2.00) / (2.20 + 2.00) /2}$$

$$= \frac{-2 /9}{.20 / 2.10}$$

$$= - .22 / .095$$

$$= -2.32$$

- In both examples, we have an elasticity coefficient that has a negative sign.
- But, remember the law of demand: as P↑, Qd ↓. The coefficient will always be a negative number.
- Since we're smart economists and know this, when we calculate price elasticity, we drop the negative sign (we know it will always be negative).

- So, in our milk example, Ep = .25
- Since Ep < 1, the demand for milk is inelastic.
- Demand does not respond strongly to changes in price.

- In our ice cream example, Ep = 2.32
- Since Ep > 1, the demand for ice cream is elastic.
- Demand responds strongly to changes in price.

Generalities About Elasticities and Their Determinants

1. Goods that are necessities tend to have inelastic demand.
- Example: the demand for insulin would be perfectly inelastic (no matter how much price changes, if you have to have insulin, you'll buy it).
- Example: the demand for dentist visits would be inelastic (if price went up, you may try to wait or shop around, but you'll still go to get rid of the pain).

2. Goods that are luxuries tend to have elastic demand.

- Example: the demand for plasma TVs (if the price is right, you may buy one, but you likely won't buy one if the price is too high for your budget).
- Example: vacations abroad (same reason as above).

3. Goods that have close substitutes tend to have elastic demand.

- Example: Coke and Pepsi (if the price of Coke goes up, many consumers will switch to Pepsi).
- Example: Eggs don't really have a close substitute (their demand is pretty inelastic).

4. Goods tend to have more elastic demand over longer time horizons.

- You can find substitutes in the long run where you can't in the short run.

5. How you define the market makes a difference.

- Example: food – inelastic
  vegetables – more elastic
  broccoli – even more elastic

- The more narrowly defined the market, the more elastic the demand for that good.

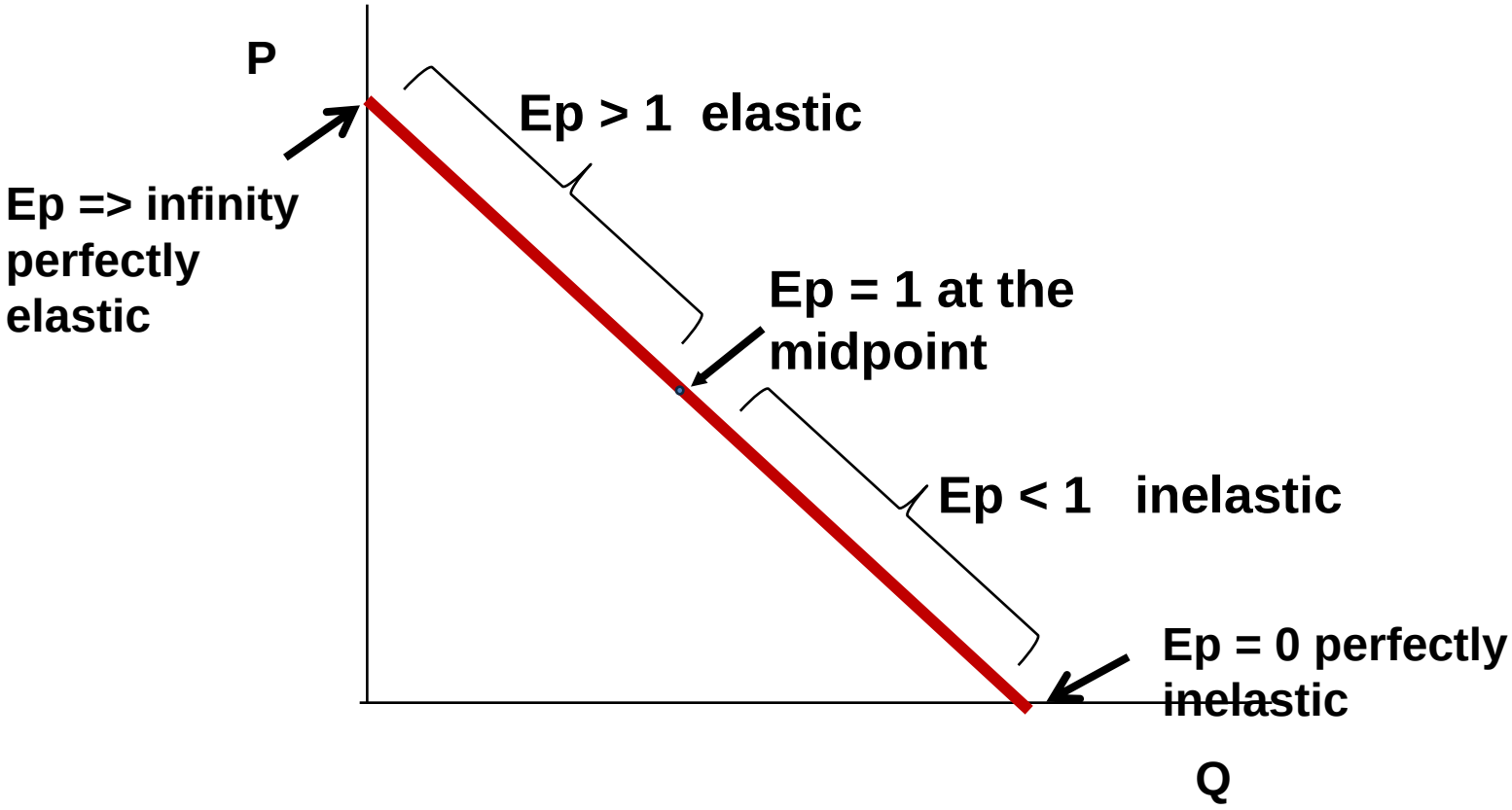
6. How much of your budget you spend on a good determines elasticity.

- If you spend a large proportion of your budget on a good, demand for that good will tend to be elastic.
- If you only spend a small proportion of your budget on a good, demand will tend to be inelastic.

- Elasticity is not constant along a linear demand curve.
- Elasticity is not the same as slope.
- Slope measures rates of change.
- Elasticity measures percentage changes.

- We can illustrate different elasticities along the demand curve:

Elasticity Along the Demand Curve



Optional – For Calculus Lovers

- Technically, elasticity measures marginal changes in Qd when price changes.
- This is point elasticity, and the formula for a demand curve specified as Q = f(p) is
- $E_p = dQ/dp * p/Q$
- Since p and Q are different combinations at different points on the demand curve, that's why elasticity changes along the demand curve.
- Since dQ/dp is the slope of the demand curve, that's why we can "see" elasticity by the steepness of the curve.

Price Elasticity and Total Revenue

- A firm wants to maximize its profit. Other things being equal, it will want to maximize its total revenue.
- The firm would like to sell as much as it could at the highest price it could get. But, it wouldn't want to charge a price so high that it loses customers and its revenue drops.
- Here's where knowing the price elasticity of demand for its good is handy for a firm.

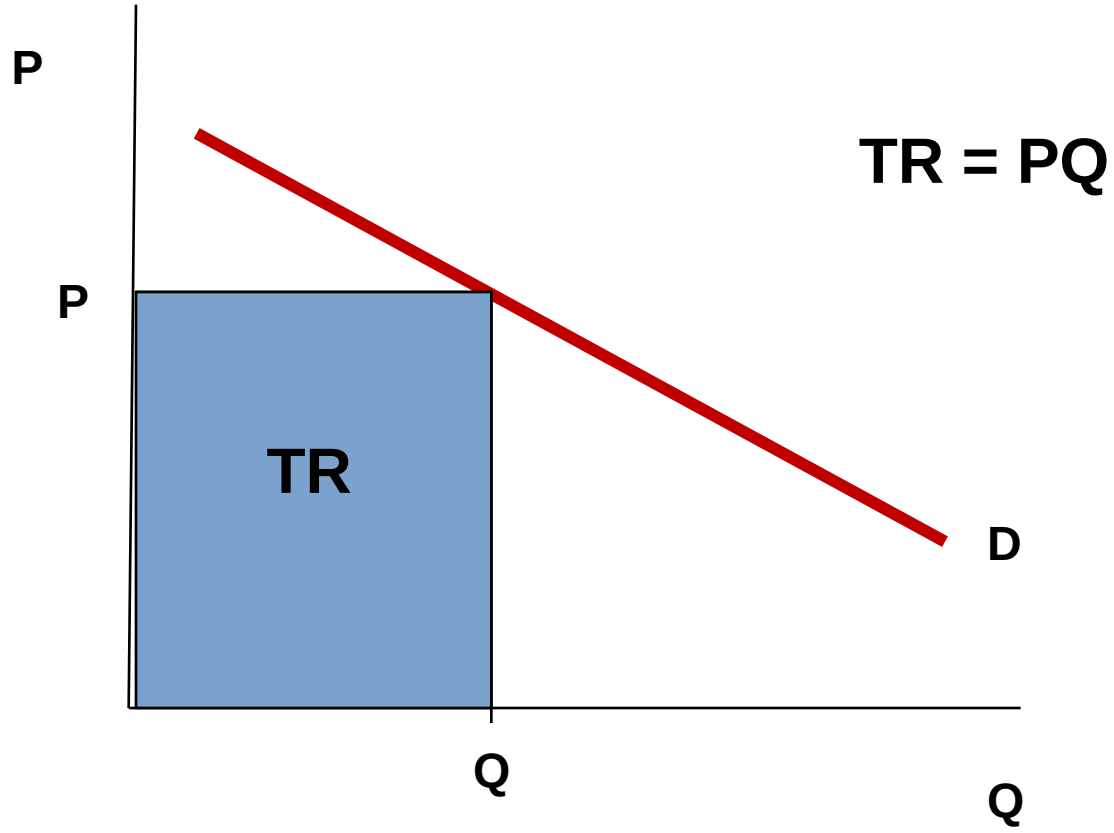
- Total revenue, TR, is defined as

  $$TR = PQ$$

  (price times the quantity traded)

- Diagrammatically,

- Total Revenue, TR



- With an inelastic demand curve, an increase in price leads to a decrease in quantity that is proportionately smaller.
- The gain to TR from the P increase will outweigh the loss to TR from a decrease in Q.
- A firm would only lose a few sales but make up for it by getting a higher price for the sales it does make.
- TR will increase if P ↑ if demand is inelastic.
- So, if a firm wants to ↑ TR and demand for its good is inelastic, it should ↑ P.

- With an elastic demand curve, an increase in the price leads to a decrease in quantity demanded that is proportionately larger.
- The gain to TR from the P increase will be outweighed by the loss in TR from lost sales.
- A firm would lose so many sales that even with a higher price on the sales it does make, it still ends up with less total revenue.
- TR will decrease if P ↑ if demand is elastic.
- So, if a firm wants to ↑ TR and demand for its good is elastic, it should ↓ P.

- If demand is unit elastic, the gain to TR from a P increase (or decrease) will be exactly offset by the decrease (or increase) in Q.
- TR will not increase if P↑ and demand is unit elastic.
- TR will not increase if P↓ and demand is unit elastic.
- No change in P will ↑ TR, so
- TR must be at a maximum when Ep = 1.

Income Elasticity of Demand

- Income elasticity of demand measures how much the quantity demanded of a good responds to a change in consumers' income.
- It is computed as the percentage change in the quantity demanded divided by the percentage change in income.
- Income elasticity is denoted E_I

- If we are given percentage changes in income and the corresponding changes in Qd, we use the formula

$$E_I = \frac{\%\triangle \text{ in Qd}}{\%\triangle \text{ in I}}$$

- If we are given 2 levels of income and their corresponding Qd, we use the midpoint formula.

- The midpoint formula is:

$$E_I = \frac{(Q_2 - Q_1) / ([Q_2 + Q_1] / 2)}{(I_2 - I_1) / ([I_2 + I_1] / 2)}$$

Here, the plus or minus sign matters.

- If $E_I > 0$
  - the good is a normal good
  - as I↑, Qd ↑

- If $E_I < 0$
  - the good is an inferior good
  - as I↓, Qd ↑

- If E_I is between -1 and 1, the good is income inelastic.
- If E_I is greater than 1 or less than -1, the good is income elastic.

Goods consumers regard as necessities tend to be income inelastic.

- Examples include food, fuel, clothing, utilities, and medical services.

Goods consumers regard as luxuries tend to be income elastic.

- Examples include sports cars, jewelry, Buffalo Bills season tickets and expensive foods.

- Example:
- Consumer incomes decrease from $45 000 to $40 000. Demand for instant mashed potatoes increases from 100 boxes to 102 boxes per year.
- $Q_1 = 100$
- $Q_2 = 102$
- $I_1 = \$45\ 000$
- $I_2 = \$40\ 000$

- $E_I = \frac{(102-100) / (102 + 100) / 2}{(40000 - 45000) / (40000 + 45000) / 2}$

  $= .02 / - .117$

  $= -.17$

Instant mashed potatoes are income inelastic (elasticity is a fraction) and inferior (elasticity is negative).

Cross-Price Elasticity of Demand

- Denoted E_{ab}, cross-price elasticity measures the response of Qd of a good "a" to a change in price of good "b".
- $E_{ab} = \dfrac{\%\triangle \text{ in Qd of good "a"}}{\%\triangle \text{ in P of good "b"}}$

- The midpoint formula is:

$$E_{ab} = \frac{(Q_{2a} - Q_{1a}) / (Q_{2a} + Q_{1a}) / 2}{(P_{2b} - P_{1b}) / (P_{2b} + P_{1b}) / 2}$$

- The plus or minus sign matters.

- If elasticity is > 0, an increase in P of "b" will lead to an increase in Qd of "a"
  - the goods are substitutes

- If elasticity is < 0, an increase in P of "b" will lead to a decrease in Qd of "a"
  - the goods are complements

- Example: The price of a soft drink increases from $1.99 to $2.49 per 2-litre bottle. Demand for a fruit juice increases from 500 to 1000 bottles.

$Q_{1a} = 500$
$Q_{2a} = 1000$
$P_{1b} = 1.99$
$P_{2b} = 2.49$

$$E_{ab} = \frac{(1000 - 500) / (1000 + 500) / 2}{(2.49 - 1.99) / (2.49 + 1.99) / 2}$$

$$= .67 / .22$$

$$= 3.05$$

- Elasticity is positive so the goods are substitutes.
- NOTE: if cross-price elasticity equals 0, the goods are <u>not</u> related.

Elasticity of Supply

- Price elasticity of supply, Es, is a measure of how much the quantity supplied of a good responds to a change in the price of that good.
- Price elasticity of supply is the percentage change in quantity supplied resulting from a percent change in price.
- Since P and Qs always move in the same direction, Es will always be > 0.

- $Es = \frac{\%\triangle \text{ in Qs}}{\%\triangle \text{ in P}}$

- The midpoint formula is:

$$Es = \frac{(Q_2 - Q_1) / ([Q_2 + Q_1] / 2)}{(P_2 - P_1) / ([P_2 + P_1] / 2)}$$

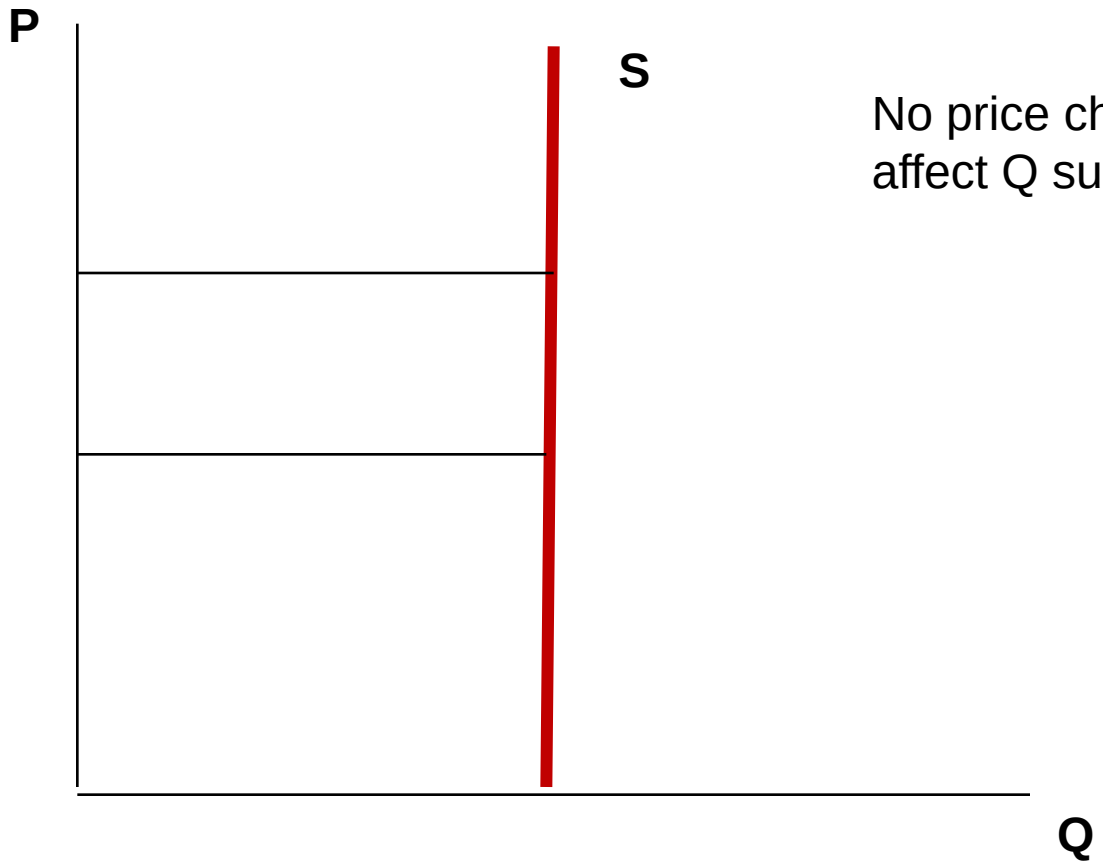
where Q = quantity supplied.

- Just as we did for price elasticity of demand, we can categorize types of elasticity of supply:

Perfectly Inelastic Supply

- Es = 0
- Supply curve is vertical.
- Examples: agricultural products, rare art.

- Perfectly Inelastic Supply

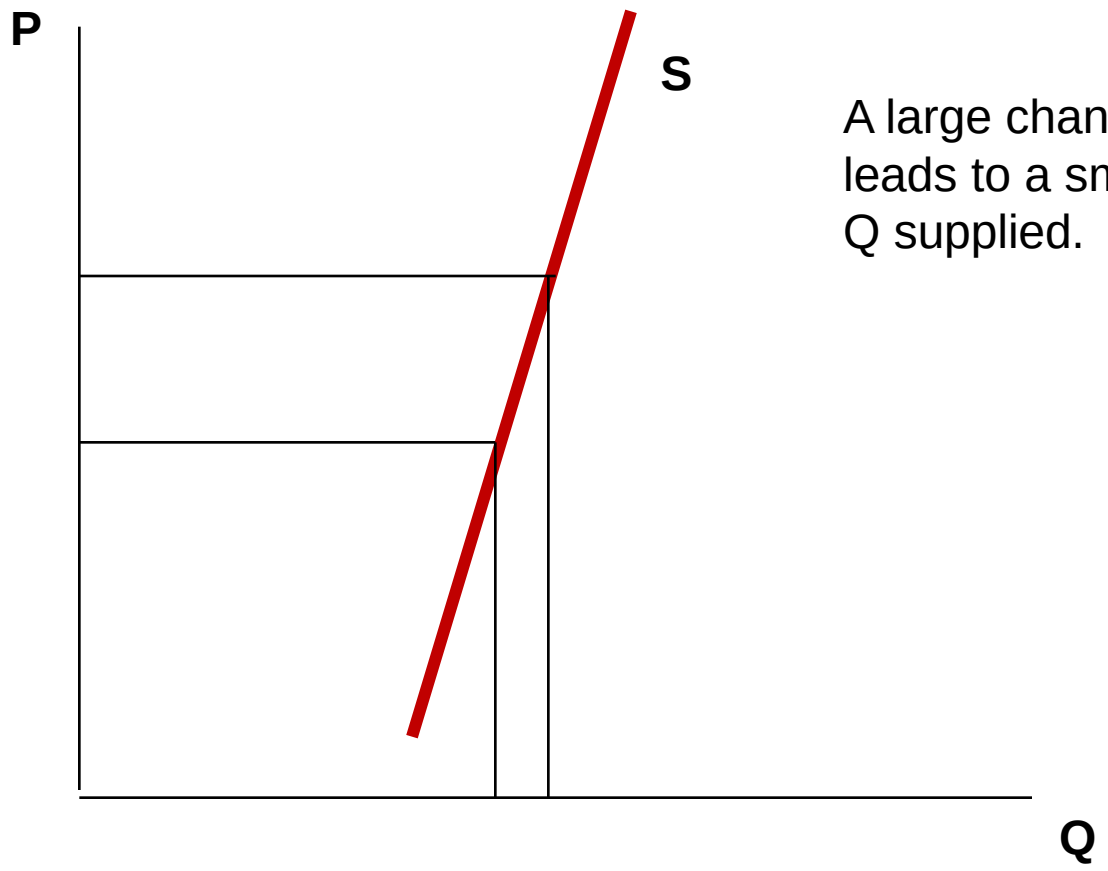


No price change can affect Q supplied.

Inelastic Supply

- Es between 0 and 1 (a fraction).
- Supply curve is fairly steep.
- Example: lakefront property.

- Inelastic Supply

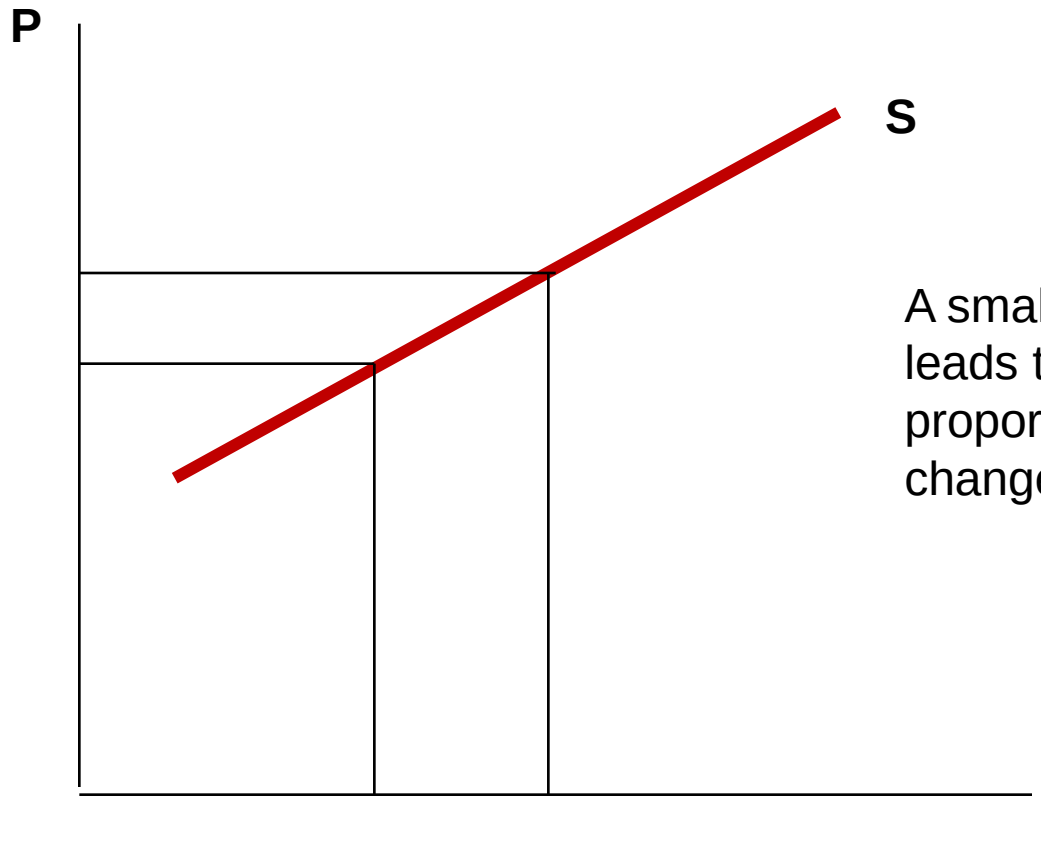


A large change in P only leads to a small change in Q supplied.

Elastic Supply

- Es > 1
- Supply curve is fairly flat.
- Example: most manufactures.

- Elastic Supply

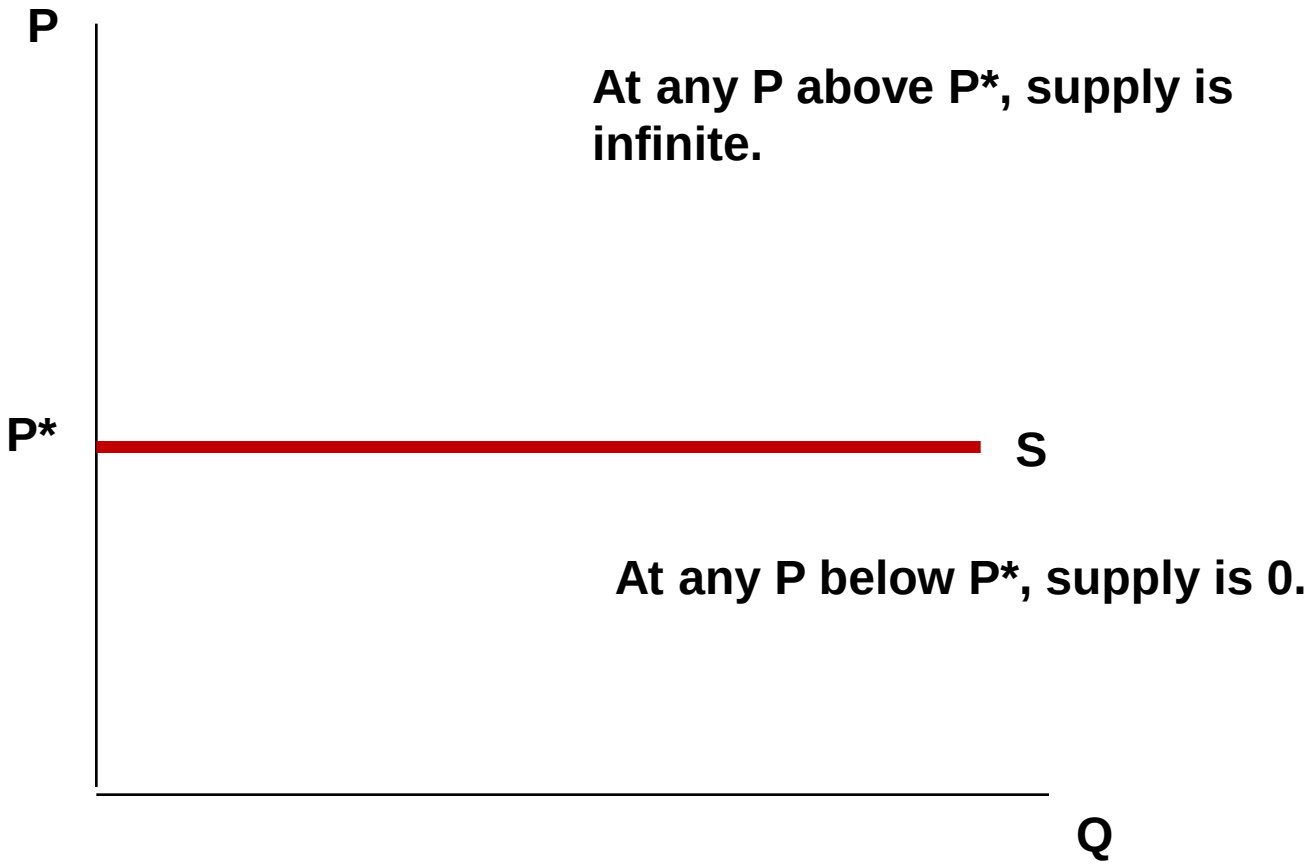


A small change in P leads to a proportionately larger change in Q supplied.

Perfectly Elastic Supply

- Es => infinity
- Supply curve is horizontal.
- Example: any good for which a decrease in selling price means a firm will not supply any amount. This would be the case if the price fell to a point where all suppliers would lose money if they produced the good.

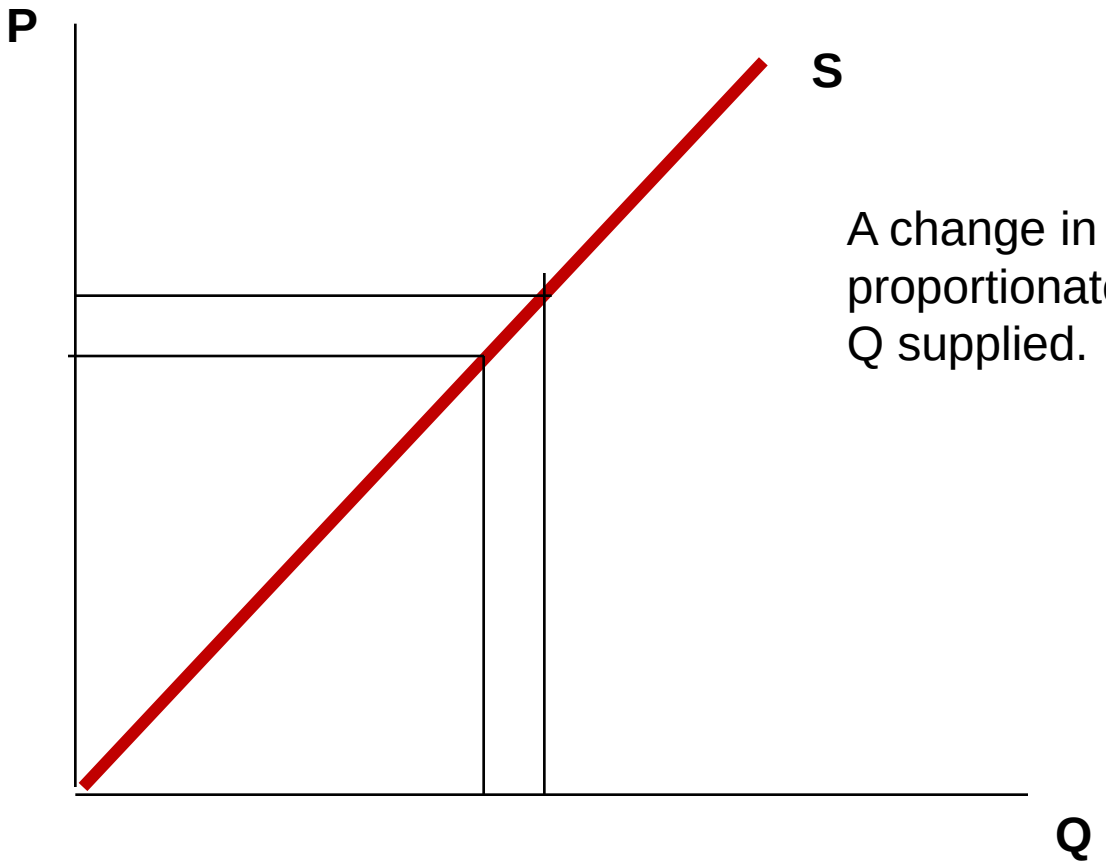
- Perfectly Elastic Supply



Unit elastic supply

- Es = 1
- Example: any good for which a percentage change in price leads to the same percentage change in quantity supplied. No, I don't know of a real world example.

- Unit Elastic Supply



A change in P leads to a proportionate change in Q supplied.

- A key determinant of supply elasticity is time.

- Supply is usually more elastic in the long run than in the short run.
  - In the long run, firms can build or close factories, enter new markets, etc.
  - In the short run, it may be hard to adjust production amounts (especially in agriculture).

- Note: just like demand, the flatter the supply curve, the more elastic is the supply of the good.

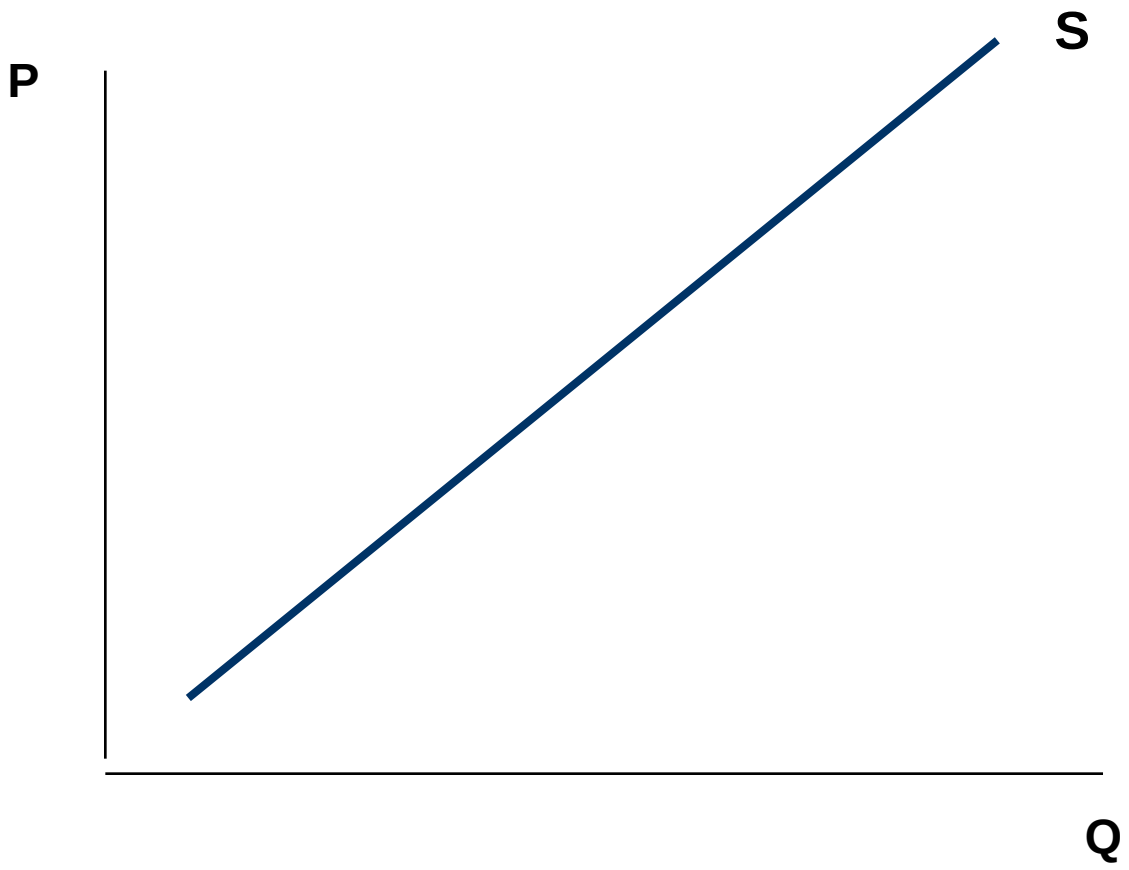
Applications: Case 1

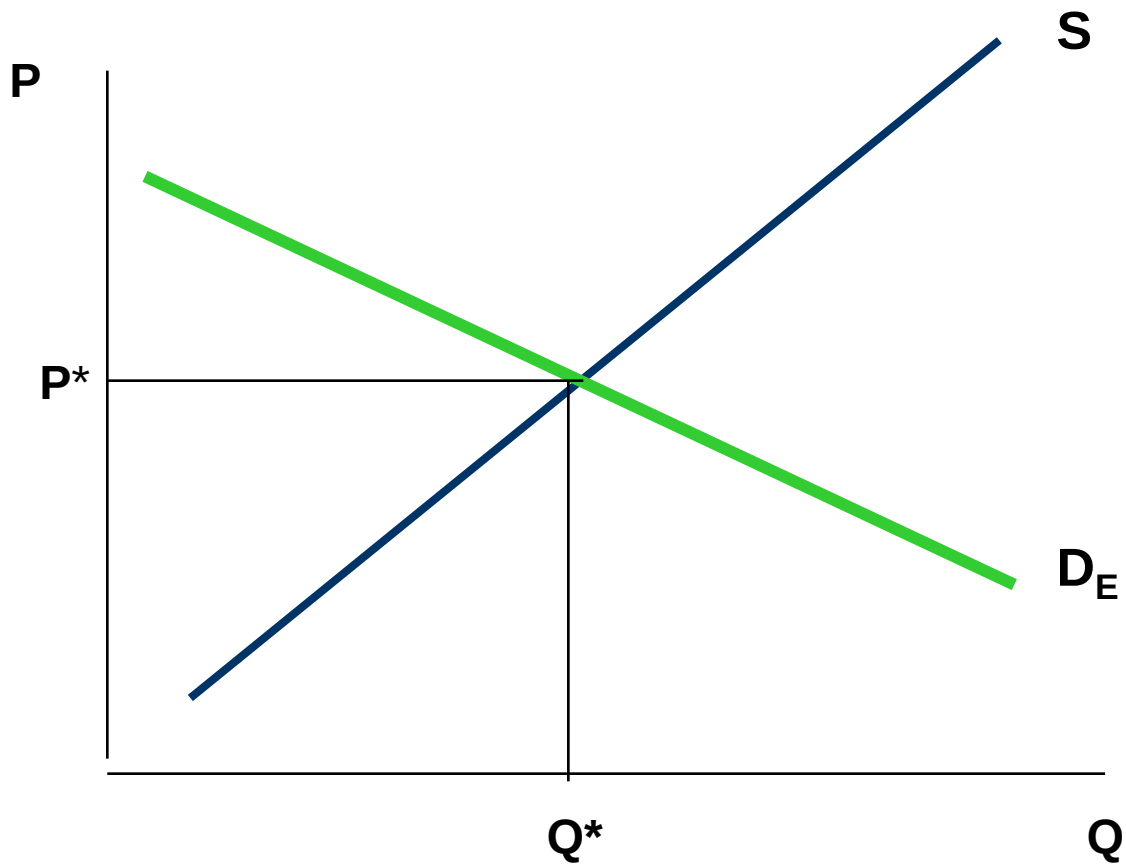
- Suppose that we have a supply curve. We have 2 demand curves – a flatter, elastic demand curve, D_E and a steeper, inelastic demand curve, D_I.

- Now suppose supply increases:

Applications: Graph 1

- Case 1: Elastic v. Inelastic Demand

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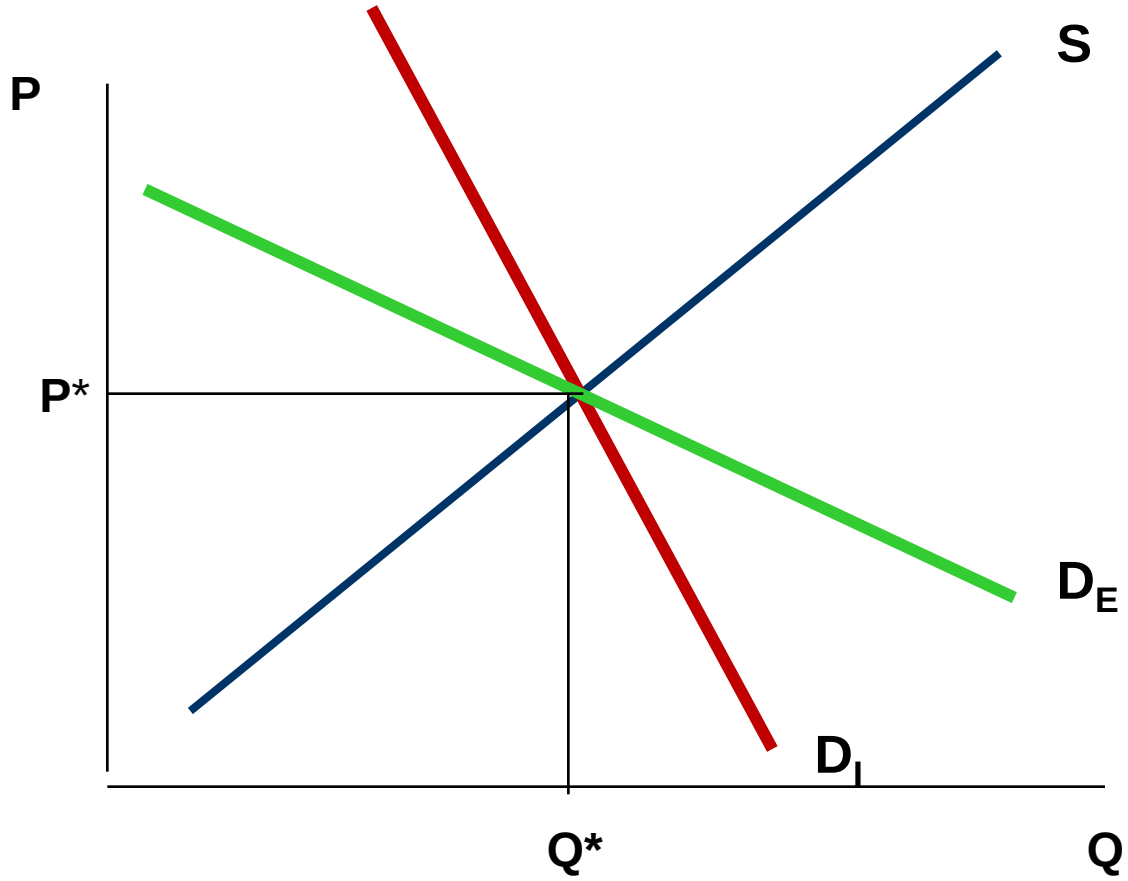
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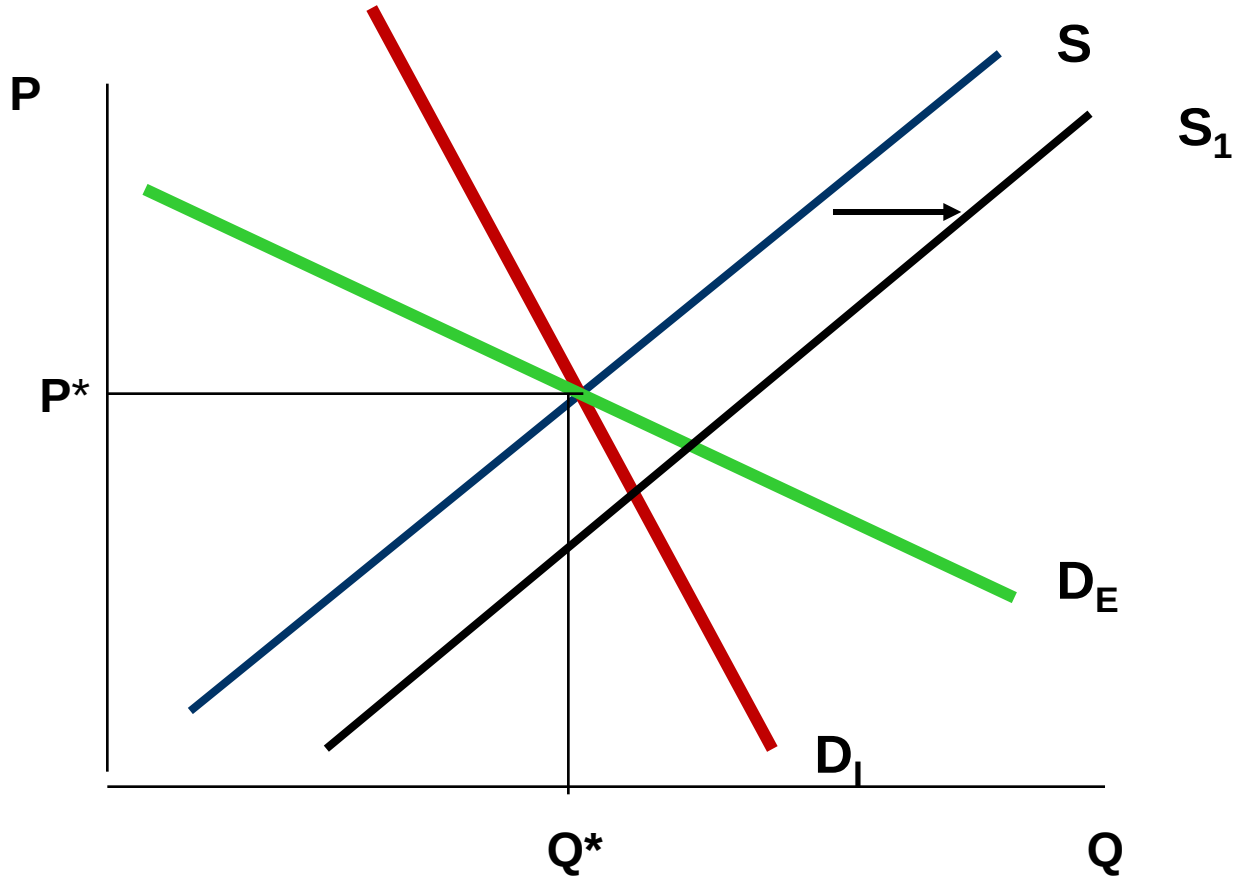
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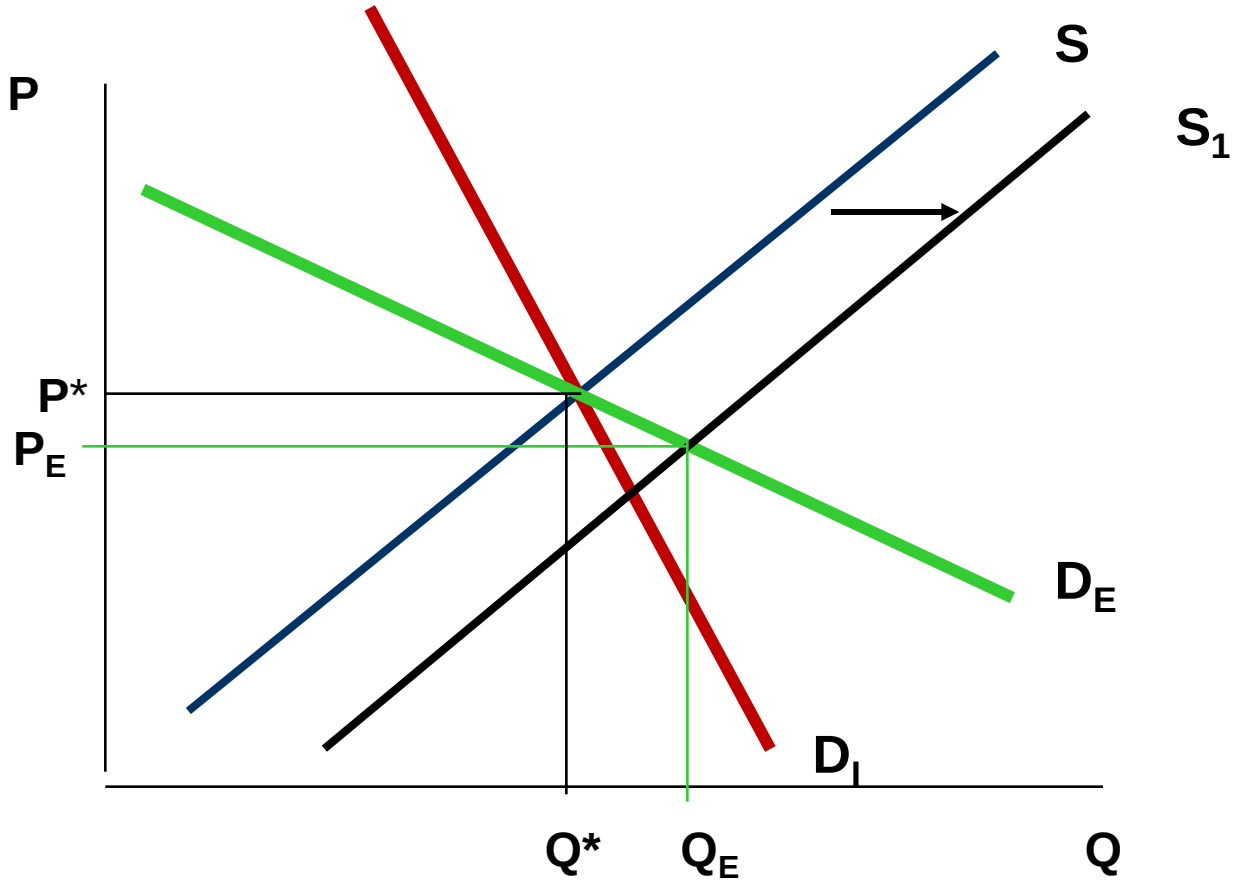
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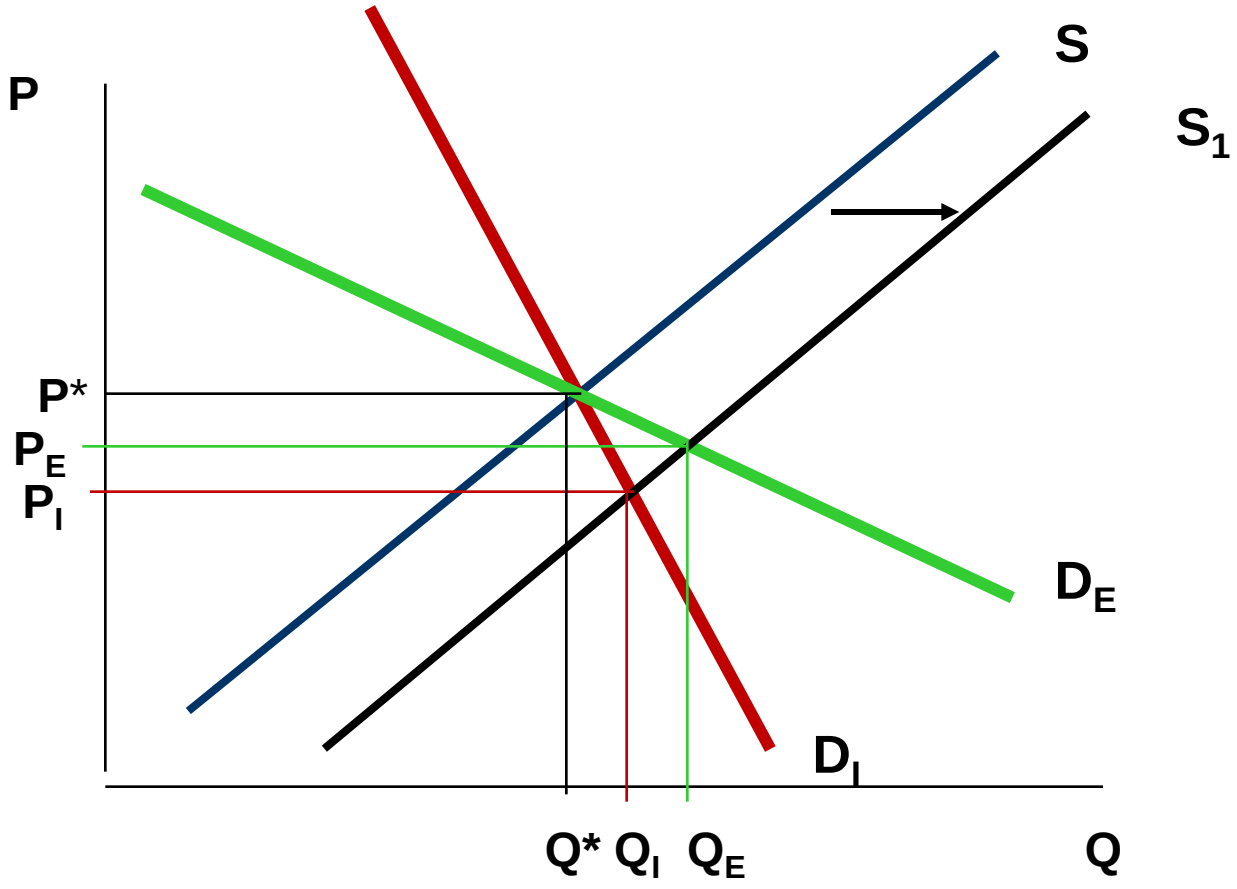
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- If D is inelastic, P* ↓to P_I and Q*↑ to Q_I
- If D is elastic, P* ↓to P_E and Q*↑ to Q_E

- If D is inelastic, an ↑ in S will ↓P by more and ↑Q by less than if demand was elastic.

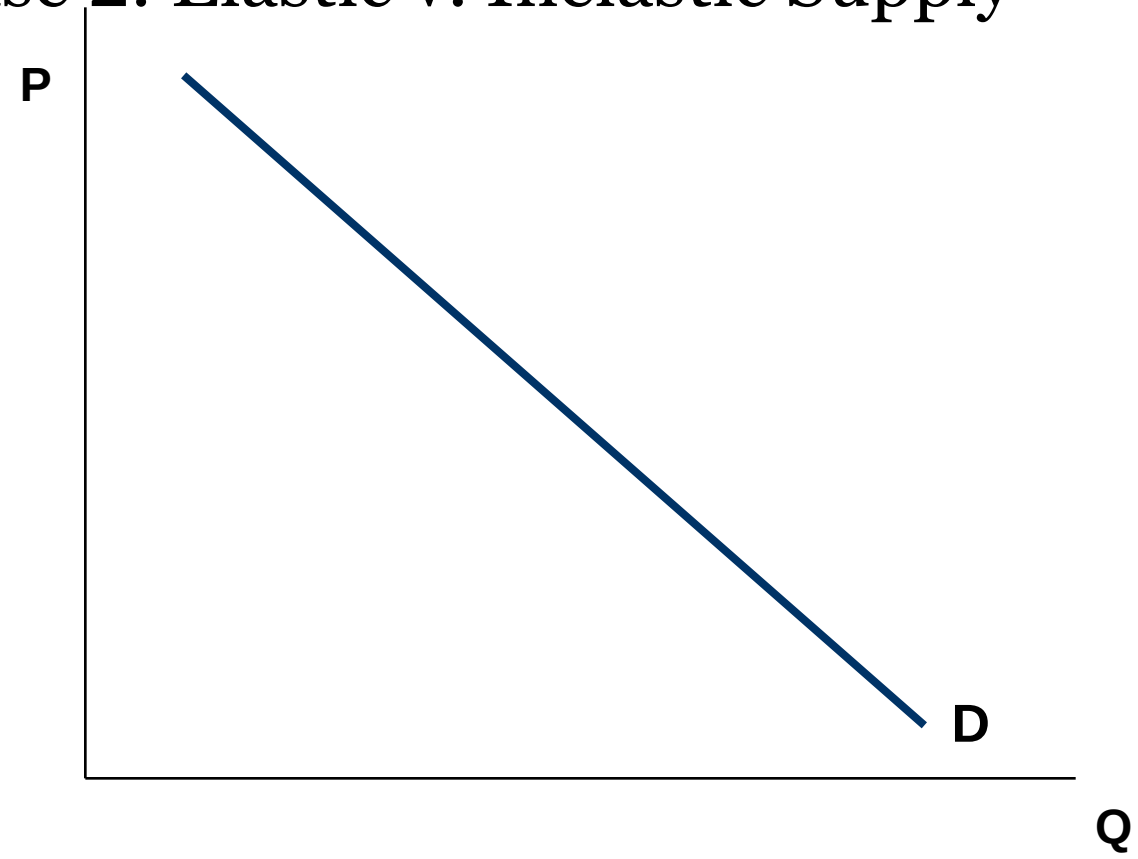
Applications: Case 2

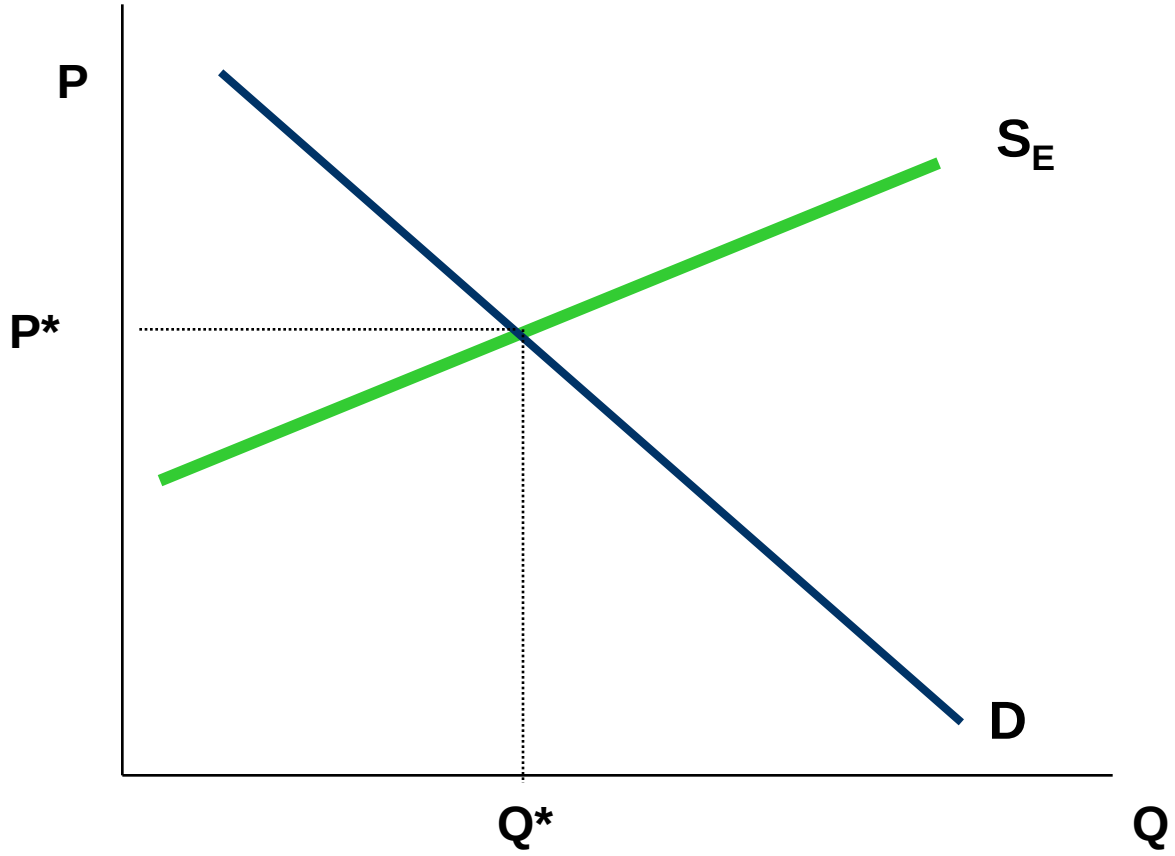
- Suppose that we have a demand curve. We have 2 supply curves – a flatter, elastic supply curve, S_E and a steeper, inelastic supply curve, S_I.

- Now suppose demand increases.

Applications: Graph 2

Case 2: Elastic v. Inelastic Supply

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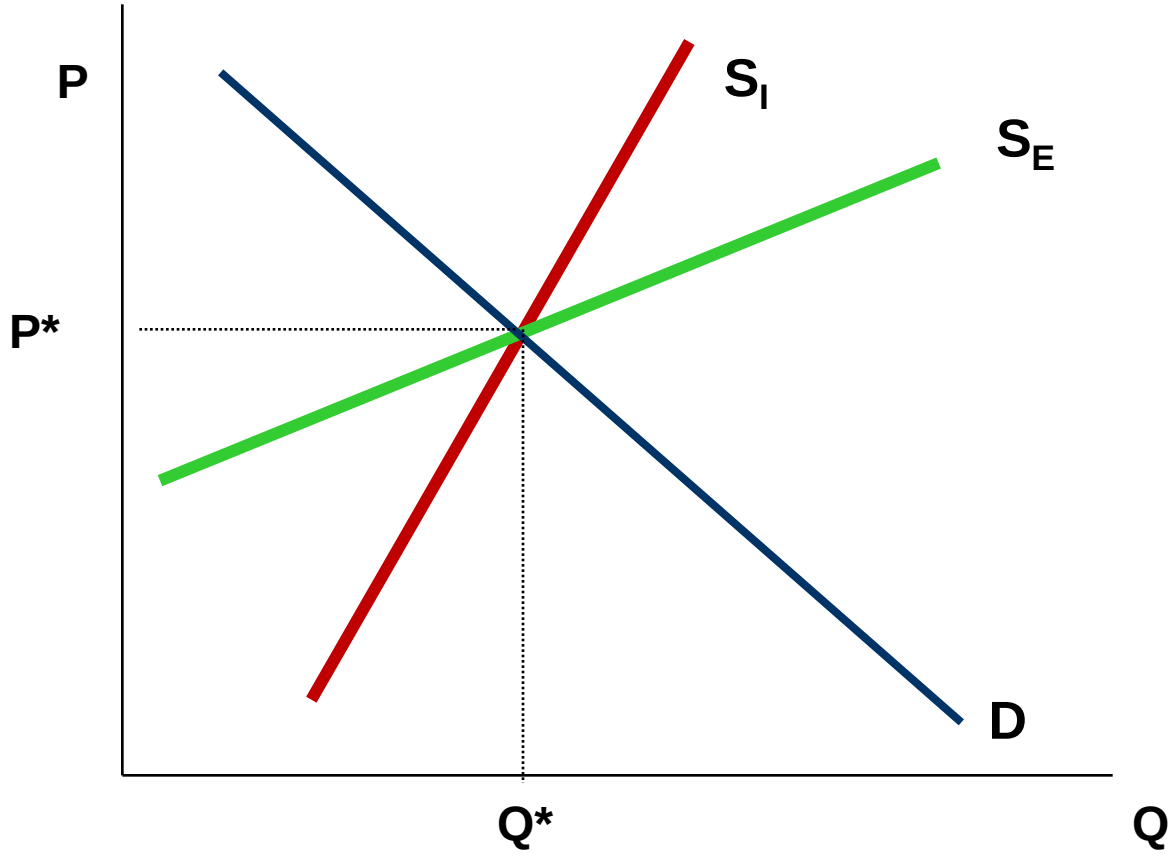
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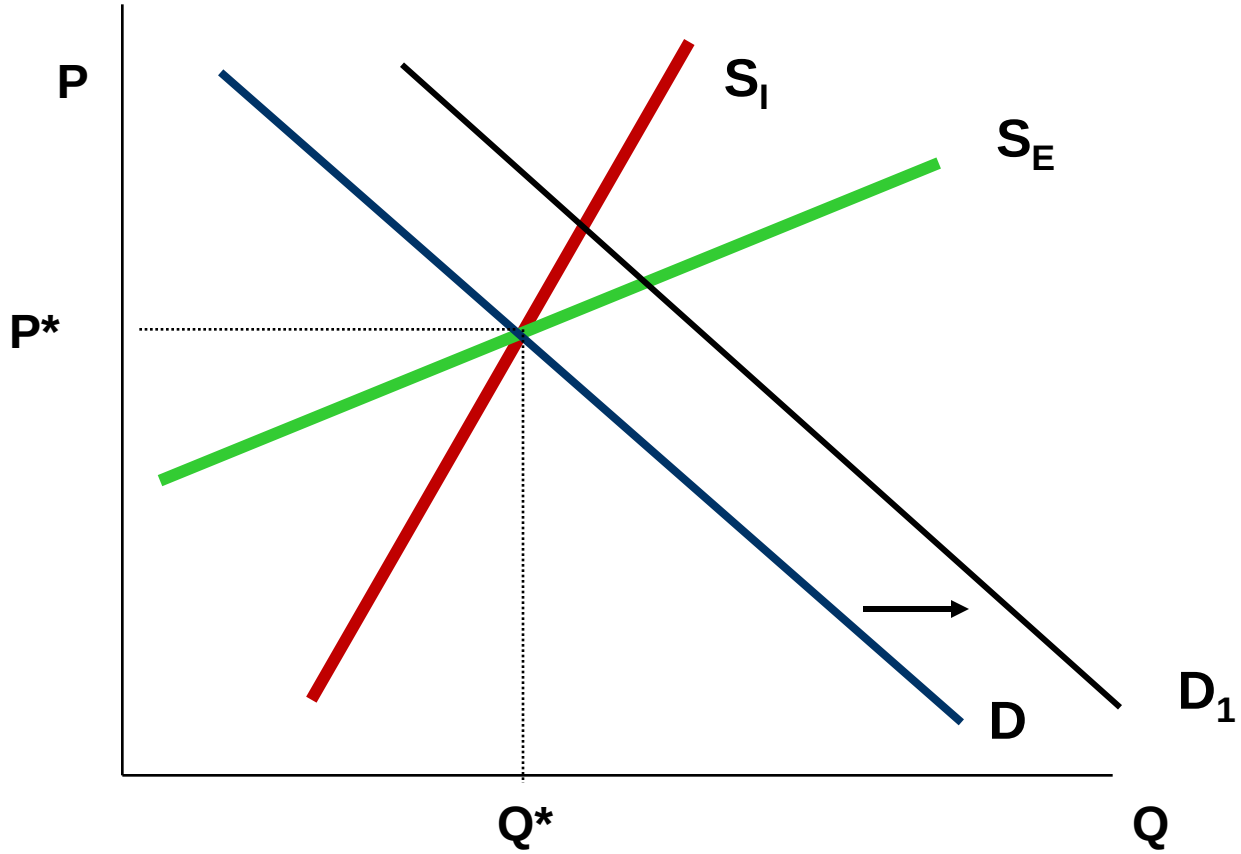
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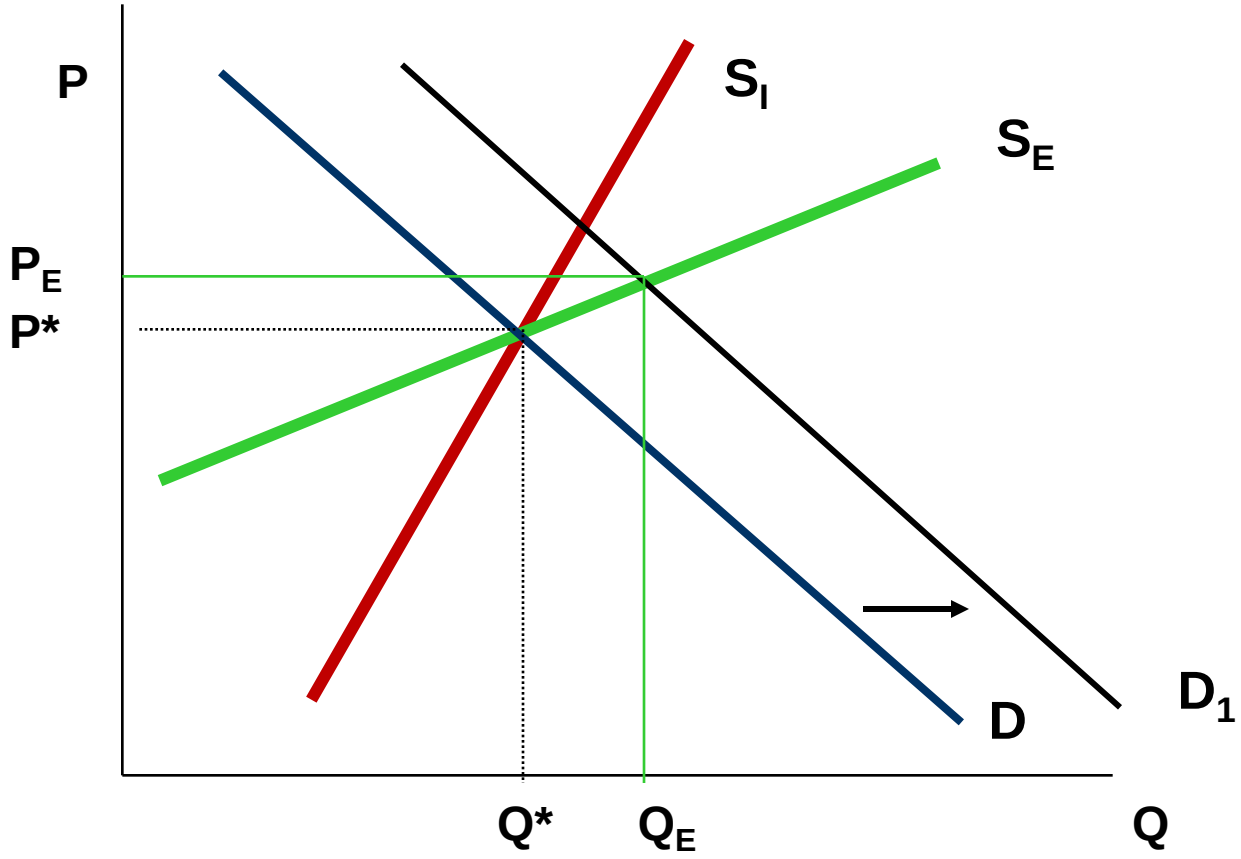
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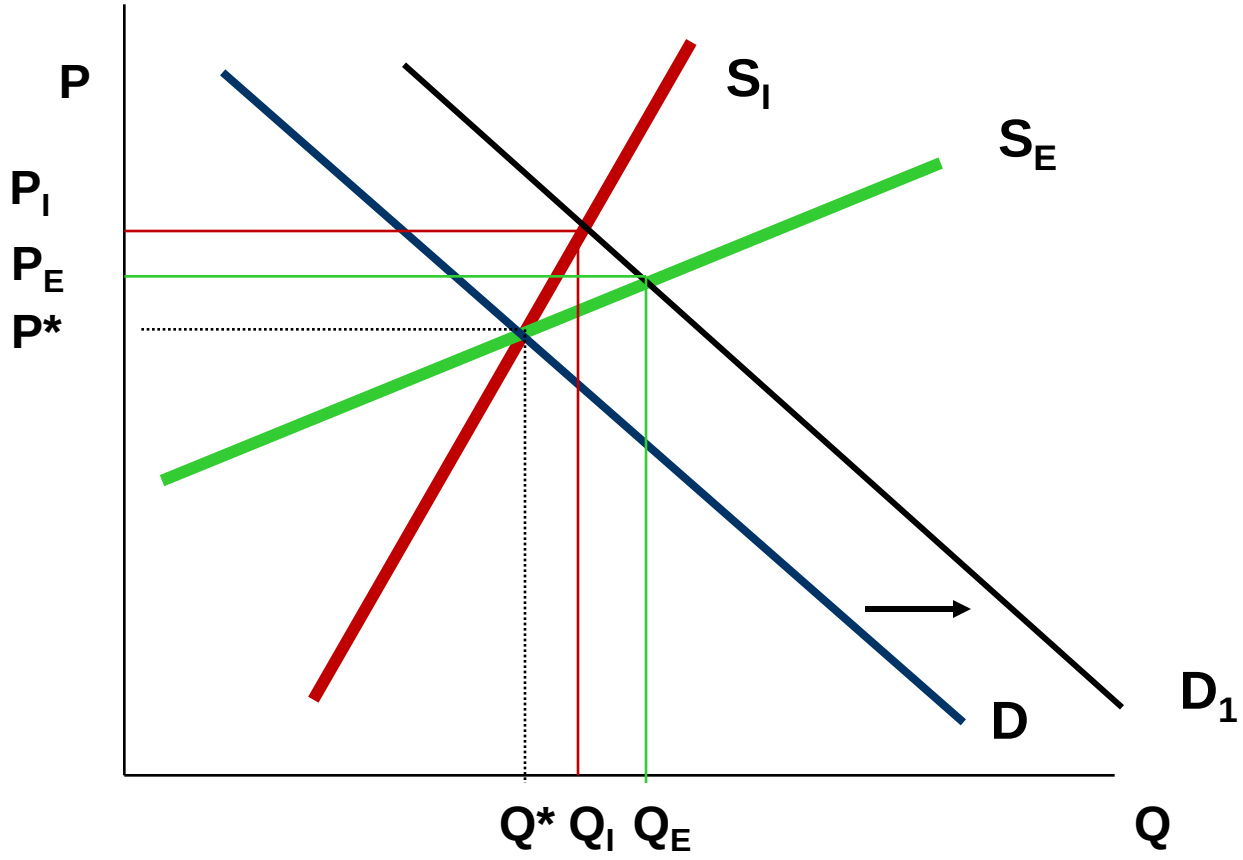
P
P_I
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- If S is elastic, P* ↑ to P_E and Q*↑ to Q_E
- If S is inelastic, P* ↑ to P_I and Q*↑ to Q_I

- If S is inelastic, an ↑ in D will ↑P by more and ↑Q by less than if supply was elastic.