Elasticity of Demand

Chapter 5

Objective

- To understand <u>elasticity of demand</u>
    - What it means
    - How it is measured
    - How to use it

(Price) Elasticity of Demand

- The Law of Demand predicts that when P up, Q_D down, and vice versa
- But it says nothing about "by how much?"

- The elasticity of demand is a measure of that "how much"
- More precisely, the elasticity of demand measures the responsiveness of Q_D (the amount that would be purchased) to changes in price along a given demand curve
  - Does Q_D fall by a lot or a little when price rises?
  - Does Q_D rise by a lot or a little when price falls?

Why do we care about the responsiveness of Q_D to price?

CONSIDER THE FOLLOWING QUESTIONS

- How many customers would your firm lose if it raised its price by 10%?
  - That depends on how much quantity demanded changes when price changes
  - You need to know the elasticity of demand for your product

- How many more burgers would Bob sell if Bob's Burgers held a sale?
  - That depends on how much quantity demanded changes when price changes
  - Bob needs to know the elasticity of demand for his burgers

Why do we care about the responsiveness of Q_D to price?

CONSIDER MORE QUESTIONS

- If cigarette taxes raise prices to consumers, by how much will smoking be reduced?
  - That depends on how much quantity demanded changes when price changes
  - Policymakers need to know the elasticity of demand for cigarettes
- If policing efforts raise the price of cocaine substantially, by how much will consumption be reduced?
  - That depends on how much quantity demanded changes when price changes
  - Enforcement officials need to know the elasticity of demand for cocaine

# Why do we care about the responsiveness of Q_D to price?

Knowing by how much Q_D changes as one moves up or down the demand curve – that is to say, knowing the elasticity of demand – is crucial to businesses and policymakers.

How do we measure (price) elasticity of demand?

- Elasticity of demand, $\epsilon_D = - \frac{\Delta Q_D}{\Delta P}$, notice how ϵ_D is negative!
- Suppose change in price is 10% and change in quantity demanded is 20%, then $\epsilon = - \frac{20}{10} = -2$
- Now, suppose change in price is 20% and change in quantity demanded is 10%, then $\epsilon = - \frac{10}{20} = -0.5$
- The first is a larger response, $|\Delta Q| > |\Delta P|$ whereas
- The second is a smaller response $|\Delta Q| < |\Delta P|$

"Elastic" versus "inelastic" demand
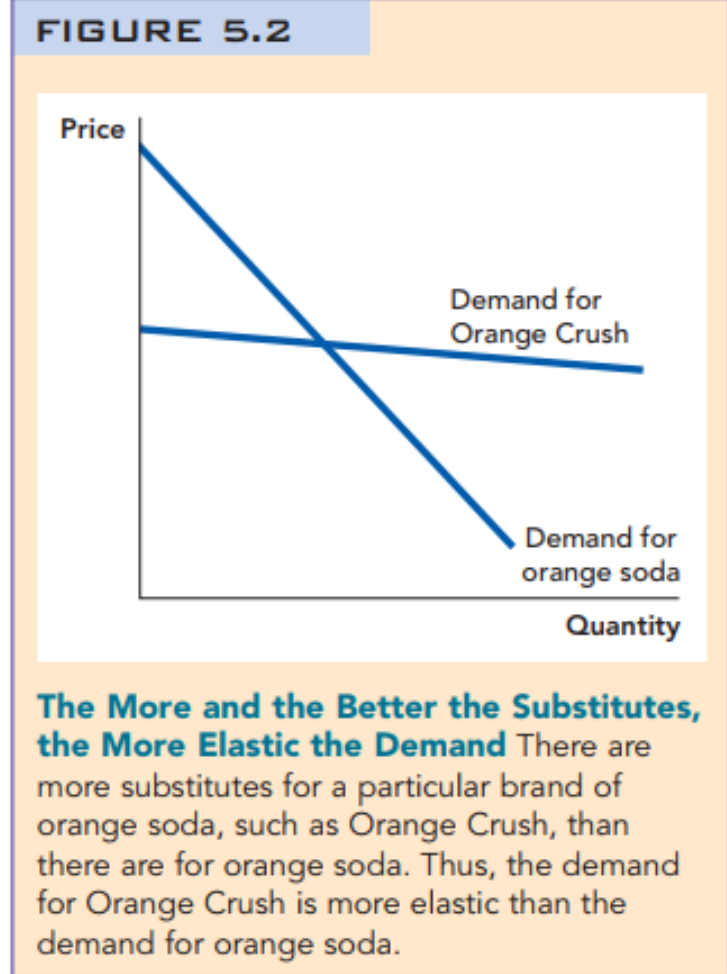

FIGURE 5.1
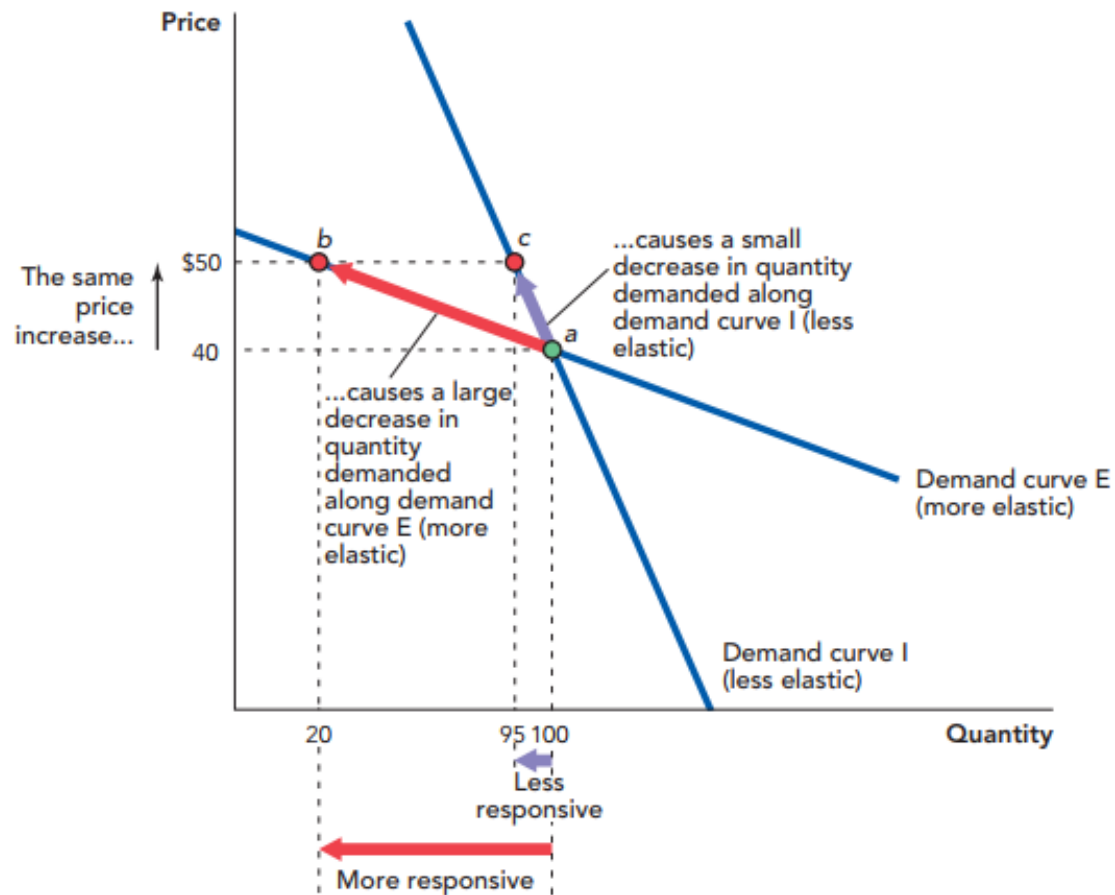
The More Responsive Quantity Demanded Is to a Change in Price, the More Elastic Is the Demand Curve Beginning at point *a*, an increase in price from $40 to $50 causes a big decrease in quantity demanded along demand curve E, from 100 units to 20 units at point *b*. But the same increase in price causes only a small decrease in quantity demanded along demand curve I from 100 to 95 units at point *c*. Since the quantity demanded is more responsive to a change in price along demand curve E, demand curve E is more elastic than demand curve I.

What determines the elasticity of demand?

- Consumers purchase fewer units when price rises, ceteris paribus ("Law of demand"). What do they do instead?

- They switch to substitutes

- The elasticity of demand for a good depends upon the **closeness of substitutes!**
  - If substitutes are very close, even a very small price change might be enough to get consumers to switch to an alternate product
  - If substitutes are not very close, consumers may keep on purchasing even in the face of a large price increase

FIGURE 5.2

The More and the Better the Substitutes, the More Elastic the Demand There are more substitutes for a particular brand of orange soda, such as Orange Crush, than there are for orange soda. Thus, the demand for Orange Crush is more elastic than the demand for orange soda.
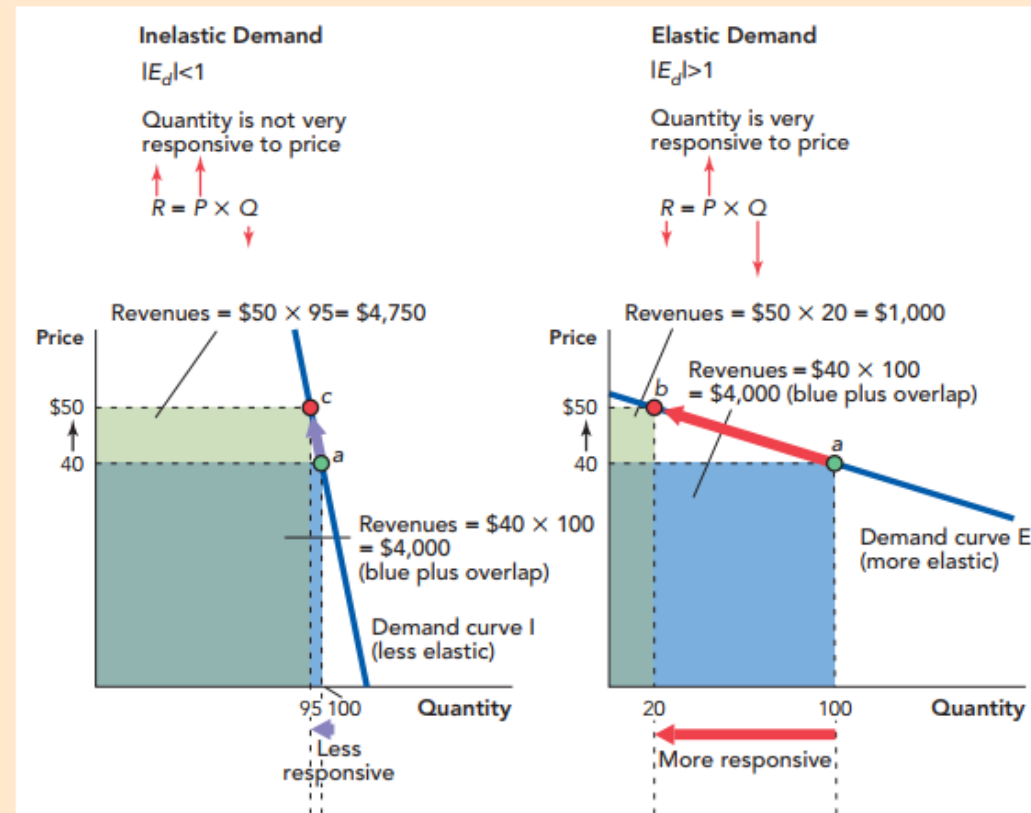
"Elastic" versus "inelastic" demand

- If Q_D (*amount purchased*) responds strongly to a price change, demand is elastic. A small price change results in large shifts in quantity demanded

- If Q_D (*amount purchased*) responds weakly to a price change, demand is inelastic. A large price change results in very small shifts in quantity demanded

- When demand is elastic, $|\epsilon_D| > 1$

- When demand is inelastic, $|\epsilon_D| < 1$

- When demand is unit elastic, $|\epsilon_D| = 1$

Elasticities and Revenue

FIGURE 5.3

Inelastic Demand
$|E_d|<1$

Quantity is not very responsive to price

$R = P \times Q$

Revenues = $50 × 95= $4,750

Price

$50

40

c

a

Revenues = $40 × 100
= $4,000
(blue plus overlap)

Demand curve I
(less elastic)

95 100   Quantity

Less responsive

Elastic Demand
$|E_d|>1$

Quantity is very responsive to price

$R = P \times Q$

Revenues = $50 × 20 = $1,000

Price

$50

40

b

Revenues = $40 × 100
= $4,000 (blue plus overlap)

a

Demand curve E
(more elastic)

20   100   Quantity

More responsive

Elasticities and Revenues
When the price increases, what happens to total revenue? If demand is inelastic, an increase in price increases revenues. In the left panel, an increase in the price from $40 to $50 increases revenues from $4,000 to $4,750, so demand is inelastic. If the demand is elastic, then an increase in price decreases revenues. In the right panel, an increase in price from $40 to $50 decreases revenues from $4,000 to $1,000, so demand is elastic.

How does elasticity of demand effect revenues?

- If the demand is inelastic, an increase in price increases revenues.

- If the demand is elastic, an increase in price decreases revenues.

Elasticity of demand and revenue

- Total revenue = price * quantity
  - TR = P x Q
    - You price at $200 and sell 5000 units, your total revenue is $1 million
- If price rises, TR may increase or decrease.
  - This depends on whether Q falls by a greater or lesser percentage than P rises

- TR will increase when price rises if demand is inelastic and decrease if demand is elastic
  - Elastic demand ($|\varepsilon| > 1$) means % change in Q > % change in P
    - I.e., when P ↑ then Q ↓ by an even greater percentage
  - Inelastic demand ($|\varepsilon| < 1$) means % change in Q < % change in P
    - I.e., when P ↑ then Q ↓ by a smaller percentage

  - And vice versa if price is lowered
    - Don't bother to hold a big sale on insulin!

Elasticity and time

- Demand is always more elastic in the long-run than in the short-run
- Suppose the price of gasoline rises enormously and you drive to campus. What can you do to reduce consumption (i.e., what are the substitutes?)
  - in the short run?
    - Take a bus (maybe), ride a bike (maybe), walk (maybe)
  - over a longer period?
    - Organize a car pool
  - over an even longer period?
    - Move closer to campus, buy a more fuel efficient car
- The <u>longer the period</u>, the greater the number of actions a consumer or producer can take (i.e., certain actions become less costly as time passes)
 - therefore, <u>the more elastic demand becomes</u>

Perfectly inelastic demand

- If demand is perfectly inelastic, $\varepsilon_D = 0$
- This would imply that even the largest change in price would not reduce quantity demanded at all!
- What must the demand curve look like?
- What would this imply about substitutes?
- For what products might demand
be perfectly inelastic?

P

Q

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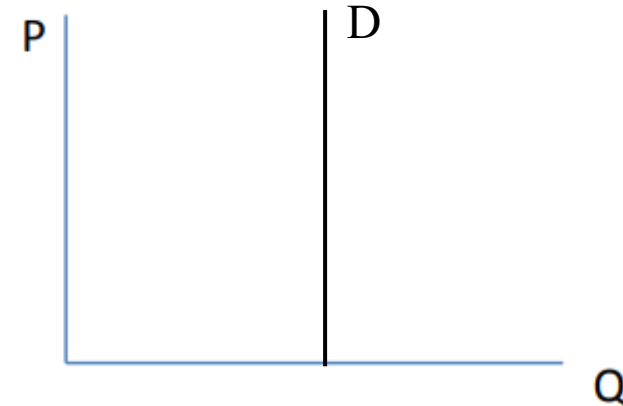
Perfectly inelastic demand rhetoric

There is a popular tendency to talk (and think!) about demand as if it were perfectly inelastic

- "Water is a necessity of life. People won't cut down on water consumption no matter how much price rises."
- "People need to drive to get to school and work. Drivers can't and won't cut back just because gas prices rises."
- "People won't use more medical treatment just because insurance pays for it."
  - All statements suggest that demand curves do <u>not</u> slope downwards
- Usually what is actually meant is that "demand is inelastic".
- Remember, demand is NEVER perfectly inelastic,. . .
 - . . . and is ALWAYS MORE ELASTIC IN THE LONG RUN!

Perfectly elastic demand

- If demand is perfectly elastic, $\varepsilon_D = \infty$

- This would imply that even the smallest rise in price would reduce quantity demanded to zero!

- What must the demand curve look like?

- What would this imply about substitutes?

- For what products might demand be

  perfectly elastic?

  - Agricultural products sold by individual producers (e.g., one farmer's wheat)

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_____ D

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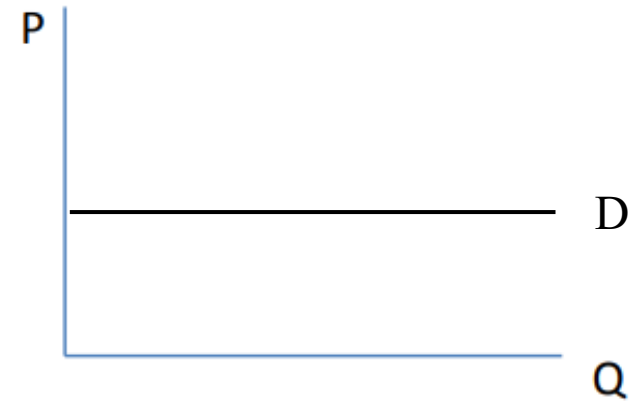
The slope of the demand curve and the elasticity of demand

- The foregoing discussion suggest there is a relationship between the slope of the demand curve and the elasticity of demand
  - $\epsilon_D = (\text{slope}) * (\frac{P}{Q_D})$

- Therefore, the slope and the elasticity are

different

- But with linear demand, at the same price,

a steeper slope generally signifies less

elastic demand

- At $P*$, $D2$ more elastic than $D1$
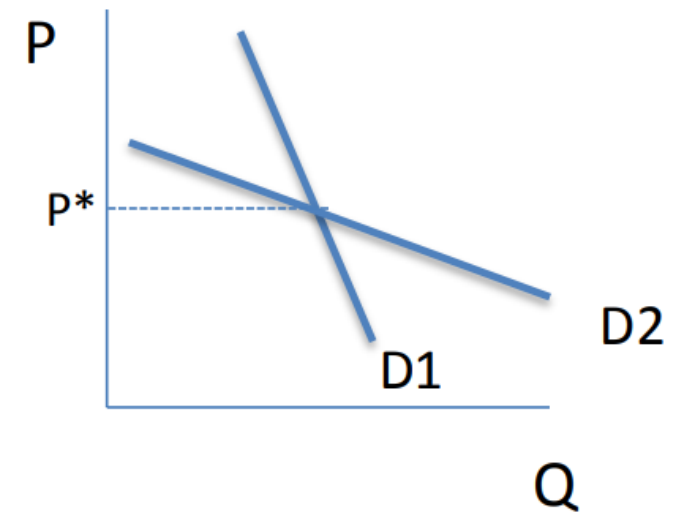
Practice Questions

If price rises from 10 to 12 and quantity demanded falls by 12%, we know that demand is

a. Elastic

b. Inelastic

c. Unit Elastic

d. There is not enough information

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a. Elastic

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d. There is not enough information

Practice Questions

Which of the following would you expect to have the least elastic demand?

a. Bananas

b. Bananas from Columbia

c. Bananas from Columbia sold at Ingles

d. All would have equal elasticity of demand, because each would have a downward sloping demand curve.

Practice Questions

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Factors Determining Elasticity of Demand

Less Elastic	More Elastic
Fewer substitutes	More substitutes
Short run	Long run
Categories of products (more general)	Specific brands (more specifically defined goods)
Necessities	Luxuries
Large part of budget	Small part of budget

Practice Questions

The demand for this product
    a. is elastic.
    b. is inelastic.
    c. is unit elastic.
    d. may be elastic or inelastic, depending on the price

Price	Quantity Demanded
10	80
9	100
8	120
7	140
6	160

Practice Questions

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Practice Questions

The elasticity of demand for a price cut from 10 to 9 is

     a. 4

     b. 2.5

     c. 2

     d. 1.5

     e. 0.5

Price	Quantity Demanded
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Practice Questions

The elasticity of demand for a price cut from 10 to 9 is
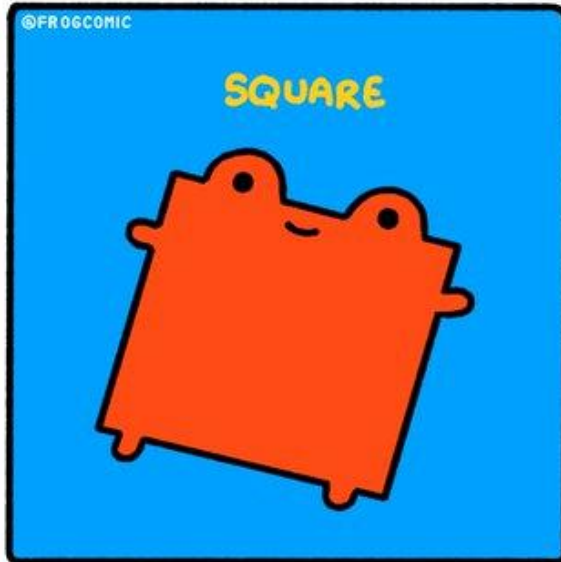
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Elasticity of Supply

Objective

- To understand elasticity of supply
    - What it means
    - How it is measured
    - How to use it

Just like elasticity of demand . . .

- *Elasticity of supply* is a measure of the responsiveness of <u>quantity supplied </u>(rather than demanded) to changes in price, *moving along the supply curve*
  - <u>Elastic</u>: big quantity response
  - <u>Inelastic</u>: small quantity response

- Why do we care?
  - How much would smart phone production increase in response to a big increase in demand?
    - i.e., How much does quantity supplied change when price changes?
  - How much would oil production decrease with a carbon tax?
   - i.e., How much does quantity supplied change when price changes?

How do we measure (price) elasticity of supply?

- Elasticity of supply, $\epsilon_s = \frac{\Delta Q_s}{\Delta P}$, notice how ϵ_s is positive!
- Suppose change in price is 10% and change in quantity supplied is 20%, then $\epsilon = \frac{20}{10} = 2$
- Now, suppose change in price is 20% and change in quantity supplied is 10%, then $\epsilon = \frac{10}{20} = 0.5$
- The first is a larger response, $|\Delta Q| > |\Delta P|$ whereas
- The second is a smaller response $|\Delta Q| < |\Delta P|$

How do we measure (price) elasticity of supply?

Notice that the elasticity of supply is positive while the elasticity of demand is negative!

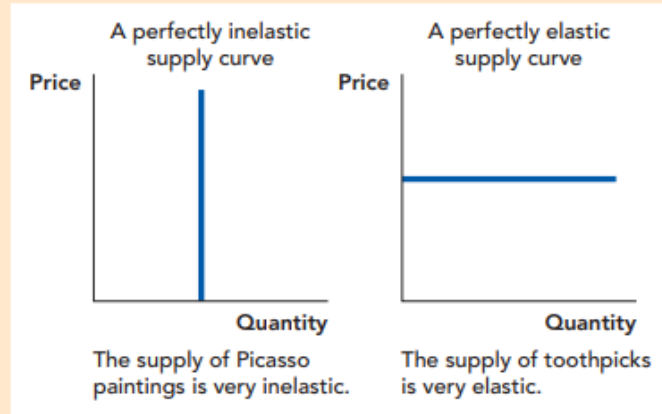This is because Q_S and P both increase at the same time!
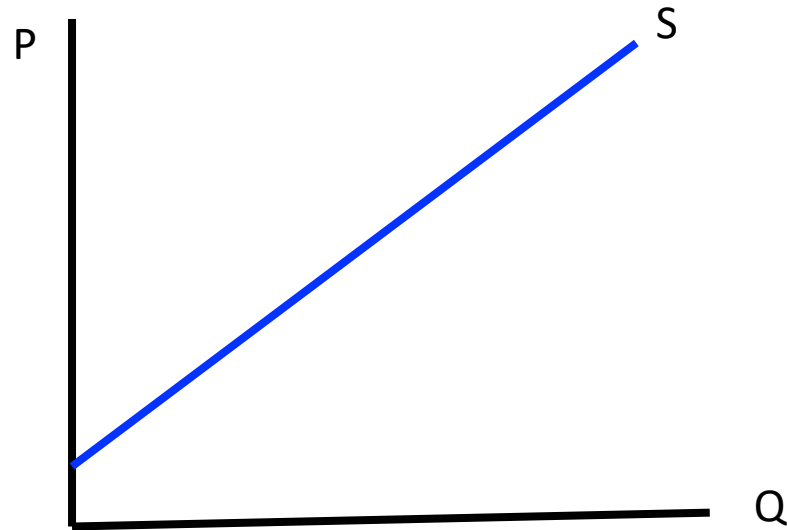
"Elastic" versus "inelastic" supply

- If Q_D (*amount supplied*) responds strongly to a price change, supply is elastic. A small price change results in large shifts in quantity supplied

- If Q_D (*amount supplied*) responds weakly to a price change, supply is inelastic. A large price change results in very small shifts in quantity supplied

- When supply is elastic, $|\epsilon_S| > 1$

- When supply is inelastic, $|\epsilon_S| < 1$
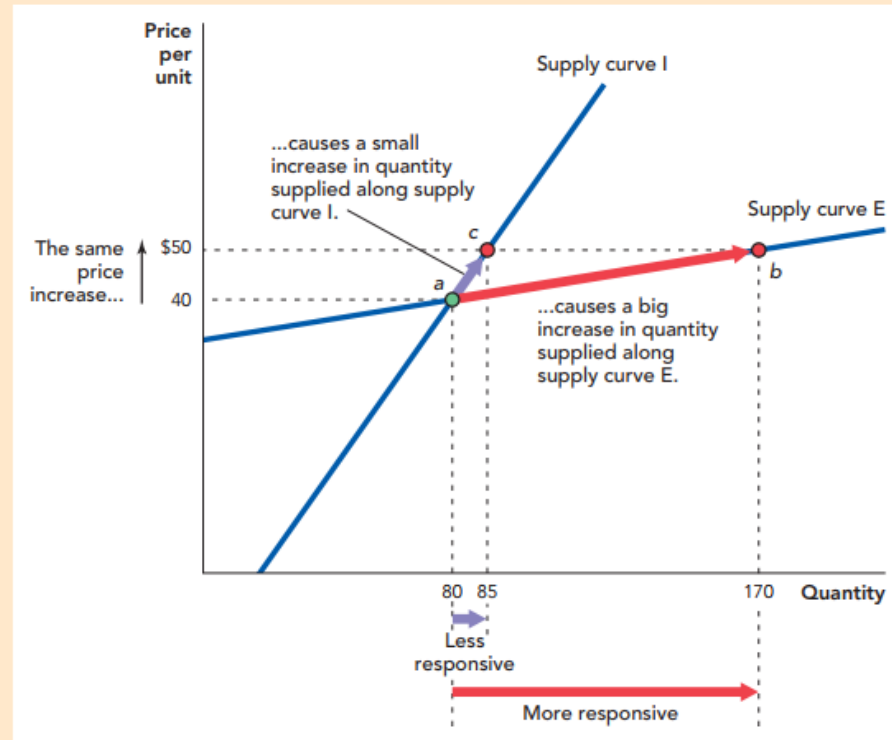
- When supply is unit elastic, $|\epsilon_S| = 1$

"Elastic" versus "inelastic" supply

- When supply is
  - elastic, $|\epsilon_S| > 1$
  - inelastic, $|\epsilon_S| < 1$

FIGURE 5.6

...causes a small increase in quantity supplied along supply curve I.

Supply curve I

Supply curve E

The same price increase...

...causes a big increase in quantity supplied along supply curve E.

Less responsive

More responsive

The More Responsive Quantity Supplied Is to a Change in Price, the More Elastic the Supply Curve Beginning at point a, an increase in price from $40 to $50 causes a small increase in quantity supplied along supply curve I, from 80 to 85 units (at point c). But the same increase in price causes a big increase in quantity supplied along supply curve E, from 80 to 170 units (at point b). Since the quantity supplied is more responsive to a change in price, supply curve E is more elastic than supply curve I.

FIGURE 5.7

A perfectly inelastic supply curve

A perfectly elastic supply curve

Price

Price

Quantity

Quantity

The supply of Picasso paintings is very inelastic.

The supply of toothpicks is very elastic.

The Elasticity of Supply of Toothpicks and Picasso Paintings The supply of Picasso paintings is very inelastic because Picasso won't paint any more no matter how high the price rises. The supply of toothpicks is very elastic because it's easy for suppliers to make more in response to even a small increase in price.

What determines elasticity of supply?

- Why do supply curves slope upwards?
  - Rising opportunity costs
    - Remember what you would charge for working 100 hours per week versus two hours per week?
- Where opportunity costs rise only slowly, supply is more elastic
  - Greater change in quantity supplied for a given change in price

- Where opportunity costs rise more quickly, supply is less elastic
  - Smaller change in quantity supplied for a given change in price

Rising opportunity costs and elasticity of supply

- Consider soybeans
  - Price rises: Easy to plant more soybeans and less corn or wheat
  - Price falls: Easy to plant fewer soybeans and more corn or wheat
  - In other words, can easily adjust quantity supplied in face of price change
    - Supply of soybeans is elastic

- Consider almonds (grown on trees)
  - Price rises: Takes time to plant and cultivate new almond trees
  - Price falls: Very costly to rip up almond trees and plant walnut or avocado trees instead
  - Thus, cannot easily adjust quantity supplied in face of price change
    - Supply of almonds is inelastic

Practice Questions

If quantity demanded falls by 100,000 when price rises by 2 cents, we know that
   a. demand is elastic.
   b. demand is inelastic.
   c. demand is unit elastic.
   d. there is not enough information to calculate elasticity.

Practice Questions

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    a. demand is elastic.
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Practice Questions

The firm is currently charging a price of 8. If it wants to increase its sales revenue, it should

a. raise price to 9.

b. lower price to 7.

c. leave the price at 8, because it will have excess demand

at a lower price and excess supply at a higher price.

d. either raising or lowering price will increase total revenue.

e. neither raising or lowering price will increase total revenue.

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Elasticity and time

- Supply (like demand) is always more elastic in the long-run than in the short-run.

- Suppose you run a restaurant and demand increases dramatically. What can you do to serve more meals…
  - the short run?
  - over a longer period?
  - over an even longer period?

- The longer the period, the greater the number of actions a producer can take (i.e., certain actions become less costly as time passes)

Primary Factors Determining Elasticity of Supply

Less Elastic	More Elastic
Difficult to increase production at constant unit cost (e.g., some raw materials	Easy to increase production at constant unit cost (e.g., some manufactured goods)
Large share of the market for inputs	Small share of the market for inputs (e.g., toothpicks re: wood)
Global Supply	Local Supply
Short Run	Long run

Practice Questions

We therefore know that at the price of 8, demand for the product
    a. will increase if price falls.
    b. decrease if price rises.
    c. is elastic.
    d. is inelastic.
    e. all of the above.

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Credits to @grebcomics and Cowen and Tabarrock (2014)