BUEC 311: Business Economics, Organization and Management
Supply and Demand - The Basics

Fall 2020

Outline

1. The Supply-and-Demand Model
   - Demand
   - Supply
   - Market Equilibrium
2. Using the Model
   - Changing fundamentals.
   - The effects of government intervention.
3. Applying the model in practice.
   - When it works.
   - When if fails.

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   - Demand
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Demand

- Supply and demand is the core of almost every economic model
- This simple model is useful for understanding many markets.
  - It works particularly well in markets with many buyers and sellers.
- Why is it useful?
  - We can use it to make clear predictions about how changes in fundamentals affect market outcomes.
  - The limitations are easy to understand

Demand

- The first piece of the model: **Demand**
- Demand is consumer's *desire* to purchase goods and services.
- What factors affect this desire? How?

Demand

- While many factors can affect consumer's desire to purchase goods and services, economists primarily focus on how a good's *own price* affects the quantity demanded.

Definition (Quantity Demanded)

The quantity demanded is the amount of a good or service a consumer is *willing* to buy at a given price, holding other factors constant.

Demand

- Empirical evidence suggests that the quantity demanded by consumers follows the *Law of Demand*.

Definition (Law of Demand)

Consumers demand a higher quantity of a good or service when the price is lower (and a lower quantity of when the price is higher), *holding all other factors that influence the amount consumers want to consume constant*.

- We can illustrate this relationship graphically using a *demand curve*.
  - To do so, let's use the example of gasoline demand.

The Demand Curve

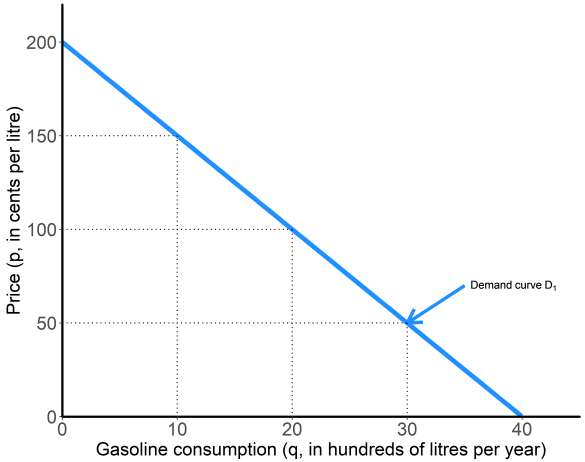


Figure: The demand for gasoline

The Demand Curve

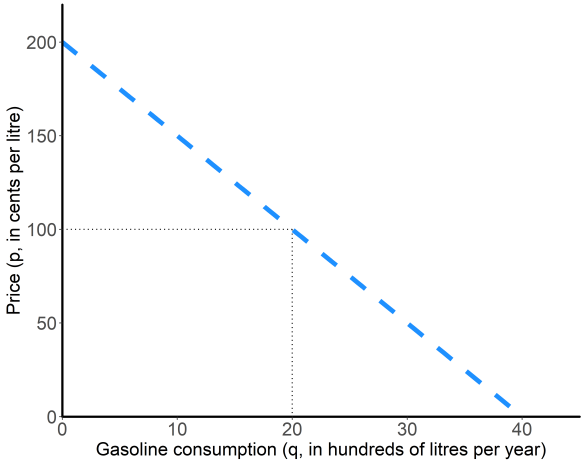


Figure: The demand for gasoline

The Demand Curve

- The demand curve provides a concise answer to the question of what happens to the quantity demanded as price changes, holding all other factors constant.
  - Here: what happens to the demand for gasoline as the price of gasoline increases or decreases.
- Changes in the quantity demanded in response to a price change are referred to as *movements along the demand curve*.
- Why is the demand curve downward sloping?

The Demand Curve

- The demand curve tells us how a change in the price of a good or service affects the quantity demanded.
  - Change in $p \implies$ *movement along the demand curve*.
- Recall that other factors also affect the quantity demanded.
  - Change in these factors $\implies$ *shift of the demand curve*.
- As an example, let's consider an increase in household income. How would you expect that to change gasoline demand?

The Demand Curve

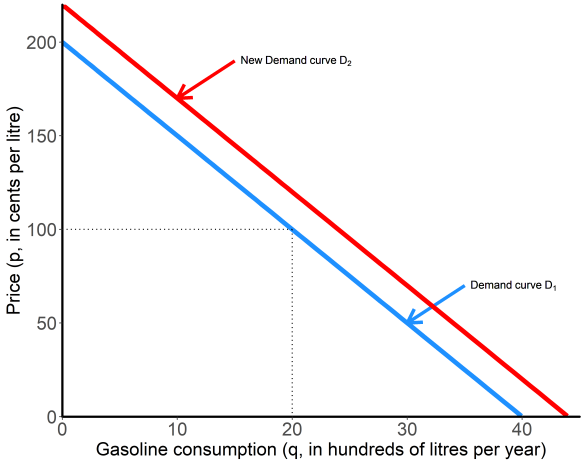


Figure: The effects of an income increase on the demand for gasoline

The Demand Curve

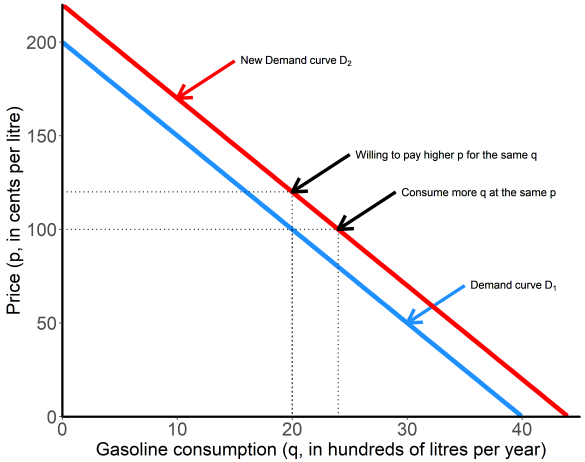


Figure: The effects of an income increase on the demand for gasoline

The Demand Curve

- How the demand curve shifts depends on the factor being considered.
  - Income
  - Price of substitute or compliment
  - Tastes
  - Government rules/regulations

- As another example, let's consider the effects of an increase in the price tolls in the core of the city, a complement to gasoline.

The Demand Curve

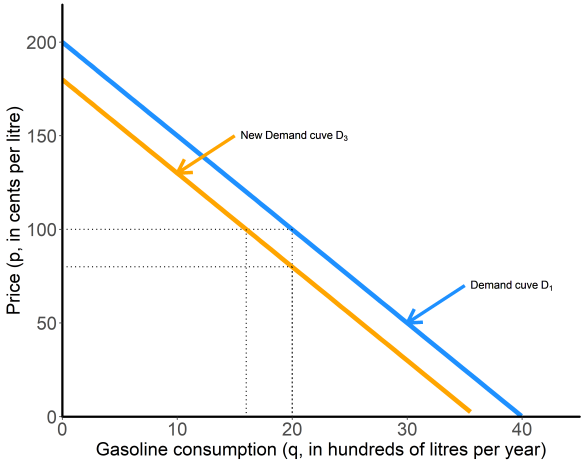


Figure: The effects of an increase in the price of tolls on the demand for gasoline

The Demand Curve

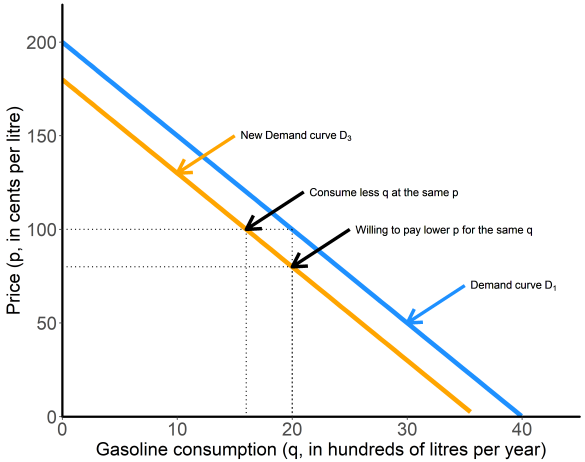


Figure: The effects of an increase in road tolls on the demand for gasoline

The Demand Curve

- The demand curve gives us a precise relationship between price and quantity demanded.
- We can also express this same relationship mathematically using a *demand function*.
- The demand function is given by:

$$Q = D(p, Y, X)$$

  where Q is the quantity demanded, and $D(\cdot)$ is the demand function that depends on the price, p, income, Y, and other factors, X.
- For simplicity, in what follows we will hold other factors (X) constant.

The Demand Function

- In the graphs above, I've used the equation

$$Q = 30 - \frac{p}{5} + 0.1Y$$

  where Q is the quantity of gasoline demanded, p is the price of gasoline, and Y is average household income in thousands of dollars per year.

- Functional form reflects available evidence about the demand for gasoline:
  - p is negative.
  - Y is positive.
  - Constant term (30) reflects all other factors.
- The parameters here ($30, \frac{1}{5}$, and 0.1 aren't estimated, they are simply illustrative.

The Demand Function

- We can obtain the demand curve for gasoline by substituting for income, Y.
- If household income is \$100,000. the demand for gasoline is given by:

$$Q = 30 - \frac{p}{5} + 0.1 \times 100$$
$$Q = 40 - \frac{p}{5}$$

- With some algebra we can obtain the *inverse demand curve*:

$$Q = 40 - \frac{p}{5}$$
$$5Q = 200 - p$$
$$p = 200 - 5Q$$

The Demand Function

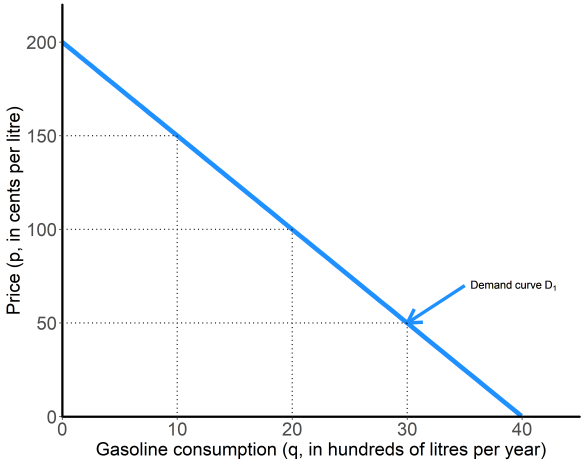


Figure: The demand for gasoline

The Demand Function

- The demand function is useful because it allows us to think precisely about how the quantity demanded will respond to a change in price, holding income (and all other factors) fixed.
- To see this, let's use two of the (price,quantity) pairs highlighted by the dotted lines in the figure:
  - Let $p_1 = 100$ denote the initial price, and $p_2 = 50$ denote the new price.
  - The quantity demanded at p_1 is $Q_1 = D(p_1) = 40 - \frac{p_1}{5} = 40 - \frac{100}{5} = 20$
  - The quantity demanded at p_2 is $Q_2 = D(p_2) = 40 - \frac{p_2}{5} = 40 - \frac{50}{5} = 30$
- Next we can use these to start thinking about response to price changes

The Demand Function

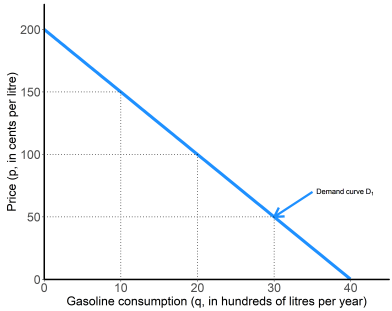
- In our gasoline example, if the price changes from p_1 to p_2, the change in quantity demanded is given by:

$$\Delta Q = D(p_2) - D(p_1) = [40 - \frac{p_2}{5}] - [40 - \frac{p_1}{5}]$$
$$\Delta Q = D(p_2) - D(p_1) = \frac{p_1}{5} - \frac{p_2}{5}$$
$$\Delta Q = D(p_2) - D(p_1) = -\frac{1}{5}\Delta P,\ \Delta P = p_2 - p_1$$

- So, we know that for a given change in price ΔP, the quantity consumed will change by $\Delta Q = -\frac{1}{5}\Delta P$

The Demand Function

- How do we see this? Check the graph:



- Changing the price from 50 to 100 decreases Q from 30 to 20, so $\Delta Q = -10$
- From the previous slide, $\Delta Q = -\frac{1}{5}\Delta P = -\frac{50}{5} = -10$

Market Demand

- In many cases we might have an estimate of the demand from all consumers in a market, but in some scenarios, we may only know the demands of individual consumers or groups of consumers.
- In these cases, we need to add up the demand from each consumer (or group).
- Key point: Total quantity demanded *at a given price* is equal to the sum of individual consumer demands at that price.

Determining Market Demand

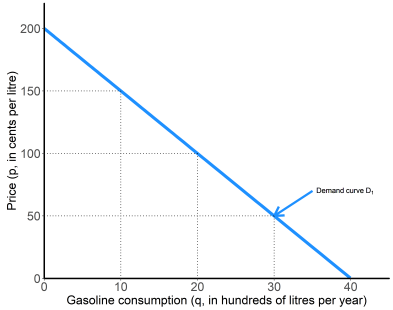
- As an example, suppose there are two people in the market for gasoline. They both have demand functions given by:

$$Q = 40 - \frac{p}{5}$$

What is the market demand for gasoline in this case?

Determining Market Demand

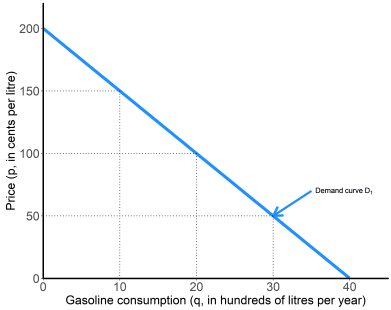
- Again, check the graph to find yourself an easy anchor point:



- What's the demand from one person at price p=100? It's 20.
- So, if the demand from one person at price p=100 is 20, what's the demand from 2 people?

Determining Market Demand

- Okay, now let's do the math



- If $Q = 40 - \frac{p}{5}$, adding both sides shows that $2Q = 80 - \frac{2 \times p}{5}$.
- Now let's check. If $p = 100$, $Q = 80 - \frac{2 \times p}{5} = 80 - \frac{2 \times 100}{5} = 40$.

Determining Market Demand

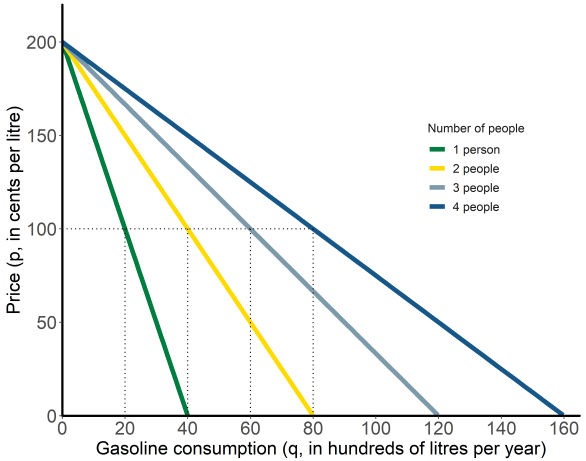


Figure: The demand for gasoline aggregated for 1, 2, 3 or 4 people

Determining Market Demand

Definition (Horizontal Summation)

When summing demand for a *private good*, you add up the quantity demanded of each individual at each price.

Trap: don't look at the graph and add the curves vertically. Just remember, if no one person demands gasoline above price p_max, the market doesn't demand any at prices above p_max either.

Determining Market Demand

Test yourself: what's the aggregate demand in this case?

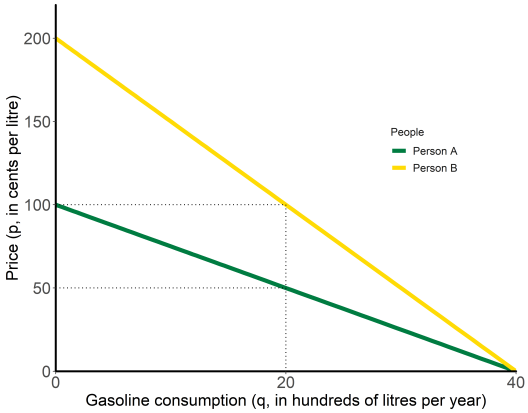


Figure: The demand for gasoline

Supply

- The second piece of the model: **Supply**
- Supply is producers' willingness to sell goods and services.
- What factors affect this willingness? How?

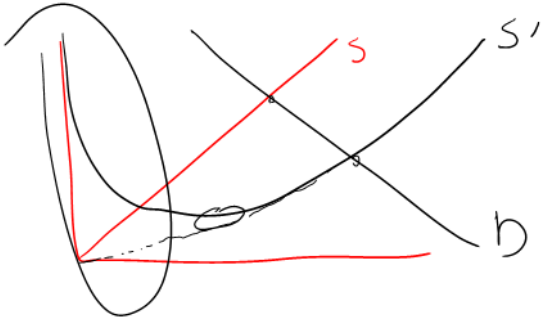
Supply

- As with demand, economists focus on how the *price* of a good or service affects the quantity supplied.

Definition (Quantity Supplied)

The amount of a good or service that producers *want* to sell at a given price, *holding other factors that influence supply decisions constant*.

Supply



- Is there a Law of Supply?
- We can illustrate the relationship between the price of a good or service and the quantity producers want to sell via a *supply curve*.

The Supply Curve

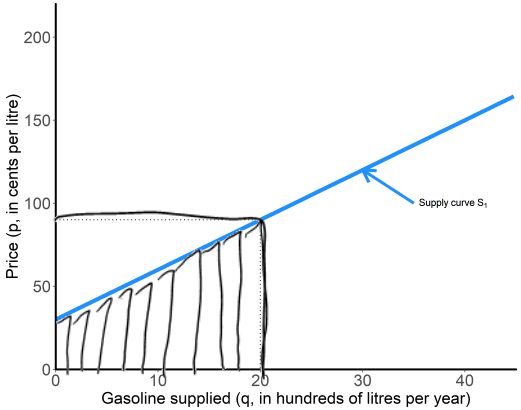


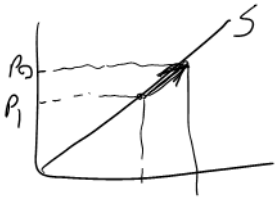
Figure: The supply of gasoline

The Supply Curve

- The supply curve provides us an answer to the question of what happens to the quantity supplied as price changes, holding all other factors fixed.
  - Here: what happens to the supply of gasoline as the price of gasoline increases or decreases.

- Changes in the quantity supplied in response to a price change are referred to as *movements along the supply curve*.

- Do supply curves always need to slope upward?



The Supply Curve

- The supply curve tells us how a change in the price of a good or service affects the quantity supplied.
  - Change in $p \implies$ *movement along the supply curve*.
- Recall that other factors also affect the quantity supplied.
  - Change in these factors $\implies$ shift of the supply curve.
- As an example, let's suppose that the price of an alternative product, yoghurt, increases in price from \$2.00 per kg to \$4.00 per kg.

The Supply Curve

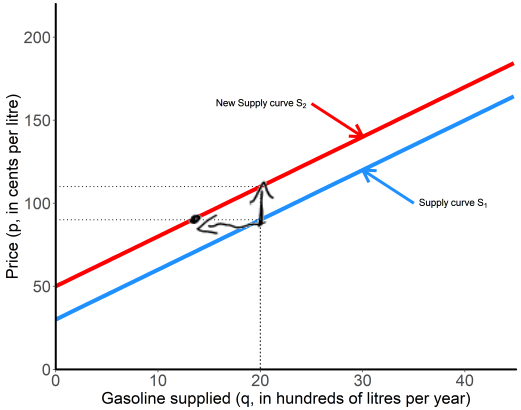


Figure: The effect of a crude oil price increase on the supply of gasoline

The Supply Curve

- How the supply curve shifts depends on the factor being considered.
  - Prices.
  - Production costs.
  - Technological change.
  - Government regulation.

- As another example, let's consider the effects of a decrease in the price of blending components.

The Supply Curve

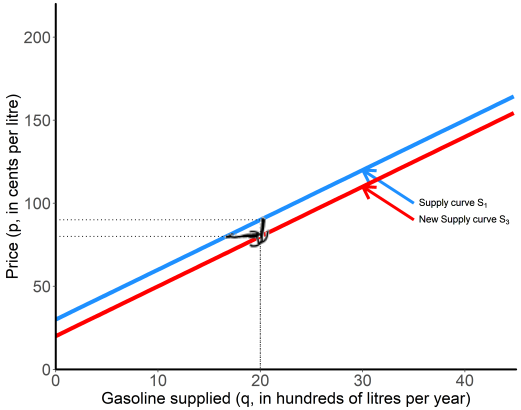


Figure: The effect of a blending component cost decreases on the supply of gasoline

The Supply Curve

- The supply curve displays the relationship between price and quantity supplied.
- We can also express this same relationship mathematically using a *supply function*.
- The supply function is given by:

$$Q = S(p, p_y, X)$$

where Q is the quantity supplied, and $S(-)$ is the supply function that depends on the price, p, the price of other possible inputs or outputs p_y, and other factors, X.

- For simplicity, in what follows, we will hold other factors (X) constant.

The Supply Function

- Suppose that the estimated supply function for gasoline is given by:

$$Q = 10 + \frac{p}{3} - 0.5p_y$$

where Q is the quantity of gasoline supplied, p is the price of gasoline, and p_y is the price of crude oil (these are just placeholder parameters).

  - the own-price effect, p, is positive: higher p means higher Q.
  - the impact of crude price changes, p_y is negative: higher crude prices means less gasoline supplied at a given price.
  - The constant term (10) reflects all other factors.

The Supply Function

- We can obtain the supply curve by substituting for the price of crude oil, p_y.
- Suppose the price of oil is \$40 per barrel. Then the supply of gasoline is given by:

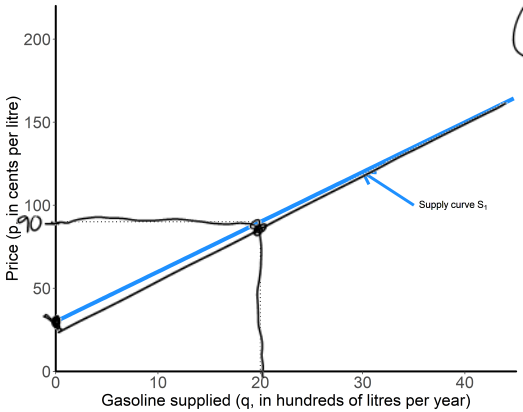
$$Q = 10 + \frac{p}{3} - 0.5p_y = 10 + \frac{p}{3} - 20$$

$$Q = \frac{p}{3} - 10 \quad \times 3 \quad 3Q = p - 30$$

$$p = 30 + 3Q$$

- Rearranging we can obtain the *inverse supply curve*, $p = 30 + 3Q$
- This is the same relationship depicted on the next slide.

The Supply Function



$P = 30 + 3Q$

@ $Q = 0$, $P = 30$

$P = 30 + 3(20)$

$= 90$

Figure: The supply of gasoline

The Supply Function

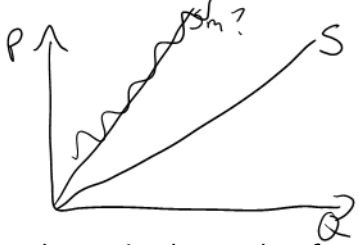
- The supply function allows us to think precisely about how price changes affect the quantity supplied, holding all other factors fixed.
- Let's use a simpler example here of $Q = 2p$ and let p_1 denote the initial price, and p_2 denote the new price.
- The quantity supplied at p_1 is $Q_1 = S(p_1) = 2p_1$, and the quantity supplied at p_2 is $Q_2 = S(p_2) = 2p_2$
- The change in quantity supplied as price goes from p_1 to p_2 is $\Delta Q = Q_2 - Q_1 = S(p_2) - S(p_1)$.
- In our simplified example, if the price changes from p_1 to p_2, the change in quantity supplied is given by:

$$\begin{aligned}\Delta Q &= S(p_2) - S(p_1) = [2p_2] - [2p_1] \\ &= 2[p_2 - p_1] = 2\Delta p\end{aligned}$$

Determining Market Supply

- In some cases, we may not have an estimate of total market supply, but rather estimates of the supply curves of each producer in the market.
- To obtain total market supply, we need to add up the supply from each producer.
- Hint: Are you adding up prices or quantities?

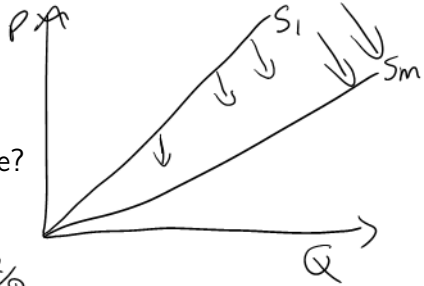
Determining Market Supply



- As an example, suppose there are 3 producers in the market for gasoline. They both have supply functions given by:

$$Q = 2p$$

what is the market supply of gasoline in this case?



$Q_1 = 2p$
$Q_2 = 2p$
$Q_3 = 2p$
$Q_m = 6p$

$P = Q_m/6$

Determining Market Supply

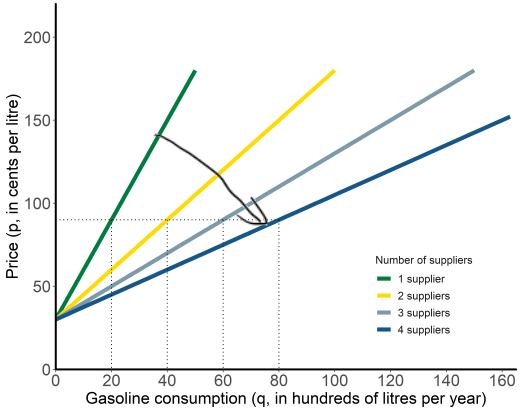


Figure: The aggregate supply of gasoline using the same equations as above

Market Equilibrium

- Once we know supply and demand in the market, we can determine the *market equilibrium*.

Definition (Market Equilibrium)

The market is in equilibrium when all market participants are able to buy or sell as much as they want; no participant wants to change their behaviour given what other market participants are doing.

Market Equilibrium

- How can we determine the market equilibrium from the supply and demand curves?

Market Equilibrium

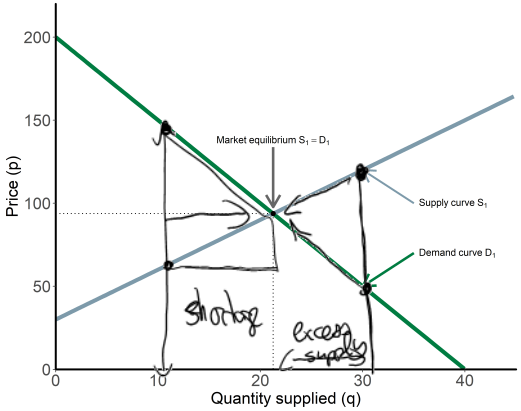


Figure: Equilibrium in the market

Market Equilibrium

Definition (Equilibrium Price)

The equilibrium price is the p at which consumers can buy as much as they want, and sellers can sell as much as they want.

Definition (Equilibrium Quantity)

The equilibrium quantity is the q such that the quantity demanded equals the quantity supplied.

Market Equilibrium

Figure: Our modern understanding of equilibrium in the market is largely due to this economist. Image: PBS

Market Equilibrium

Figure: They even made a movie about him: A Beautiful Mind (2001)

Market Equilibrium

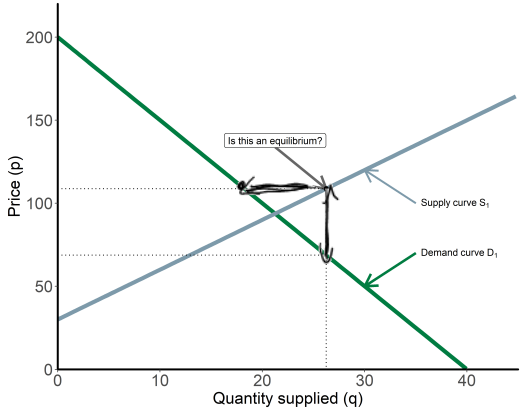
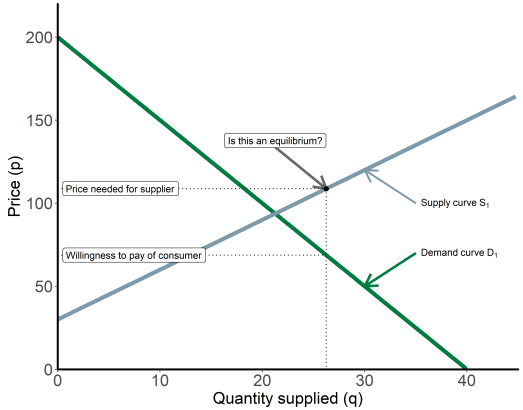


Figure: Off-equilibrium points, and the rationale of equilibrium

Market Equilibrium



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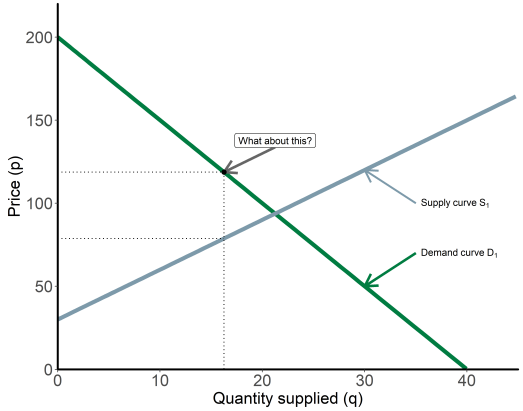
Market Equilibrium



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Market Equilibrium

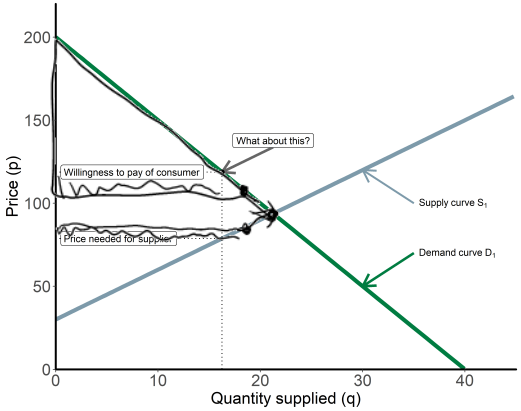

Figure: Off-equilibrium points, and the rationale of equilibrium

Market Equilibrium

- We can also solve for the market equilibrium analytically using algebra:

$$Q_D = 40 - \frac{p}{5} \quad \text{and} \quad Q_S = \frac{p}{3} - 10$$

- In equilibrium $Q_D = Q_S$. Substituting yields:

$$40 - \frac{p}{5} = \frac{p}{3} - 10$$

$$\frac{8p}{15} = 50$$

$$p = 93.75$$

- Substituting in the equilibrium price into Q_D or Q_S yields the equilibrium quantity of 21.25.

Market Equilibrium Check

- We can do the same off-equilibrium checks with algebra too. For example, let's consider whether Q=25 is an equilibrium.
- Start with the marginal willingness to pay (or demand) at Q=25:

$$Q_D = 40 - \frac{p}{5} \quad \text{so if} \quad 25 = 40 - \frac{p}{5}, \; p \text{ must be } \frac{p}{5} = 15, \; p = 75$$

- But, at p=75, how much are firms willing to supply?

$$Q_S = \frac{75}{3} - 10 Q_S = 15$$

- So, at a quantity of Q=25, the marginal consumer who sets the price is willing to pay p=75, but at a price of p=75, there's only going to be a supply of Q=15. Not an equilibrium

Market Equilibrium

Remember this graph? Same thing as the algebra in the previous slide

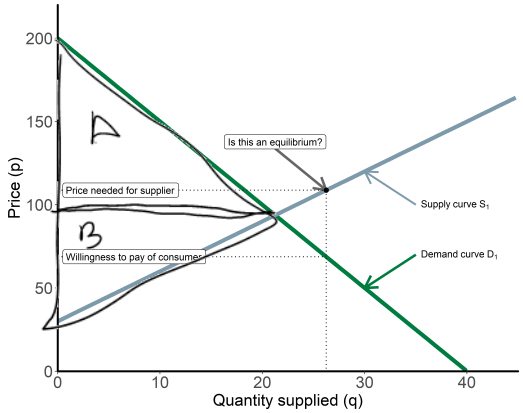

Figure: Off-equilibrium points, and the rationale of equilibrium