

Market Structure, Supply, and Market Outcomes

Fall 2023
Econ 2316, Northeastern University
Prof. Josh Abel

P&R: chapters 8 (especially 8.3-8.8), 16.4, 10 (especially 10.1, 10.3-10.5, 10.7) and 12 (especially 12.1-12.2)
Emerson: chapters 9, 13, 14 (14.4 only), 15, 18 (skim 18.3), 19 (skim)

Introduction

Some guiding structure

- Almost always, economists assume firms seek to maximize profits:

$$\pi(q) = TR(q) - TC(q)$$

- Choose q optimally to set derivative equal to 0:

$$MC(q) = MR(q)$$

From earlier

Result of demand and market structure (we'll study these later)

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study these **now**)

“Market Power”

- Market power refers to an entity’s ability to influence marketwide outcomes
- We typically assume there are many, many **consumers** and so an individual consumer has no market power
 - Not always true:
 - The Pentagon is a dominant buyer of fighter jets – its decisions affect the market
 - Apple, Dell, and just a handful of others buy hard drives
 - A local factory may be a town’s major employer – it can influence the wage
- With **firms**, economists frequently consider models with market power.
 - At the broadest level, there are 3 types of market structures

Three structures of supply side of market

1. Perfect competition:

- Many, many firms compete
- An individual firm is a price taker, meaning it assumes its actions do not affect the price
- New firms enter market in the long run if there are positive profits, and they exit if there are losses

2. Monopoly:

- One firm supplies all quantity
- The monopolist understands that its quantity choice affects the market price
- Barriers to entry prevent new firms from competing

3. Oligopoly:

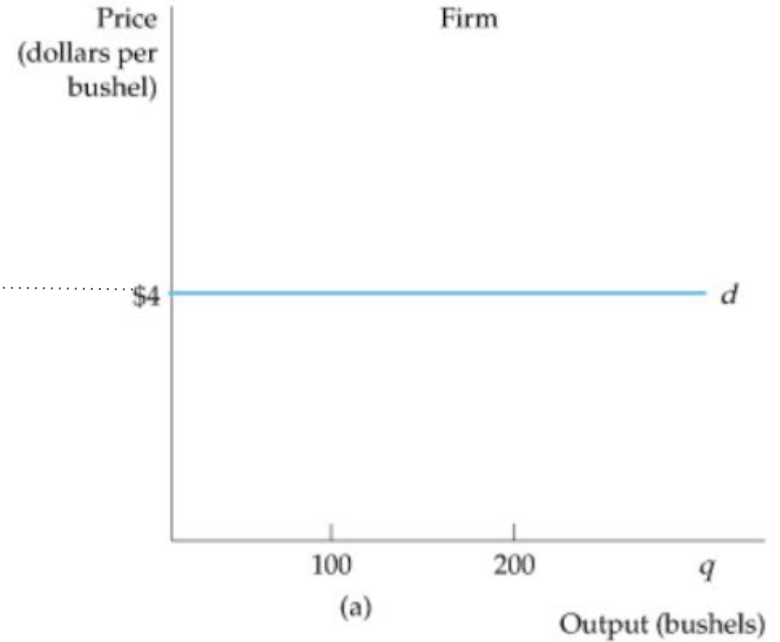
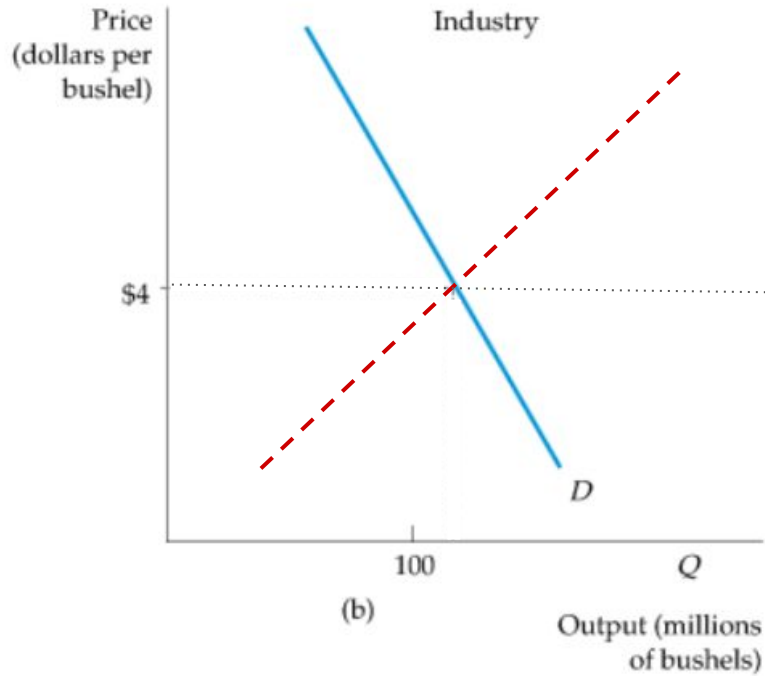
- A “small” number of firms compete
- An individual firm considers its’ competitors actions when making its decisions – and understands that competitors are doing the same – all of which affects market outcomes
- Barriers to entry prevent new firms from competing
 - Game Theory is used to solve these models

Perfect Competition

Key assumptions of Perfect Competition

1. Firms are price takers
 - Each individual firm perceives that it is so small that it cannot affect the market price.
 - The market generates a price; the firm can sell as much quantity as it wants at that price
2. Free entry and exit
 - Firms that are losing money are free to shut down without paying extra costs
 - Short run or long run
 - New firms are free to enter without prohibitive costs if they think it will be profitable

Price taking (visualization)



Price taking (discussion)

- Price taking is a “sleight of hand” by economic modelers
 - Even if there 1,000 firms, an individual firm should still have **some** impact on price
 - Therefore, no firm can truly take the price as given, regardless of the quantity it chooses
 - I.e. all firms have **some** market power
- However, it’s a very useful trick
 - As we’ll see later, the model gets a lot harder when firms understand their market power
 - The price-taking assumption allows us to ignore those complications while giving a good approximation of how firms behave when that market power is low (competition is fierce)

Profit maximization for price takers

$$MC(q) = MR(q)$$

Profit maximization for price takers

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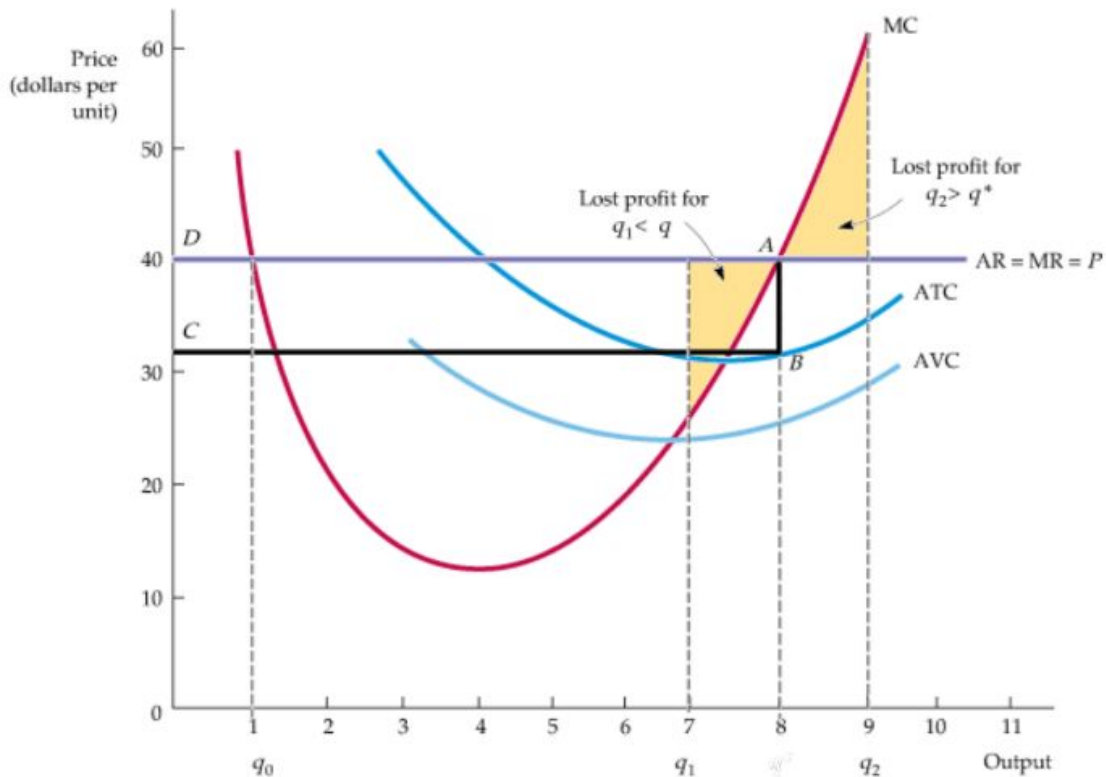
- How much additional revenue do you get from selling 1 more unit? (i.e. what is marginal revenue?)

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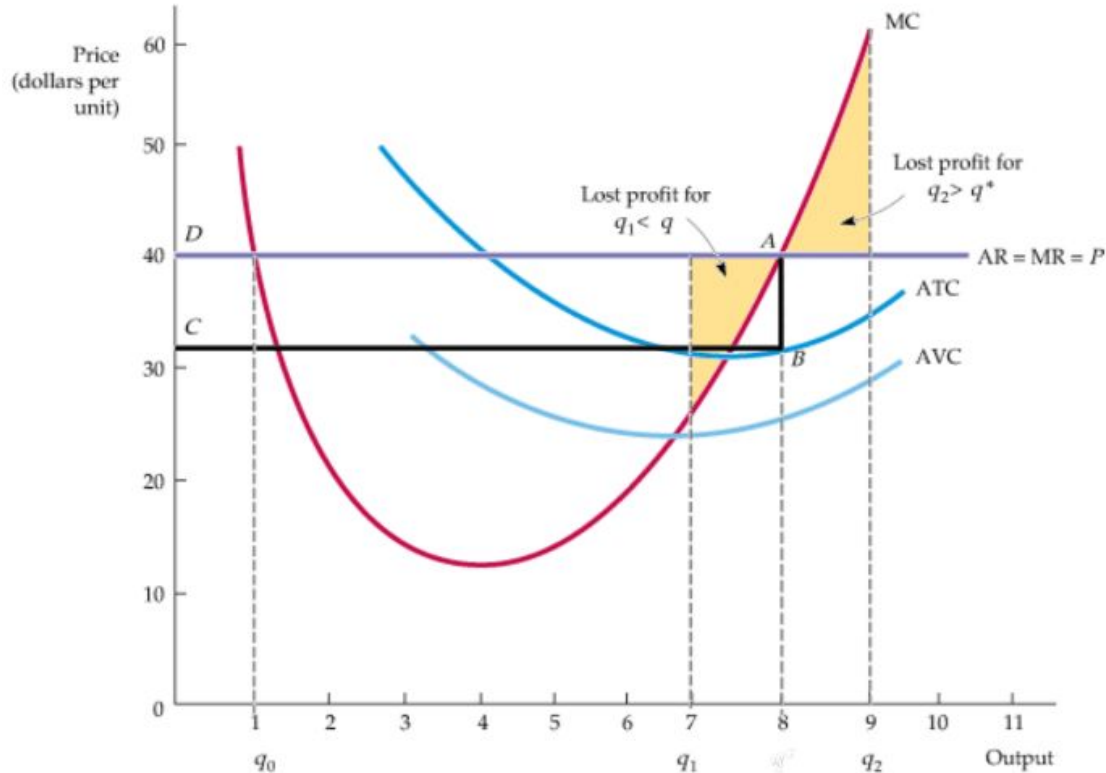
- How much additional revenue do you get from selling 1 more unit? (i.e. what is marginal revenue?)
 - The price!
 - And that's true for every single unit, since the price is assumed to be unaffected by the firm's quantity sold
 - As we will see later, this is different for firms with market power

Profit maximization for price takers (visualization)



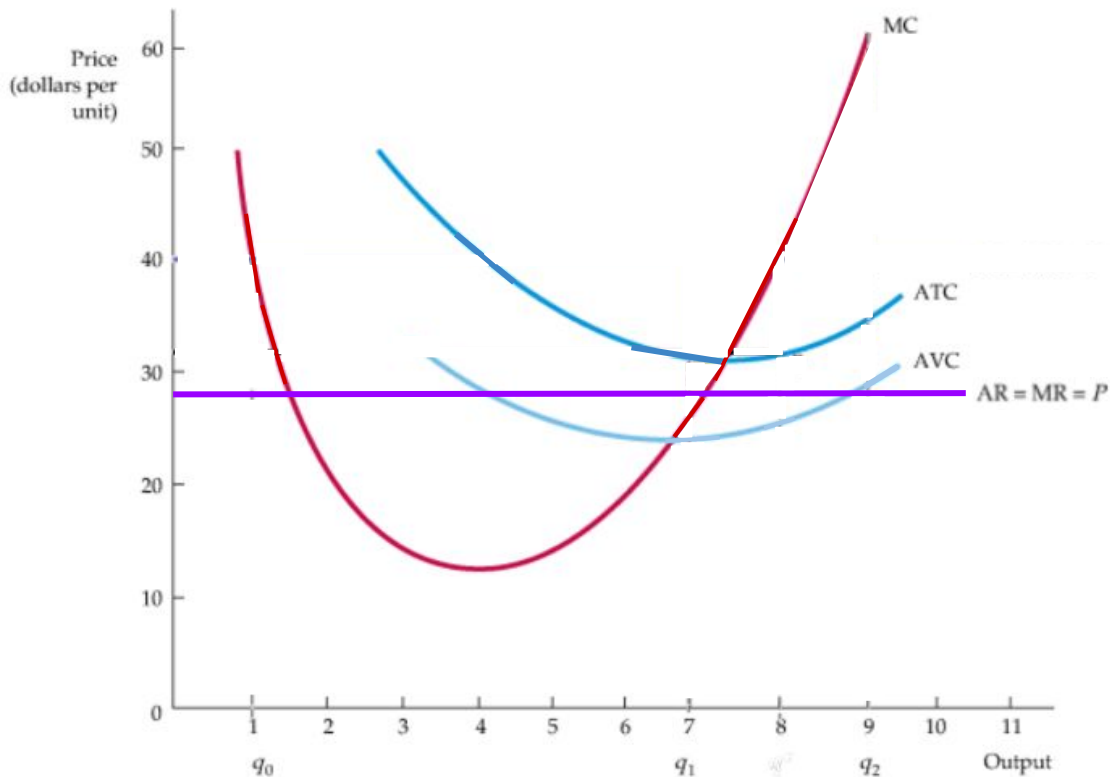
- Profit maximized at $q = 8$
 - Lower quantity forgoes profitable units
 - Higher quantity sells unprofitable units
- Profit is positive, as $P > ATC$.
- In long run, will firms enter or exit?

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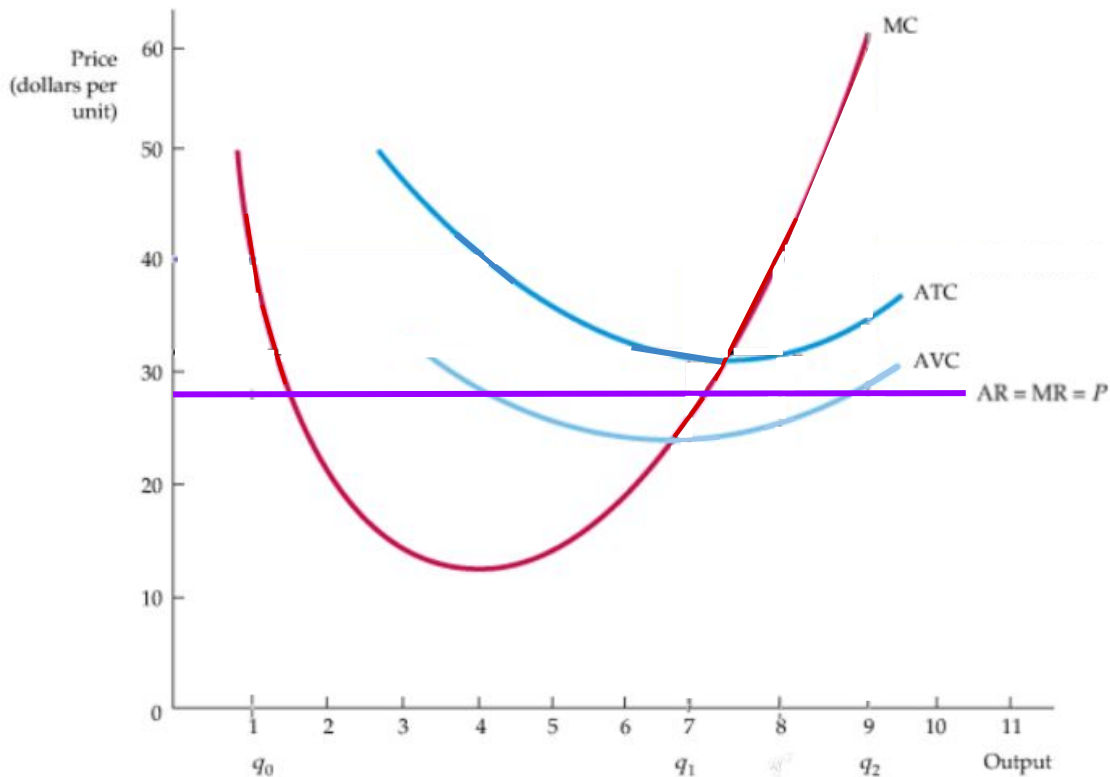
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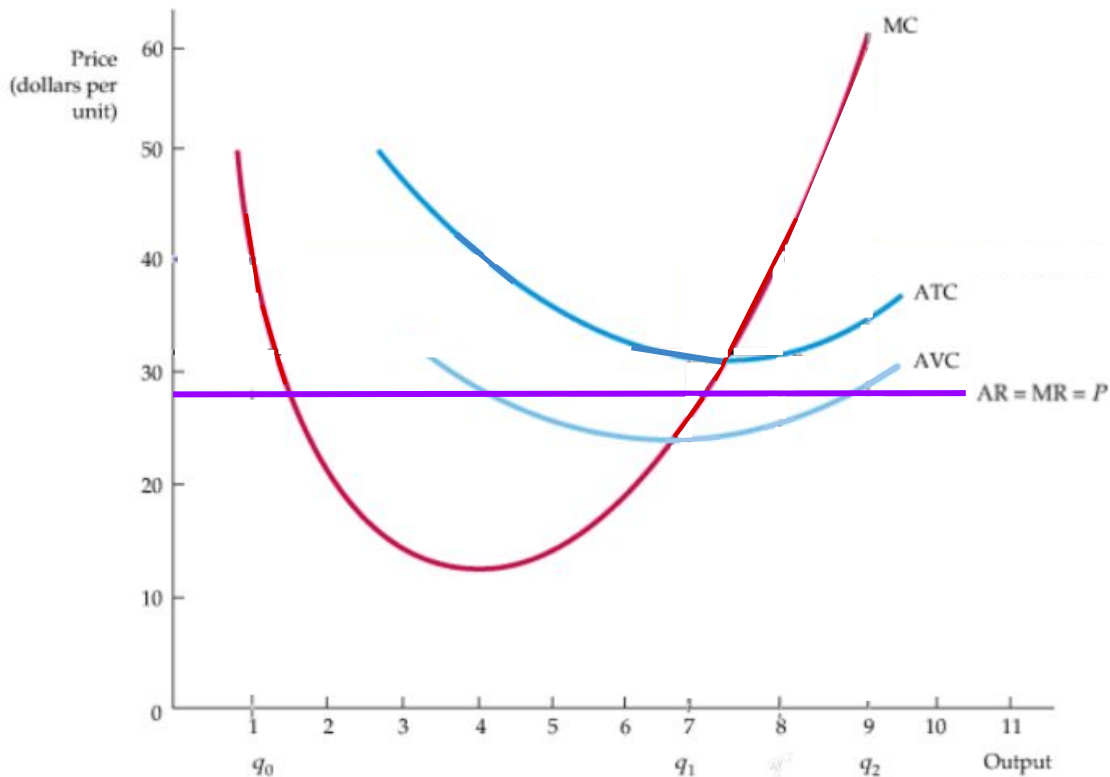
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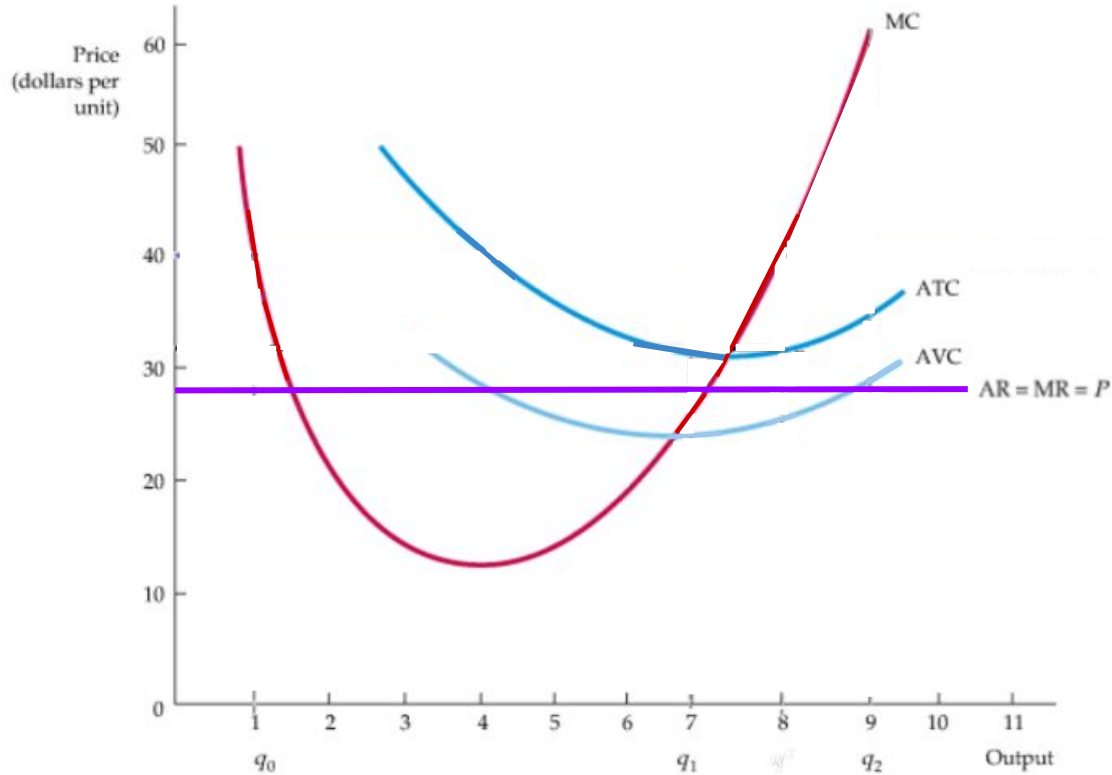
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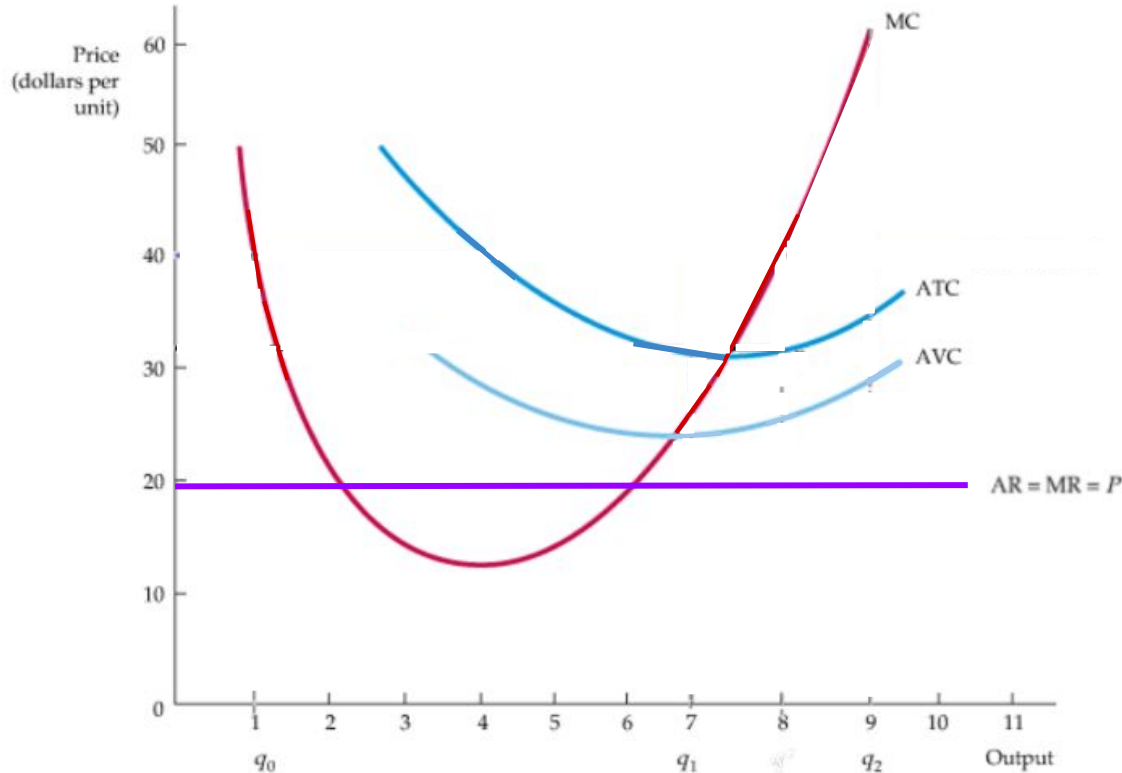
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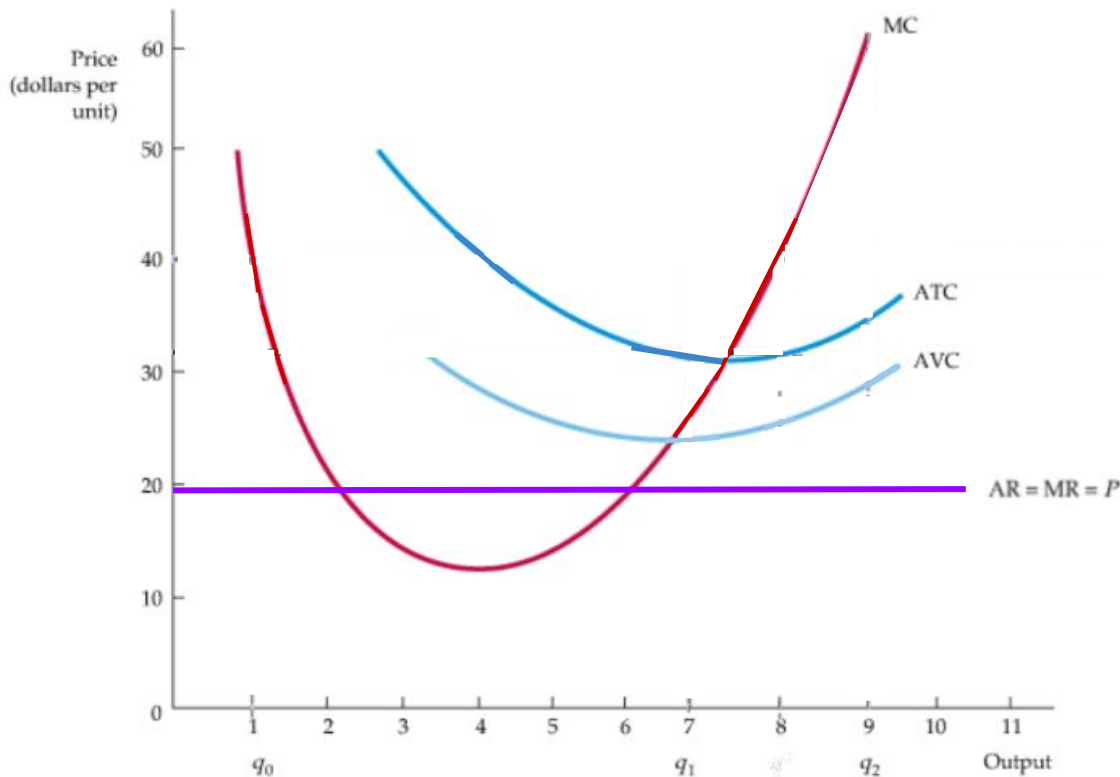
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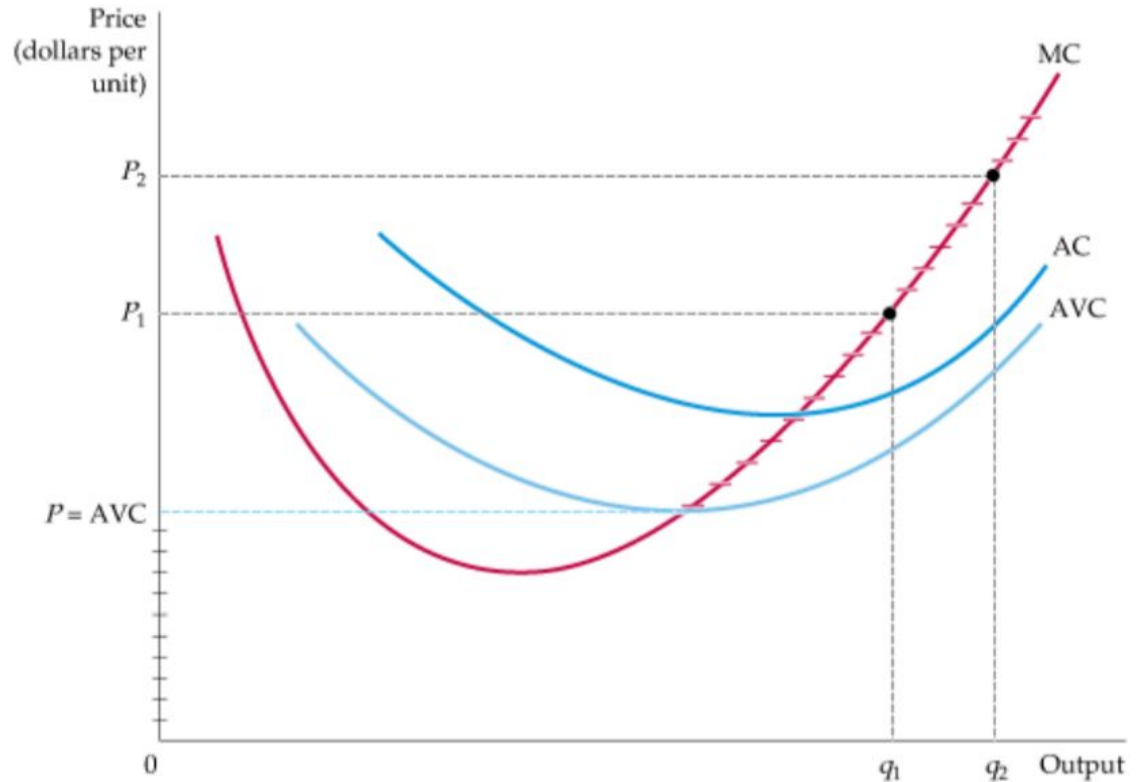


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- What if $P < AVC$?
 - Shut down, even in short run.

2 primary takeaways from this analysis:

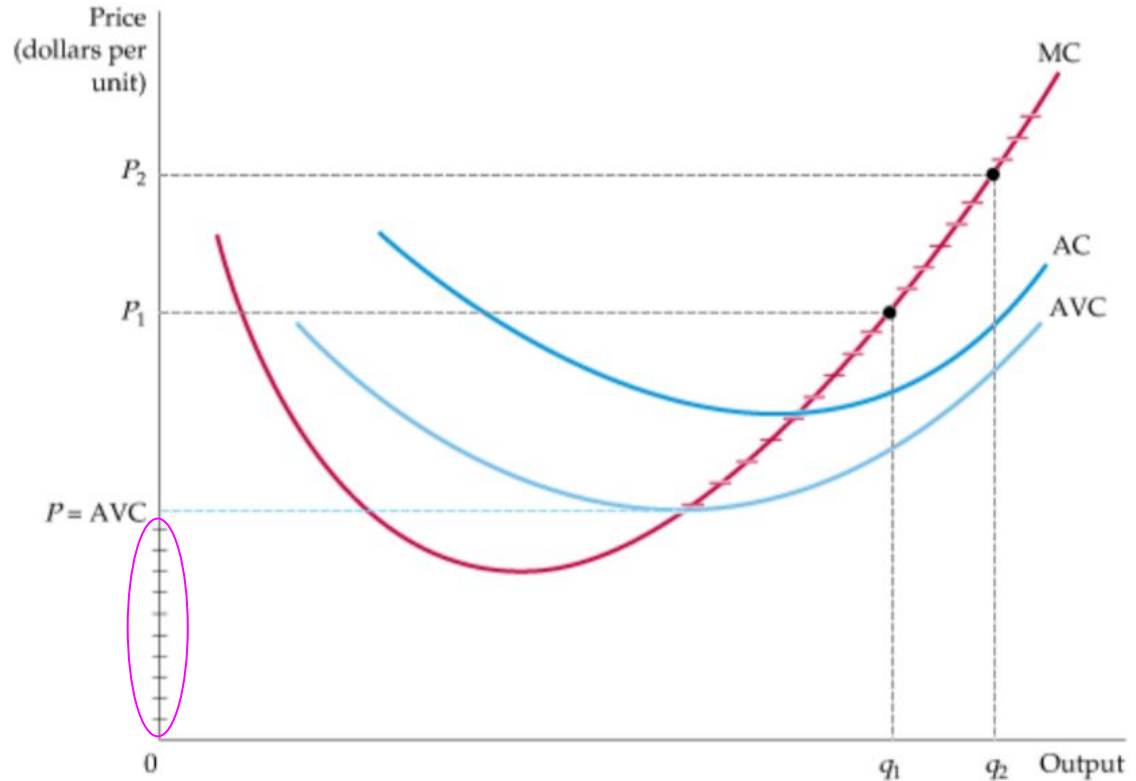
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2. In long run, firms produce at ATC-minimizing quantity

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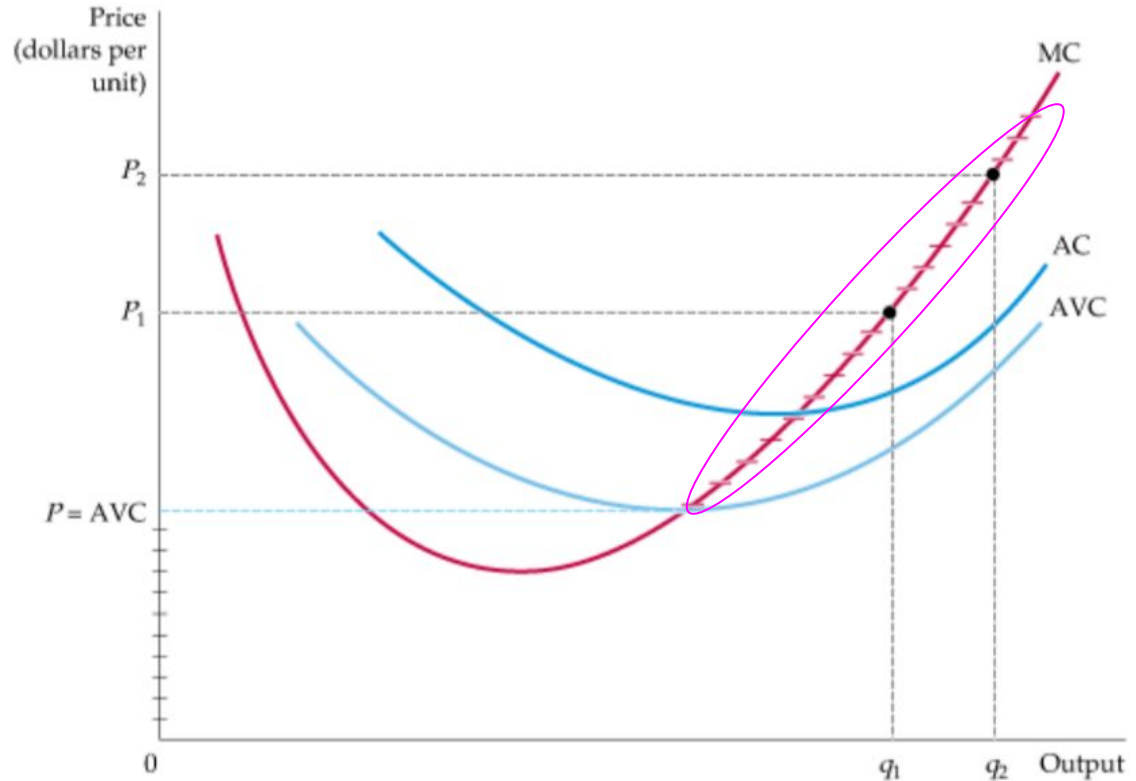
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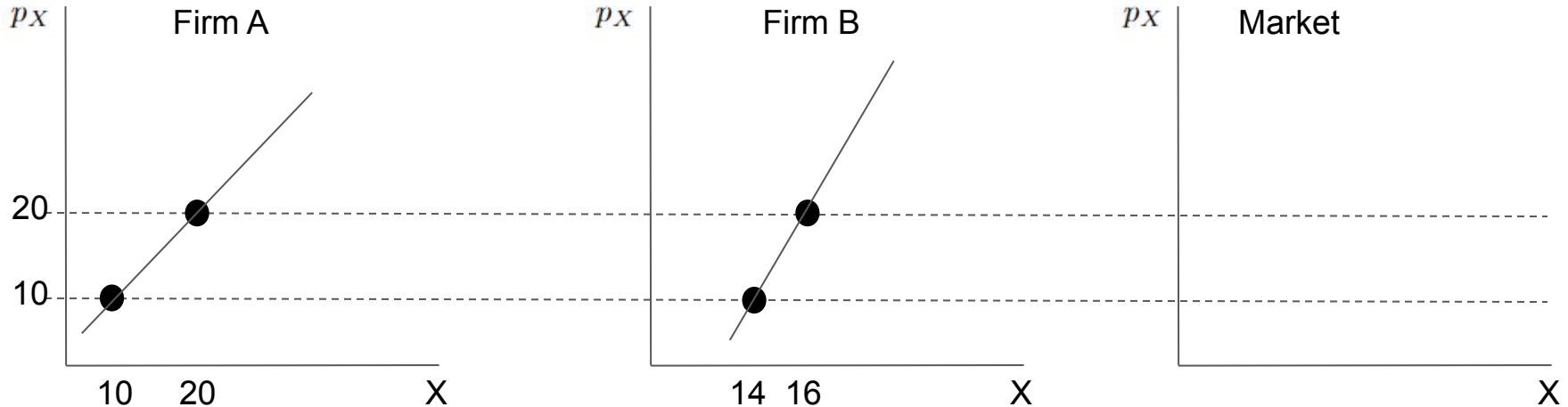
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- When price is below AVC, the firm shuts down even in the short run, setting $q=0$
- When price is above AVC, firm chooses q such that $P = MC$
 - So MC curve shows how much q to produce for any P – which is exactly what a supply curve is!



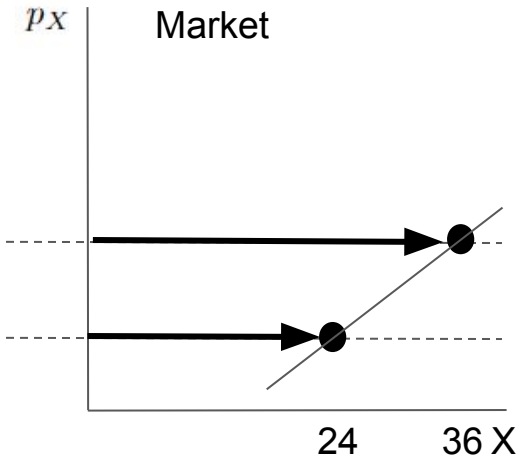
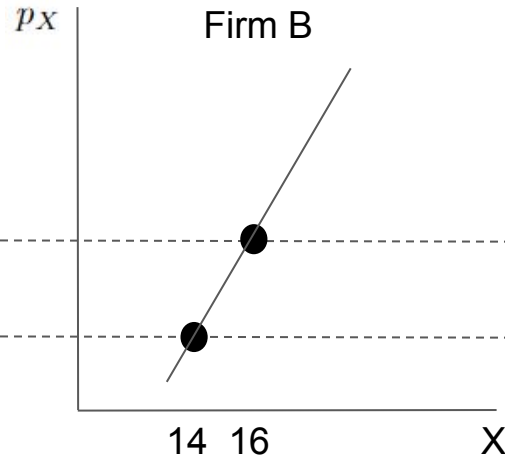
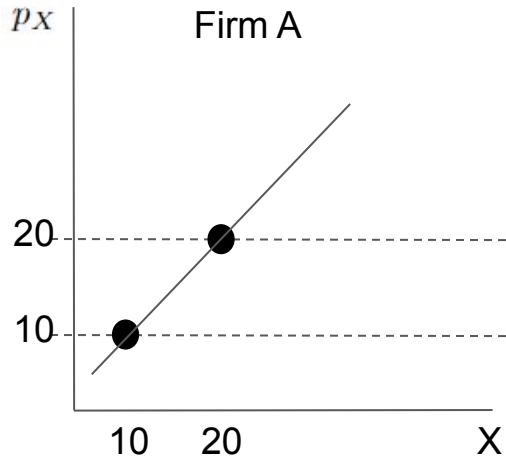
Market supply

- Just like with demand, market supply is the horizontal sum of firm supplies
 - a. At price 10, firm A would supply 10 units of the good. At price 20, it would supply 20
 - b. At price 10, firm B would supply 14 units of the good. At price 20, it would supply 16
- What is the market supply?

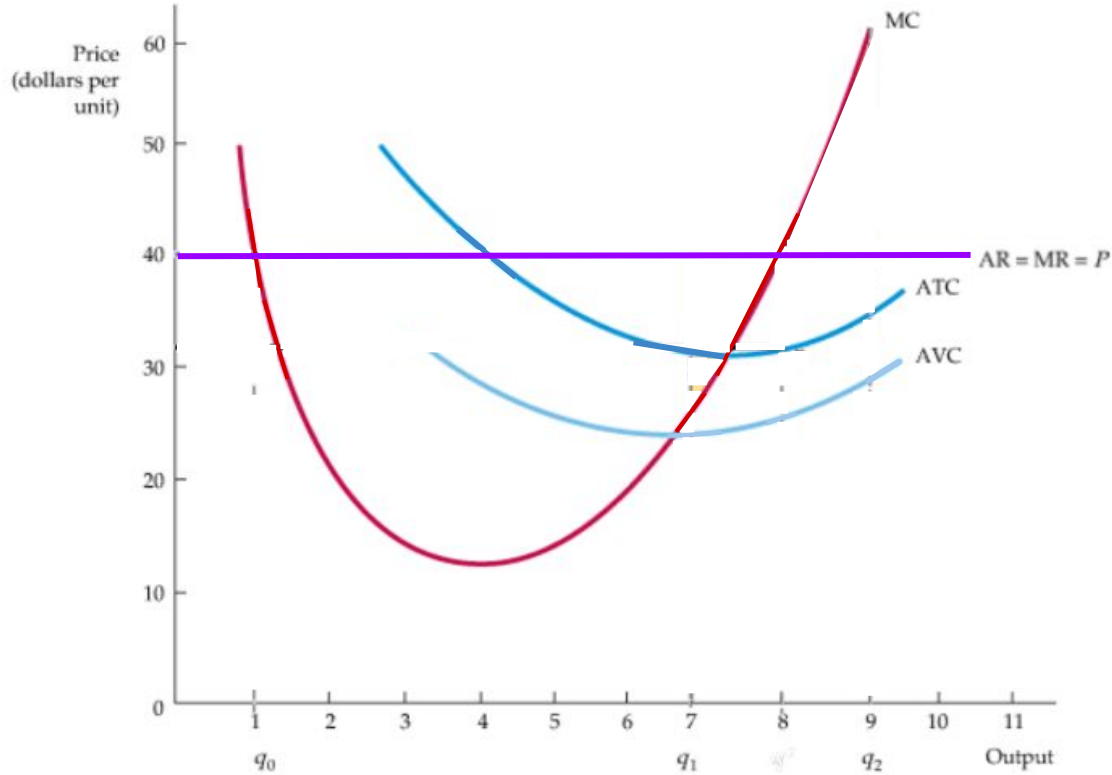


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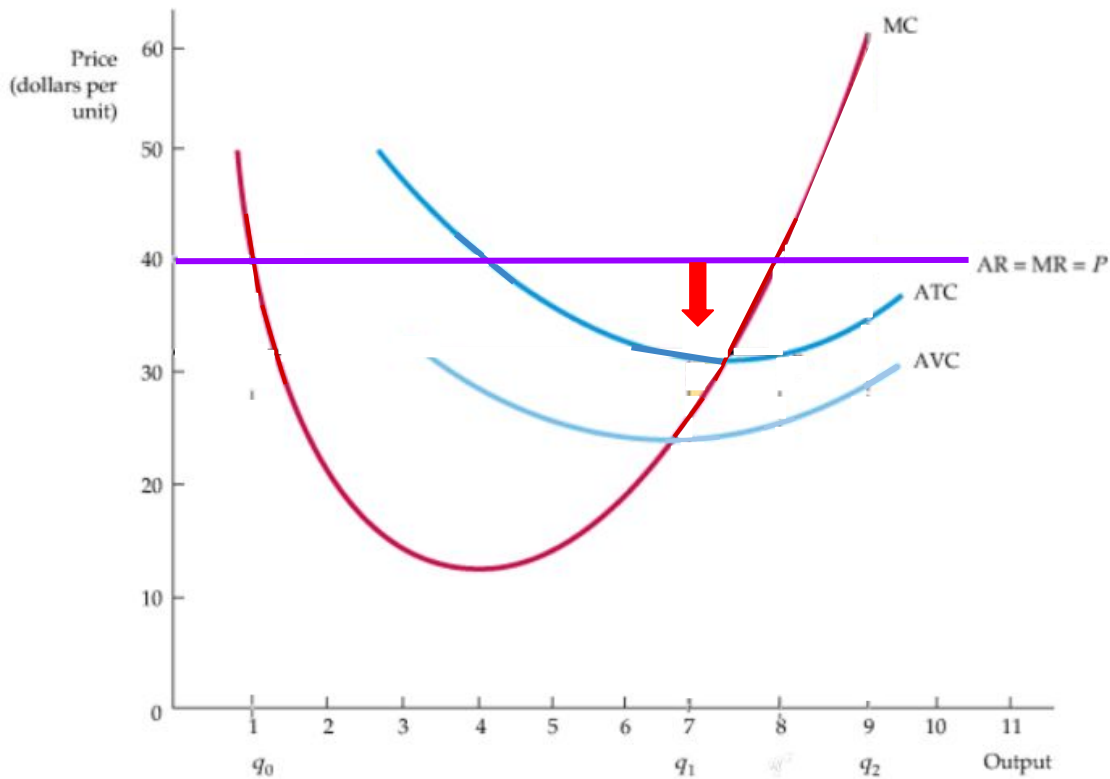


2. In long run, firms produce at ATC-minimizing quantity



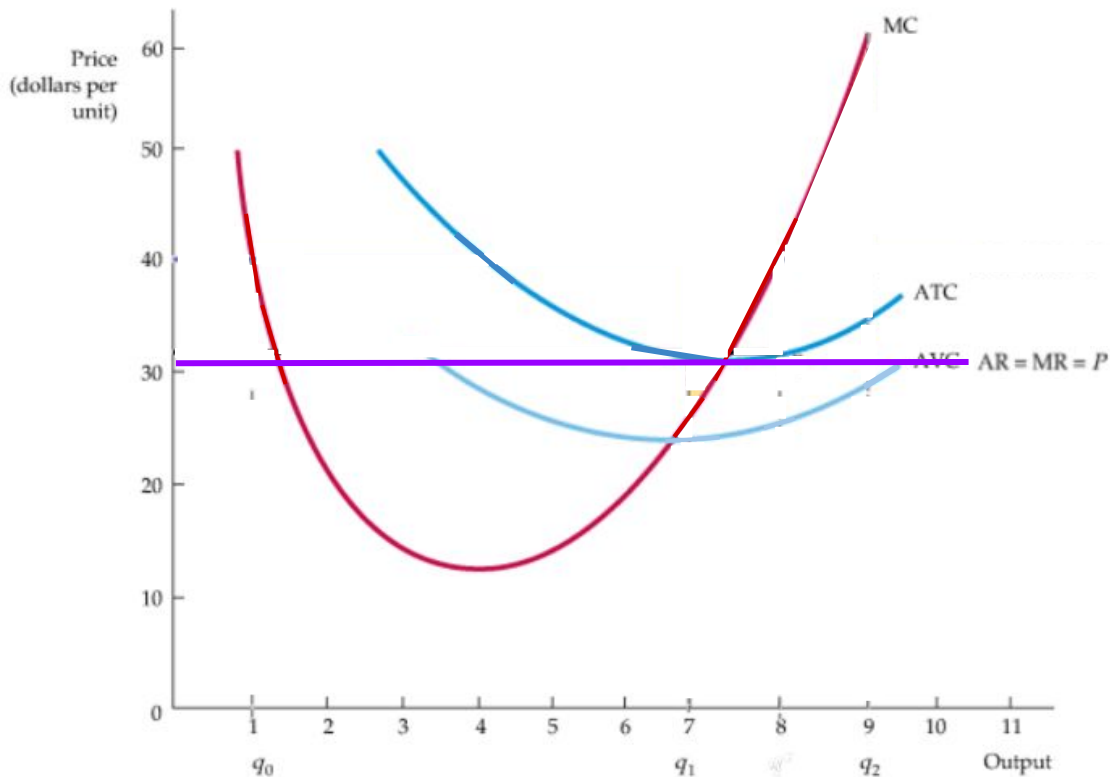
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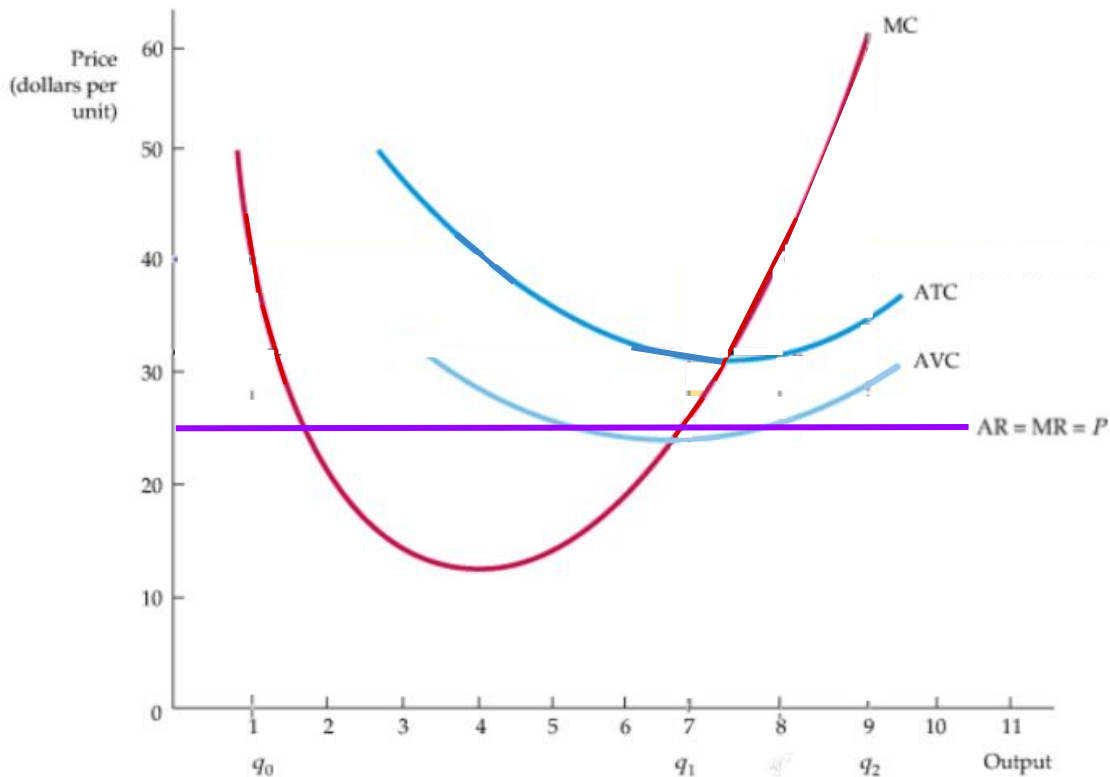
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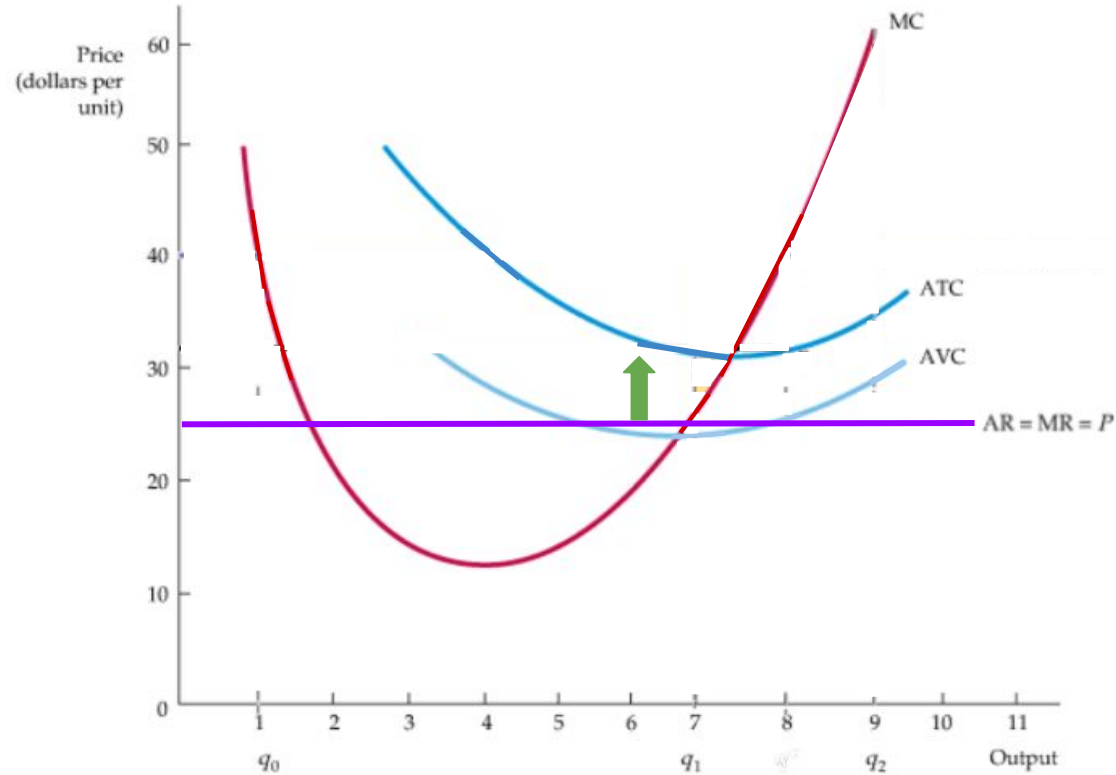
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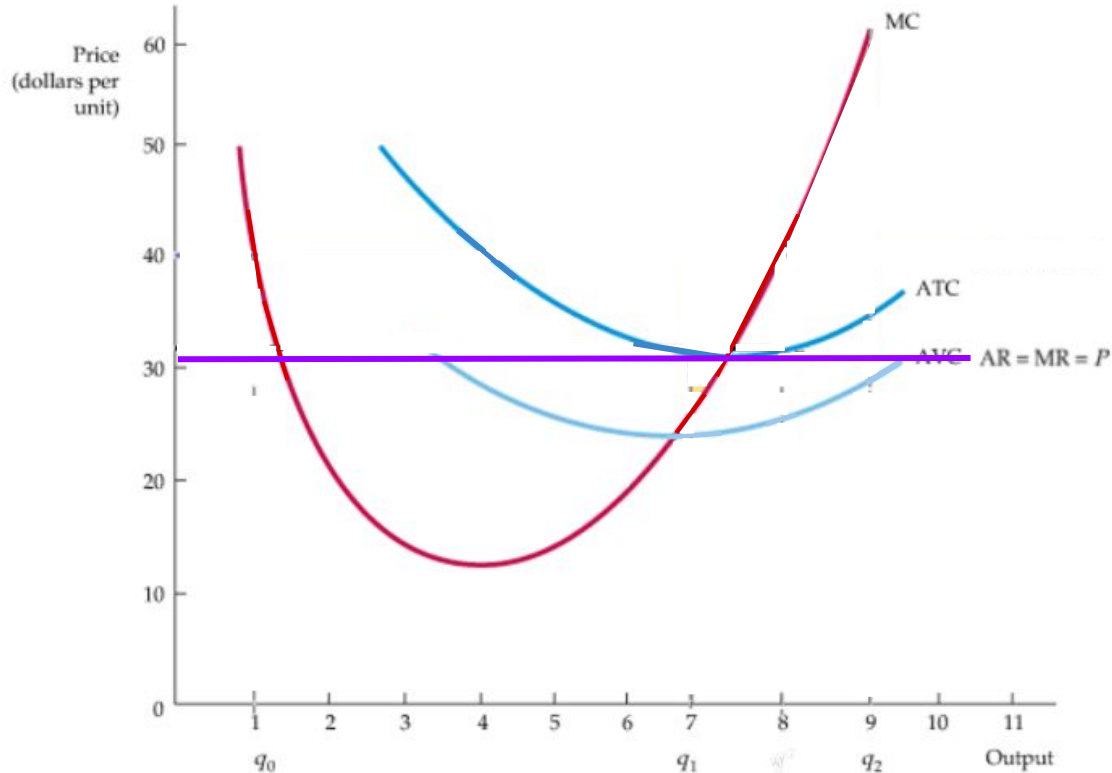
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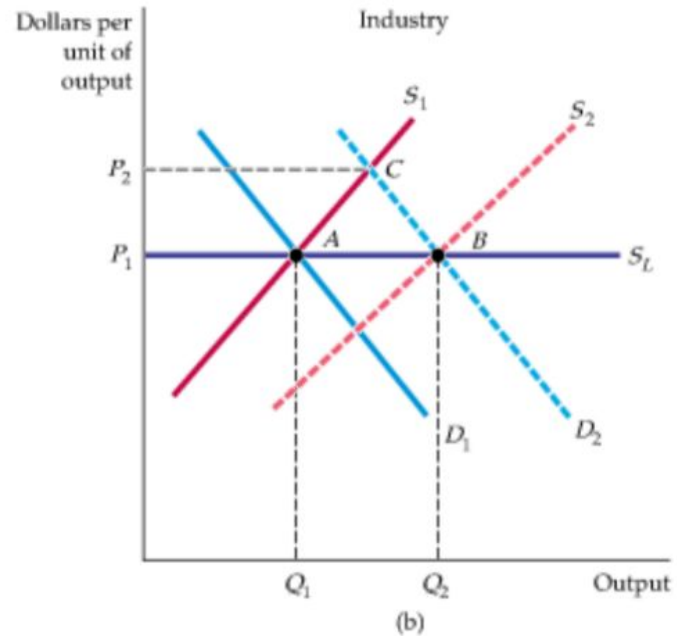
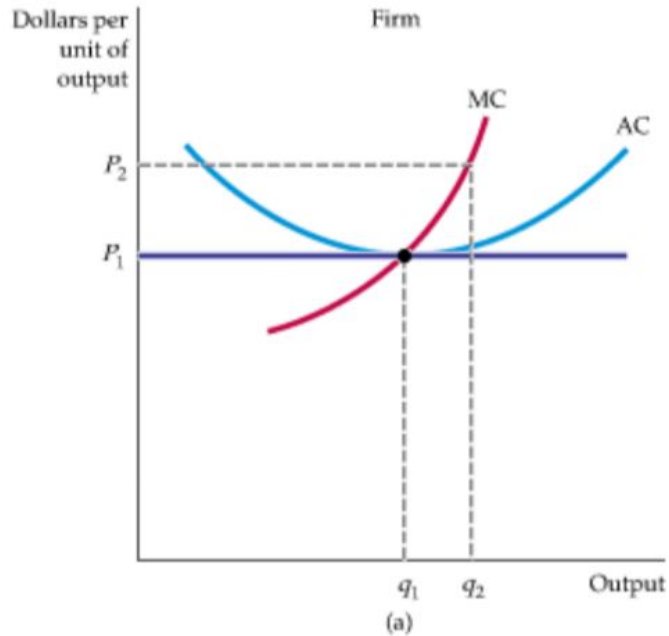
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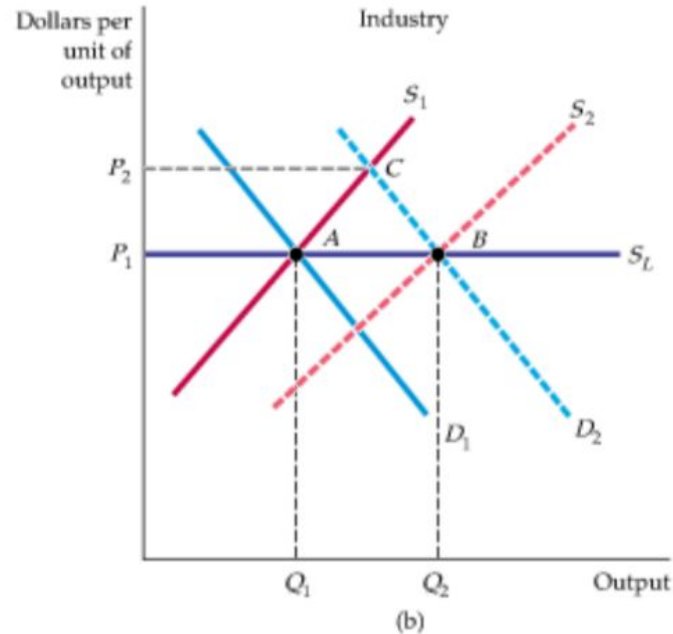
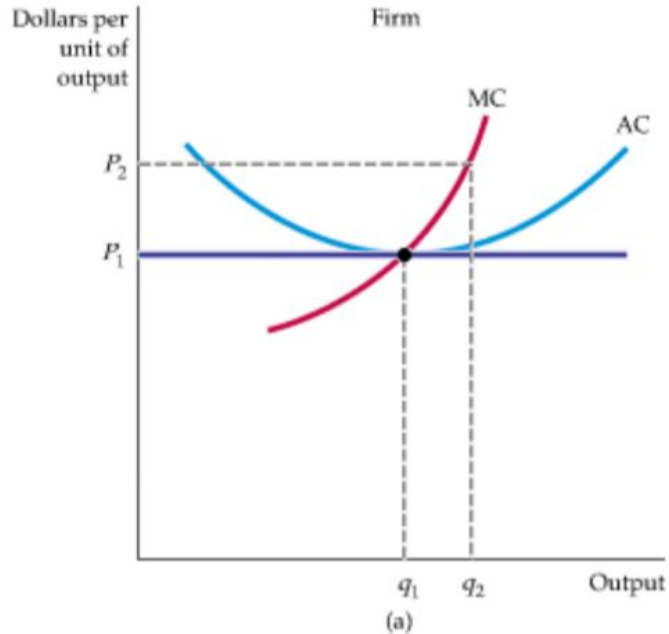
Market dynamics: constant-cost industry

1. Start in LR equilibrium ($P = \min AC$)



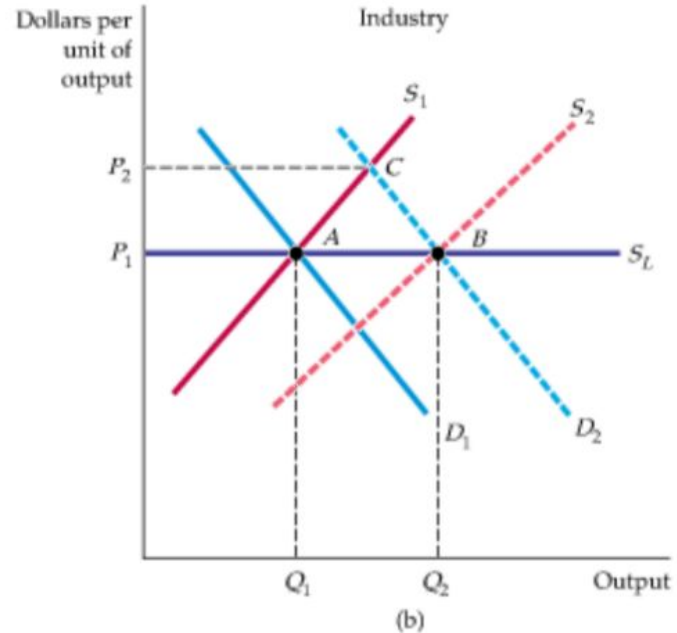
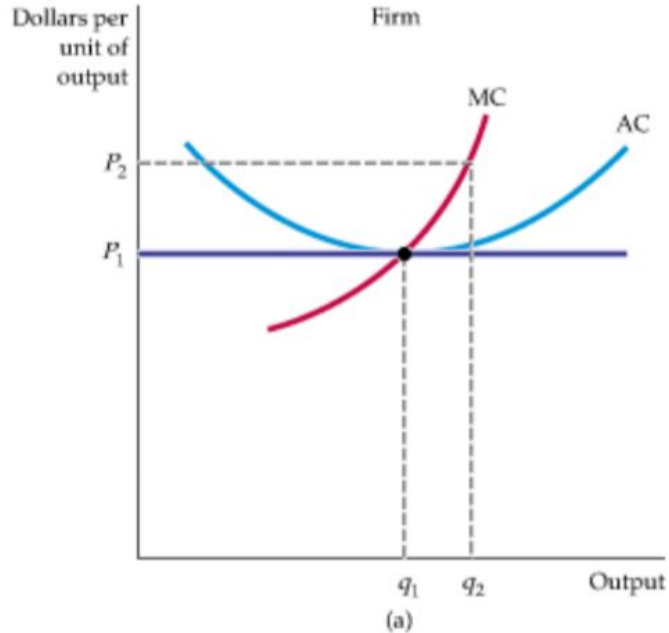
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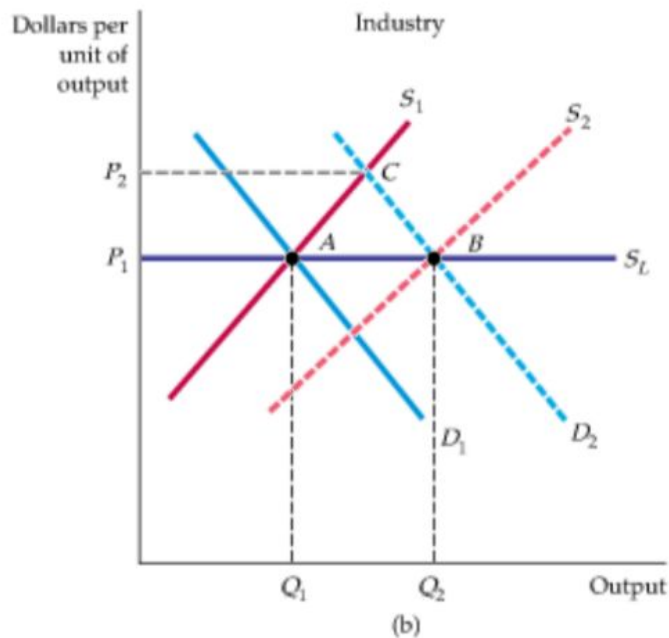
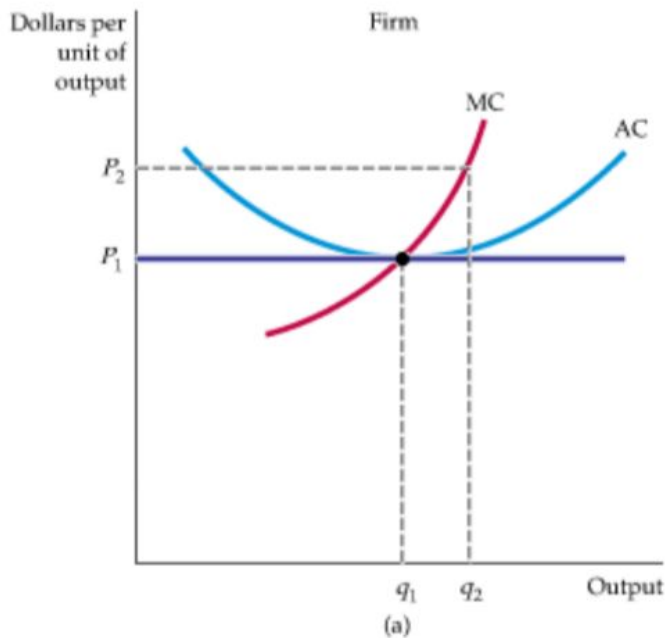
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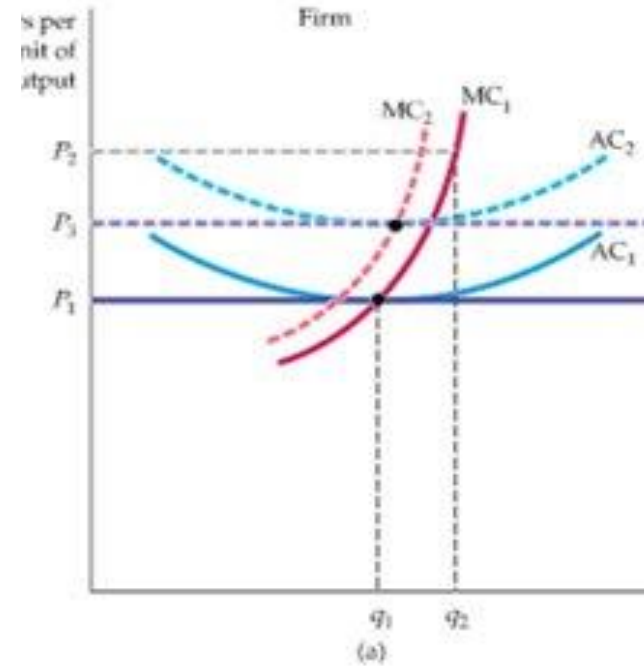
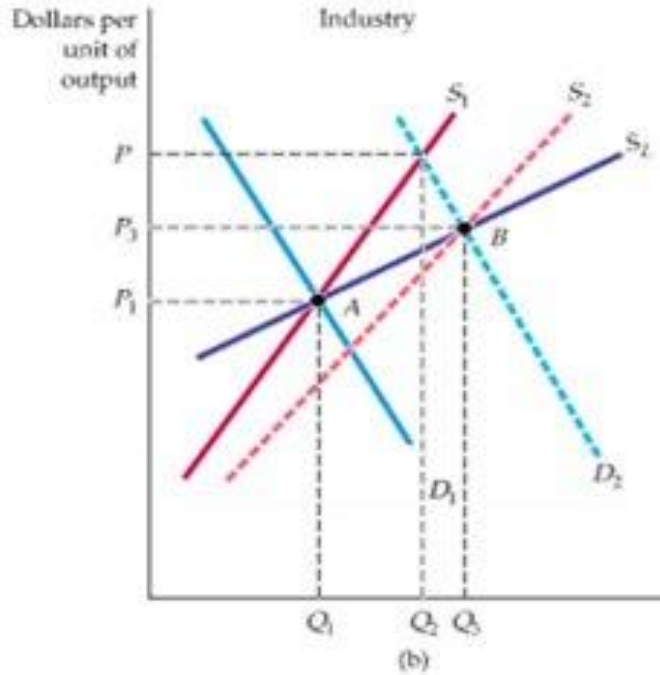
1. Start in LR equilibrium ($P = \min AC$)
2. Increase in demand
 - SR: no entry yet; firms raise price and produce more
3. LR: firms enter to compete away profits
4. Each firm returns to minimum AC
 - LR: more firms and output than before
 - LR: price goes back to starting level



Market dynamics: increasing-cost industry

- In previous example, firms' cost curves did not change as the industry equilibrium evolved
- So in the long run, price was constant (because the minimum of ATC was constant)
 - SR supply was upward-sloping, but LR supply was flat
 - In LR, demand shock goes entirely into quantity, not at all into price
- But suppose there are diseconomies of scale
 - Perhaps because firms are forced to compete for a scarce resource, like land or skilled workers
 - As industry expands, costs increase
 - This will lead to an upward-sloping LR supply curve

Market dynamics: increasing-cost industry (2)

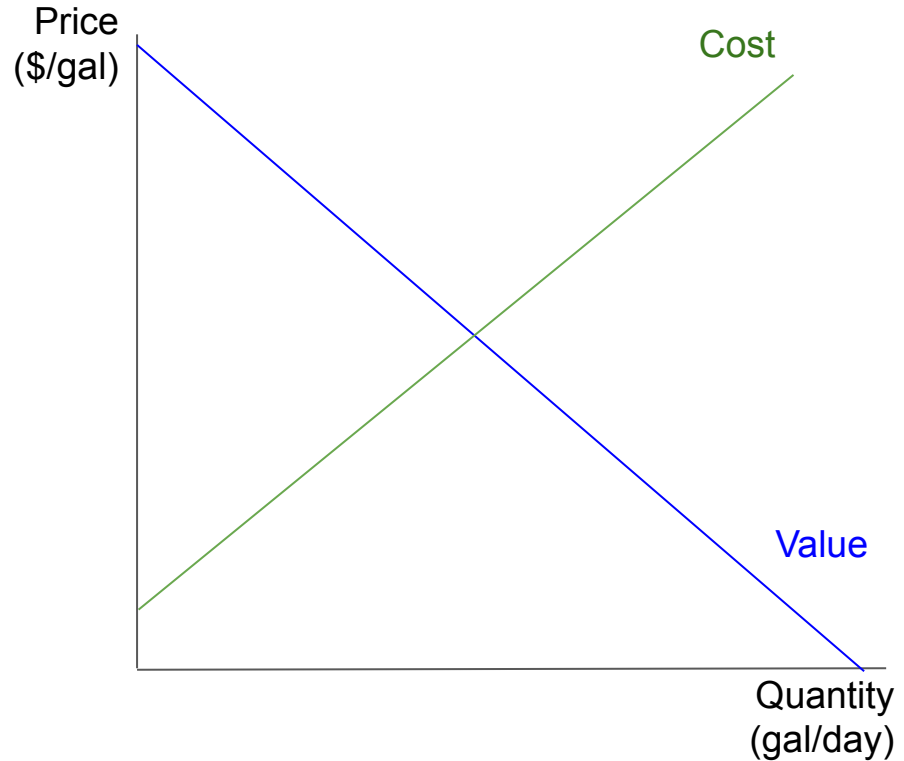


Market Efficiency, Revisited

Efficiency

- If consumers are rational, demand curve represents their value of the good
- If firms maximize profits and market is competitive, supply shows marginal cost
 - Will dive deeper later in semester

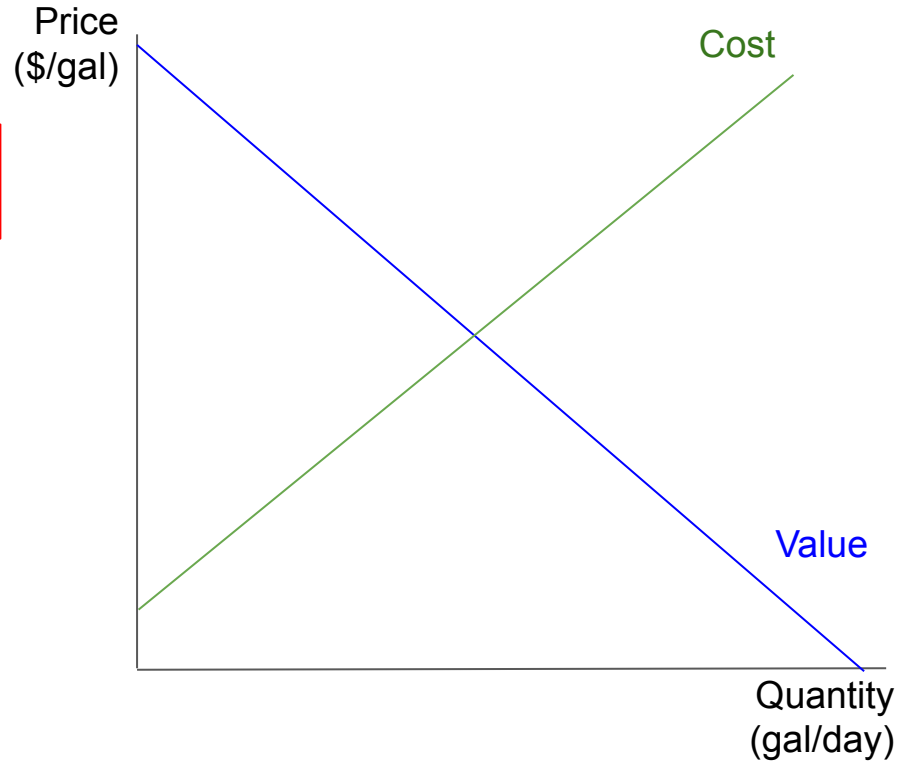
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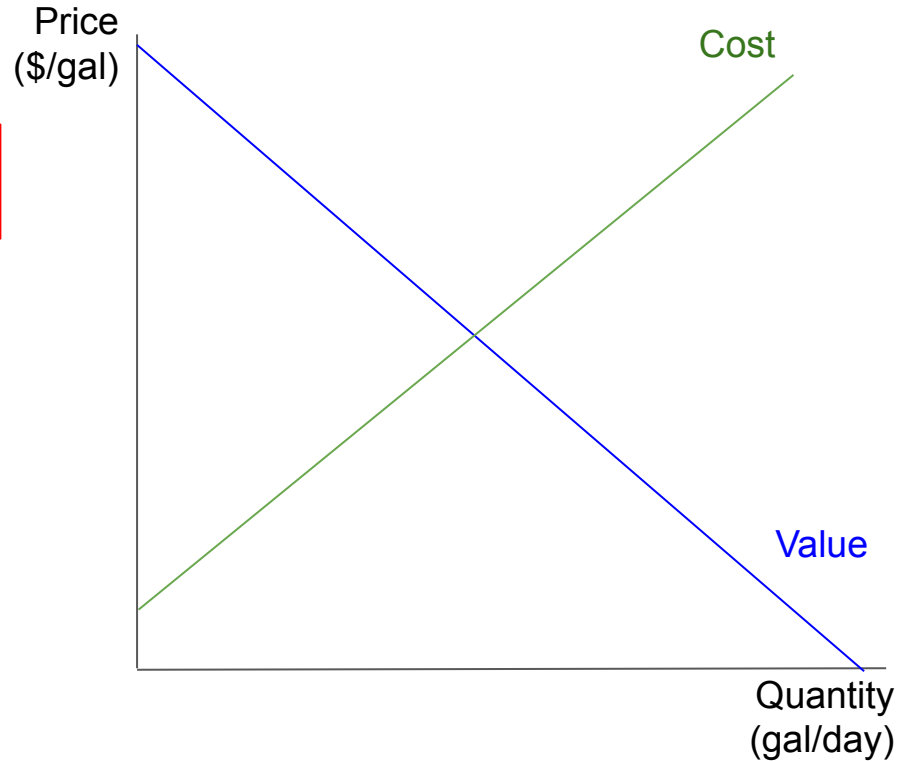
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Efficiency, revisited

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- Now we see why:

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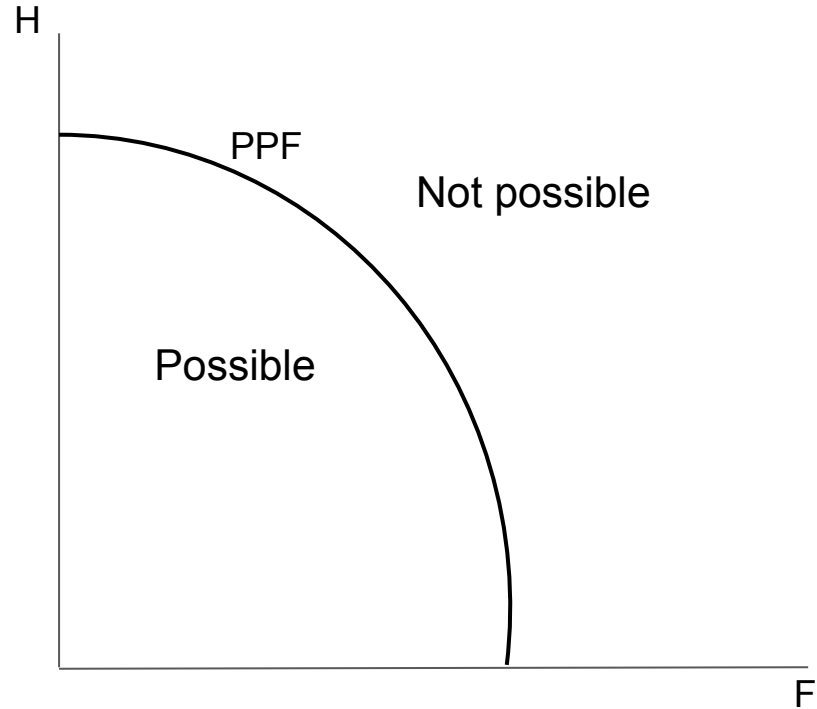
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 - Allocative efficiency: Producers with low cost produce in equilibrium – those with high costs are left out
 - Just as consumers with highest value buy the good in equilibrium

Efficiency, revisited

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- Leads to 2 types of efficiency
 - Allocative efficiency: Producers with low cost produce in equilibrium – those with high costs are left out
 - Just as consumers with highest value buy the good in equilibrium
 - Productive efficiency: In the long run, output is produced at minimum ATC

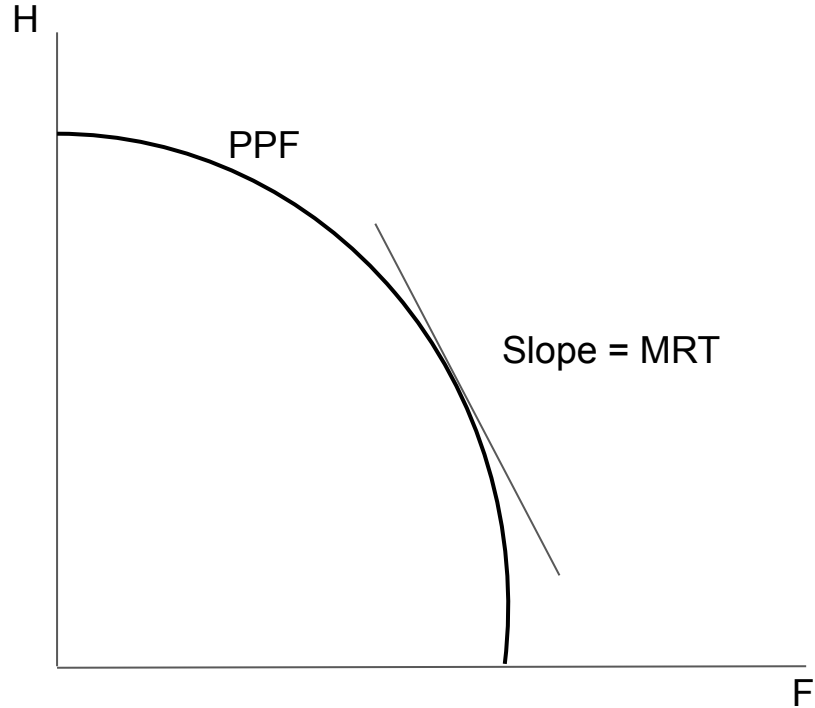
Production Possibilities Frontier

- Consider an economy that produces 2 goods, Food and Housing
- The Production Possibilities Frontier shows what combinations of F and H are achievable by means of production



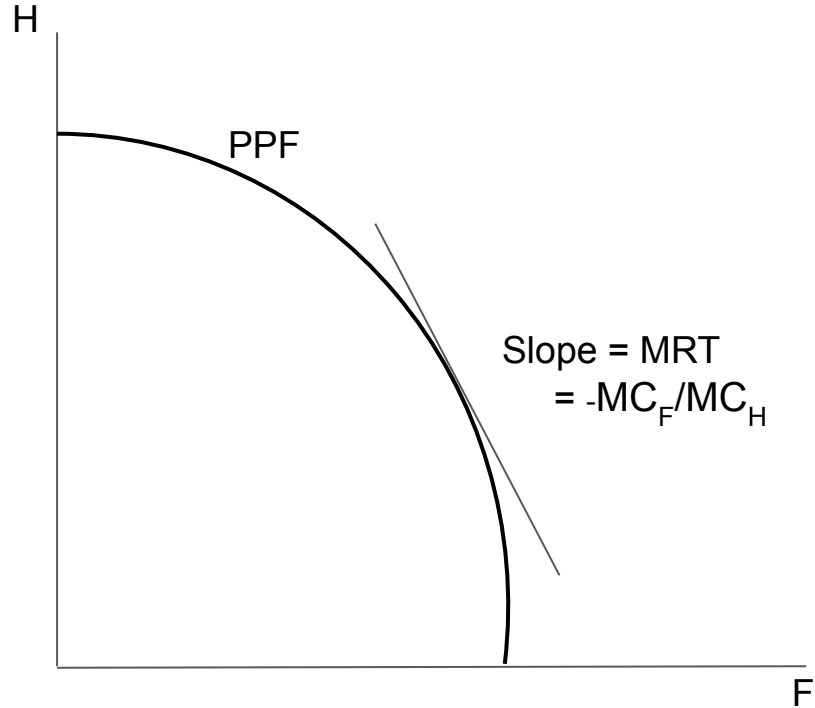
Marginal Rate of Transformation

- The slope of the PPF is called the Marginal Rate of Transformation
- MRT: “If we produce one more unit of food, how much housing must we give up?”



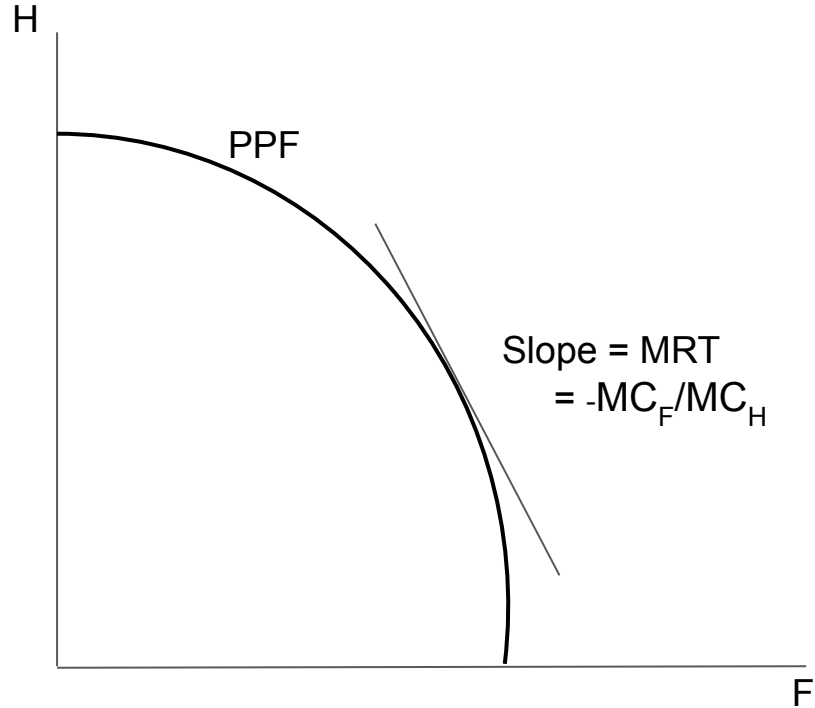
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- So if we take MC_F away from housing, we have to give up MC_F/MC_H housing
- So that's the slope



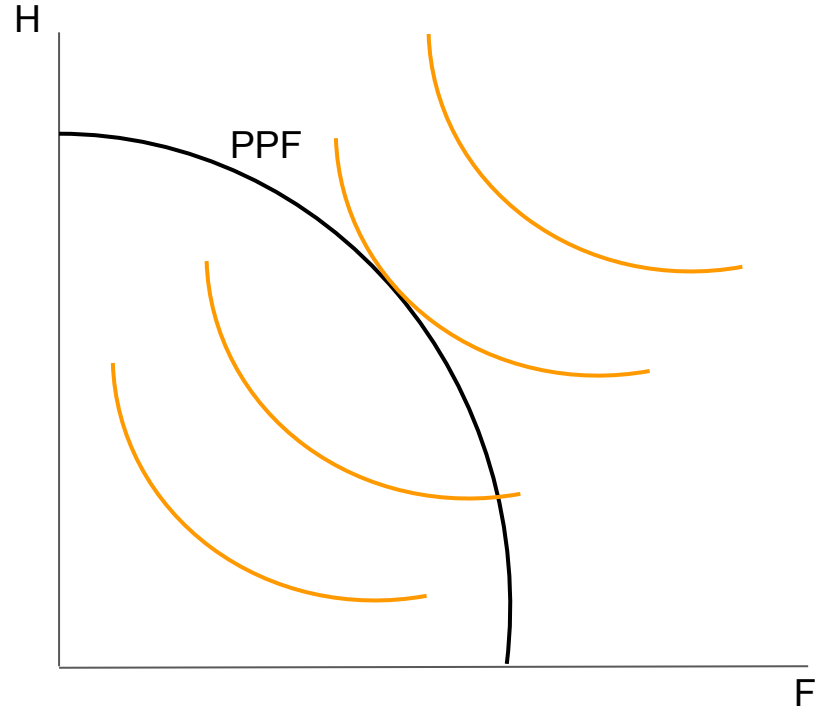
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- So that's the slope
- If MCs are increasing, then PPF will be concave



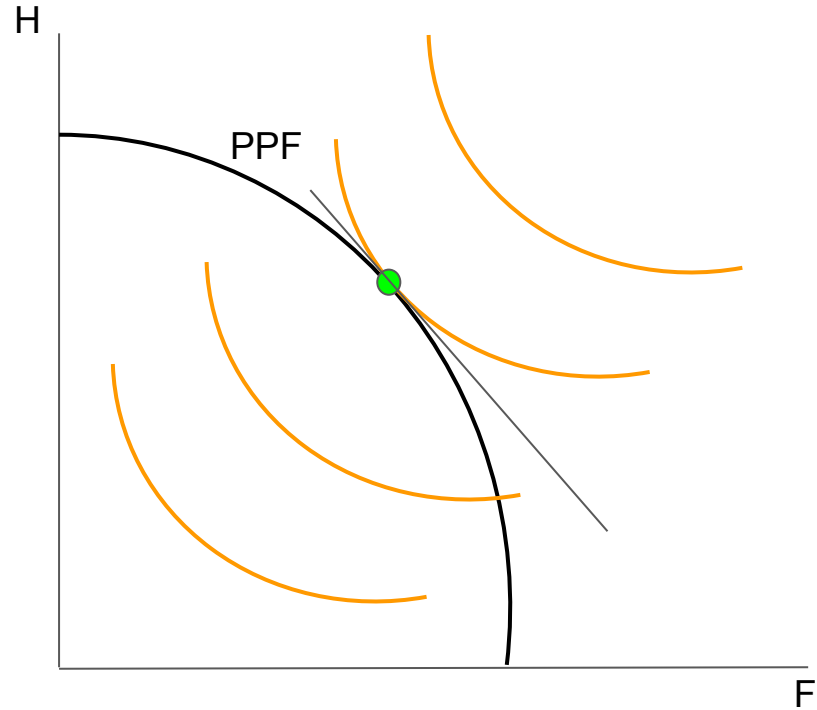
Productive Efficiency

- The optimal combination of F and H is the one that allows the representative consumer to have highest utility



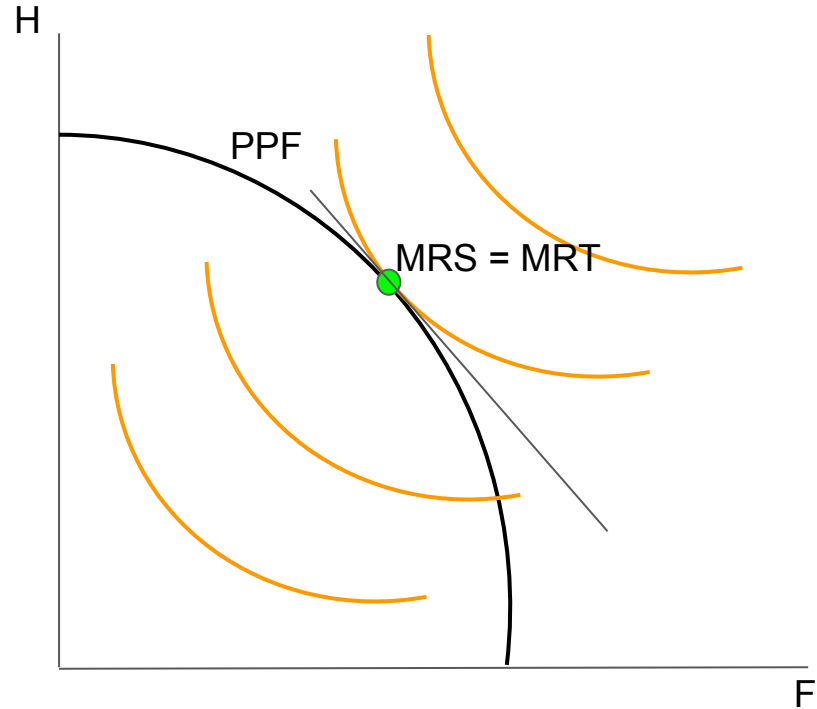
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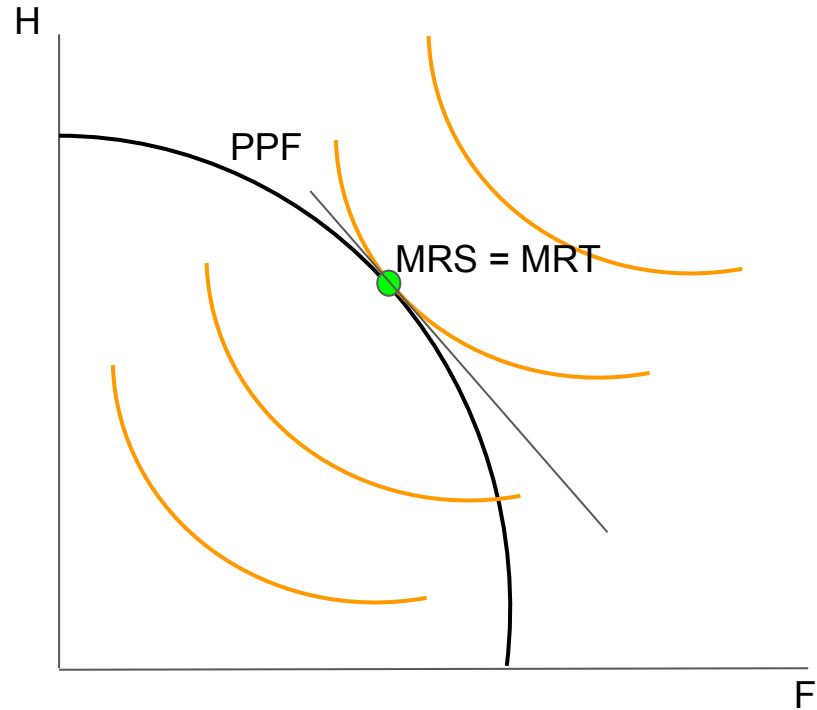
Productive Efficiency

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- $MRS = MRT$
- $MC_F / MC_H = MU_F / MU_H$
 - Ratio of costs equals ratio benefits
 - Tradeoff consumer is willing to make is equal to the tradeoff technology allows
- $MU_F / MC_F = MU_H / MC_H$
 - Bang-per-bucks of F and H are equal



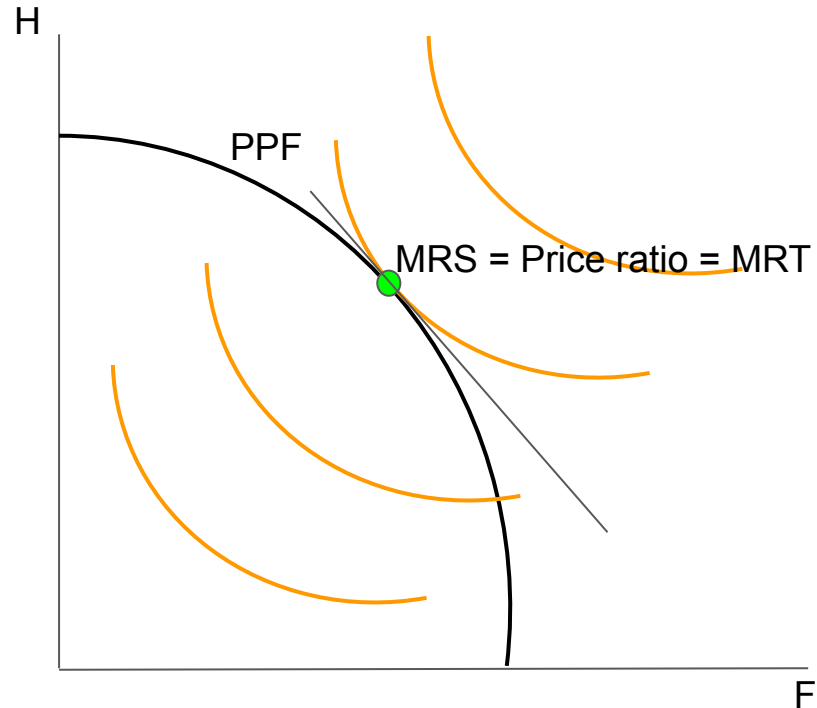
Market generates Productive Efficiency

- In a competitive market, suppliers set price equal to marginal cost
 - $MC_F = P_F$, $MC_H = P_H$
 - Therefore, $MC_F/MC_H = P_F/P_H$
- Recall, consumer optimization gives:
 - $MU_F/MU_H = P_F/P_H$



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 - Therefore, $MC_F/MC_H = P_F/P_H$
- Recall, consumer optimization gives:
 - $MU_F/MU_H = P_F/P_H$
- So in a market, we get:
 - $MC_F/MC_H = P_F/P_H = MU_F/MU_H$
 - Productive efficiency!
- In the absence of externalities and market power, market will lead to production where we are indifferent on the margin toward a shift in production – optimality!



Monopoly

Barriers to entry

- Now that we've studied markets where no firms have any market power, we turn to a market where a single firm has all the power
- A monopoly (one-firm market) may exist for a number of reasons (barriers to entry):
 1. Overwhelming economies of scale (ATC falls with size)
 - E.g. Amtrak for passenger rail service
 2. Government prevention of competition
 - E.g. Patent rights for brand pharmaceuticals (think Lipitor)
 3. Network externalities (consumer value rises with size)
 - E.g. Facebook vs. MySpace
 4. Control over key resource
 - E.g. DeBeers in the diamond market

Marginal revenue for the monopolist

- We know that any profit-maximizer should obey this:

$$MC(q) = MR(q)$$

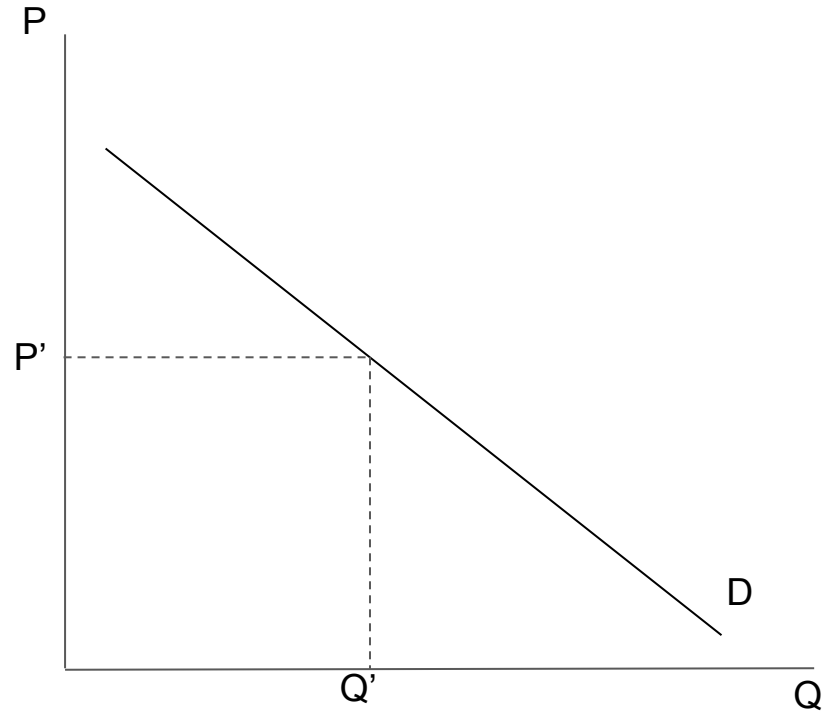
- We showed that under perfect competition, this implies:

$$MC(q) = MR(q) = P$$

- However, a monopolist is not a price taker:
 - Her market power means that as she increases q , P will fall
 - So, her individual demand curve is downward-sloping
- As shown on the next slide, this implies:

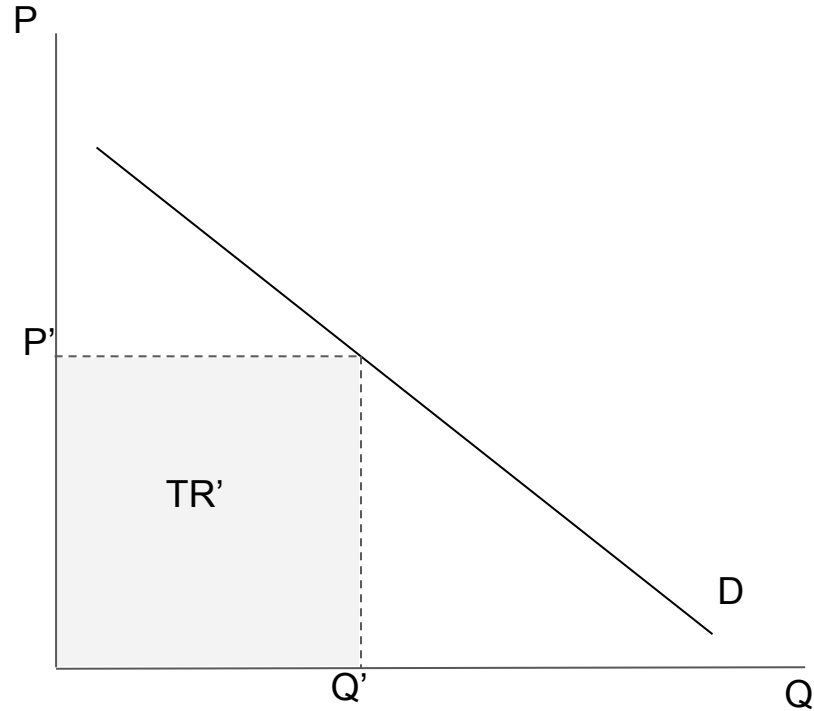
$$MC(q) = MR(q) < P(q)$$

Marginal revenue for the monopolist, visualized



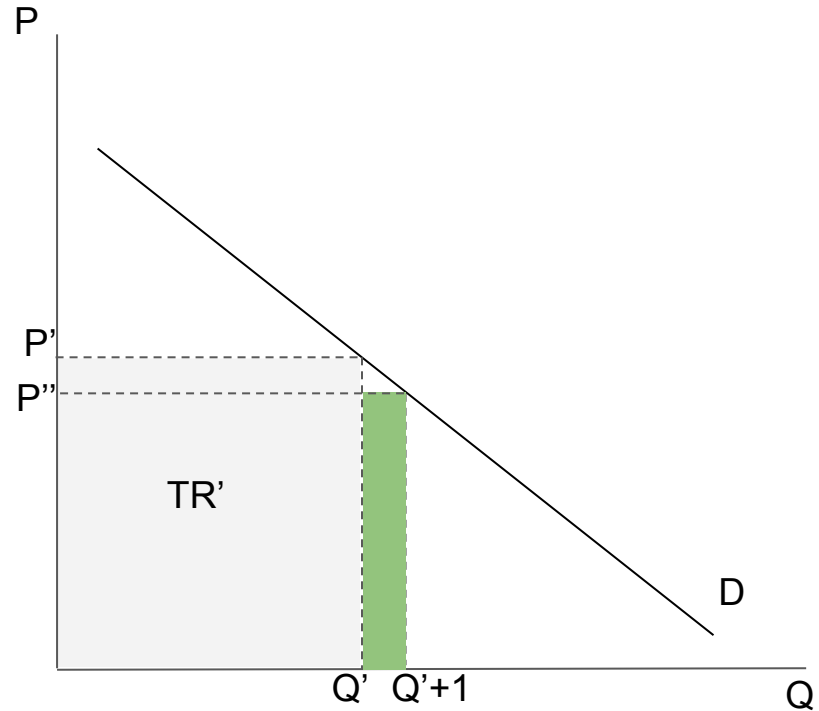
Marginal revenue for the monopolist, visualized

- Total revenue is $P \cdot Q$



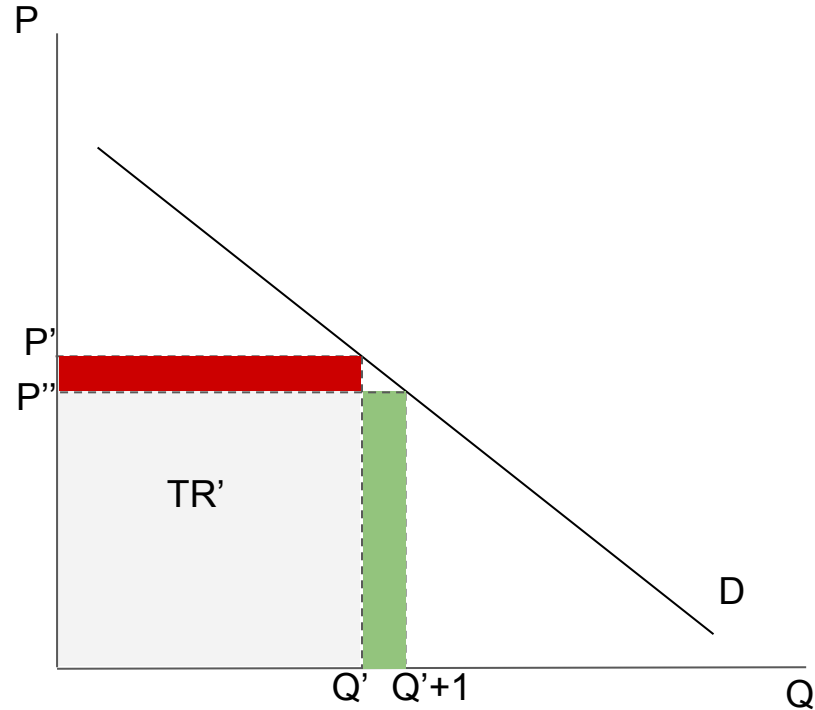
Marginal revenue for the monopolist, visualized

- Total revenue is $P \cdot Q$
- If she sells another unit, the customer pays P'' for that unit, raising revenue by $1 \cdot P''$



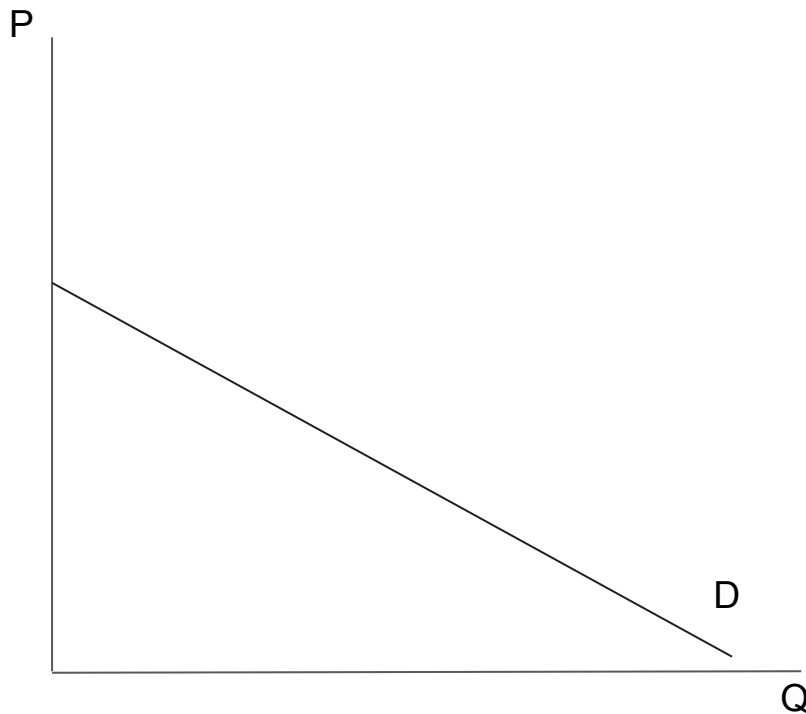
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- Total revenue is $P \cdot Q$
- If she sells another unit, the customer pays P'' for that unit, raising revenue by $1 \cdot P''$
- But she had to lower the price all previous customers pay, decreasing revenue by $Q' \cdot (P' - P'')$



Marginal revenue for the monopolist, numerical example

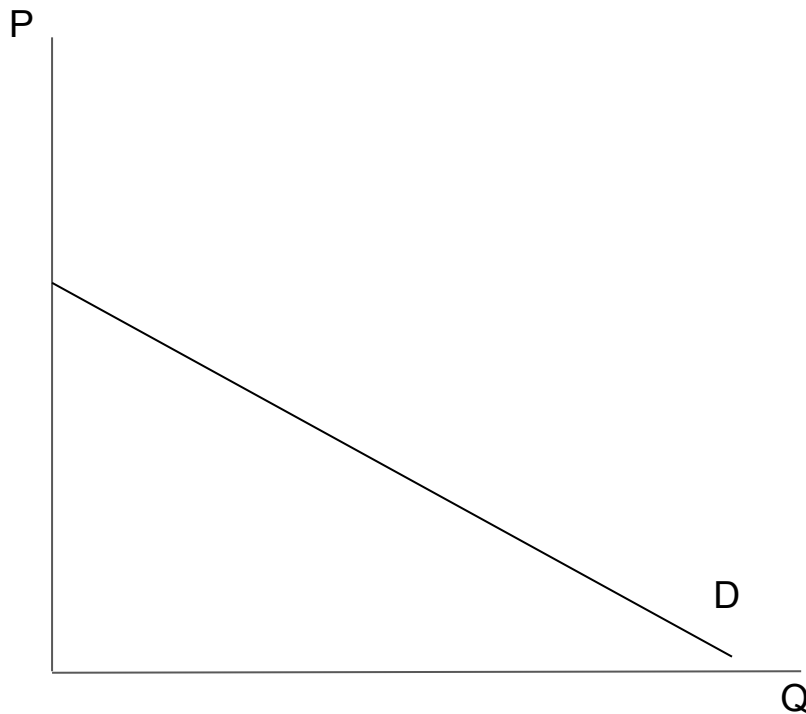
Demand: $P = 50 - 0.5*Q$



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$$\text{Demand: } P = 50 - 0.5 * Q$$

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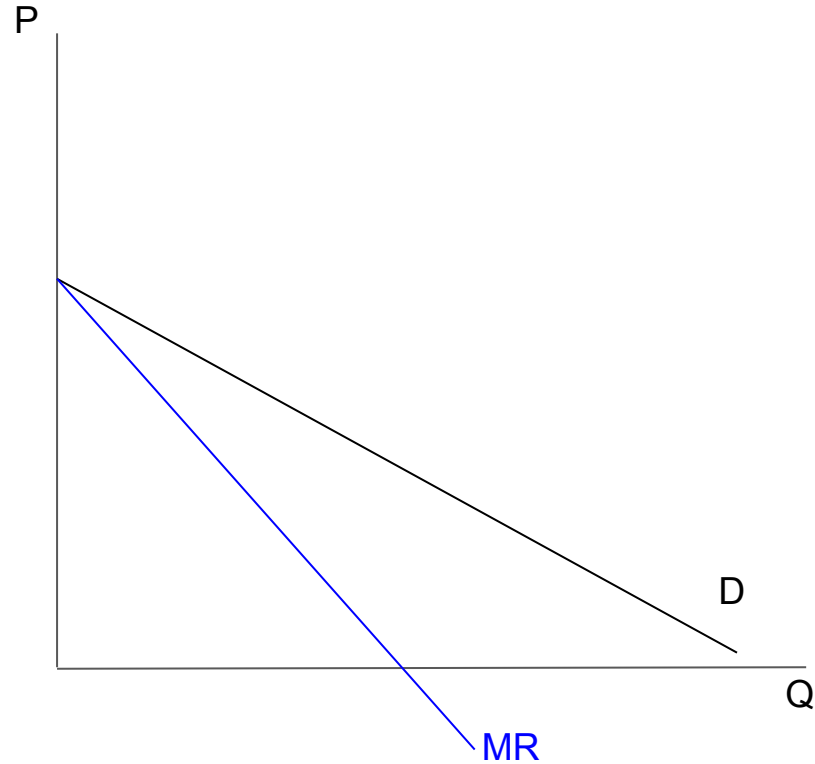


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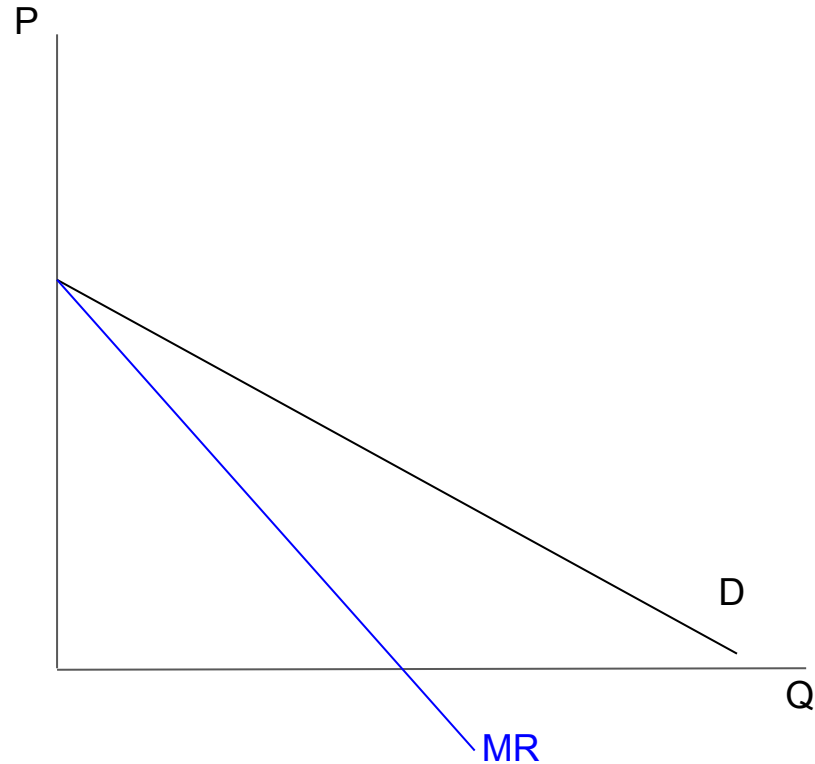
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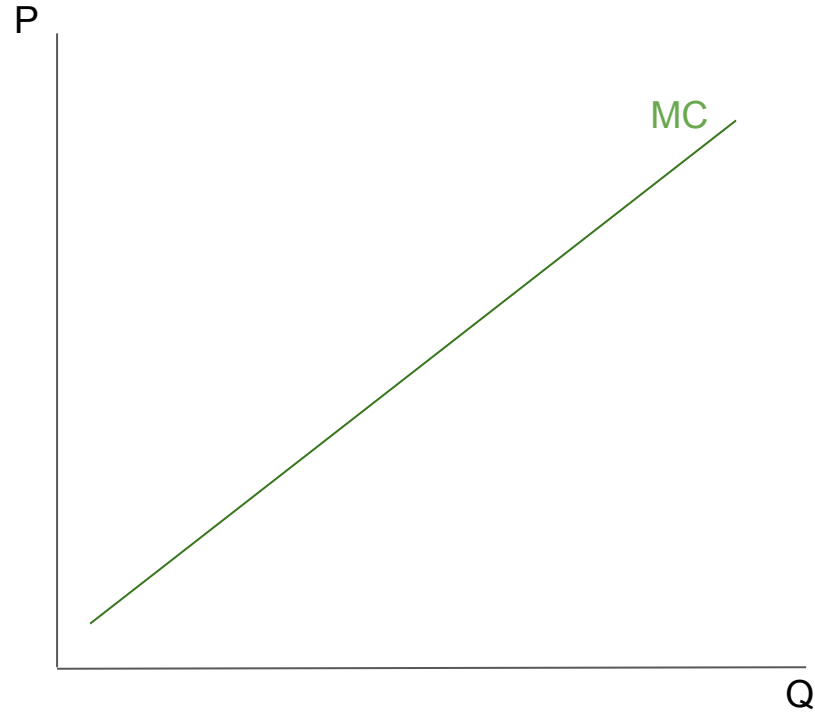
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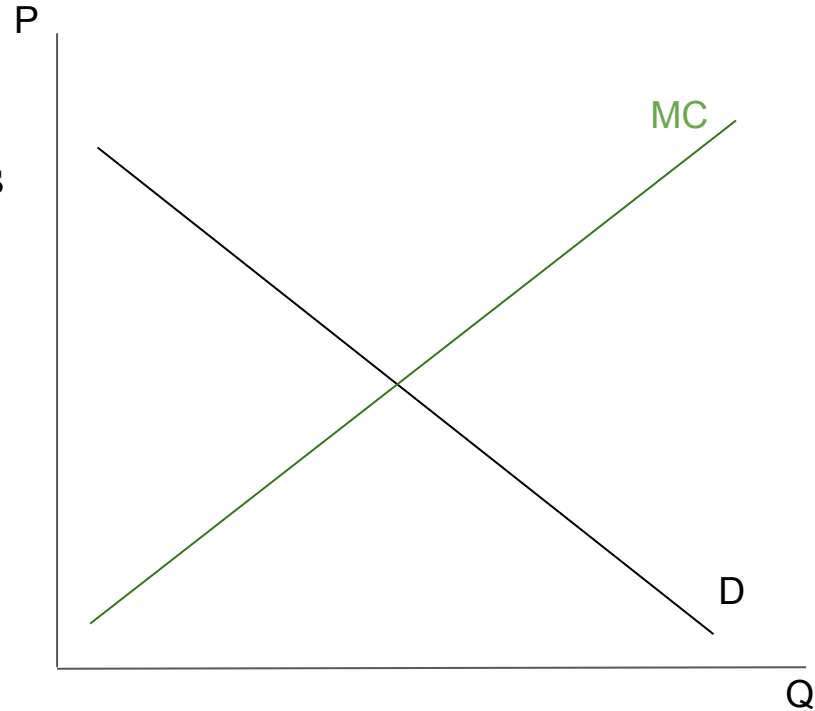
Profit maximization for the monopolist, setup

- Monopolist has an MC curve just like any other firm



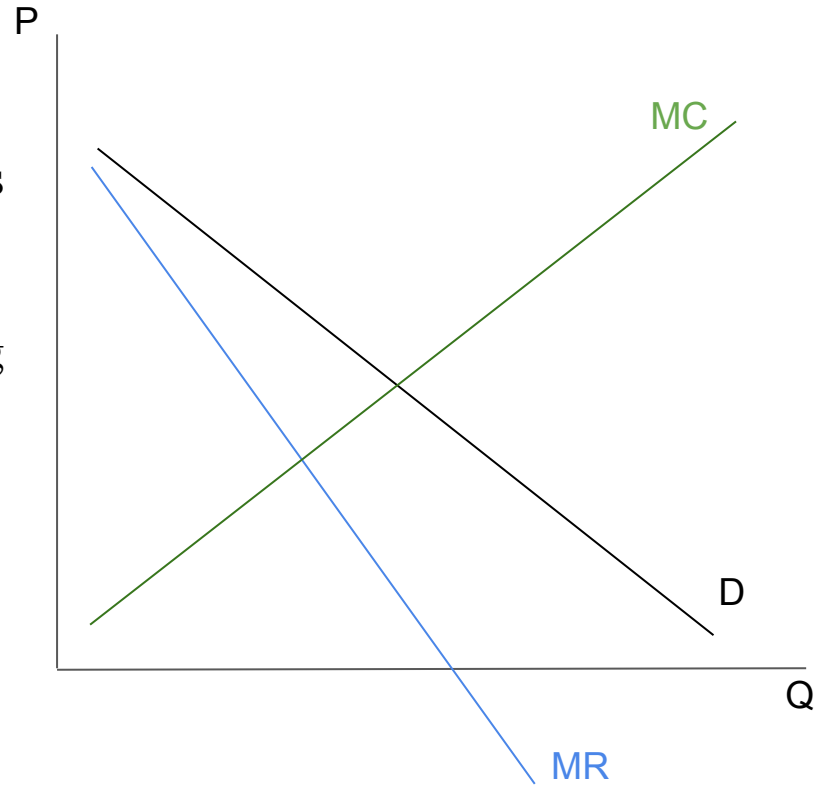
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- Monopolist has an MC curve just like any other firm
- Unlike perfectly competitive firm, monopolist has downward-sloping demand
- Marginal Revenue lies below demand



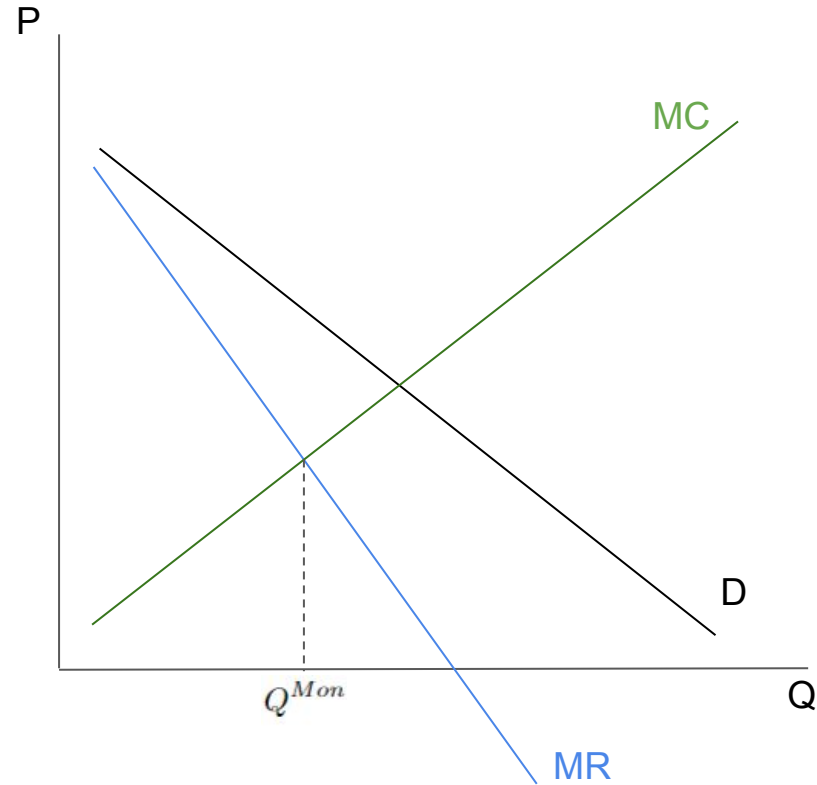
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 - It is steeper because as Q increases, lowering the price impacts more “inframarginal” units



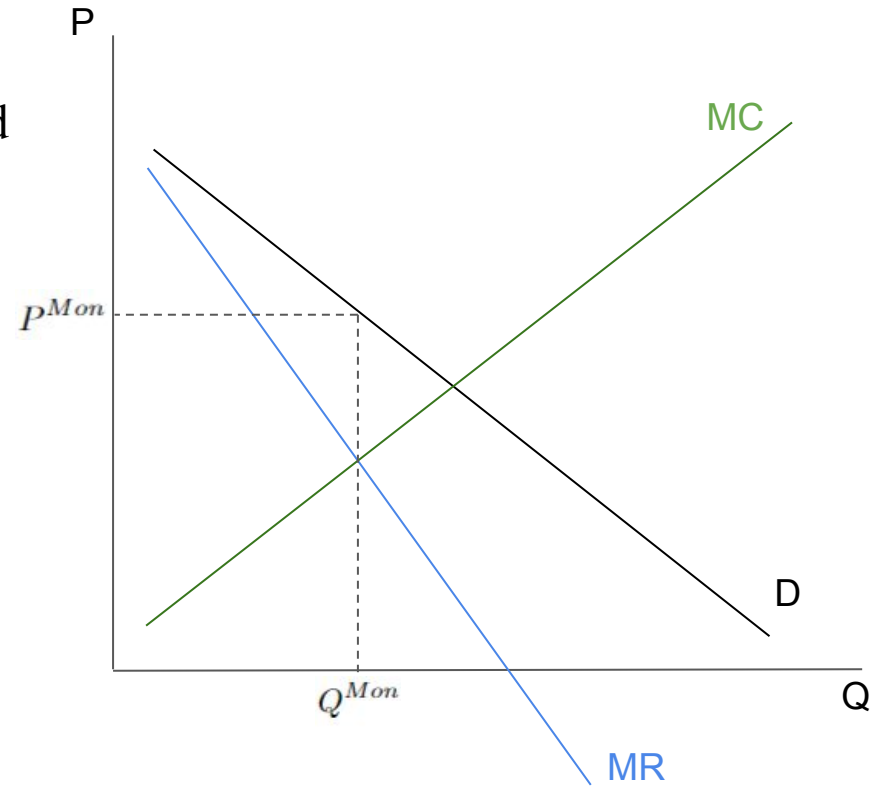
Profit maximization for the monopolist, solution

- Monopolist picks Q such that $MC = MR$



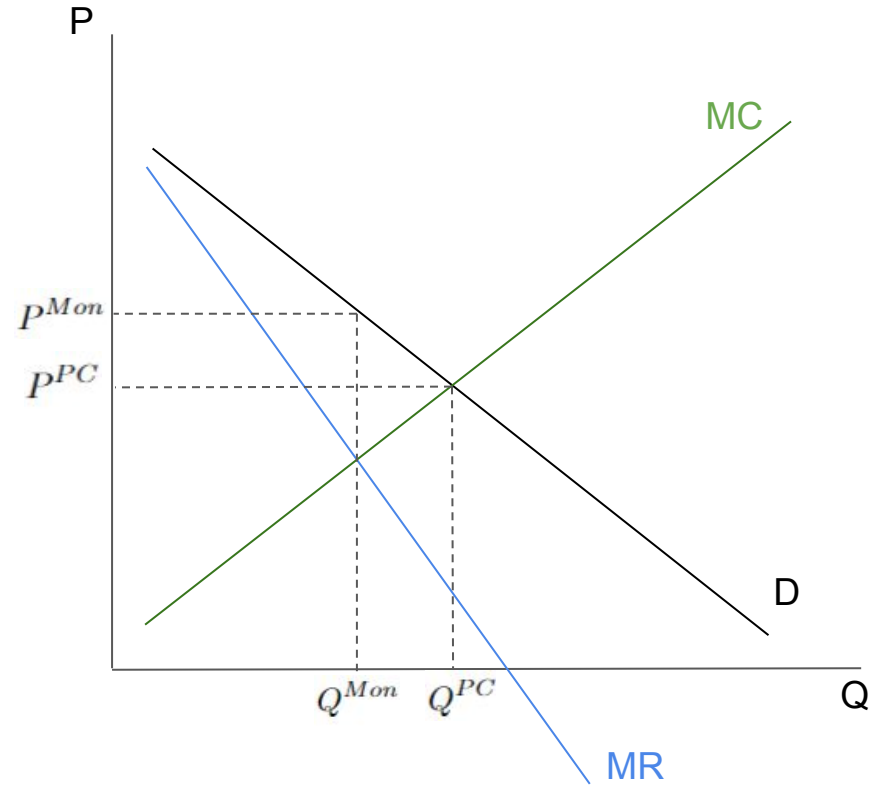
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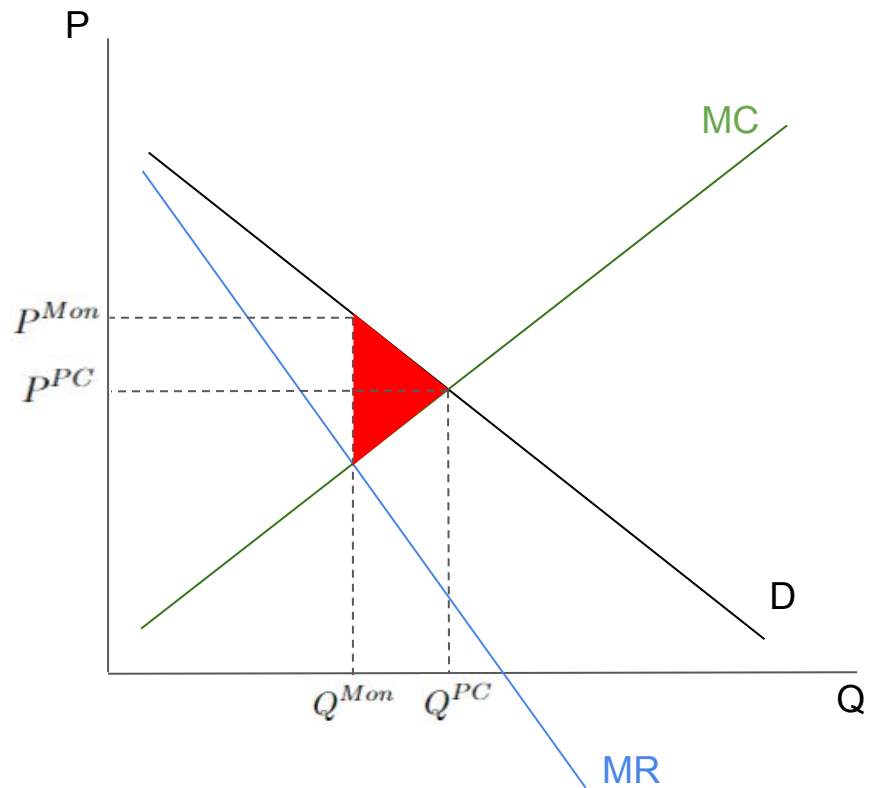
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 - Monopolist restricts quantity in order to keep the price high
 - Loses some customers so she can gouge others
- Monopoly outcome is inefficient because the missing units were valued above cost



Policy responses to monopoly

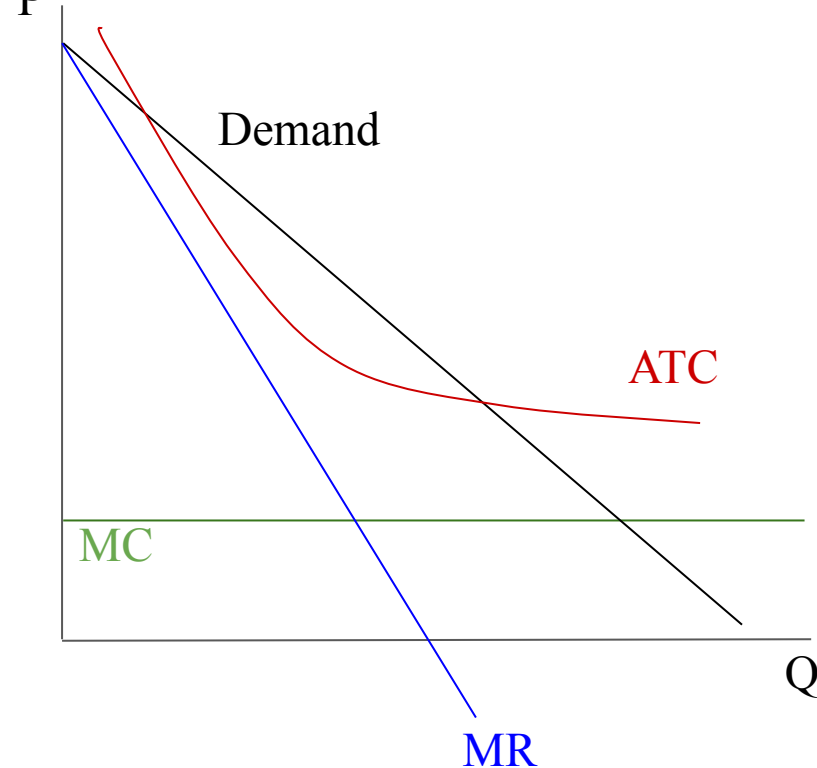
1. Antitrust enforcement can eliminate monopolies created by unfair practices
 - E.g. predatory pricing; unfair prioritization on a network
2. Antitrust enforcement can also break up monopolies into smaller competitors
 - E.g. AT&T became (eventually) AT&T, Verizon, and CenturyLink

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3. Natural monopolies (from economies of scale) shouldn't be broken up. The government can own them to avoid gouging, or regulate
 - E.g. Amtrak
 - Note that a price ceiling is an effective regulation for monopoly. Since she can't inflate the price, the monopolist won't restrict quantity.

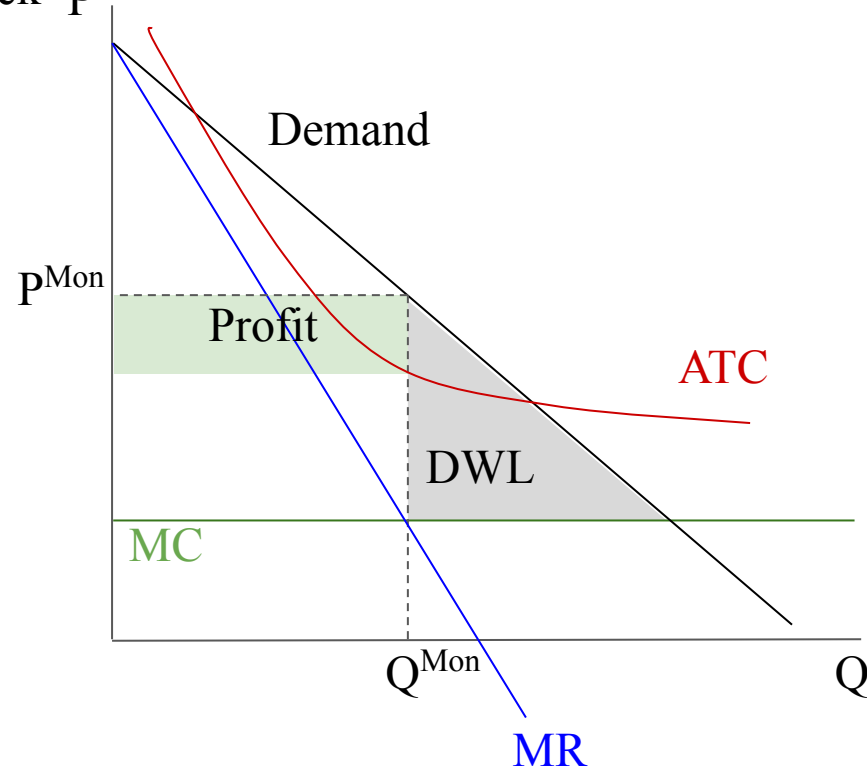
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 - E.g. railroads, with millions of miles of track
- This is called a Natural Monopoly
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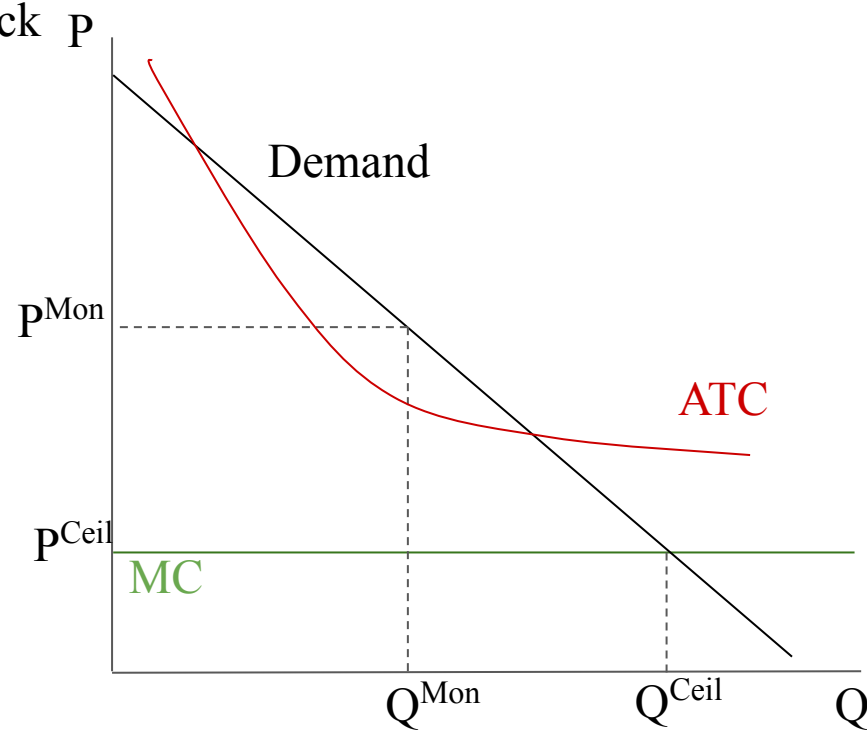
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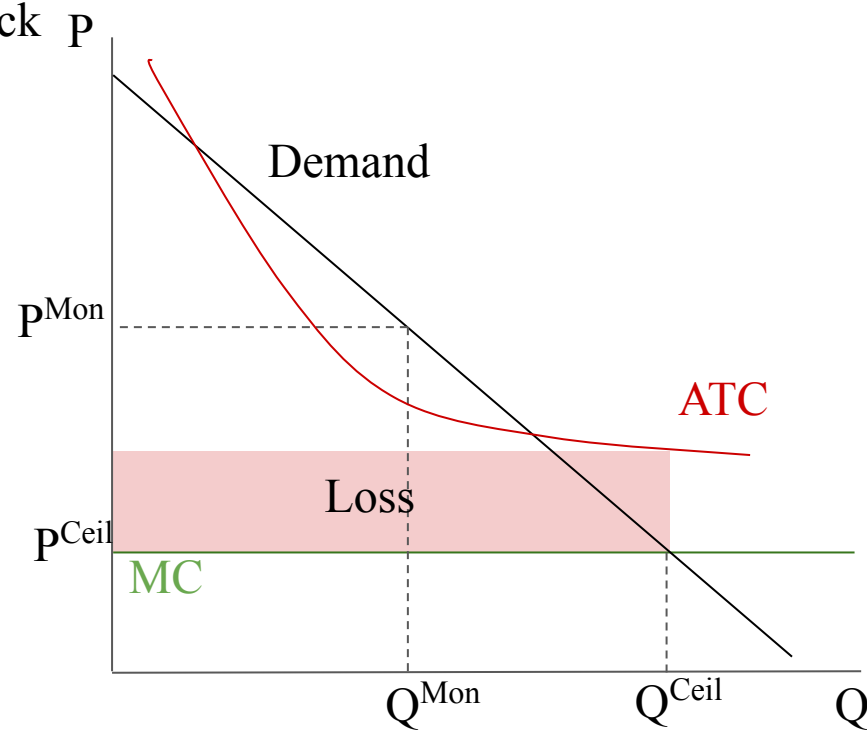
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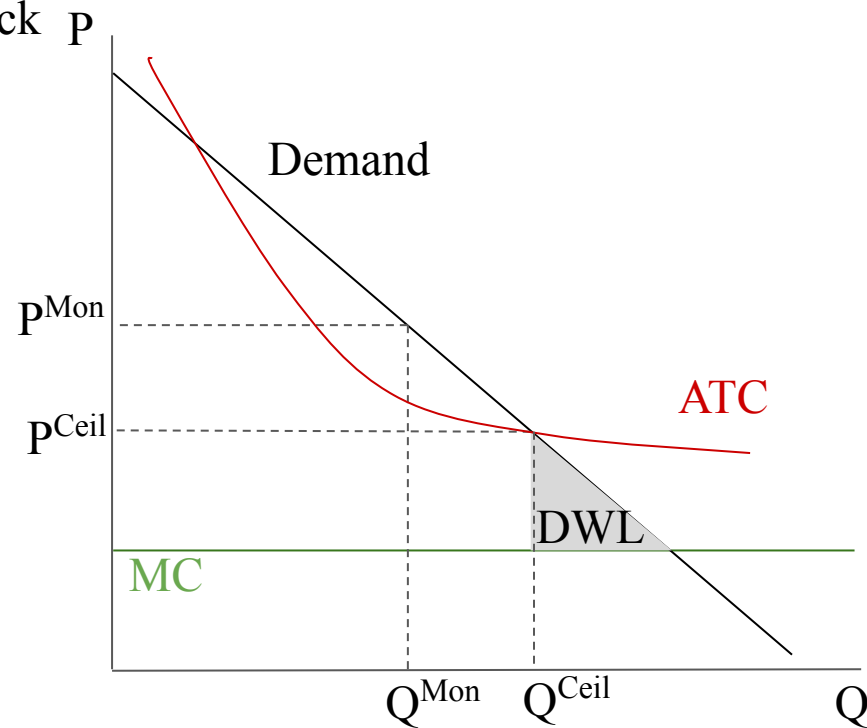
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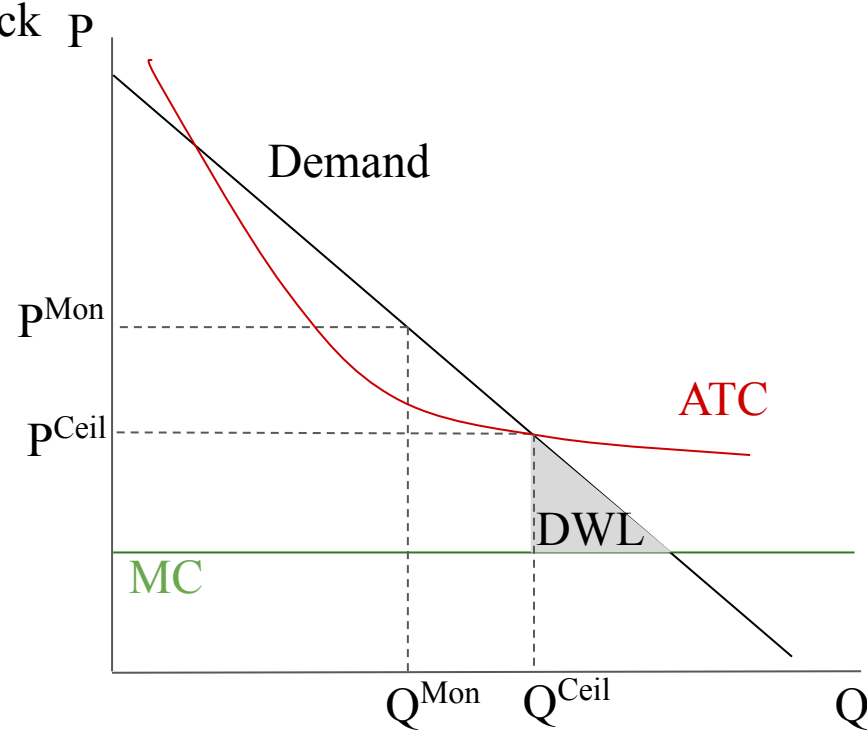
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- Could set ceiling higher, like ATC
- Could also:
 - Use subsidy, as discussed before
 - Or nationalize the industry



Patents

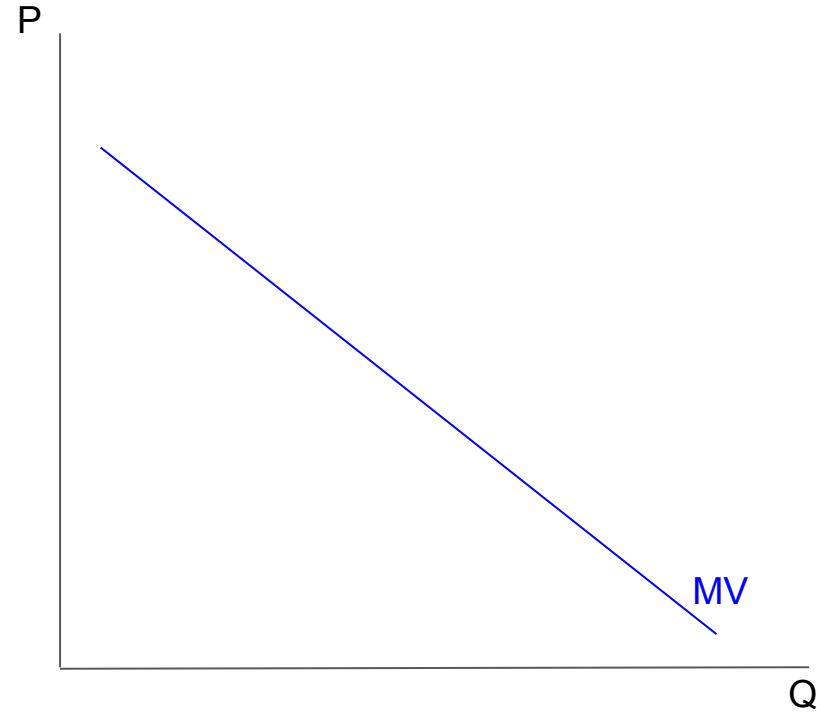
- In modern economies, inventors are given a monopoly over their product for a fixed amount of time
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Patents

- In modern economies, inventors are given a monopoly over their product for a fixed amount of time
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- We have seen how monopolies are inefficient; is Patent Protection a bad policy?
- Monopoly is statically inefficient, but may be “dynamically efficient”
 - Encourages innovation
 - If you spend billions to create a new drug, others cannot copy you immediately
 - We tolerate some inefficiency in the short-run to get longer-run benefits
 - Some products would not exist in the first place without Patent Protection

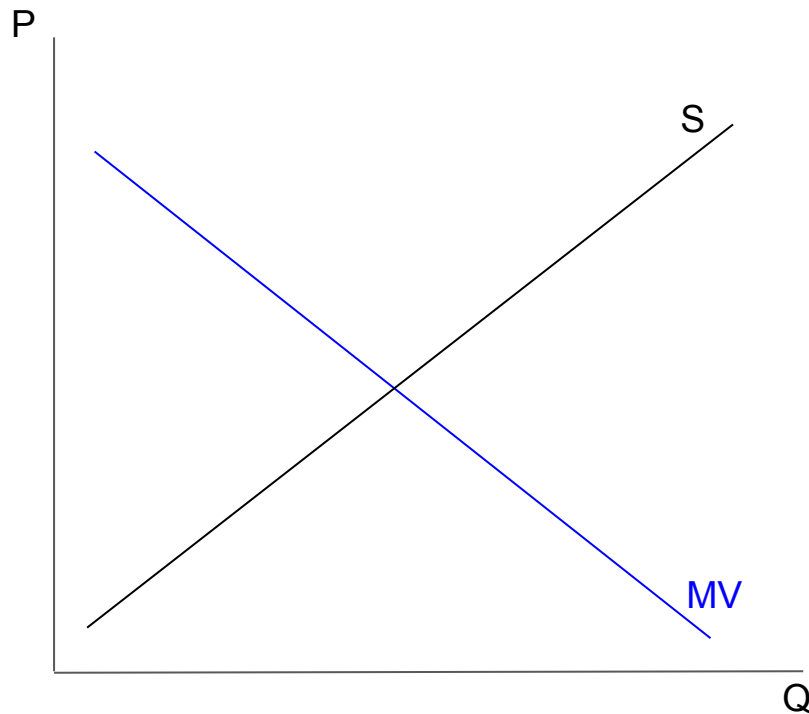
Monopsony

- Monopsony is a closely-related concept: there is a single **buyer** in the market



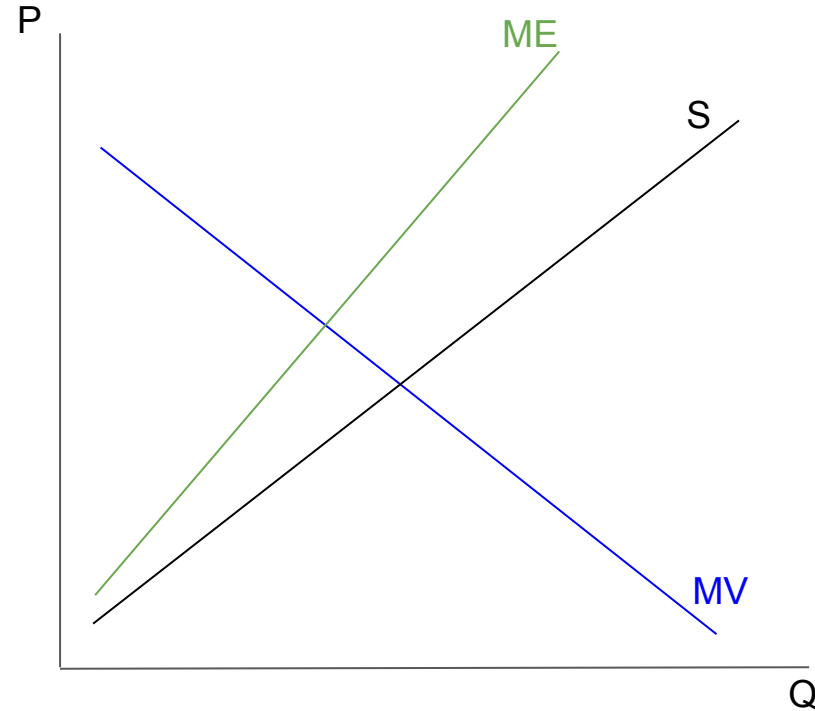
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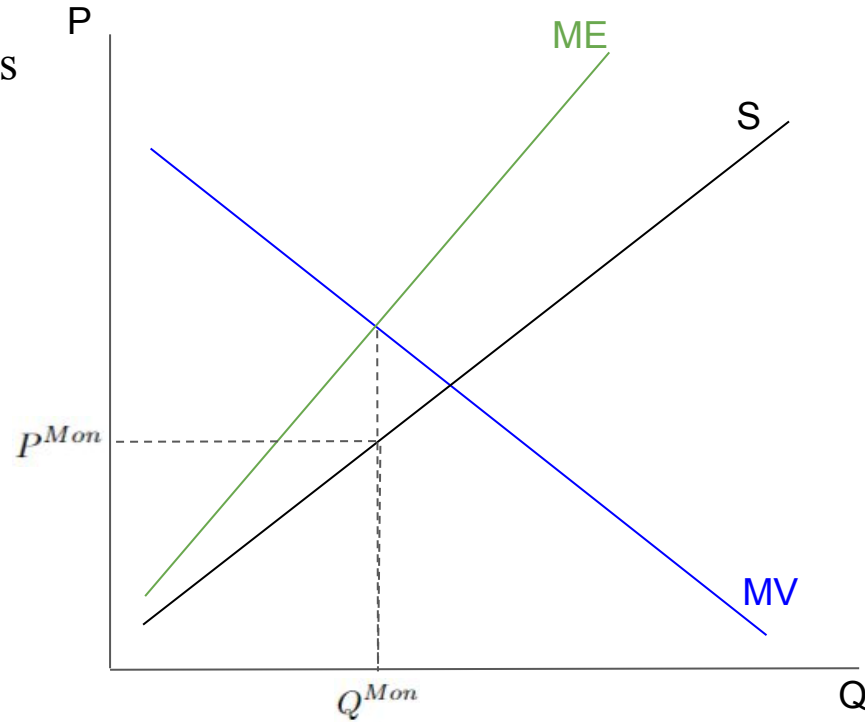
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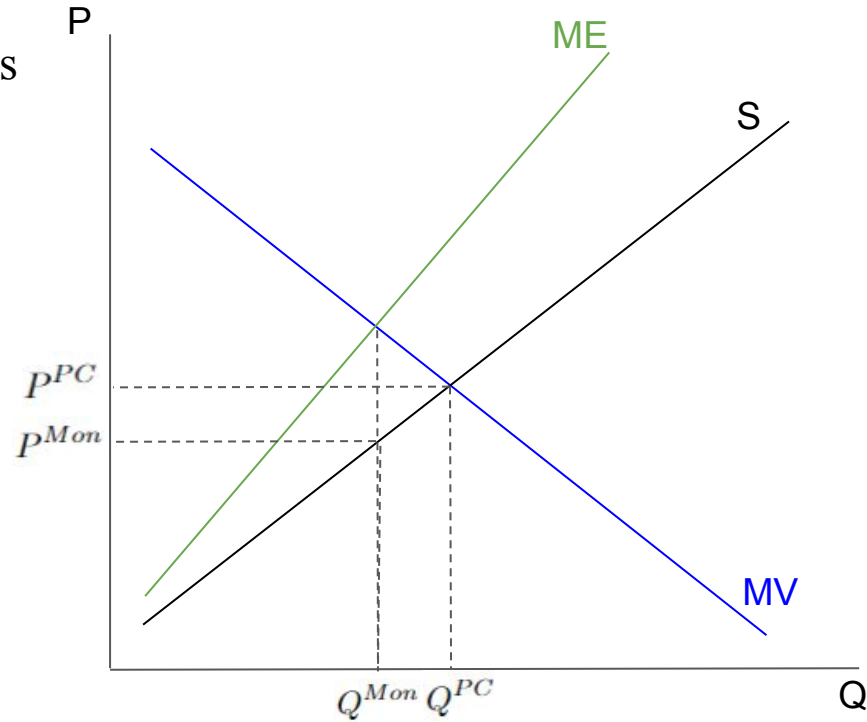
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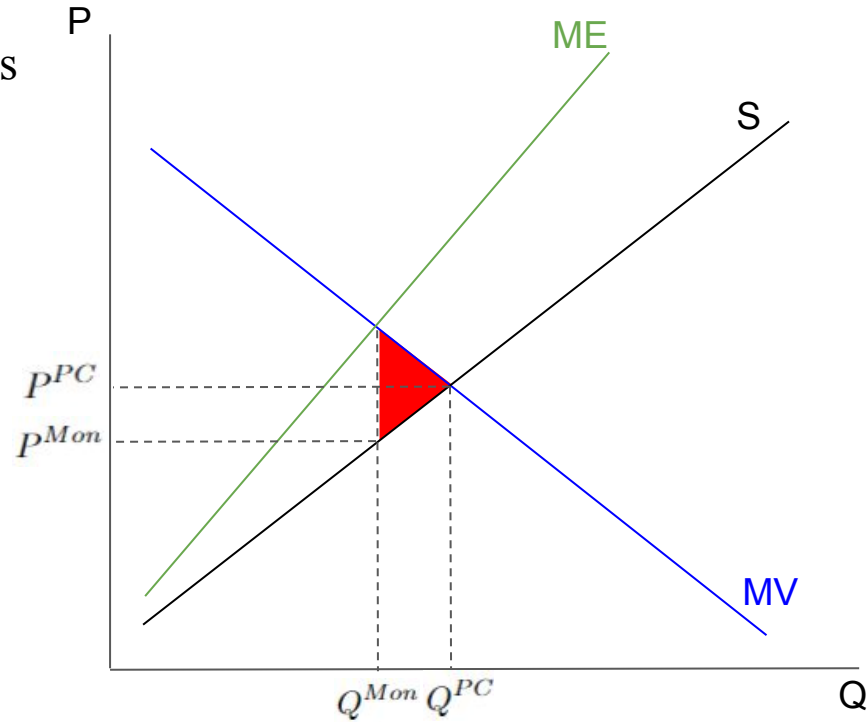
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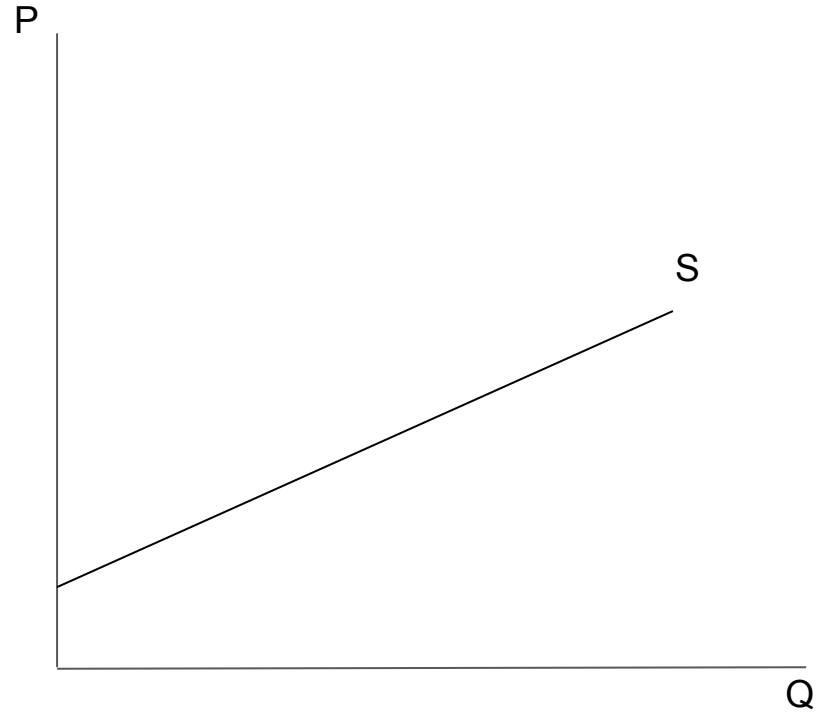
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 - As with monopoly, this is inefficient



Marginal expenditure for the monopsonist, numerical example

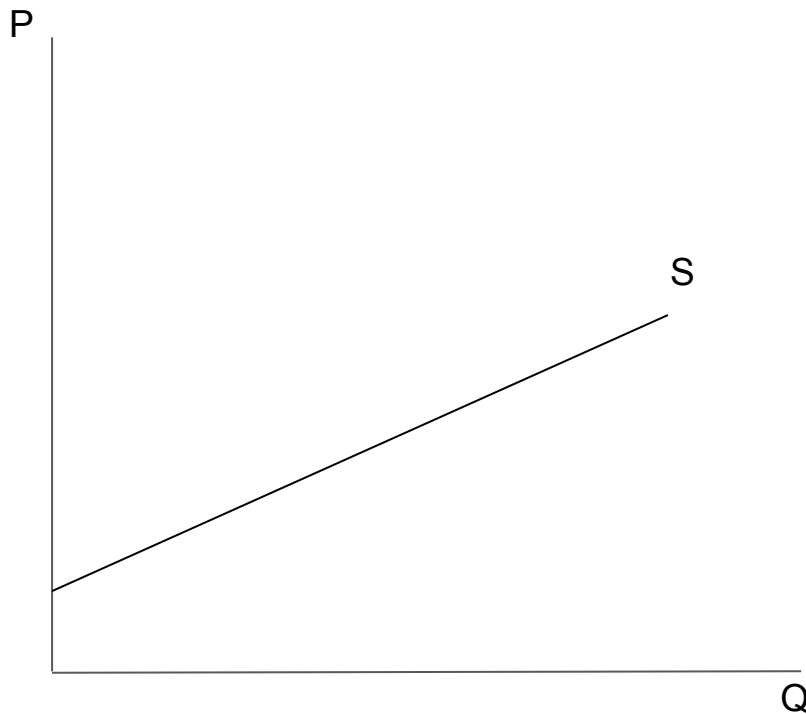
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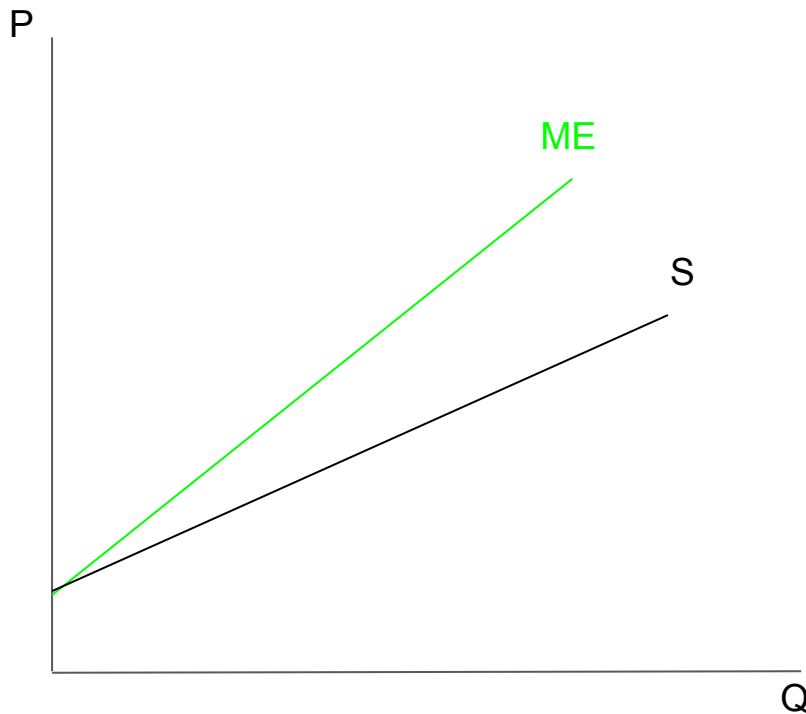


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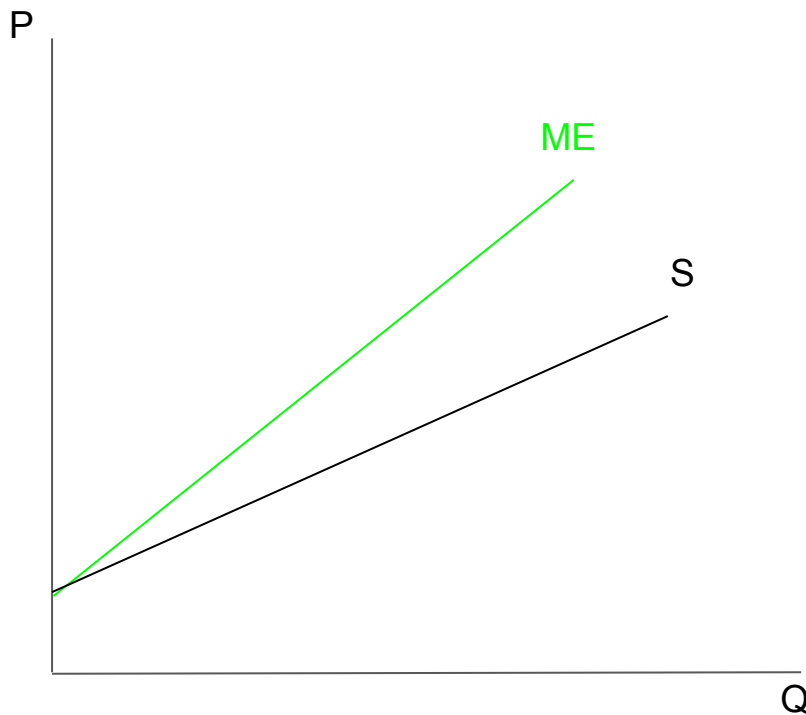
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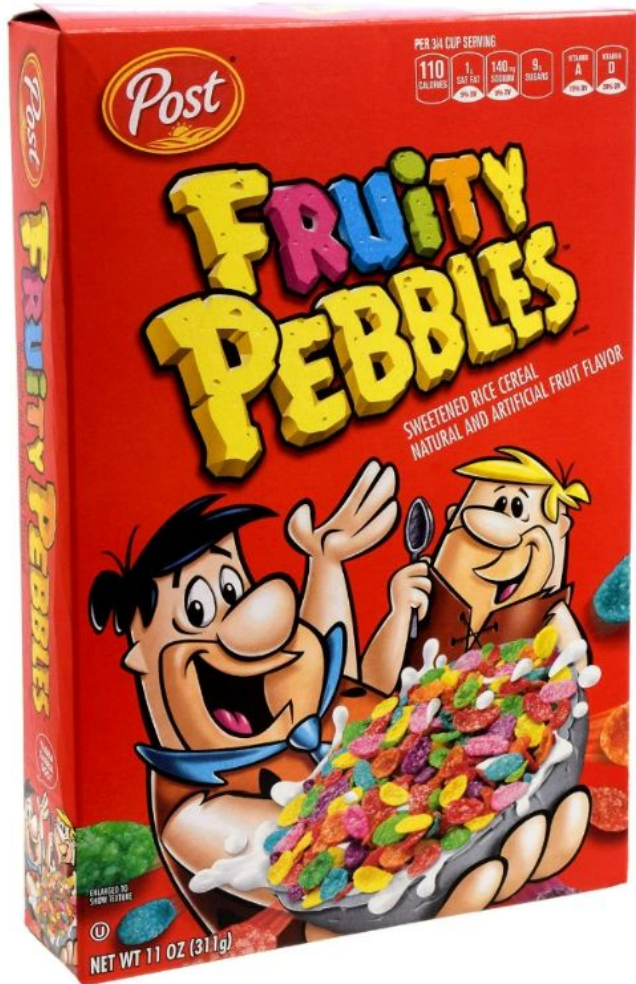
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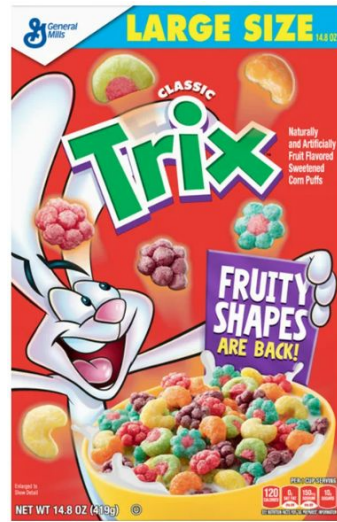
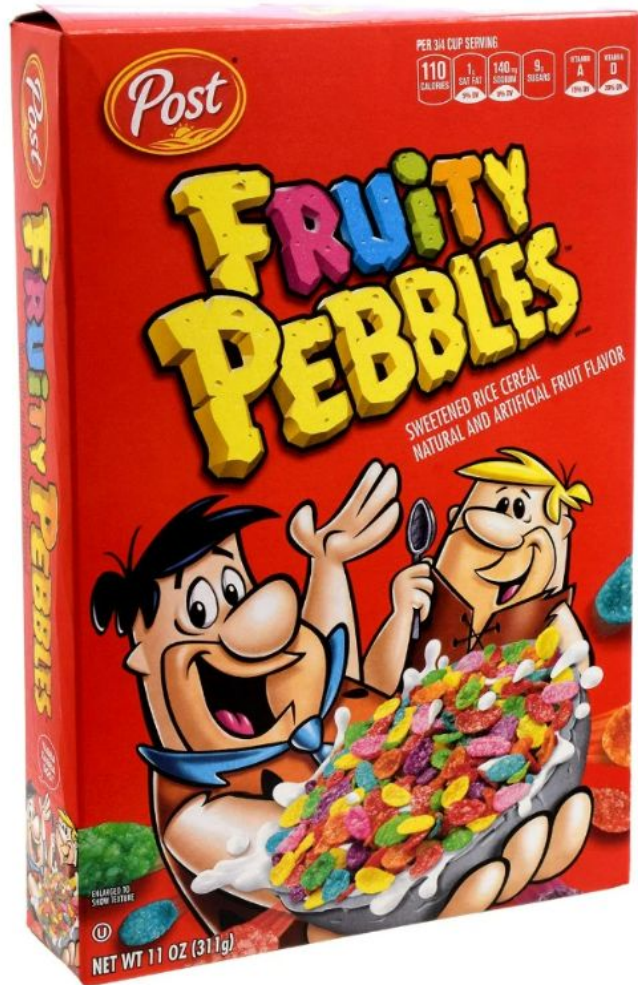
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Comments on “monopolistic competition”

- Many markets have components of both monopoly and competition
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Comments on “monopolistic competition”

- Many markets have components of both monopoly and competition
- Consider items at a supermarket
 - Fruity Pebbles is manufactured exclusively by Post
 - There are many close substitutes
 - So while Post has market power, it faces competitive discipline
- In monopolistic competition, firms have downward-sloping demand curves
 - Generates some inefficiency, with $P > MC$
 - But typically economists think the demand curves facing these firms are quite flat – similar to perfect competition, little inefficiency

Oligopoly

Oligopoly introduction

- We have studied markets with:
 - 1 firm (monopoly)
 - “Many” firms (perfect competition)
- Oligopoly refers to a market with a small number of firms greater than 1
- In terms of outcomes, oligopoly typically lies between monopoly and perfect competition
- But the dynamics at play require a new type of solution method: Game Theory
 - We will study Game Theory more broadly in later
 - But we will borrow some insights now to study oligopoly

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 - And so on.
- These issues are absent from monopoly and perfect competition
- And at first glance, they seem pretty confusing and difficult!

Cournot competition

- There are many models of oligopoly, and they can be quite different
- Here we will study Cournot competition
 - It is canonical
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- Model assumptions:
 - Firms sell identical goods
 - Each individual firm has a constant MC
 - Firms simultaneously choose how much quantity to sell, without knowing what others have chosen
 - All quantity is then sold at the market-clearing price

Cournot example

Suppose 2 countries, Saudi Arabia and Iran, supply all of the world's oil.

We'll assume demand for oil is reflected in the following (inverse) demand curve:

$$P = 100 - Q^D$$

Further they have constant, identical marginal costs of 10:

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Each country will pick a quantity of oil to sell in order to maximize profits, without knowing what the other has chosen.

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We will now solve for the equilibrium in this market.

Saudi Arabia's marginal revenue

Saudi Arabia's revenue is given by:

$$TR_S = q_S \cdot P$$

$$TR_S = q_S \cdot (100 - q_S - q_I)$$

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Saudi Arabia's *marginal revenue* is given by:

$$MR_S = 100 - q_I - 2 \cdot q_S$$

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Marginal revenue is a decreasing revenue of both countries' quantity: more quantity leads to lower prices and so lower marginal revenue

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We now find Saudi Arabia's reaction function, which describes its optimal quantity as a function of Iran's quantity.

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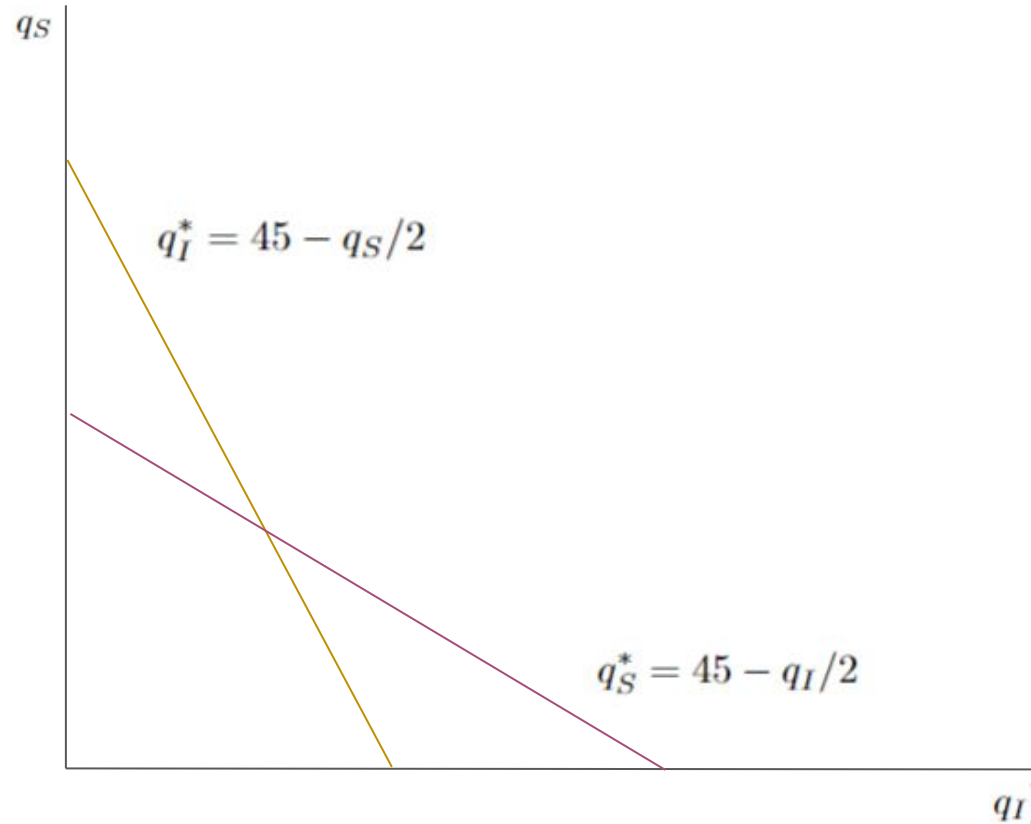
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The symmetry of the problem ensures that if we follow the same steps for Iran, we get:

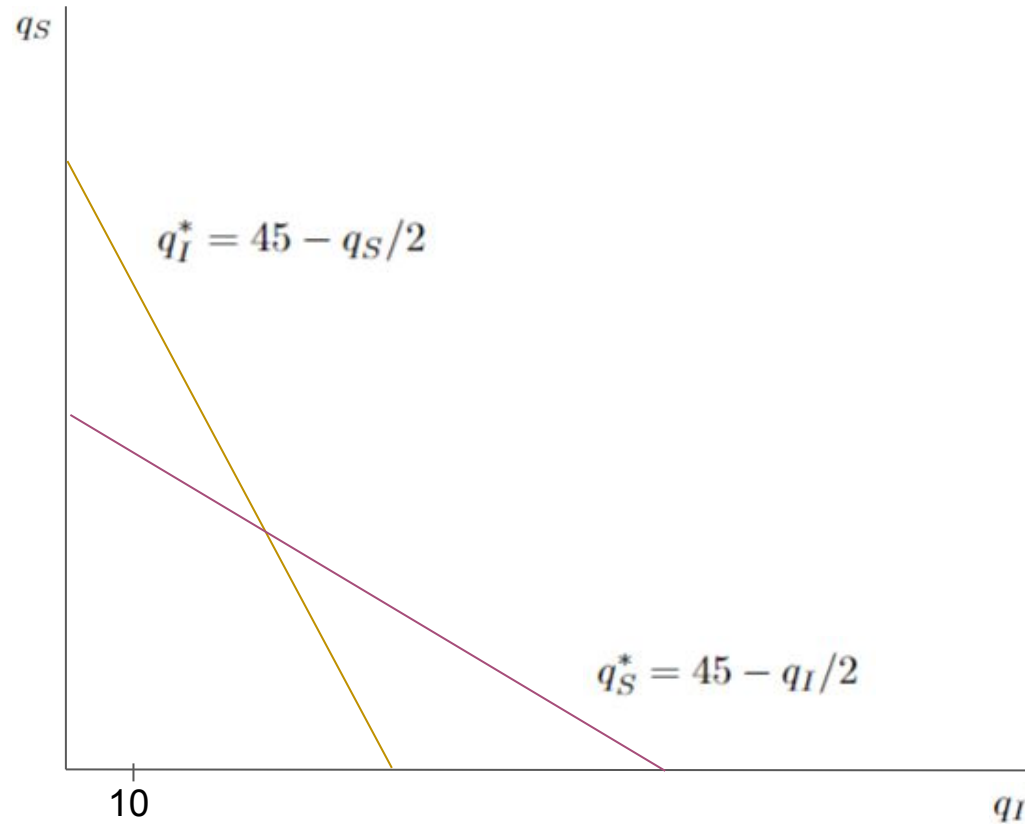
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Visualizing the reaction functions



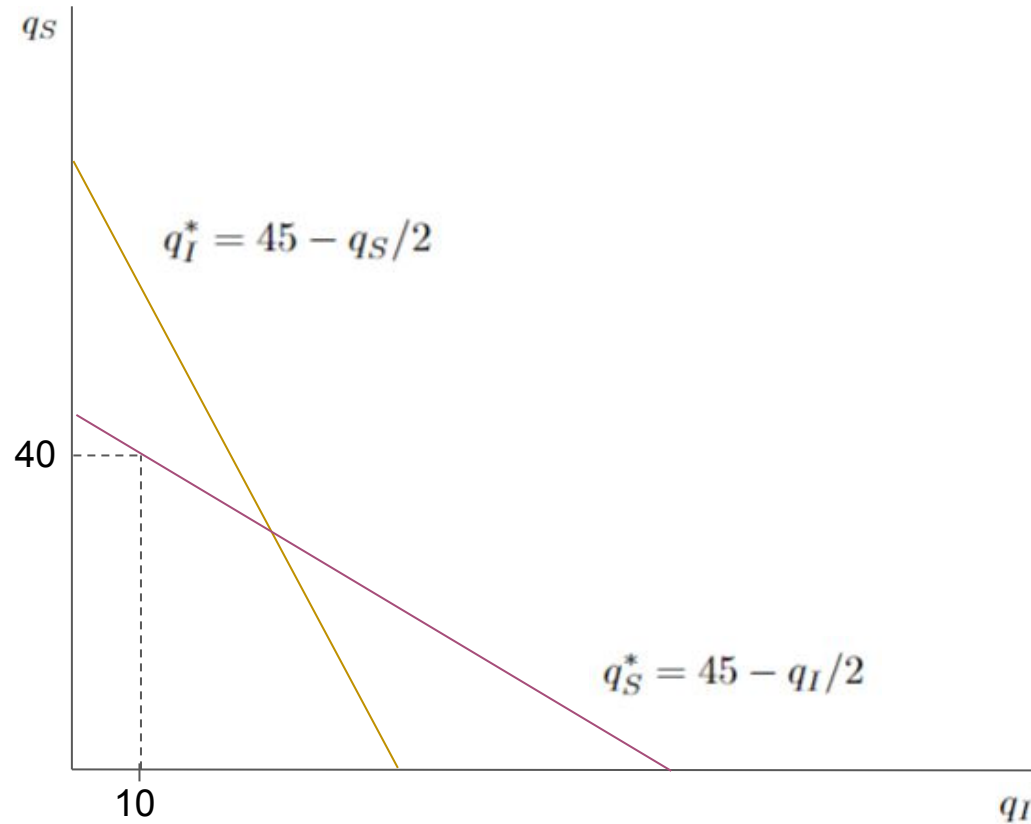
The logic of the equilibrium

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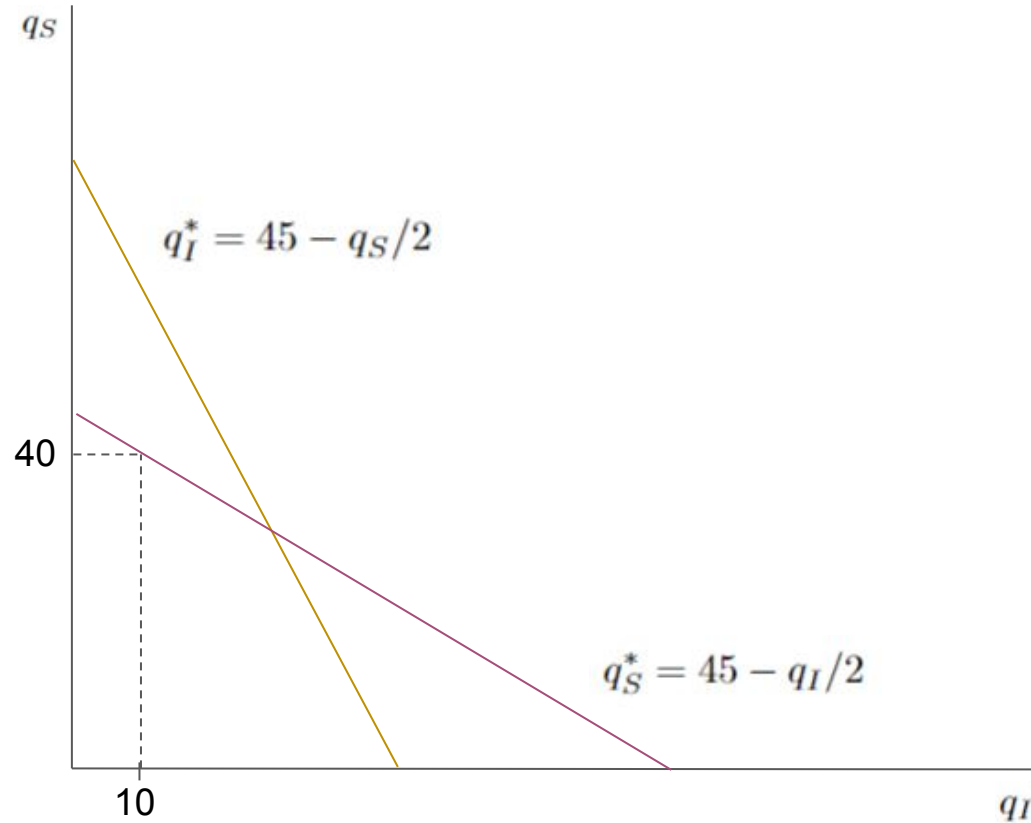


The logic of the equilibrium

- Suppose SA expected Iran to produce 10
 - SA would produce 40

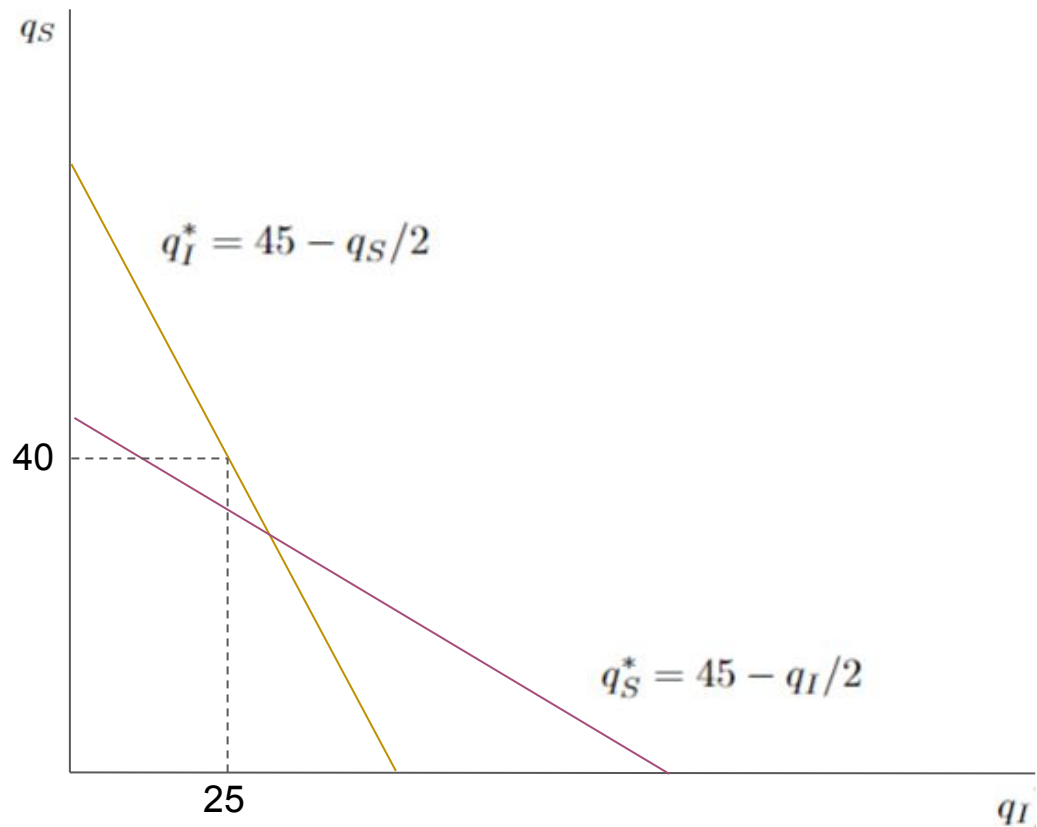


The logic of the equilibrium



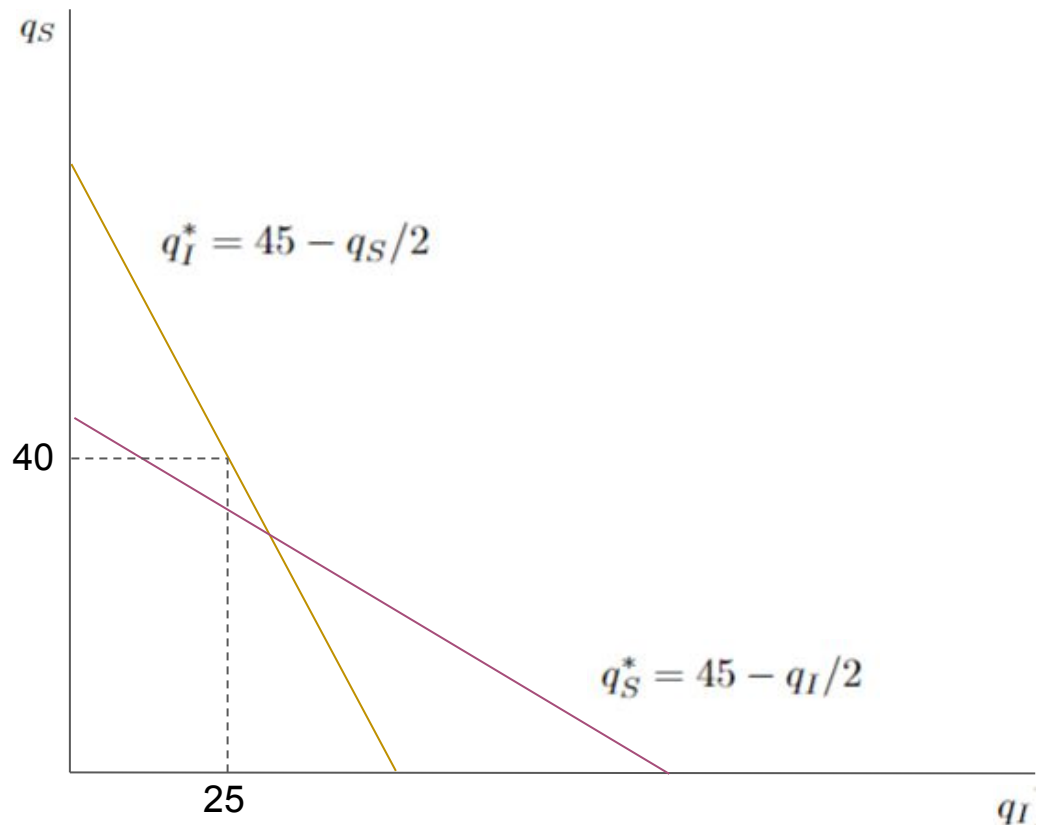
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The logic of the equilibrium



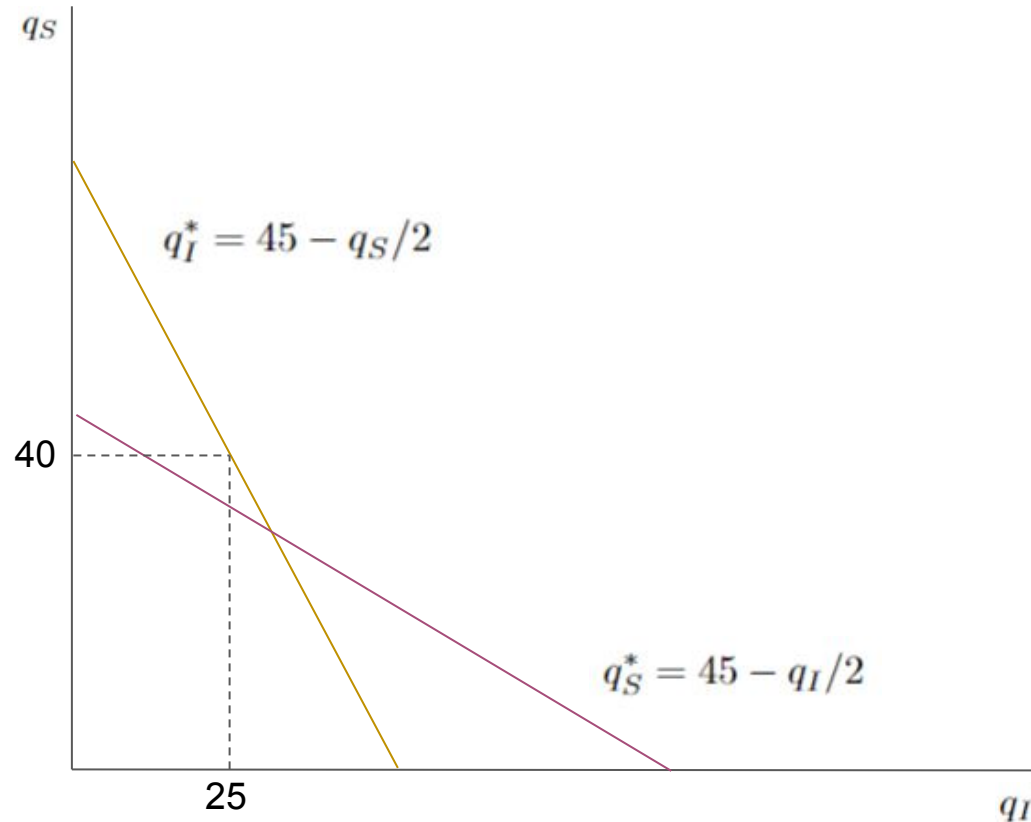
- Suppose SA expected Iran to produce 10
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The logic of the equilibrium



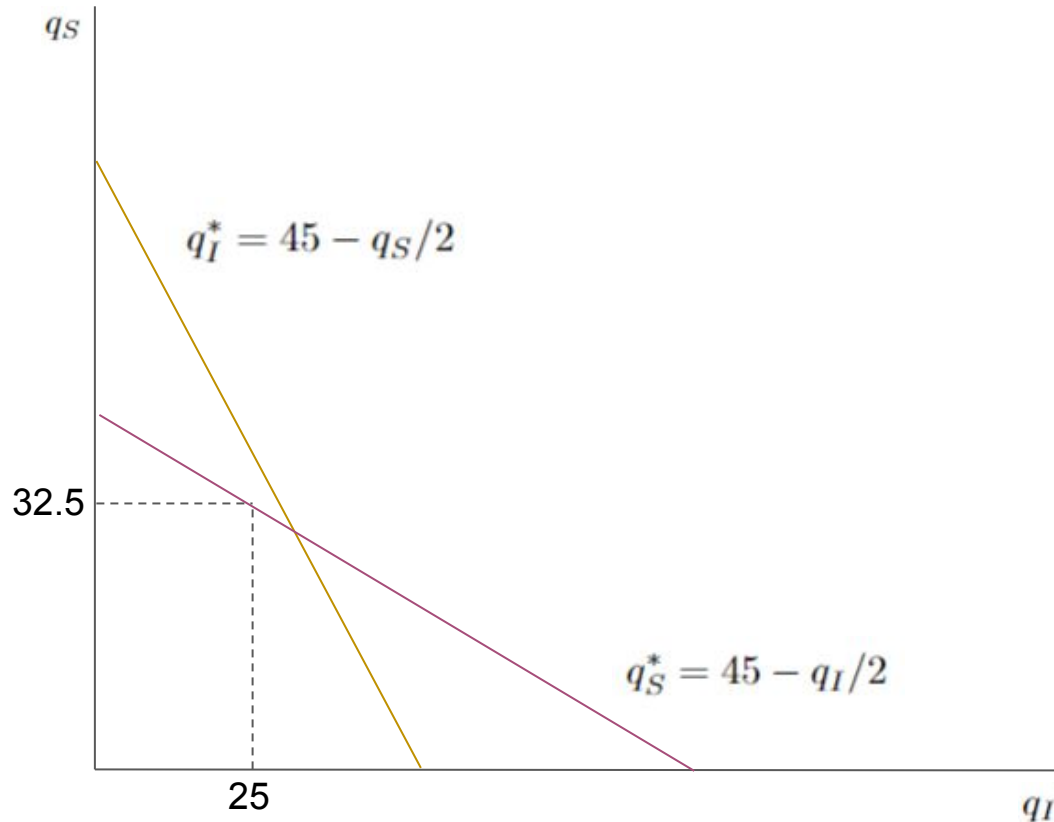
- Suppose SA expected Iran to produce 10
 - SA would produce 40
- But Iran can predict that, and if SA produces 40:
 - Iran would want 25
 - (So SA should know Iran won't produce 10.)

The logic of the equilibrium



- Suppose SA expected Iran to produce 10
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- But Iran can predict that, and if SA produces 40:
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 - (So SA should know Iran won't produce 10.)
- Again, Saudi Arabia could predict that, and if Iran does 25:

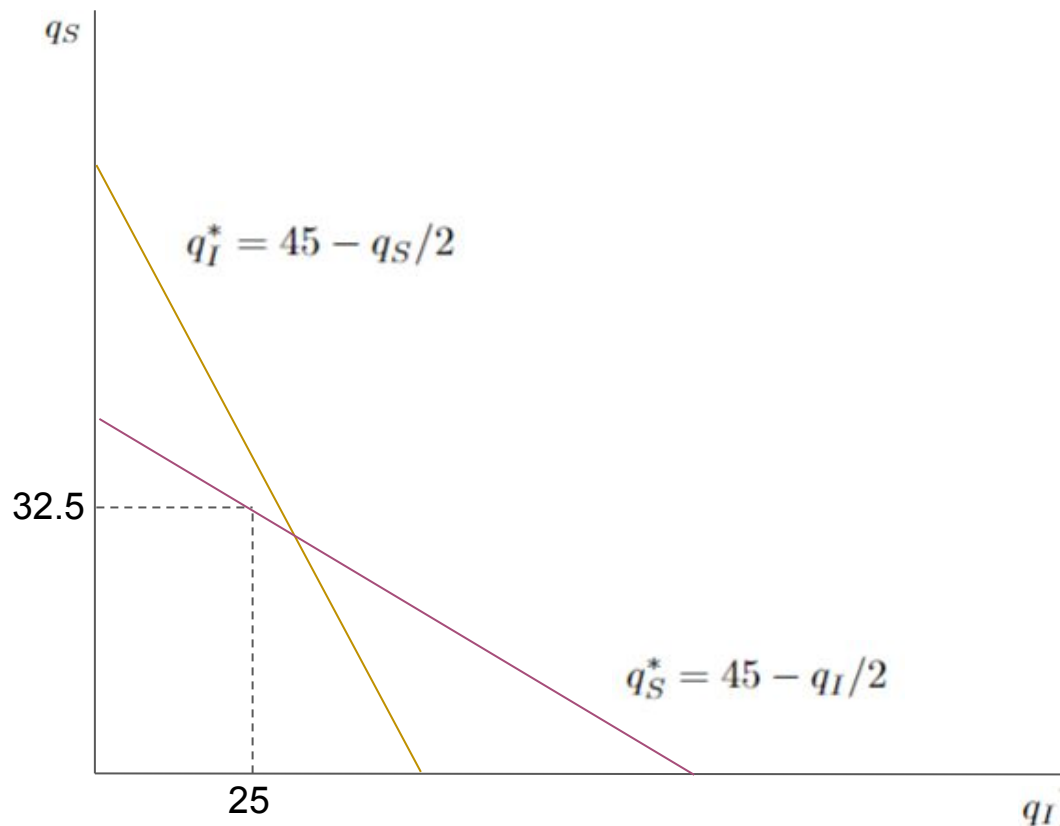
The logic of the equilibrium



- Suppose SA expected Iran to produce 10
 - SA would produce 40
- But Iran can predict that, and if SA produces 40:
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 - (So SA should know Iran won't produce 10.)
- Again, Saudi Arabia could predict that, and if Iran does 25:
 - SA will choose 32.5
 - (So Iran should know SA won't produce 40.)

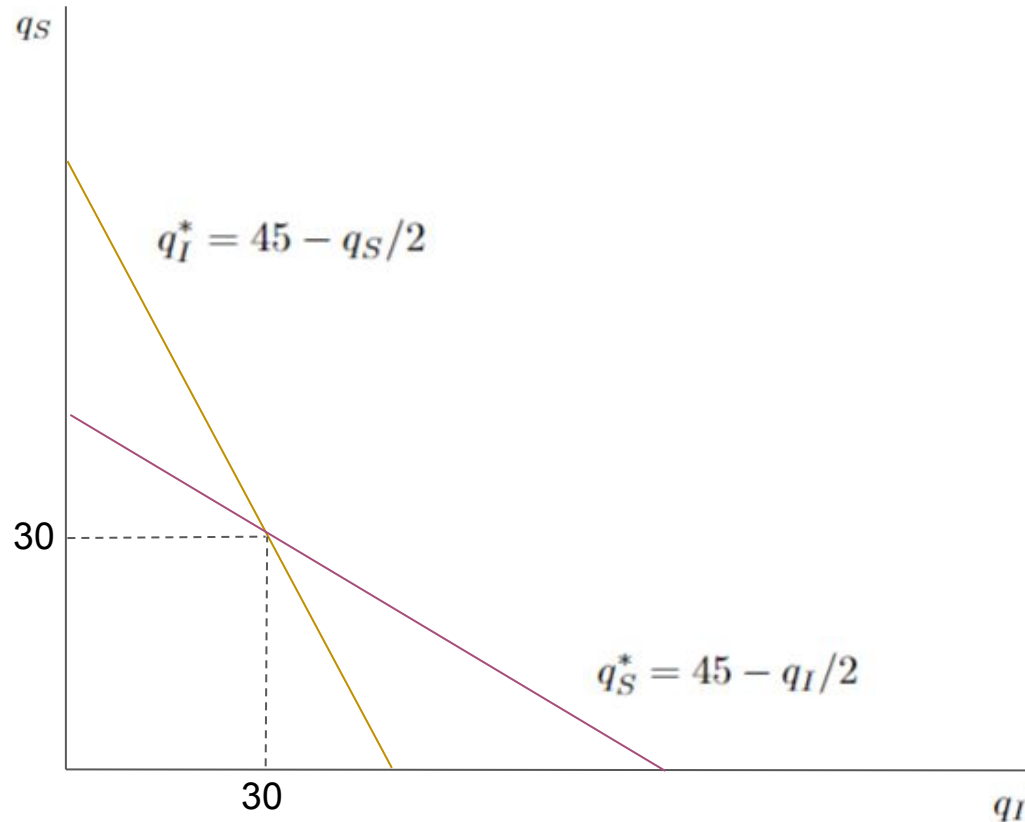
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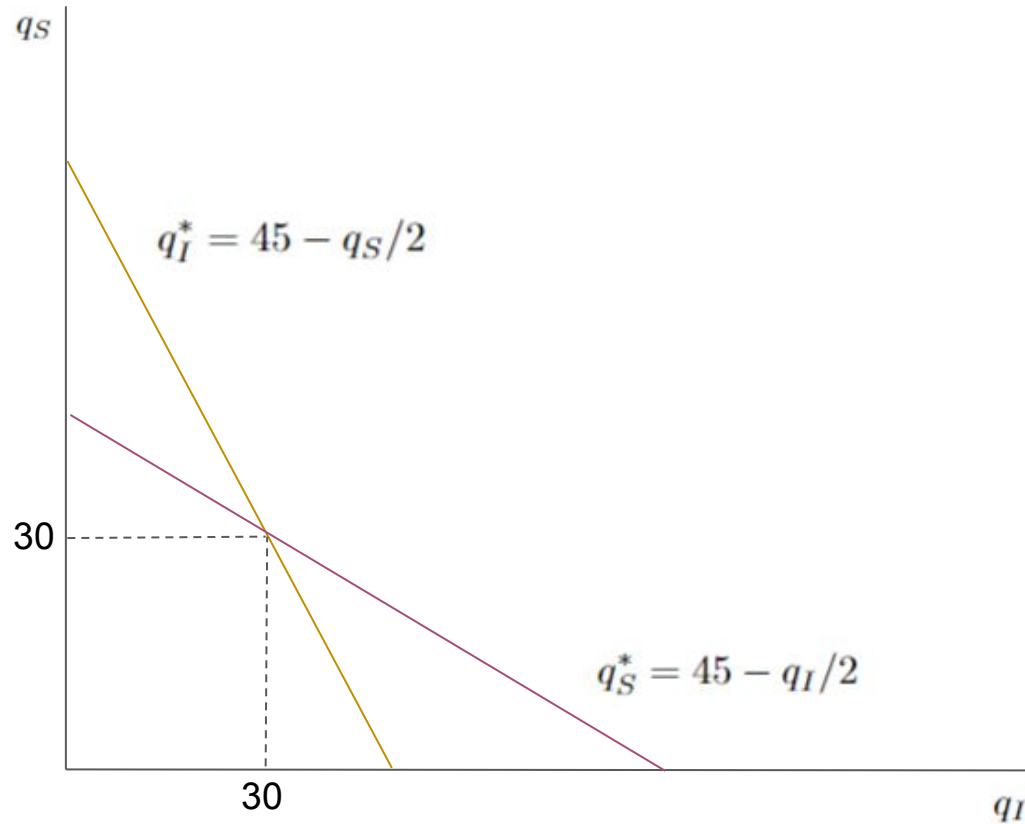
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- We reach the intersection of the reaction functions

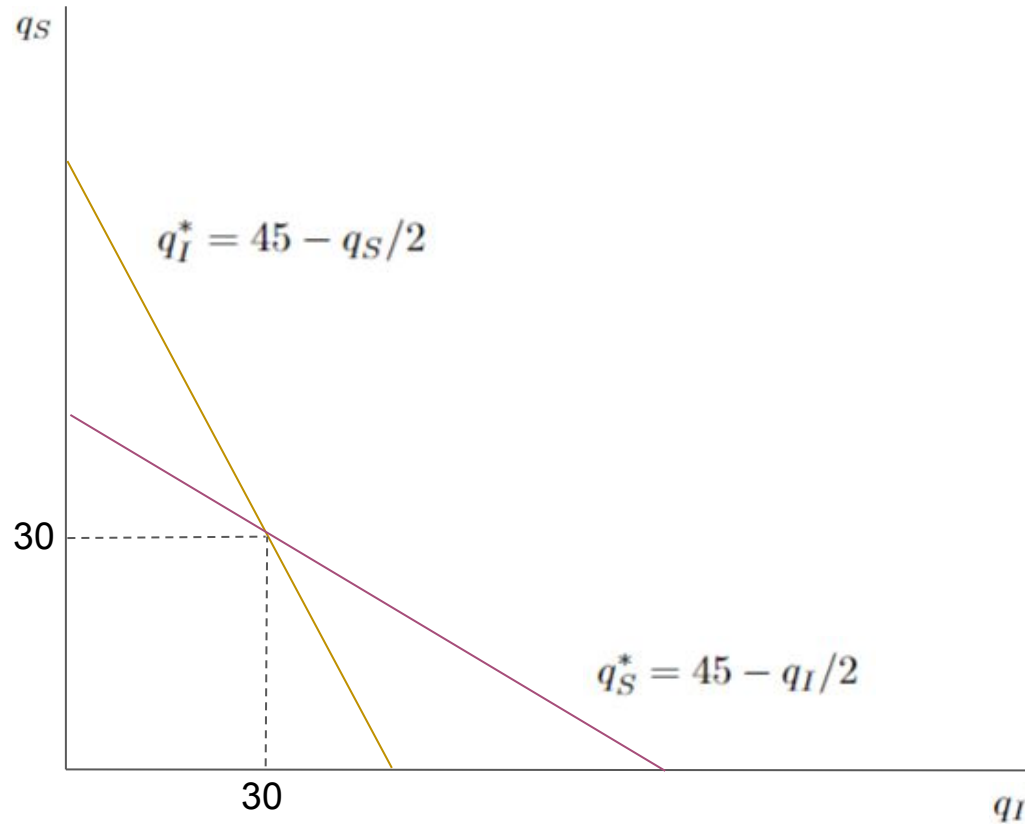
The logic of the equilibrium

- Suppose SA expected Iran to produce 30

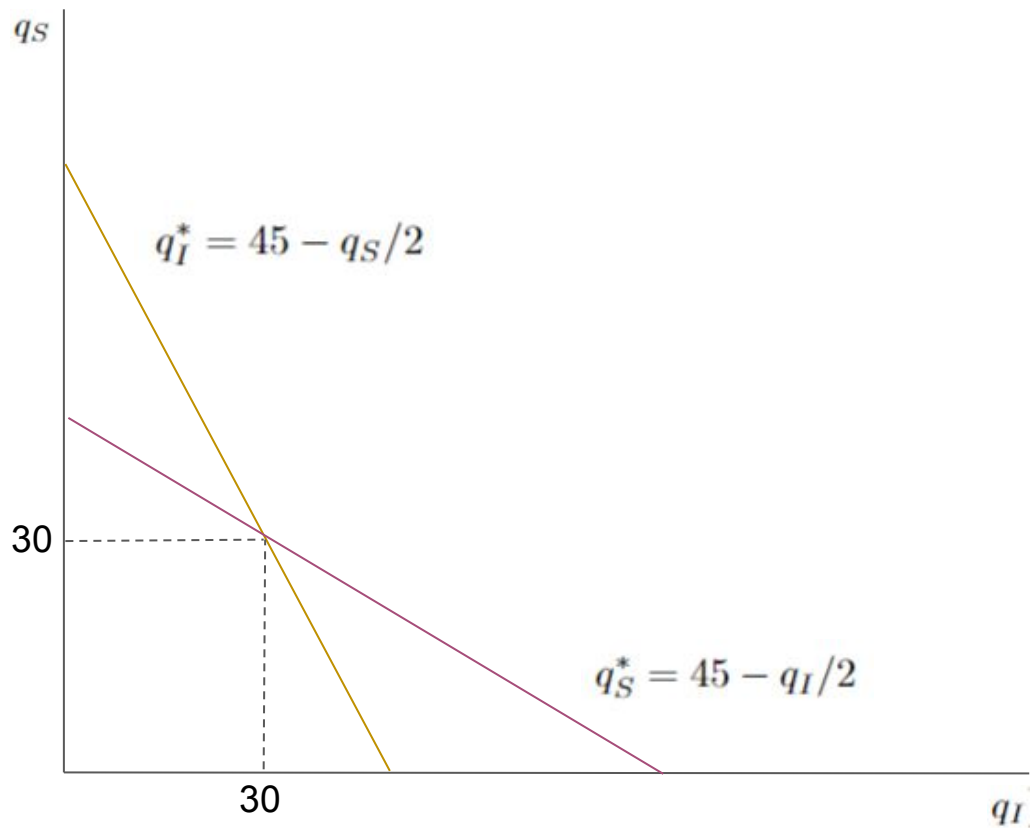


The logic of the equilibrium

- Suppose SA expected Iran to produce 30
 - SA would produce 30

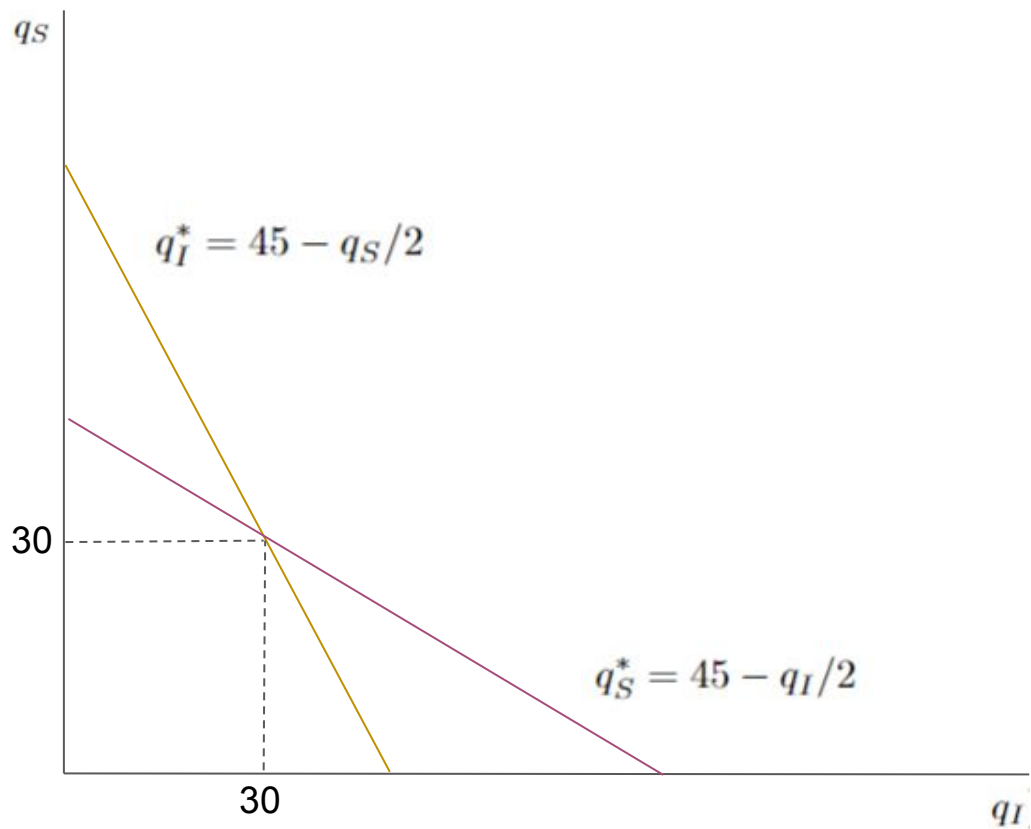


The logic of the equilibrium



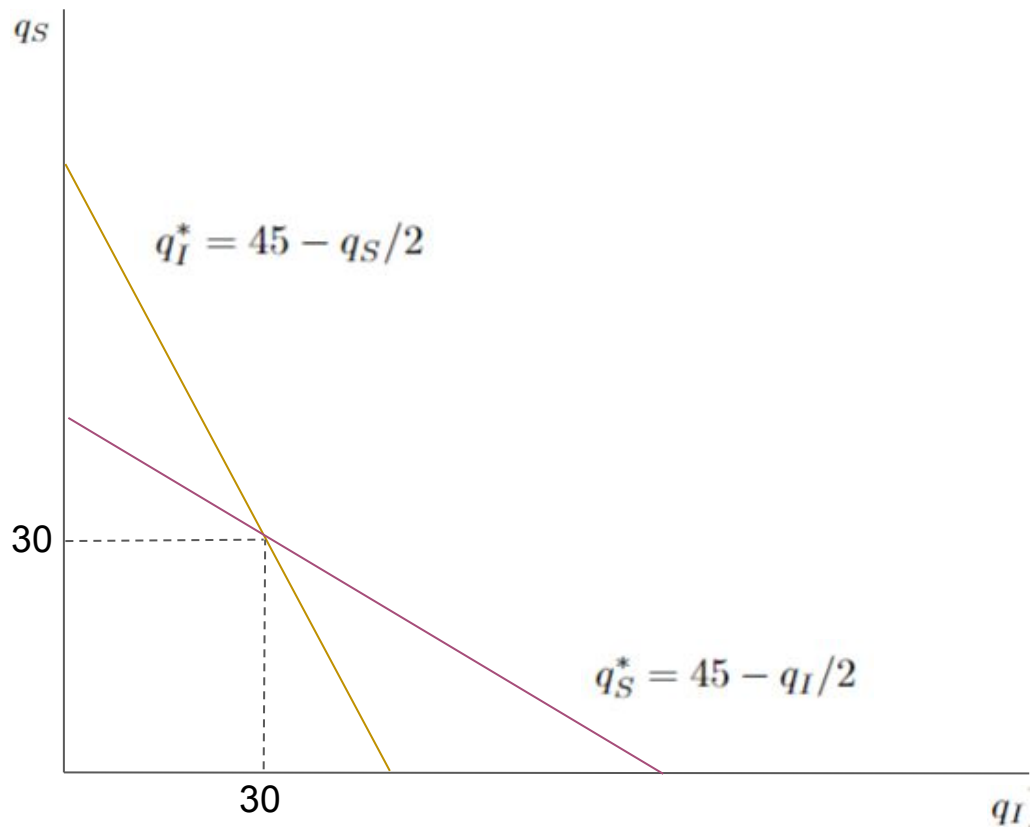
- Suppose SA expected Iran to produce 30
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- And Iran would predict that, and if SA produces 30:

The logic of the equilibrium



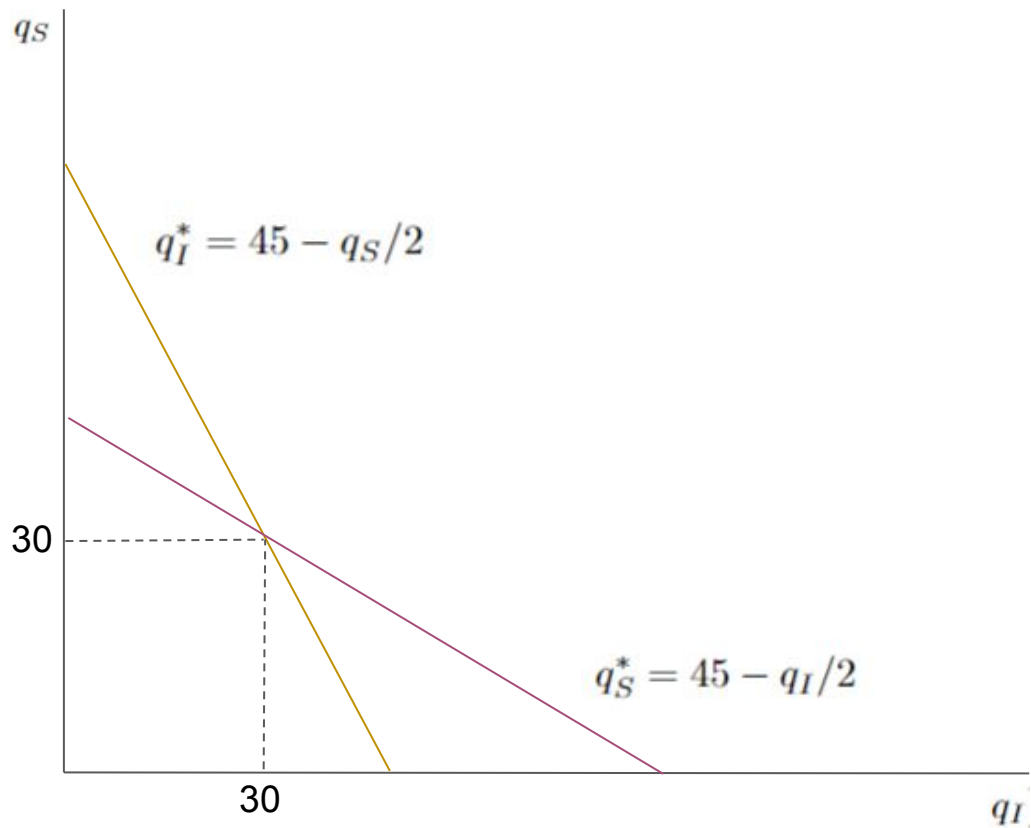
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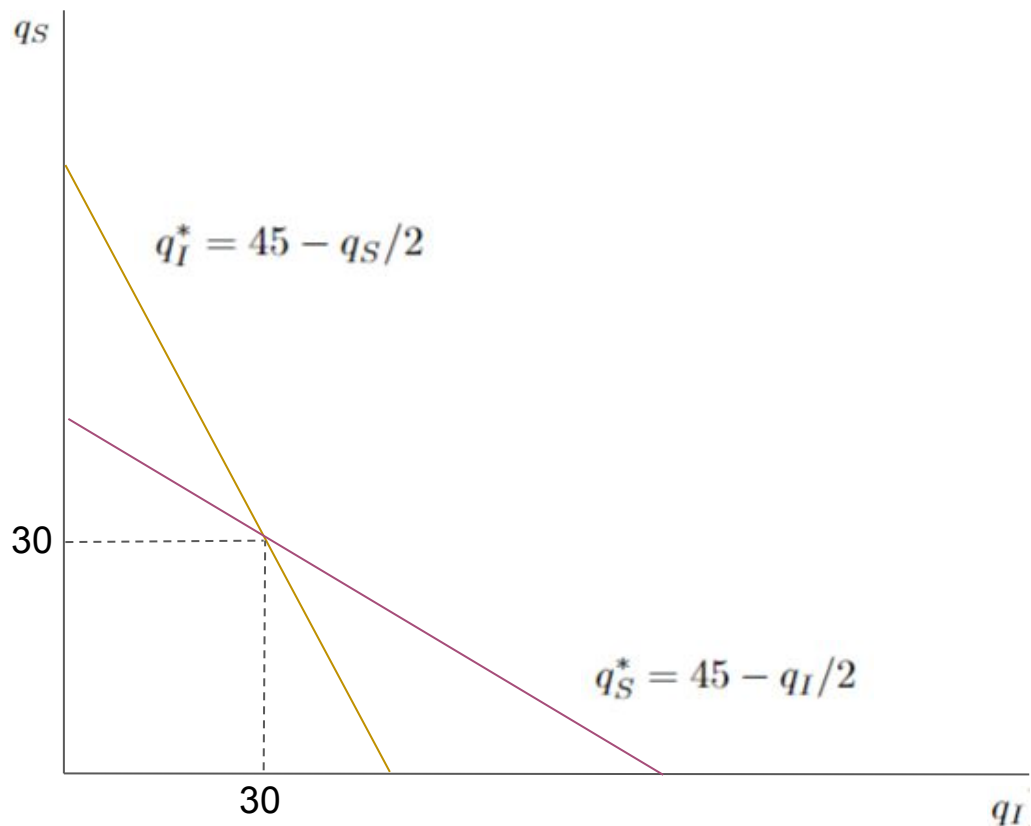
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- So SA's prediction was correct!

The logic of the equilibrium



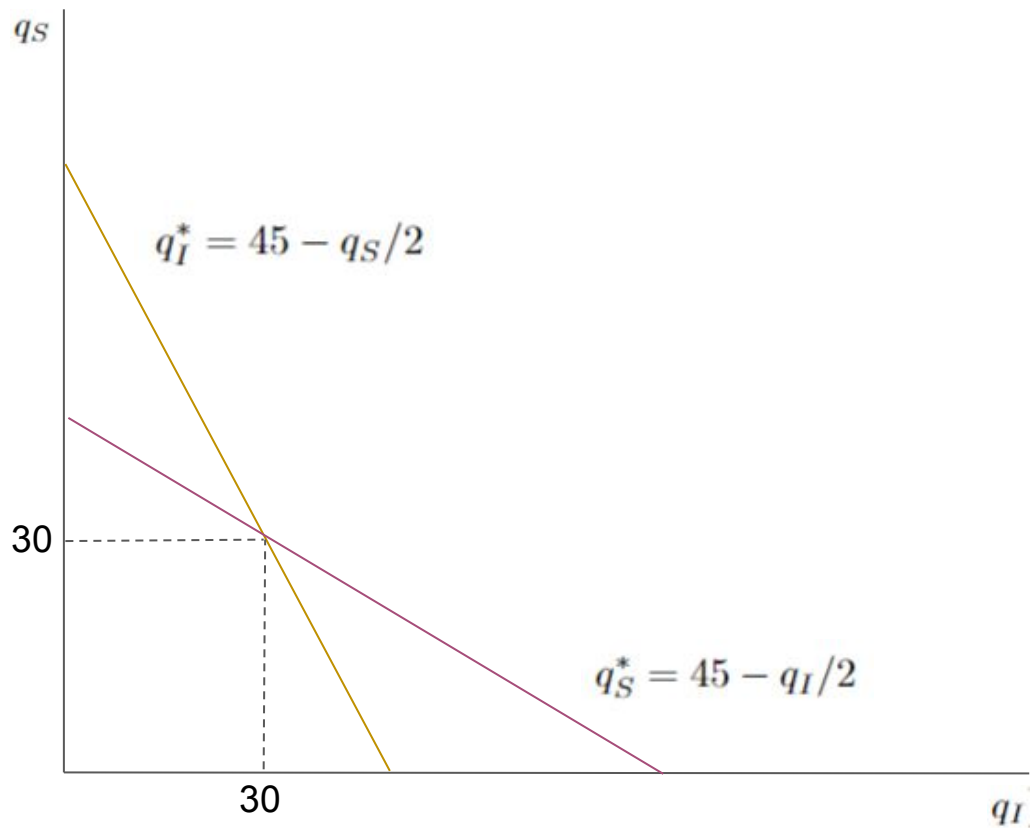
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- And Iran's prediction was correct!
- So both are happy at 30 – it is stable

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- And Iran's prediction was correct!
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Algebraic solution

Finding the equilibrium quantities amounts to solving a system of 2 equations (reaction curves) in two unknowns (q_I, q_S):

$$q_S = 45 - q_I/2$$

$$q_I = 45 - q_S/2$$

Substitution yields:

$$q_S = 45 - \frac{45 - q_S/2}{2}$$

$$q_S = 45/2 + q_S/4$$

$$\frac{3}{4} \cdot q_S = 45/2$$

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$$q_I = 45 - 30/2 = 30$$

Oligopolistic equilibrium

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Oligopolistic equilibrium

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Oligopolistic equilibrium

$$q_S = 30$$

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$$Q = 60, P = 40$$

$$\pi_S = \pi_I = 30 \cdot (40 - 10) = 900, \pi_S + \pi_I = 1800$$

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How does this compare to perfect competition?

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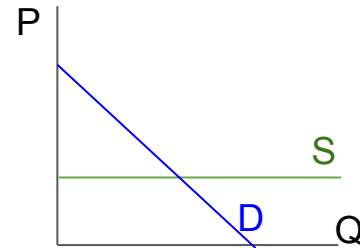
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Oligopolistic equilibrium

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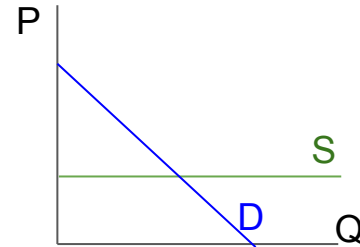
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$$S = MC = 10 = P = 100 - Q$$



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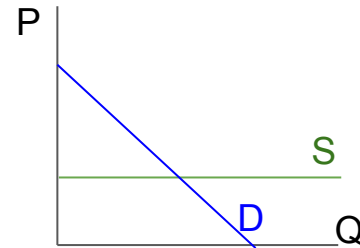
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How does this compare to perfect competition?

$$S = MC = 10 = P = 100 - Q$$

$$Q = 90, P = 10, \pi = 0$$



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How does this compare to monopoly?

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$$MR = 100 - 2 \cdot Q = 10 = MC$$

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$$\pi = 45 \cdot (55 - 10) = 2025$$

Intuition of oligopoly

- Just showed the following results:

$$Q^{Mon} < Q^{Olig} < Q^{PC}$$

$$P^{Mon} > P^{Olig} > P^{PC}$$

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- Profit is higher for the monopolist than the (combined) oligopolists.
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 - Lower overall profits is the price they pay for this inability to commit
 - A topic we'll study more with game theory!

The Bertrand Model: another type of oligopoly

- The details of how firms compete are extremely important
- Cournot: firms choose quantity, then charge the market-clearing price
- Bertrand: firms choose price, then sell whatever is demanded
 - Results are extremely different!

Bertrand example

Take the same example, and again assume $MC_S = MC_I = 10$

What price will Saudi Arabia charge? And Iran?

Bertrand example

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 - No, Saudi Arabia could charge 12, and steal the whole market.

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 - No, Saudi Arabia could charge 12, and steal the whole market.
- If we play this out, what will the prices be?

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- If we play this out, what will the prices be?
 - Both competitors will charge 10, the marginal cost.
 - This is true regardless of the demand curve.

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So if we assume the oligopolists are choosing price rather than quantity, the Bertrand oligopoly leads to the same outcome as perfect competition!

Takeaway 1: measuring competition is hard

- The contrast between Cournot and Bertrand outcomes highlight that just counting the number of firms is insufficient to measure the level of competition
- Competition depends crucially on how firms compete
 - Cournot: 2 competing firms can partially implement the monopoly outcome
 - Bertrand: 2 competing firms replicate the perfectly competitive outcome
- The most common way for economists to measure competition is the Lerner Index

$$L = \frac{P - MC}{P}$$

- Captures the (percent) markup over marginal cost.
- If you have market power, you can charge a price above your cost
 - Perfect competition: $P = MC$, so no markup
 - Monopoly: high markup
 - Oligopoly: likely somewhere in between.

Takeaway 2: in strategic environment details matter

- When multiple firms have market power, market results can depend very heavily on the details of how they interact
- Game Theory is the formal study of strategic interactions, and we turn to it next