Econ 1101
Spring 2013
Week 11

Section 038

4/3/2013

Announcements

- Midterm 2 is coming up (April 8th, 7:30-8:30)! Review sessions this Wednesday, April 3rd
  - First one: 4-5:30pm (Anderson 350)
  - Second one: 6-7:30pm (Anderson 250)
- Sample midterms already posted, with solution guides
- Sign up for makeup midterm by today, 4pm. (email headgrader@gmail.com with documentation)
- Students who need accommodations through Disability Services should have signed up by now
- Extra office hours: Mon, April 8th, 12.00 – 2.00pm

Agenda for today

- Theory of the Firm
  - Costs
  - Short-run Supply of a Firm
- Short-run Supply of a Competitive Firm
- Long-run Supply of a Competitive Firm
- Long-run Supply of a Competitive Industry
- Short-run Supply of a Competitive Industry
- Broader applications of perfectly competitive industry analysis

Costs

- Costs were pretty simple in the setup we analyzed so far in this course

  S1: can make 0 or 1 widget.

  Cost to make 0 widget: $0

  Cost to make 1 widget: $1

- In real world, things are more complicated.

Important remark about costs

- Accountings costs
  - All the bills, invoices, bank statements, etc.
- Economic costs
  - Opportunity cost!
  - This consists of **implicit and explicit costs.**
- Hence we will have:
  - **Economic profit vs. accounting profit.**

New type of seller

- Meet S11: a seller with two kinds of costs.
- Fixed Cost of $4 to stay in the business.
  - These are the costs that are always the same, regardless of quantity produced.
  - Examples:
    - Salary of the CEO
    - Rent of the factory facility
- Variable Input:
  - Wages for workers ($2 an hour)
  - Materials ($1 a unit), e.g. fabric, flour, gasoline…

Costs summary

Q	L (hours)	Labor Cost ($2)	Material Cost ($1)	Variable Cost
0	0.0	0	0	0
1	0.5	1	1	2
2	2.0	4	2	6
3	4.5	9	3	12
4	8.0	16	4	20

You can verify that the variable cost for this seller satisfies the following equation:

$$VC = Q + Q^2$$

Important Remark

- The cost structure for S11 exhibits:

  Diminishing Marginal Returns
  - To get the first unit, we need 0.5h of labor
  - To get second, we need 1.5h of labor more
  - And so on…
- So the return on additional units of labor added is diminishing.
- Interpretation: low vs. high hanging fruit.
- We don’t have the same thing with materials!

Overall picture

Q	Fixed Cost (FC)	Variable Cost (VC)	Total Cost (TC)
0	4	0	**4**
1	4	2	**6**
2	4	6	**10**
3	4	12	**16**
4	4	20	**24**

TC = FC + VC
AFC = Average Fixed Cost = **FC/Q**
AVC = Average Variable Cost = **VC/Q**

Marginal Cost = change in total cost from increasing output by one unit

Put them in the table

AFC	AVC	ATC	MC

MC between 0 and 1 is: 2 = 6 - 4
MC between 1 and 2 is: 4 = 10 - 6
MC between 2 and 3 is: 6 = 16 – 10

So what is MC at Q=1?
Use midpoint -> MC(Q=1) = 3
Similarly -> MC(Q=2) = 5

Put them in the table

Q	AFC	AVC	ATC	MC
0	-	-	-	-
1	4	2	6	3
2	2	3	5	5
3	1.333	4	5.333	7
4	1	5	6	9

MC between 0 and 1 is: 2 = 6 - 4
MC between 1 and 2 is: 4 = 10 - 6
MC between 2 and 3 is: 6 = 16 – 10

So what is MC at Q=1?
Use midpoint -> MC(Q=1) = 3
Similarly -> MC(Q=2) = 5

General Formulas (1)

- Total Costs

$$TC = aQ^2 + bQ + c$$

- Marginal Cost:

$$MC = 2aQ + b$$

- What's going on here?
  - a,b,c are parameters of the cost function. This general form allows for many particular cases.
  - Different firms will have different values of a,b,c

General Formulas (2)

- For our example, we have:

$$TC = Q^2 + Q + 4$$

$$MC = 2Q + 1$$

- Therefore, a = 1, b = 1 and c = 4
- The parameters have an interpretation:
  - c is obviously the fixed cost – the one that doesn't vary with output.
  - For Airbus manufacturing the A380

    c = 16 billion !!!

More on parameters

- b: variable cost that is proportionate to output (cost of materials)

  example: to paint twice as many houses, you need twice as much paint.

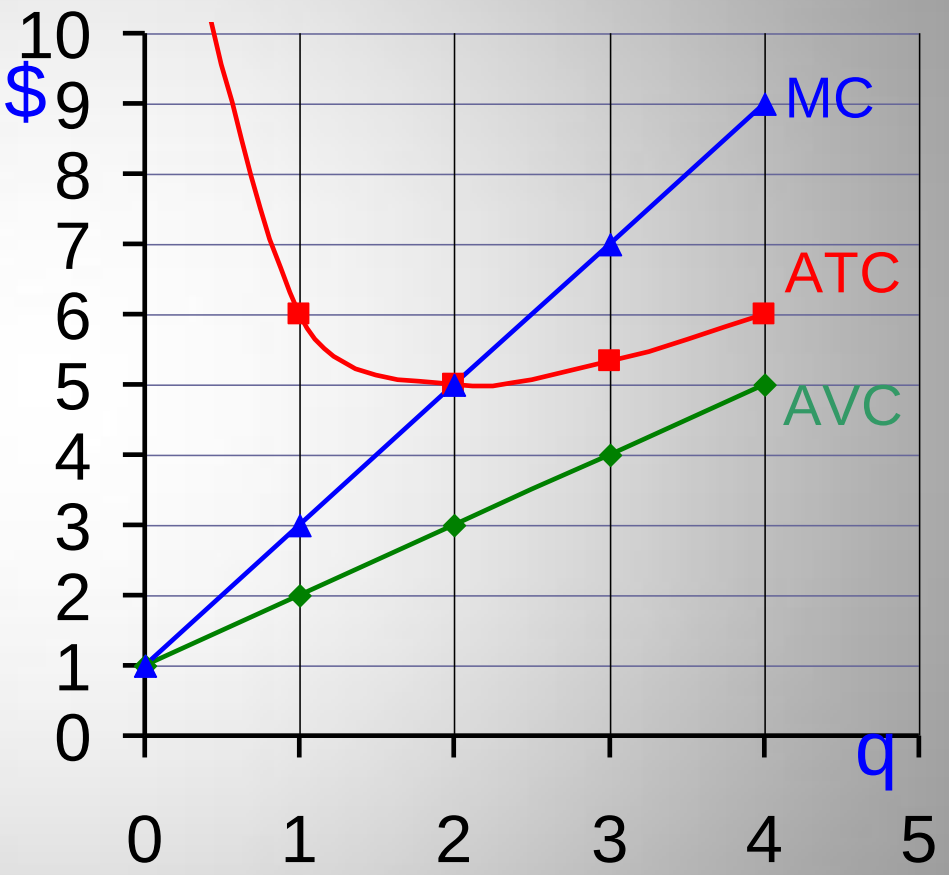
- a: the hardest one to understand. In many cases we don't need to worry about it and a = 0
- when a is positive, we have **increasing marginal cost** (=> diminishing marginal returns)
- low- and high-hanging fruit story

Graph of this cost structure (1)

Q	AFC	AVC	ATC	MC
0	-	0	-	-
1	4	2	6	3
2	2	3	5	5
3	1.333	4	5.333	7
4	1	5	6	9

Graph of this cost structure (2)

Q	AFC	AVC	ATC	MC
0	-	0	-	-
1	4	2	6	3
2	2	3	5	5
3	1.333	4	5.333	7
4	1	5	6	9



U-shaped cost curve (1)

- For Q < 2, ATC is falling

Region of: **Increasing returns to scale**

(also called economies of scale)

- For Q > 2, ATC is rising

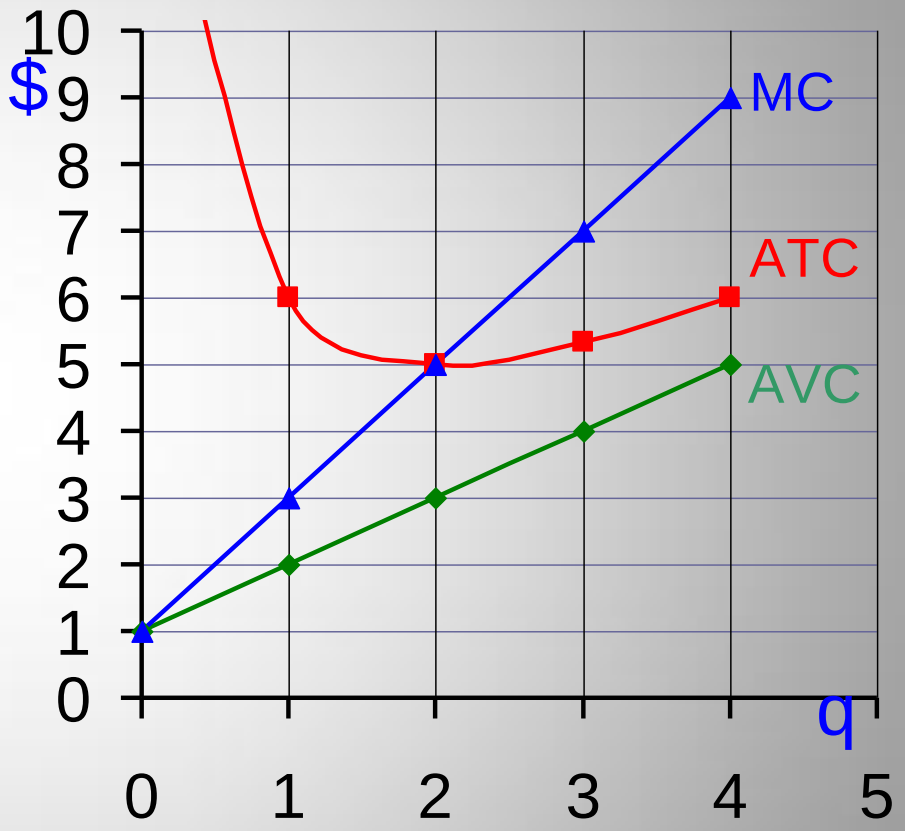
Region of: **Decreasing returns to scale**

(also called diseconomies of scale)

- For Q = 2, **Minimum Average Cost**

Facts:

  - Q < 2, MC < ATC and ATC falling
  - Q >2, MC > ATC and ATC rising
  - Q = 2, MC = ATC and ATC at its minimum

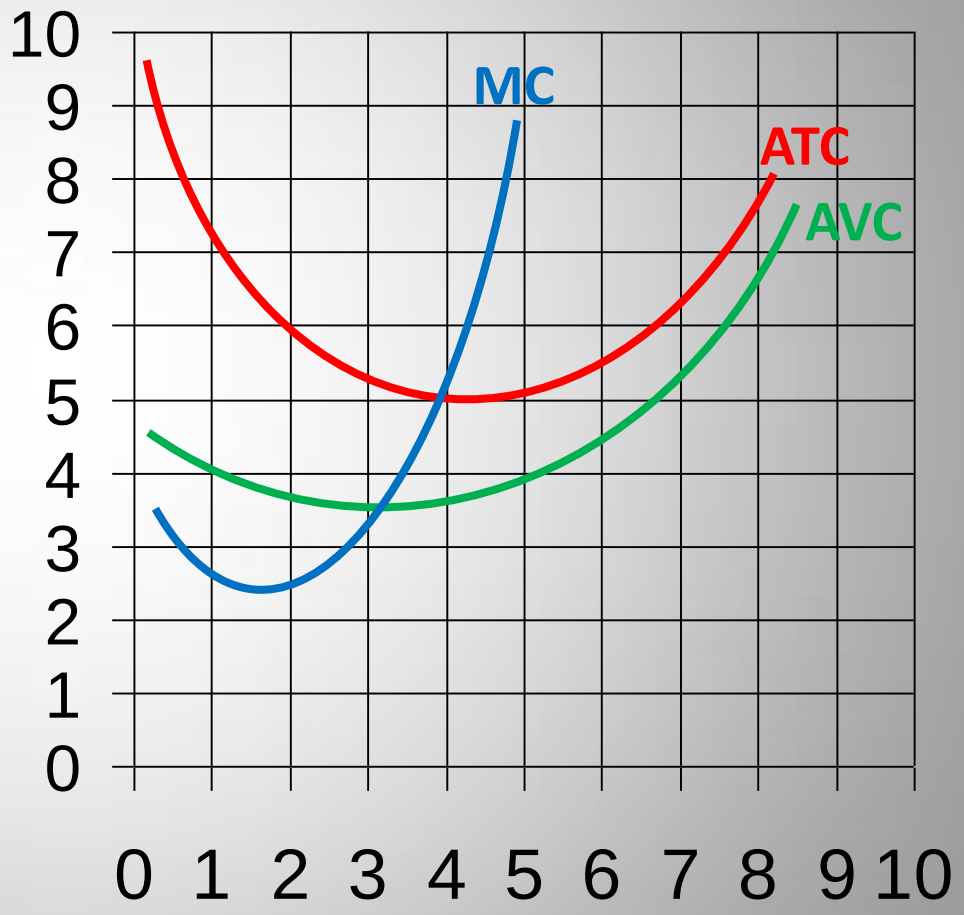


U-shaped cost curve (2)

Don’t be thrown off guard if you also see a different, a little more complicated example of the AVC curve.

In this case, the variable cost is simply also a hyperbolic function.

What is the interpretation of such a cost structure?



Constant Returns to Scale

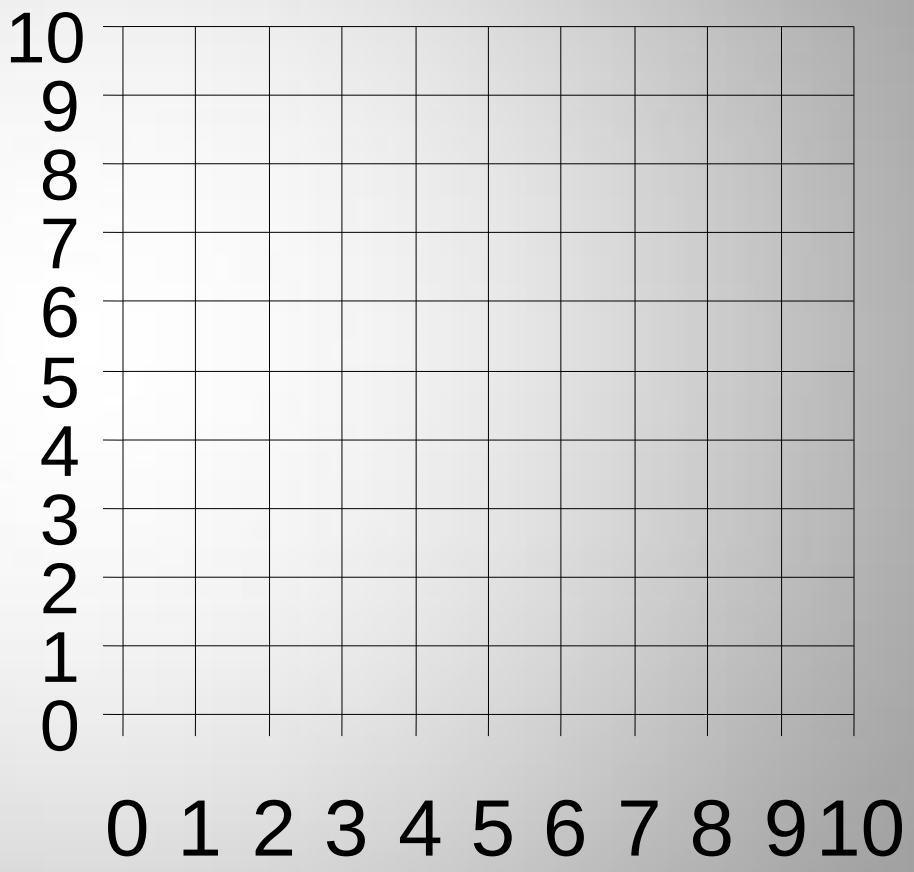
- This is a special example of the cost structure
- As you increase production, all inputs need to be scaled up in the same proportion. Hence, costs increase proportionately.
- Example: housepainting.
- What is the cost function in this case?

  $TC = 5Q$

  $(a = 0, b = 5, c = 0)$

Graph of the costs under CRS

Q	TC	ATC
0	0	-
1	5	
2	10	
3	15	
4	20	



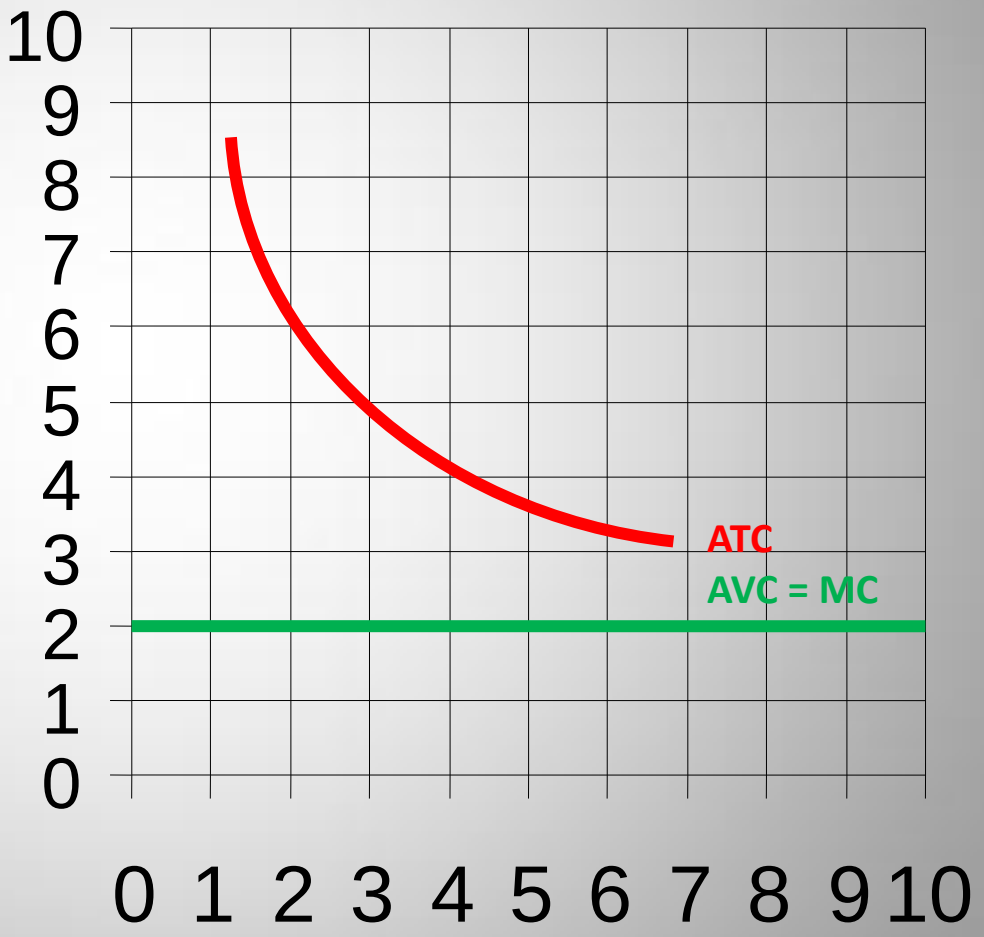
Economies of Scale (over the entire range of Q)

- Suppose a firm has FC = 8 and a constant marginal cost of 2
- Example of such companies in real world?
- TC = 2Q + 8 => (a = 0, b = 2, c = 8)
- ATC = TC/Q = 2 + 8/Q
- Complete the TC/ATC table and plot the cost curves

Economies of Scale

Q	TC	ATC
0	8	-
1	10	10
2	12	6
3	14	4.7
4	16	4
…	…	…
8	24	3

ATC is always falling, never turns back up. So decreasing over the entire range of Q.



Example of industries where economies of scale are important

- Pharmaceuticals
  - Fixed cost of research
  - MC of making pills is small compared to AFC
- Software
  - MC quite low relative to AFC
  - If distributed on the Internet: MC = 0!
- Jumbo jet type of airplanes (>500 passengers)
  - Airbus A380 consumed $16 billion in development costs before the first aircraft could even fly!

Wal-Mart Example (1)

- Discount retailing: by maintaining a large scale, Wal-Mart has kept average total cost from its logistics low.
- For example, there is a fixed cost to set up a distribution center. By putting many stores close to distribution centers, Wal-Mart enjoys economies of scale (and can keep inventories low and replenish empty shelves quickly, e.g. restocked flags on 9/11).
- You can read about the strategy of packing stores close to each other to enjoy the economies of density in the forthcoming Holmes paper.

Wal-Mart Example (2)

- The paper is technical, so let's just look at a movie of how Wal-Mart rolled out its store openings. <Click here for a link>
- In industries where economies of scale are huge relative to the market size, there is only room for a few players, for instance:
  - Discount retailing: Wal-Mart, Target, K-Mart, etc.
  - Wide-body Jets: Boeing, Airbus, Embraer, …
- After the midterm, we will specifically talk about industries where individual firms are large. But first, let's figure out industries where firms are small relative to the market (so firms take price as given).

Perfect Competition

- A perfectly competitive market is such that:
  - There are large numbers of sellers and buyers
  - The goods offered by all sellers are homogeneous
  - Sellers can enter and exit the market freely (no barriers to entry or exit)
  - Sellers and buyers take the market price as given
  - There is a uniform production technology that is available to all sellers
  - Buyers and sellers have a perfect information about the market
- Examples of such a market structure?

Supply of a Competitive Firm

- Remember that P is taken as given.

Supply of S1? (Back in our old Econland framework)

Easy. P>1 then Q = 1

P<1 then Q = 0

Supply of S11? (from last class)

- Harder to figure out

Suppose P = $7. What do we do to see how much S11 produces?

- Start by making a table.

Profit = Revenues minus Total Cost

Pick Q to maximize profit

Maximizing profit

Q	TR = PxQ	Total Cost	Profit=R-TC	MC	MR
0					
1					
2					
3					
4					

Maximizing profit (price = $7)

Q	TR = PxQ	Total Cost	Profit=R-TC	MC	MR
0	0	4	-4	-	7
1	7	6	1	3	7
2	14	10	4	5	7
3	21	16	5	7	7
4	28	24	4	9	7

- Easy to notice that the profit-maximizing quantity is Q = 3.
- Is there some shortcut to figuring this out?
- Look at Marginal Revenue (change in Total Revenue from producing one more unit).
- For a competitive firm, MR = P always.
- Compare Marginal Revenue to Marginal Cost.

Entrepreneurs think at the margin

- If MR > MC, more production will increase profit
- If MR < MC, less production will increase profit
- If MR = MC? Just right!
- General rule for a profit-maximizing output of a perfectly competitive firm:

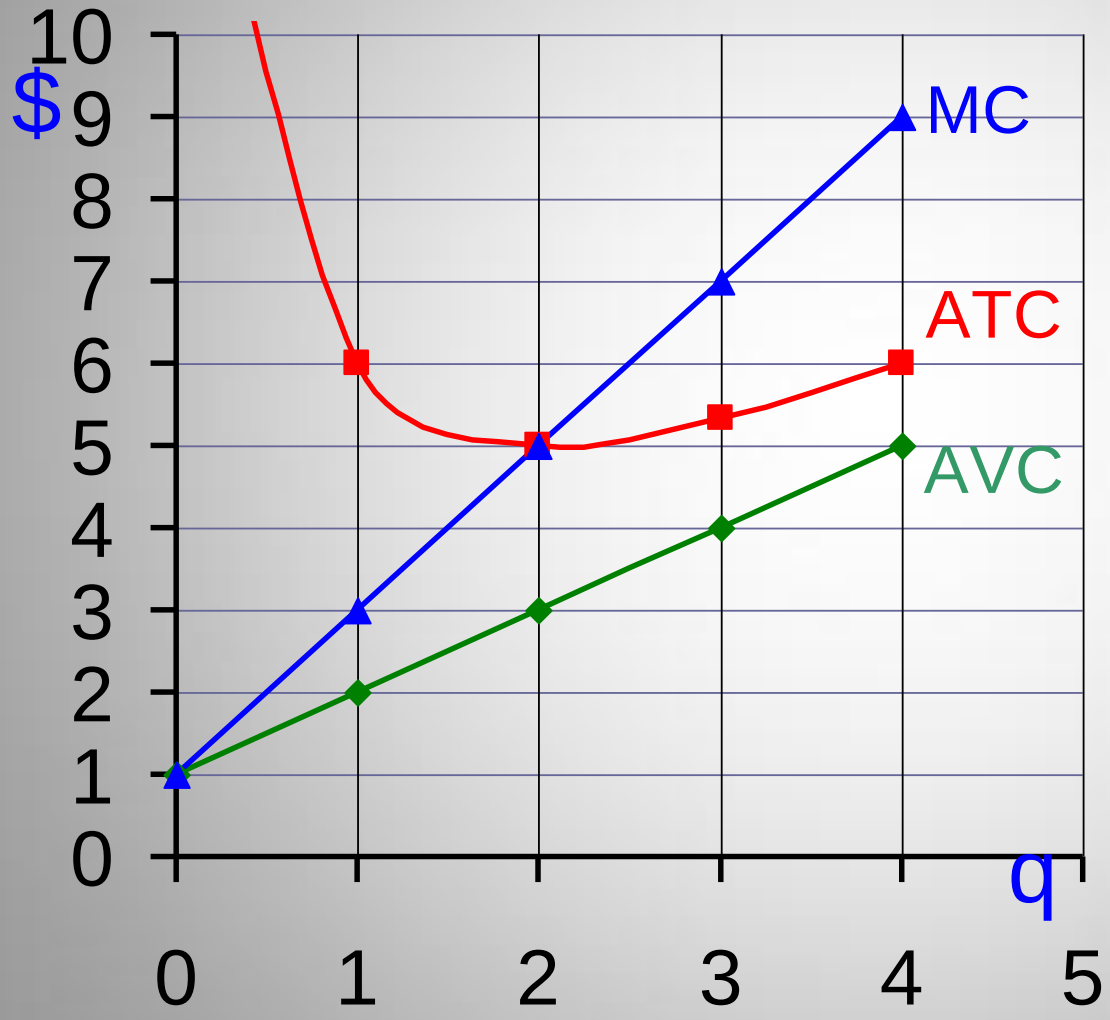
Marginal Revenue = Marginal Cost

- But we also need to check whether it make sense to operate the firm at all.
- Here, also the distinction between long and short run comes into play.

Short vs. Long Run

- Short Run: fixed costs cannot be avoided. For instance, we have to pay the rent regardless of the amount produced (here, FC = $4).
- However, the firm can give up employing labor and buying materials, in which case VC = $0.
- When Q is decided, firm takes FC as *sunk cost.*
  - **Produce as long as P ≥ AVC**
- Long Run: firm can exit the industry (decide not to renew the lease).
  - **Produce as long as P ≥ ATC**

Short Run Supply Curve



Remember, FC = $4

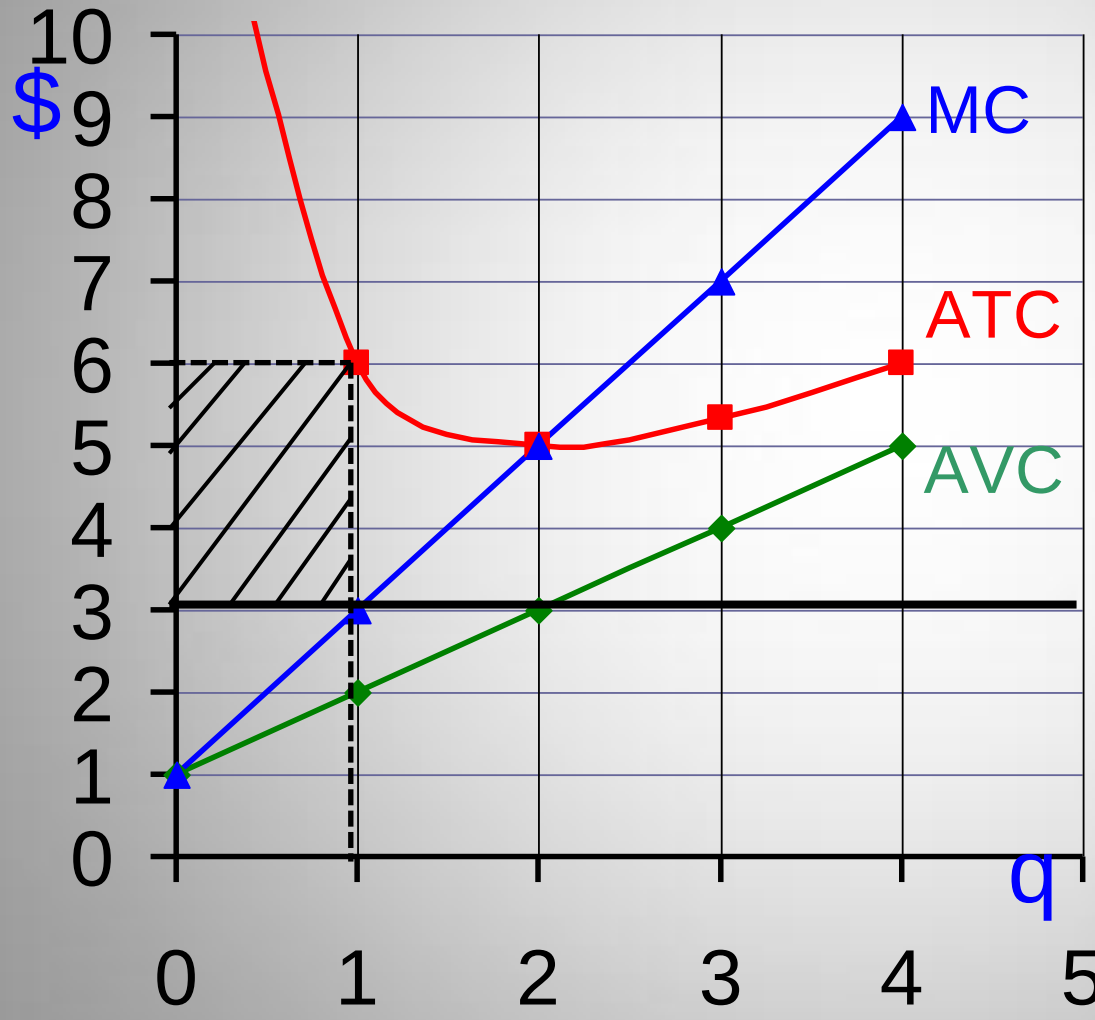
What happens if P = $3 ?

What if P = 3?

- P = MC at Q = 1
- AVC = 2 at Q = 1 so that P > AVC
- Profit = TR – TC

  = PxQ – FC – VC = 3x1 – 4 – 2 = -3
- Compare it to the loss incurred at Q = 0

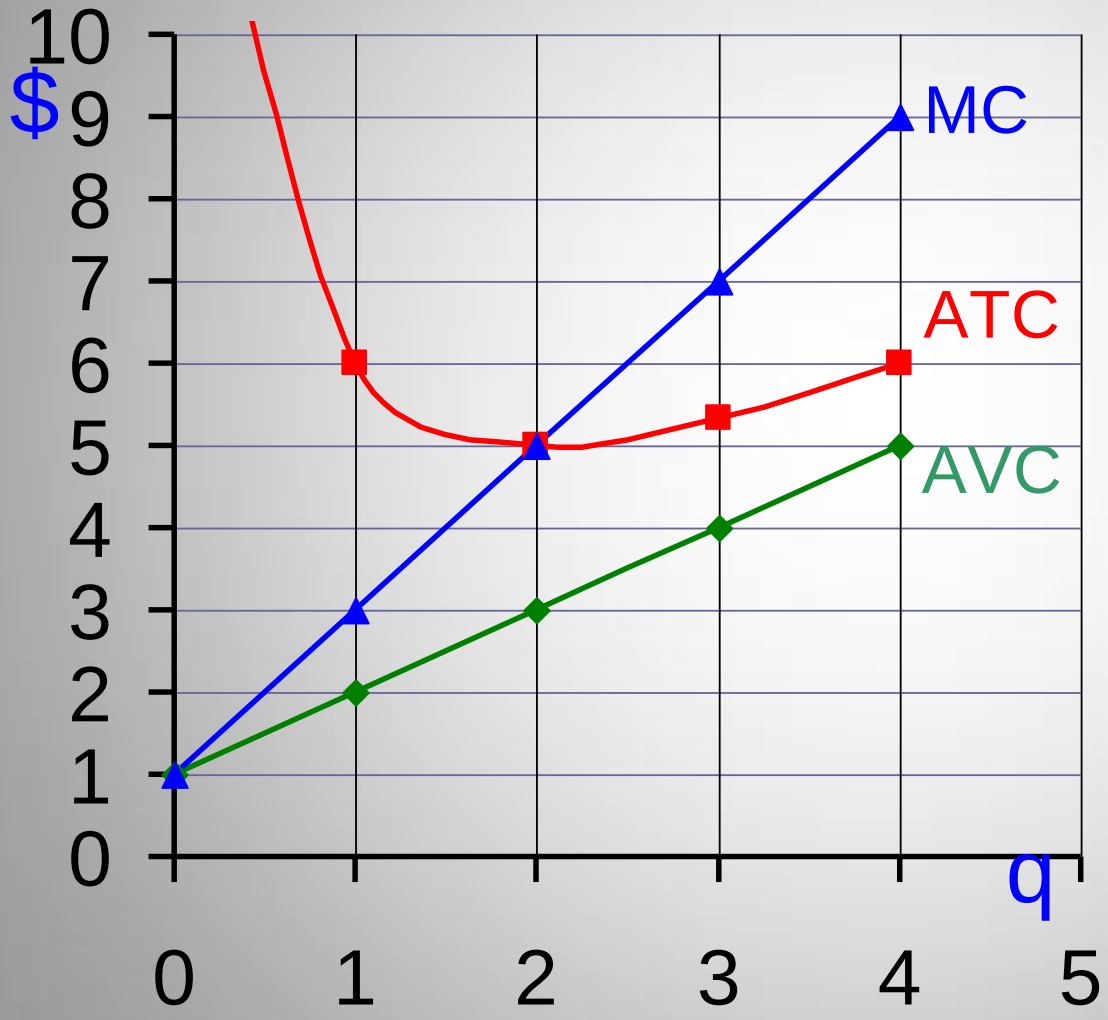
Short Run Supply Curve (1)



Remember, FC = $4

What happens if P = $3 ?

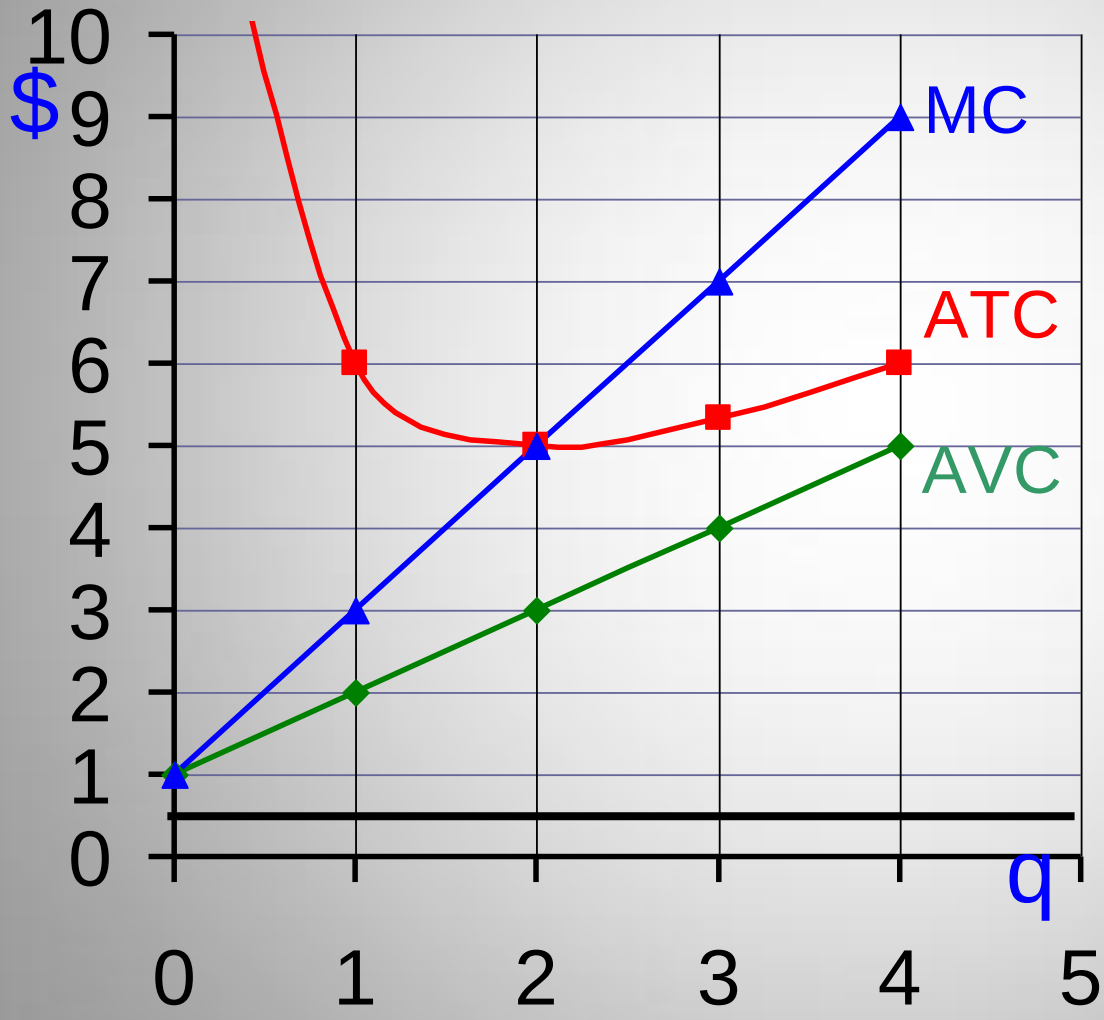
Short Run Supply Curve (2)



Remember, FC = $4

Now, what if P = $0.5 ?

Short Run Supply Curve (3)



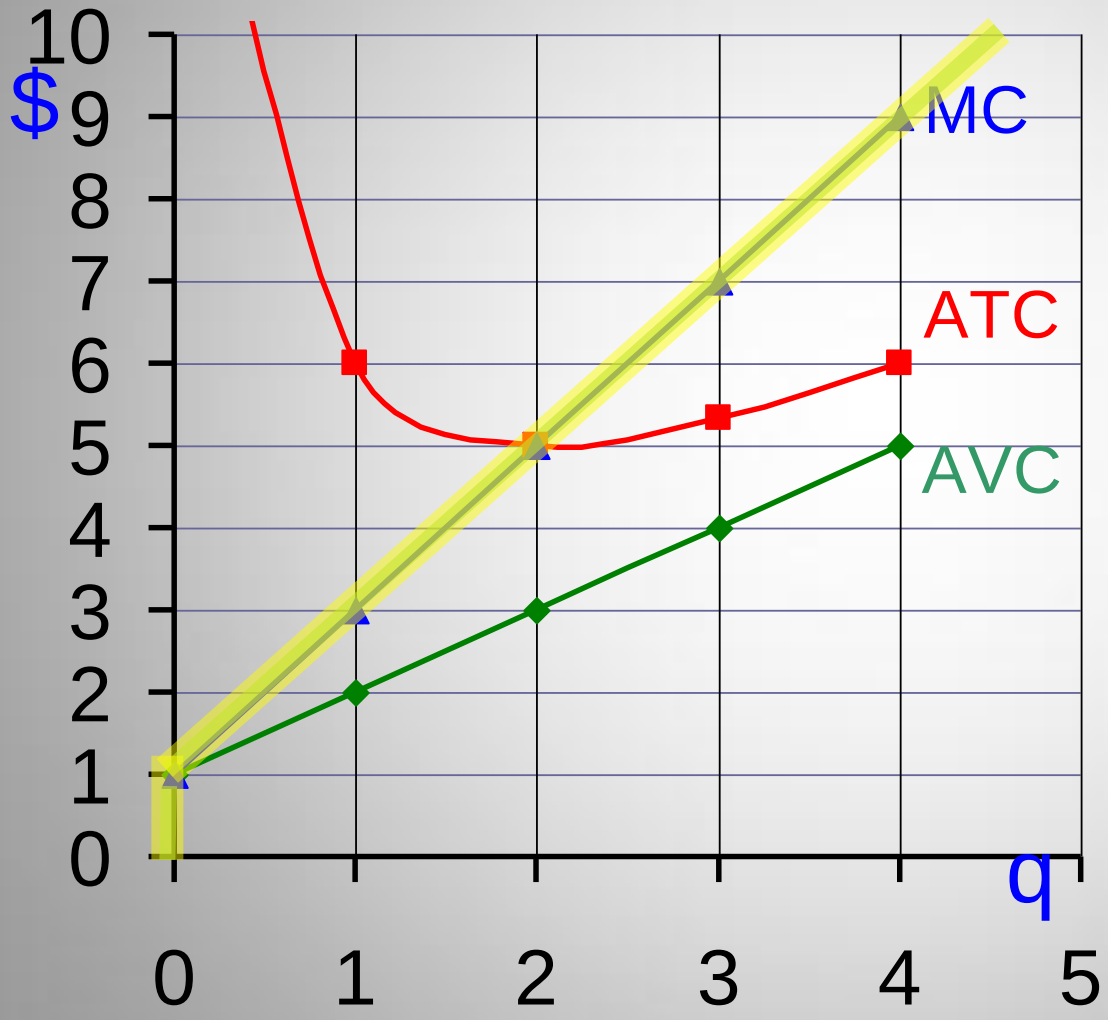
Remember, FC = $4

Now, what if P = $0.5 ?

Price always below the Average Variable Cost!

Hence, no production!

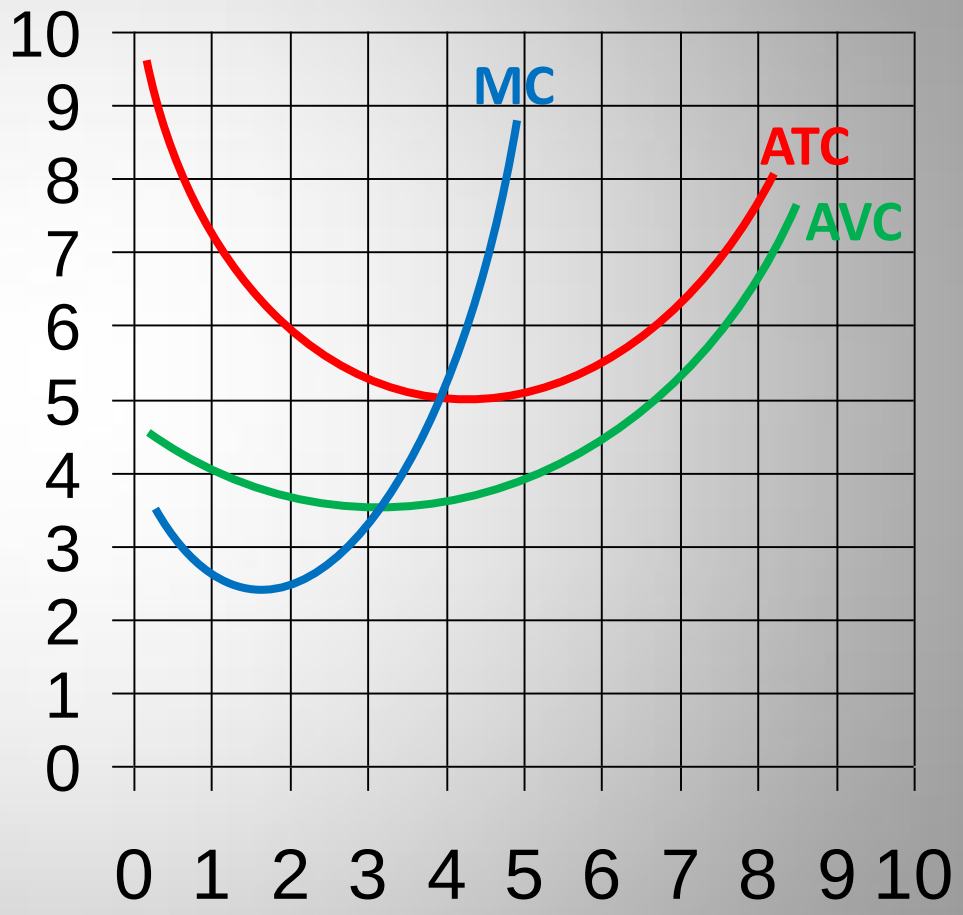
Short Run Supply Curve (4)



Putting the two together, we get our **short run supply curve** (highlighted in glowing yellow)

Supply with U-shaped cost curve (1)

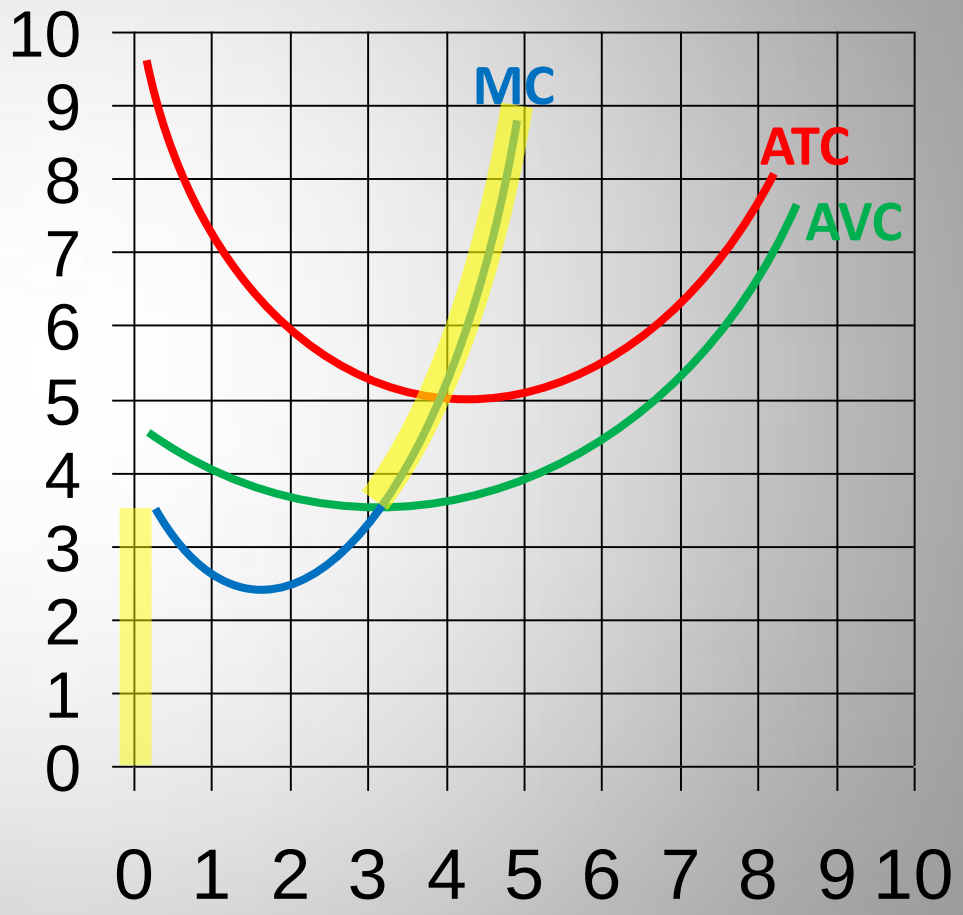
The same applies to the hyperbolic AVC type of curve that we mentioned in the previous lecture.



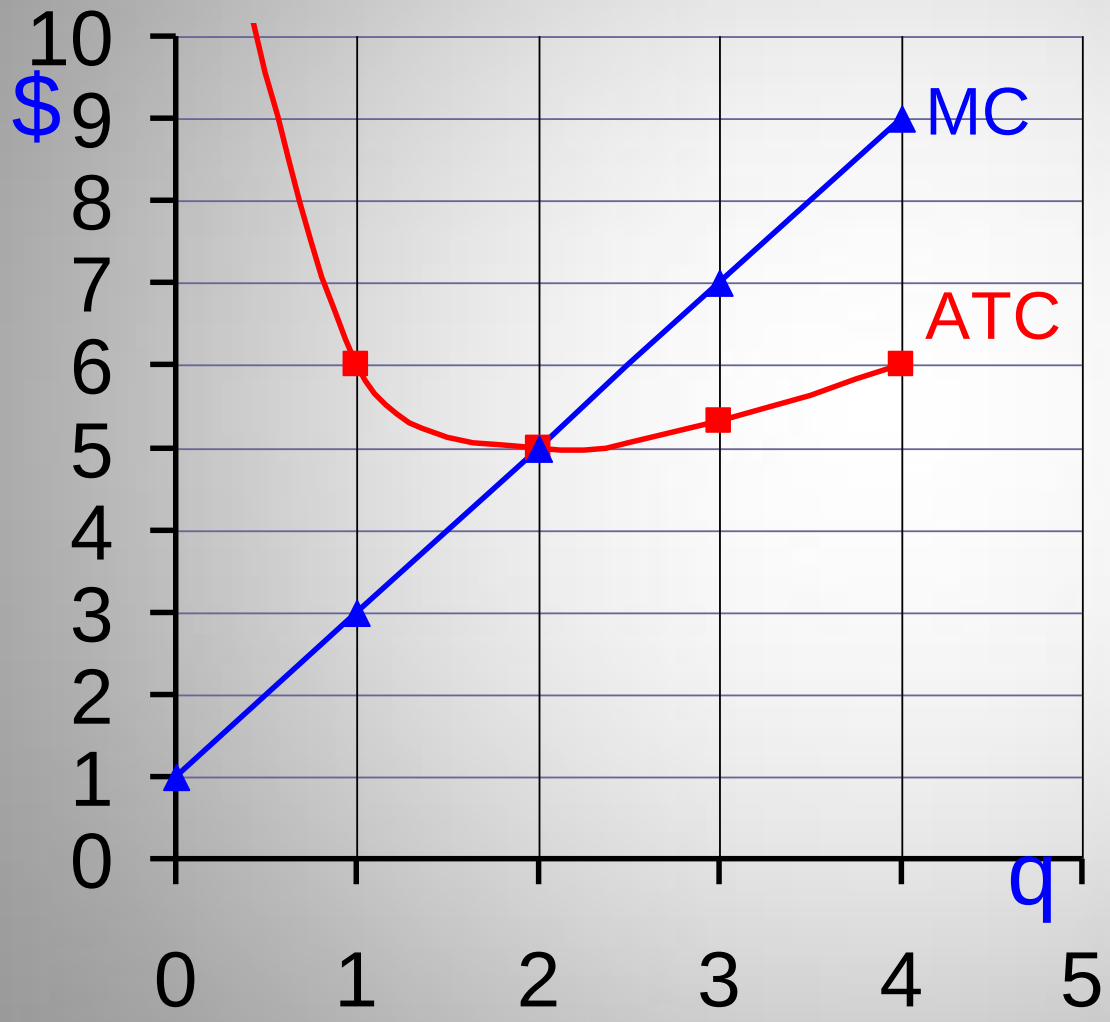
Supply with U-shaped cost curve (2)

The same applies to the hyperbolic AVC type of curve that we mentioned in the previous lecture.

The firm's supply is zero when P < AVC and is equal to the part of MC curve when P ≥ AVC.



Long Run Supply Curve (1)

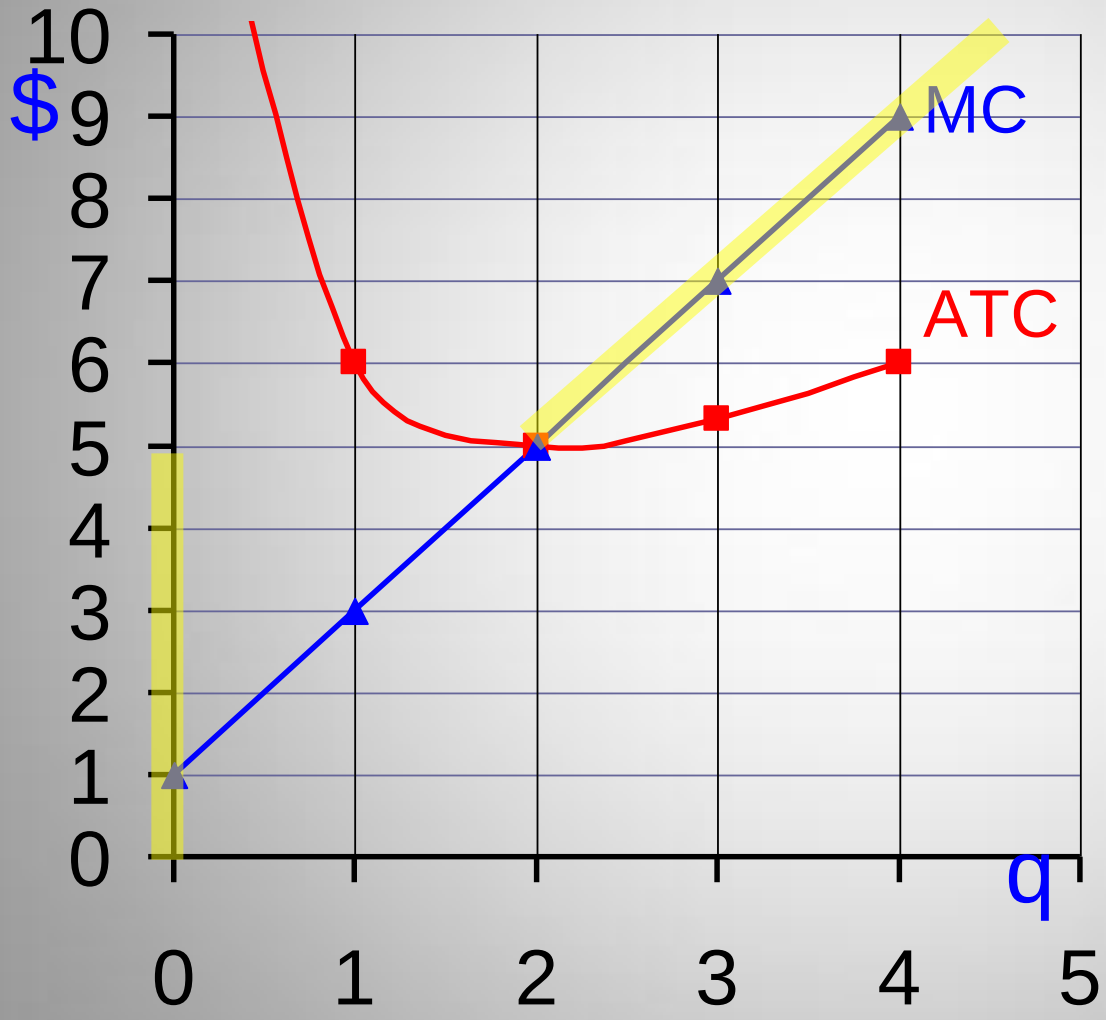


Now, there are no fixed costs, just variable costs (even stuff like rent, CEO's salary, etc).

All the firm is facing is the average total cost curve.

Supply is zero when P < ATC and is equal to the part of MC curve when P ≥ ATC.

Long Run Supply Curve (2)



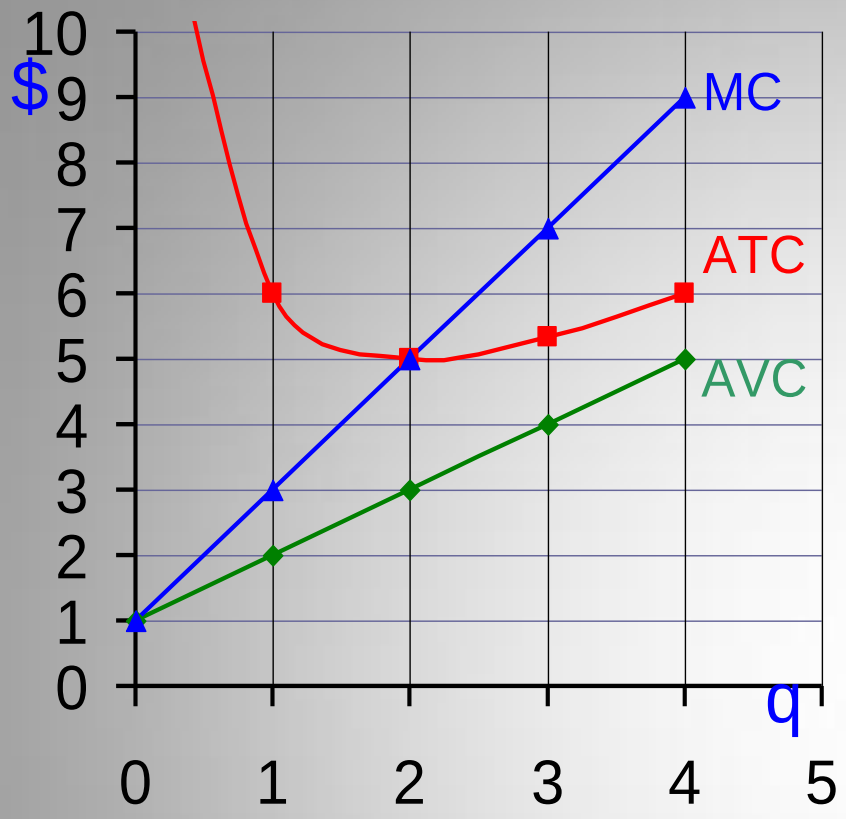
Now, there are no fixed costs, just variable costs (even stuff like rent, CEO's salary, etc).

All the firm is facing is the average total cost curve.

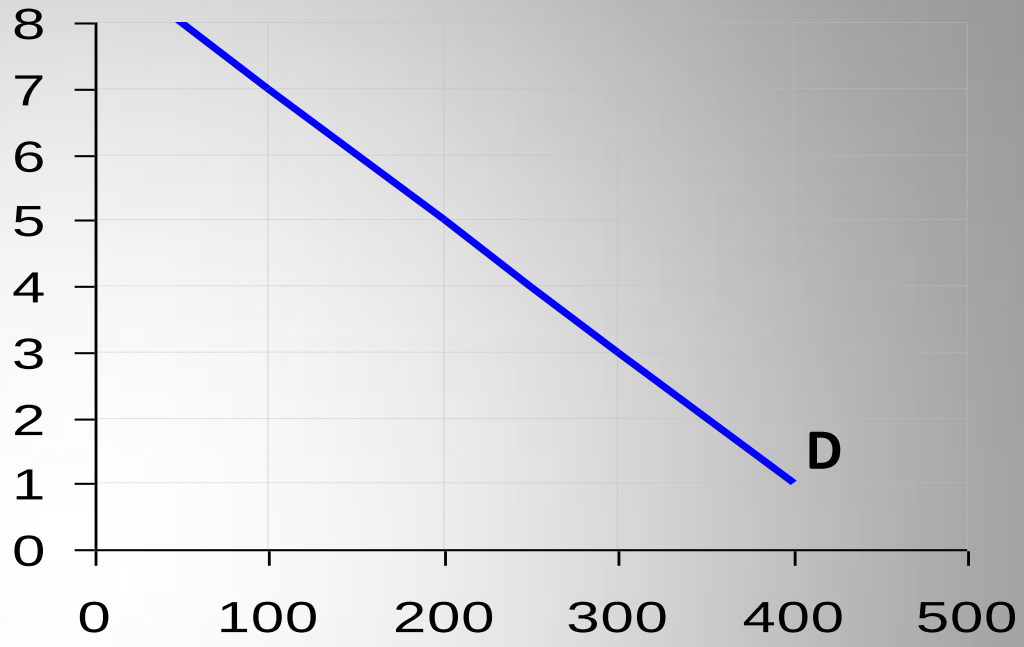
Supply is zero when P < ATC and is equal to the part of MC curve when P ≥ ATC.

Long Run Supply of a Competitive Industry with Free Entry

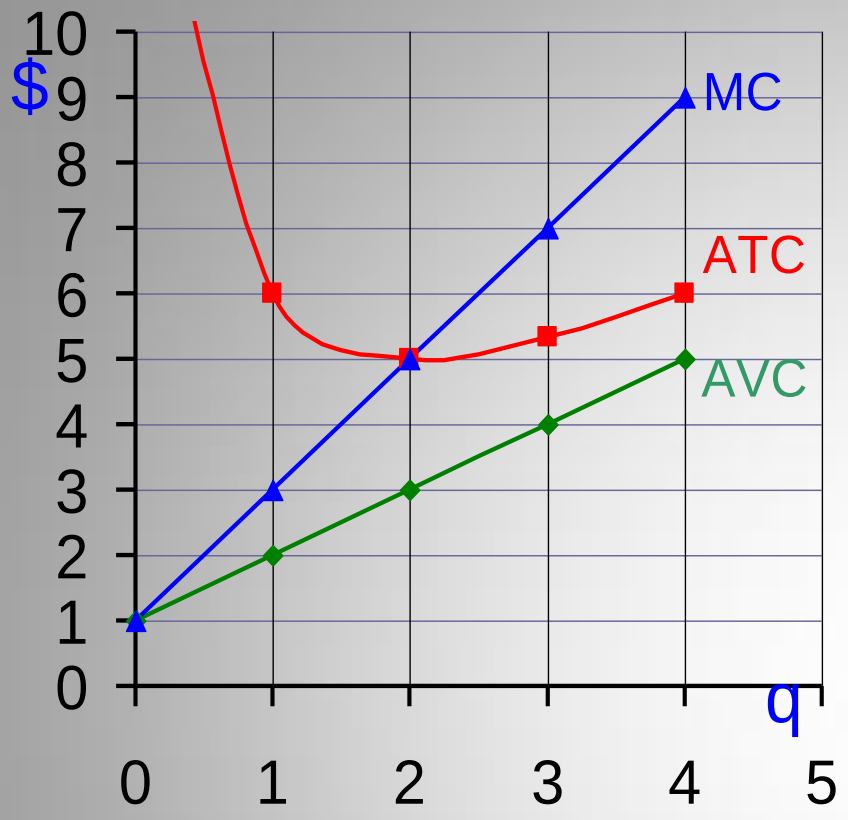
- Suppose:
  - Same technology is available to all firms
  - No barriers to entry
  - Input prices to industry do not go up as the industry expands
- Then, in the long-run equilibrium:
  - Price equals P* = min ATC
  - Each firm produces quantity q* where ATC is minimized
  - Number of firms N* is the demand at P* divided by q*



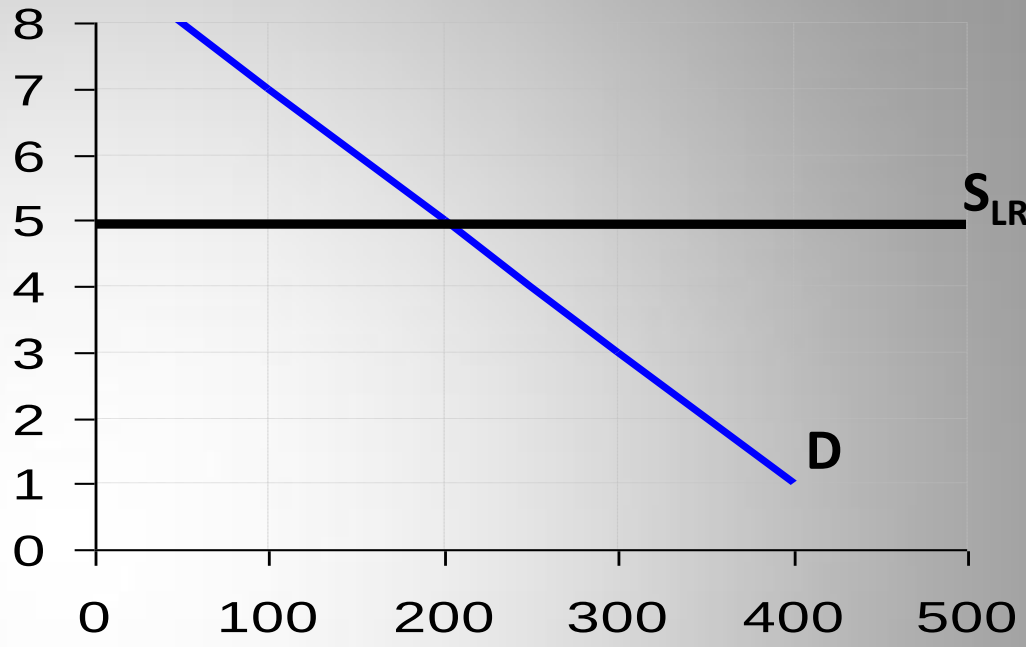
Reasoning? If price is higher than min ATC, what happens?
If price if lower than min ATC, what happens ?
(Hint: look at the profit of a firm)



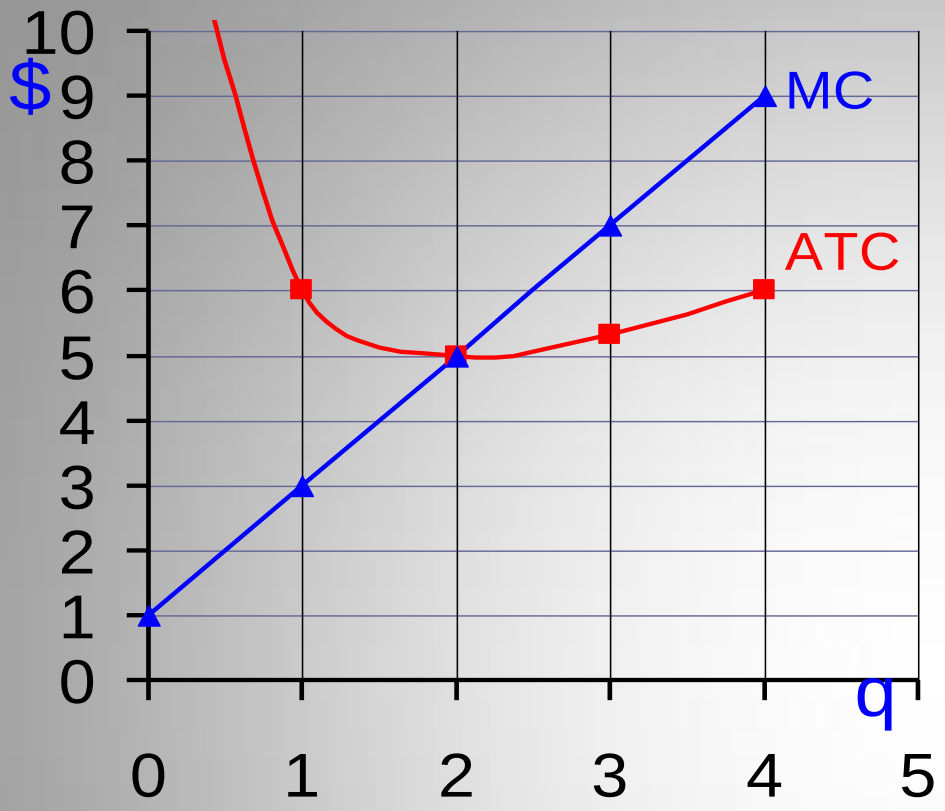
Variable	Definition	Formula	Result
P^{LR}	long-run price	= min ATC	
Q^{LR}	long-run quantity	= q*	
q^{LR}	output per firm	= Q*	
N^{LR}	number of firms	= Q* / q*	

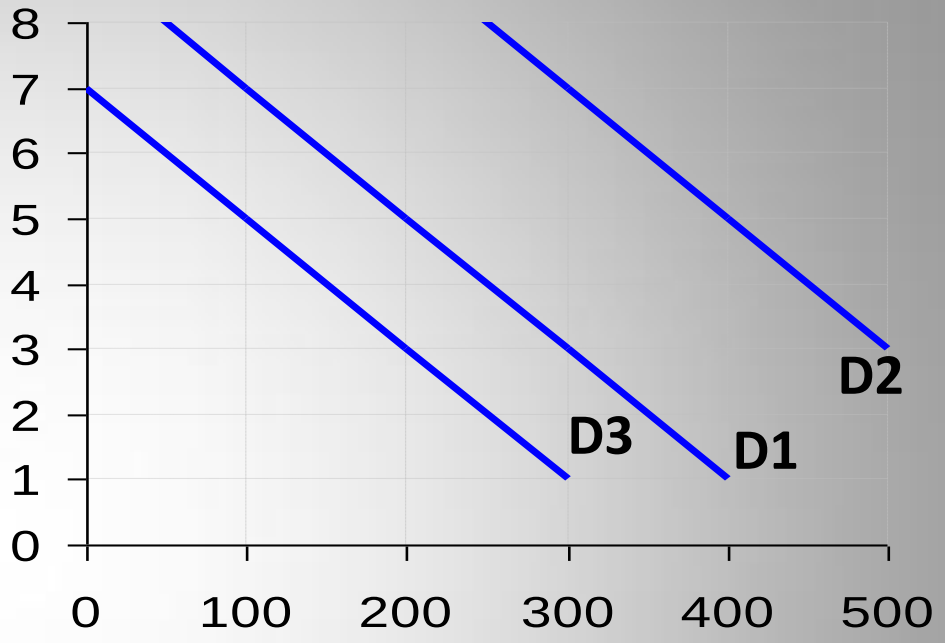


Small "q" denotes a single firm's production, big Q is quantity of the industry. How did we find q*?

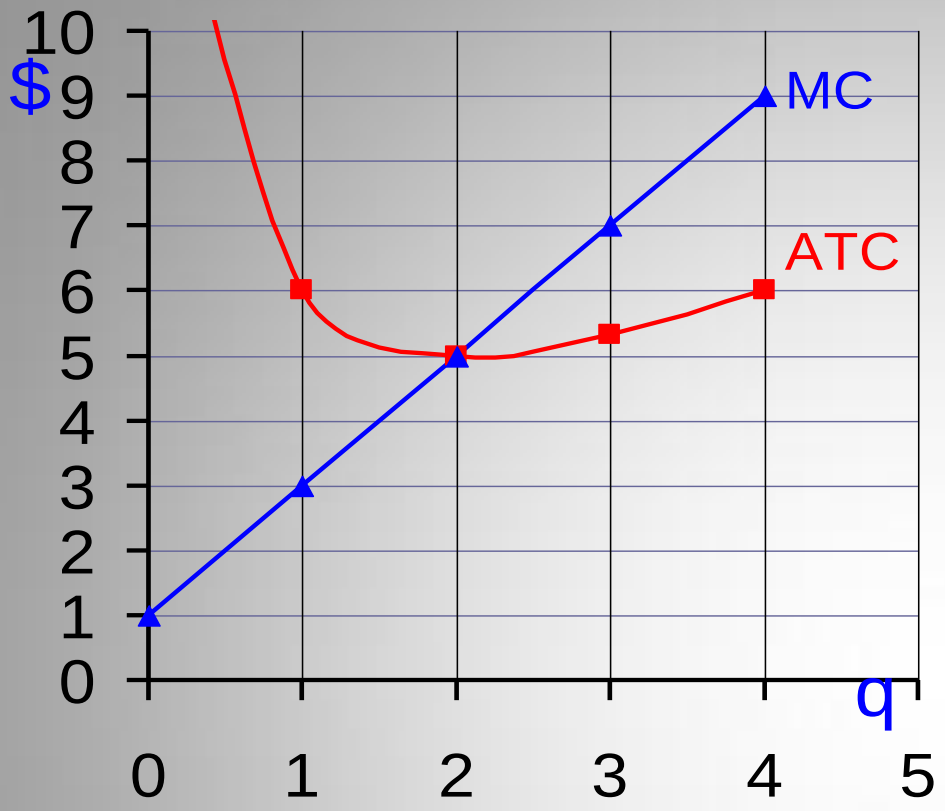


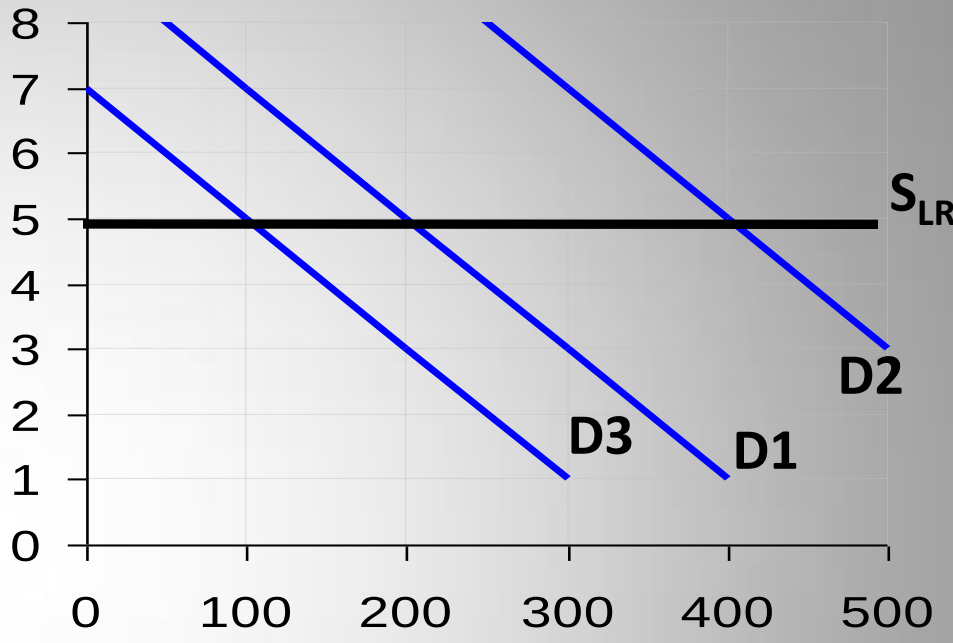
Variable	Definition	Formula	Result
P^{LR}	long-run price	= min ATC	$5
Q^{LR}	long-run quantity	= q*	200
q^{LR}	output per firm	= Q*	2
N^{LR}	number of firms	= Q* / q*	100





	Demand		
	D1	D2	D3
P^{LR}			
Q^{LR}			
q^{LR}			
N^{LR}			





	Demand		
	D1	D2	D3
P^{LR}	5	5	5
Q^{LR}	200	400	100
q^{LR}	2	2	2
N^{LR}	100	200	50

	Demand		
	D1	D2	D3
P^{LR}	5	5	5
Q^{LR}	200	400	100
q^{LR}	2	2	2
N^{LR}	100	200	50

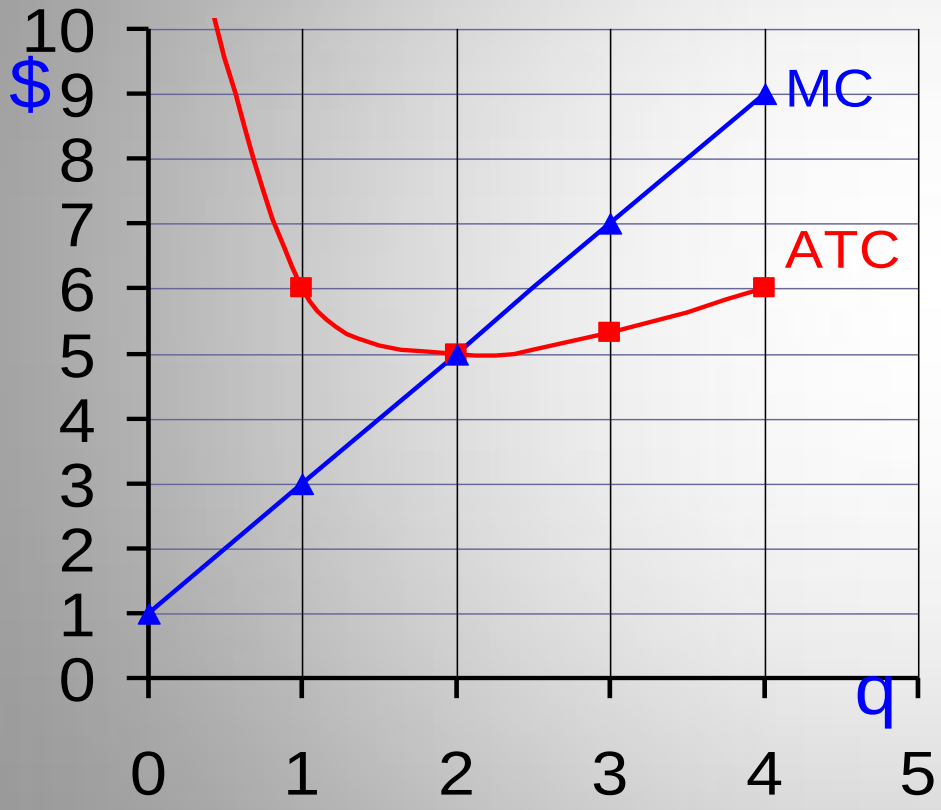
- With different demand curves, we see that it does not affect how much an individual firm will produce. They will still produce q*=2.
- What changes though is the number of firms. In long run equilibrium we have: P* = min ATC.
- If P > min ATC, then companies make positive profits and new firm decide to enter the market.

  They keep doing so, until we hit P = min ATC.

Short Run Industry Supply

- First Welfare Theorem at work here
- In a long-run competitive equilibrium, Q^{LR} is produced in the minimum-cost way (Efficient Production).
- In the short run, **number of firms is fixed.**
- Suppose we start in the long-run equilibrium where demand is represented by D1 (so that N*=100)
- What is the Short-Run Supply Curve?

Let's take a look at the costs again



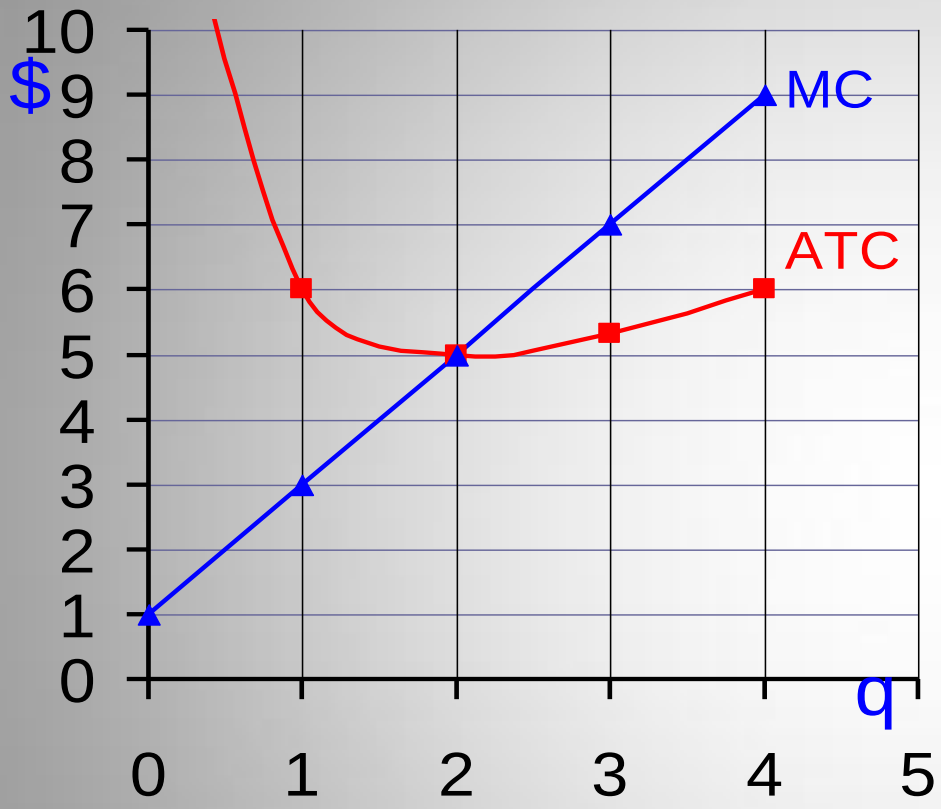
Price	Firm's SR supply	Industry SR supply (N = 100)	ATC
3			
4			
5			
7			
9			

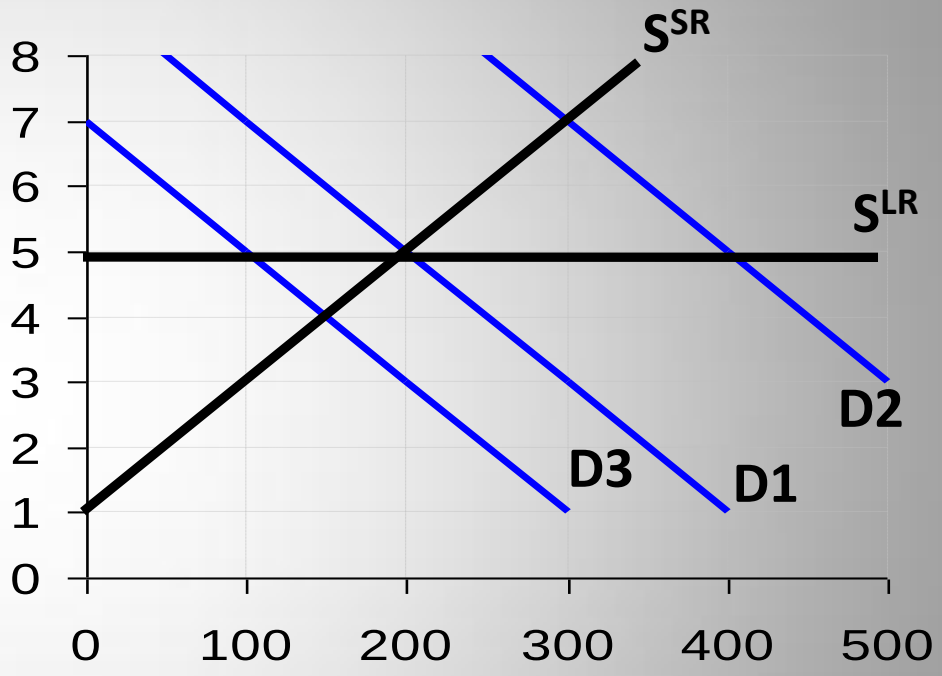
Price	Firm's SR supply	Industry SR supply (N = 100)	ATC
3	1	100	6
4	1.5	150	5.17
5	2	200	5
7	3	300	5.33
9	4	400	6

We can now use this information to obtain the industry's supply curve.

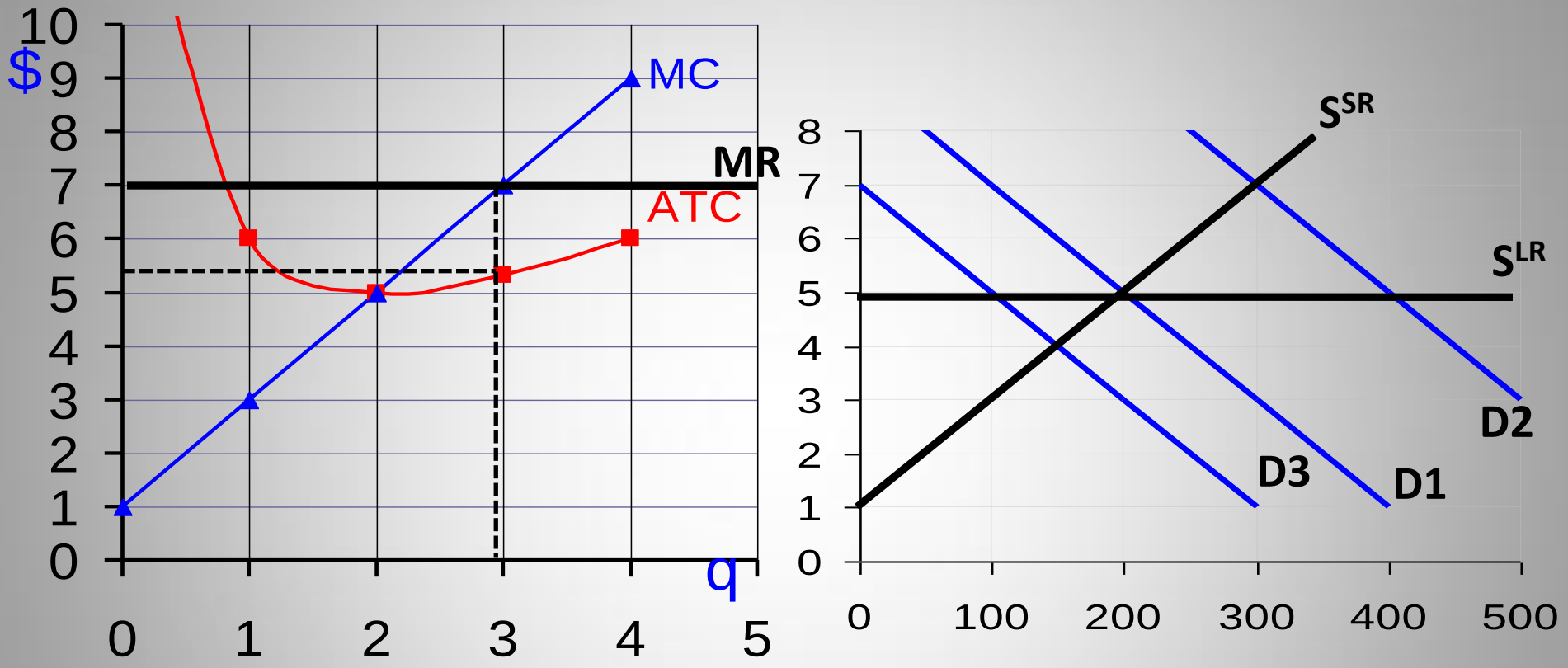
Note: The values of ATC are listed here for future reference. You do not have to memorize them. On the final exam, you will be given either a table like this or you will be able to find that information on the graph.

Short-Run Industry Supply (1)





Short-Run Industry Supply (2)



Suppose we start at D1 in a long-run equilibrium.

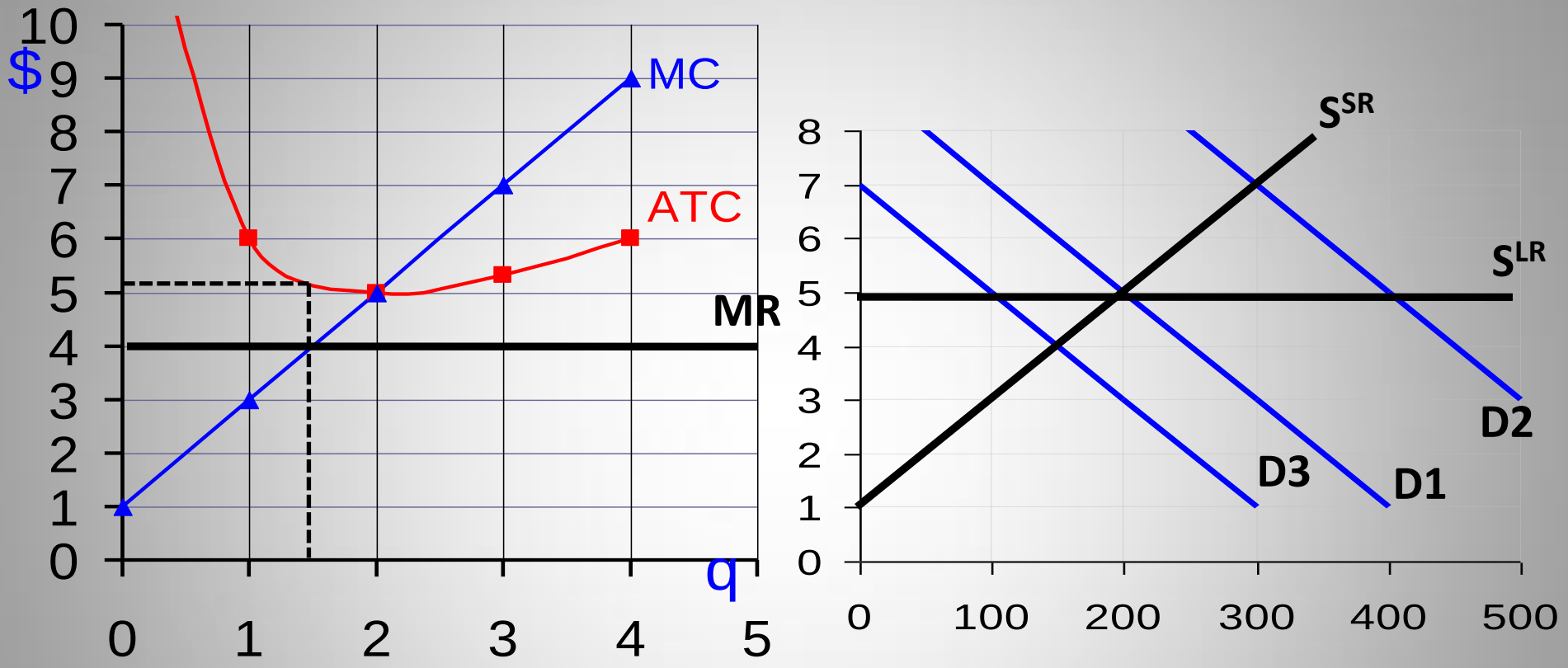
Suppose there is a shift to D2. In short run we have:

P -> 7; q -> 3; Q -> 300;

firm's profit = [P – ATC]*q = [7 - 5.33]*3 = 5

=> New companies are attracted to enter the market

Short-Run Industry Supply (3)



Suppose we start at D1 in a long-run equilibrium.

Suppose there is a shift to D3. In short run we have:

P -> 4; q -> 1.5; Q -> 150;

firm's profit = [P – ATC]*q = [4 - 5.17]*1.5 = -1.75

=> Some of the existing companies will decide to exit.

Summing up

- With positive profits in the short run, firms from outside are encouraged to enter the market. As more of them enter, the price gets knocked down, eventually reaching the long-run level of P*=5. Profits are equal to zero then, and the industry has converged to a new long-run equilibrium (with Q*=400).

- Similarly, with negative profits (losses), current firms decide to exit, as a result of which the price gradually increases and profits are eventually equal to zero. The industry is at another long-run equilibrium (with Q*=100).

Magnitude of effects

- Notice the following: if we start in a long-run equilibrium and the demand shifts up (or down), then:
  - The impact on _____ is bigger in the long run than in the short run
  - The impact on _____ is smaller in the long run than in the short run

Magnitude of effects

- Notice the following: if we start in a long-run equilibrium and the demand shifts up (or down), then:
  - The impact on **quantity** is bigger in the long run than in the short run
  - The impact on **price** is smaller in the long run than in the short run
  - In what way is this like the discussion of long-run and short-run demand elasticity in the first part of the course?

Conclusions

- Long-run industry supply is perfectly elastic at $P^* = \min ATC$
- In the short run, the number of firms is fixed, but in the long run, firms can enter and exit the market freely.
- Firms will enter as long as there is some positive economic profit. This causes the price of the good to fall and eventually every single firm is breaking even
- Similarly, but in reversed way (exits) with economic losses.

Perfect Competition again

- Again, we make the assumptions of the perfect competition model:
  - same technology available to all producers
  - no barriers to entry
  - sellers take the market price as given
  - input prices do not go up as the industry expands
- What other examples of such a market structure can we think of?

Garden statue business

- Technology for making garden gnomes available to everyone
- No restrictions to entry
- Such a small part of the market for all inputs (e.g. cement, paint, unskilled labor) that demand for garden gnomes might increase by the factor of 10 and it won't make any difference
- Are gnomes homogeneous though?

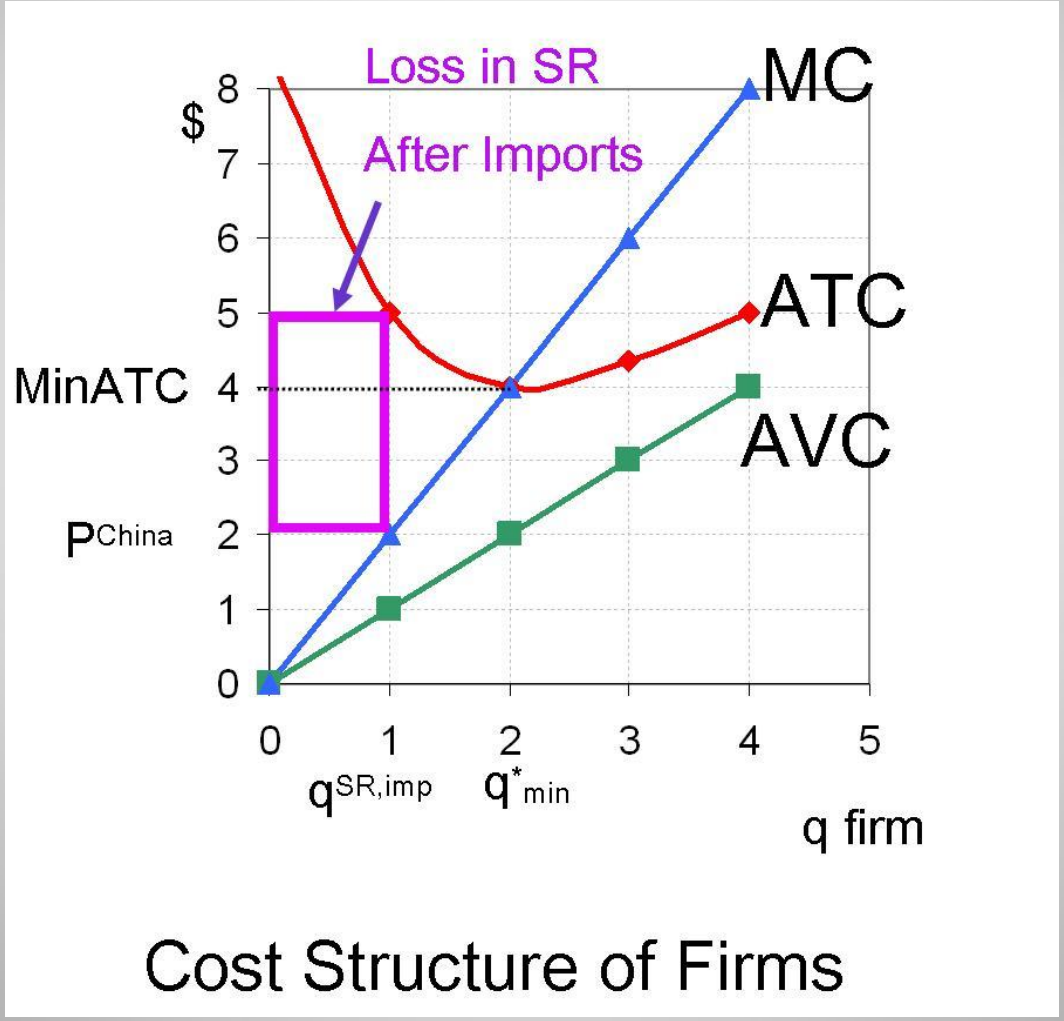
- How about week-long ocean cruises?
  - In the short run, # of vessels (and captains) is fixed, in the short run as demand goes up, price of the cruise increases
  - In the long run, we get more entry (and captains)
- Should also work for goods like:
  - chicken meat
  - granite countertops
- Gasoline market for a small country like Norway
- Does the theory work as well for the gasoline market in the United States?

- Remember that if the US doubles its consumption of gasoline, the price of oil will be driven up as well (as an input of gasoline, since the US has such a huge share of the world demand). This causes the ATC curve to shift up.
- How about the market for playing 18 holes of golf in…
  - Manhattan?
  - Anywhere in North Dakota?

Application – impact of imports

- Initial situation: no imports from China (not yet developed or because of import restrictions)
- New situations: imports come in from China at the price $P^{china} = 2$
- We make a distinction between the short and long run

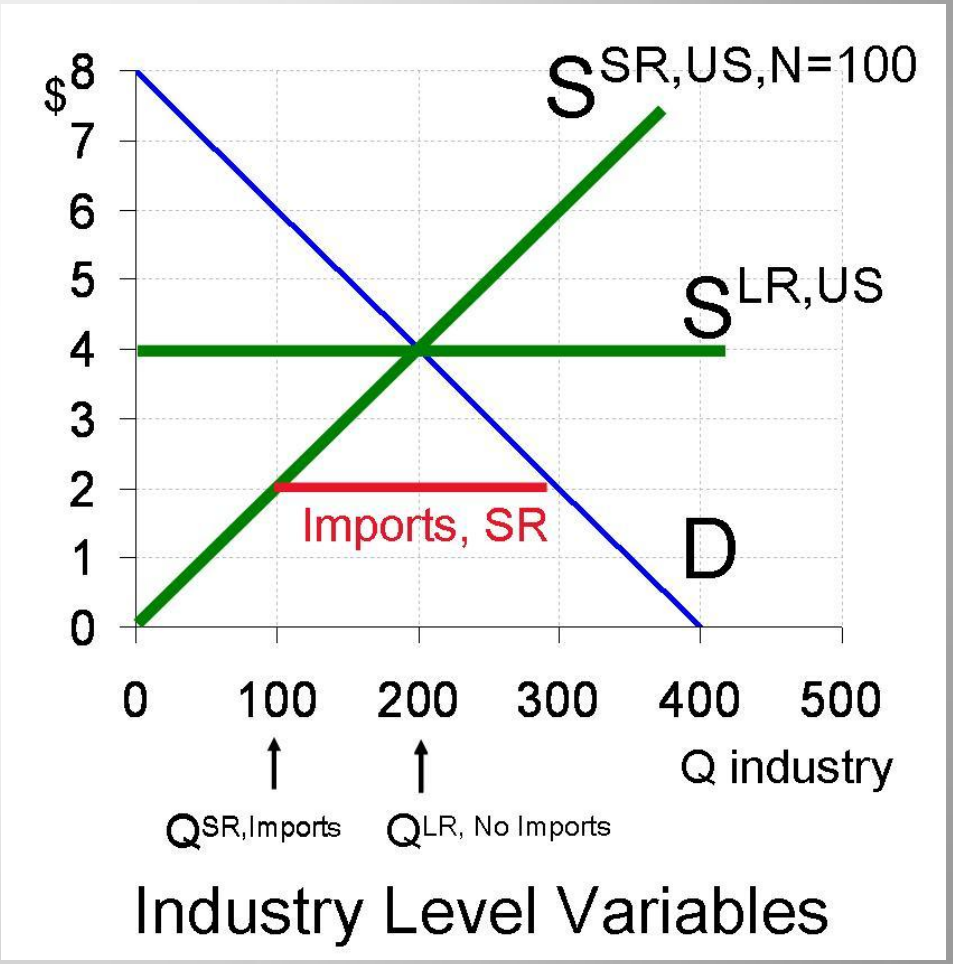
Impact of imports in the short and long run



Cost Structure of Firms

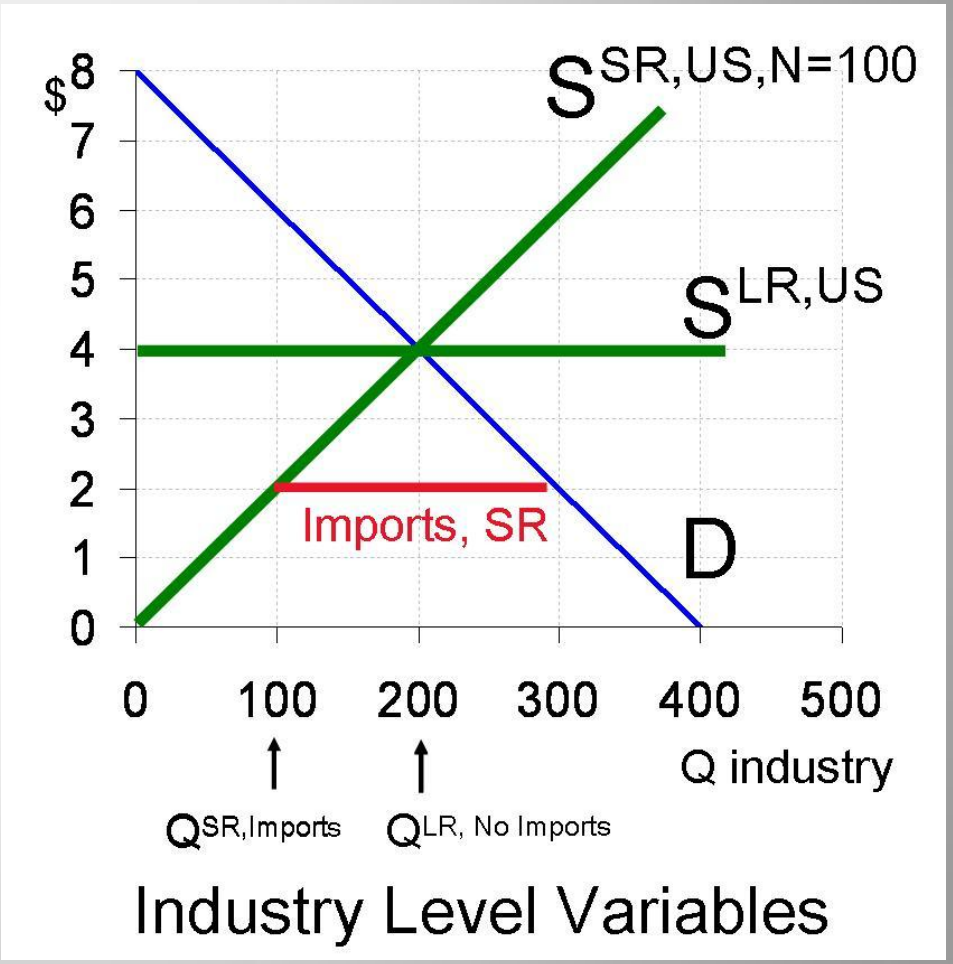
Quantity supplied in the SR by US producers after there are imports

- Initial LR equilibrium
  P =4; Q =200; q =2; N =100
- Short Run impact:
  Q^{SR} = _____
  p^{SR} = _____
  Im^{SR} = _____
- Long Run Impact:
  Q^{LR} = _____
  p^{LR} = _____
  Im^{LR} = _____



Quantity supplied in the SR by US producers after there are imports

- Initial LR equilibrium
  P =4; Q =200; q =2; N =100
- Short Run impact:
  Q^{SR} = 100
  p^{SR} = 2
  Im^{SR} = 200
- Long Run Impact:
  Q^{LR} = 0
  p^{LR} = 2
  Im^{LR} = 300



So we see that the domestic production is completely shut down!

How about the real world?

- Well, it's not that extreme obviously
- Let's take a look at a list of industries hit by the Chinese imports
  - You can also find it in the reading by Thomas Holmes posted on the website
  - „Consumer Goods Manufacturing: The Rise of China and Plant Exit in the United States"

	Import Share of Shipments		China Share of Imports		Percent Change in U.S Employment
	(percent)		(percent)		
Industry	1997	2007	1997	2007	1997-2007
Curtain & drapery mills	8	56	38	65	-47
Other household textile prod mill	22	68	25	49	-51
Women's & girls' cut & sew dress	29	67	21	55	-71
Women's & girls' cut & sew suit,	48	92	19	49	-91
Infants' cut & sew apparel mfg	60	99	8	62	-97
Hat, cap, & millinery mfg	44	80	26	67	-74
Glove & mitten mfg	58	88	50	63	-78
Men's & boys' neckwear mfg	25	56	2	59	-67
Other apparel accessories	39	80	35	64	-75
Blankbook, looseleaf binder,	18	47	43	52	-51
Power-driven handtool mfg	28	56	18	46	-56
Electronic computer mfg	12	49	0	56	-68
Electric housewares & fan mfg	52	78	48	76	-54
Wood household furniture mfg	29	62	18	46	-51
Metal household furniture mfg	29	55	37	85	-48
Silverware & plated ware mfg	44	91	31	73	-82
Costume jewelry & novelty mfg	31	68	31	67	-63
Mean of China Surge Industries (N=17)	**34**	**70**	**26**	**61**	**-66**

- Within industries, the segments that have survived tend to be different from the part that has left!
- Example of wood furniture industry
  - In 1997 and earlier, dominated by places like Highpoint, NC
  - Large plants making standardized products for mass market
  - These places mostly concentrated in the South
  - Custom, hand-crafted segment scattered around the country in small plants
    - Need to be close to supply of craftsmen (e.g. Amish)
    - Good to be close to consumers of custom work

- Example of the clothing industry
  - Also dominated by places in the South
  - New York City retained a fashion element in small, craft-oriented plants

- What has happened?
  - China is knocking out the large plants in North Carolina making standardized goods for the mass market (China: the new North Carolina)
  - Small plants doing custom work have increased share (and places like New York)

- China's comparative advantage is weakest in:
  1. Custom element (helps to be close geographically for this, quicker turnaround, better communication)
  2. Cases with high and niche products, with premium on fashion and creativity
- But even for these segments, the future does not look so great for American manufacturers
  - The segment is small
  - Communication getting better so it's possible to do craftswork from a distance
  - China is moving up the quality ladder

- Let’s take a closer look at the remaining domestic producers
- Toys:
  - 1600 employees left in „Doll and Stuffed Toy Manufacturing” in 97 establishments
  - Most companies are quite small (< 20 employees)
  - One plant with over 500 employees in Burlington, Vermont. What does this „factory” do?

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But if we dig a little deeper….

And what about all these little guys producing toys in the US?

- Most employees work in small shops offering hand-crafted toys
- An interesting article in NY Times is cited in Reading 6
- New safety laws requiring inspections (imposed because of lead paint used in some imported toys from China) are particularly burdensom on these small craft shops
- They are simply too small to enjoy the economies of scale in running testing procedures

How it looks like in the US…

… and in China

Luckily, there is still some serious manufacturing in the US…

New Boeing 787 production line in Washington State

Conclusions

- The perfect competition model predicts the brutal truth about this market segment
  - All firms are forced to produce close to their minimum-cost point, incurring (almost) no profit
  - Those firms that cannot keep up, or have a naturally higher-lying average cost curve get wiped out of the market
- The data generally confirms this observation, although not to such an extreme extent
  - Remember that in the real world hardly any market is exactly as the assumptions of the model describe it
- This trend is not observed in the industries whose characteristics are far from being perfectly competitive
  - Custom-oriented products
  - Knowledge- and skill-based industries
  - Capacity for diversifying a product (e.g. through customer service)

Midterm 2 tips

Look over the review notes I posted. If you don't understand something, or if I refer to something in the lecture slides in those notes, you should go back and look through it in the lecture slides!

Make sure you do the sample test.

Make sure you know how to do the three worksheets.

Make sure you've read the three readings on Moodle (Readings 4, 5, and 6)

Make sure you ask if you have any questions.