LECTURE 11
PERFECT COMPETITION IN THE LONG RUN

Where are we?

- Firm's supply curve in the short run
  - Profit-maximizing *Q* in the short run as a function of market price
- Short-run market supply curve
- Short-run equilibrium
- Firm's supply curve in the long run
  - Profit-maximizing *Q* in the long run as a function of market price
- Long-run equilibrium
- Long-run market supply curve completely diff from short-run market supply curve

Part 1

Long-Run Equilibrium

Long-Run Decisions

capital no longer fixed

Diff between SR & LR: In the SR, firm has fixed capital, it's stuck in the industry, cannot exit the industry. Similarly, potential entrants cannot enter the market (coz fixed capital, stuck in other industries).
Production decision is the only decision they make in SR.

- Production same as in SR
  - If the firm stays in the industry or if the potential entrant enters the industry, what is the optimal output level?
- Entry
  - Potential entrants decide whether to enter the market by starting new firms
- Exit
  - Existing firms decide whether to completely withdraw capacity

Profit-Maximizing Condition: Marginal Revenue Equals Long-Run Marginal Cost

still choose to produce to max profit

- Long-run profit maximizing output choice is
  - *MR=P=LMC*

MR = P coz in perfectly competitive market, firms are price takers.

- If *P>LMC*
  - Producing too little

total profit will increase if u produce more

  - Adjust both *K* and *L* to increase *Q*
- If *P<LMC*
  - Producing too much

should reduce Q to earn higher profit

  - Adjust both *K* and *L* to decrease *Q*

The quantity decision, as long as the firm produces, is the same as in SR. Only diff is now use LMC instead of SMC.

Individual Firm: Incentive for Entry

- If market price is such that
  - If enters, the firm can make positive profit
    - There is incentive for entry
- When are firms making positive profit?
  - When *TR>LTC*
  - Or equivalently when *P>LAC*
  - But can we say more?

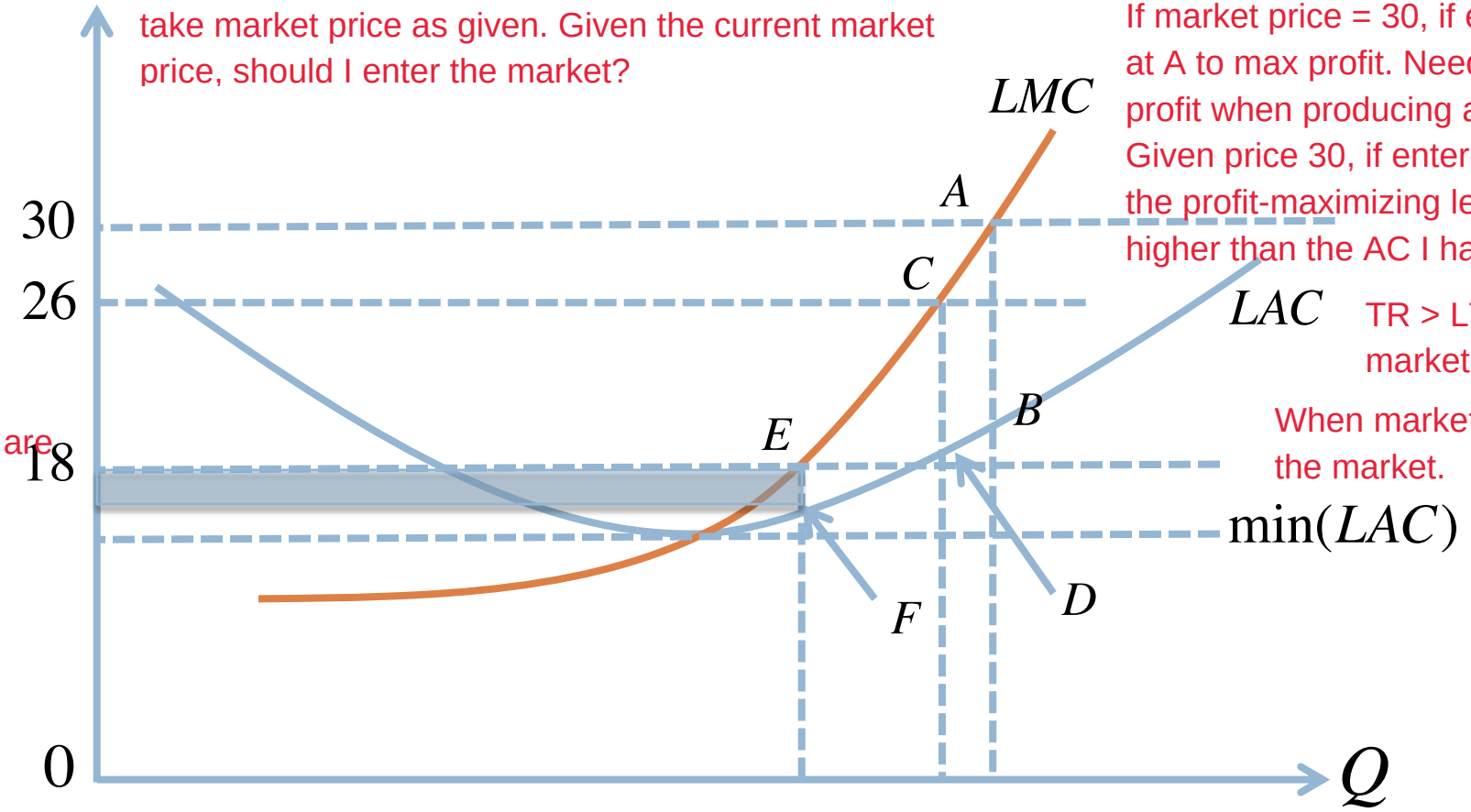
divide by Q

as long as this is true, u will make +ve profit if u produce.

Incentive for Entry: *P*>min(*LAC*)

a potential entrant, not a firm yet, but i know if i enter the market (start a new firm), this gonna be the LR cost curves I face.

take market price as given. Given the current market price, should I enter the market?



If market price = 30, if enter the market, will produce at A to max profit. Need to look at whether u make profit when producing at this Q? Compare A with B. Given price 30, if enter the market and produce at the profit-maximizing level, the price I receive is higher than the AC I have to pay for each unit.

TR > LTC, +ve profit if enter the market.

When market price = 26, 18, should enter the market.

shaded area: +ve profit u are making when price = 18 and u enter the market.

As long as P > min (LAC), when producing at the profit-maximizing quantity, P > LAC, so TR > LTC, +ve profit, so enter.

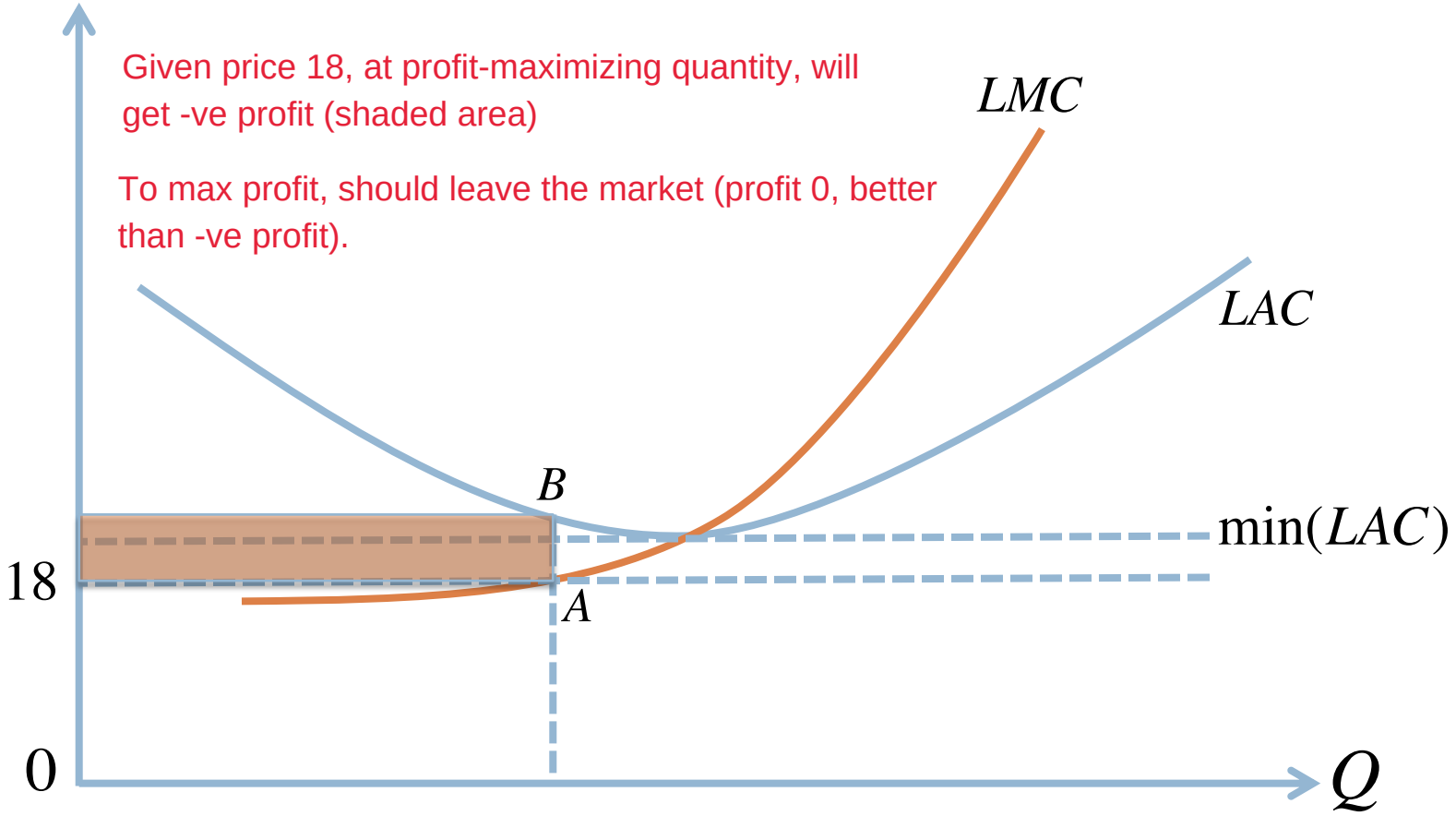
Individual Firm: Incentive for Exit

- If market price is such that
  - Existing firms are making negative profit
  - There is incentive for exit
- When are existing firms making negative profit?

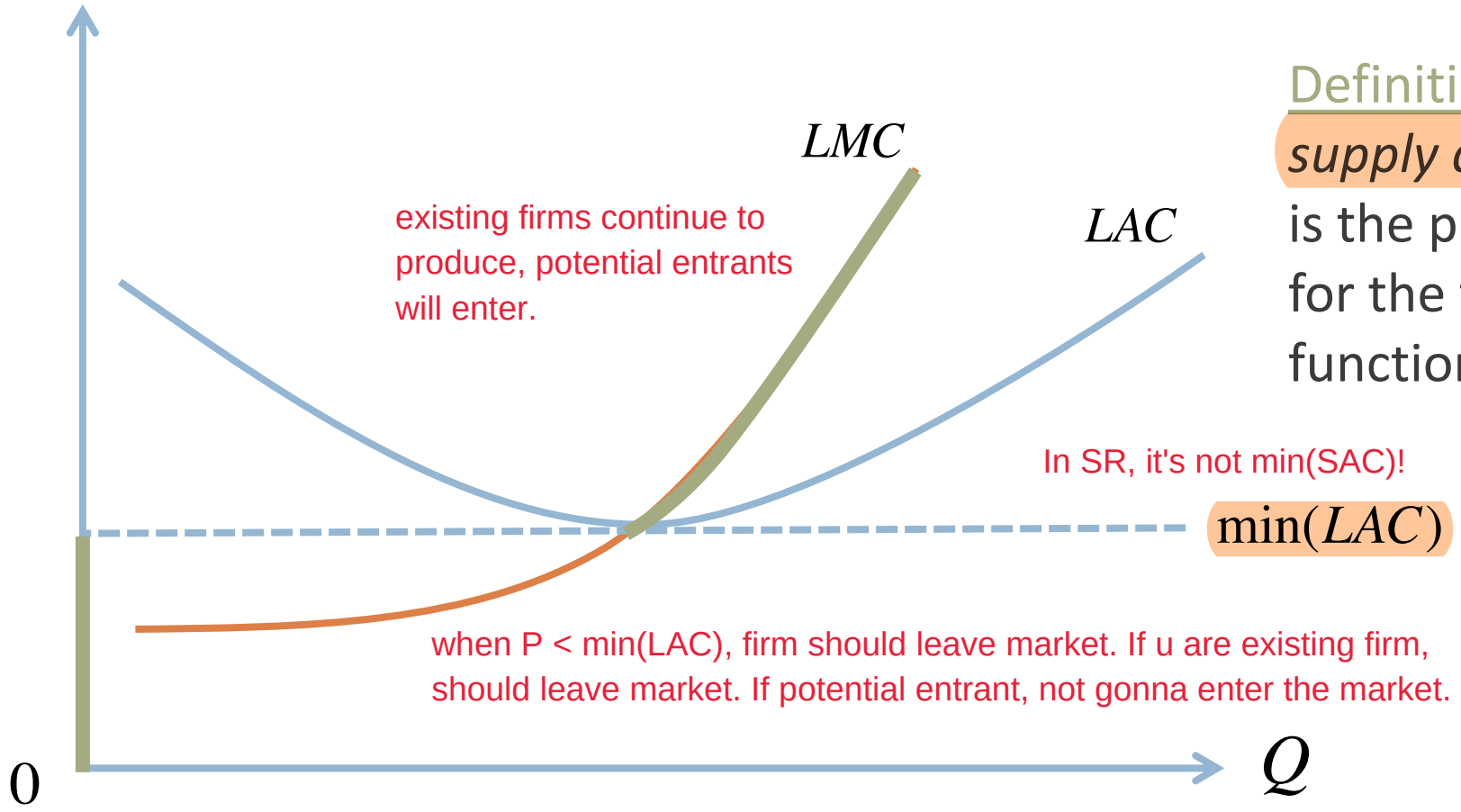
if leave market, will get 0 profit. So only leave market when making -ve profit by staying in the market

Incentive for Exit: $P<\min(LAC)$

When P < min(LAC), price lies completely below LAC curve. At any quantity, LAC > P, leave market.



Individual Firm's Long-Run Supply Curve



Definition 11.1 The *long-run supply curve for an individual firm* is the profit-maximizing quantity for the firm in the long run as a function of the market price

What if P = min(LAC)?
Firm is indiff between staying in the market and producing, and leaving the market.
If leave, 0 profit.
If stay, will produce at min(LAC) point, 0 profit.

Convention: assume firm will stay in market and produce when P = min(LAC).

Market: Entry, Supply Curve, and Price

no. of firms changing in the LR.

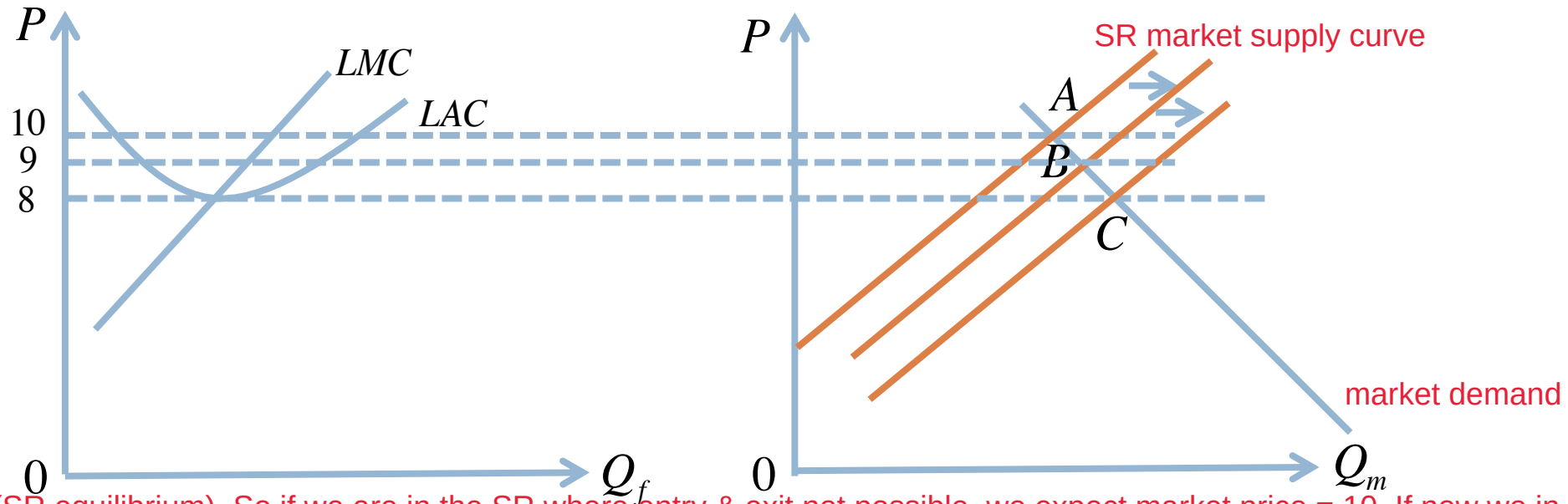
- Assume all firms are identical identical cost curves.
- What happens when new firms start to enter the market?
- More firms in the market SR market supply curve is the summation of individual firm's supply curve in SR.
- Short-run market supply curve will shift to the right coz adding up more firms.
- Market price will drop (new equilibrium price)

If market price decreases, will affect each individual firm's decision about entry or exit.

Entry stops when *P*=min(*LAC*)

Typical Firm's Cost and Supply

Market Supply and Demand



Initially market price=10 (SR equilibrium). So if we are in the SR where entry & exit not possible, we expect market price = 10. If now we in the LR, entry & exit possible, do u expect market price stay at 10 in LR? No. Coz 10 > min(LAC), all existing firms in the market earning +ve profit. So as a potential firm, look at price 10, will enter the market to make +ve profit. So if market price = 10, gonna have more firms in the market. It takes time for firm to start a new firm, after 1 month, some new firms in market. --> SR market supply curve shifts right. --> new market equilibrium B, equi price = 9. Expect price to stay at 9? No (9>min(LAC)). Incentive for entry, SR market supply curve shifts right until equilibrium is C. Equilibrium price = 8 = min(LAC). No incentive to enter.

Market: Exit, Supply Curve, and Price

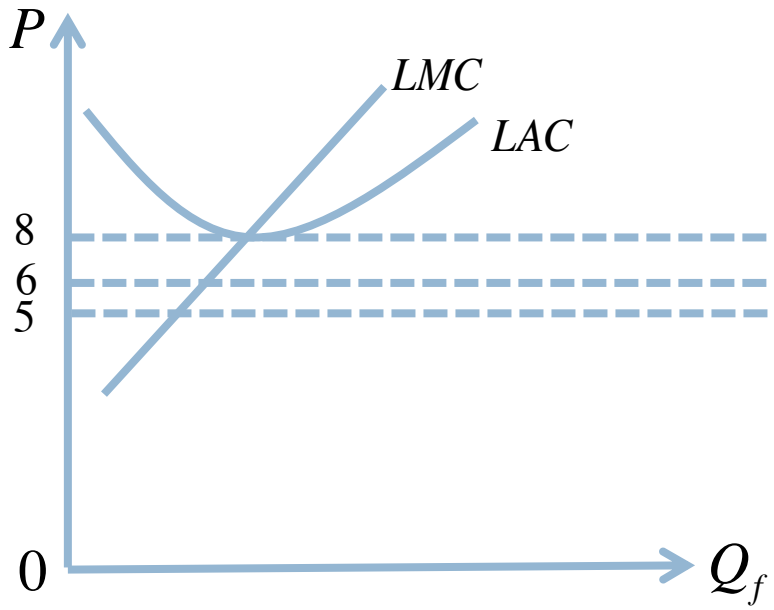
- What happens when existing firms start to exit the market?
- Fewer firms in the market
- Short-run market supply curve will shift to the left
- Market price will rise

market price rises --> affect firm's incentive to leave the market

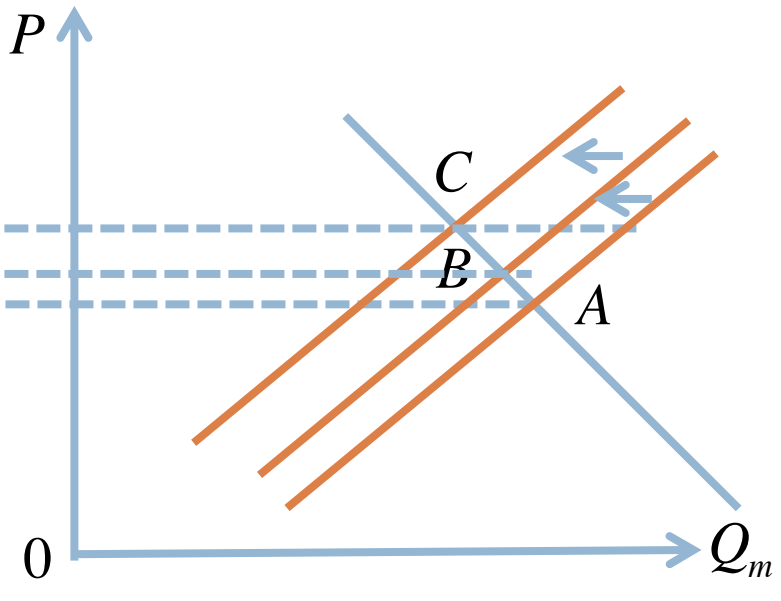
Exit stops when *P*=min(*LAC*)

We can see that in the LR, the entry & exiting process will affect market price.

Typical Firm's Cost and Supply



Market Supply and Demand



Initially SR equilibrium price = 5, at this price, demand = supply. If in SR, we expect price to stay at 5. (stable state, no excess demand/supply)

In LR, existing firms making -ve profit, incentive to leave market. (not possible in SR, but possible in LR)

More firms gonna leave the market until market supply curve move to the left so that the equilibrium point is C, equilibrium price = min(LAC).

Long Run Market Equilibrium

for competitive market

- Definition 11.2 At the *long-run market equilibrium* in a competitive market
  - No existing firm has an incentive to exit the market
  - No potential entrant has an incentive to enter the market
  - Total quantity demanded equals total quantity supplied
  - Each firm produces at the profit-maximizing output level given the equilibrium price
  - Each consumer buys the utility-maximizing quantity given the equilibrium price

there is entry & exit in the long run, but in LR equilibrium, there is no entry & no exit.

markets clear

the last 3 conditions same as short-run equilibrium

Implication of Long-Run Equilibrium

NOTE: this is not the definition of LR equilibrium!!
The definition of LR equilibrium never says that firm will earn 0 profit and P = min(LAC).

- No incentive to enter
  - $P <= \min(LAC)$
- No incentive to exit
  - $P >= \min(LAC)$

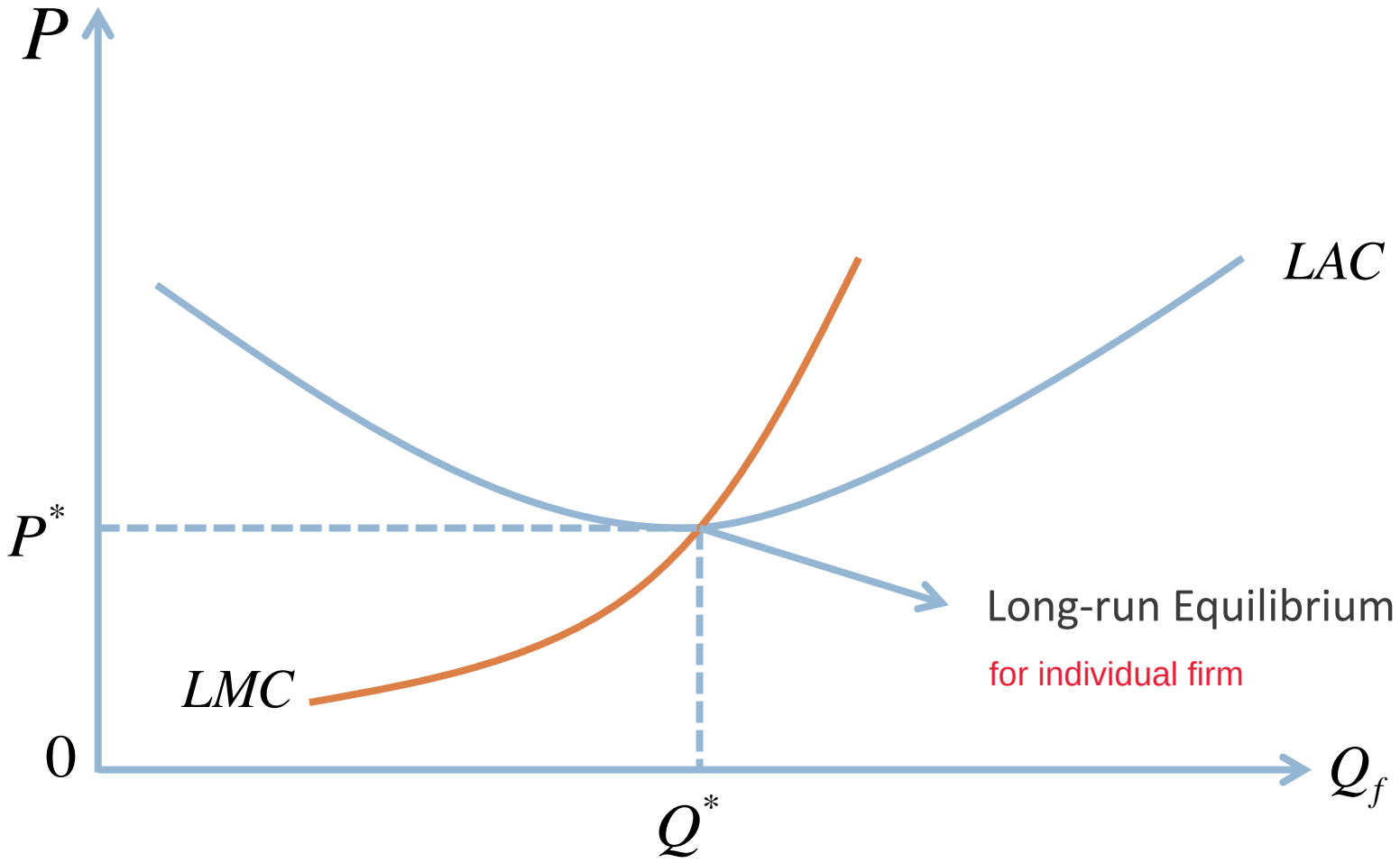
these 2 have to hold at the same time

- Long-run equilibrium price
  - $P^* = \min(LAC)$
- Long-run equilibrium output for each firm
  - $P^* = LMC(Q^*) = \min(LAC) = LAC(Q^*)$
- Long-run equilibrium profit for each firm
  - $[P^* - LAC(Q^*)]Q^* = 0$!

This implication might change if we change the assumptions of the model, but the definition will never change.

the firm is gonna produce at a quantity where LMC curve cuts the min point of LAC curve. At that point, LMC = LAC.
--> in LR equilibrium, firm is gonna produce at a quantity where price = LAC.

Long-run Equilibrium in Graph



Number of Firms in Equilibrium

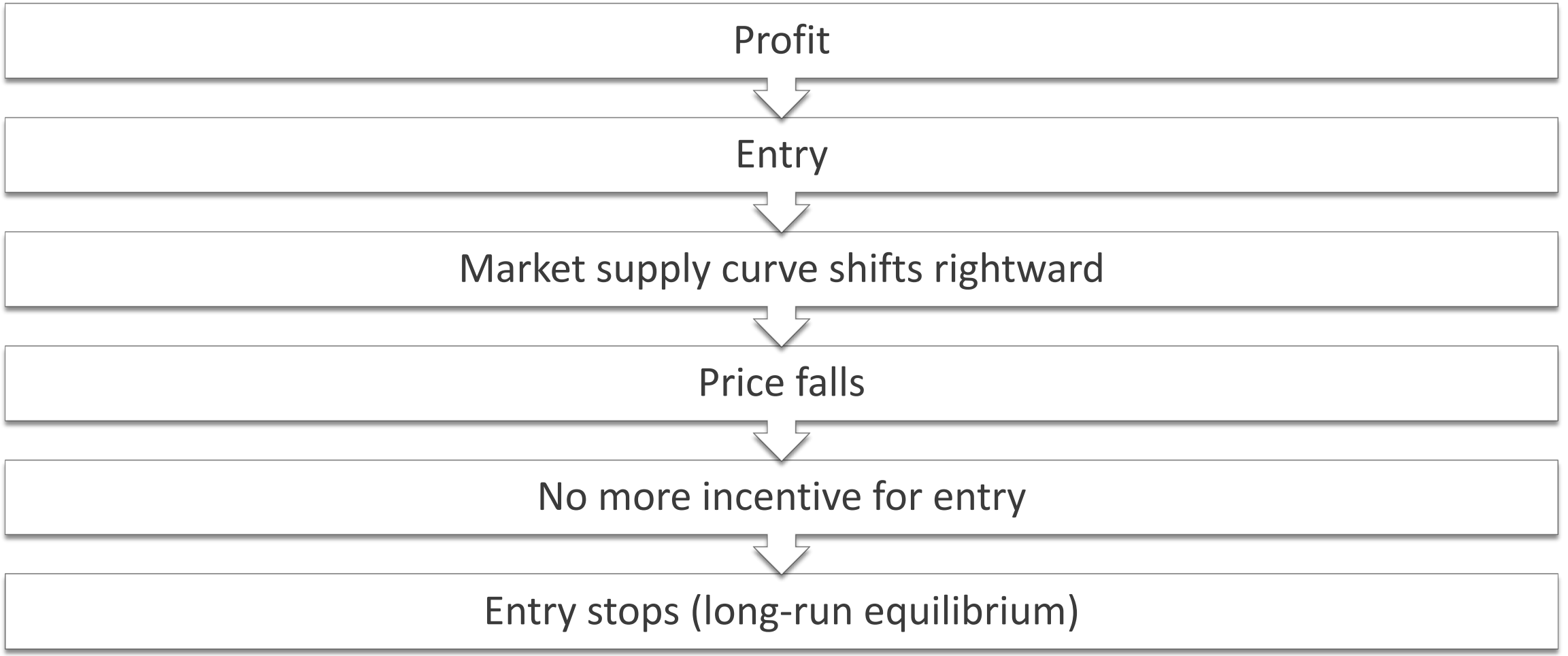
- Number of firms is not fixed in the long run
  - Entry and exit are possible

In LR equilibrium, no entry & exit, so we gonna have a stable set of firms in equilibrium.

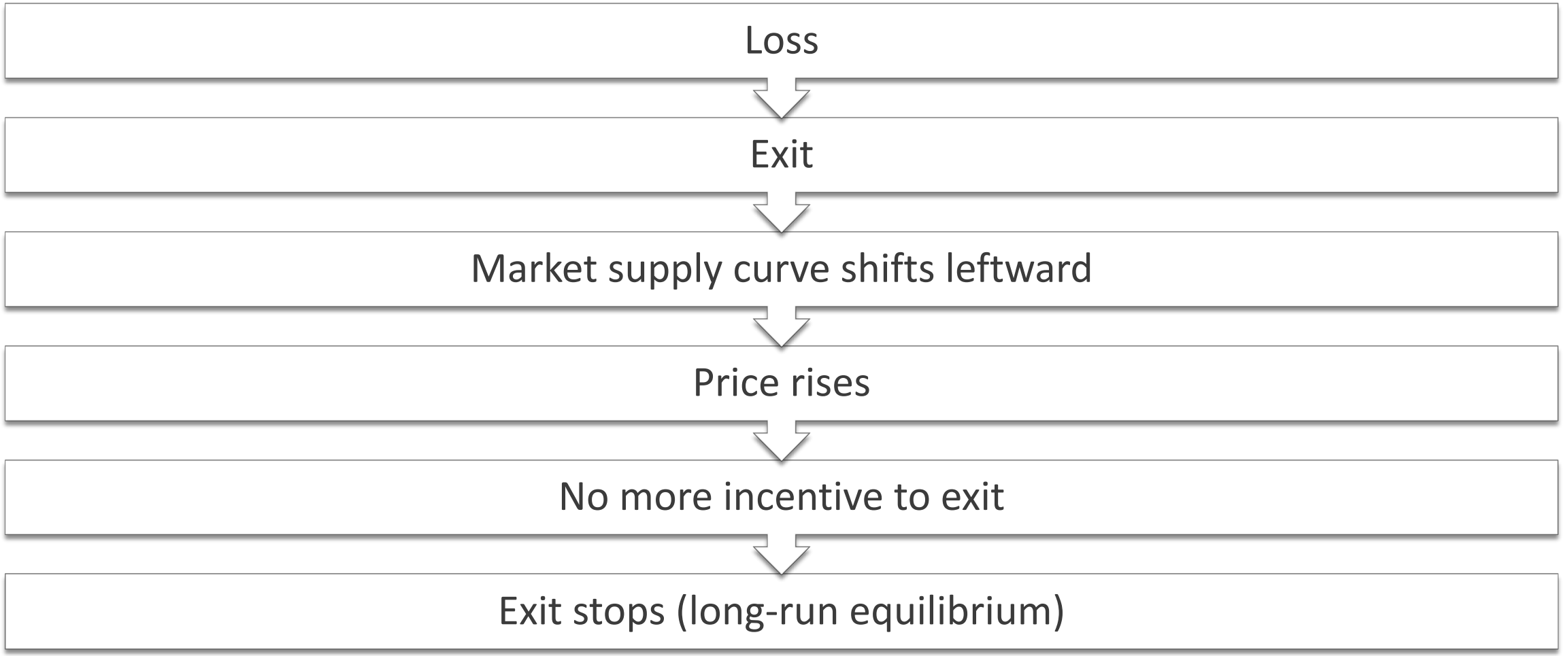
- Number of firms in the long-run equilibrium can be determined
  - Suppose the long-run equilibrium price is 10
  - Given this price, each firm produces 5 units
  - Given this price, the total quantity demanded in the market is 80
  - There are 80/5=16 firms in the long-run equilibrium

same as total quantity supplied

Long-Run Dynamic: Entry



Long-Run Dynamic: Exit



0 economic cost means firm doesn't earn any money?

Is it true that 0 profit in the LR equilibrium means firms don't earn any money?

Economic Profit: An Example

All costs we talked abt in this mod is economic cost (explicit + implicit cost). --> profit we talk abt is economic profit (TR - total economic cost).

- Suppose you own and run a small software development firm
- In 2019 your total revenue=$400,000
- Your incurred a cost of $250,000 for is this economic cost?
  - wages paid to workers, supplies, rents, utilities, and etc.
- The amount of money you made is
  - $400,000-$250,00=$150,000 is this economic profit?

Economic Profit: An Example Cont'

- Your best alternative is to work for Google for $150,000 per year
- Your total economic cost is
  - $250,000+$150,000=$400,000
- Your economic profit is
  - $400,000-$400,000=$0
- By operating your own firm, you are making the same amount of money as you could have made had you worked for Google

implicit cost

--> even thought u are getting 0 economic profit, doesn't mean u didn't earn any money.

0 economic profit meaning: u are making the same amt of money as u would have u chosen your best alternative.

--> so it doesn't mean u are not making any money, it just means that u are not making more money than u could if u choose your best alternative.

How to interpret economic profit?

Implication of economic profit: tell u how much more/ less money u are making compared to your best alternative.

- Zero economic profit

  get the same return as u could get if u choose your best alternative.

  - All resources (entrepreneur's time, assets, capital) are getting a return equivalent to the best returns they could get elsewhere
- Positive economic profit
  - The business is delivering returns above and beyond the returns from the best alternative
- Negative economic profit

  could make more money if u choose your best alternative.

  - The resources could be used somewhere else to generate higher returns

What does long-run equilibrium tell us?

- In long-run equilibrium all firms earn zero profit
- Free entry and exit eventually drives profit down to 0
  - Economic profit will not last in perfectly competitive market
- But market is not always in long-run equilibrium!
  - Positive profit is possible in the short run

treat LR equilibrium as a destination of the market.

also possible to make -ve profit

A long-run equilibrium is a stable state (markets clear, no entry/exit).
If market is in LR equilibrium, we expect the market price to stay the same.
In reality, there are many shocks on demand/supply side, so even if the market is in LR equilibrium, when there is a shock, the market is no longer in LR equilibrium anymore.

Part 2

Long-Run Market Supply Curve

Input Prices in the Long Run

2 markets here: output market (what firm produces, industry output is the total quantity produced of this output in the market) & input market.

LR market supply curve for the 3 types of industry are not the same!

- Definition 11.3 *Constant-cost industry*

  no matter how high/low demand for input is, it doesn't change input price.

  - Changes in industry output does not affect input prices in the long run
- Definition 11.4 *Increasing-cost industry*

  a higher demand for the output will lead to a higher demand for the input. If input is scarce resource, input price will rise.
  As least one of the inputs u are using must be rare.

  - Increase in industry output causes the prices of inputs to rise in the long run
  - Decrease in industry output causes the prices of inputs to drop in the long run
- Definition 11.5 *Decreasing-cost industry*

  - Increase in industry output causes the prices of inputs to drop in the long run
  - Decrease in industry output causes the prices of inputs to rise in the long run

input cannot be rare in this case. Or else it will be an increasing-cost industry.

--> So it's sth abundant.

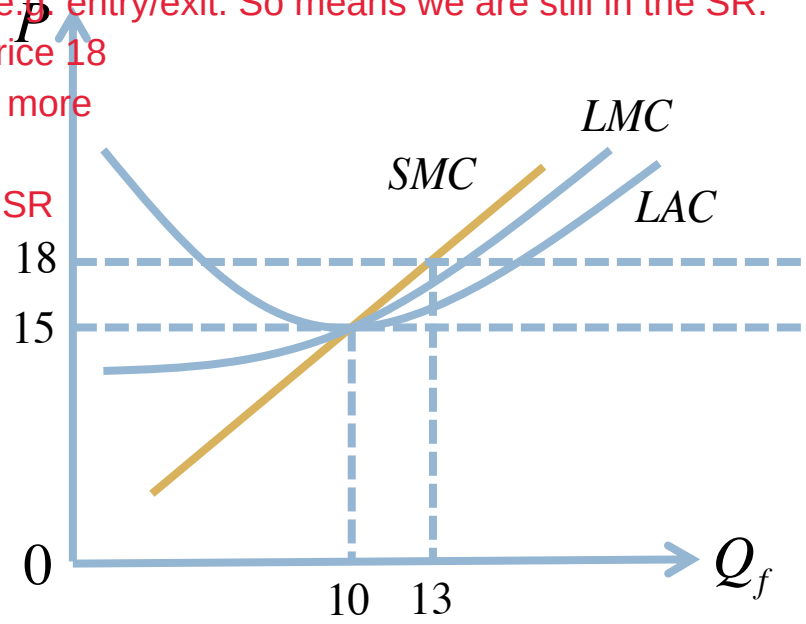
higher demand for output increases demand for inputs. As a producer, need to buy more of this input from suppliers. When u buy higher quantity of the inputs, u can get a discount. The more u buy, u get a lower price for inputs.

Constant-Cost Industry: What happens when demand increases?

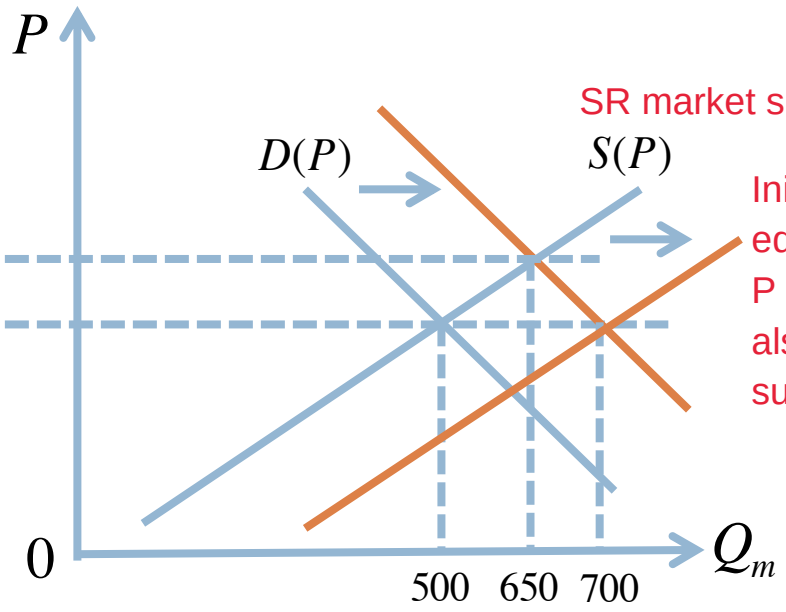
What gonna happen in LR? (6 mths / 1 year after demand increases)
Market price won't stay at 18. Coz 18>min(LAC) for each firm, at 18, every firm is making +ve profit --> entry of new firms in this market in LR. Constant-cost industry: even u have increasing industry output from 500 to 650, input price doesn't change. --> cost of production still the same, so cost curves of the firm won't change. Not affecting min(LAC). Entry gonna stop when market price goes back to 15. Gonna get higher total quantity 700.

What happens shortly after demand increases (a few days)? too soon for any LR adjustment to happen e.g. entry/exit. So means we are still in the SR.
-> higher equilibrium price 18
-> every firm produces more at 13 given price 18. (produces according to SR MC curve)
-> total Q produced in market increases, 650.

Typical Firm's Cost and Supply



Market Equilibrium with 50 identical firms at the initial equilibrium



SR market supply curve

Initially market starts with LR equilibrium. Because at P=15, P = min(LAC) for each firm, also at this point demand = supply, market clears.

Equilibrium price increases in the short run but goes back to the same level in the long run

We start from LR equilibrium (15, 500), move to a new LR equilibrium (15, 700).

Constant-Cost Industry: Price and Quantity Dynamics after Permanent Increase in Demand

	Before demand increase	After demand increase	
	Long-run equilibrium	Short-run equilibrium	Long-run equilibrium
Price	15	18	15
Total quantity	500	650	700
Each firm's output	10	13	10
Number of firms	50	50	70

from 500 to 650, due to every firm producing more

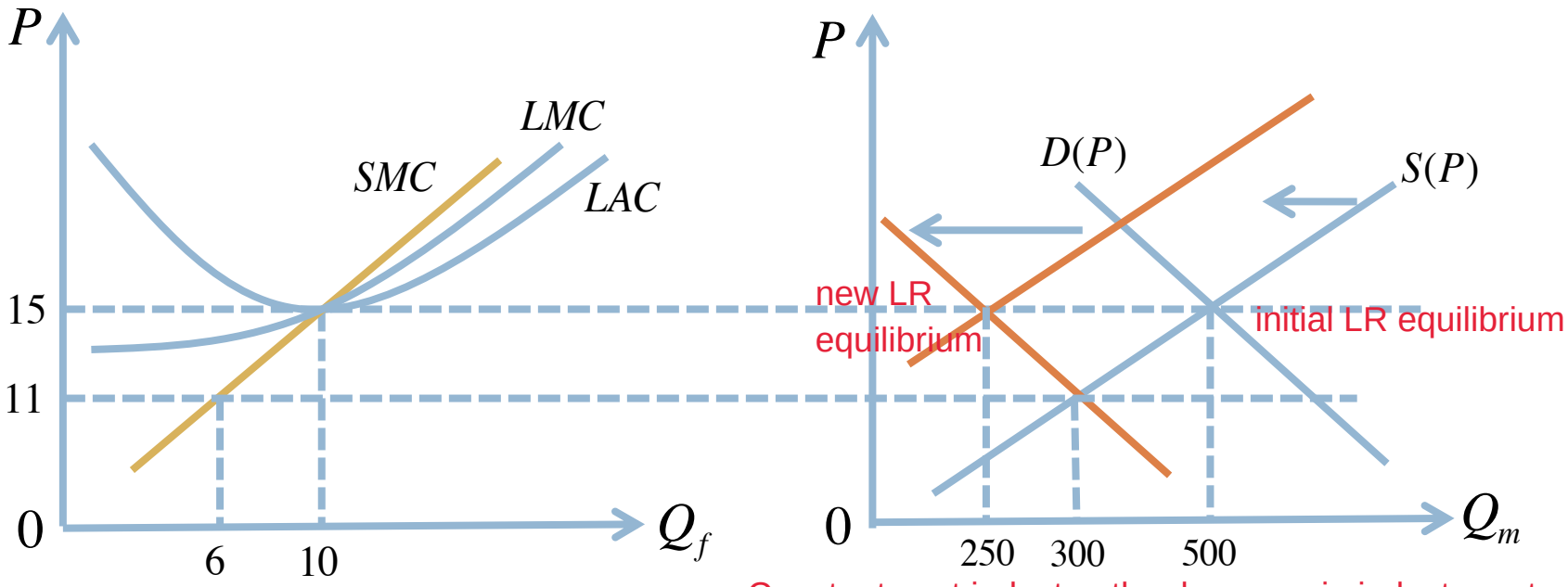
from 650 to 700, due to more firms in market. In fact, every firm is producing less due to lower price.

each firm's output will go up in SR coz price higher, but eventually produce same Q as before.

Constant-Cost Industry: What happens when demand decreases?

Typical Firm's Cost and Supply

Market Equilibrium with 50 identical firms at the initial equilibrium



Constant-cost industry: the decrease in industry output from 500 to 300 doesn't change input price, so doesn't change cost curves. --> min(LAC) = 15

Equilibrium price decreases in the short run but goes back to the same level in the long run

Constant-Cost Industry: Price and Quantity Dynamics after Permanent Decrease in Demand

	Before demand decrease	After demand decrease	
	Long-run equilibrium	Short-run equilibrium	Long-run equilibrium
Price	15	11	15
Total quantity	500	300	250
Each firm's output	10	6	10
Number of firms	50	50	25

What is the long-run market supply curve?

- How to get long-run market supply curve?
  - Set of firms in the market is not fixed in the long run
  - Number of firms can only be determined in long-run equilibrium
- Long-run market supply curve describes the relationship between price and total quantity in long-run equilibrium
- Definition 11.6 *Long-run market supply curve*
  - Total quantity supplied in long-run equilibrium as a function of long-run equilibrium price

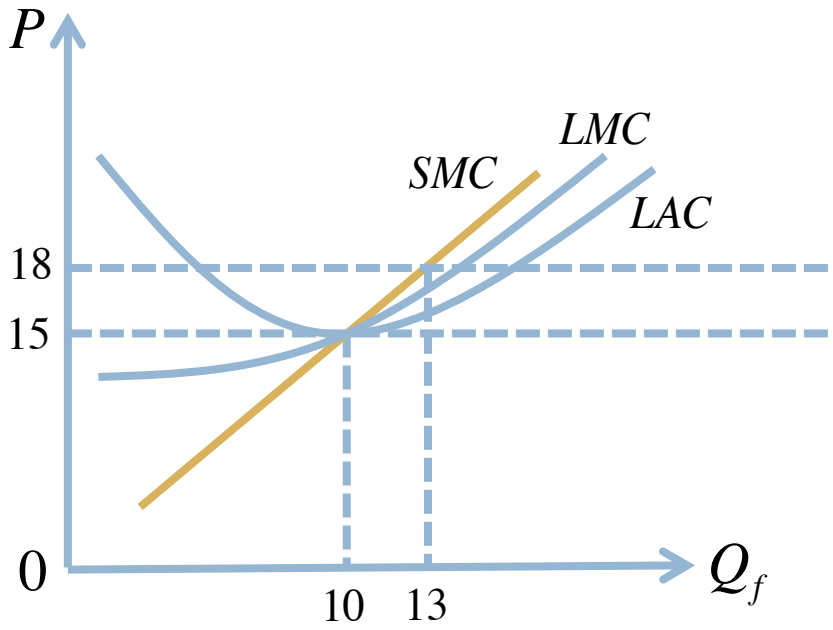
to get the curve, need to have more than 1 LR equilibrium in your graph.

SR market supply curve simply tells u the relationship between any price and total quantity in the market. It doesn't have to be equilibrium price. However, we cannot do that in LR coz we can only determine how many firms we have in LR equilibrium.

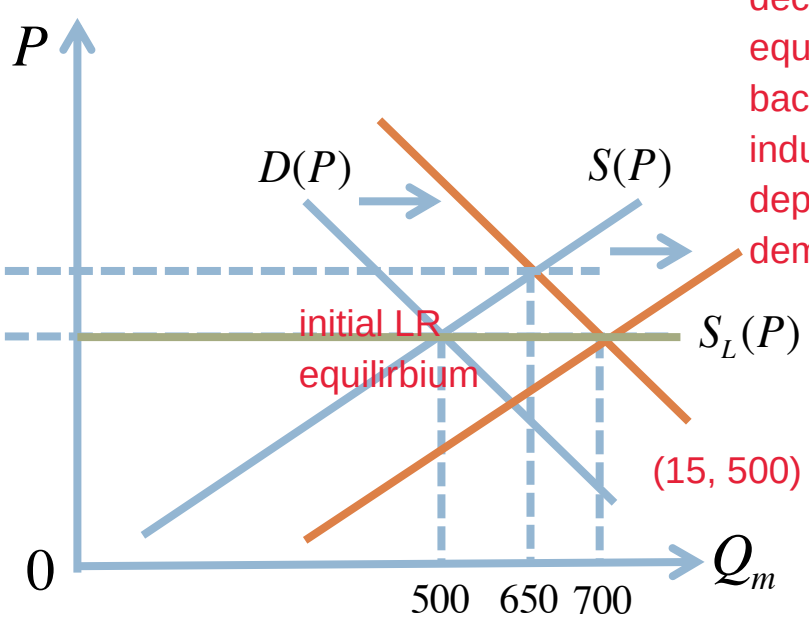
Long-Run Market Supply Curve in a Constant-Cost Industry

The green horizontal line. What does it mean that the LR market supply curve in a constant-cost industry is a horizontal line? -- It means that no matter how the LR quantity changes, it won't affect input prices, thus won't affect cost curves, so won't affect min(LAC). So long run equilibrium price is always gonna be the same, min(LAC). The LR equilibrium quantity will depend on how high/low the demand curve is.

Typical Firm's Cost and Supply



Market Equilibrium with 50 identical firms at the initial equilibrium



after demand increases/ decreases, in the new LR equilibrium, price will still go back to 15 in a constant-cost industry. The quantity will depend on where the new demand curve is.

(15, 500) to (15, 700)

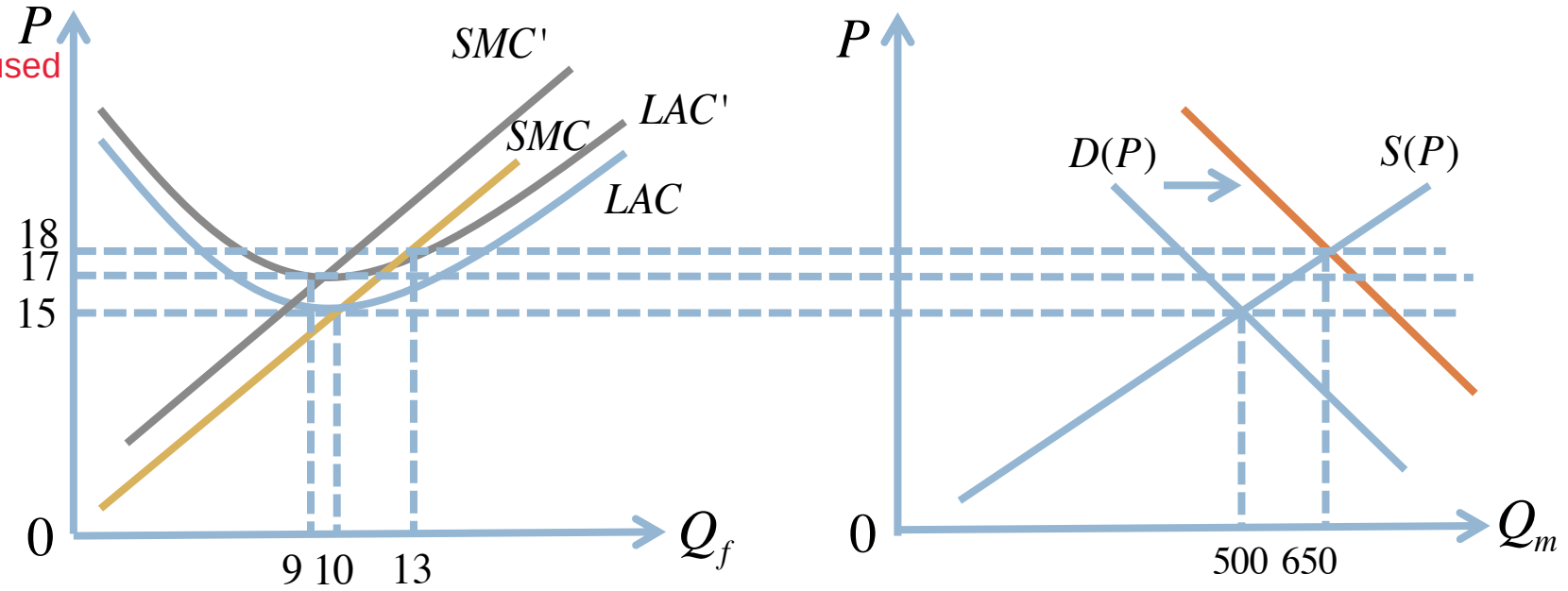
No matter where the demand curve is, in LR equilibrium, the equilibrium price will always be the same 15, min(LAC).

Long-Run Market Supply Curve in an Increasing-Cost Industry

Typical Firm's Cost and Supply

Market Equilibrium with 50 identical firms at the initial equilibrium

here we removed LMC curve, never used it in analysis here.

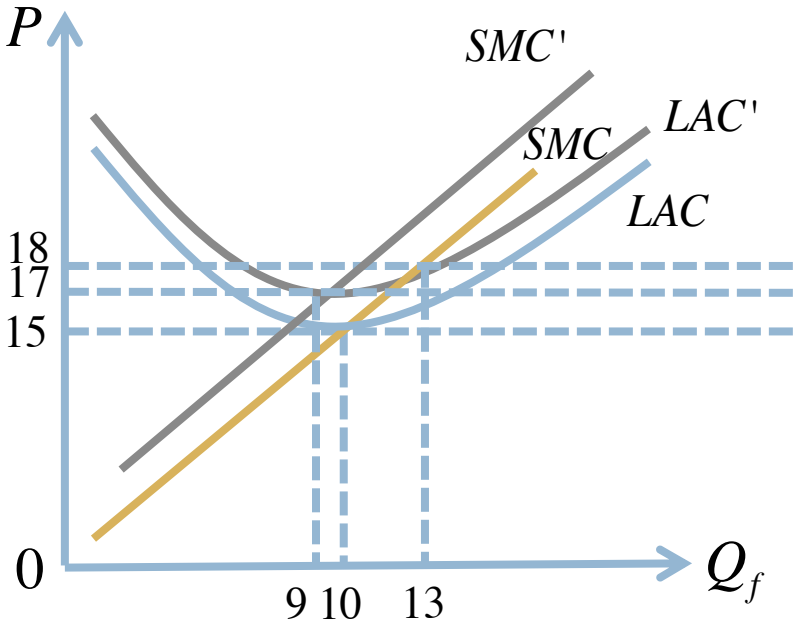


initial LR equilibrium (15, 500). Demand increases --> in SR, price higher at 18, every firm produces more, total Q increases to 650. Increasing-cost industry --> when higher industry output, input price gonna increase. --> cost of production higher, in LR cost curves shift up. More costly to produce the same Q (the shift in cost curves doesn't need to be parallel) --> higher min(LAC) = 17 --> SR equilibrium price18 still higher than the new min(LAC). --> At price 18, still gonna see entry, SR market supply curve shifts right, It will stop when market price goes back to 17. (17, 670)

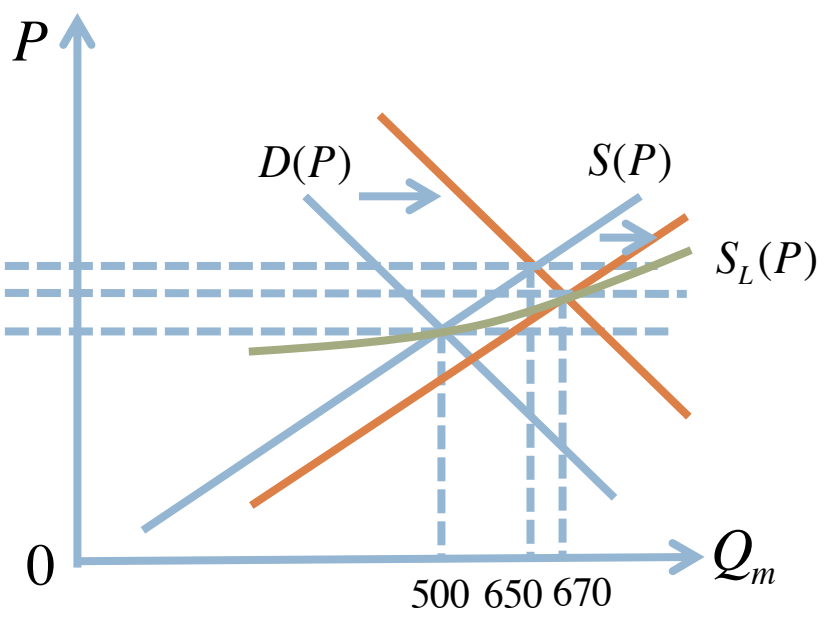
Long-Run Market Supply Curve in an Increasing-Cost Industry Cont'

we just need to identify initial LR equilibrium and new LR equilibrium

Typical Firm's Cost and Supply



Market Equilibrium with 50 identical firms at the initial equilibrium



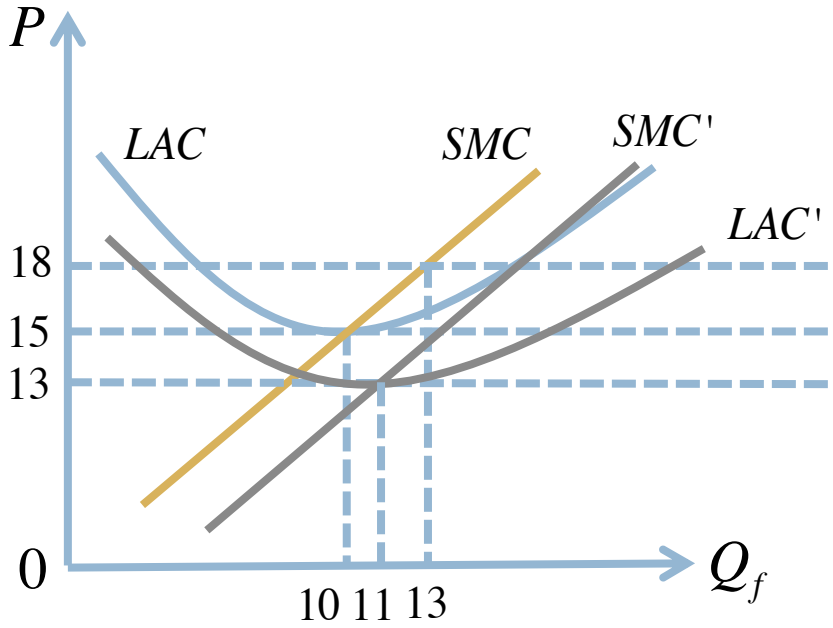
LR market supply curve for an increasing-cost industry is upward sloping.

--> Positive relationship between the LR equilibrium price & LR equilibrium quantity.

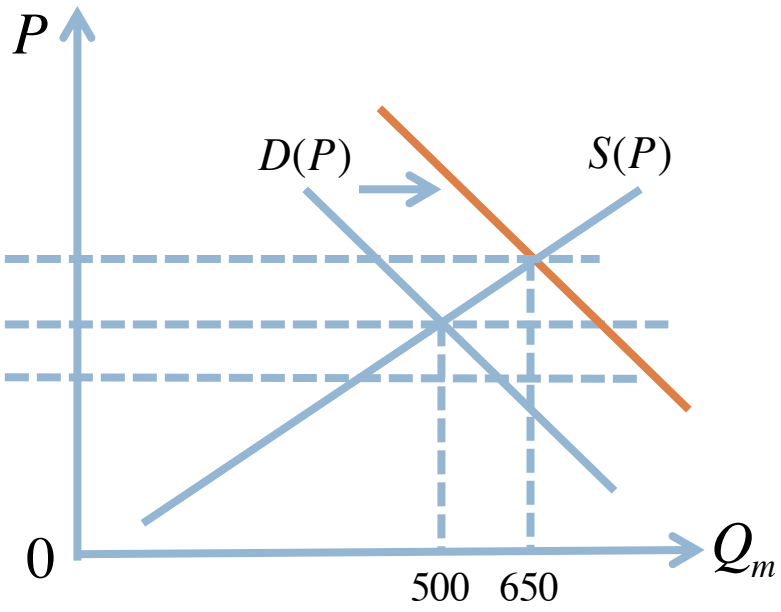
--> How does that happen? Coz as the industry output increases, input price higher, cost of production higher , so the new LR equilibrium price will be higher coz LR equilibrium price is determined by min(LAC).

Long-Run Market Supply Curve in a Decreasing-Cost Industry

Typical Firm's Cost and Supply

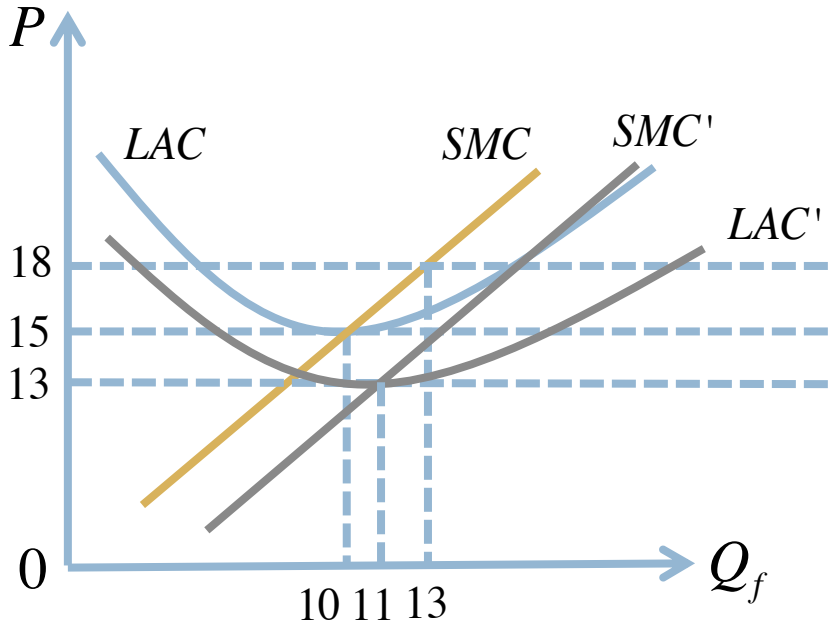


Market Equilibrium with 50 identical firms at the initial equilibrium



Long-Run Market Supply Curve in a Decreasing-Cost Industry Cont'

Typical Firm's Cost and Supply



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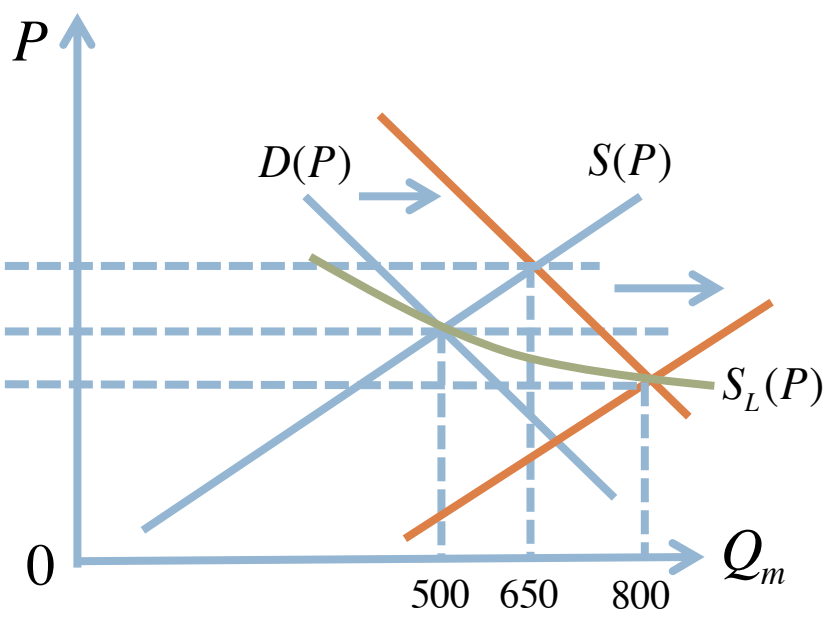

downward sloping
-> negative relationship between LR equilibrium price and quantity

Types of Industry and Long-Run Market Supply Curve

- Constant-cost industry
  - An industry in which long-run market supply curve is horizontal
- Increasing-cost industry
  - An industry in which long-run market supply curve is upward sloping
- Decreasing-cost industry
  - An industry in which long-run market supply curve is downward sloping

Short Run vs. Long Run

	In Short-run Equilibrium		In Long-run Equilibrium
Equilibrium price	Determined by $D(P^*)=S(P^*)$		$P^*=\min(LAC)$
Firm's supply	$P^*=SMC(Q_f^*)$	produce at a quantity where P = MC	$P^*=LMC(Q_f^*)$
Number of firms	Fixed		Determined by $D(P^*)/Q_f^*$
Profit	Could be positive, negative, or 0		0