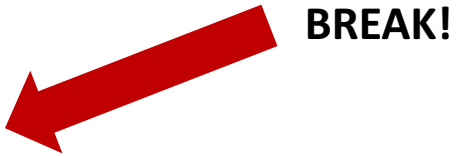
# Monopoly, oligopoly and game theory.
# EC1101E. Week 6.

# Today

- Externalities overview
- Monopoly
  - Definition and examples
  - Monopoly decision-making
  - Welfare analysis
- Review questions




- Game theory basics
- Application to oligopoly

# Externalities overview

| | Consumption | Production |
|---|---|---|
| **Positive** | | |
| **Negative** | | |

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| Negative | | |

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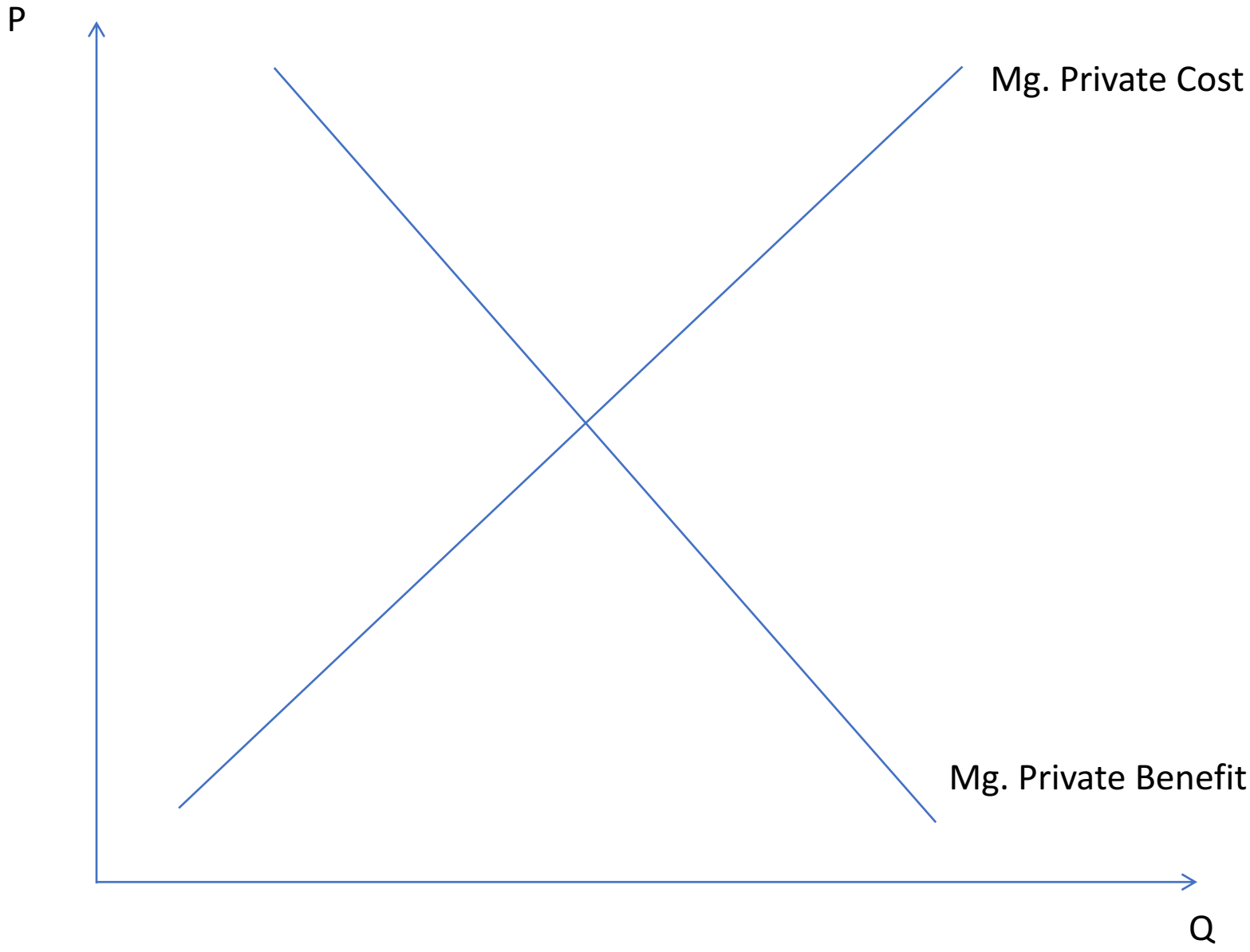
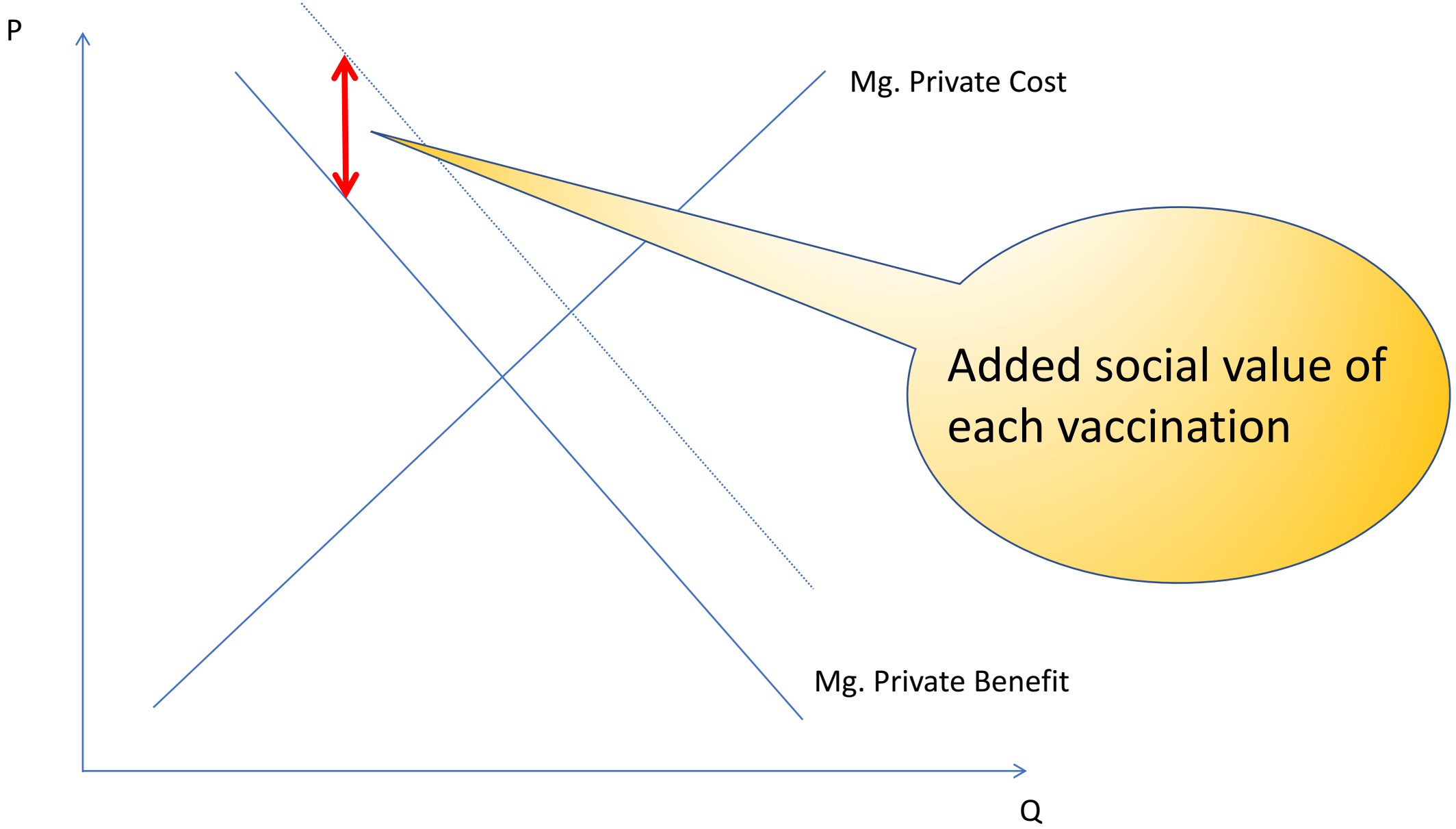

P
Mg. Private Cost
Mg. Private Benefit
Q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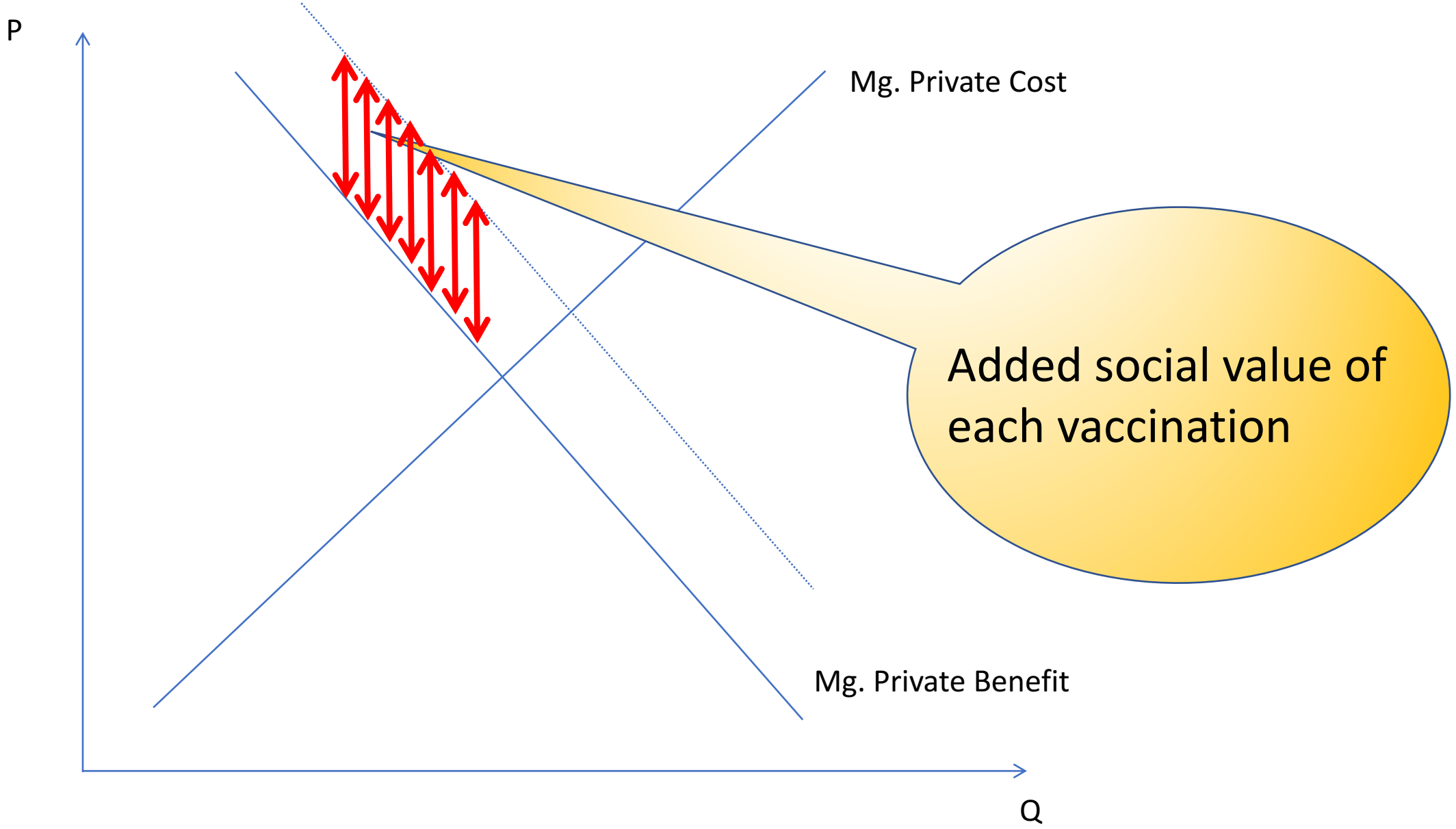
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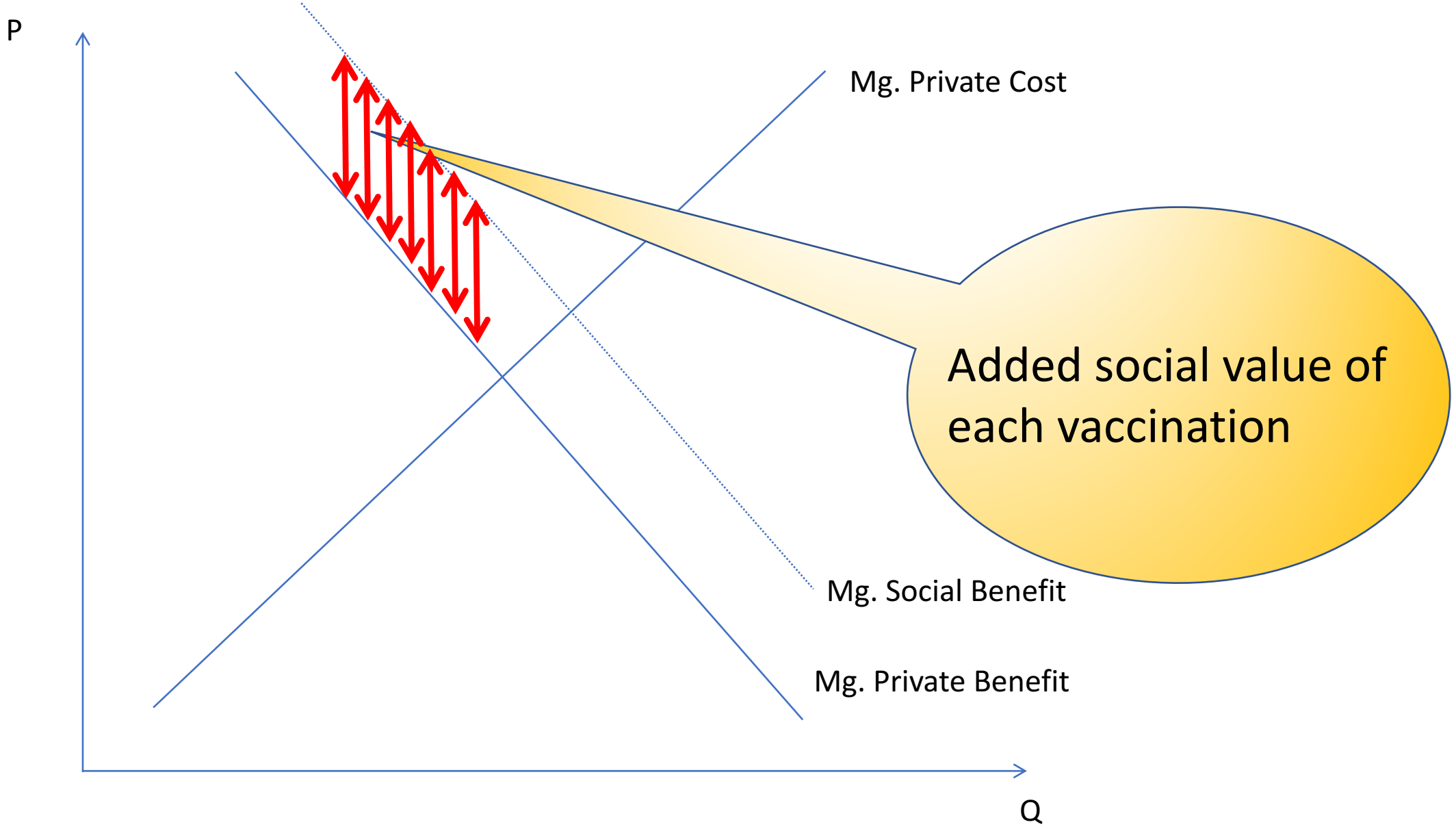
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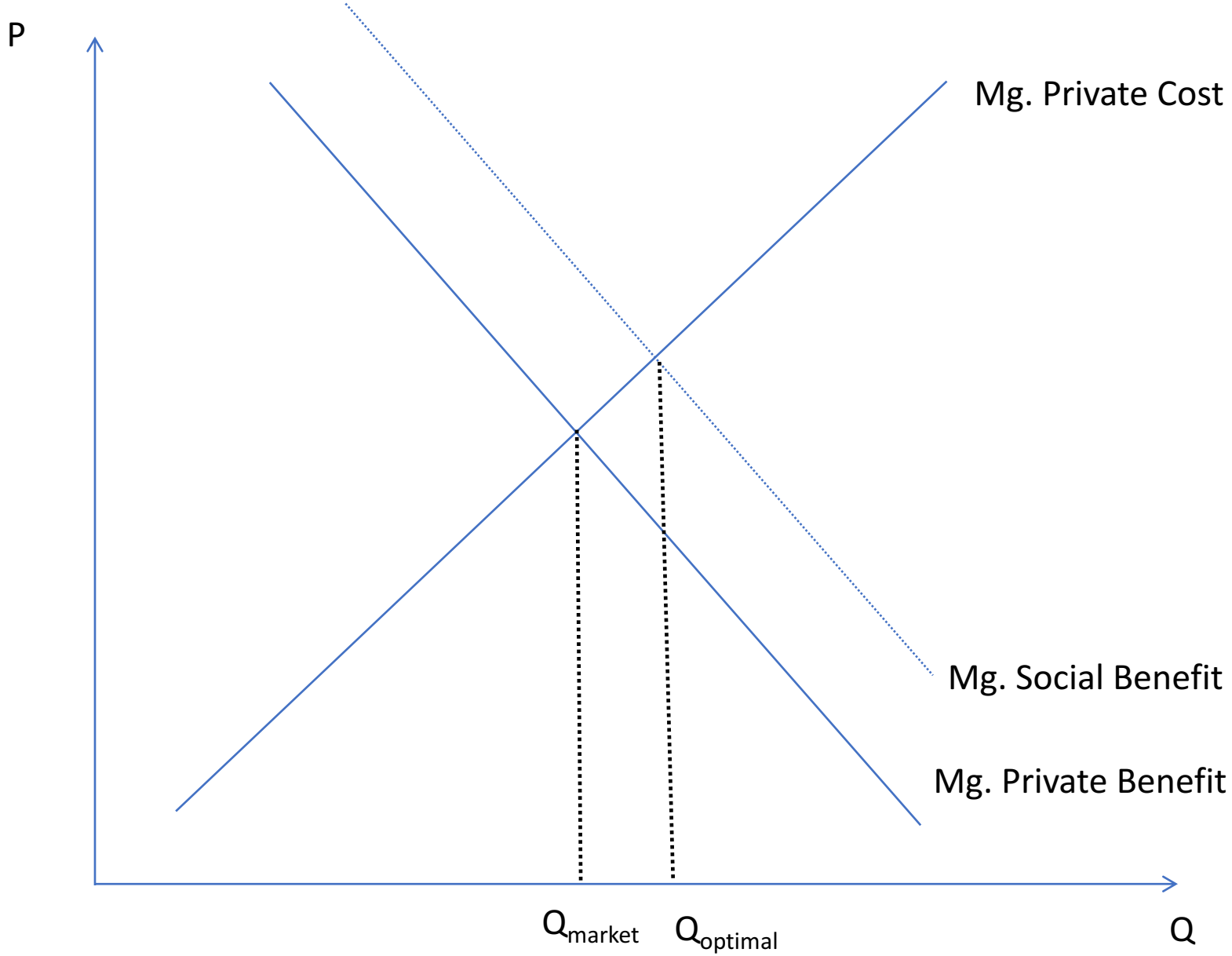
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$Q_{optimal}$
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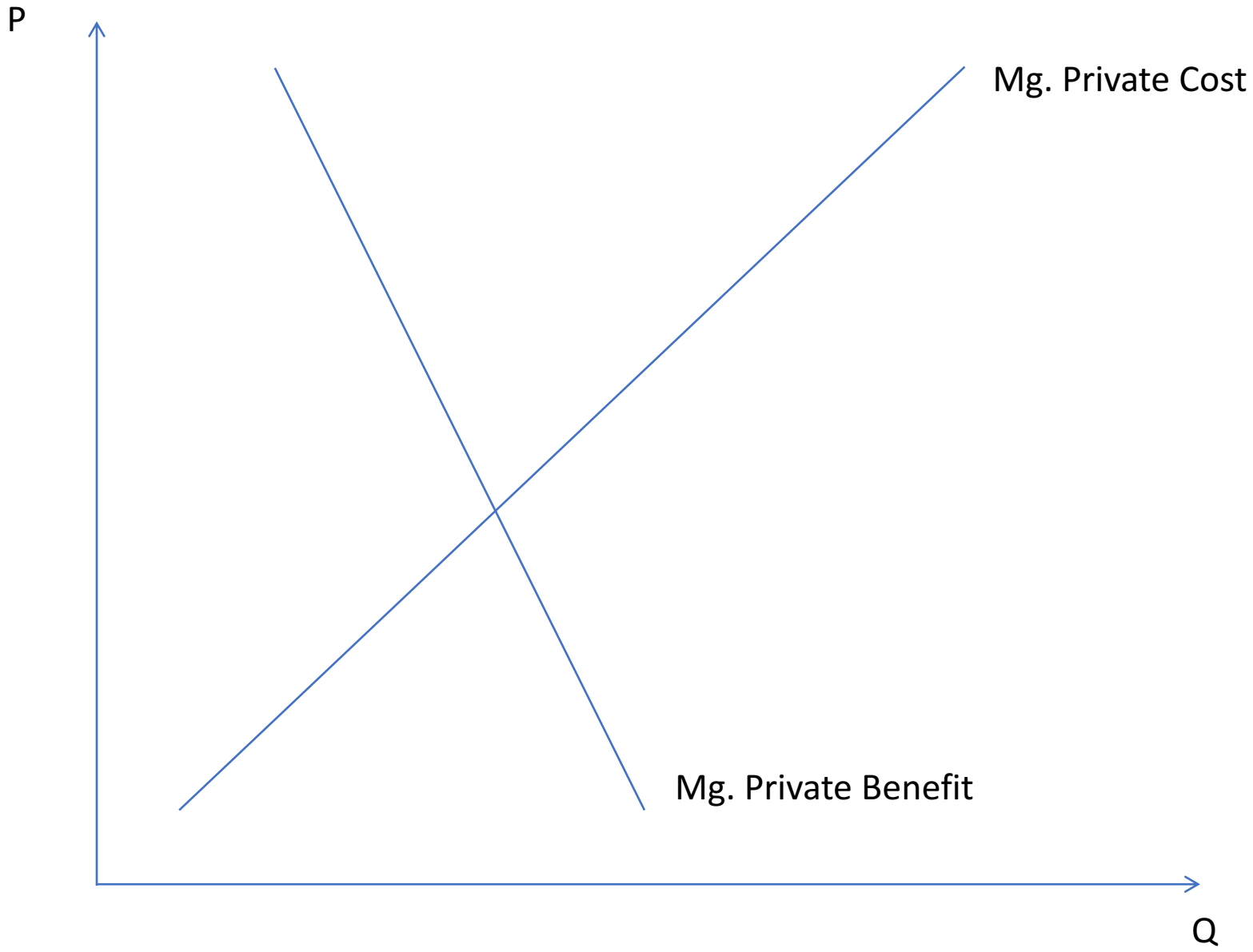
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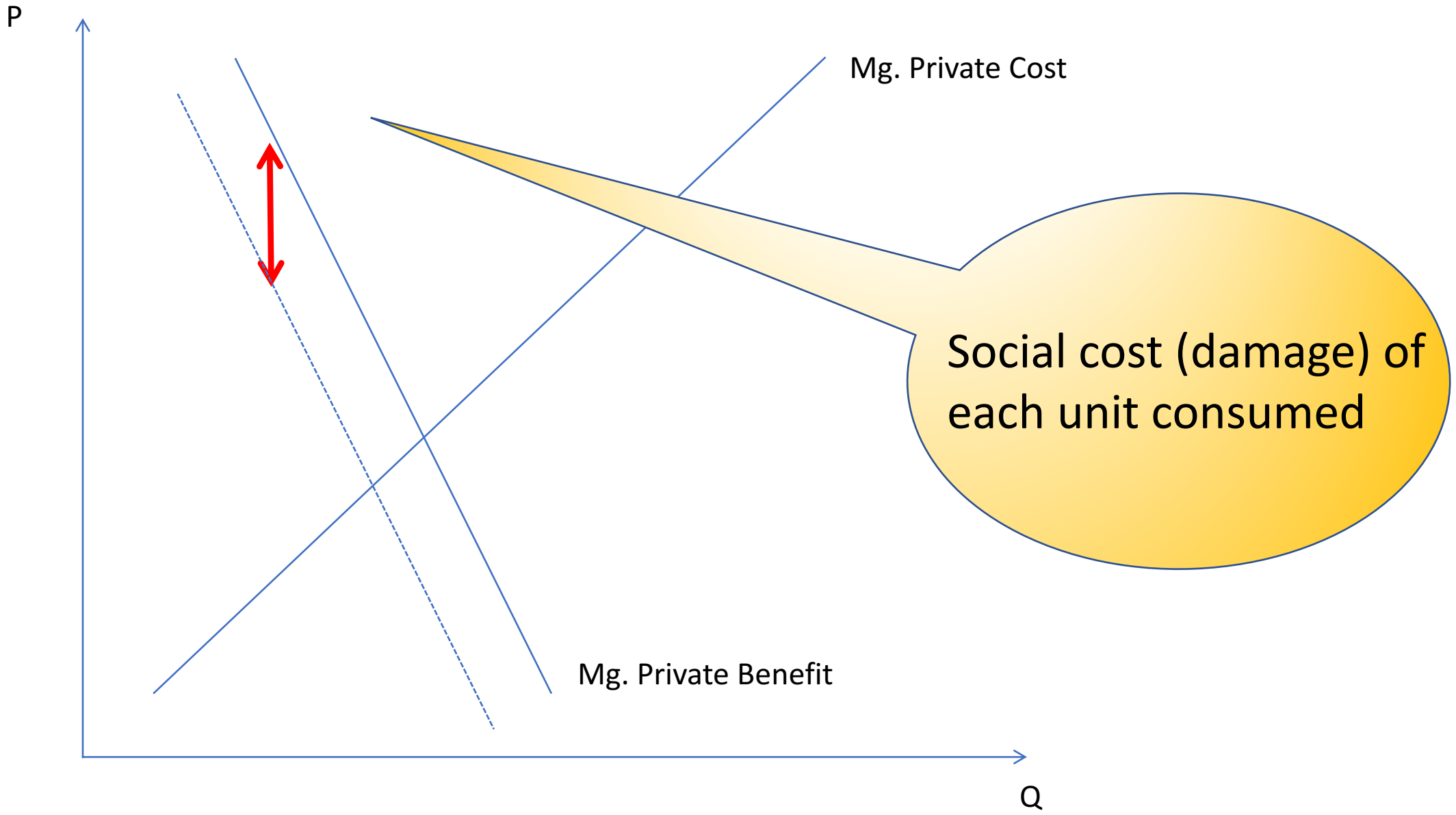
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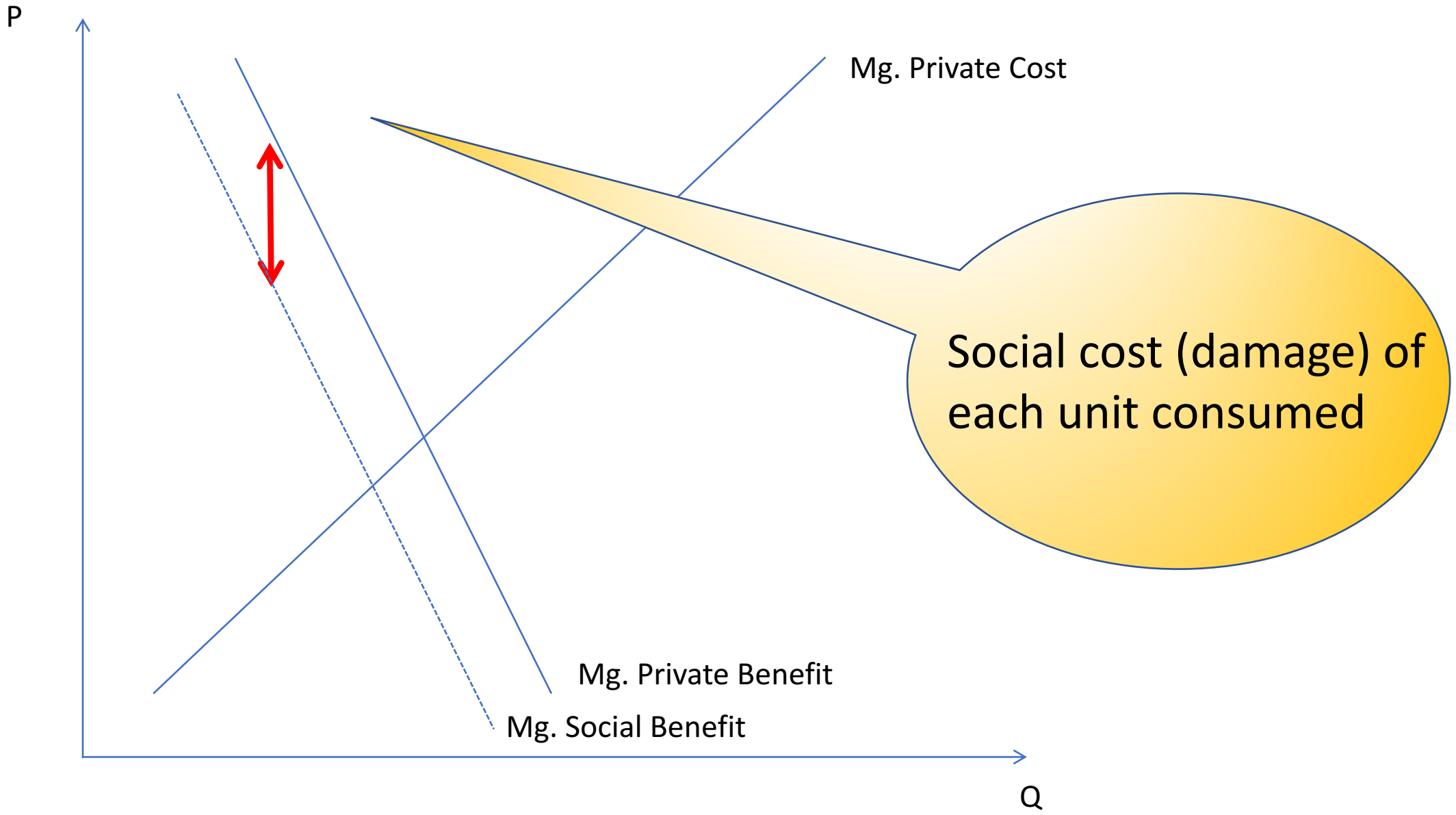
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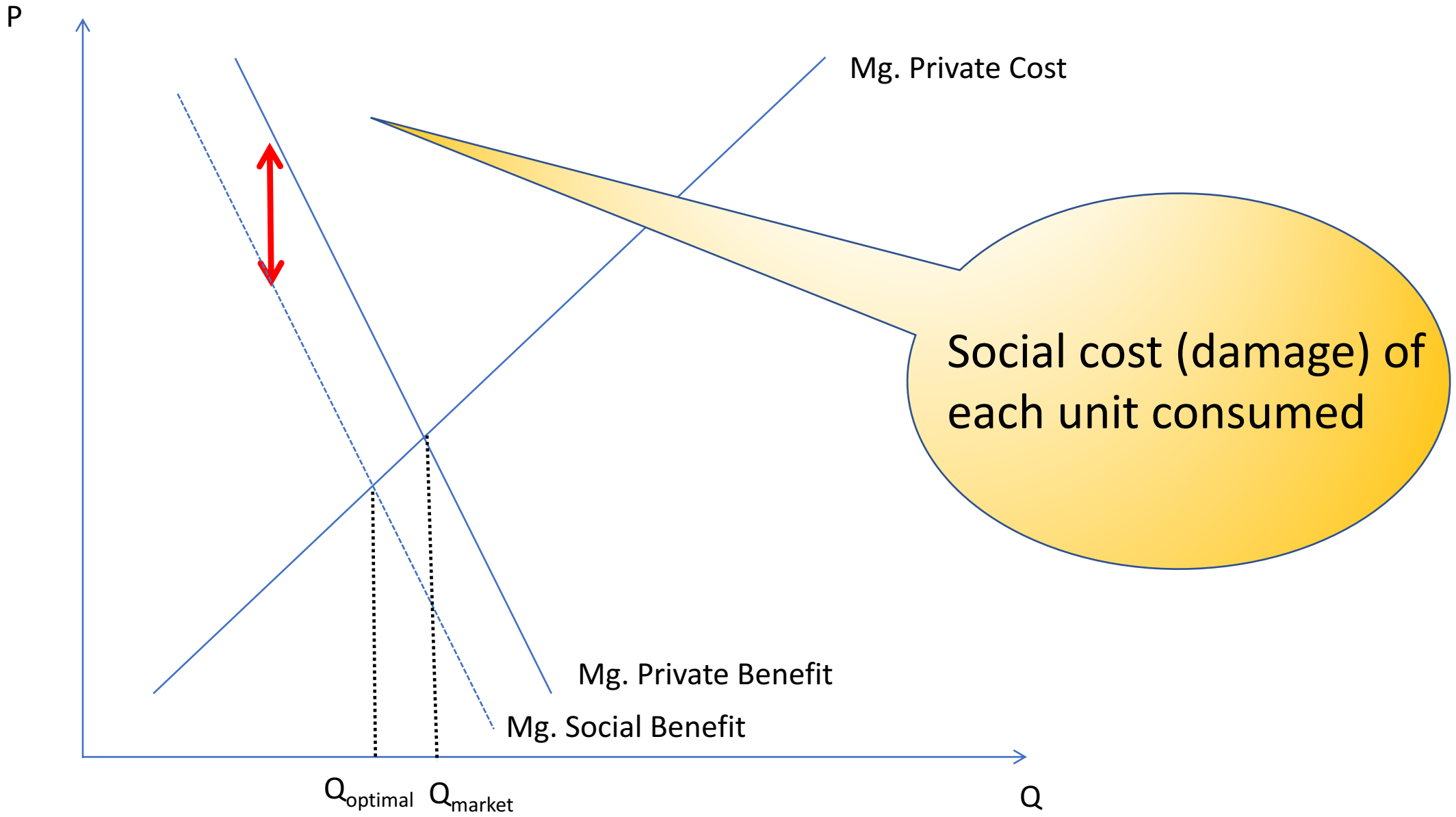
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- **Monopoly**
  - **Definition and examples**
  - Monopoly decision-making
  - Welfare analysis
- Review questions
- Game theory basics
- Application to oligopoly

# Monopoly

- **A monopoly is a market with just one seller.**

# Monopoly

- **Why do monopolies arise?**
  - **Economies of scale / natural monopoly**
  - **Legal Barriers**
  - **Network externalities**

# Monopoly

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  - **Economies of scale / natural monopoly**
    -

# Monopoly

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    - **Large fixed costs**
    - **Very small marginal costs in comparison**
    - **→ Decreasing average costs**

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    - **Copyright and patents**
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  - Network externalities
    - The more users, the better
    - One company optimises consumer experience

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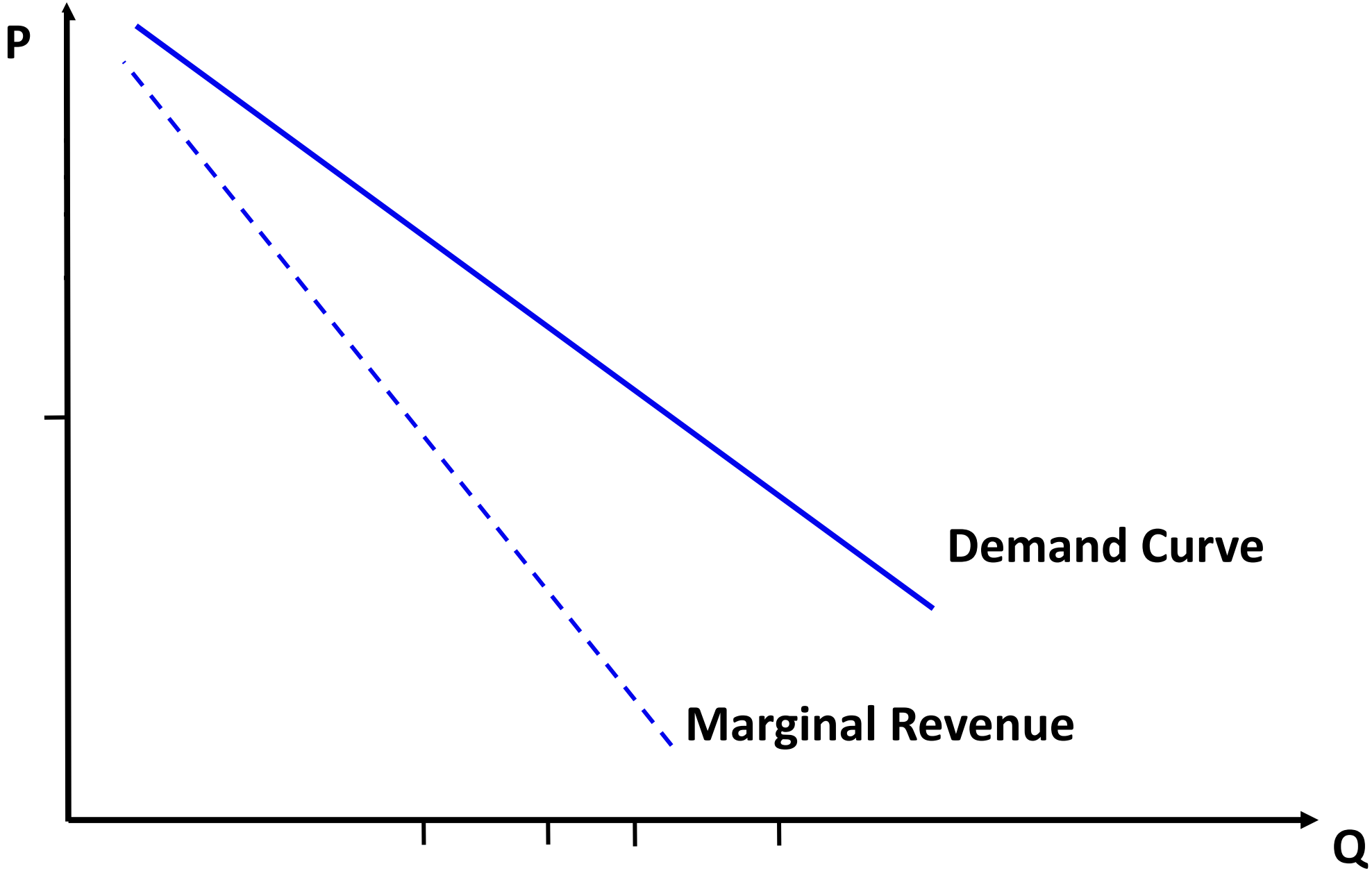
# Maximizing profits



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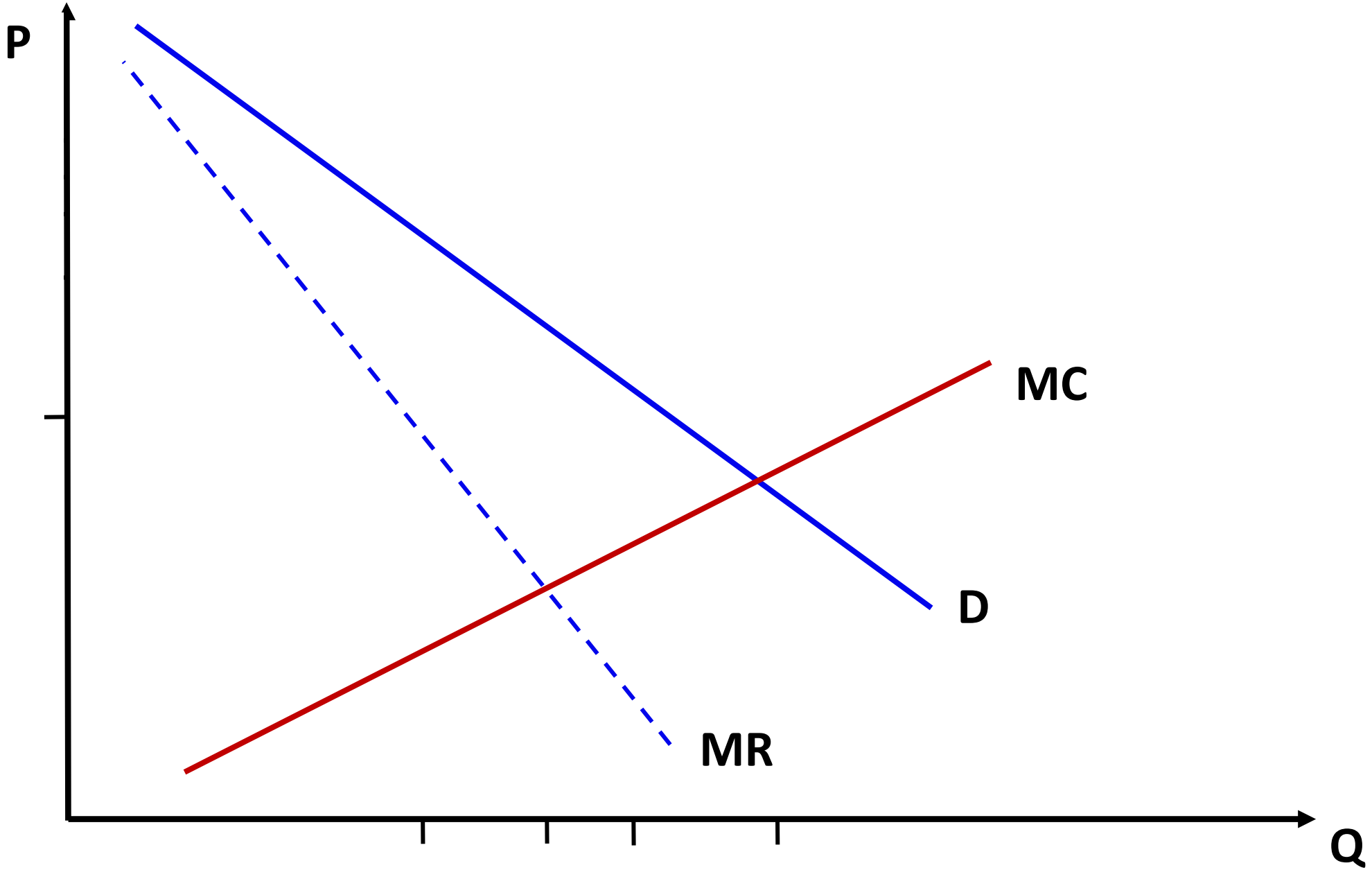

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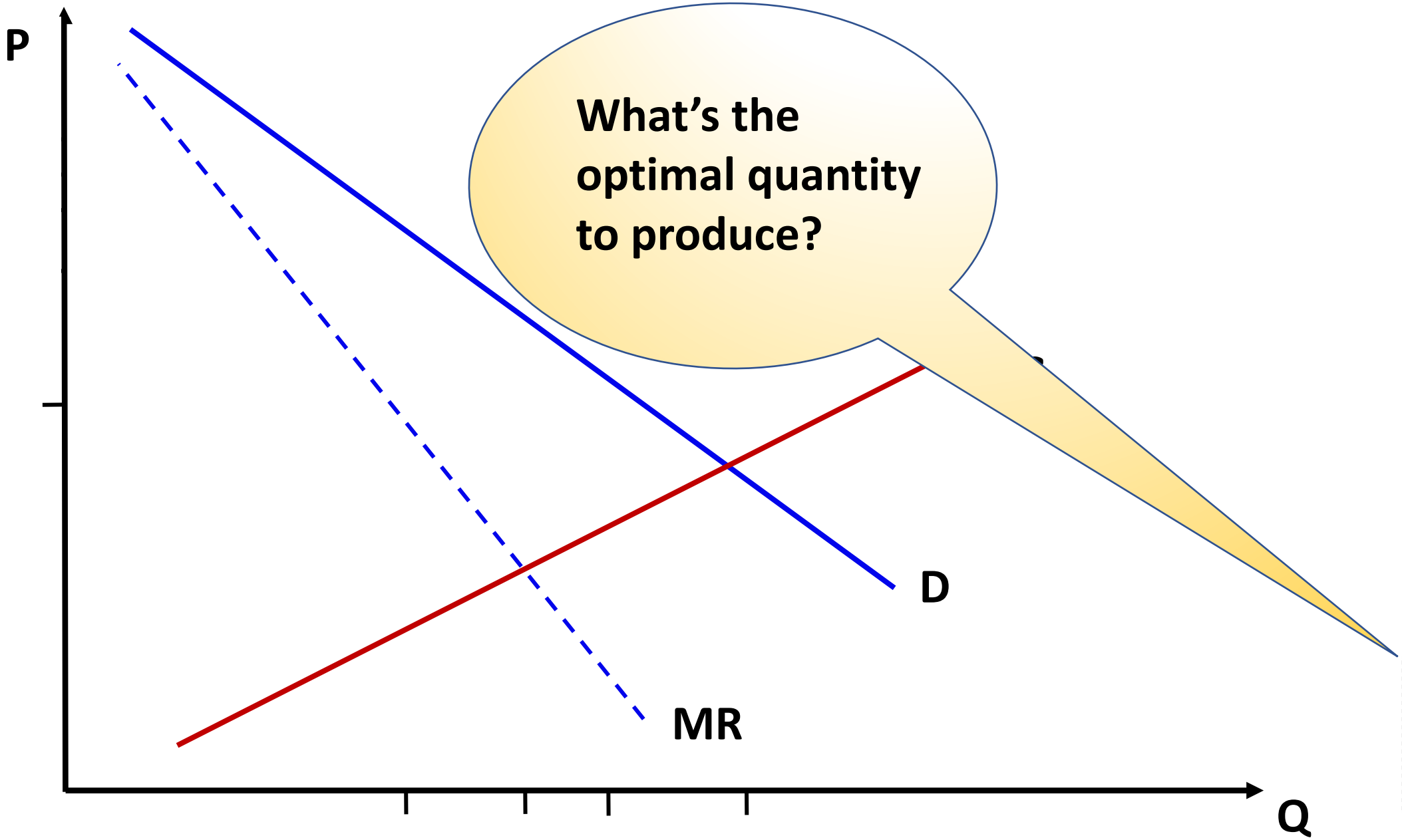

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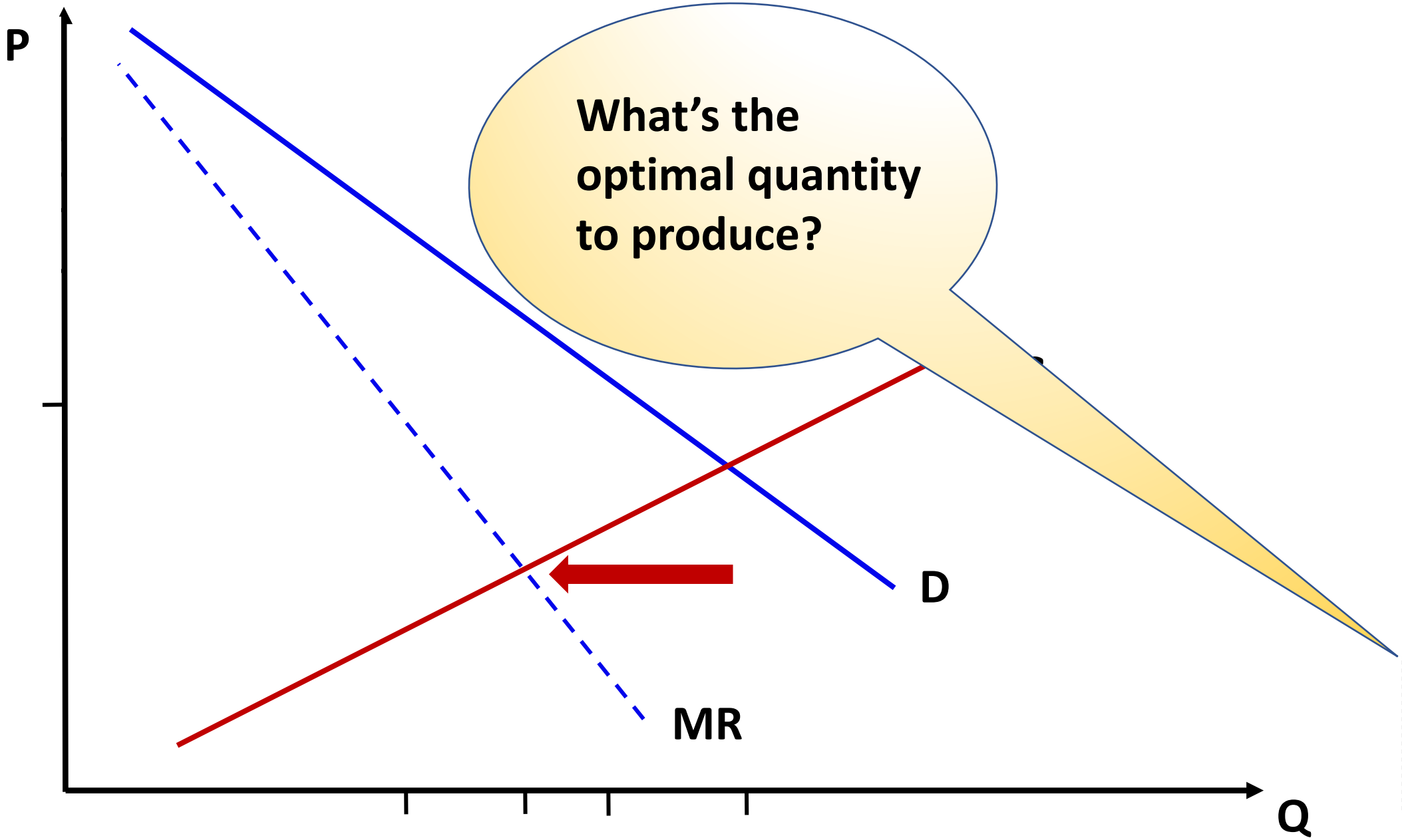

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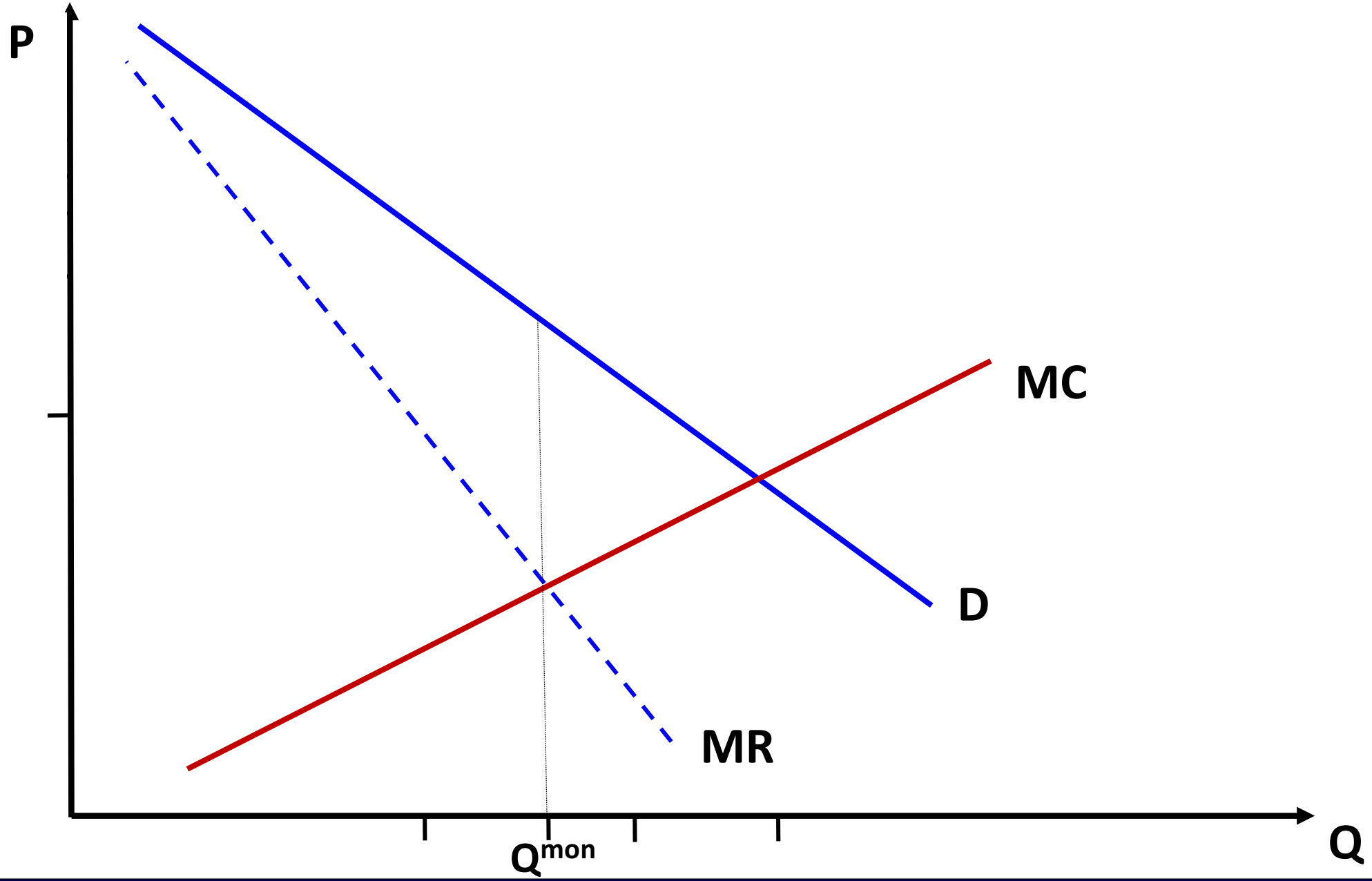

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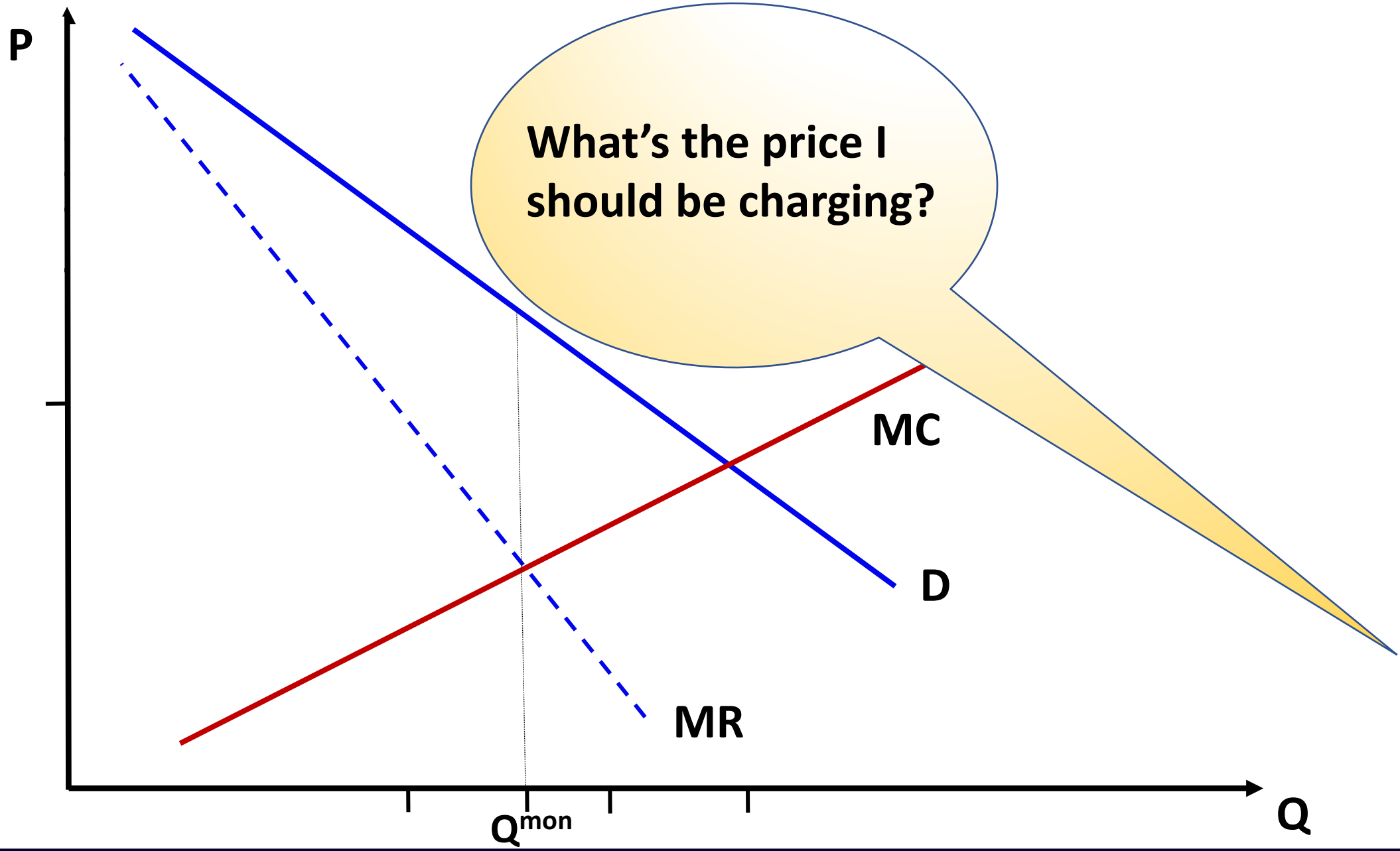

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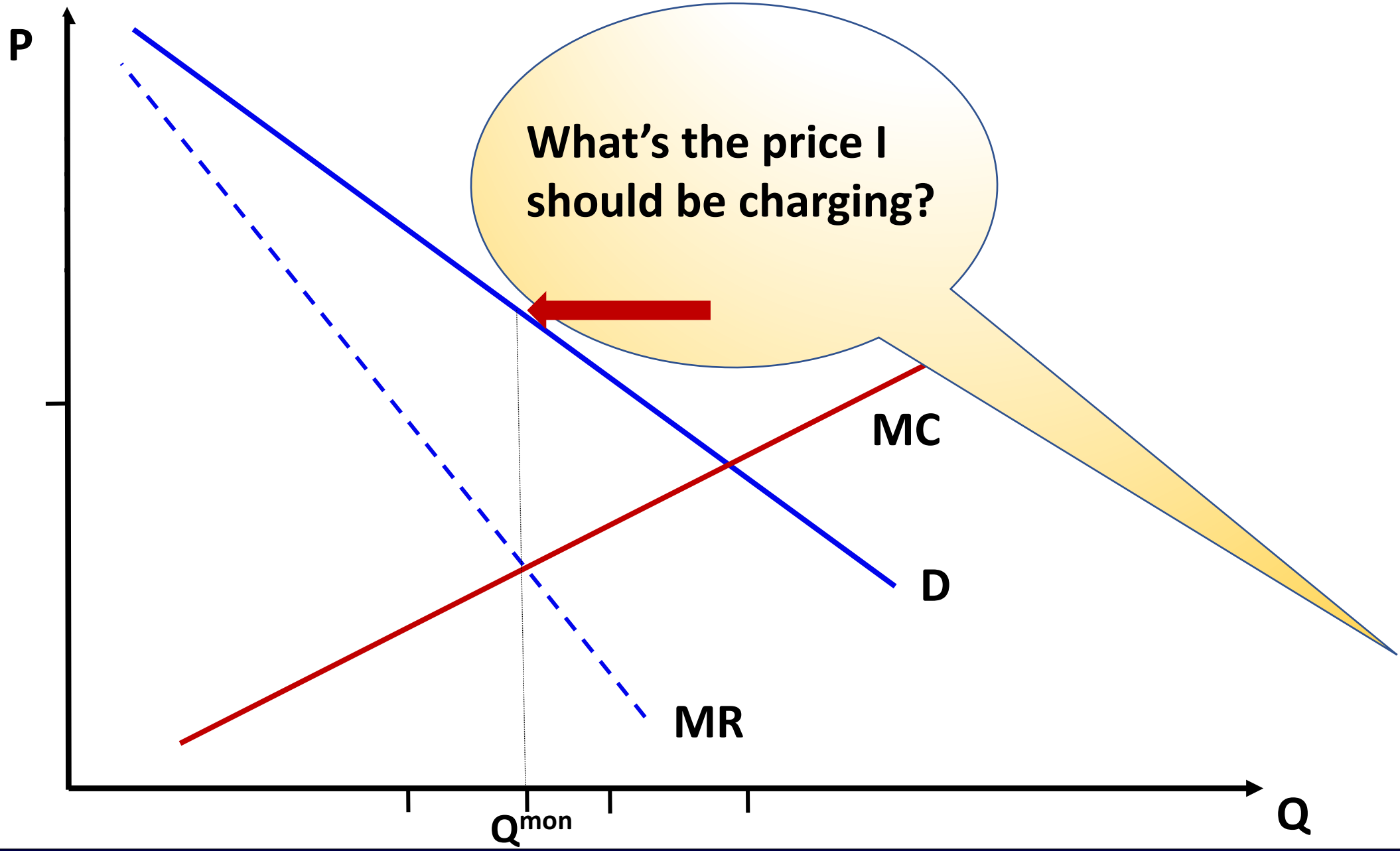


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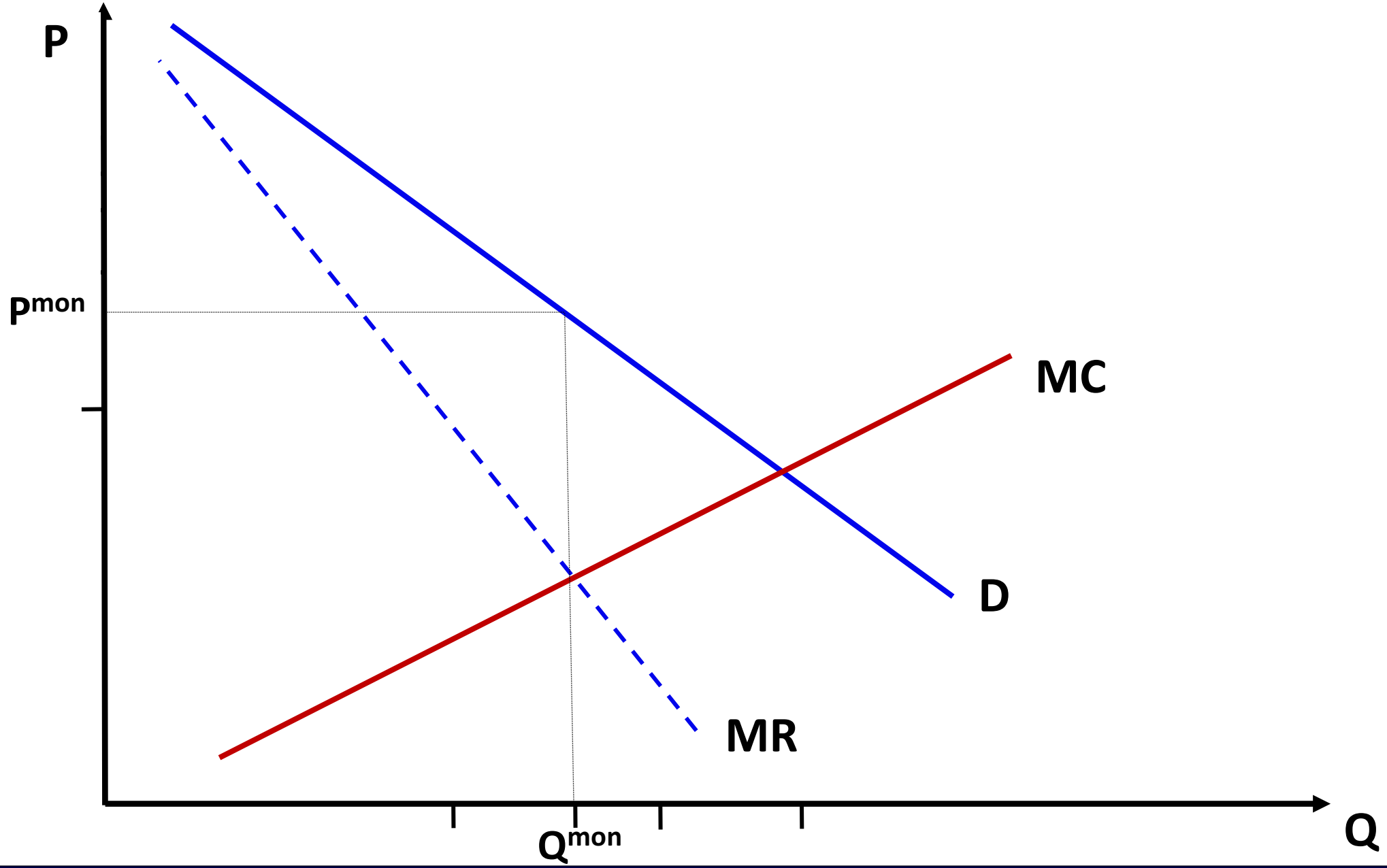

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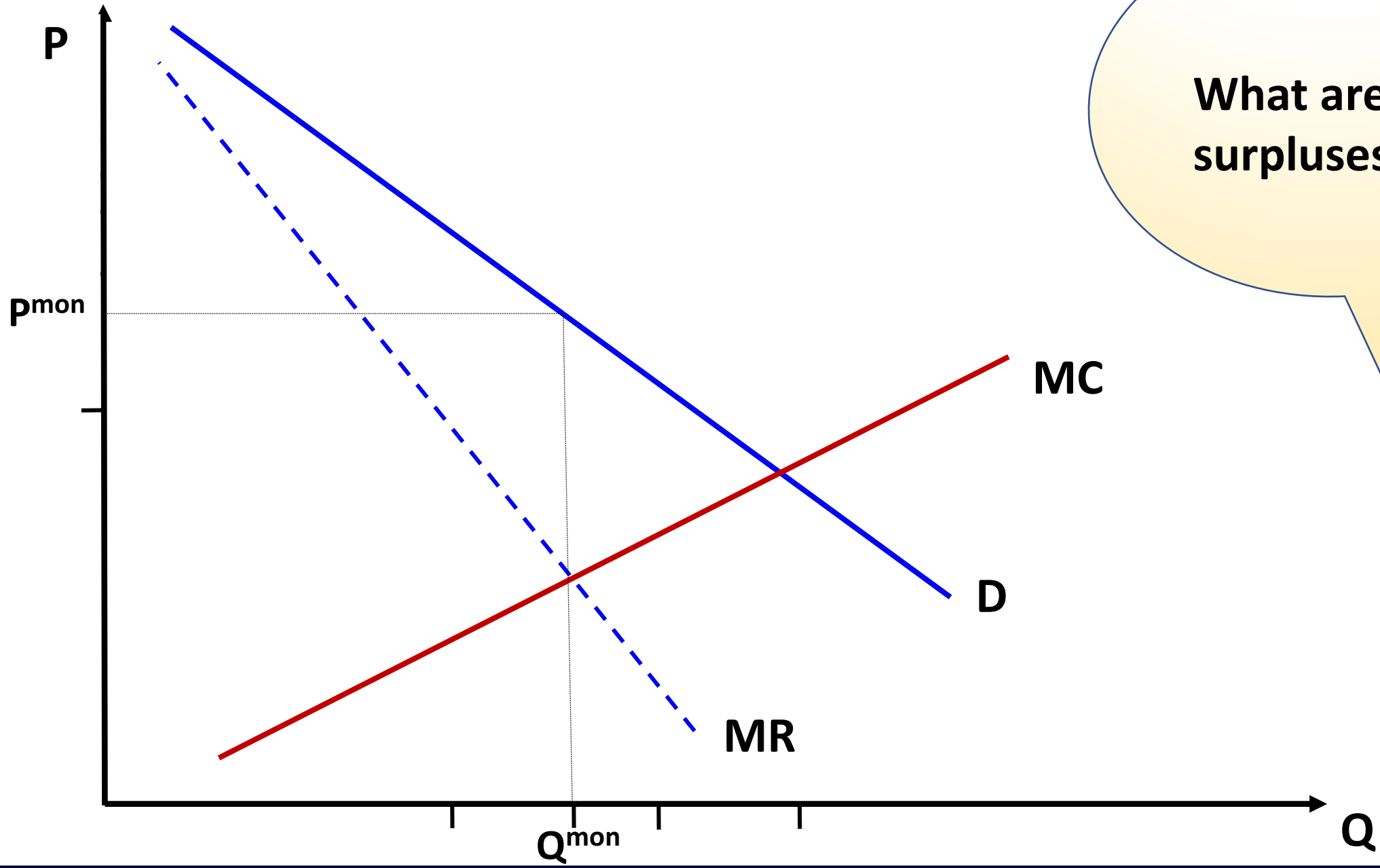
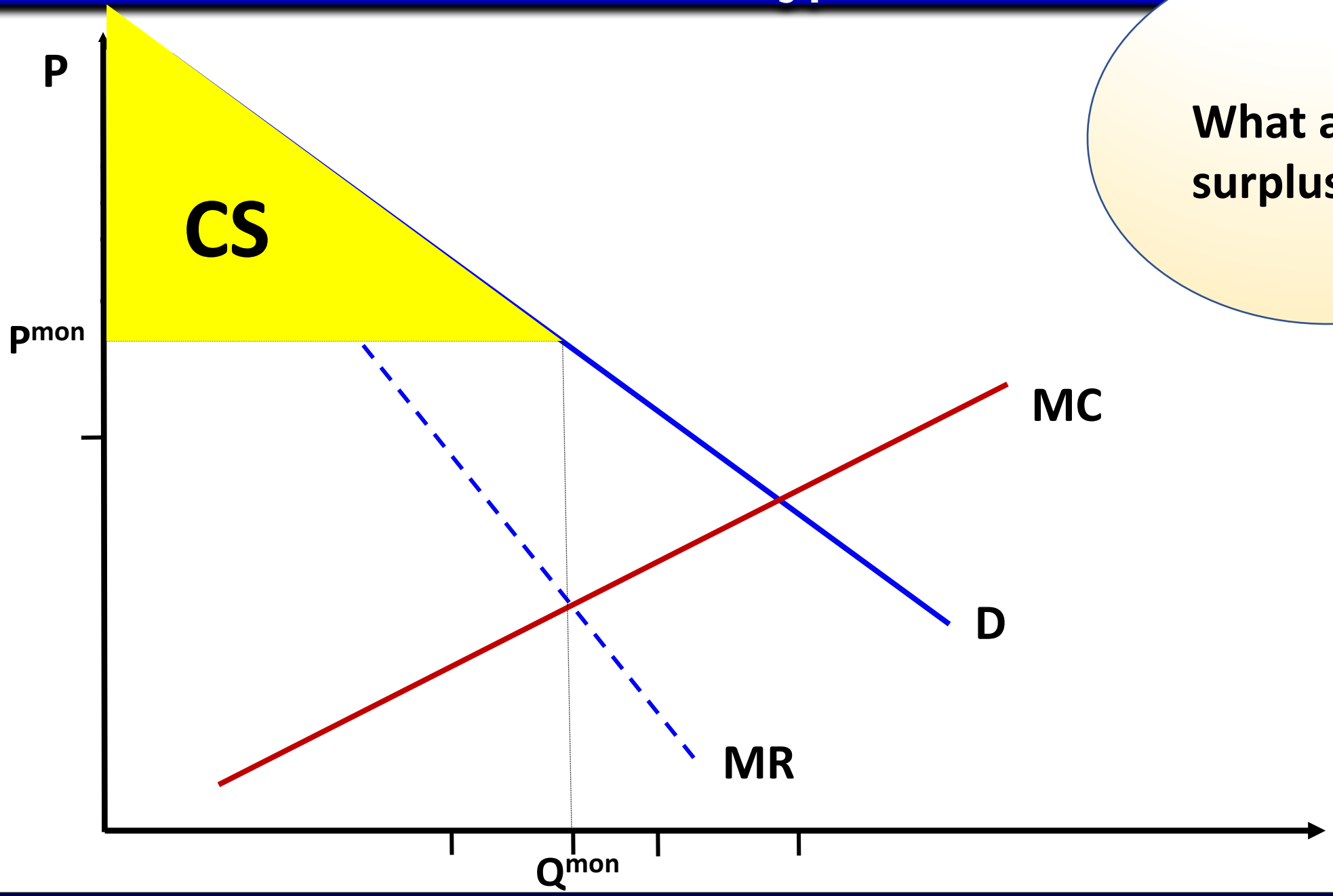



What are the surpluses?

# Maximizing profits

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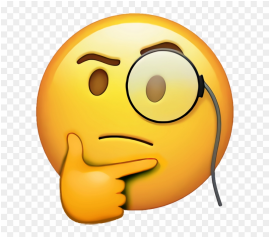

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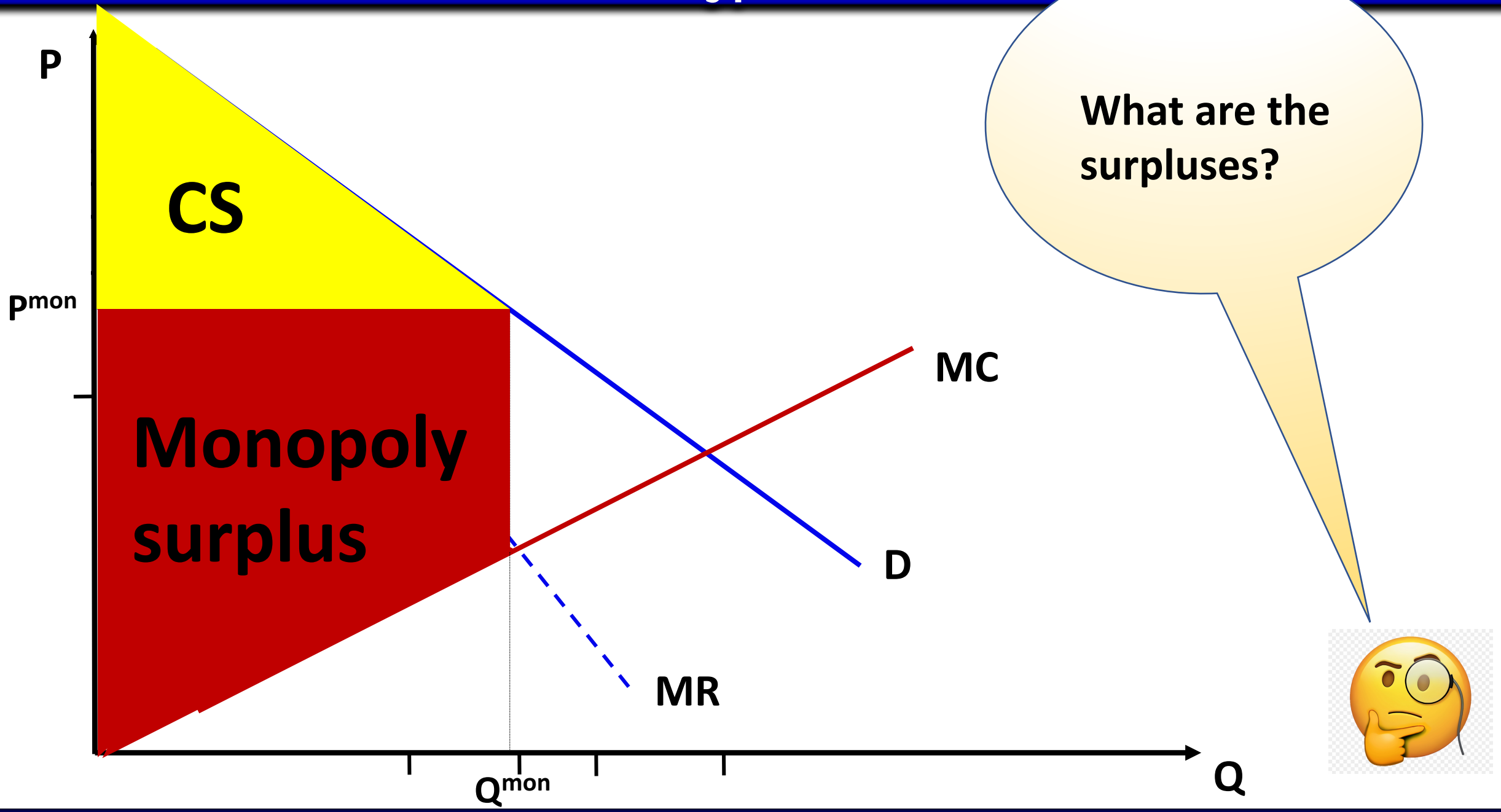

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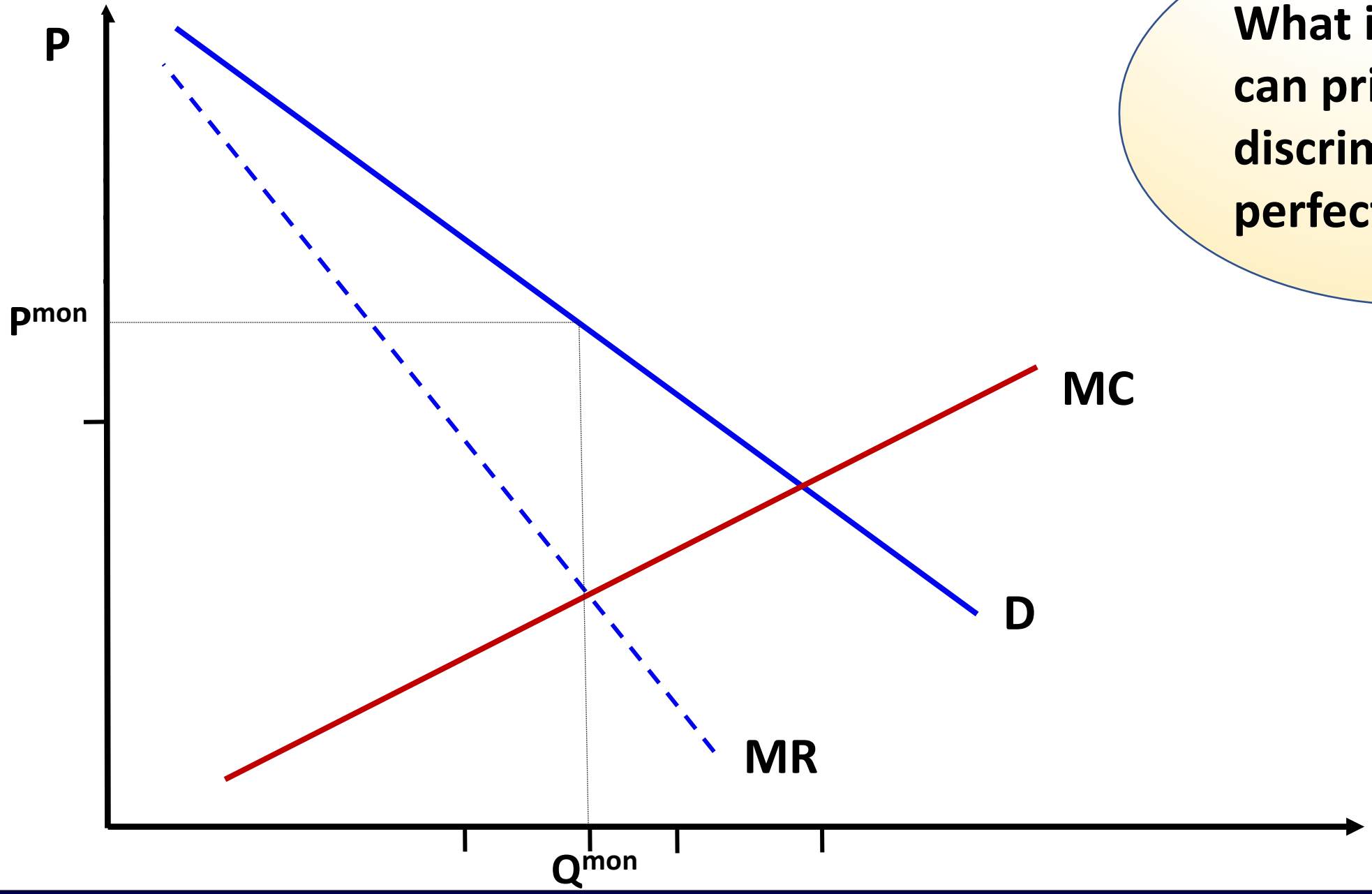
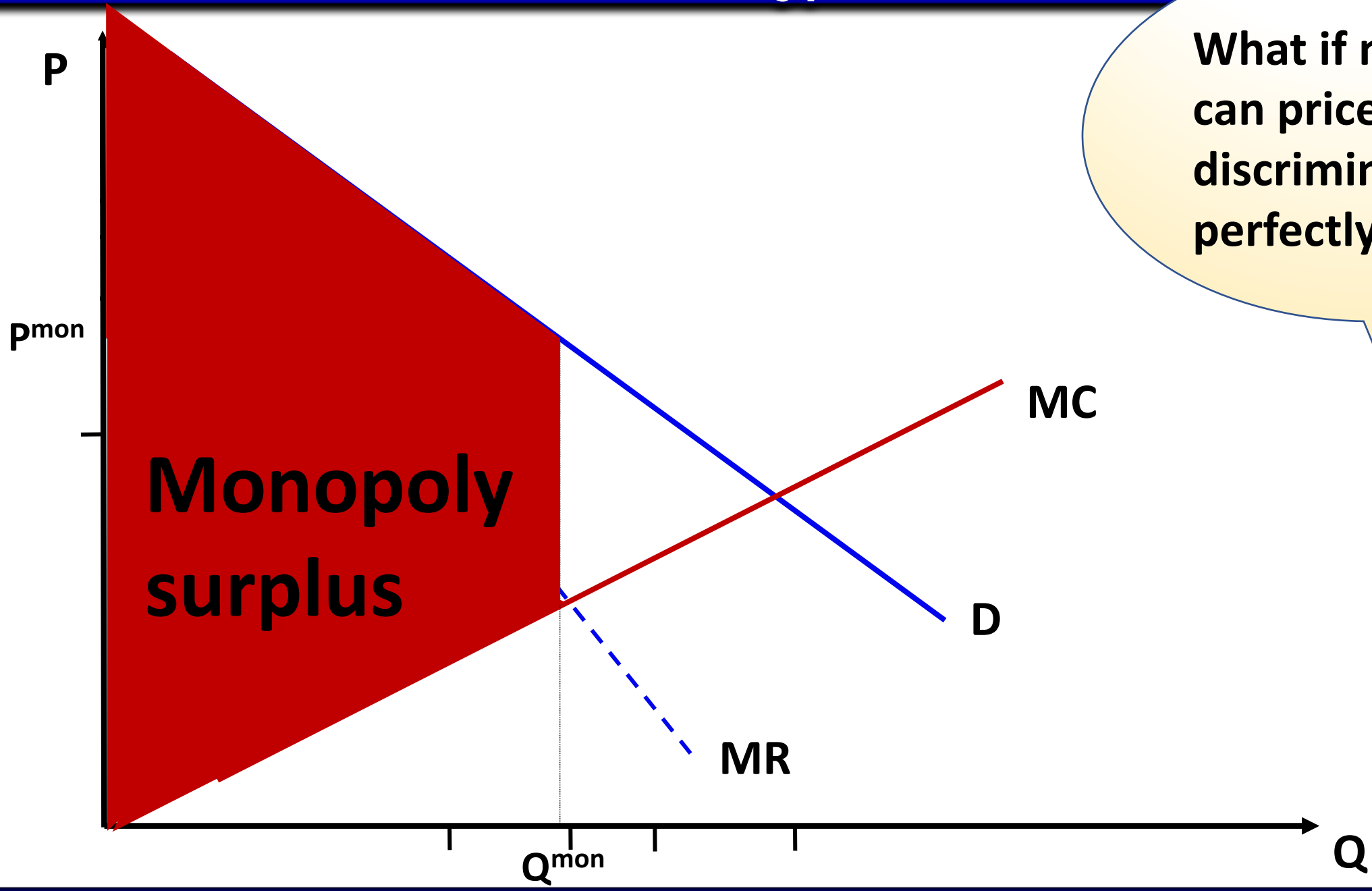



What if monopolist can price discriminate perfectly?

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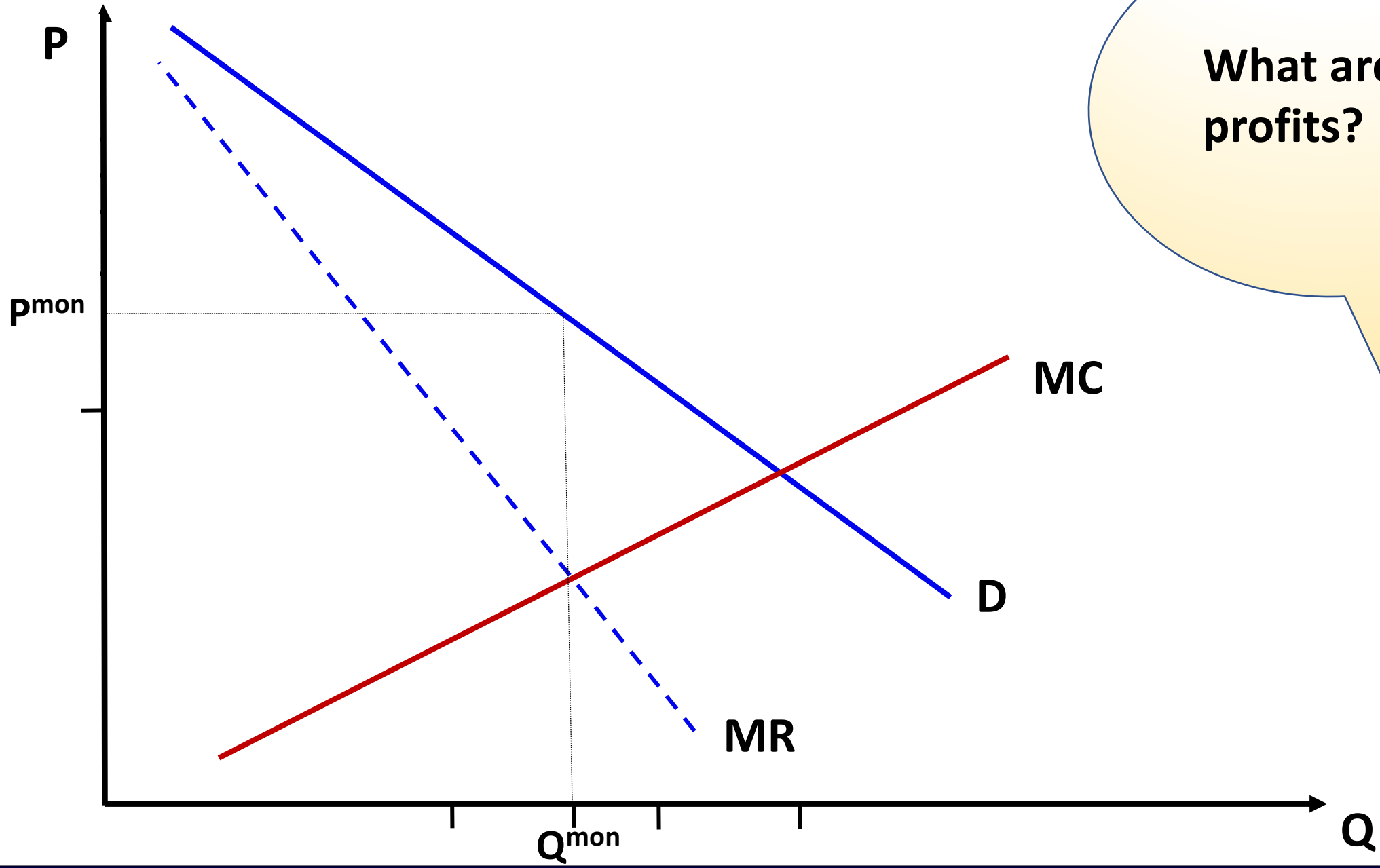
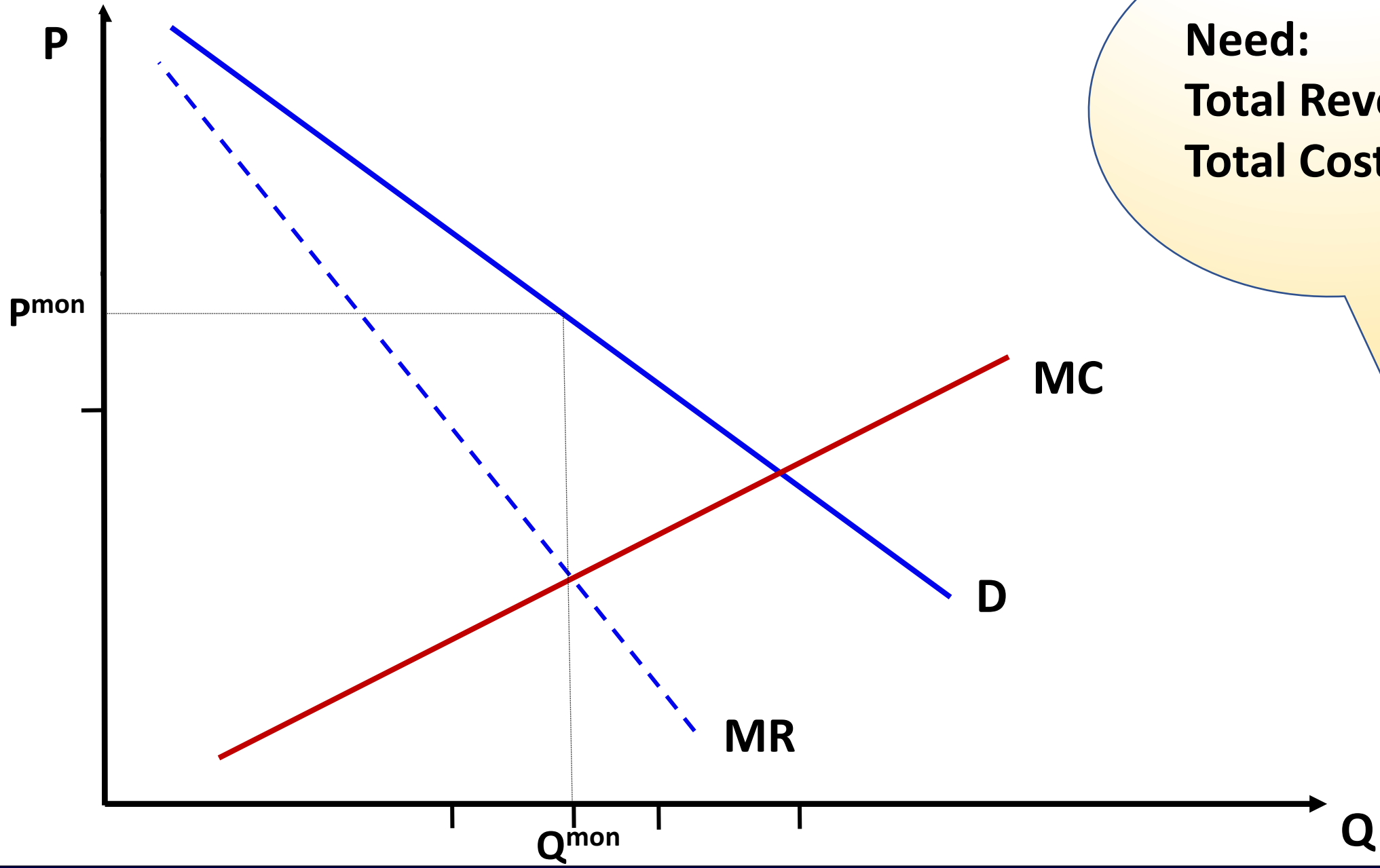
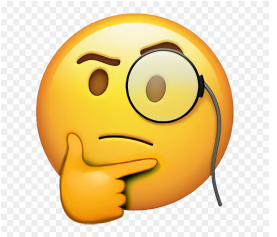



What are the profits?

# Maximizing profits




Need:
Total Revenue
Total Cost



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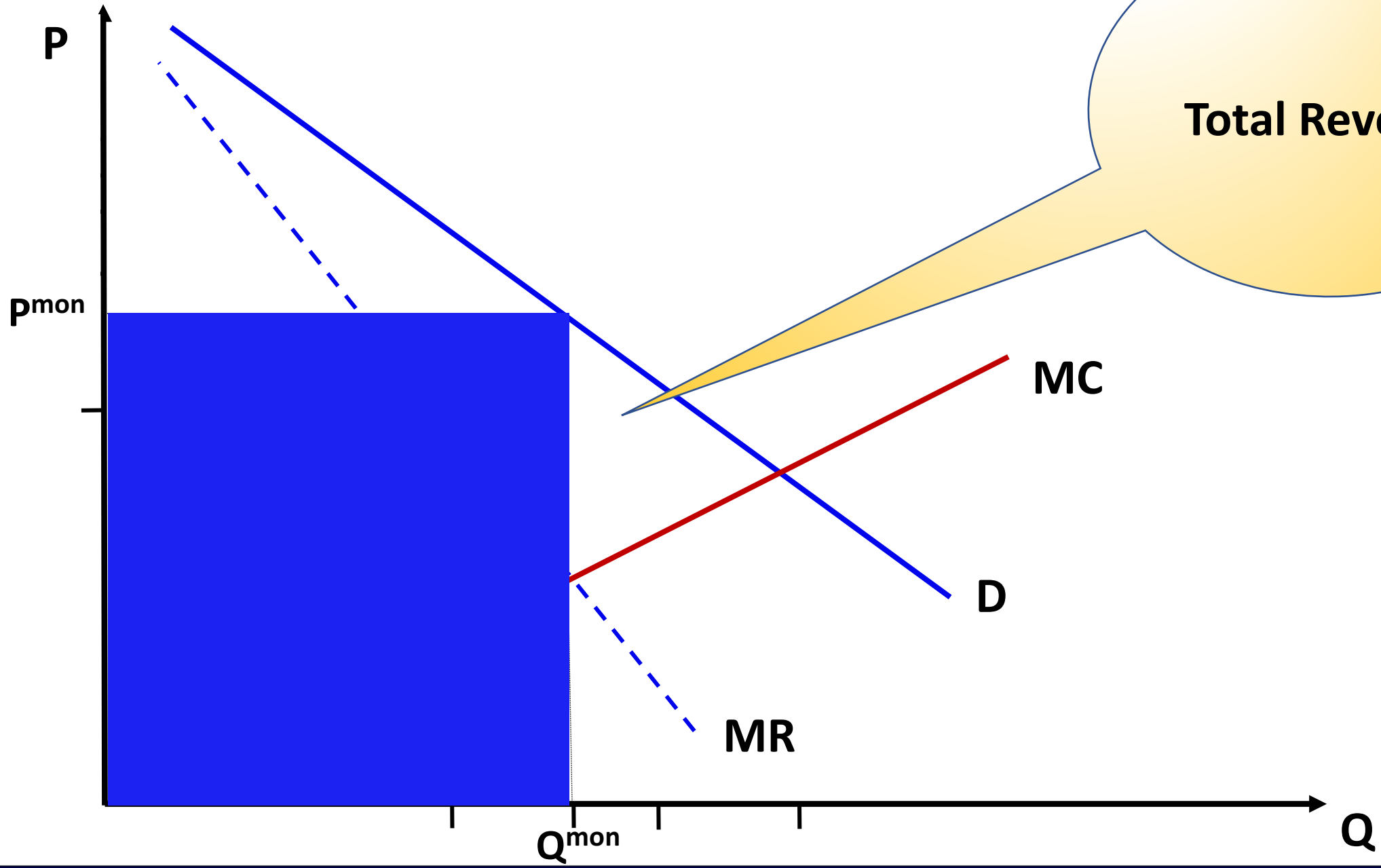


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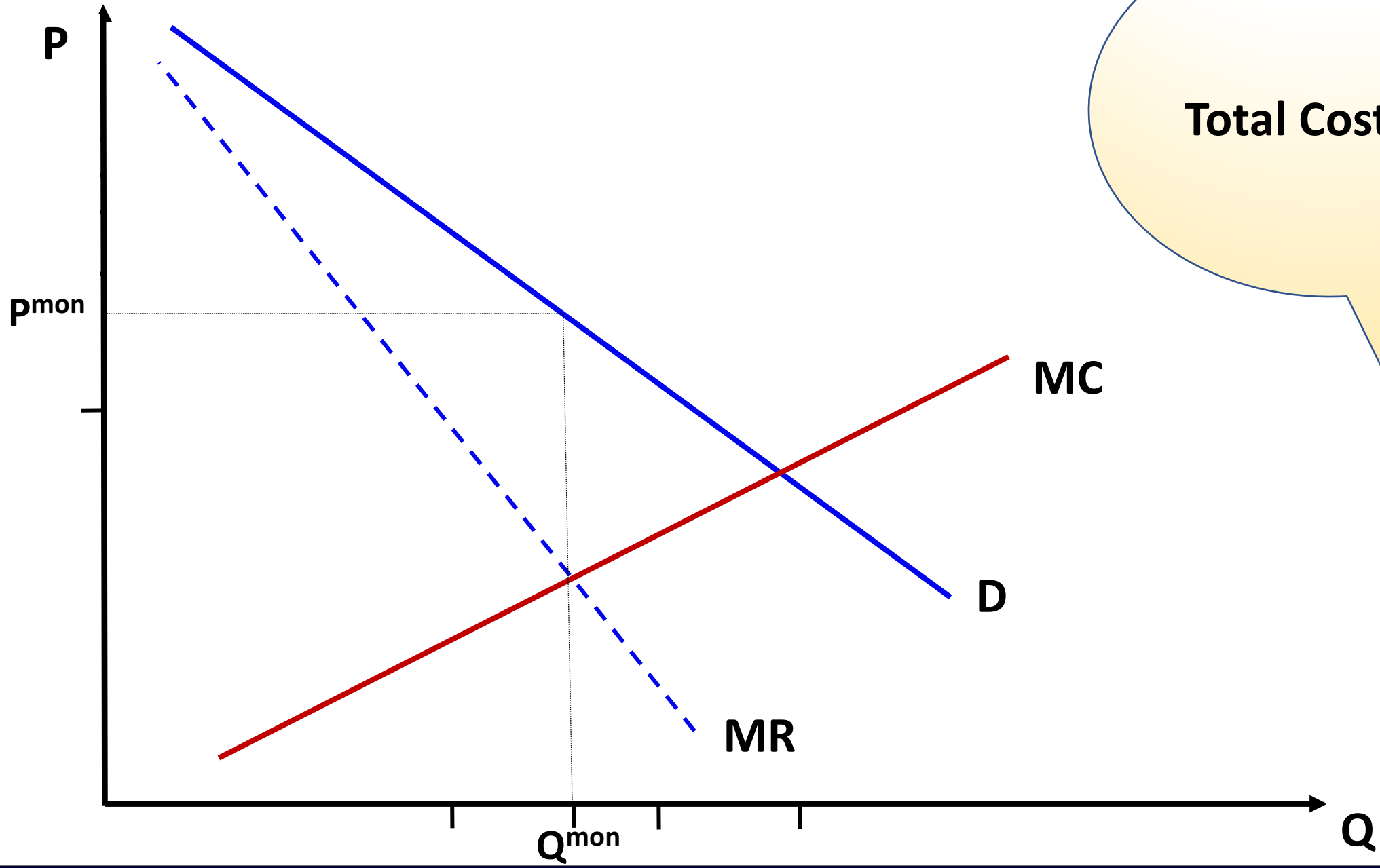
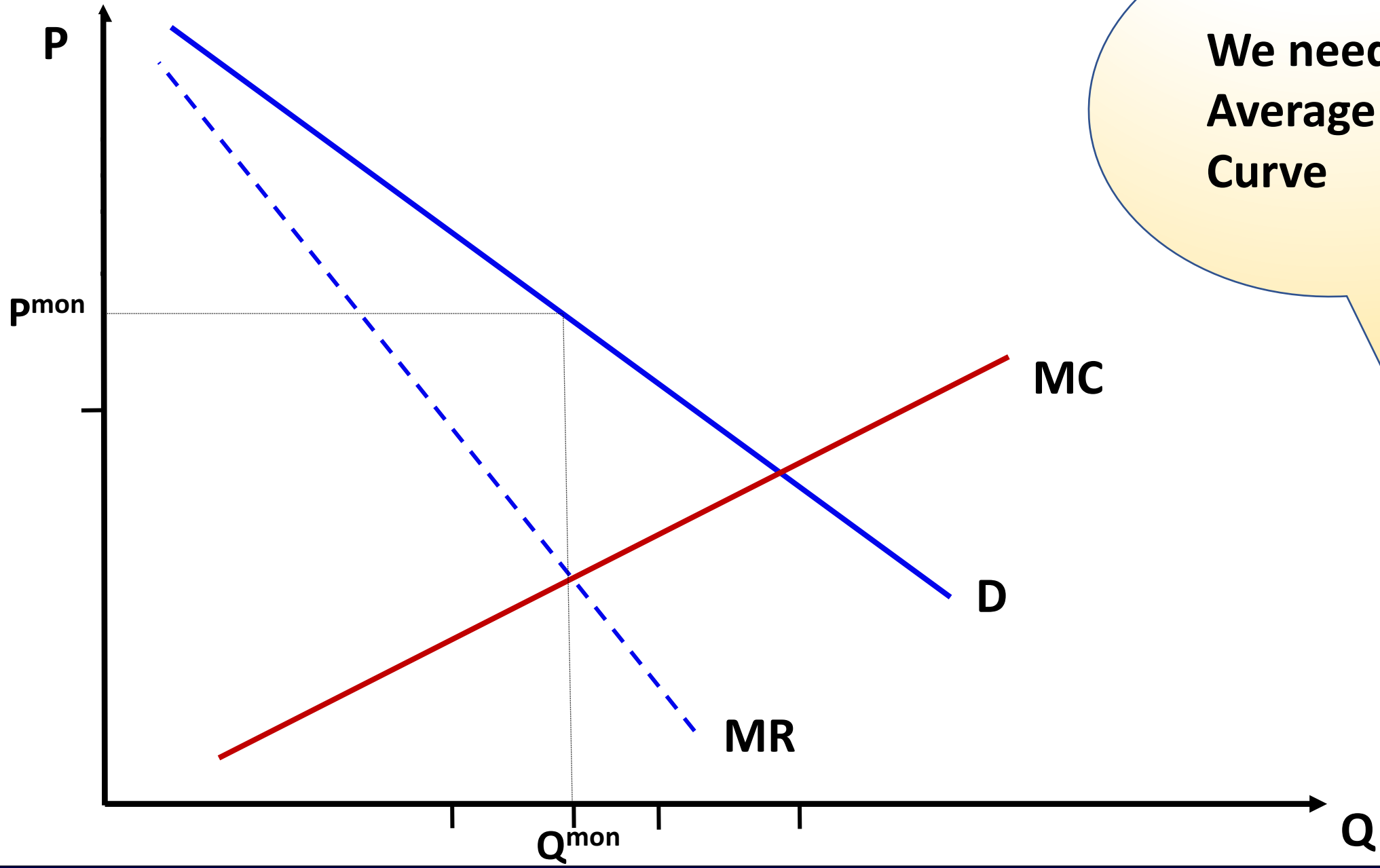
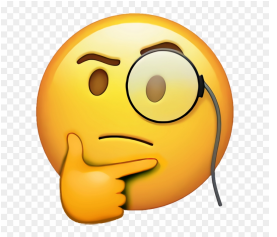



Total Cost?

# Maximizing profits




We need Average Cost Curve



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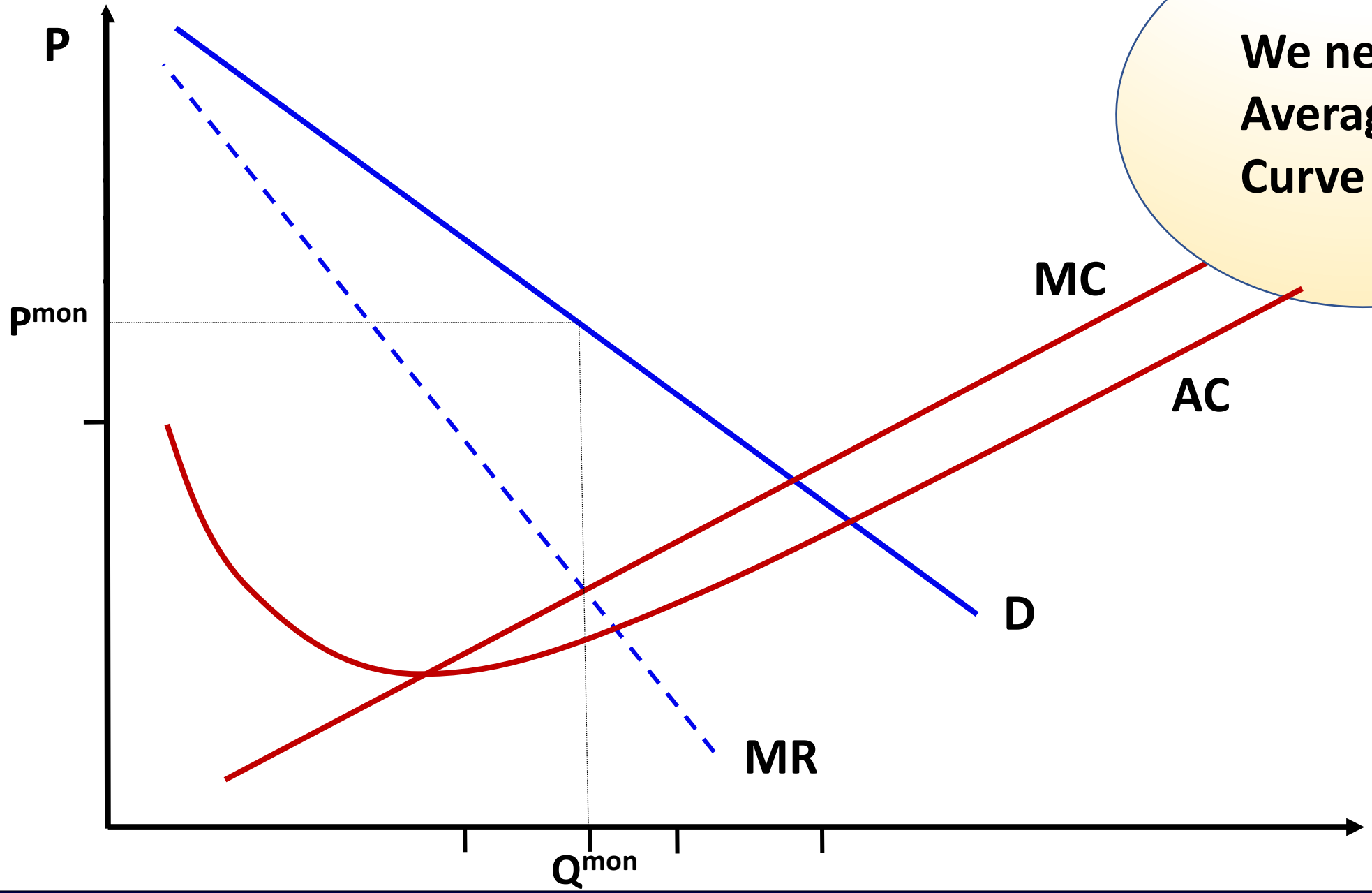


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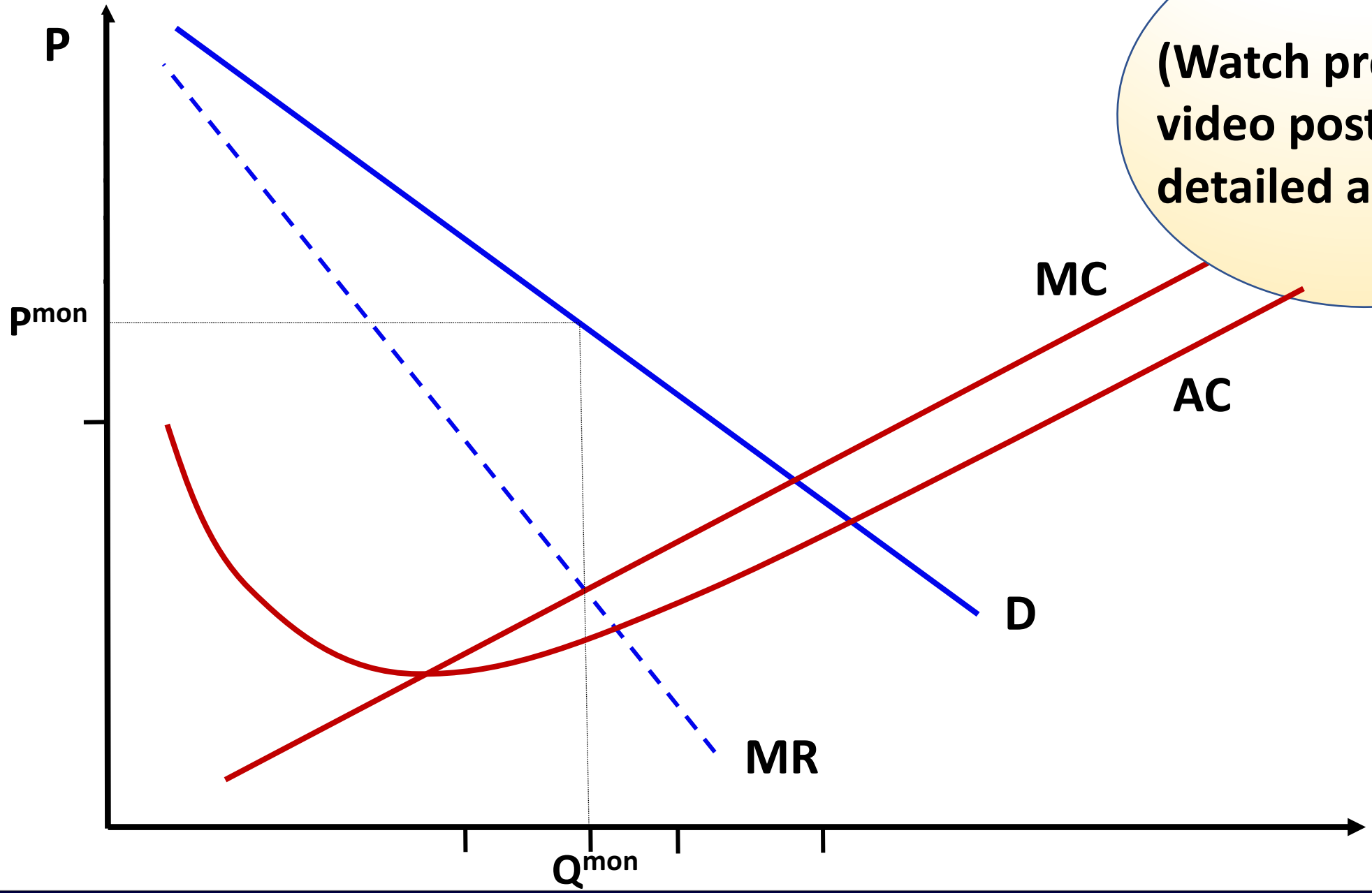



(Watch pre-lecture video posted for detailed analysis)

# A note on Profits

- **Profit = TR – TC**

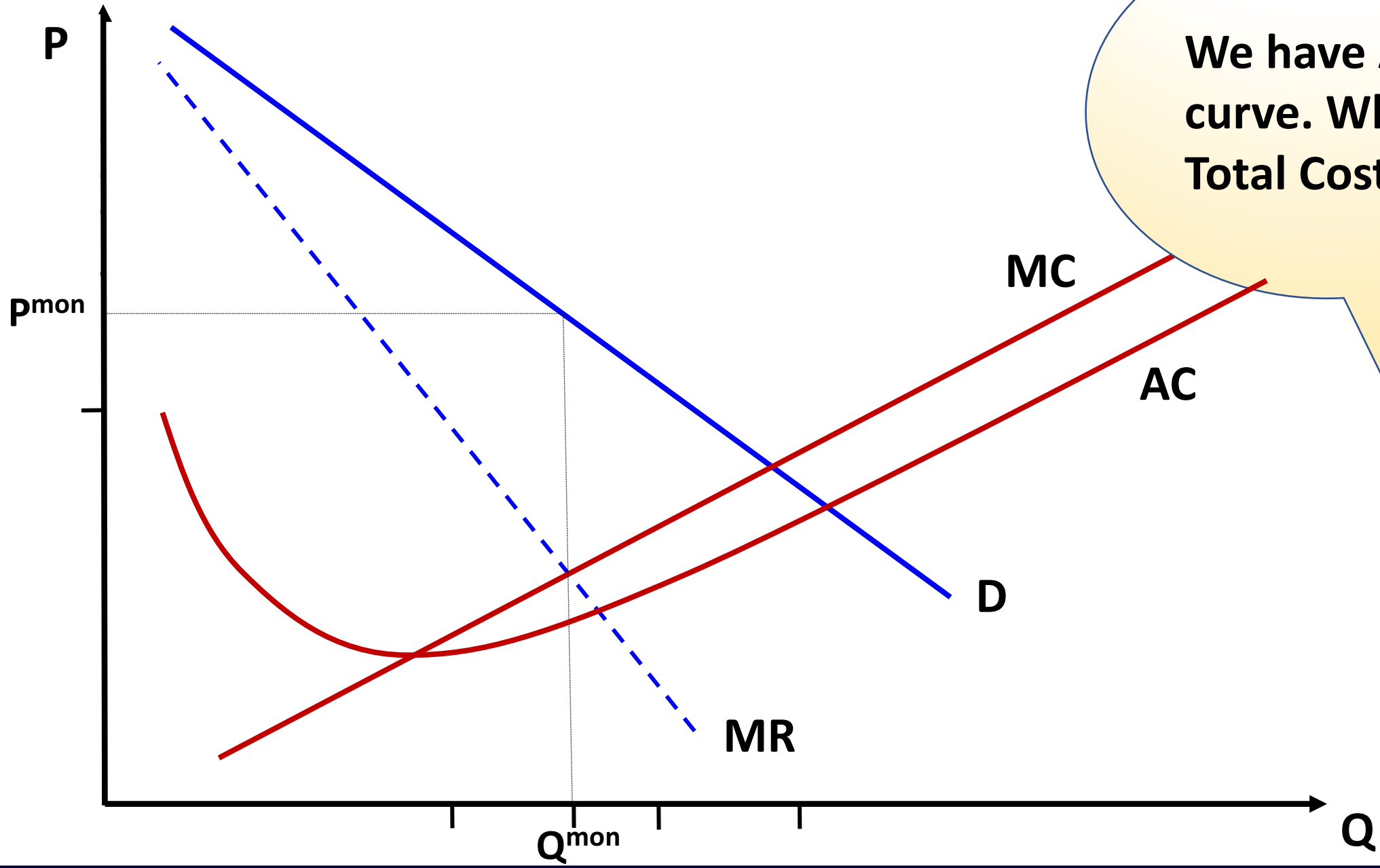
$$= PQ - Q \times \frac{TC}{Q}$$

$$= PQ - Q \times \text{Average Cost}$$

$$= PQ - Q \times AC$$

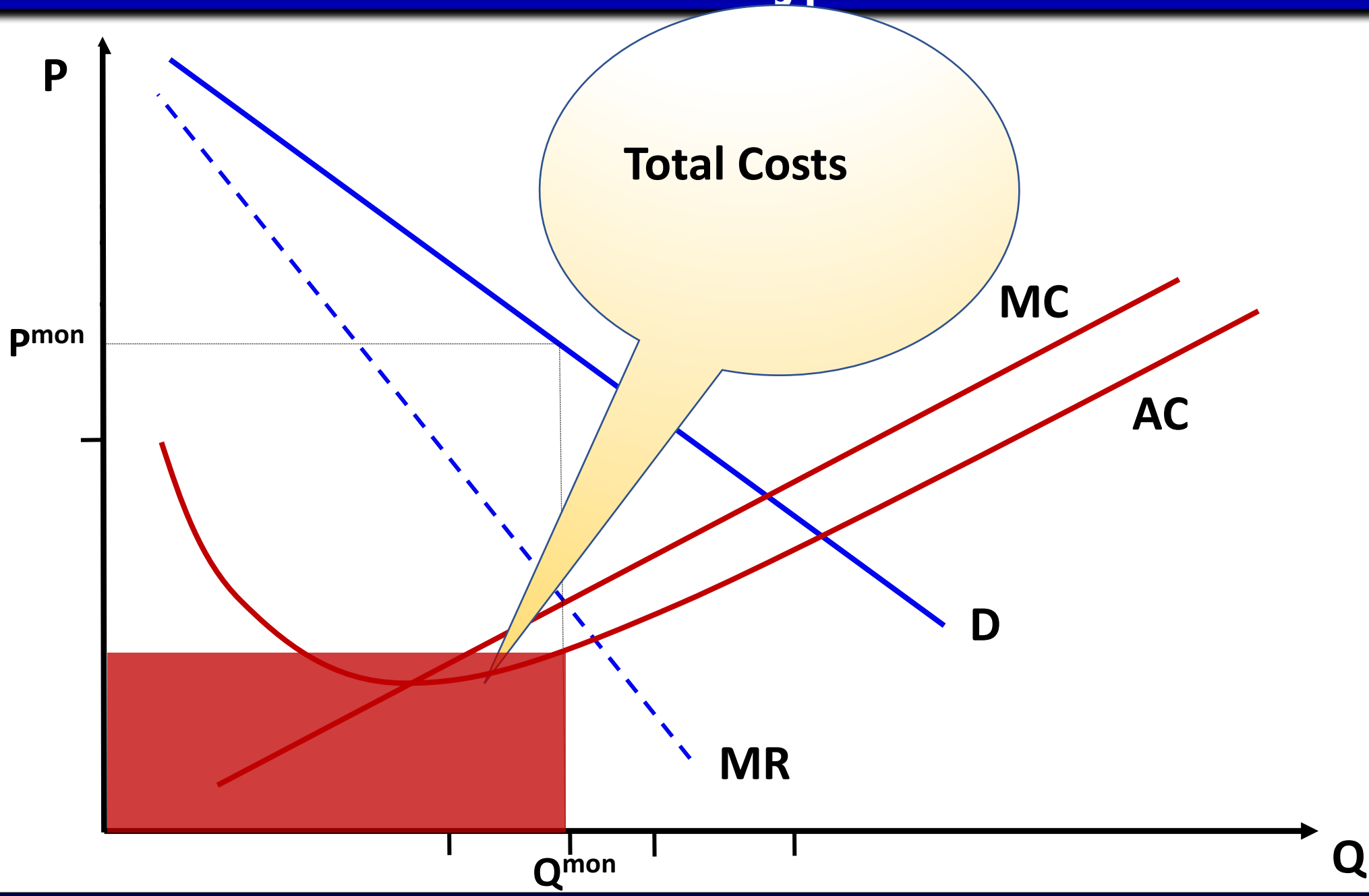
**To compute profits, we only need to know Price, Quantity, and Average Cost**

# Maximizing profits




We have AC curve. What is Total Cost?

# Maximizing profits

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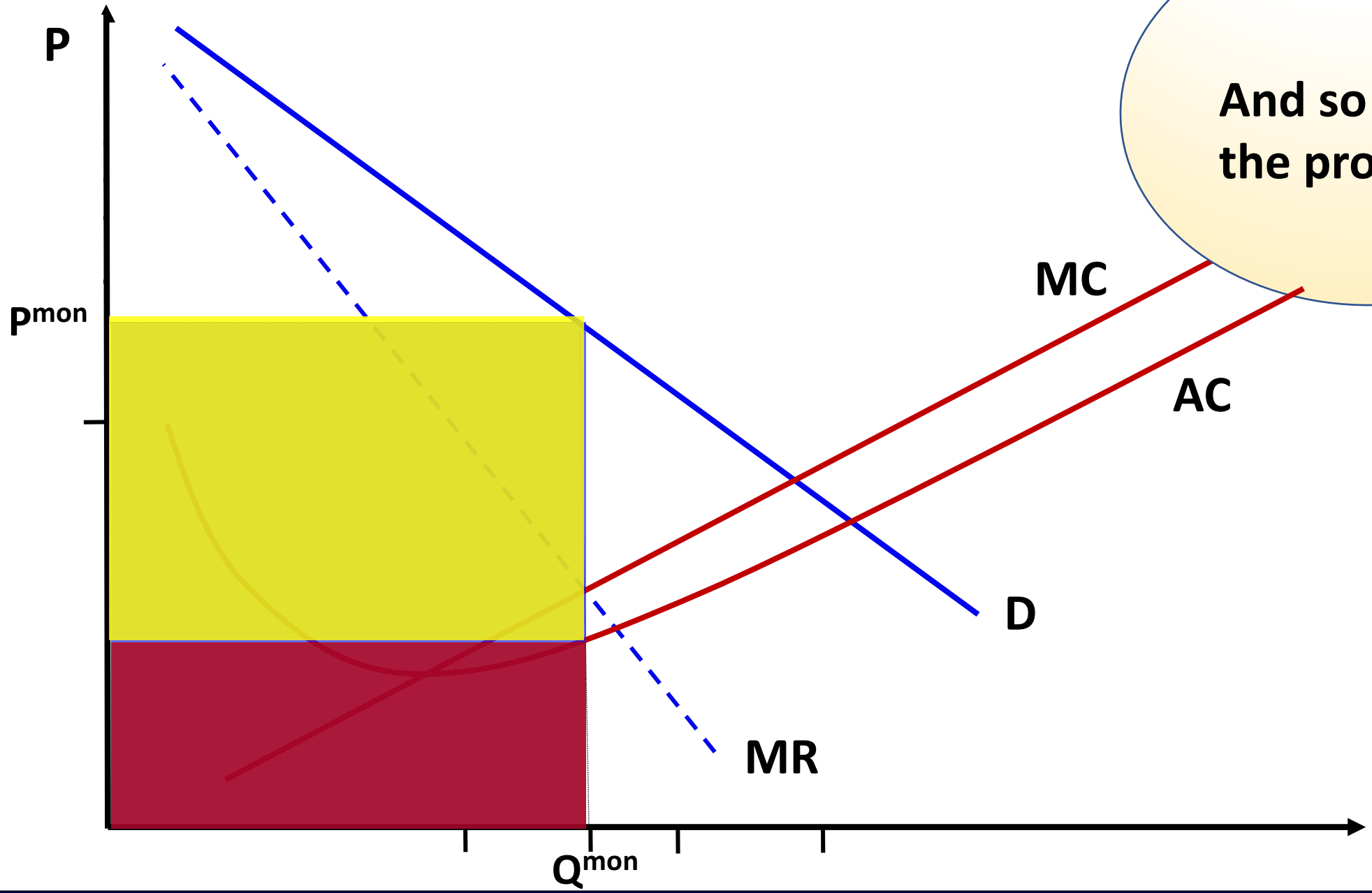
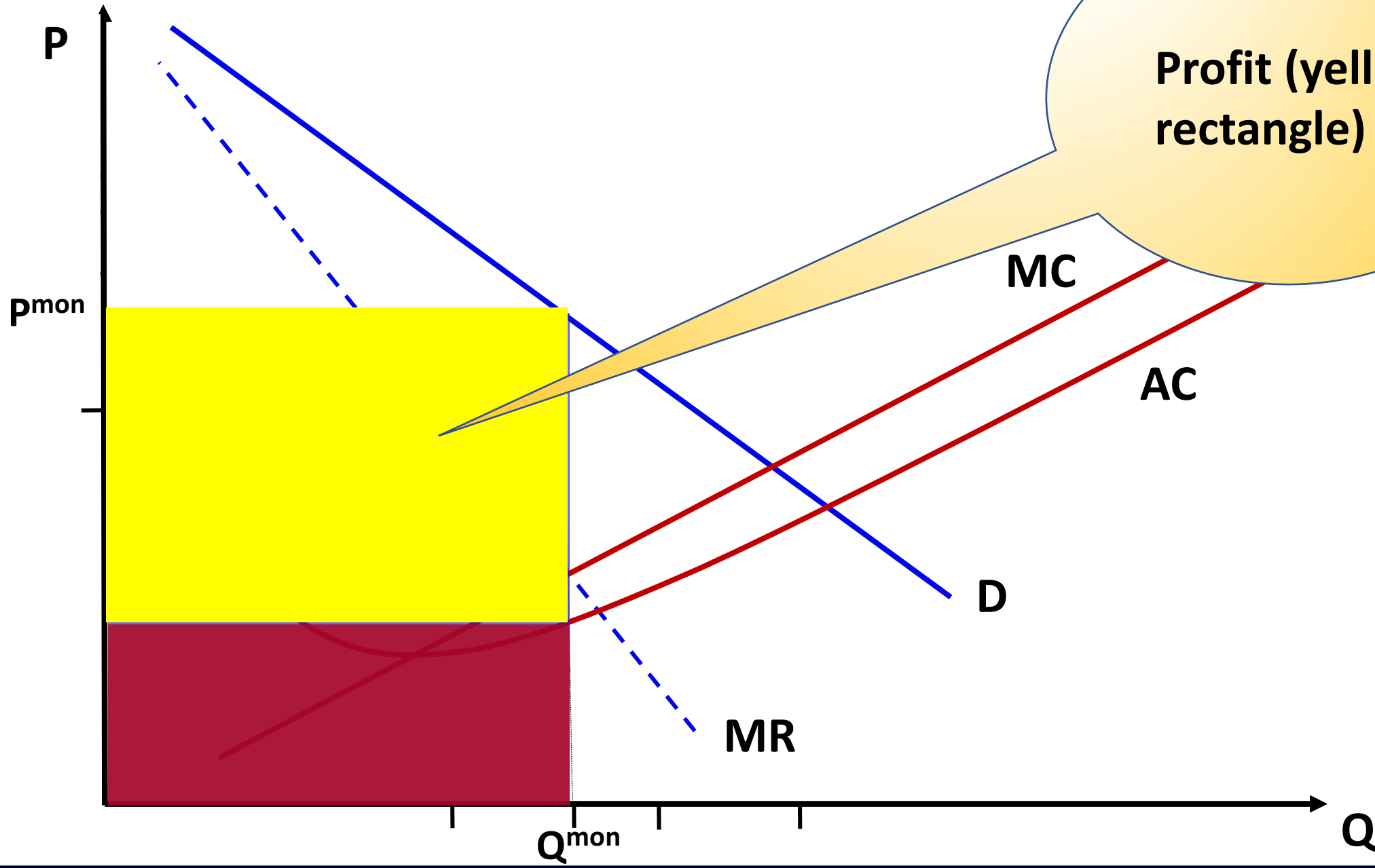



And so what is the profit?

# Maximizing profits




Profit (yellow rectangle)

# Review

- https://play.kahoot.it/v2/?quizId=fa98223a-900f-4b4d-9730-91bfd42754b1

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- **Game theory basics**
- **Application to oligopoly**

# Game Theory and Oligopoly

- **Game theory basics**
- Application to oligopoly
    - Simultaneous games
    - Sequential games

- Practise exercises

# Game Theory: key concepts

- Payoffs
- Strategy
- Best response
- Dominant strategy / dominated strategy
- Nash equilibrium

# Analyzing the game formally

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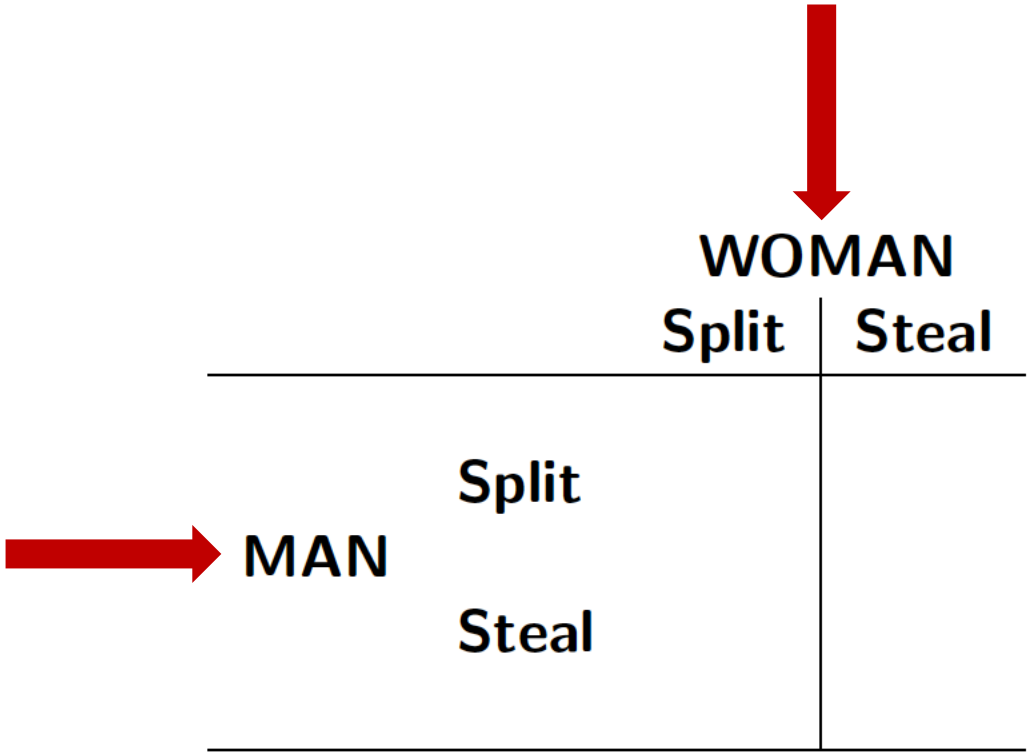
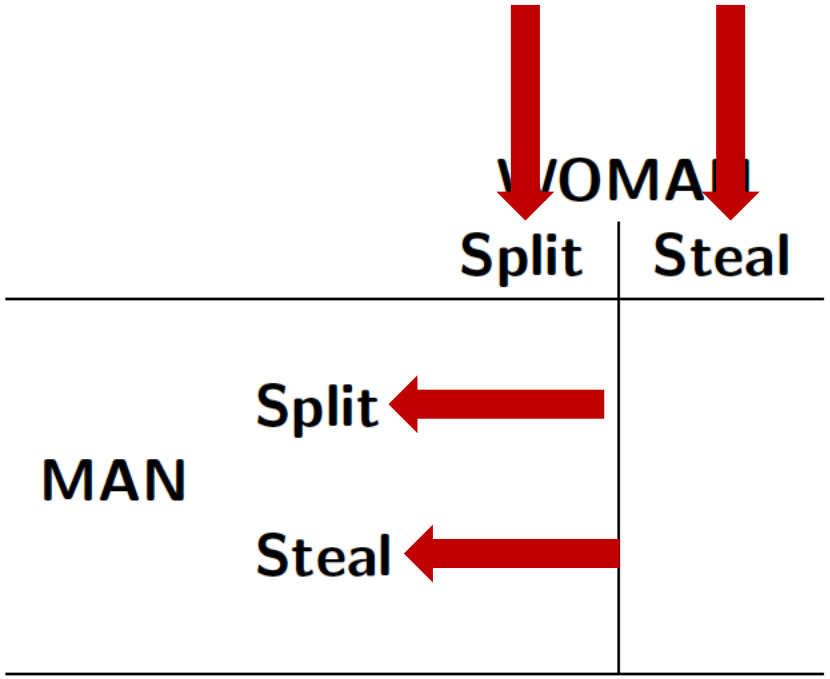
| | | WOMAN | |
|---|---|---|---|
| | | Split | Steal |
| MAN | Split | | |
| | Steal | | |

# Analyzing the game formally




**PLAYERS**

# Analyzing the game formally




**STRATEGIES**

# Analyzing the game formally

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | ($Man, $Woman) | ($Man, $Woman) |
| | Steal | ($Man, $Woman) | ($Man, $Woman) |

# Analyzing the game formally

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | ($Man, $Woman) | ($Man, $Woman) |
| | Steal | ($Man, $Woman) | ($Man, $Woman) |

# Analyzing the game formally

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | ($50,000, $50,000) | ($0, $100,000) |
| | Steal | ($100,000, $0) | ($0, $0) |

**PAYOFFS**

# The options for her

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN: Split | | (, $50,000) | (, $100,000) |
| MAN: Steal | | | |

If man splits $\Rightarrow$ Her best response is to **steal**

# The options for her

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | (, ) | (, ) |
| MAN | **Steal** | (, **$0** ) | (, **$0** ) |

If man steals $\Rightarrow$ **steal** is her best response (or as good as any other strategy)

# The options for her

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | ($50,000, $50,000) | ($0, $100,000) |
| | Steal | ($100,000, $0) | ($0, $0) |

**No matter what he does, her best option is always to play "steal"**

# The options for her

## STEAL = Dominant Strategy

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | ($50,000, $50,000) | ($0, $100,000) |
| | Steal | ($100,000, $0) | ($0, $0) |

**No matter what he does, her best option is always to play "steal"**

# The options for her

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | (\$50,000, \$50,000) | (\$0, \$100,000) |
| | Steal | (\$100,000, \$0) | (\$0, \$0) |

**Steal** is *always* her best strategy $\rightarrow$ Dominant Strategy

# The options for her

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | (\$50,000, \$50,000) | (\$0, \$100,000) |
| | Steal | (\$100,000, \$0) | (\$0, \$0) |

**Steal** is *always* her best strategy → Dominant Strategy

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# The options for her

Outcome of the game?

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | (\$50,000, \$50,000) | (\$0, \$100,000) |
| MAN | Steal | (\$100,000, \$0) | (\$0, \$0) |

**Steal** is *always* her best strategy → Dominant Strategy

**Steal** is *always* his best strategy → Dominant Strategy

# The options for her

Outcome of the game?

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | (\$50,000, \$50,000) | (\$0, \$100,000) |
| MAN | Steal | (\$100,000, \$0) | (\$0, \$0) |

**Steal** is *always* her best strategy → Dominant Strategy
**Steal** is *always* his best strategy → Dominant Strategy
**(Steal, Steal)**

# The options for her

All players play the "best response" given the strategy of the other player

| | | WOMAN: Split | WOMAN: Steal |
|---|---|---|---|
| MAN | Split | (\$50,000, \$50,000) | (\$0, \$100,000) |
| MAN | Steal | (\$100,000, \$0) | (\$0, \$0) |

**Steal** is *always* her best strategy → Dominant Strategy
**Steal** is *always* his best strategy → Dominant Strategy
**(Steal, Steal)** is what we call a Nash Equilibrium

# Analyzing the game formally

- **Analysis is the same for him**
- **She is being rational: using all information to maximize utility**
- **Playing “Steal” makes her RATIONAL. This is NOT a value judgment.**

# Game Theory and Oligopoly

- Game theory basics
- **Application to oligopoly**
  - **Simultaneous games**
  - Sequential games

- Practise exercises

# Summary of Oligopoly

- Market dominated by a small number of strategically interacting firms
- Origins (similar to monopoly)
- Measuring it: Herfindahl index
- Spotting it: rocket & feather

# Measuring it

- **Herfindahl index (or Hirsch-Herfindahl Index)**

- **$HHI = Share_1^2 + Share_2^2 + Share_3^2 + \ldots Share_N^2$**
-

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# Measuring it

- **Herfindahl index (or Hirsch-Herfindahl Index)**
- **$HHI = Share_1^2 + Share_2^2 + Share_3^2 + \ldots Share_N^2$**
- 

**50%**

**30%**

**17.5%**

# Measuring it

- **Herfindahl index (or Hirsch-Herfindahl Index)**
- **$HHI = Share_1^2 + Share_2^2 + Share_3^2 + \ldots Share_N^2$**
- 


  **50%** **30%** **17.5%**

- **$HHI = 0.5^2 + 0.3^2 + 0.175^2 = 0.370625$**

**(Note: the book uses %, so $50^2 + 30^2 + 17.5^2 = 3706.25$)**

# Measuring it

- **Herfindahl index (or Hirsch-Herfindahl Index)**

- **Always between 0 and 1 (book: btw. 0 and 10,000)**

    - **What would 0 mean?**
    - **What would 1 mean?**

# Measuring it

- **Herfindahl index (or Hirsch-Herfindahl Index)**

- **Always between 0 and 1 (book: btw. 0 and 10,000)**

    - **What would 0 mean?**
    - **What would 1 mean?**

# Measuring it

- Herfindahl index (or Hirsch-Herfindahl Index)

- Always between 0 and 1 (book: btw. 0 and 10,000)

    - What would 0 mean? Perfect competition
    - What would 1 mean? Monopoly

# Spotting it: rocket & feather

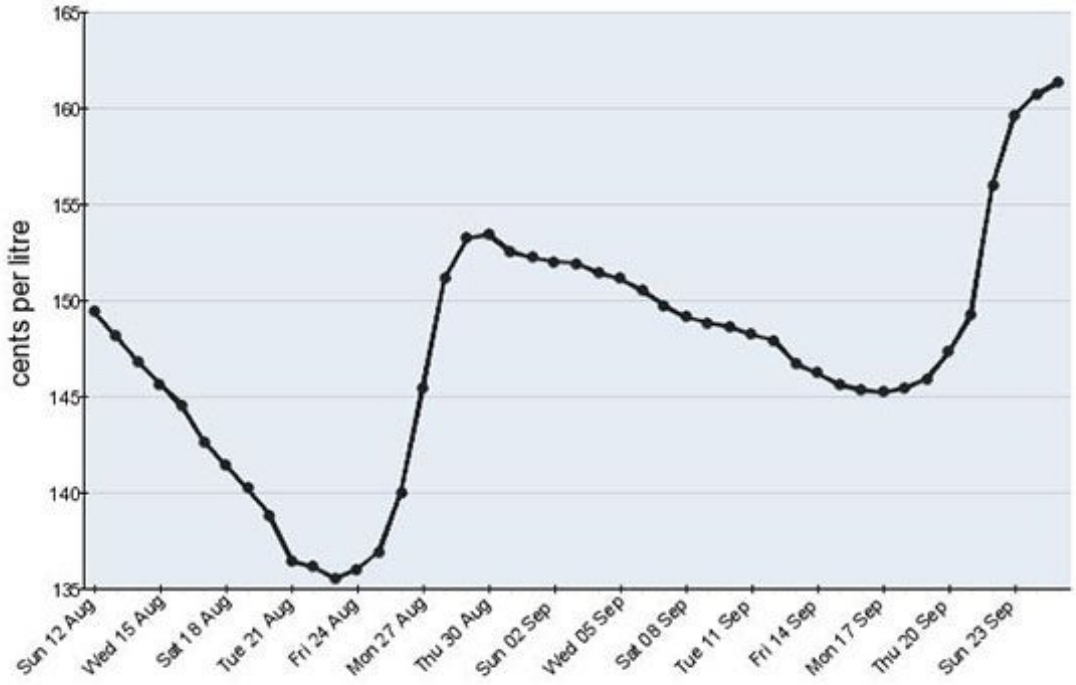
# Spotting it: rocket & feather

## Petrol prices in Sydney

**Buying tip** (updated Monday, Wednesday and Friday):

- prices are **decreasing** but they are likely to decrease further
- if possible, motorists should **delay** buying petrol until later.

The chart below shows daily average E10 petrol prices in Sydney over the past 45 days.




Source: FUELtrac

# Spotting it: rocket & feather

- **Prices increase fast**
- **Prices decrease very slowly**

Petrol prices in Sydney

**Buying tip** (updated Monday, Wednesday and Friday):

- prices are **decreasing** but they are likely to decrease further
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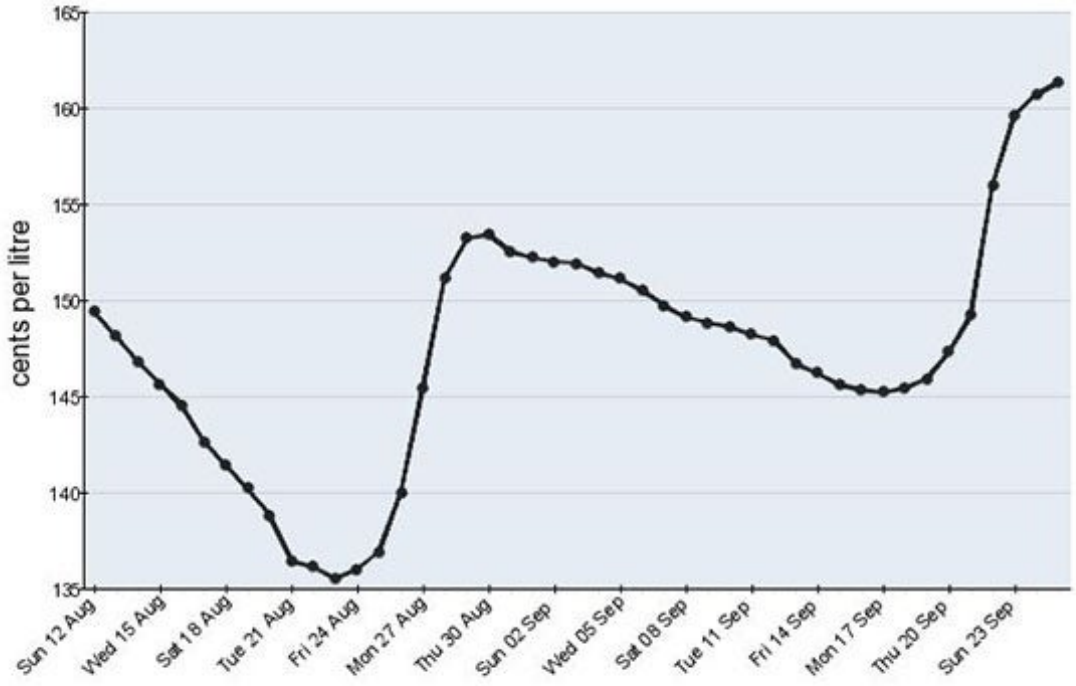


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# SINGTEL AND STARHUB


# SINGTEL AND STARHUB



| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

# SINGTEL AND STARHUB

## PLAYERS?



| | Charge $20 | Charge $50 |
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# SINGTEL AND STARHUB

## PLAYERS?





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# SINGTEL AND STARHUB

## STRATEGIES?



| | Charge $20 | Charge $50 |
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# SINGTEL AND STARHUB

## STRATEGIES?



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# SINGTEL AND STARHUB

## PAYOFFS?



| | Charge $20 | Charge $50 |
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| Charge $20 | (2M, 2M) | (5M, 1M) |
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# SINGTEL AND STARHUB

## PAYOFFS SINGTEL?



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|---|---|---|
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# SINGTEL AND STARHUB

## PAYOFFS STARHUB?

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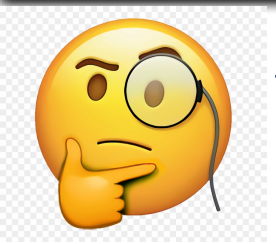
# SOLVING THE GAME



**Suppose Starhub charges $20. What's the best thing Singtel can do?**

StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
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| **Charge $50** | **(1M, 5M)** | **(4M, 4M)** |

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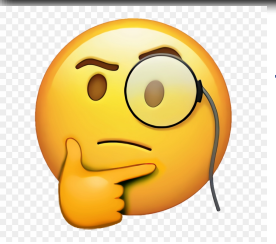

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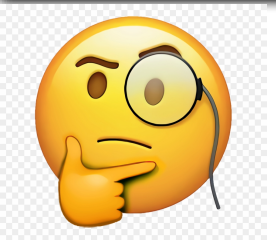

StarHub

Charge $20

| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

Singtel

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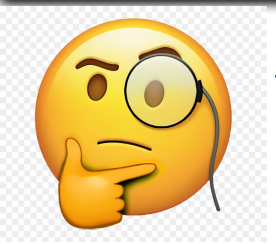

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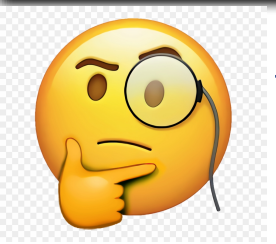

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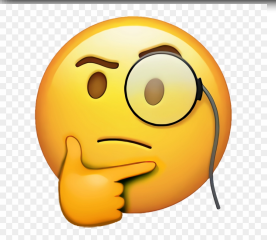

Charge $20

StarHub

Singtel

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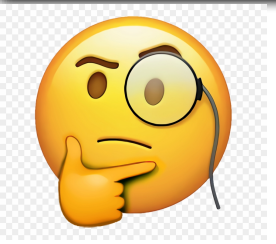


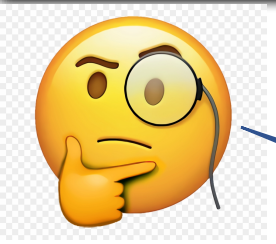
Charge $20 is a dominant strategy for Singtel

StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

# SOLVING THE GAME



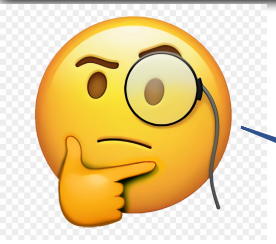
StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | |
| Charge $50 | (1M, 5M) | |

**Check:**
**Charge $20 is a dominant strategy for Starhub**

# SOLVING THE GAME



StarHub

Singtel

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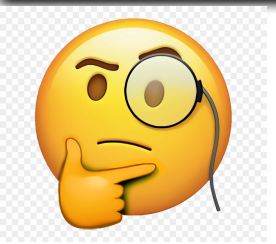
**Outcome of the game (=Nash Equilibrium)?**

# SOLVING THE GAME



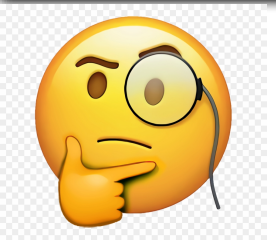
Both charge $20 and win 2M

StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

# SOLVING THE GAME



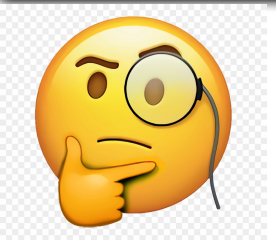
If Both charged $50 they would win 4M

StarHub

| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

Singtel

# SOLVING THE GAME



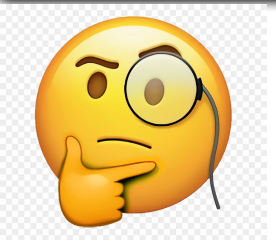
But it's not the rational outcome. Why?

StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

# SOLVING THE GAME



Both have an incentive to "deviate"

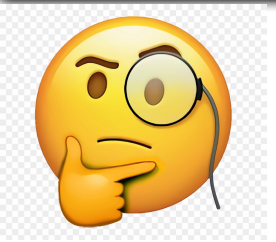
| | Charge $20 | Charge $50 |
|---|---|---|
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

# SINGTEL AND STARHUB

- Sometimes when players are rational they end up with seemingly suboptimal payoffs
- If this game is played only once, they both end up with small profits
- In this case, it is clear they have an incentive to collude (since they can both double up on profits)

| | | |
|---|---|---|
| | Charge $20 | Charge $50 |
| Charge $20 | (2M, 2M) | (5M, 1M) |
| Charge $50 | (1M, 5M) | (4M, 4M) |

# SOLVING THE GAME



**IMPORTANT!!**

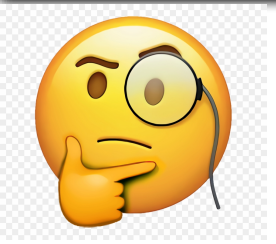
**If they play many times (many years)…**

StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
| **Charge $20** | **(2M, 2M)** | **(5M, 1M)** |
| **Charge $50** | **(1M, 5M)** | **(4M, 4M)** |

# SOLVING THE GAME



**IMPORTANT!!**

**Then they reach ($50, $50) outcome**

StarHub

Singtel

| | Charge $20 | Charge $50 |
|---|---|---|
| **Charge $20** | **(2M, 2M)** | **(5M, 1M)** |
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# SINGTEL AND STARHUB

- **If play repeatedly, many many times, and both charge $20 every time, they are not maximizing benefits. Not optimal.**

# SINGTEL AND STARHUB

- **If play repeatedly, many many times, and both charge $20 every time, they are not maximizing benefits. Not optimal.**

- **So, if both know they will play this game many many times in a row, they better start "testing the waters" – that is, charging $50.**

# SINGTEL AND STARHUB

- **If play repeatedly, many many times, and both charge $20 every time, they are not maximizing benefits. Not optimal.**

- **So if both know they will play this game many many times in a row, they better start "testing the waters" – that is, charging $50.**

- **If one firm (say Singtel) deviates at some point to increase her benefits, then the other one (Starhub) retaliates by charging also $20 next period ("to punish"). Knowing that (that is, knowing that Starhub will retaliate), Singtel is better off by not lowering to $20 ever.**

# SINGTEL AND STARHUB

- If play repeatedly, many many times, and both charge $20 every time, they are not maximizing benefits. Not optimal.
- So if both know they will play this game many many times in a row, they better start "testing the waters" – that is, charging $50.
- If one firm (say Singtel) deviates at some point to increase her benefits, then the other one (Starhub) retaliates by charging also $20 next period ("to punish"). Knowing that (that is, knowing that Starhub will retaliate), Singtel is better off by not lowering to $20 ever.
- → Long run best solution: both play $50

# VENEZUELA AND SAUDI ARABIA

| | | SAUDI ARABIA: Cut oil production | SAUDI ARABIA: Max. oil production |
|---|---|---|---|
| VENEZUELA | Cut oil production | | |
| | Max. oil production | | |

# VENEZUELA AND SAUDI ARABIA

| | | SAUDI ARABIA |
|---|---|---|
| | **Cut oil production** | **Max. oil production** |
| **VENEZUELA** **Cut oil production** | **(25M, 50M)** | **(8M, 30M)** |
| **Max. oil production** | **(20M, 18M)** | **(18M, 28M)** |

# VENEZUELA AND SAUDI ARABIA

If Saudi Arabia cuts, then Venezuela should …

| | | SAUDI ARABIA: Cut oil production | SAUDI ARABIA: Max. oil production |
|---|---|---|---|
| VENEZUELA | Cut oil production | (25M, 50M) | (8M, 30M) |
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# VENEZUELA AND SAUDI ARABIA

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# VENEZUELA AND SAUDI ARABIA

If Venezuela cuts, then Saudi Arabia should …

| | | SAUDI ARABIA | |
|---|---|---|---|
| | | Cut oil production | Max. oil production |
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# VENEZUELA AND SAUDI ARABIA

If Venezuela cuts, then Saudi Arabia should cut

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|---|---|---|
| | Cut oil production | Max. oil production |
| VENEZUELA: Cut oil production | (25M, 50M) | (8M, 30M) |
| VENEZUELA: Max. oil production | (20M, 18M) | (18M, 28M) |

# VENEZUELA AND SAUDI ARABIA

## "Cut" is a best response to "cut" for both → Nash Equilibrium

| | | SAUDI ARABIA: Cut oil production | SAUDI ARABIA: Max. oil production |
|---|---|---|---|
| VENEZUELA | Cut oil production | (25M, 50M) | (8M, 30M) |
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# VENEZUELA AND SAUDI ARABIA

If Saudi Arabia maximizes, then Venezuela should …

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# VENEZUELA AND SAUDI ARABIA

If Saudi Arabia maximizes, then Venezuela should maximize

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# VENEZUELA AND SAUDI ARABIA

If Venezuela maximizes, then Saudi Arabia should maximize

| | | SAUDI ARABIA | |
|---|---|---|---|
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# VENEZUELA AND SAUDI ARABIA

## "Maximize" is a best response to "maximize" for both → Nash Equilibrium

| | | SAUDI ARABIA: Cut oil production | SAUDI ARABIA: Max. oil production |
|---|---|---|---|
| VENEZUELA | Cut oil production | (25M, 50M) | (8M, 30M) |
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# VENEZUELA AND SAUDI ARABIA

- **Two Nash Equilibria (=two rational outcomes)**
  - **Both cutting production**
  - **Both maximising production**

- **We cannot predict which one will take place**

# Game Theory and Oligopoly

- Game theory basics
- **Application to oligopoly**
  - Simultaneous games
  - **Sequential games**

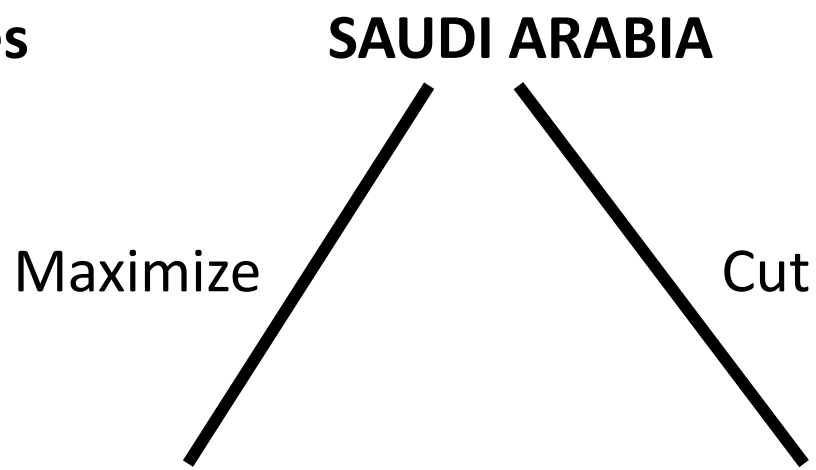
- Practise exercises

# VENEZUELA AND SAUDI ARABIA

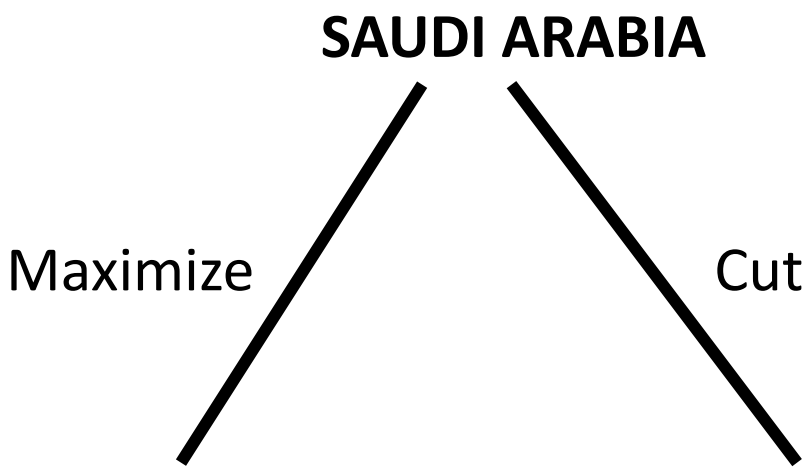
- **Now suppose they do not decide simultaneously**
- **Suppose Saudi Arabia moves first**
- **Is that to her advantage?**

# VENEZUELA AND SAUDI ARABIA

**STAGE 1: SAUDI chooses**

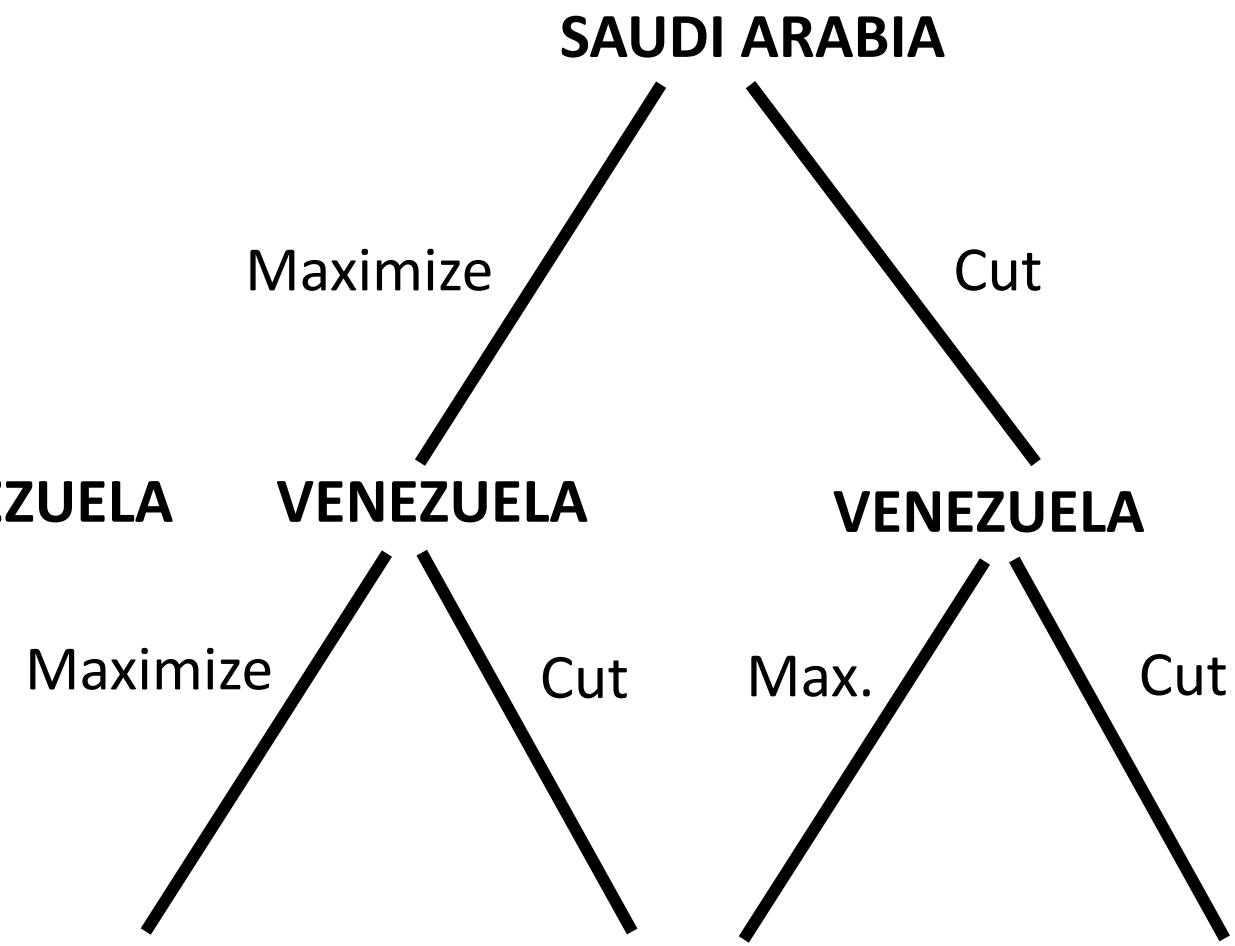


# VENEZUELA AND SAUDI ARABIA



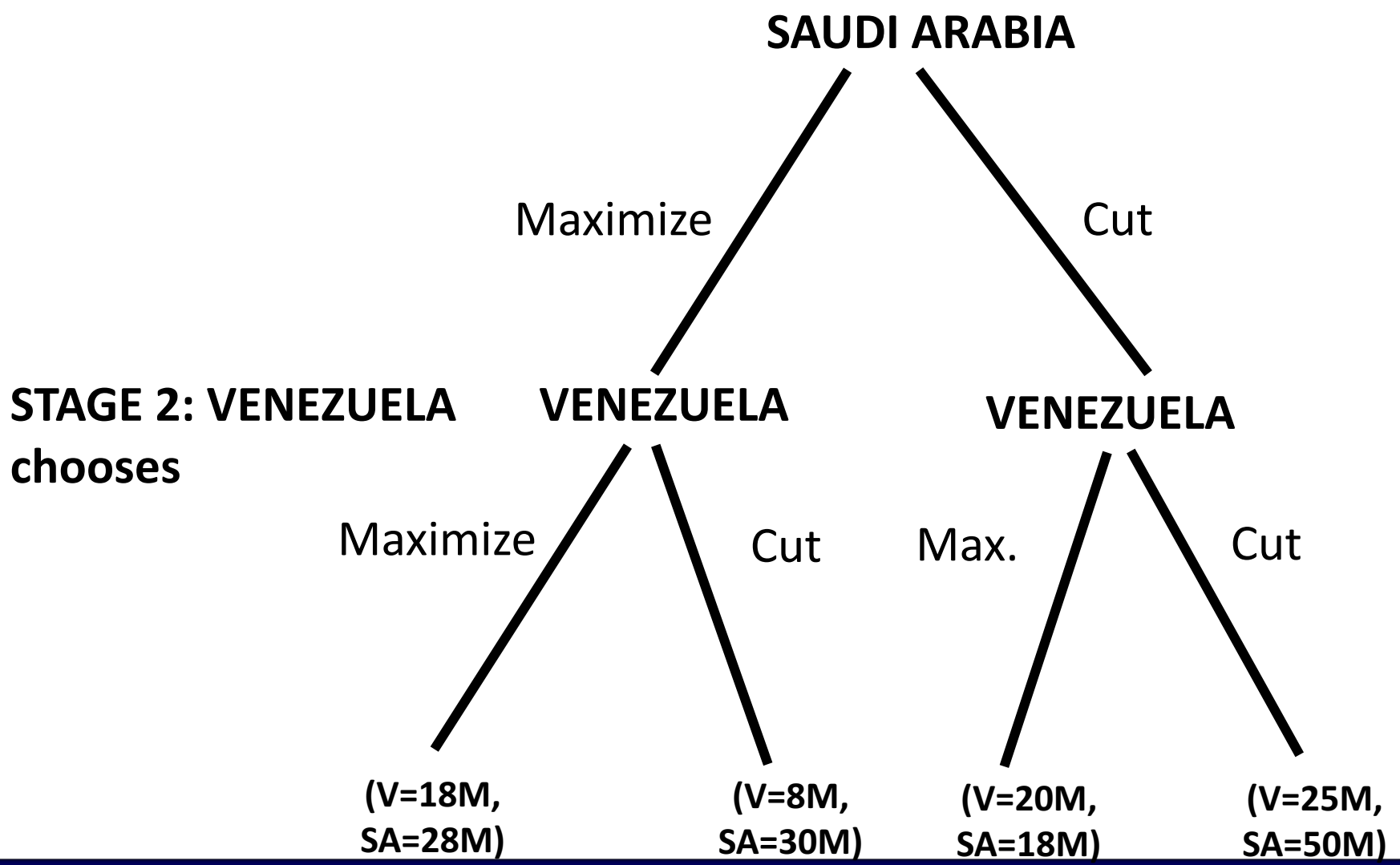

**STAGE 2: VENEZUELA chooses**

# VENEZUELA AND SAUDI ARABIA




**STAGE 2: VENEZUELA chooses**

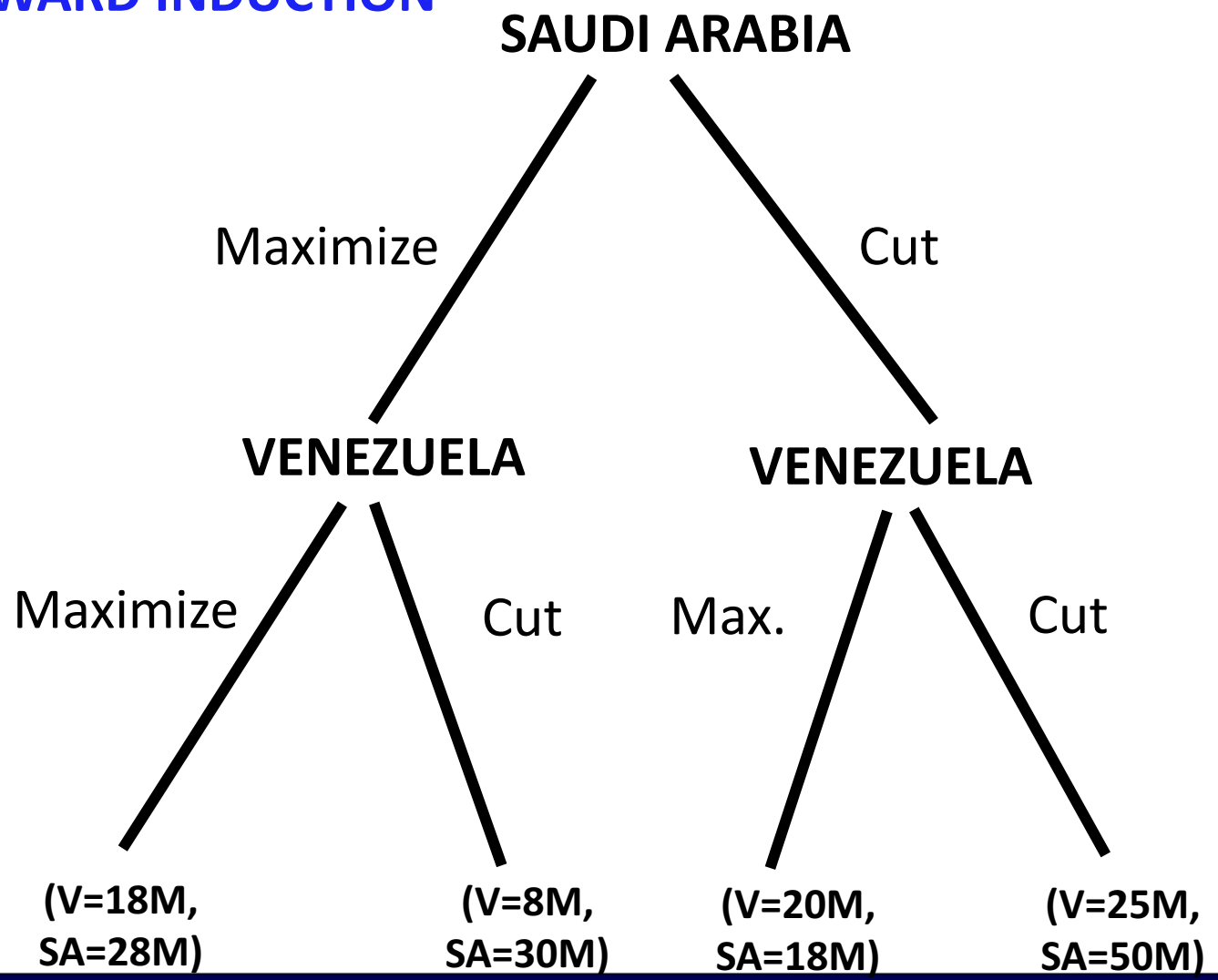
# VENEZUELA AND SAUDI ARABIA




**STAGE 2: VENEZUELA chooses**

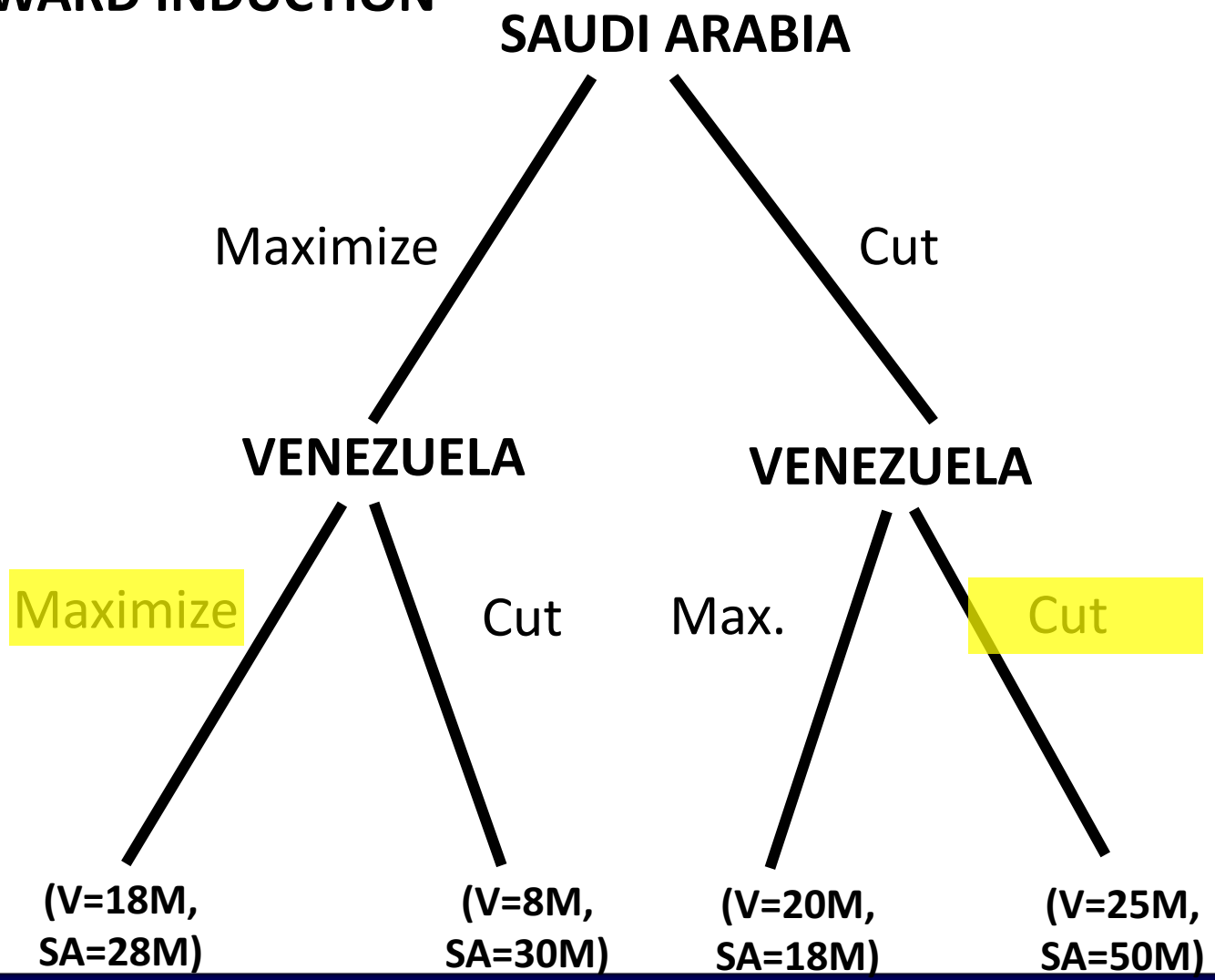
# VENEZUELA AND SAUDI ARABIA

## SOLVE BY BACKWARD INDUCTION



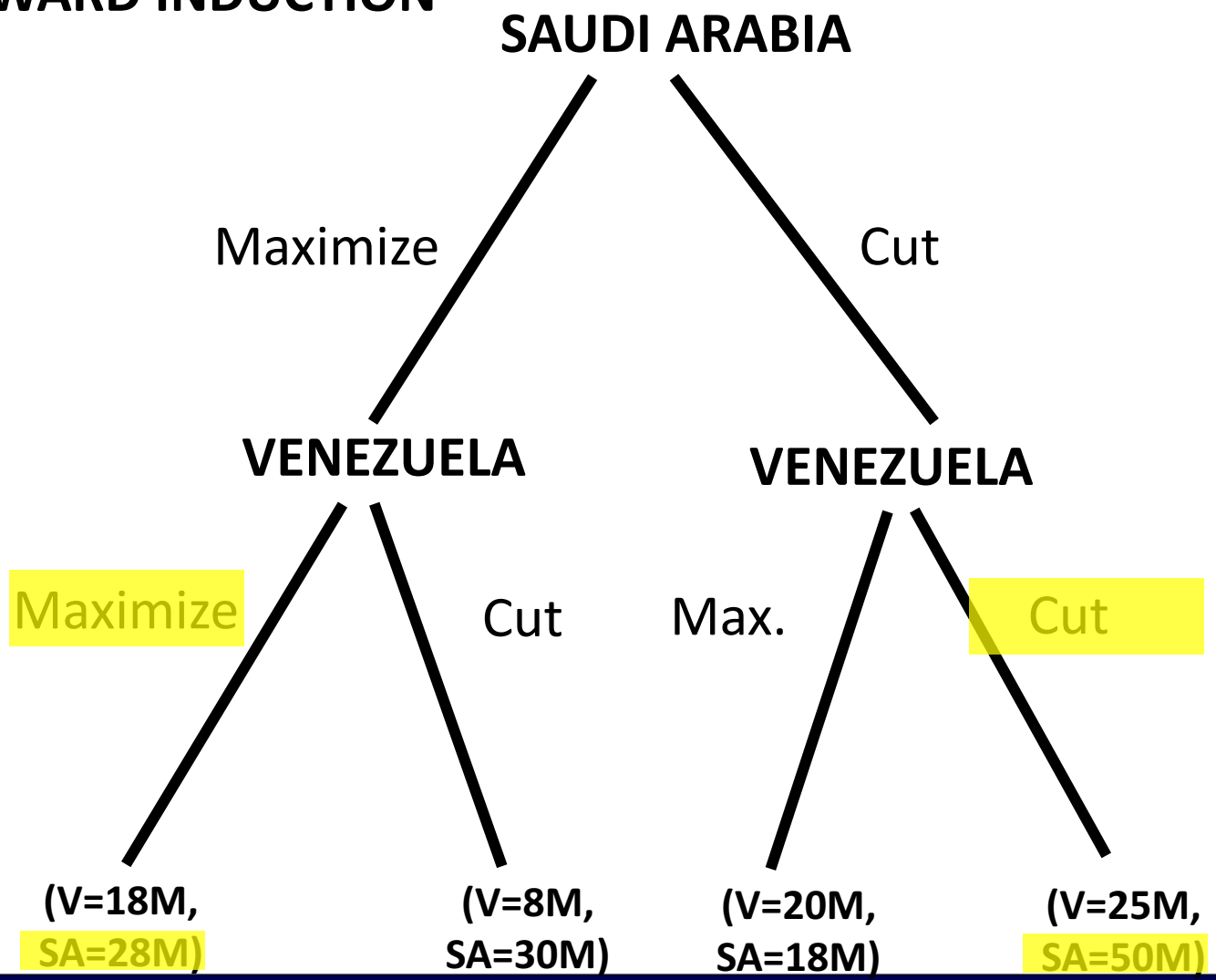
# VENEZUELA AND SAUDI ARABIA

**SOLVE BY BACKWARD INDUCTION**



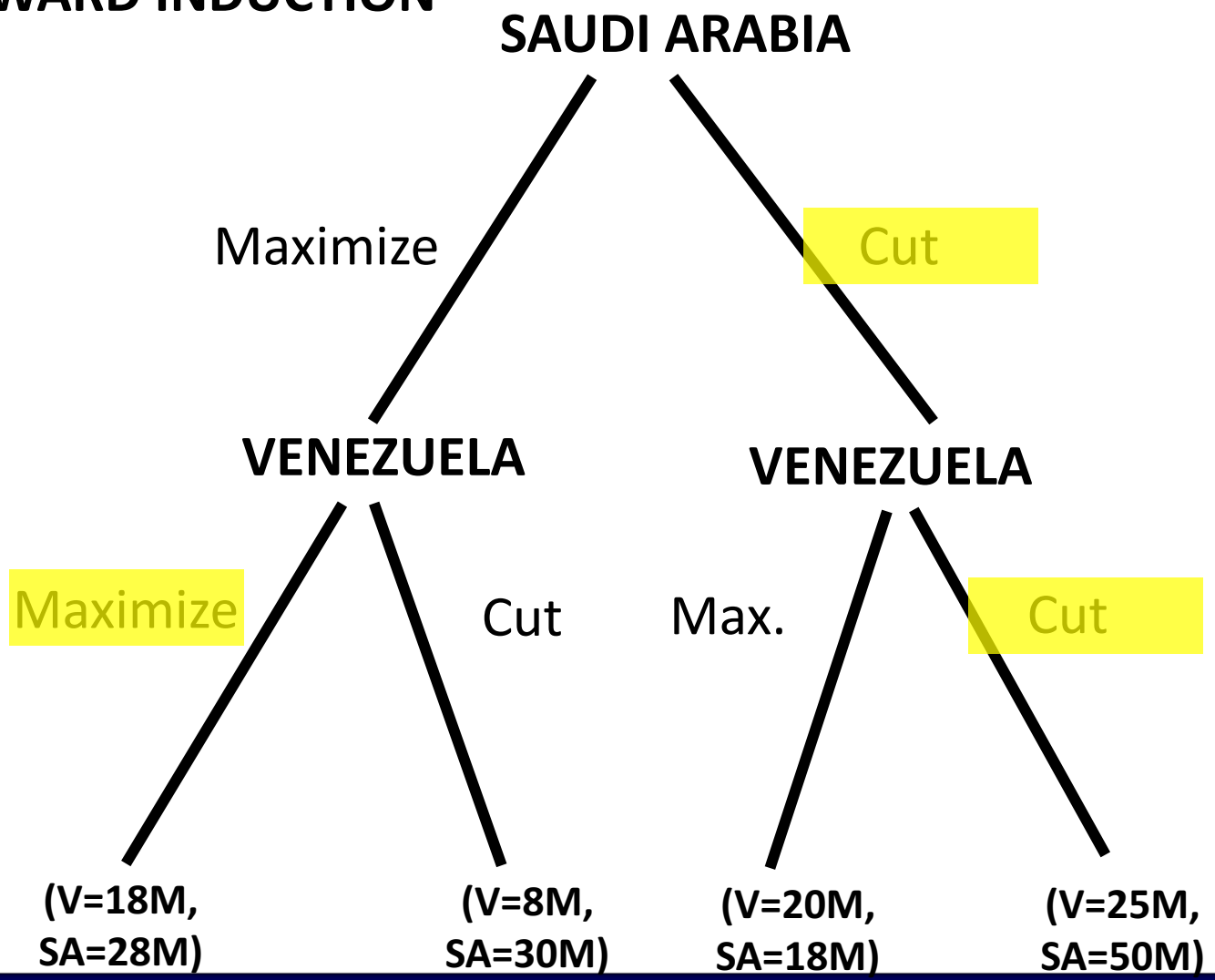
# VENEZUELA AND SAUDI ARABIA

**SOLVE BY BACKWARD INDUCTION**



# VENEZUELA AND SAUDI ARABIA

**SOLVE BY BACKWARD INDUCTION**



# VENEZUELA AND SAUDI ARABIA

- **Outcome: Saudi Arabia cuts, Venezuela cuts**
- **Key is backward induction: knowing what Venezuela will do, Saudi Arabia can optimize**

# VENEZUELA AND SAUDI ARABIA

- **Now suppose they do not decide simultaneously**
- **Suppose Saudi Arabia moves first**
- **Is that to her advantage?**

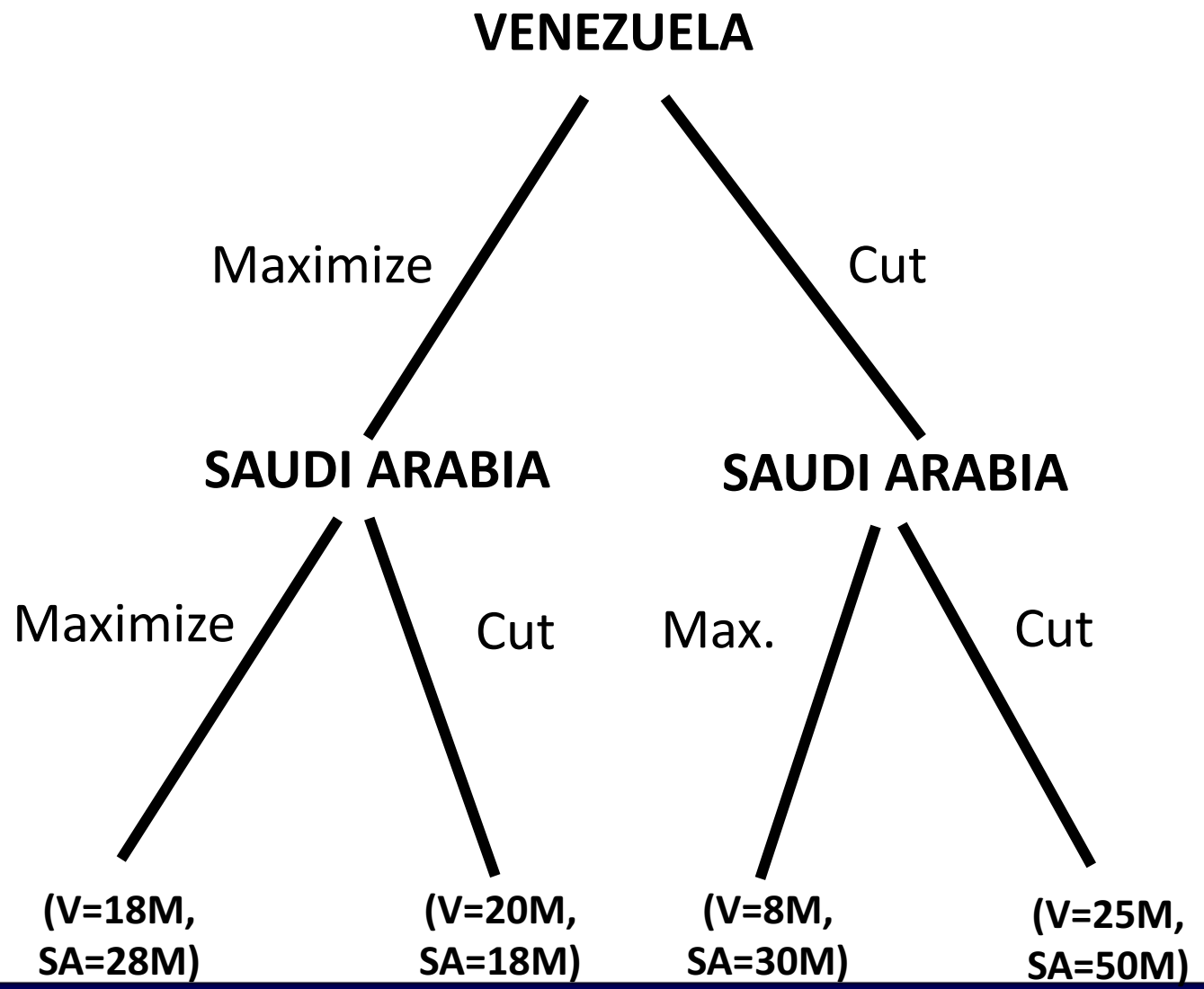
# VENEZUELA AND SAUDI ARABIA

- **Now suppose they do not decide simultaneously**
- **Suppose Saudi Arabia moves first**
- **Is that to her advantage? In this case it does not really matter. How do we know? Check what happens if Venezuela moves first. BUT USUALLY IT MATTERS! Firms/Countries would want to move first.**

# VENEZUELA AND SAUDI ARABIA

**STAGE 1: Venezuela chooses**

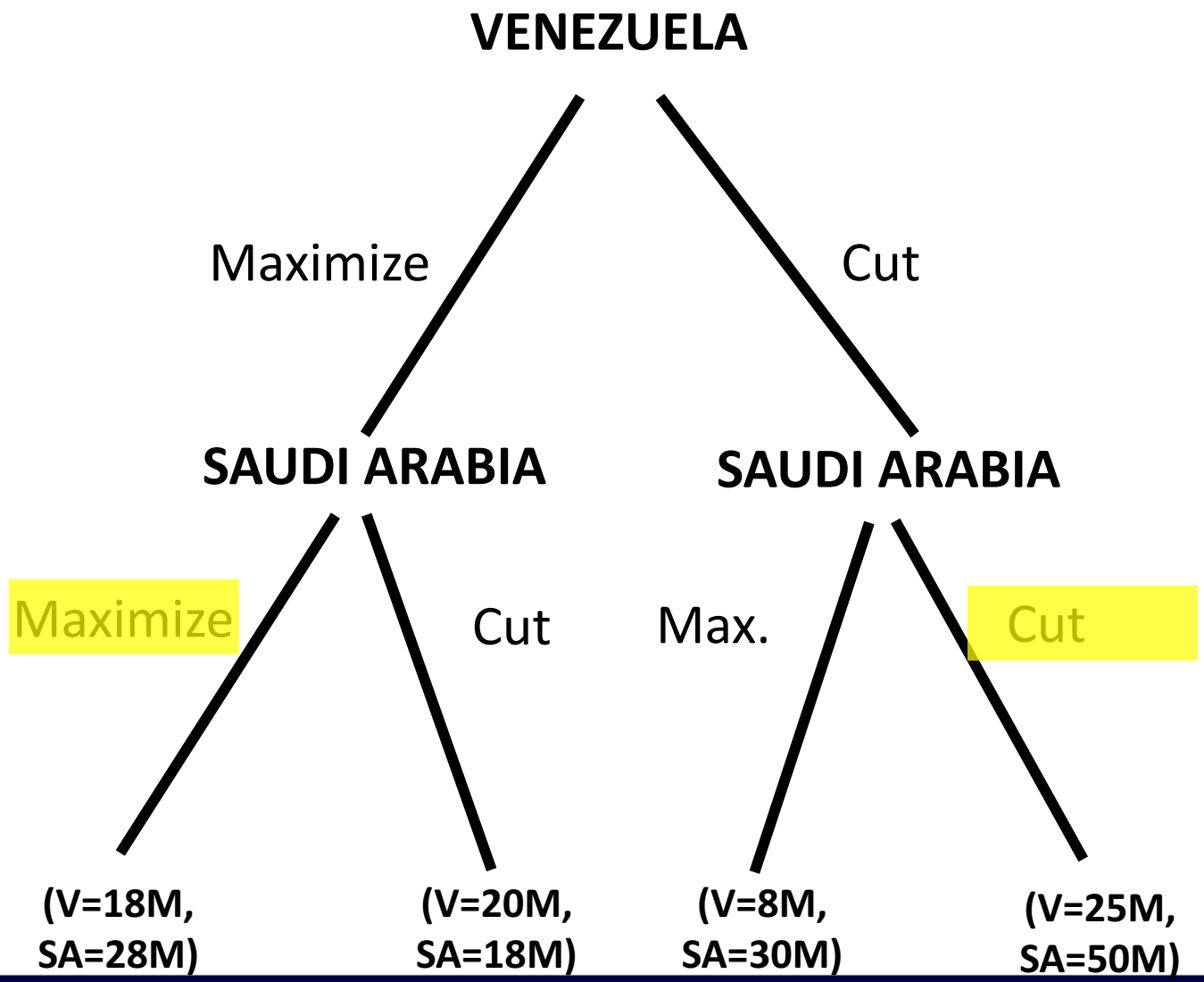
**STAGE 2: Saudi Arabia chooses**



# VENEZUELA AND SAUDI ARABIA

**STAGE 1: Venezuela chooses**

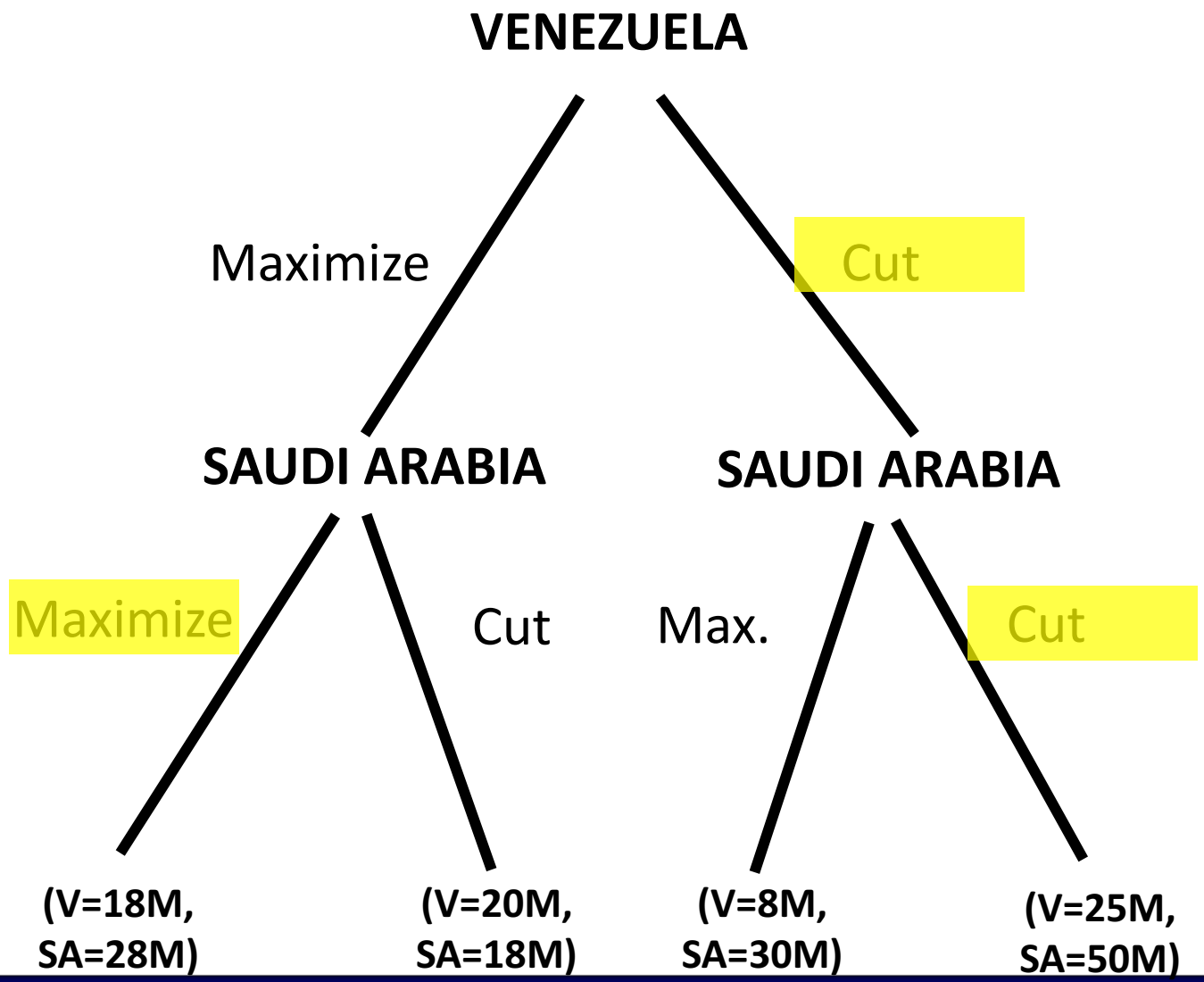
**STAGE 2: Saudi Arabia chooses**



# VENEZUELA AND SAUDI ARABIA

**STAGE 1: Venezuela chooses**

**STAGE 2: Saudi Arabia chooses**



# A NEW GAME

# A NEW GAME

- Amanda says a number between 0 and 10
- Afterwards, Billy says a number between 0 and 10
- If both numbers add up to 10, they get the quantity they said in $
- What will happen?

# A NEW GAME

- Amanda says a number between 0 and 10
- Afterwards, Billy says a number between 0 and 10
- If both numbers add up to 10, they get the quantity they said in $
- What will happen?

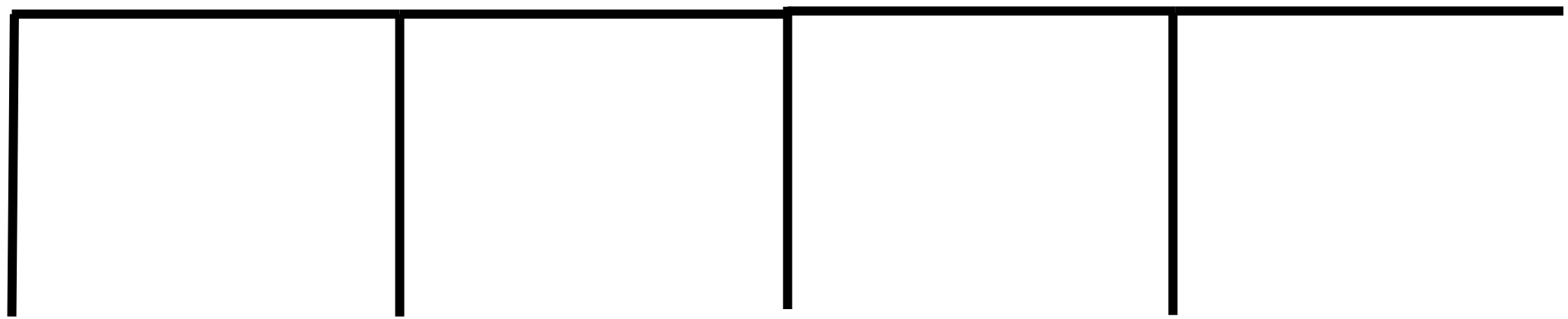
# A NEW GAME

- **Amanda will say 9, Billy will say 1**
- **What if we reverse the order?**

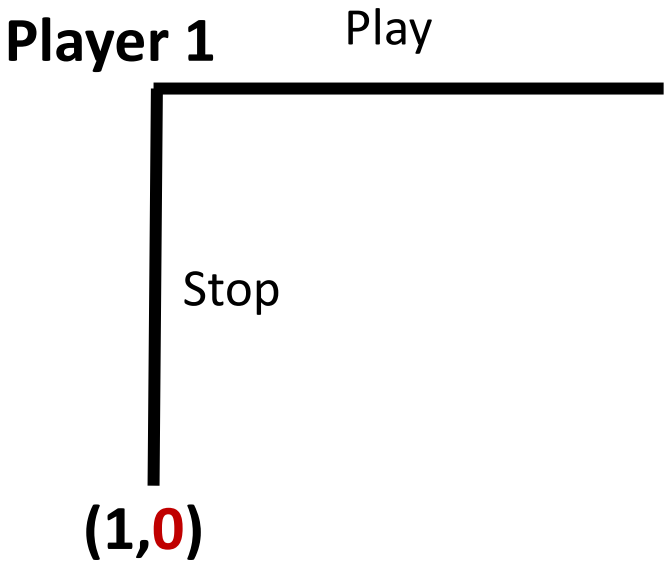
# A NEW GAME

- **Amanda will say 9, Billy will say 1**
- **What if we reverse the order?**
- **Billy will say 9, Amanda will say 1**
- **Order really matters for welfare!**

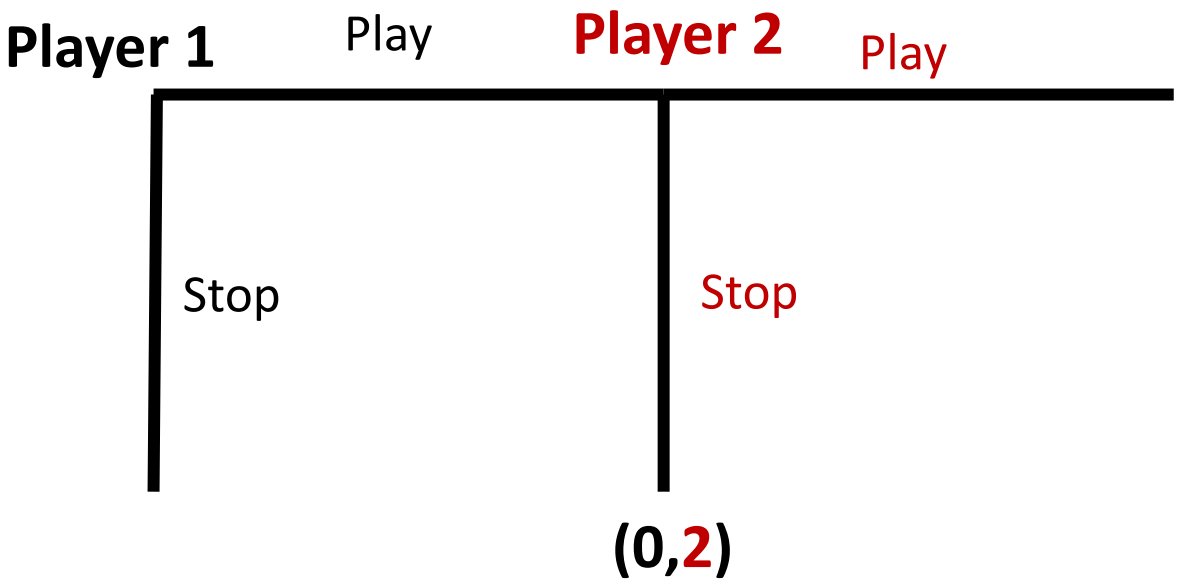
# A new game



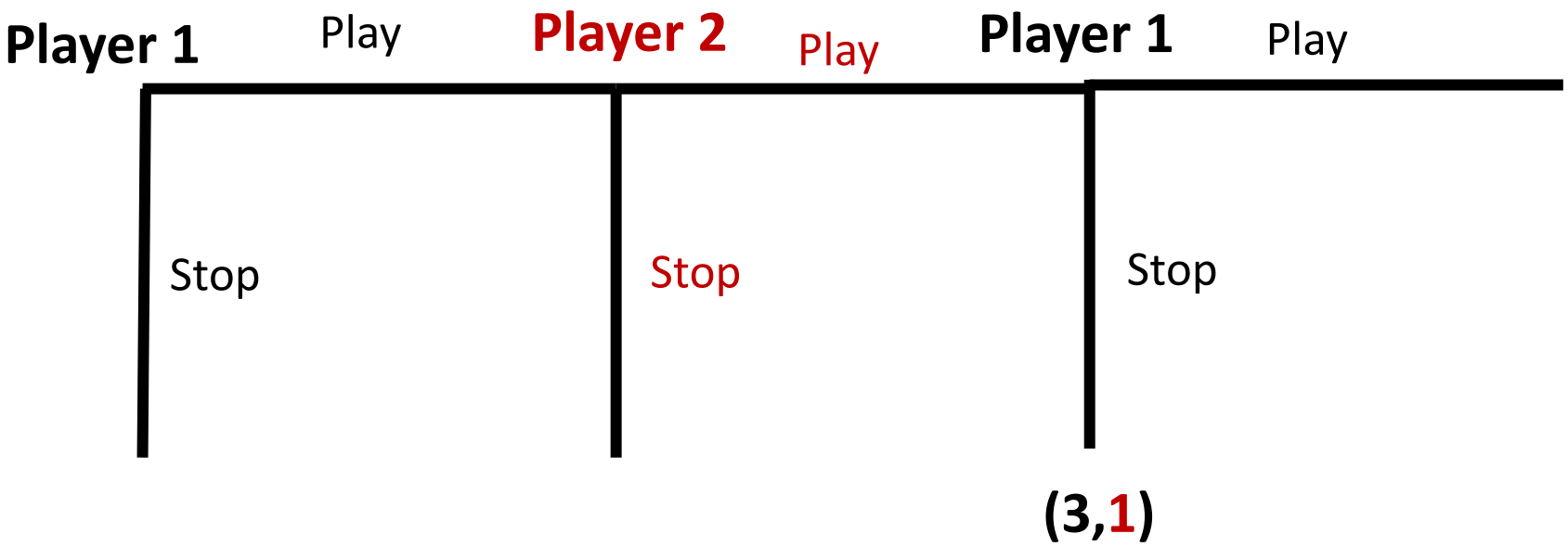
# A new game



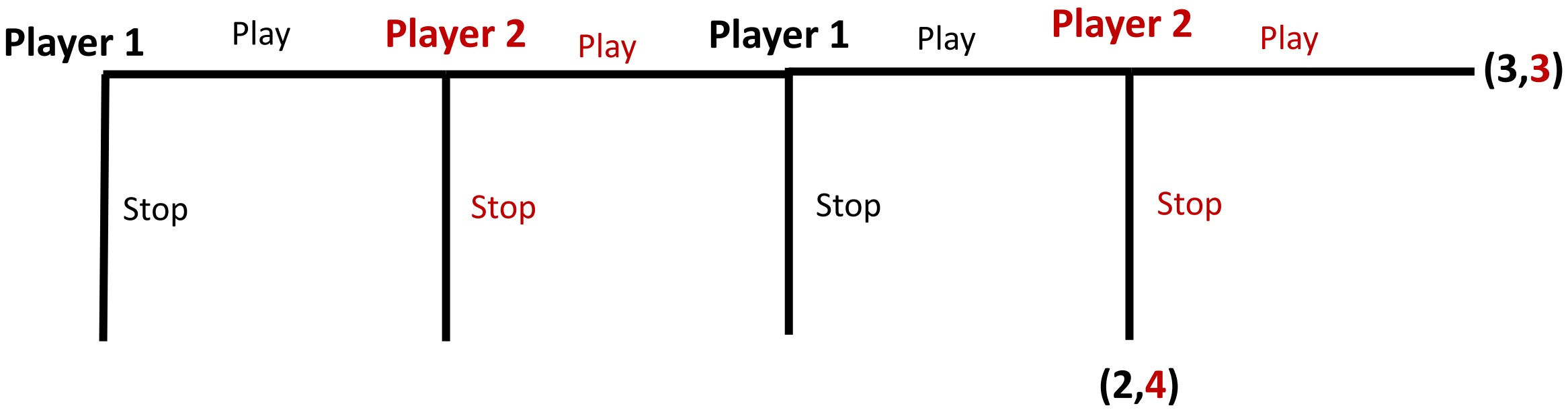
# A new game



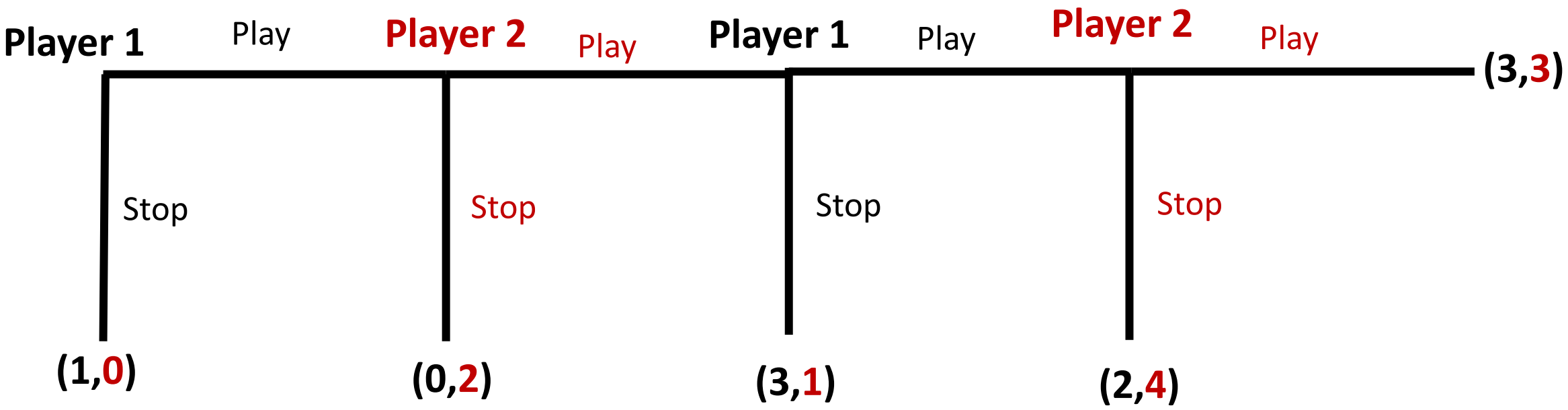
# A new game



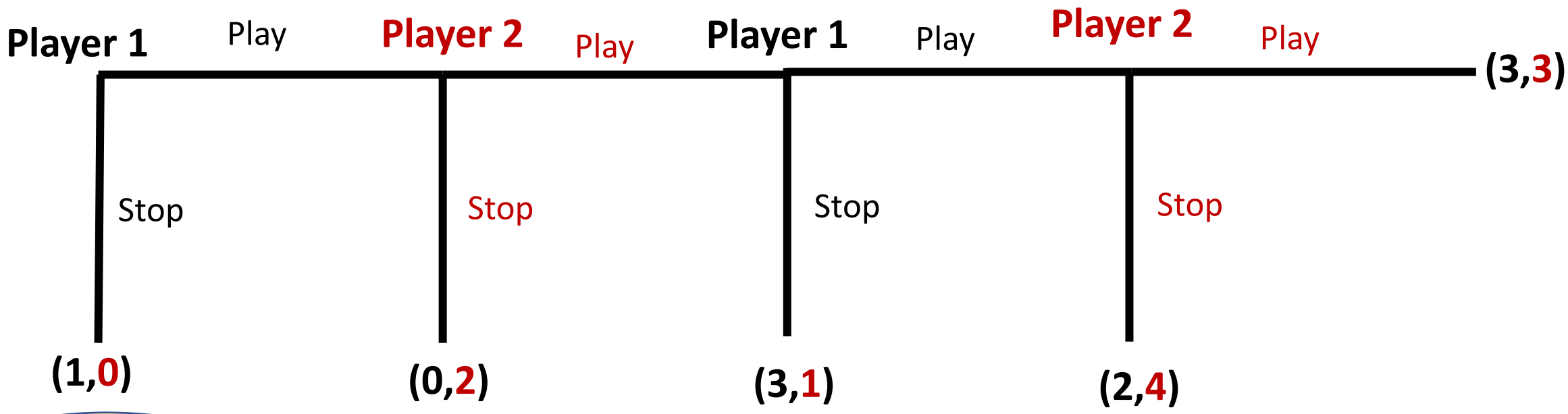
# A new game


Player 1
Play
Player 2
Play
Player 1
Play
Player 2
Play
(3,3)
Stop
Stop
Stop
Stop
(2,4)

# A new game

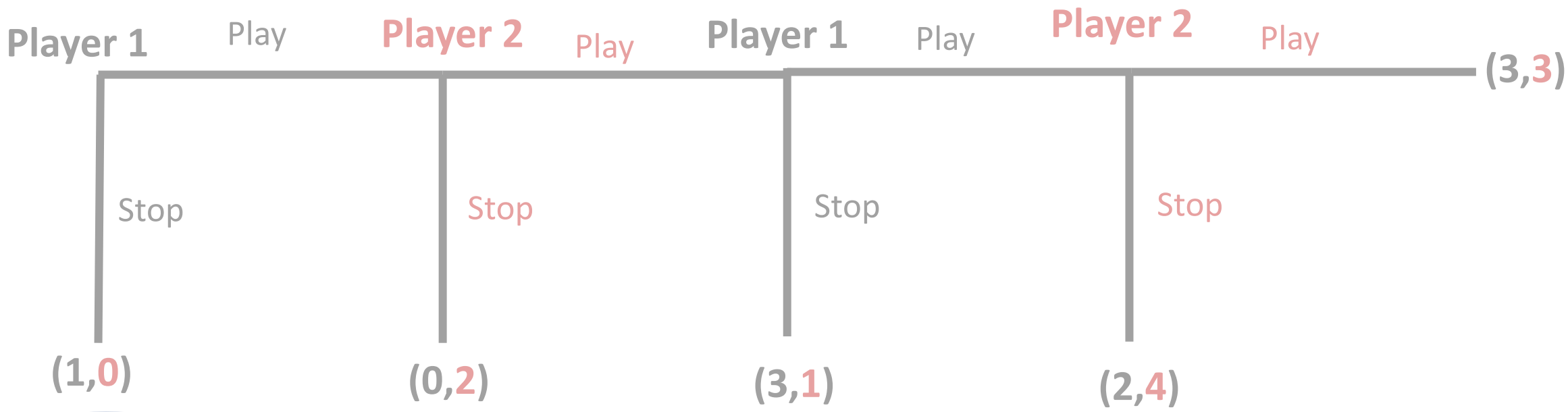

Player 1
Play
Player 2
Play
Player 1
Play
Player 2
Play
(3,3)
Stop
Stop
Stop
Stop
(1,0)
(0,2)
(3,1)
(2,4)

# A new game



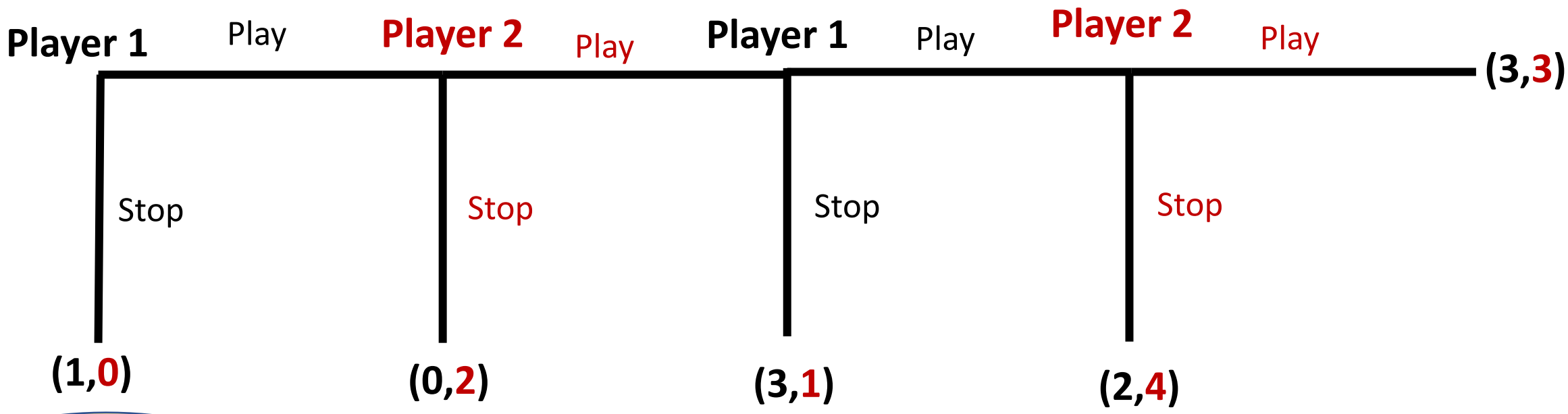

**What is the outcome of this game?**

# A new game




What is the outcome of this game?

# A new game




**Player 1 will stop at the very beginning**

# Game Theory and Oligopoly

- Game theory basics
- Application to oligopoly
    - Simultaneous games
    - Sequential games

- **Practice exercises**

# AIRBUS AND BOEING


# AIRBUS AND BOEING


**BOEING**


**AIRBUS**

| | Not compete | Compete for new companies |
|---|---|---|
| **Not compete** | **(50M, 30M)** | **(30M, 50M)** |
| **Compete for new companies** | **(45M, 25M)** | **(24M, 22M)** |

# AIRBUS STRATEGIES

# AIRBUS STRATEGIES

- If Boeing does not compete

Airbus best option is not compete

- If Boeing does compete

Airbus best option is not compete

→ **Airbus has a dominant strategy (compete)**

# AIRBUS AND BOEING


**BOEING**


**AIRBUS**

| | Not compete | Compete for new companies |
|---|---|---|
| **Not compete** | **(50M, 30M)** | **(30M, 50M)** |
| **Compete for new companies** | **(45M, 25M)** | **(24M, 22M)** |

# BOEING STRATEGIES

# BOEING STRATEGIES

- If Airbus does not compete

Boeing best option is compete

- If Airbus does compete

Boeing best option is not compete

→ **Boeing has no dominant strategy**

# AIRBUS AND BOEING


**BOEING**


**AIRBUS**

| | Not compete | Compete for new companies |
|---|---|---|
| Not compete | (50M, 30M) | (30M, 50M) |
| Compete for new companies | (45M, 25M) | (24M, 22M) |

# WHAT IS THE OUTCOME

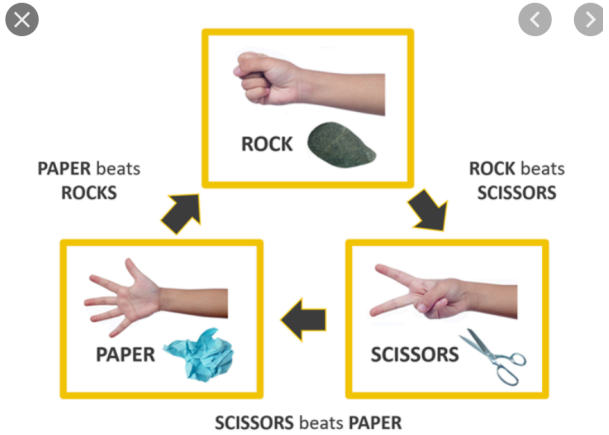
- Airbus plays its dominant strategy (compete)
- Boeing plays its best response to compete (= not compete)

# WHAT IS THE OUTCOME

- Airbus plays its dominant strategy (compete)
- Boeing plays its best response to compete (= not compete)

→ **Only one Nash Equilibrium (= outcome of the game):**
**Airbus competes, Boeing does not compete**

# RPS


- **Can you analyze this game using game theory?**

# RPS

**PLAYERS?**

**Xin Hui**

**Summer**

| | |
|---|---|
| | |
| | |

# RPS

## STRATEGIES?

**Xin Hui**

**Summer**

| | |
|---|---|
| | |

# RPS

## STRATEGIES

**Xin Hui**

**Summer**

| | | | |
|---|---|---|---|
| |  |  |  |
|  | | | |
|  | | | |
|  | | | |

# RPS

## PAYOFFS?

**Xin Hui**

**Summer**

| | | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

# RPS

## PAYOFFS

**Xin Hui**

**Summer**

| | | | |
|---|---|---|---|
| | (0,0) | (1,-1) | (-1,1) |
| | (-1,1) | (0,0) | (-1,1) |
| | (1,-1) | (-1,1) | (0,0) |

# ZERO SUM GAMES

- When one player wins, the other one loses
    - Examples?

# ZERO SUM GAMES

- When one player wins, the other one loses
    - Penalty kicks
    - Chess

# ZERO SUM GAMES

- When one player wins, the other one loses
    - Penalty kicks
    - Chess
    - Elections

# ZERO SUM GAMES

- When one player wins, the other one loses
    - Penalty kicks
    - Chess
    - Elections
    - …

# REMARKS

- **Game Theory Summary**

- **Market Structure Summary**

# Game Theory SUMMARY

- Who are the players?
- What are the strategies?
- What are the payoffs?

# Game Theory SUMMARY

- Who are the players?
- What are the strategies?
- What are the payoffs?

- Do they have dominant strategies?
- Does at least one have a dominant strategy?
- What is the outcome (Nash Equilibrium) of the game?

# Game Theory SUMMARY

- **Do they have dominant strategies?**
  - If Yes for both, Unique Nash Equilibrium
-

# Game Theory SUMMARY

- **Do they have dominant strategies?**
  - If Yes for both, Unique Nash Equilibrium
- **Does at least one have a dominant strategy?**
  - If Yes, maybe more than one Nash Equilibrium (at least one for sure)

# Game Theory SUMMARY

- **Do they have dominant strategies?**
  - If Yes for both, Unique Nash Equilibrium
- **Does at least one have a dominant strategy?**
  - If Yes, maybe more than one Nash Equilibrium (at least one for sure)
  - If No, maybe no Nash Equilibrium, maybe one, maybe more than one

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | | | |
| **Output** | | | |
| **Pricing** | | | |
| **Barriers to entry or exit?** | | | |
| **Strategic interdependence?** | | | |
| ***PREDICTIONS*** | | | |
| **Price and output** | | | |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | | | |
| **Pricing** | | | |
| **Barriers to entry or exit?** | | | |
| **Strategic interdependence?** | | | |
| ***PREDICTIONS*** | | | |
| **Price and output** | | | |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | | | |
| **Barriers to entry or exit?** | | | |
| **Strategic interdependence?** | | | |
| ***PREDICTIONS*** | | | |
| **Price and output** | | | |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | | | |
| **Strategic interdependence?** | | | |
| ***PREDICTIONS*** | | | |
| **Price and output** | | | |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | NO | YES | YES |
| **Strategic interdependence?** | | | |
| ***PREDICTIONS*** | | | |
| **Price and output** | | | |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | NO | YES | YES |
| **Strategic interdependence?** | NO | YES | NO |
| ***PREDICTIONS*** | | | |
| **Price and output** | | | |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | NO | YES | YES |
| **Strategic interdependence?** | NO | YES | NO |
| ***PREDICTIONS*** | | | |
| **Price and output** | MC = MR | Strategic interdependence | MC = MR |
| **Short run profit** | | | |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | NO | YES | YES |
| **Strategic interdependence?** | NO | YES | NO |
| ***PREDICTIONS*** | | | |
| **Price and output** | MC = MR | Strategic interdependence | MC = MR |
| **Short run profit** | >0, 0, or <0 | >0, 0, or <0 | >0, 0, or <0 |
| **Long-run profit** | | | |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | NO | YES | YES |
| **Strategic interdependence?** | NO | YES | NO |
| ***PREDICTIONS*** | | | |
| **Price and output** | MC = MR | Strategic interdependence | MC = MR |
| **Short run profit** | >0, 0, or <0 | >0, 0, or <0 | >0, 0, or <0 |
| **Long-run profit** | 0 | >0 or 0 | >0 or 0 |
| **Advertising?** | | | |

# Market Structure SUMMARY

| | Perfect competition | Oligopoly | Monopoly |
|---|---|---|---|
| ***ASSUMPTIONS*** | | | |
| **# firms** | Many | Few | One |
| **Output** | Standarized | Standarized or differentiated | - |
| **Pricing** | Price taker | Price setter | Price setter |
| **Barriers to entry or exit?** | NO | YES | YES |
| **Strategic interdependence?** | NO | YES | NO |
| ***PREDICTIONS*** | | | |
| **Price and output** | MC = MR | Strategic interdependence | MC = MR |
| **Short run profit** | >0, 0, or <0 | >0, 0, or <0 | >0, 0, or <0 |
| **Long-run profit** | 0 | >0 or 0 | >0 or 0 |
| **Advertising?** | Never | Maybe | Sometimes |

# REMINDERS

- **LT34 and S17-0405 (at Level 4) in S17. Digital midterm test on 12 March, Thursday, 6.30-8.30pm. I will email all those who need to go to S17-0405. Everyone on Friday tutorials goes to LT34.**

- **Tutorial problems to be posted over the weekend**

- **Any questions? ecsgra@nus.edu.sg or griambau@gmail.com**

# NEXT

- **MOCK TEST NOW!!**
- **Password:** MOCKEC1101E

# NEXT

- **MOCK TEST NOW!!**
- **Password:** MOCKEC1101E