Announcement

- Since September 11th is Polling Day, Homework #1 will be due Monday , September 14th at 9 a.m.
- Please place them in your TA's mailbox
- I will post solutions to IVLE as soon as all homework assignments are accounted for.
- You can pick up your graded homework between 9 a.m. and 12 p.m. on Friday , September 25th from your my office.

Announcement

- Office hours:
  - Monday: 1pm-2pm
  - Wednesday: 2pm-3pm
- You will not be responsible to know
  - Section 32.10: Example – "Monopoly in the Edgeworth Box"

Chapter 25: Monopoly

Pure Monopoly

	Perfectly Competitive Market	Monopoly Market
Industry Structure	Fragmented (no seller has significant market share)	Concentrated (one firm dominates the entire market
Pricing	Price takers	Price makers
Barriers to entry	None	Significant
Examples	Raw commodities (palm oil, soybeans, wheat)	Drugs with patents (Viagra until 2019)

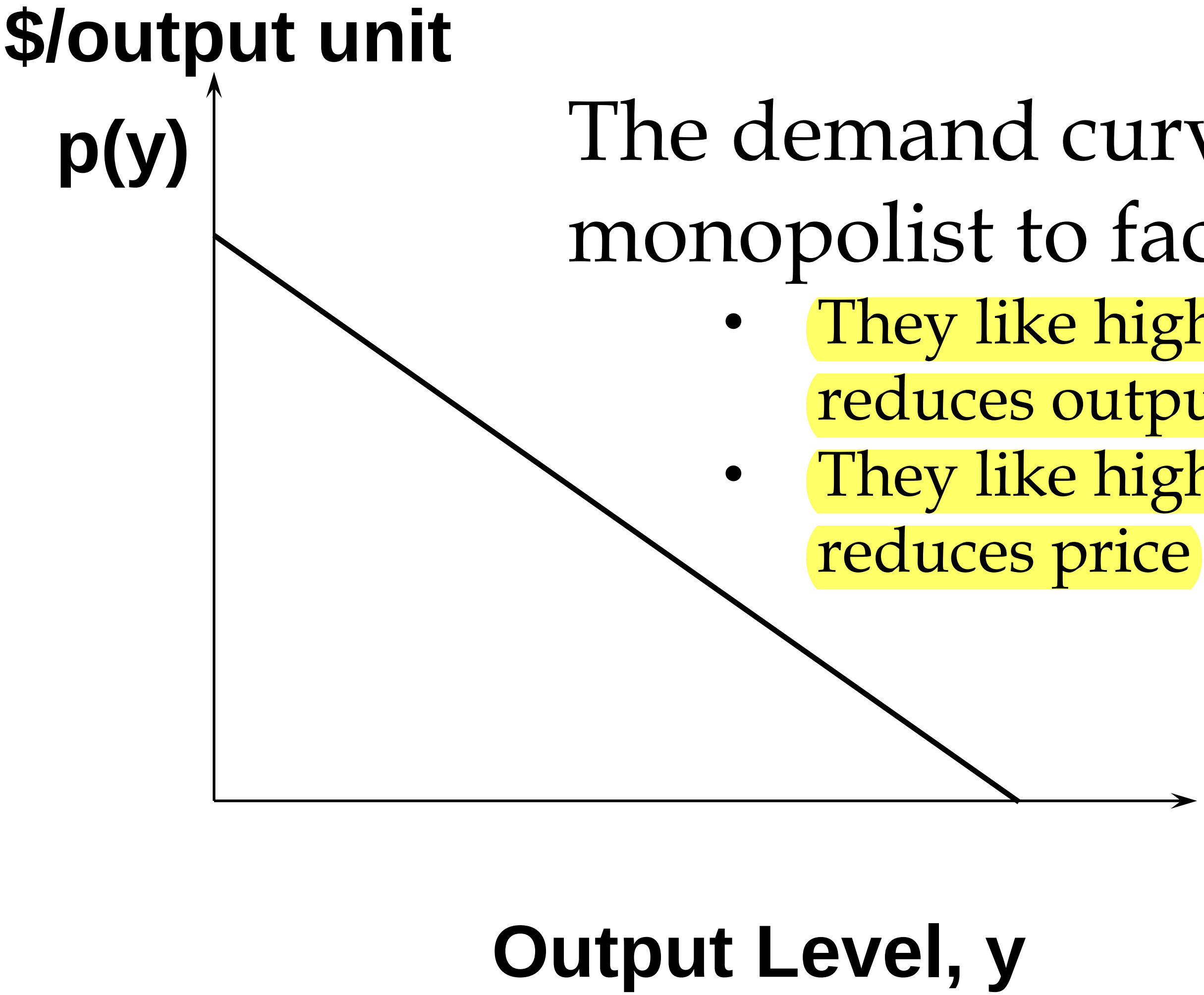
Pure Monopoly

- A monopolized market has a single seller.
- The monopolist's demand curve is the (downward sloping) market demand curve.
- The monopolist can alter the market price by adjusting its output level
  - Or alter its output by adjusting the price

Pure Monopoly

- Our goal today is to understand:
  - How monopolies make decisions (i.e. maximize profits)
  - How demand elasticities affect monopoly outcomes
  - The inefficiencies of monopoly markets
  - Barriers to entry
  - Natural monopolies
  - How taxes affect monopoly outcomes

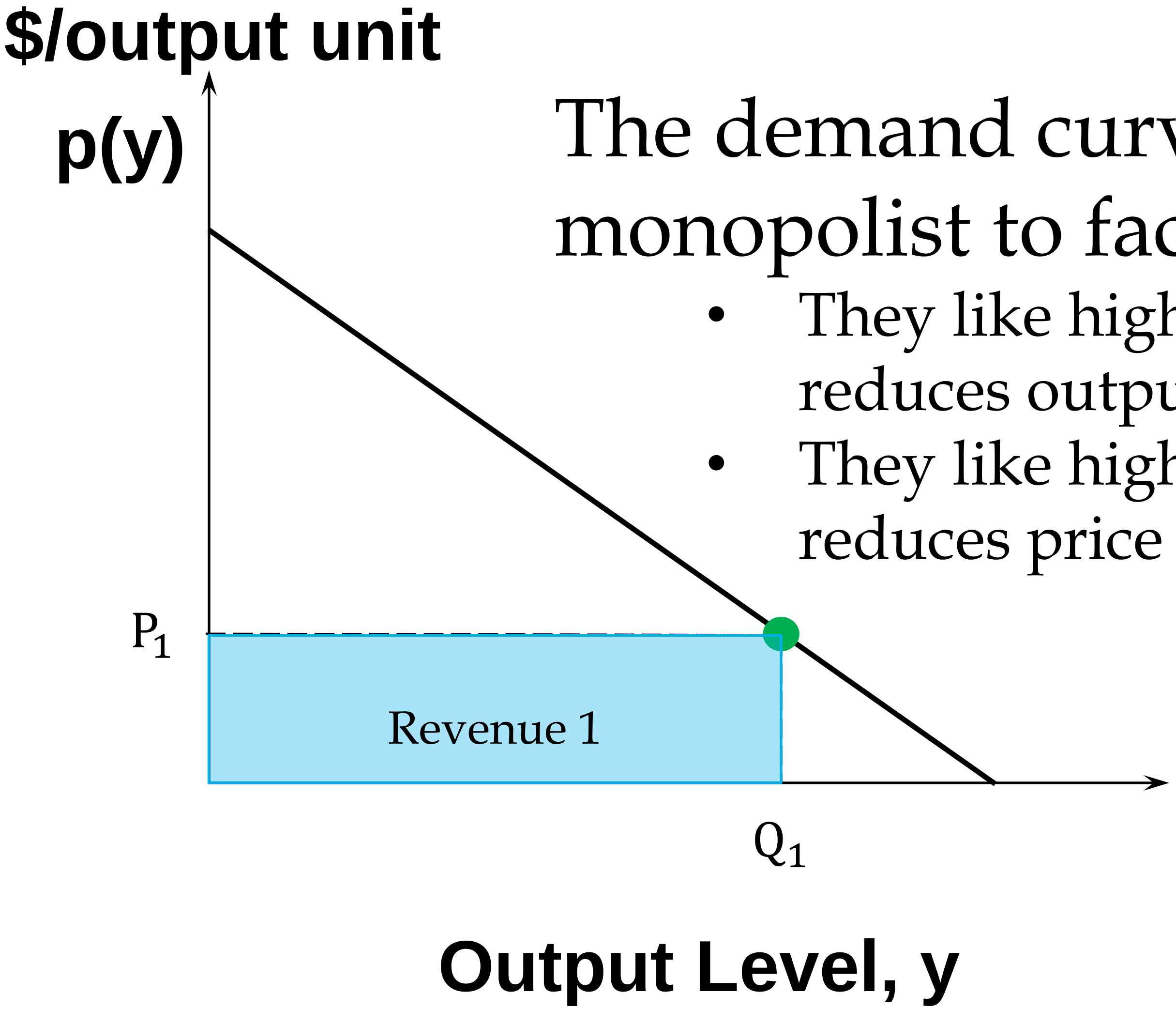
Pure Monopoly



The demand curve causes the monopolist to face a trade-off

- They like high prices but that reduces output
- They like high output but that reduces price

Pure Monopoly



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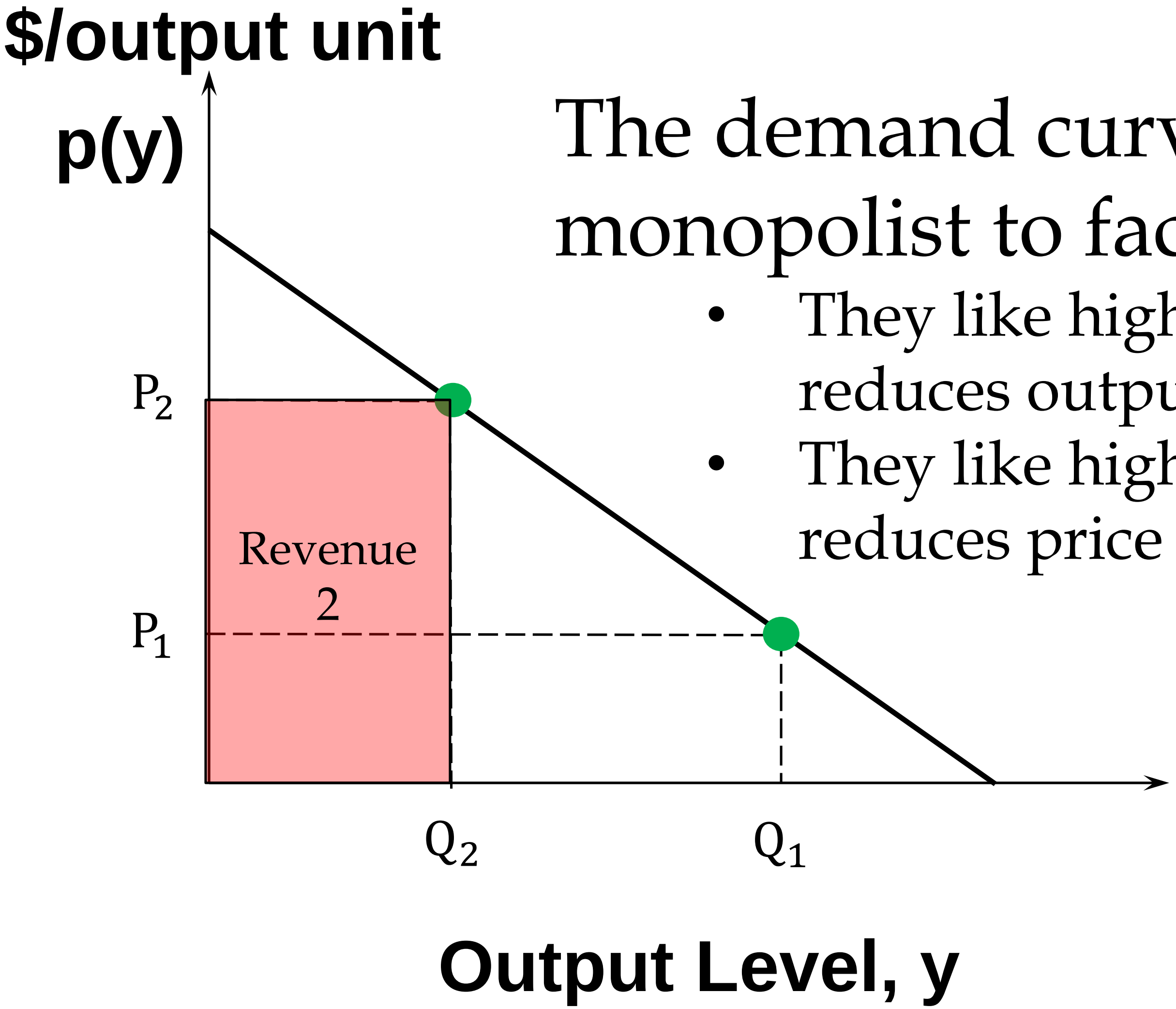

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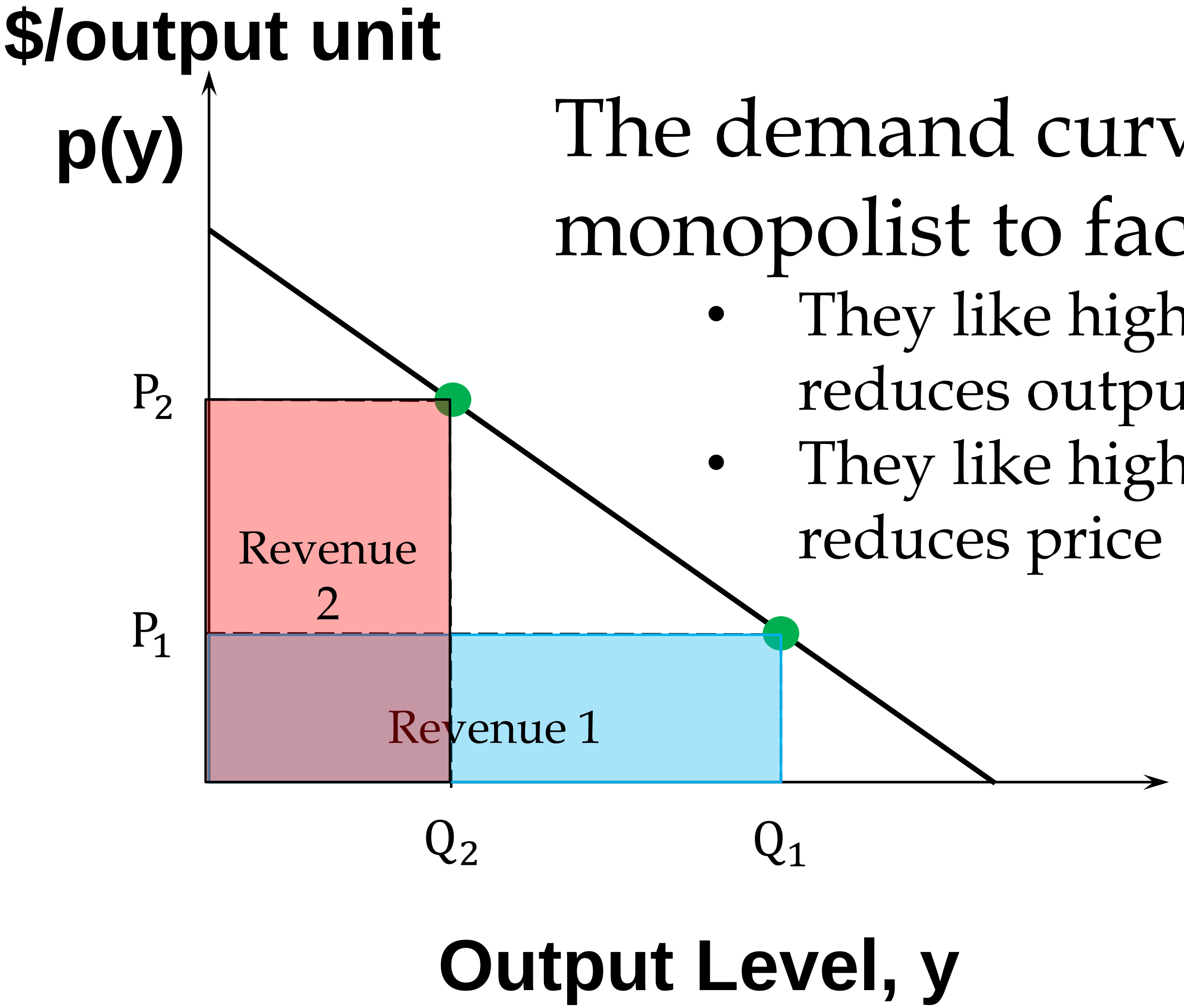

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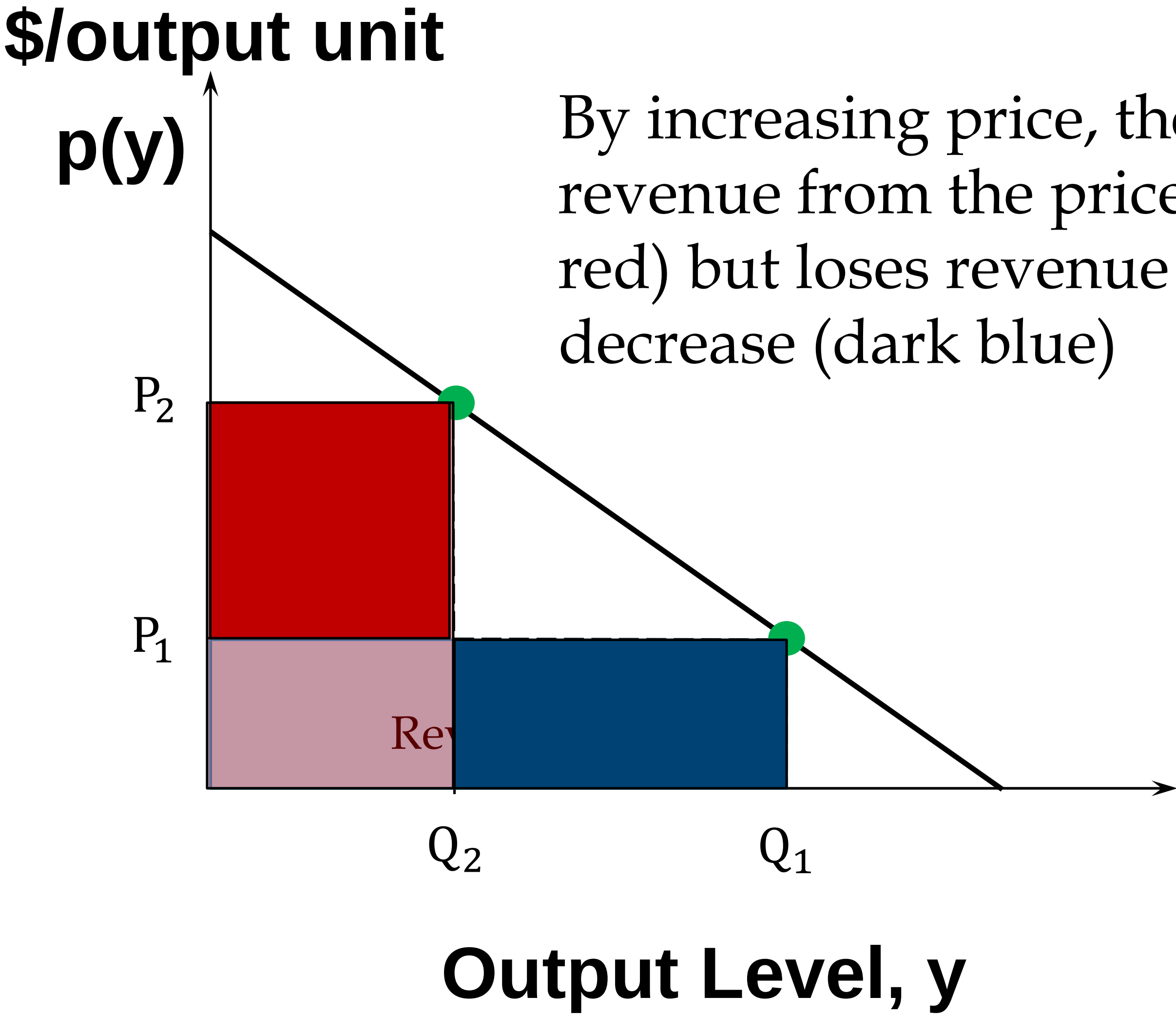


By increasing price, the monopolist gains revenue from the price increase (dark red) but loses revenue from the quantity decrease (dark blue)

Pure Monopoly

- Suppose that the monopolist seeks to maximize its economic profit:

Profit = Revenue – Cost

$$\pi(y) = r(y) - c(y)$$

$$\pi(y) = p(y)y - c(y)$$

- What output level y* maximizes profit?

Profit-Maximization

At the profit-maximizing output level y*

- To maximize the profit function, take the first derivative and set it equal to zero:

$$\frac{d\pi(y)}{dy} = \frac{d}{dy}[p(y)y] - \frac{dc(y)}{dy} = 0$$

- At the profit maximizing output level, y*

$$\frac{d}{dy}[p(y)y] = \frac{dc(y)}{dy}$$

Marginal Revenue

- What is $\frac{d}{dy}[p(y)y]$?
  - It is the increase change in revenue caused by a change in output: Marginal Revenue
- By the chain rule, $\frac{d}{dy}[p(y)y]$:

$$= p(y) + p'(y)y$$

Increasing output by one unit, raises revenue by the price of that unit

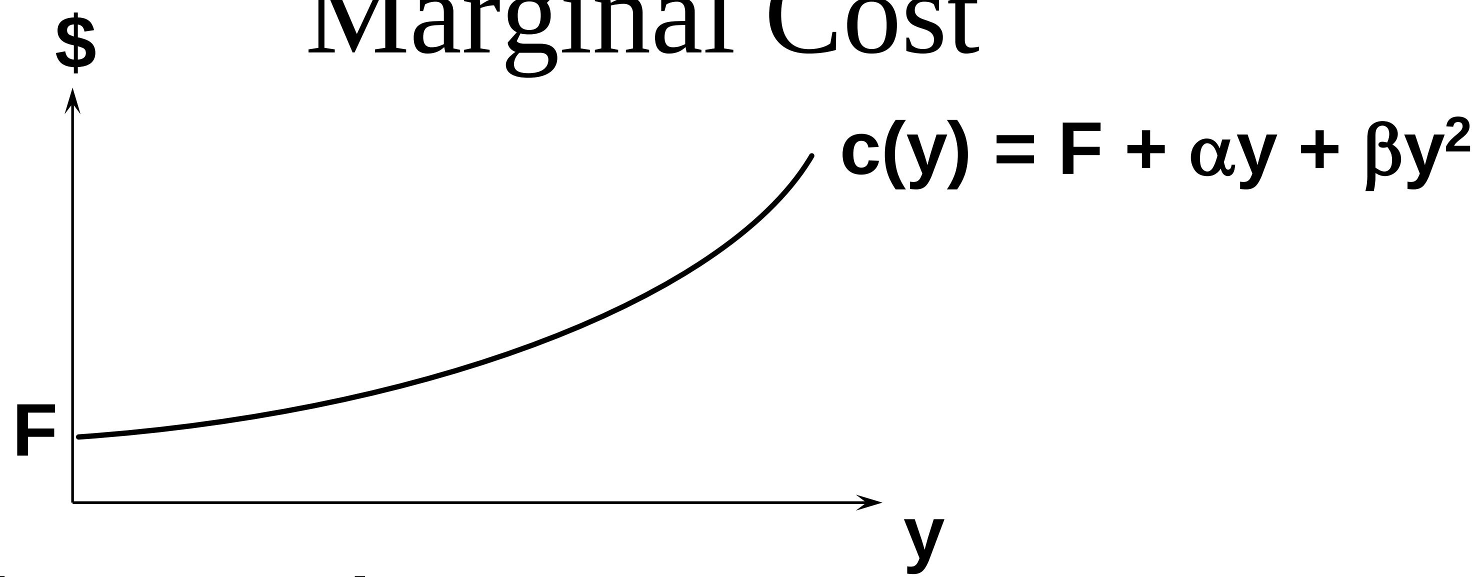
Increasing output also lowers the price of all units, so revenue decreases by this change in price multiplied by all units (This value is negative)

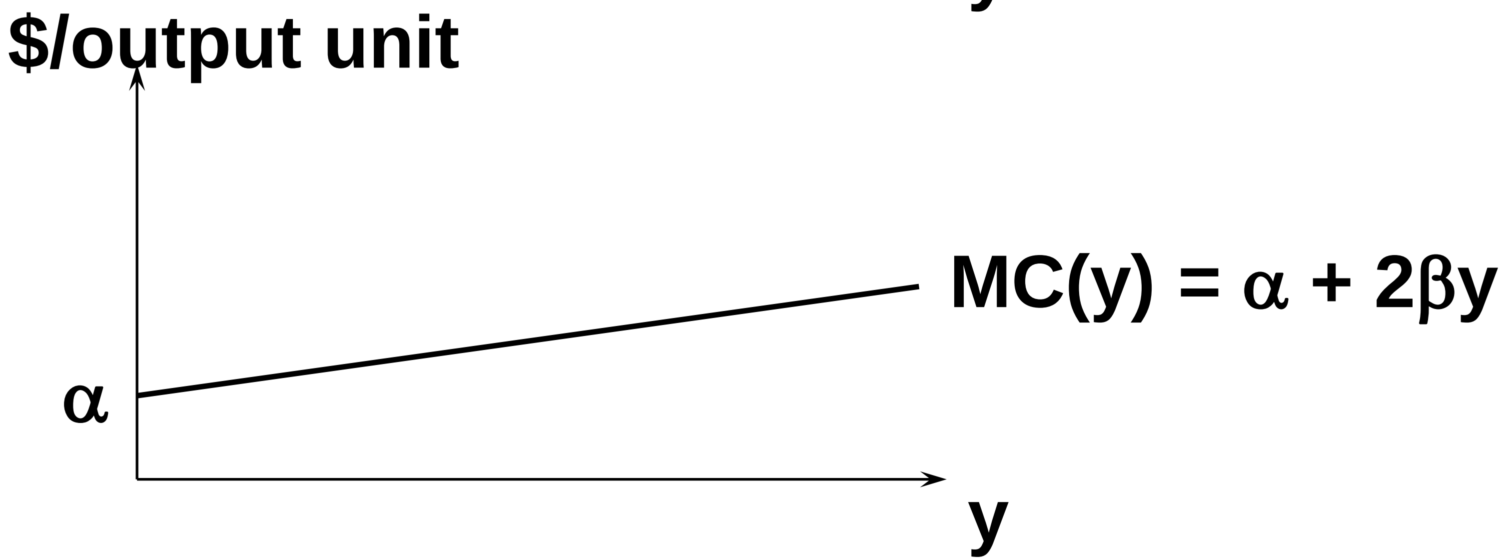
Marginal Cost

- What is $\frac{dc(y)}{dy}$?
- It is the change in cost caused by a change in output: Marginal Cost

- Example: if $c(y) = F + \alpha y + \beta y^2$, then
$$MC(y) = \alpha + 2\beta y$$

Marginal Cost





Profit Maximization

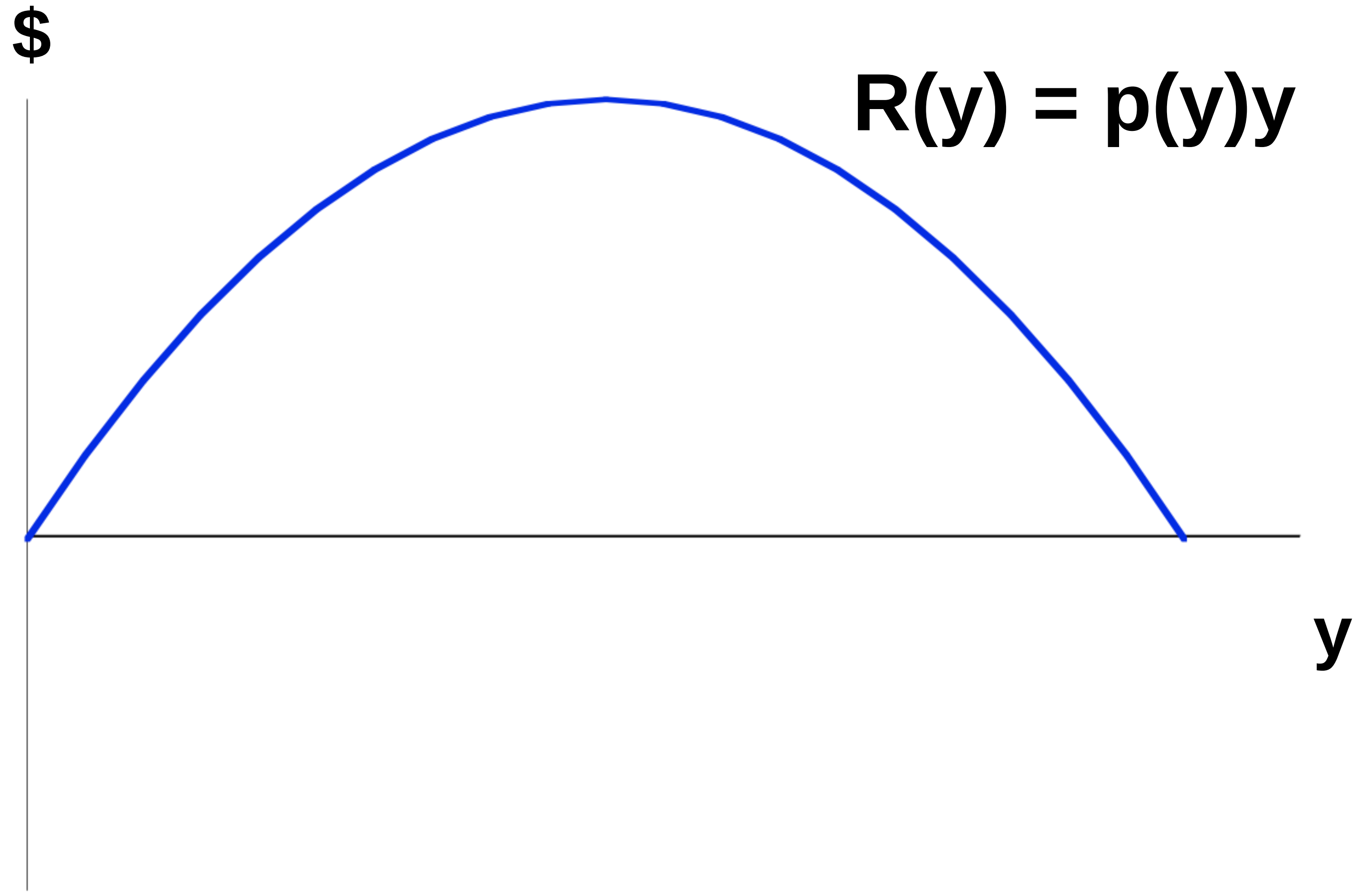
- At the profit maximizing output level, y*

$$\frac{d}{dy}[p(y)y] = \frac{dc(y)}{dy}$$

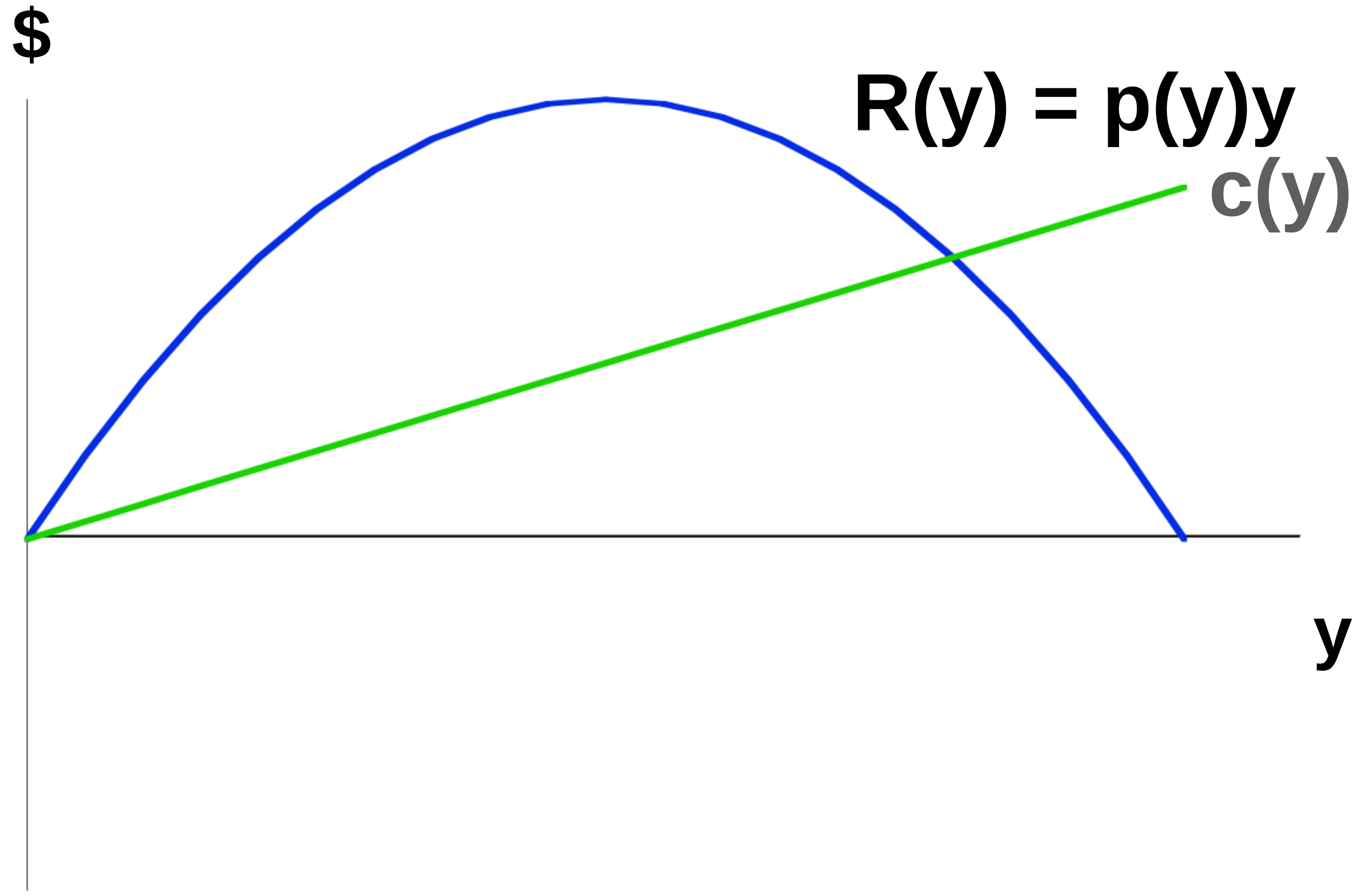
Marginal Revenue = Marginal Cost

$$MR(y) = MC(y)$$

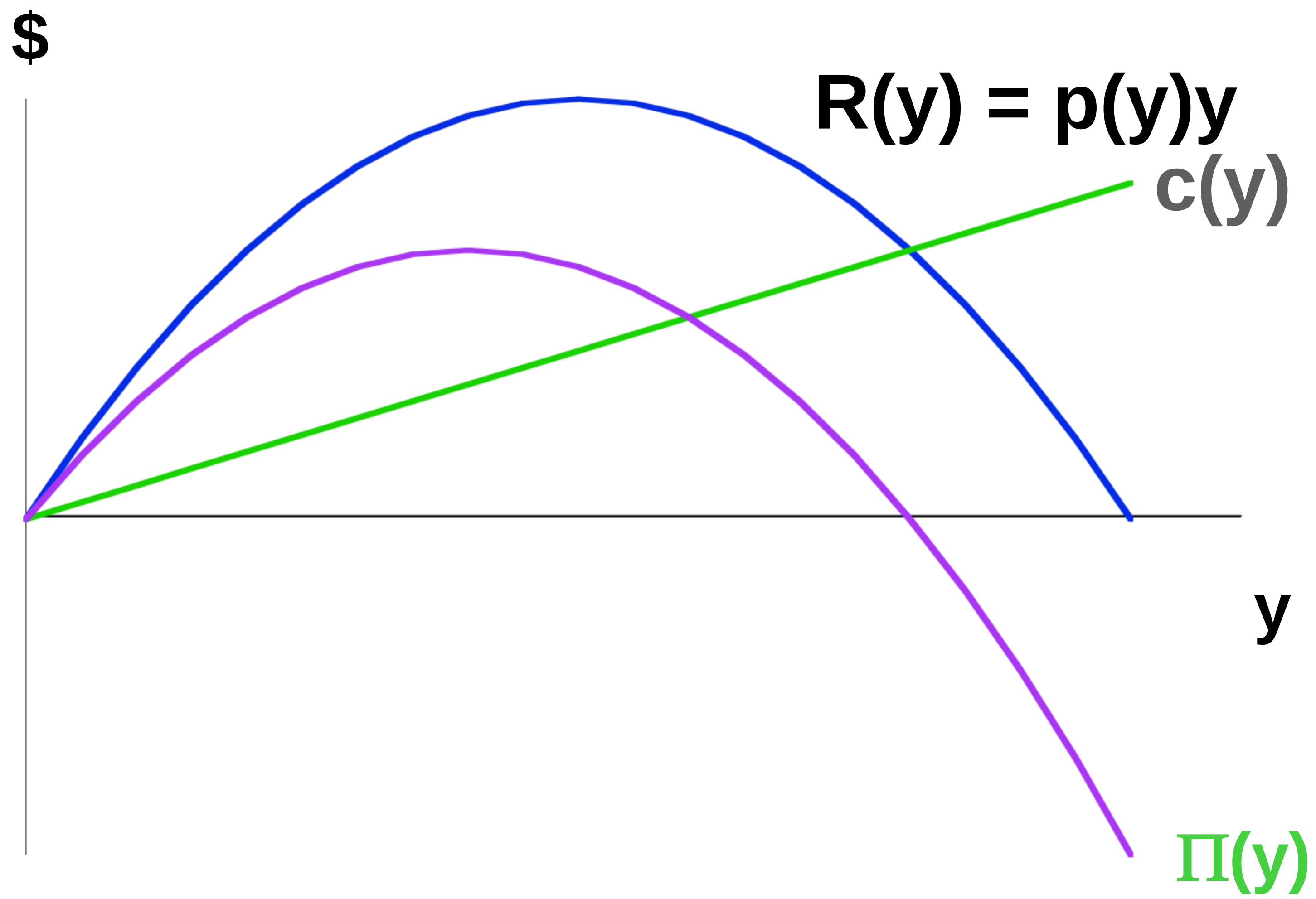
Profit-Maximization



Profit-Maximization



Profit-Maximization



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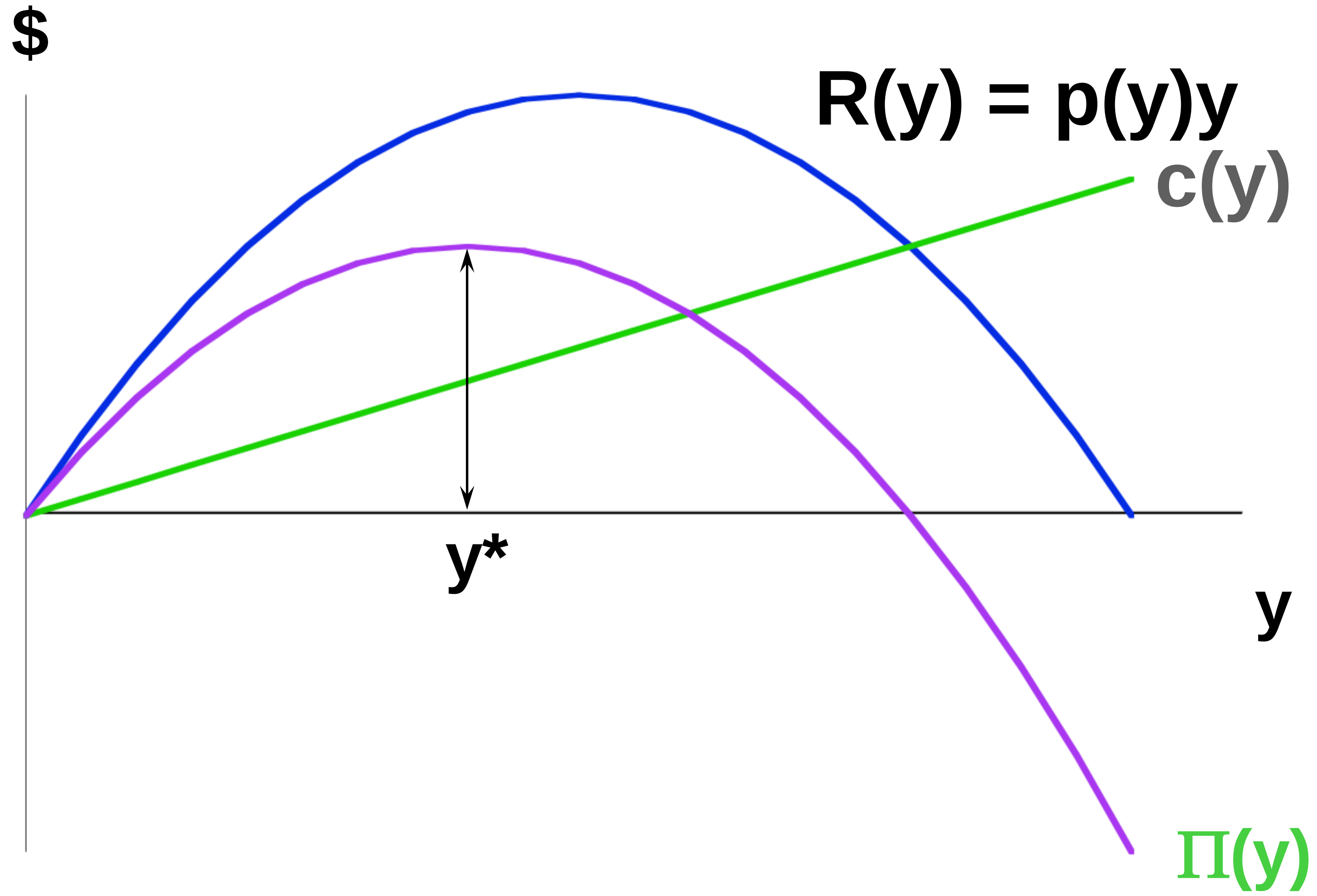

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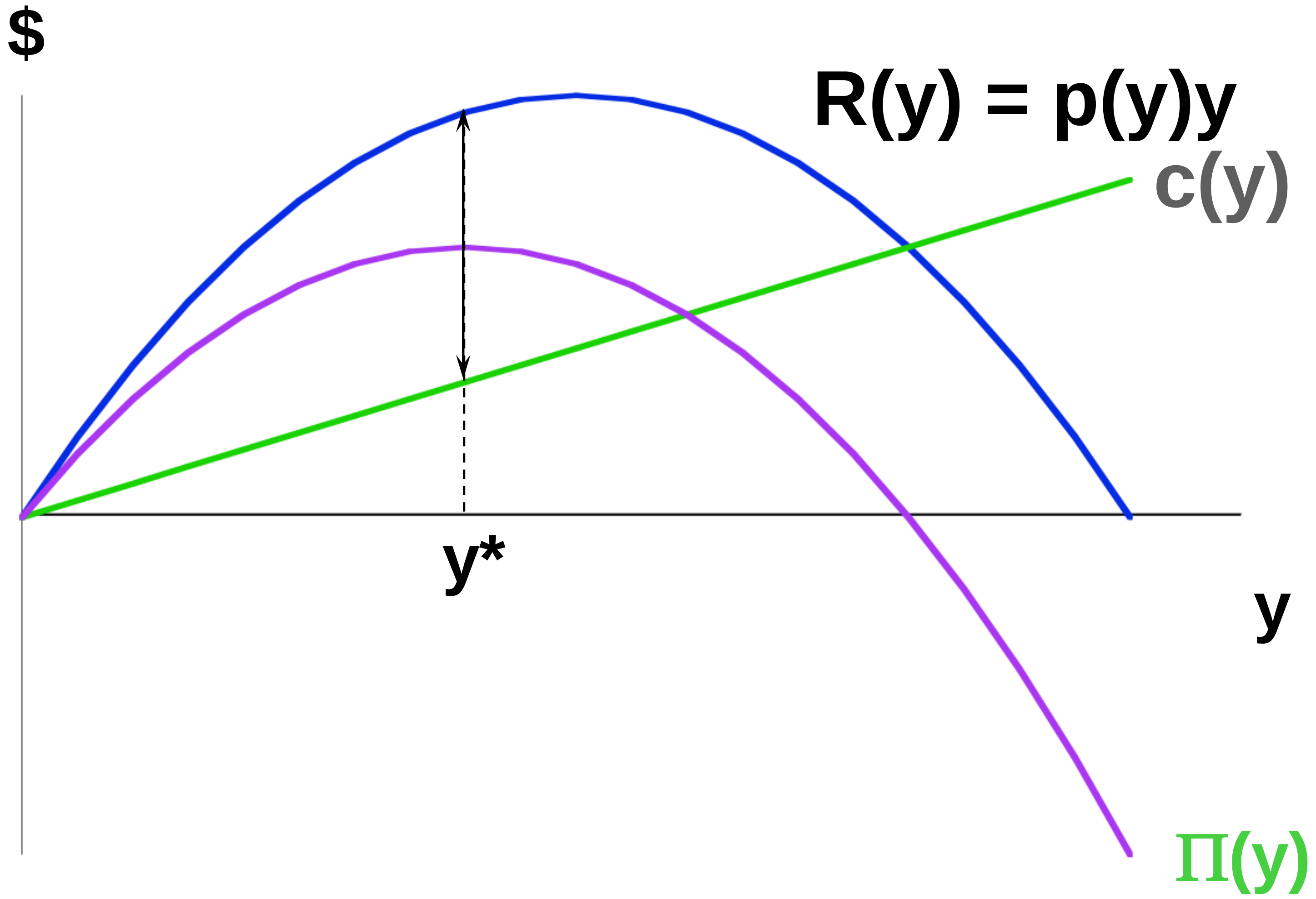
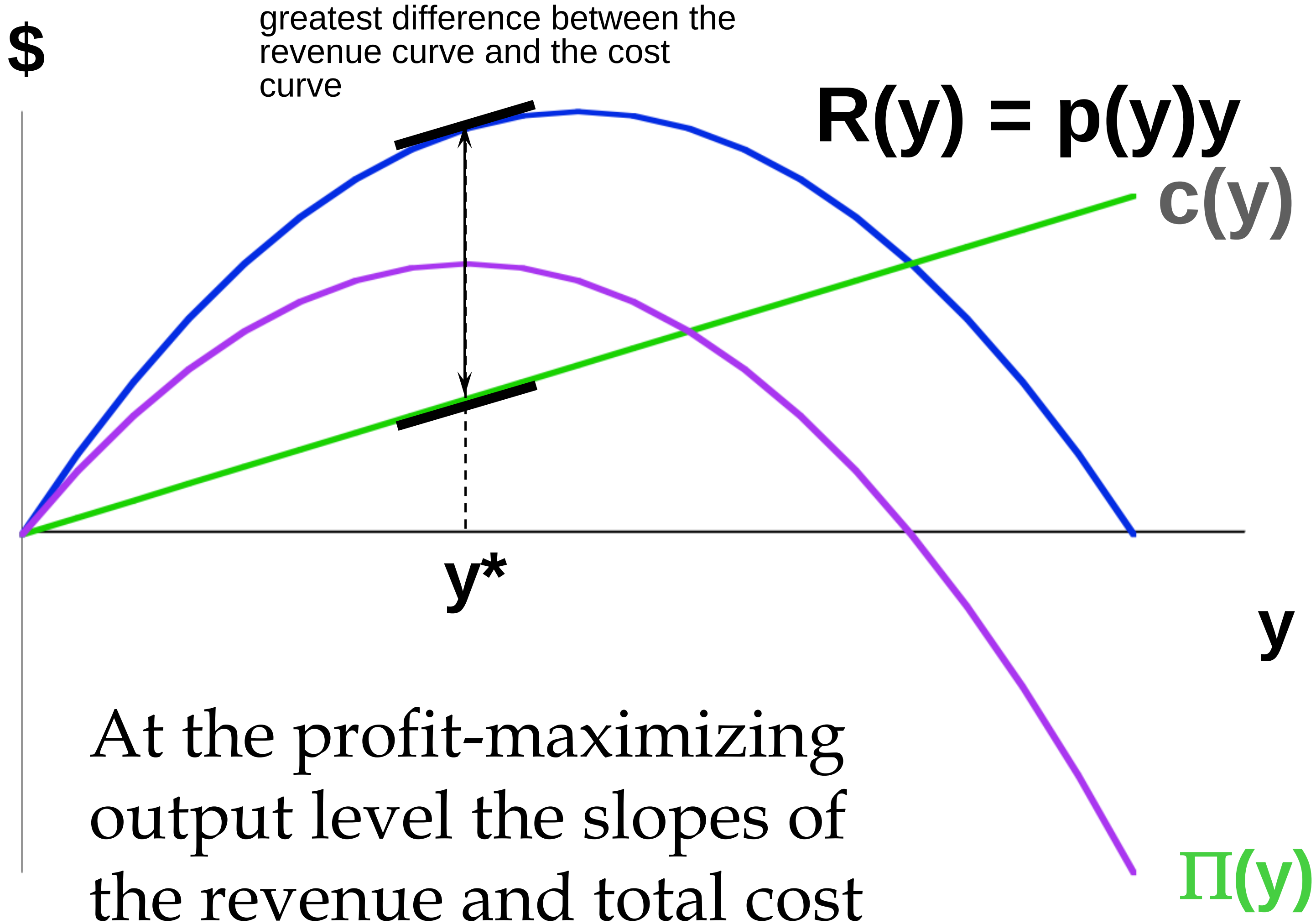


Profit-Maximization



At the profit-maximizing output level the slopes of the revenue and total cost curves are equal; MR(y*) = MC(y*).

Profit Maximization: An Example

Inverse Demand: $p(y) = a - by$

Cost: $c(y) = F + \alpha y + \beta y^2$

- What is the profit maximizing level of output?

Profit Maximization: An Example

Inverse Demand: $p(y) = a - by$

Cost: $c(y) = F + \alpha y + \beta y^2$

- What is the profit maximizing level of output?
  - We know that profit is maximized where

$$MR(y) = MC(y)$$

Profit Maximization: An Example

Inverse Demand: $p(y) = a - by$

Cost: $c(y) = F + \alpha y + \beta y^2$

- What is the profit maximizing level of output?

$$
\begin{aligned}
MR(y) &= \frac{d}{dy}[p(y)y] \\
&= p(y) + p'(y)y \\
&= [a - by] + [-by] \\
&= a - 2by
\end{aligned}
$$

Profit Maximization: An Example

Inverse Demand: $p(y) = a - by$

Cost: $c(y) = F + \alpha y + \beta y^2$

- What is the profit maximizing level of output?

$$MC(y) = \frac{d}{dy}C(y)$$

$$= \alpha + 2\beta y$$

Profit Maximization: An Example

Inverse Demand: $p(y) = a - by$

Cost: $c(y) = F + \alpha y + \beta y^2$

- What is the profit maximizing level of output?

$$MR(y) = MC(y)$$
$$a - 2by = \alpha + 2\beta y$$
$$y^* = \frac{a - \alpha}{2(b + \beta)}$$

Profit Maximization: An Example

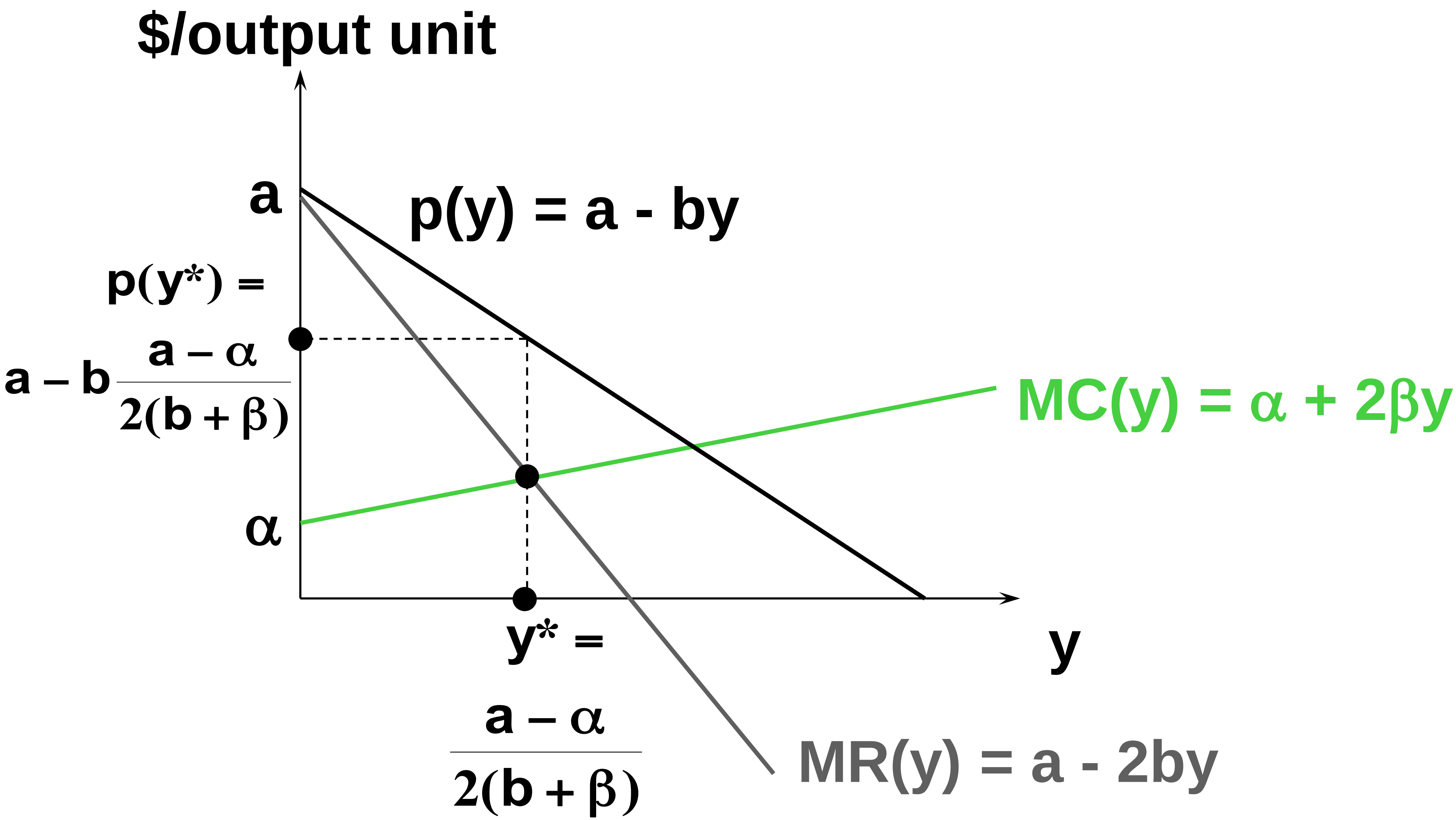
Inverse Demand: $p(y) = a - by$

Cost: $c(y) = F + \alpha y + \beta y^2$

- What is the profit maximizing level of output?
  - Plugging y^* into the inverse demand function, we have that

$$p^* = a - b\left[\frac{a - \alpha}{2(b + \beta)}\right]$$

Profit-Maximization; An Example



Monopolistic Pricing & Own-Price Elasticity of Demand

- Suppose that market demand becomes less sensitive to changes in price (*i.e*. the own-price elasticity of demand becomes less negative/more inelastic). Does the monopolist exploit this by causing the market price to rise?

Monopolistic Pricing & Own-Price Elasticity of Demand

$$MR(y) = \frac{d}{dy}[p(y)y] = p(y) + p'(y)y$$

$$= p(y)\left[1 + \frac{y}{p(y)}p'(y)\right]$$

Note that price elasticity of demand,

$$\epsilon = \frac{dy}{dp(y)}\frac{p(y)}{y}, \text{ and } \frac{1}{\epsilon} = \frac{dp(y)}{dy}\frac{y}{p(y)}.$$

inverted

Thus, $MR(y) = p(y)\left[1 + \frac{1}{\epsilon}\right]$

Monopolistic Pricing & Own-Price Elasticity of Demand

- Remember that ϵ is always negative. Therefore, we can re-write

$$MR(y) = \underbrace{p(y)}_{\text{price}} \left[1 - \frac{1}{|\epsilon|}\right]$$

If $|\epsilon|$ =1, Marginal Revenue is 0 and we cannot equate it to marginal cost (since MC is unlikely to ever be 0)

In the case of unit elasticity, a firm cannot produce at MR=MC when elasticity=1

Monopolistic Pricing & Own-Price Elasticity of Demand

$$MR(y) = p(y)\left[1 - \frac{1}{|\epsilon|}\right]$$

Therefore, for a profit maximizing firm,

$$p(y)\left[1 - \frac{1}{|\epsilon|}\right] = MC(y)$$

- In the perfectly competitive case, demand is flat, $|\epsilon| = \infty$. Then $MC(y) = p(y)$
- The less elastic the demand curve is, the smaller ϵ is, and the larger MR is compared to MC

Monopolistic Pricing & Own-Price Elasticity of Demand

exam

- However, a profit maximizing monopolist will never operate on the inelastic portion of a demand curve

$$MR(y) = p(y)\left[1 - \frac{1}{|\epsilon|}\right]$$

- If $|\epsilon| < 1$, $\frac{1}{|\epsilon|} > 1$
- Then, $MR(y) < 0$. But $MR(y)$ cannot be negative

Monopolistic Pricing & Own-Price Elasticity of Demand

- Why won't a profit maximizing firm operate on the inelastic portion of the demand curve?

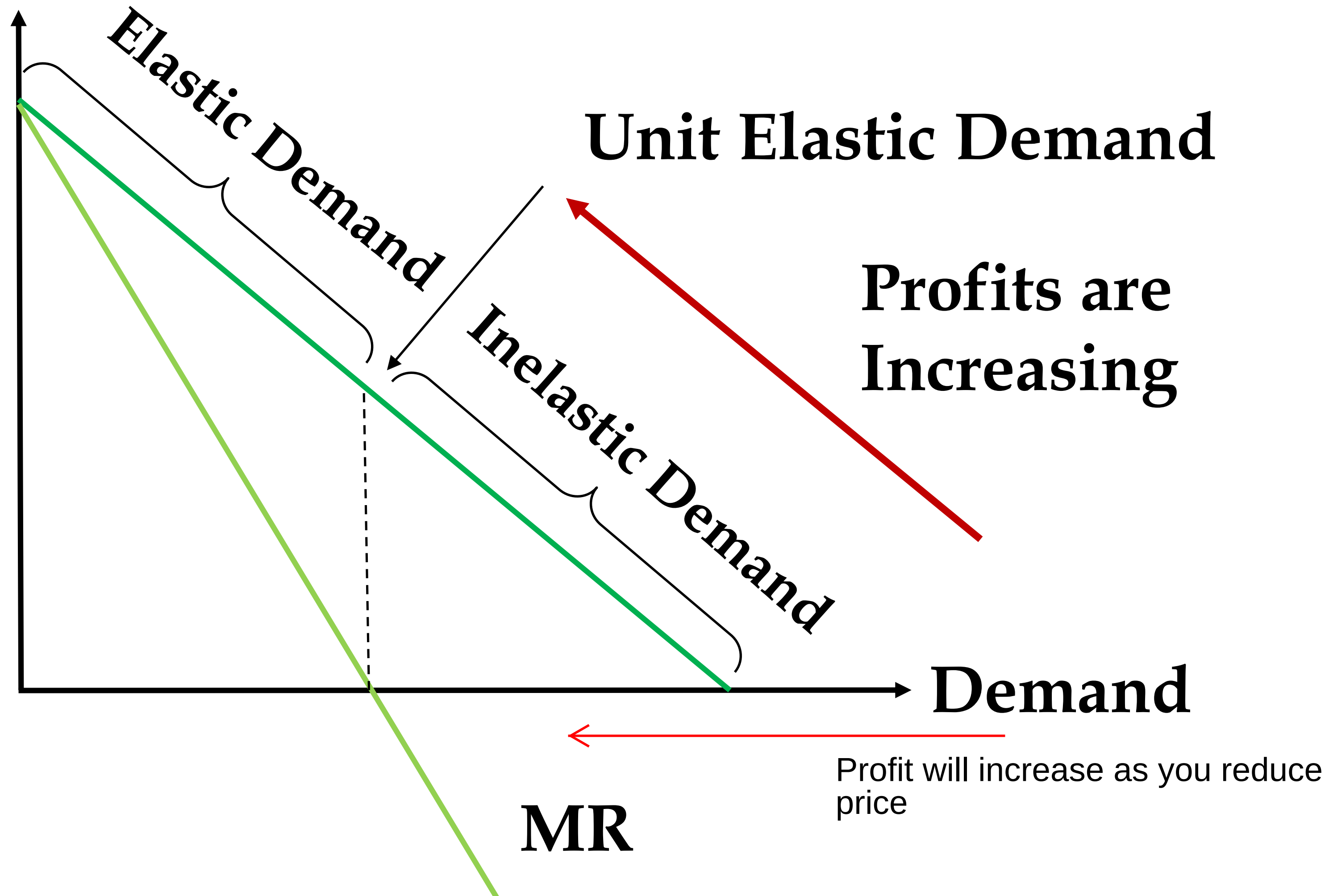
$$\boxed{\varepsilon = \frac{\%\Delta Q}{\%\Delta P} < 1}$$

- Inelastic demand:
  - For a 1% increase in price, quantity decreases by less than 1%.
  - Therefore, a 1% decrease in quantity causes price to rise by more than 1%

Monopolistic Pricing & Own-Price Elasticity of Demand

- Revenue increases when quantity is reduced
- Total cost must decrease when quantity is reduced
- Profits (Revenue – Total Cost) rise by decreasing quantity when on the inelastic portion of demand.
- No point on the inelastic portion of a demand curve generates the most profit

Monopolistic Pricing & Own-Price Elasticity of Demand



Markup Pricing

$$MR(y) = MC(y)$$

$$p(y)\left[1 - \frac{1}{|\epsilon|}\right] = MC(y)$$

$$p(y) = \frac{1}{1 - \frac{1}{|\epsilon|}} MC(y)$$

- A monopolist's mark up over marginal cost is a function of the price elasticity of demand.

Markup Pricing

$$MR(y) = MC(y)$$

$$p(y)\left[1 - \frac{1}{|\epsilon|}\right] = MC(y)$$

$$p(y) = \boxed{\frac{1}{1-\frac{1}{|\epsilon|}}} MC(y)$$

- The mark up is higher if $|\epsilon|$ is small
  - If $|\epsilon| = 3$, mark up is 1.5
  - If $|\epsilon| = 2$, mark up is 2
  - If $|\epsilon| = 1.1$, mark up is 11

The closer to inelastic, then the higher the mark up

Markup Pricing

$$p(y) = \boxed{\frac{1}{1-\frac{1}{|\epsilon|}}} MC(y)$$

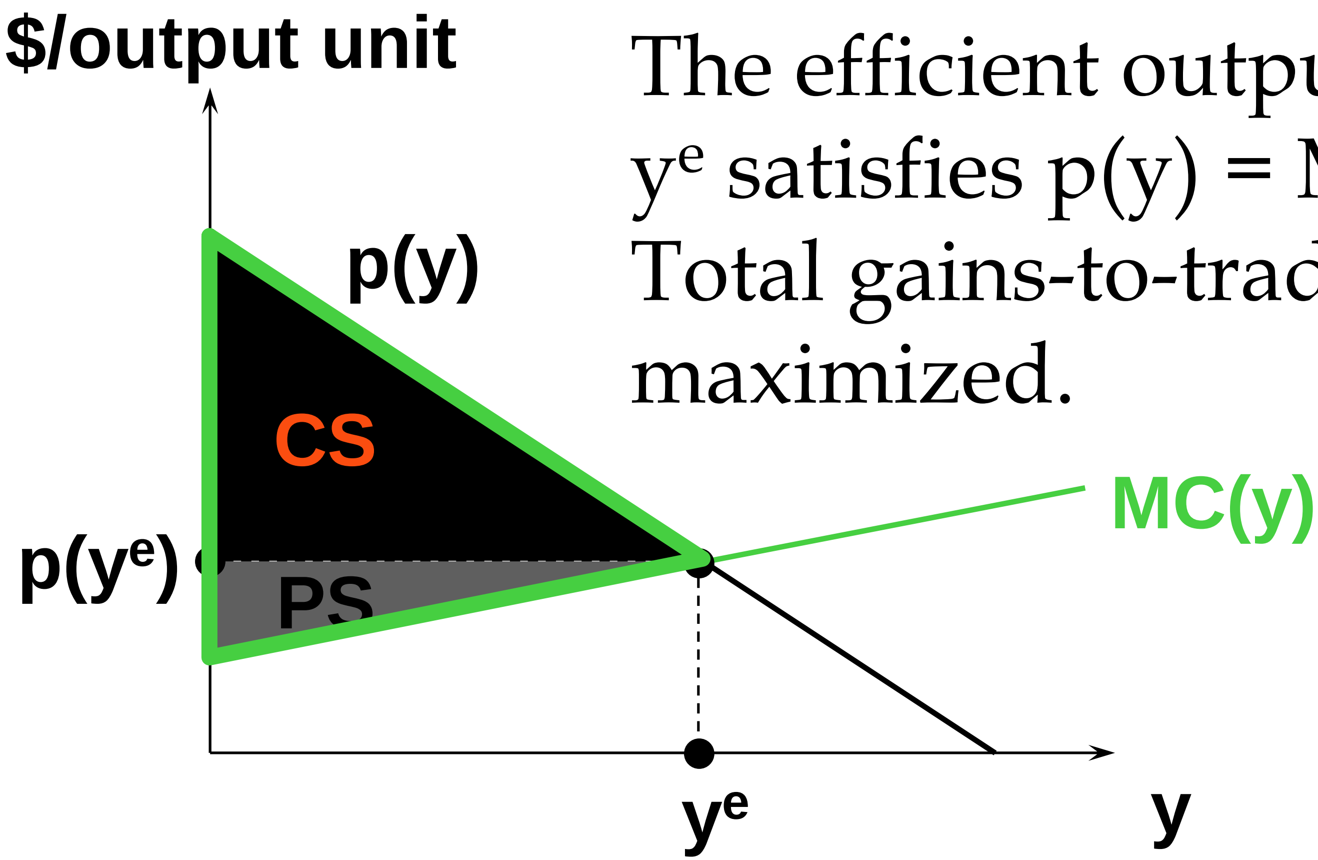
- To answer the question that started this all, if demand becomes more inelastic:
  - $|\epsilon|$ becomes smaller,
  - $\frac{1}{|\epsilon|}$ becomes bigger,
  - $1 - \frac{1}{|\epsilon|}$ becomes smaller,
  - $\frac{1}{1-\frac{1}{|\epsilon|}}$ becomes bigger, $p(y) \uparrow\uparrow$

The Inefficiency of Monopoly

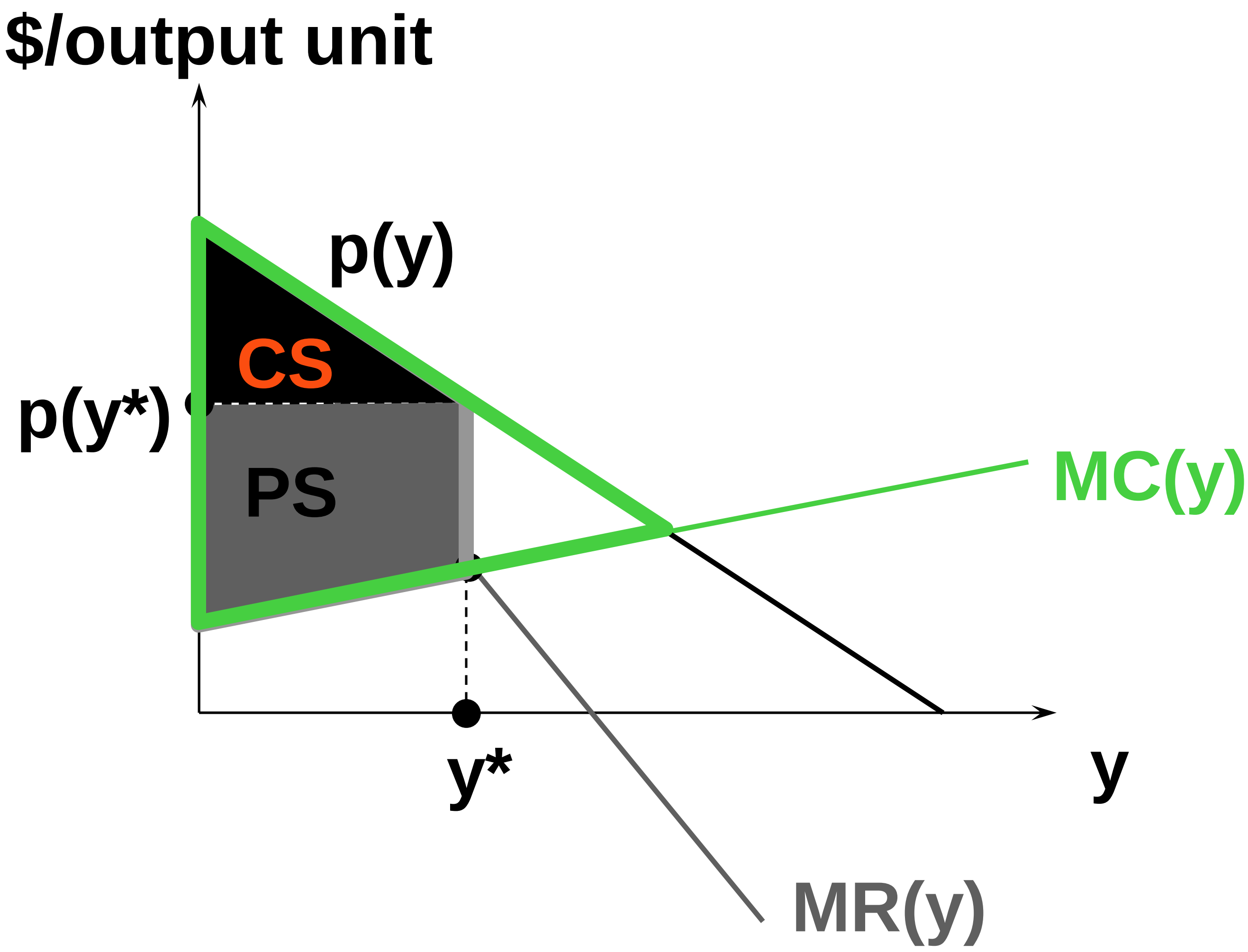
- A market is Pareto efficient if it achieves the maximum possible total gains-to-trade.
- Otherwise a market is Pareto inefficient.

The Inefficiency of Monopoly

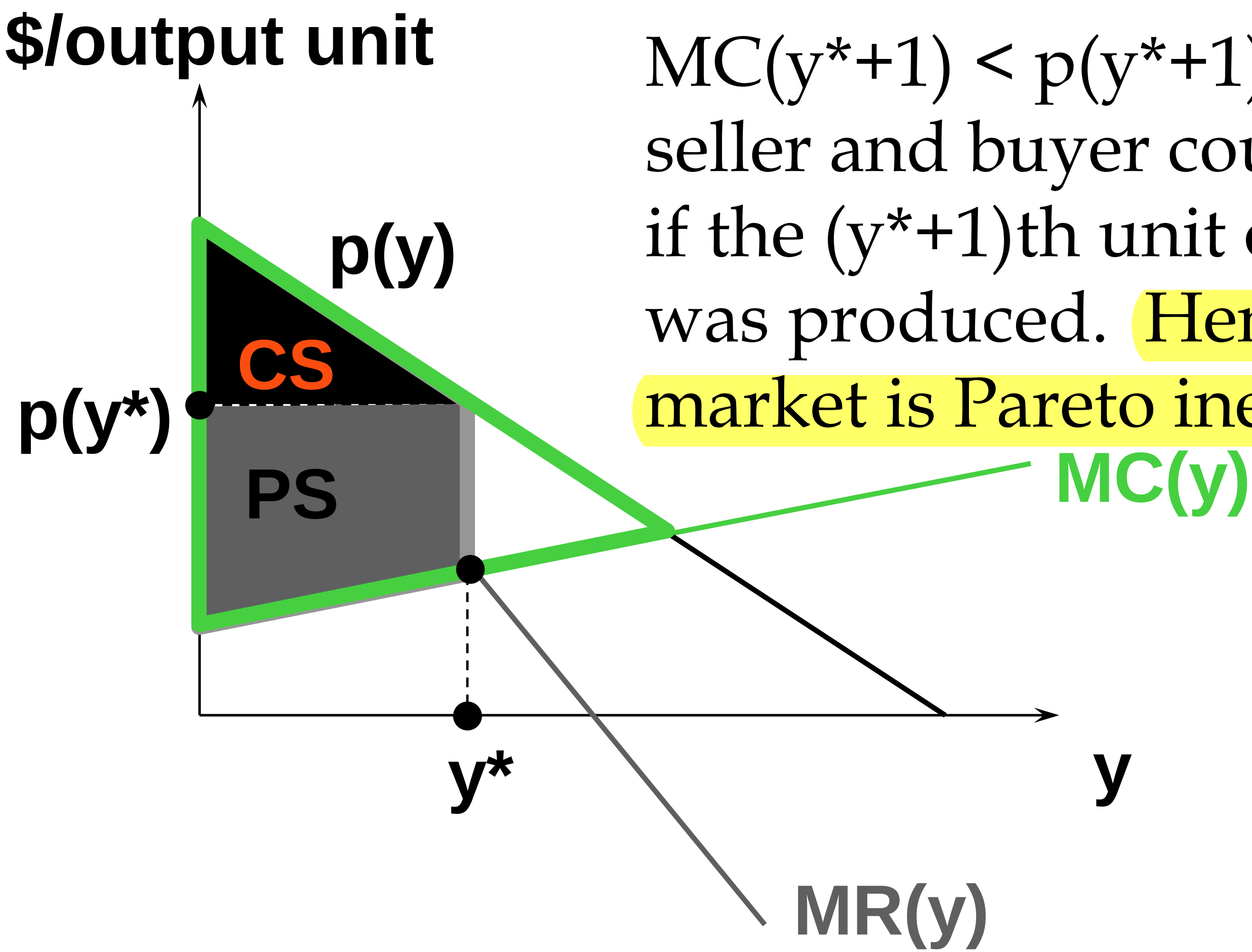
The efficient output level y^e satisfies $p(y) = MC(y)$. Total gains-to-trade is maximized.



The Inefficiency of Monopoly



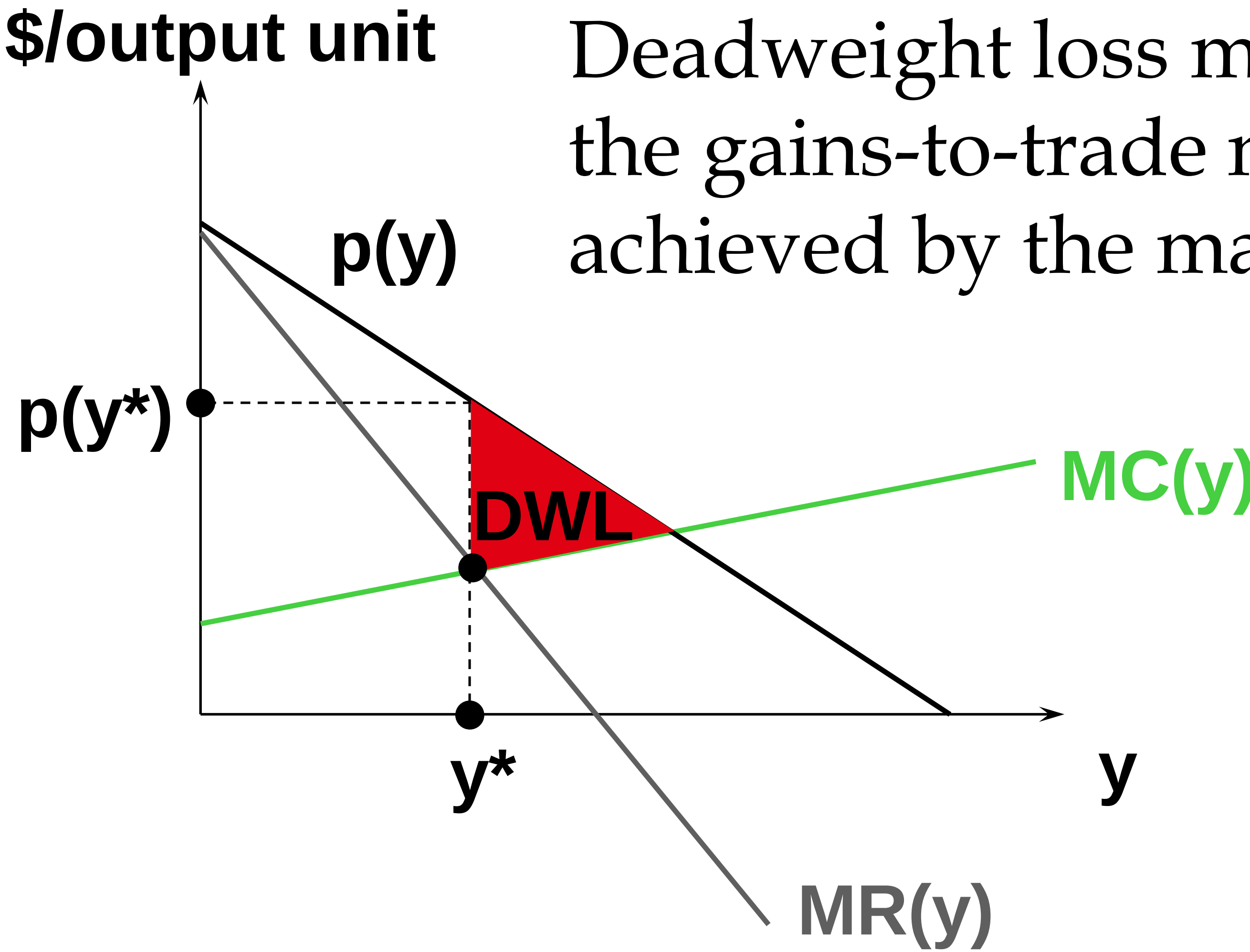
The Inefficiency of Monopoly



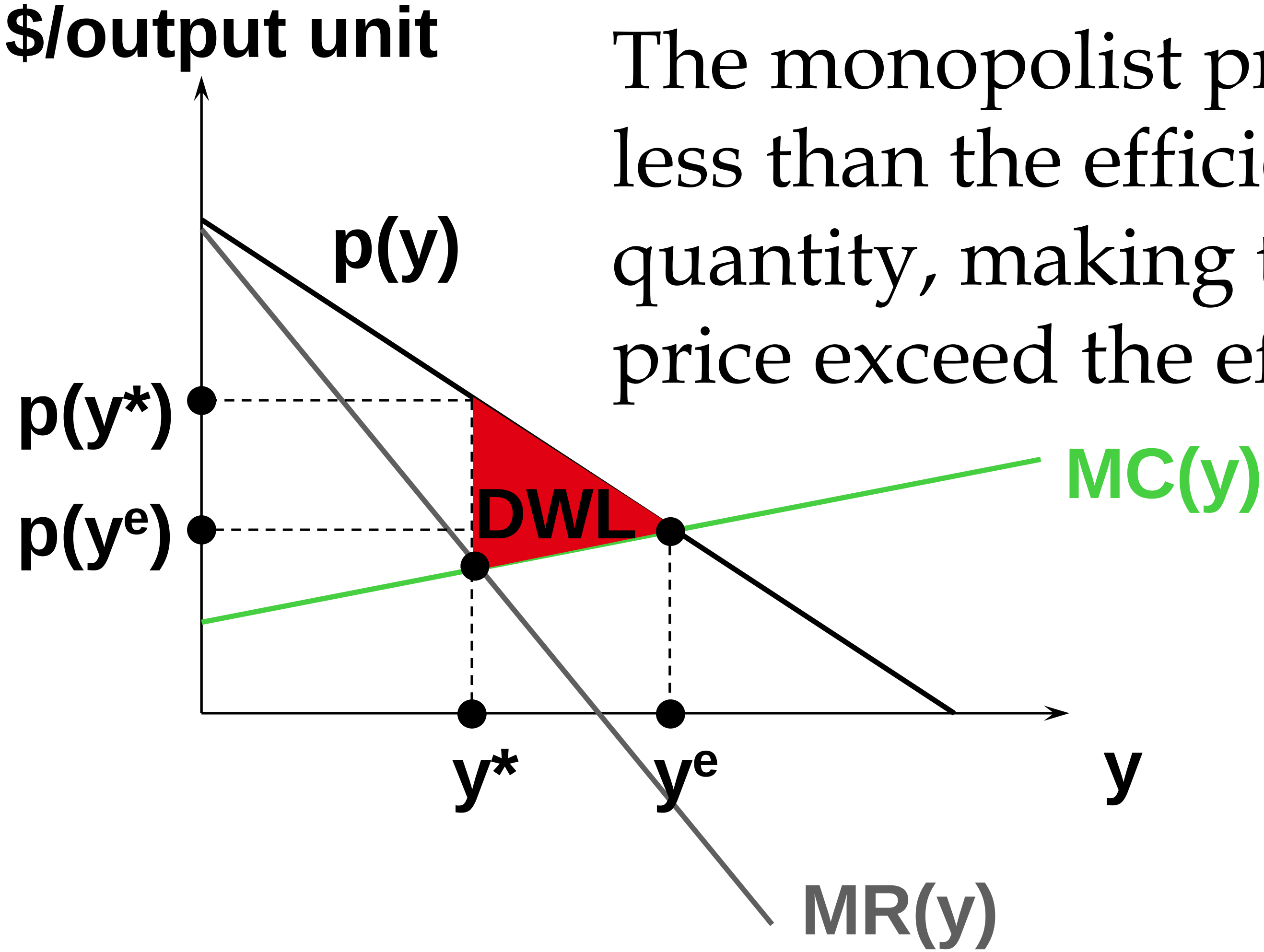
MC(y*+1) < p(y*+1) so both seller and buyer could gain if the (y*+1)th unit of output was produced. Hence the market is Pareto inefficient.

The Inefficiency of Monopoly

Deadweight loss measures the gains-to-trade not achieved by the market.

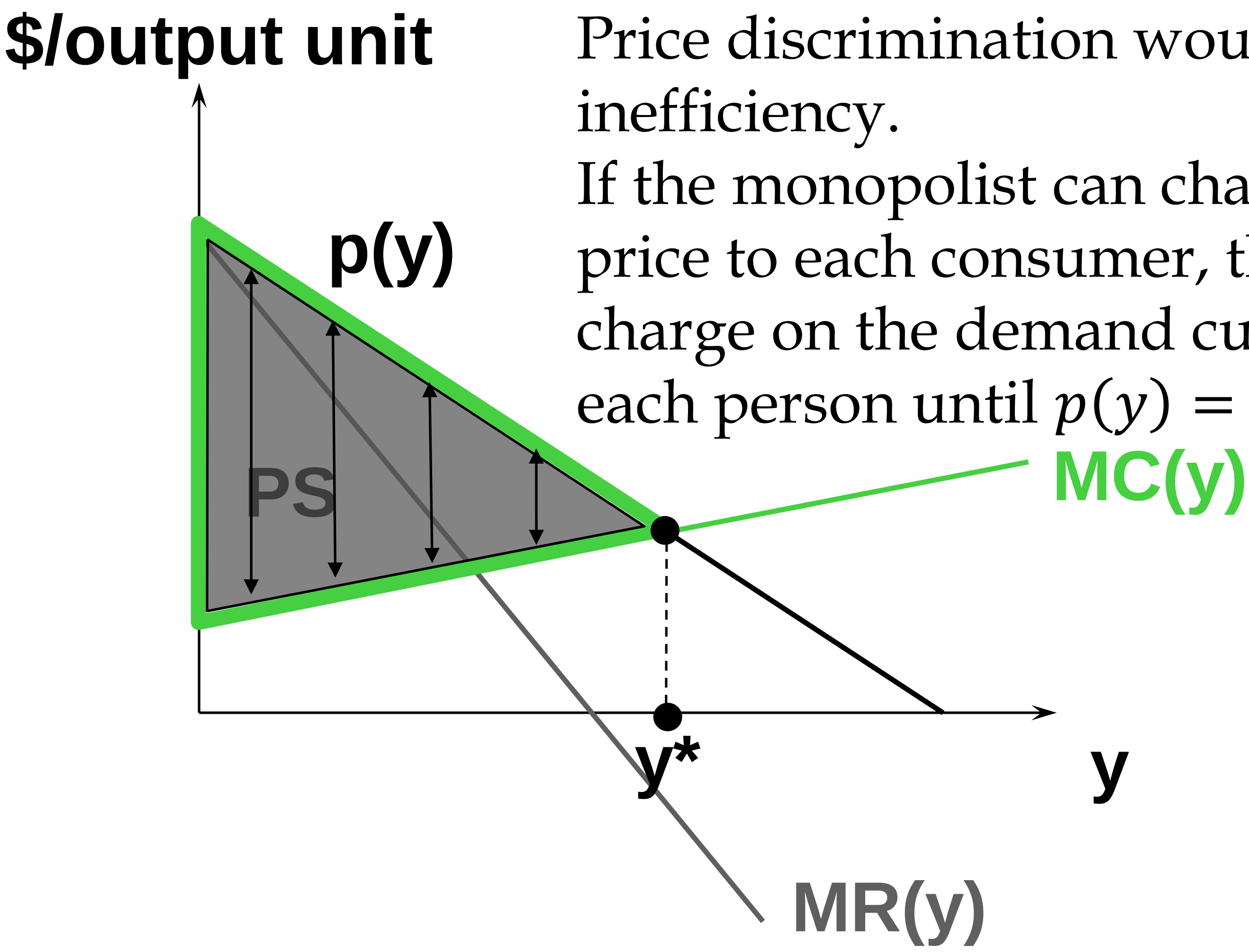


The Inefficiency of Monopoly



The monopolist produces less than the efficient quantity, making the market price exceed the efficient market price.

The Inefficiency of Monopoly



Price discrimination would fix this inefficiency.
If the monopolist can char a different price to each consumer, then he will charge on the demand curve for each person until $p(y) = MC(y)$

Barriers to Entry

- Why do monopolies exist?
  - In perfectly competitive markets, if existing firms make profits, new firms enter to drive profit back to zero
- Monopoly markets have barriers to entry

Barriers to Entry

- Barriers to entry are factors that allow an existing firm to earn positive profits while making it unprofitable for newcomers to enter the industry.

Types of Barriers to Entry

- Legal
  - Patents on drugs, technological innovations
- Strategic
  - limit pricing (Entry deterrent pricing)
    - Incumbent firm charges a lower price before entry occurs
  - predatory pricing
    - Large incumbent firms lower its price to drive smaller rivals out of the market

Types of Barriers to Entry

- Structural
  - Positive network externalities
    - The value of the product increases with the size of the market captured by a particular firm
    - e.g. QWERTY keyboards, gasoline cars, Microsoft Windows, Facebook, Google, Android

Value of Facebook comes from alot of people using it.

  - Natural Monopoly

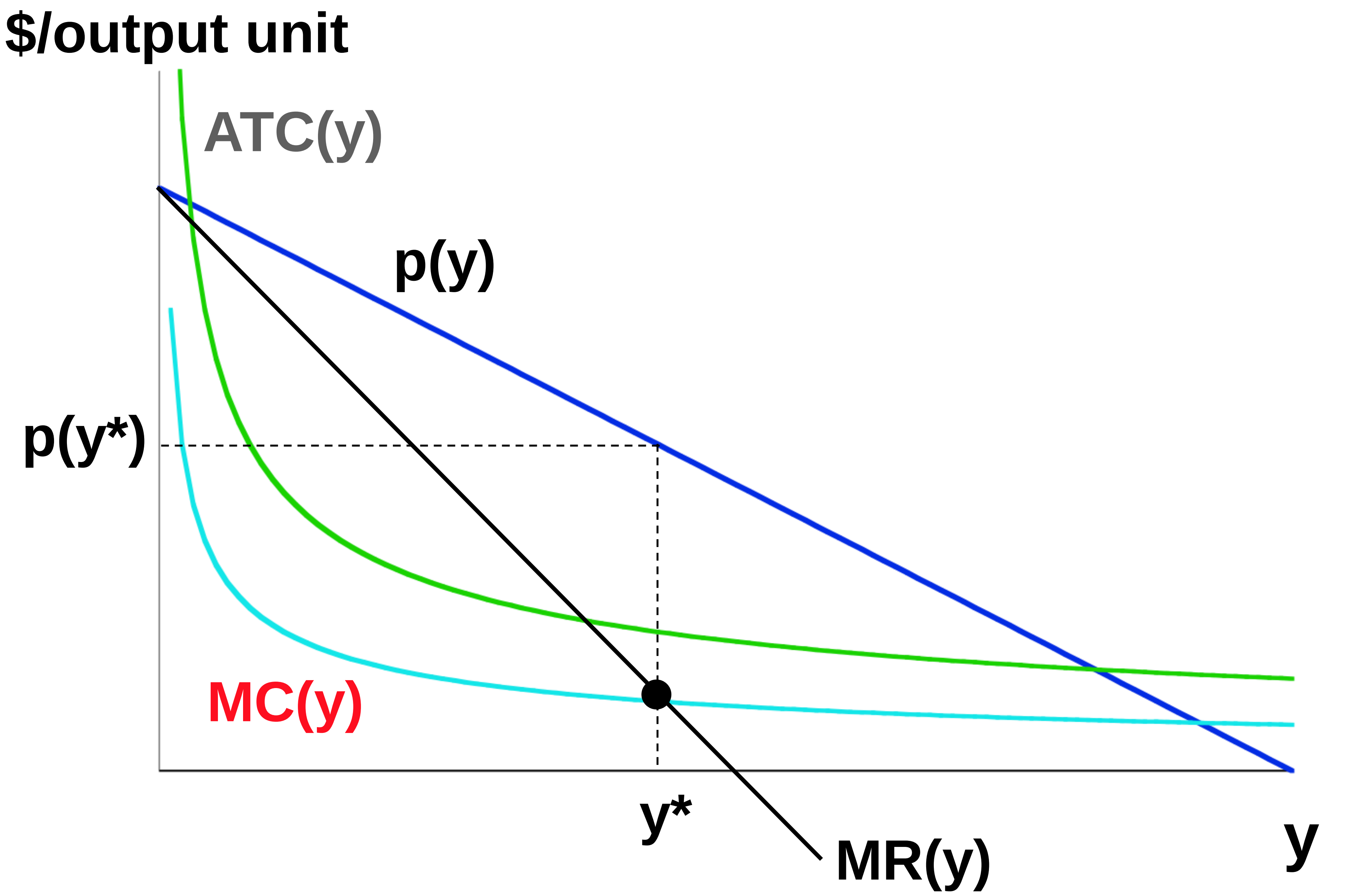
Natural Monopoly

- A natural monopoly arises when the total cost a single firm would incur is less than the combined total cost that two or more firms would incur if they divide the output among them
  - Economies of scale
    - High fixed cost, low marginal cost
    - Decreasing average total cost
  - Demand is small (relative to the cost structure)

Natural Monopoly

- Examples of natural monopolies:
  - Utilities (e.g. water, power, natural gas)
  - Transportation (railways, roads)

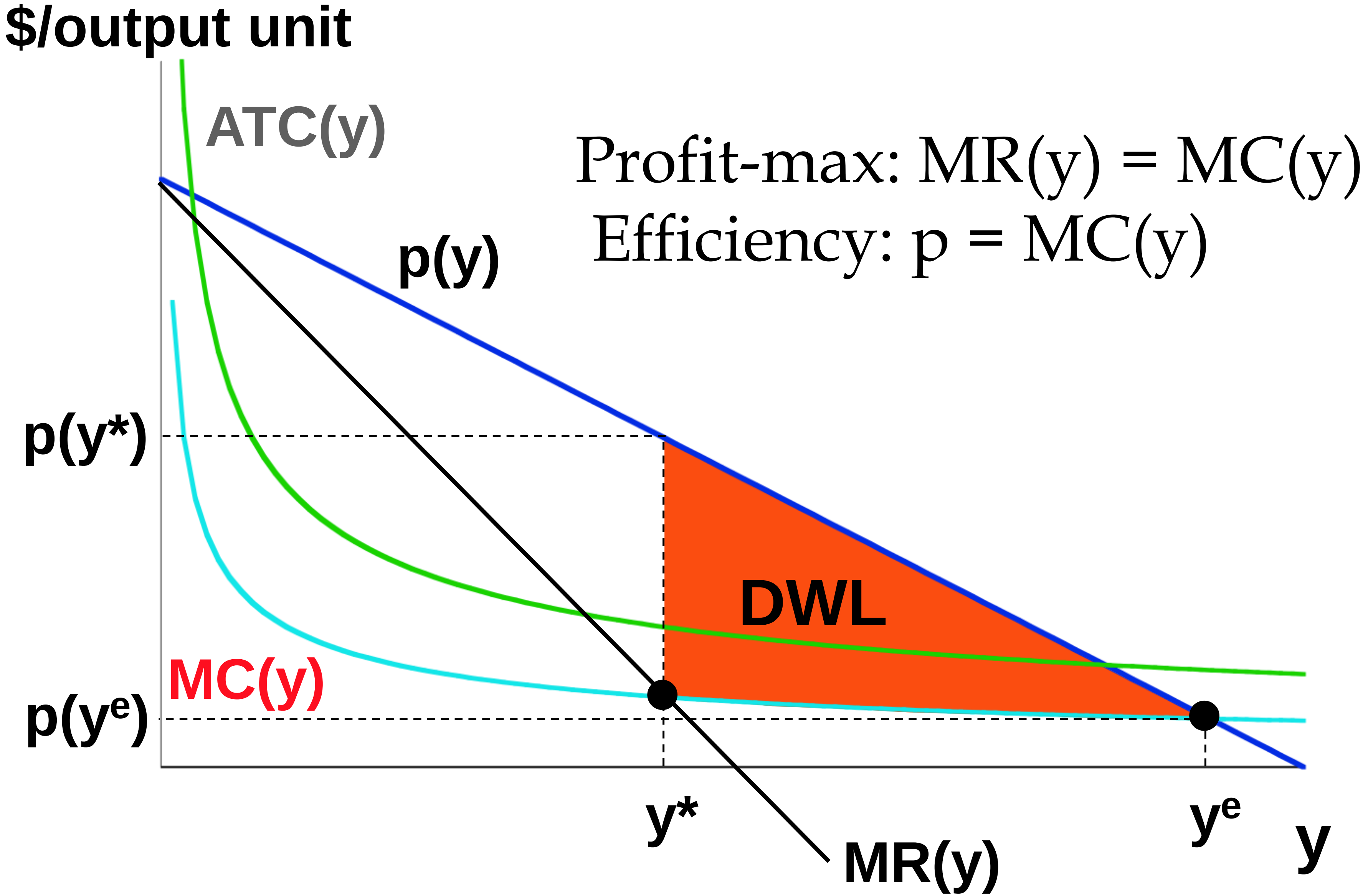
Natural Monopoly



Inefficiency of a Natural Monopolist

- Like any profit-maximizing monopolist, the natural monopolist causes a deadweight loss.

Inefficiency of a Natural Monopoly

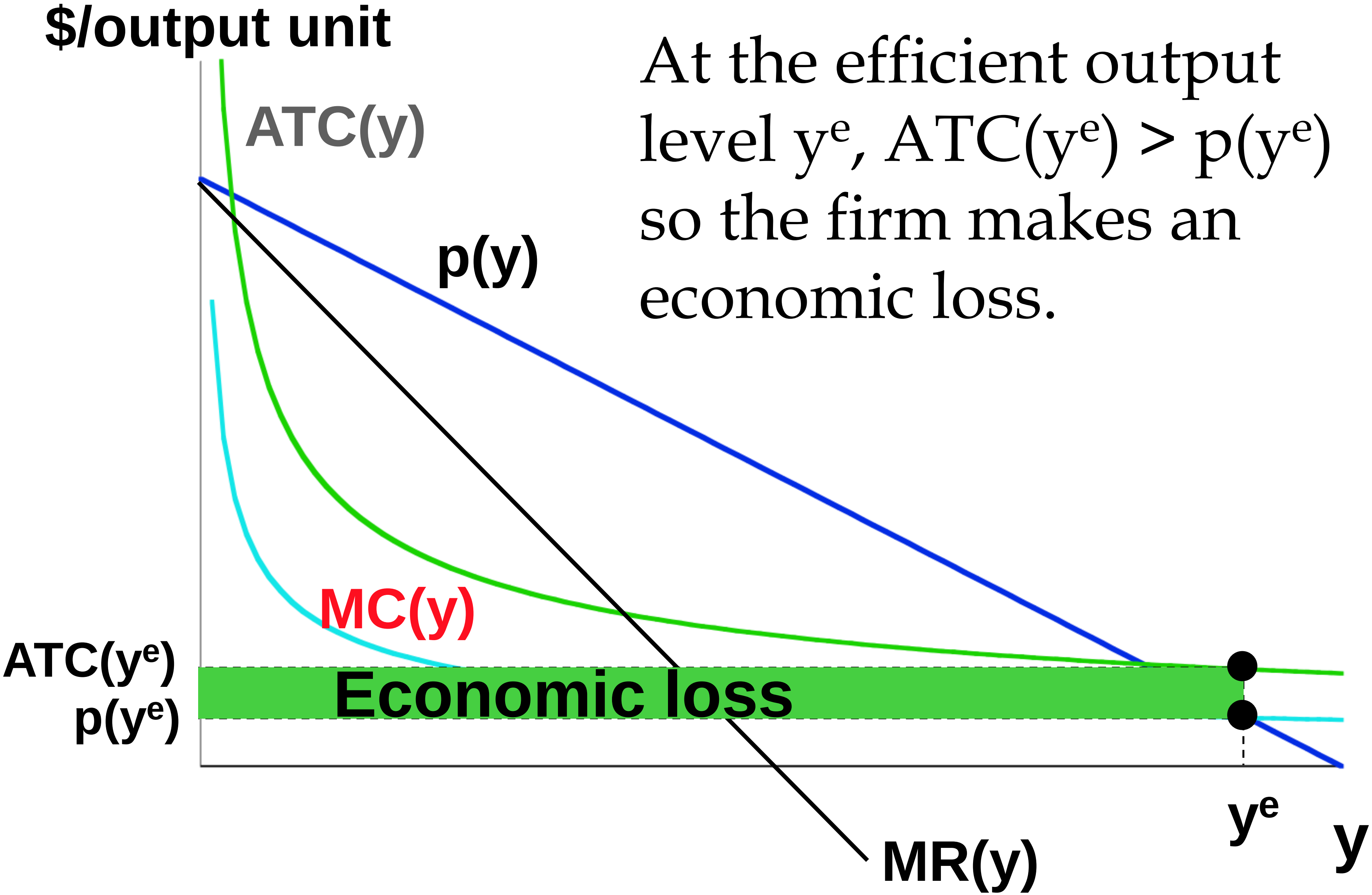


Regulating a Natural Monopoly

- Why not command that a natural monopoly produce the efficient amount of output?
- Then the deadweight loss will be zero, won't it?

Regulating a Natural Monopoly

At the efficient output level y^e, $ATC(y^e) > p(y^e)$ so the firm makes an economic loss.



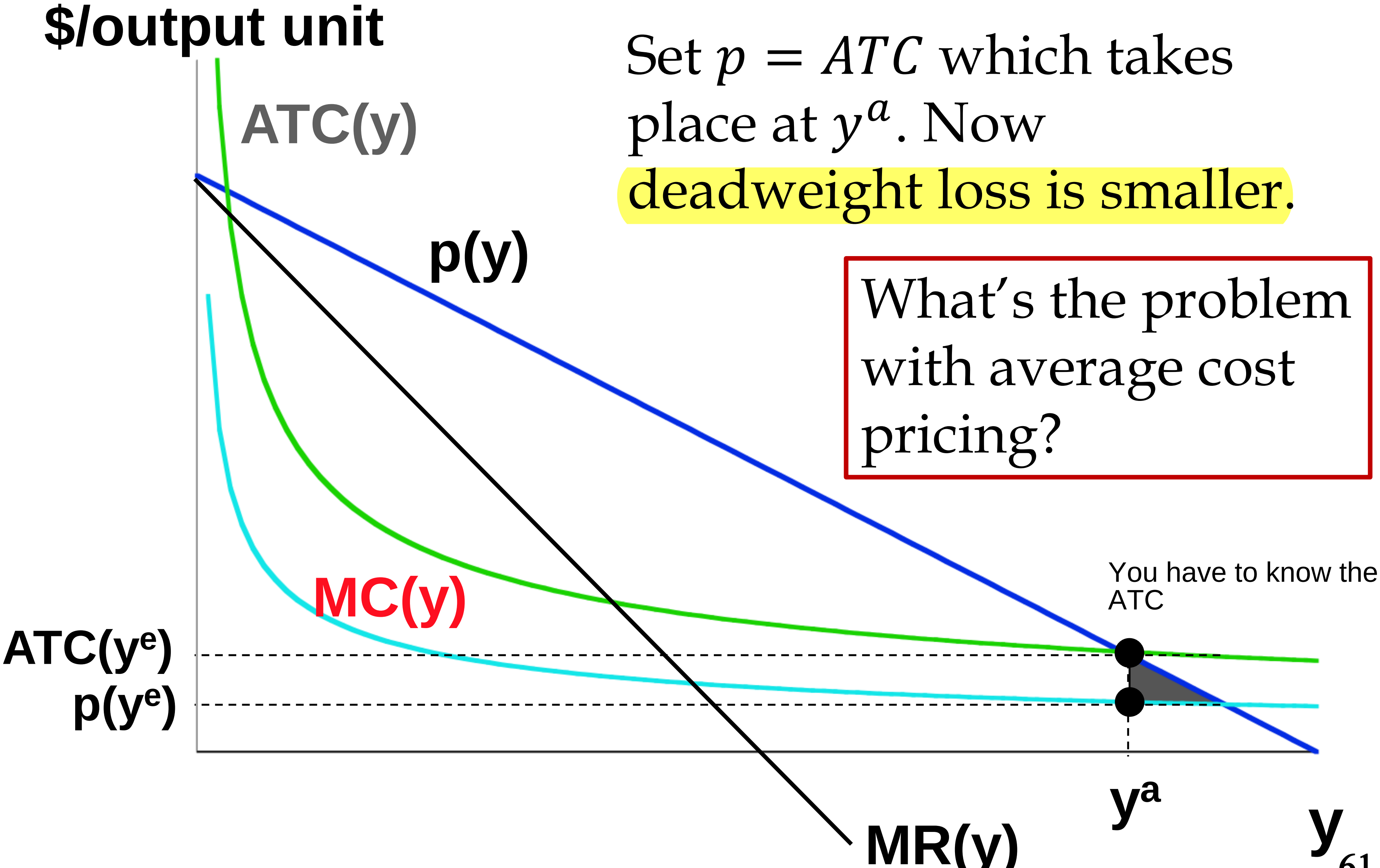
Regulating a Natural Monopoly

- So a natural monopoly cannot be forced to use marginal cost pricing. Doing so makes the firm exit, destroying both the market and any gains-to-trade.
- Regulatory schemes can induce the natural monopolist to produce the efficient output level without exiting.
- One scheme is average cost pricing

Regulating a Natural Monopoly

Set $p = ATC$ which takes place at y^a. Now deadweight loss is smaller.

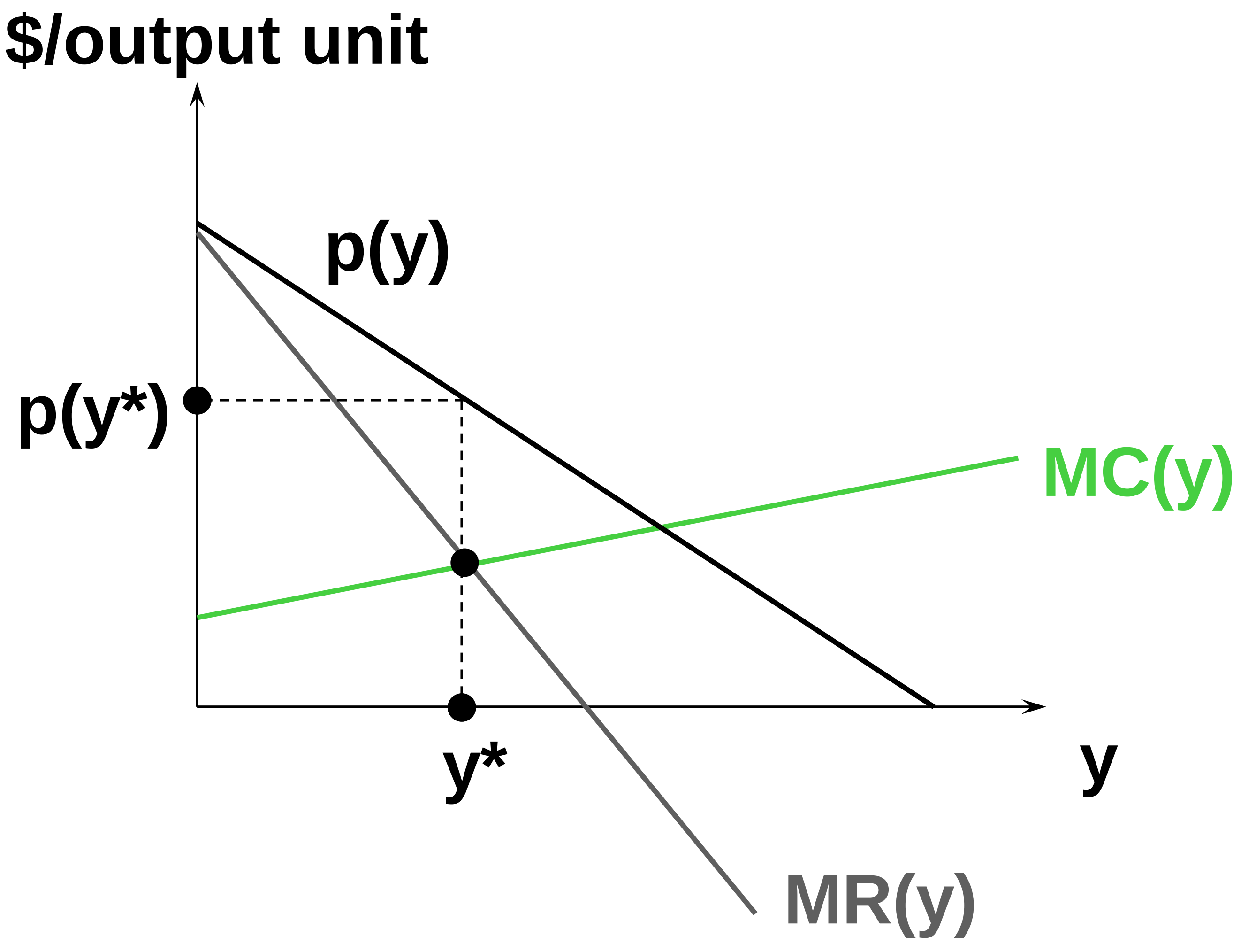
What's the problem with average cost pricing?



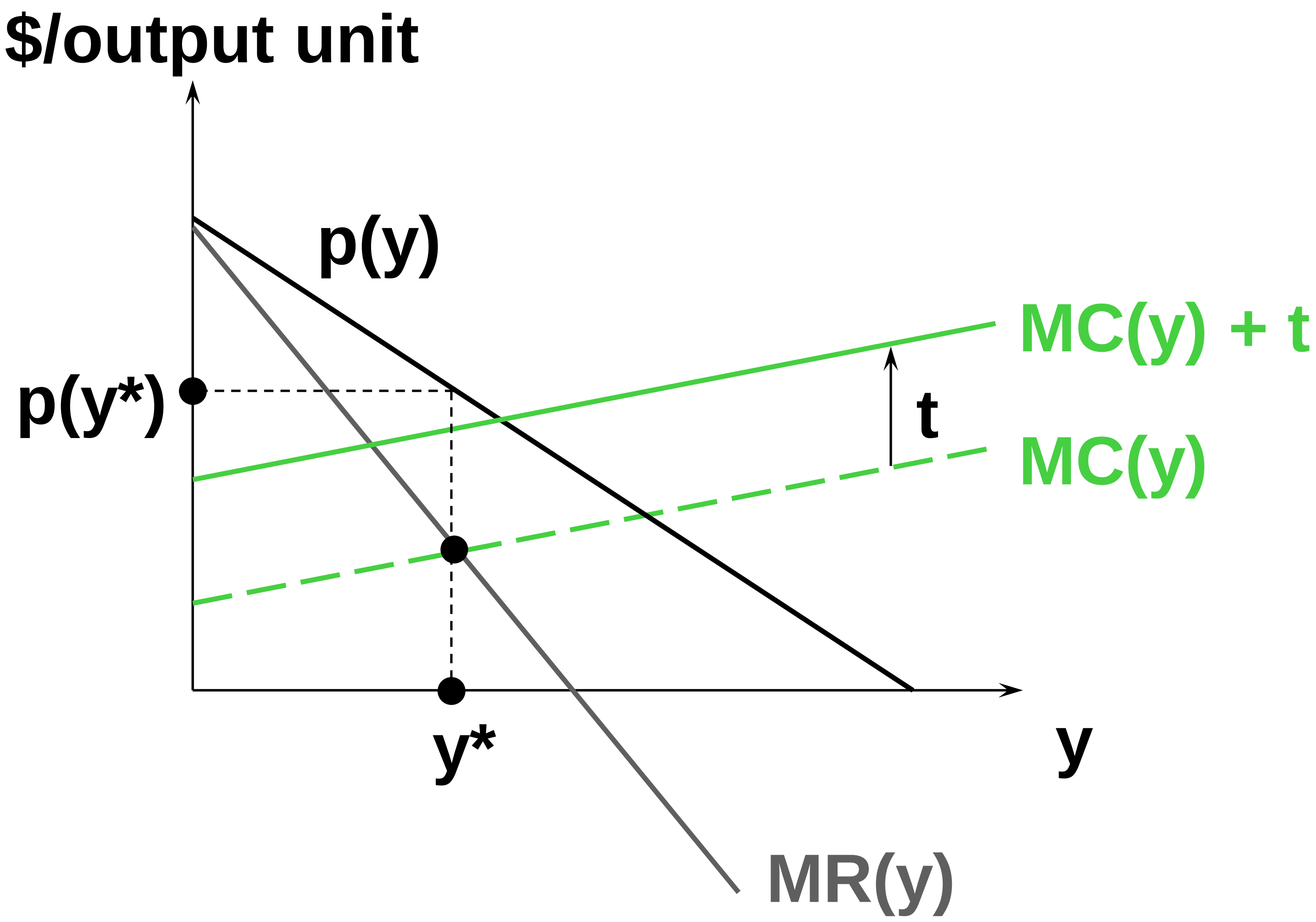
Quantity Tax Levied on a Monopolist

- A quantity tax of \$t/output unit raises the marginal cost of production by \$t.
- So the tax reduces the profit-maximizing output level, causes the market price to rise, and input demands to fall.
- The quantity tax is distortionary.

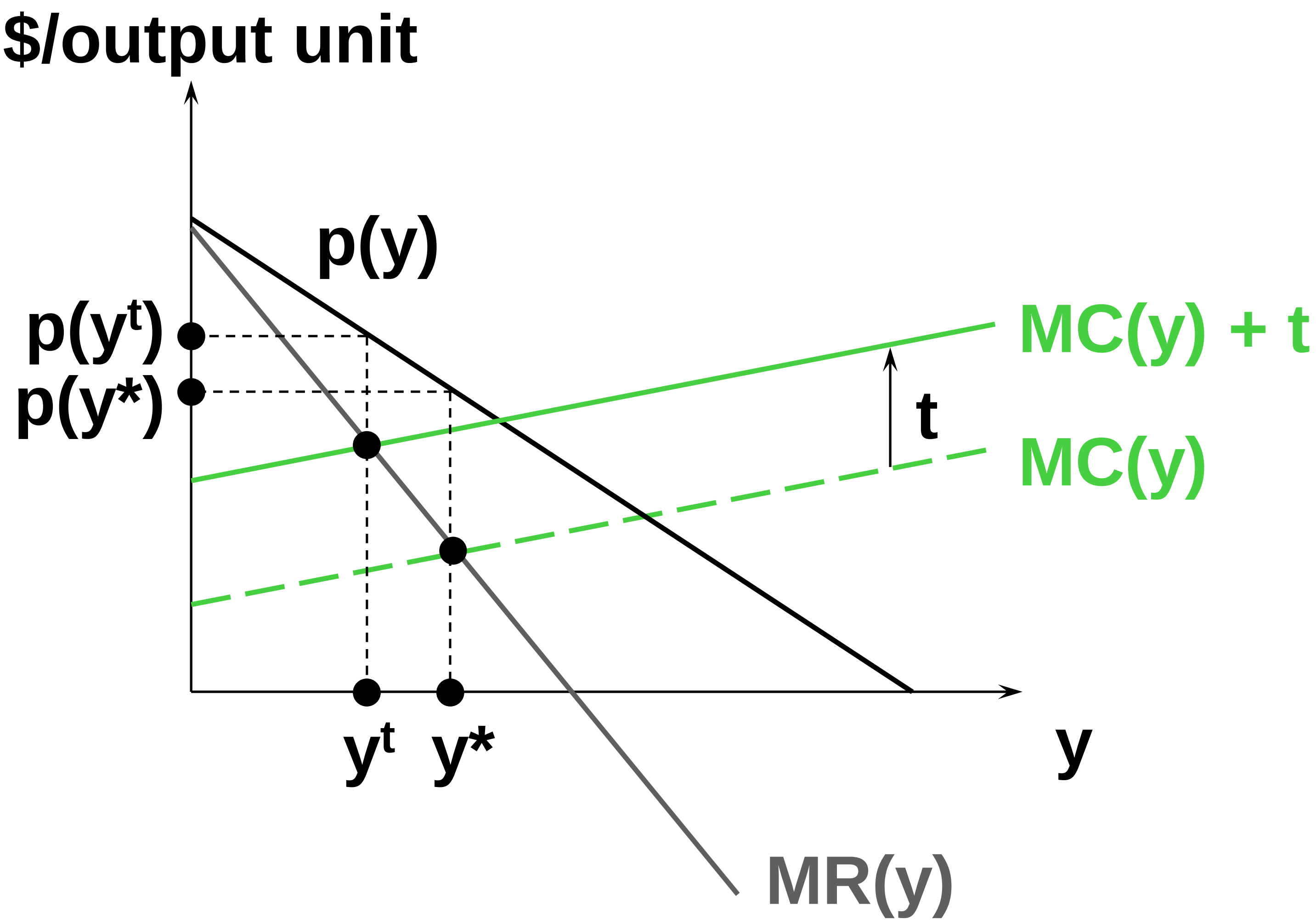
Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist

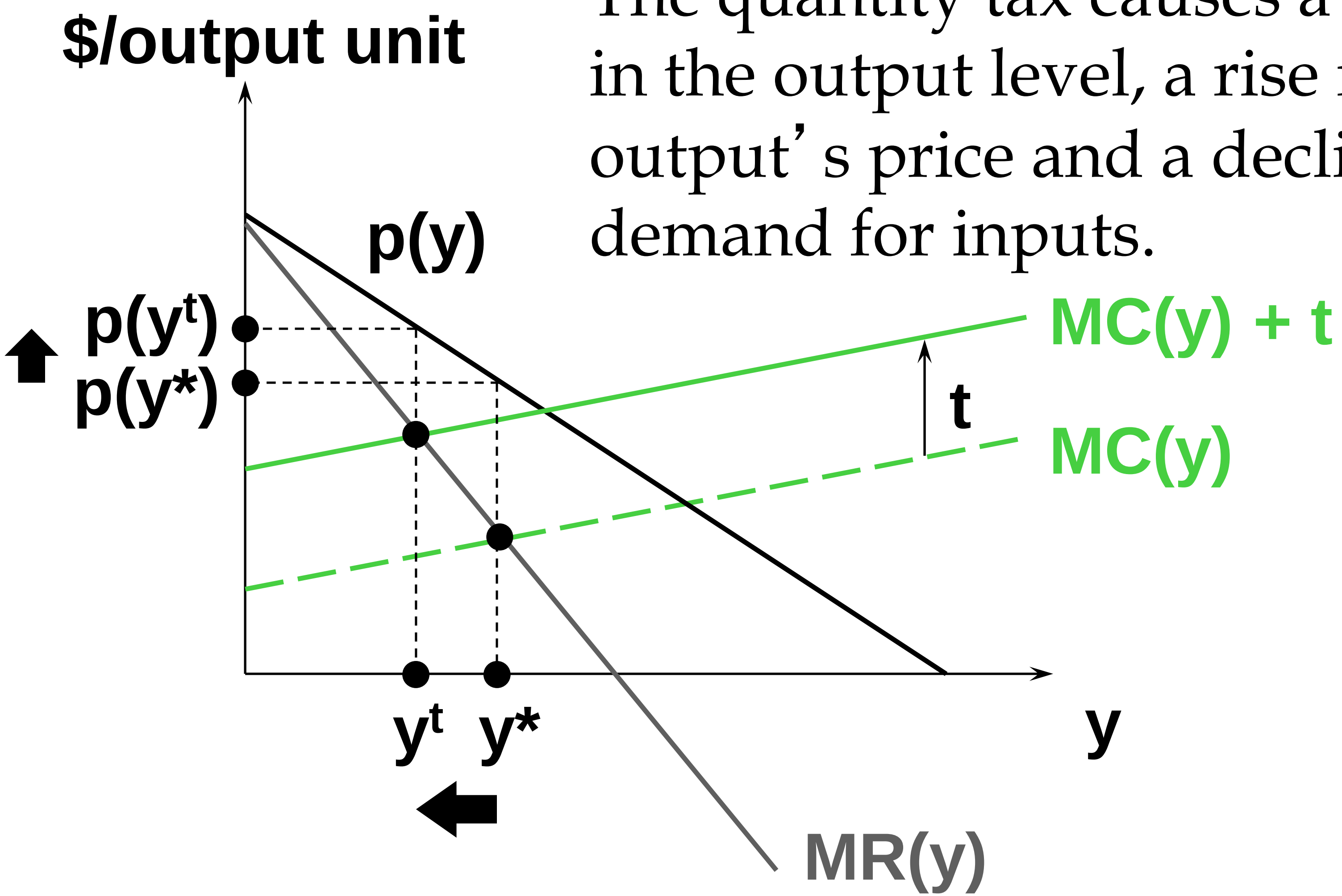


Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist

The quantity tax causes a drop in the output level, a rise in the output's price and a decline in demand for inputs.



Quantity Tax Levied on a Monopolist

- Can a monopolist "pass" all of a $t quantity tax to the consumers?
- Suppose the marginal cost of production is constant at $k/output unit.

- Recall that $MR(y) = p(y)\left[1 + \frac{1}{\epsilon}\right] = MC$

So, $p(y) = \frac{MC}{\left[1+\frac{1}{\epsilon}\right]} = \frac{\epsilon MC}{1+\epsilon}$

With no tax, the monopolist's price is

$$p(y^*) = \frac{k\epsilon}{1+\epsilon}$$

Quantity Tax Levied on a Monopolist

- The tax increases marginal cost to \$(k+t)/output unit, changing the profit-maximizing price to

$$p(y^t) = \frac{(k+t)\varepsilon}{1+\varepsilon}.$$

- The amount of the tax paid by buyers is

$$p(y^t) - p(y^*).$$

Quantity Tax Levied on a Monopolist

$$p(y^t) - p(y^*) = \frac{(k+t)\varepsilon}{1+\varepsilon} - \frac{k\varepsilon}{1+\varepsilon} = \frac{t\varepsilon}{1+\varepsilon}$$

is the amount of the tax passed on to buyers. E.g. if ϵ = -2, the amount of the tax passed on is 2t.

Because the monopolist always operates on the elastic portion of the demand curve, ϵ < -1.

This means that $\frac{\epsilon}{1+\epsilon}$ > 1 and so the monopolist passes on to consumers more than the tax!

Pass on more of the tax to maximize profit

Quantity Tax Levied on a Monopolist

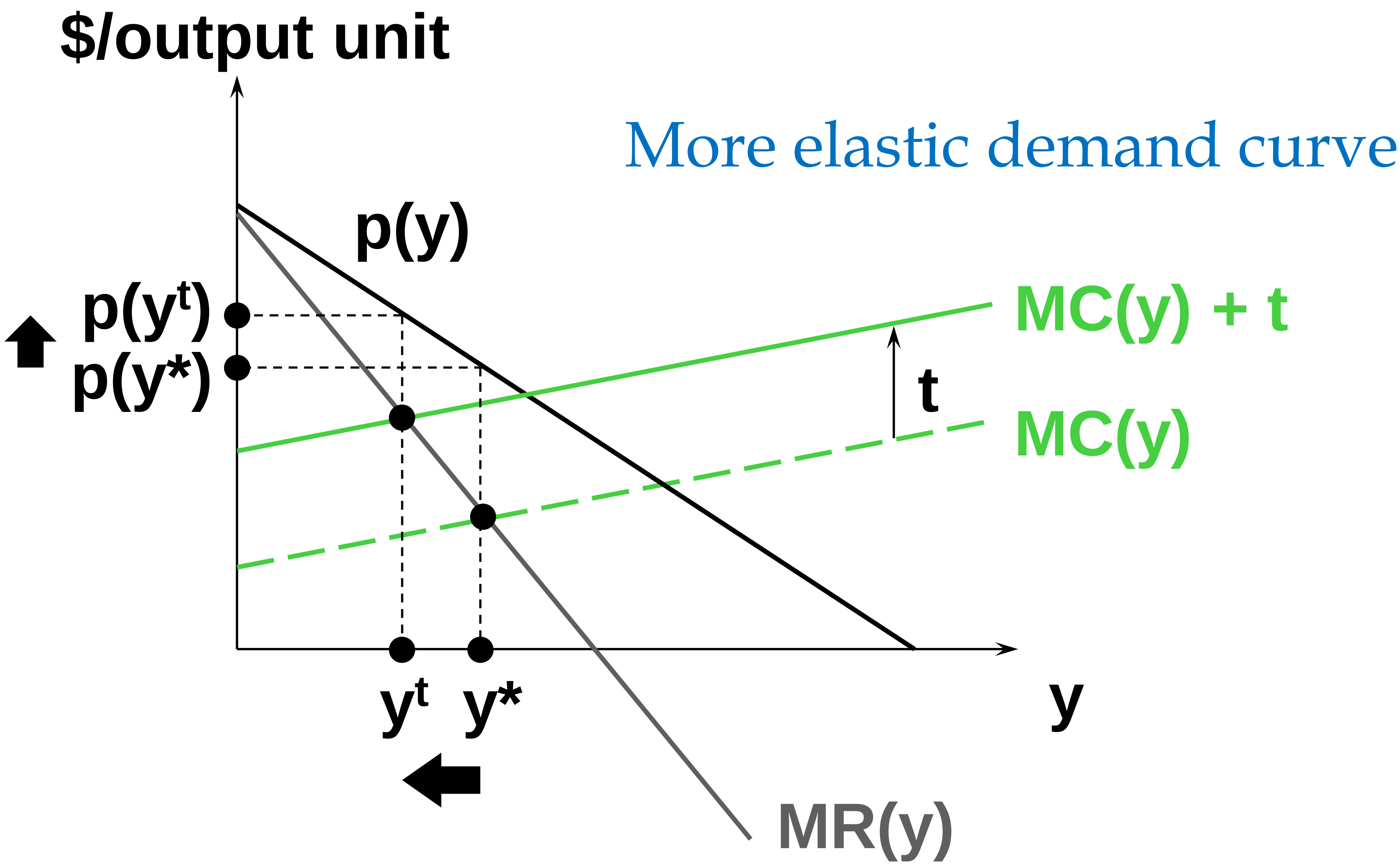
- The closer demand is to unit elastic, that is the less elastic demand is, the larger the difference in $p(y^t) - p(y^*)$.
- Example:

$$\epsilon = -2, \frac{\epsilon t}{1+\epsilon} = 2t$$

$$\epsilon = -4, \frac{\epsilon t}{1+\epsilon} = \frac{4}{3}t = 1.33t$$

$$\epsilon = -100, \frac{\epsilon t}{1+\epsilon} = \frac{100}{99}t = 1.01t$$

Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist