



Lecture 15

Monopoly



Pure Monopoly

A monopolized market has a single seller.

The monopolist's demand curve is the (downward sloping) market demand curve.

垄断厂商面临的需求曲线是整条市场需求曲线

So the monopolist can alter the market price by adjusting its output level.

Pure Monopoly

\$/output unit

$p(y)$

Higher output y causes a lower market price, $p(y)$.

p_1

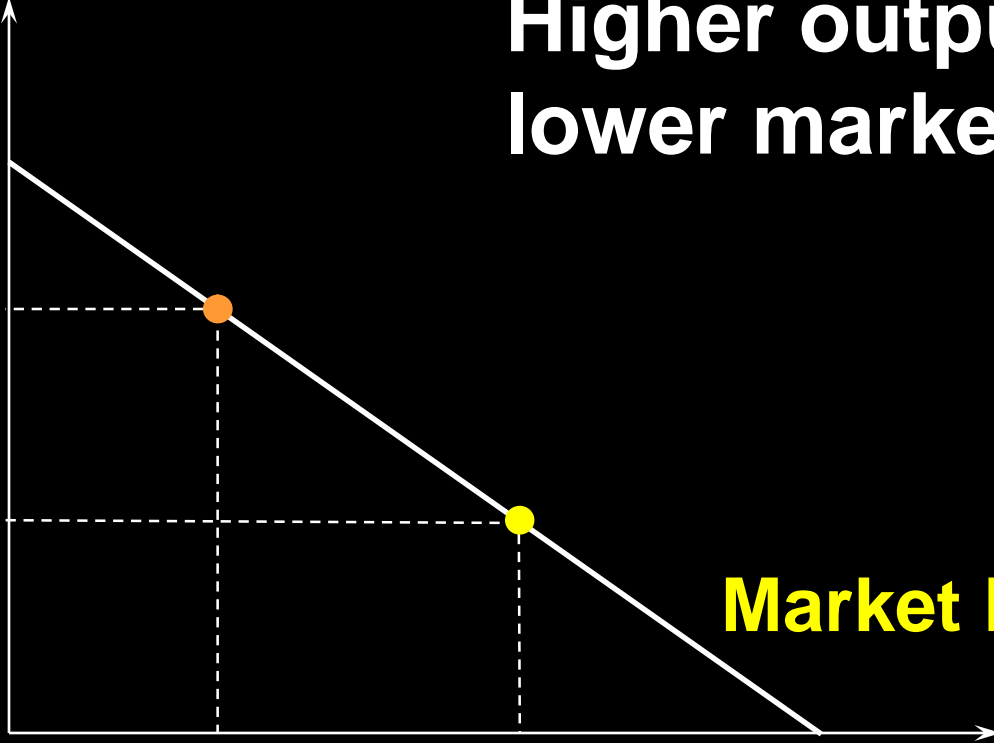
p_2

Market Demand

y_1

y_2

Output Level, y



Why Monopolies?

What causes monopolies?

- a legal fiat; e.g. US Postal Service**
- a patent; e.g. a new drug**
- sole ownership of a resource; e.g. a toll highway**
- formation of a cartel; e.g. OPEC**
- large economies of scale; e.g. local utility companies.**

Pure Monopoly

Suppose that the monopolist seeks to maximize its economic profit,

$$\Pi(y) = p(y)y - c(y).$$

What output level y^* maximizes profit?

Profit-Maximization

$$\Pi(y) = p(y)y - c(y).$$

At the profit-maximizing output level y^*

$$\frac{d\Pi(y)}{dy} = \frac{d}{dy}(p(y)y) - \frac{dc(y)}{dy} = 0$$

so, for $y = y^*$,

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

Marginal Revenue

Marginal revenue is the rate-of-change of revenue as the output level y increases;

$$MR(y) = \frac{d}{dy}(p(y)y) = p(y) + y \frac{dp(y)}{dy}.$$

$dp(y)/dy$ is the slope of the market inverse demand function so $dp(y)/dy < 0$. Therefore

$$MR(y) = p(y) + y \frac{dp(y)}{dy} < p(y)$$

for $y > 0$.

Marginal Revenue

E.g. if $p(y) = a - by$ then

$$R(y) = p(y)y = ay - by^2$$

and so

$$MR(y) = a - 2by < a - by = p(y) \text{ for } y > 0.$$

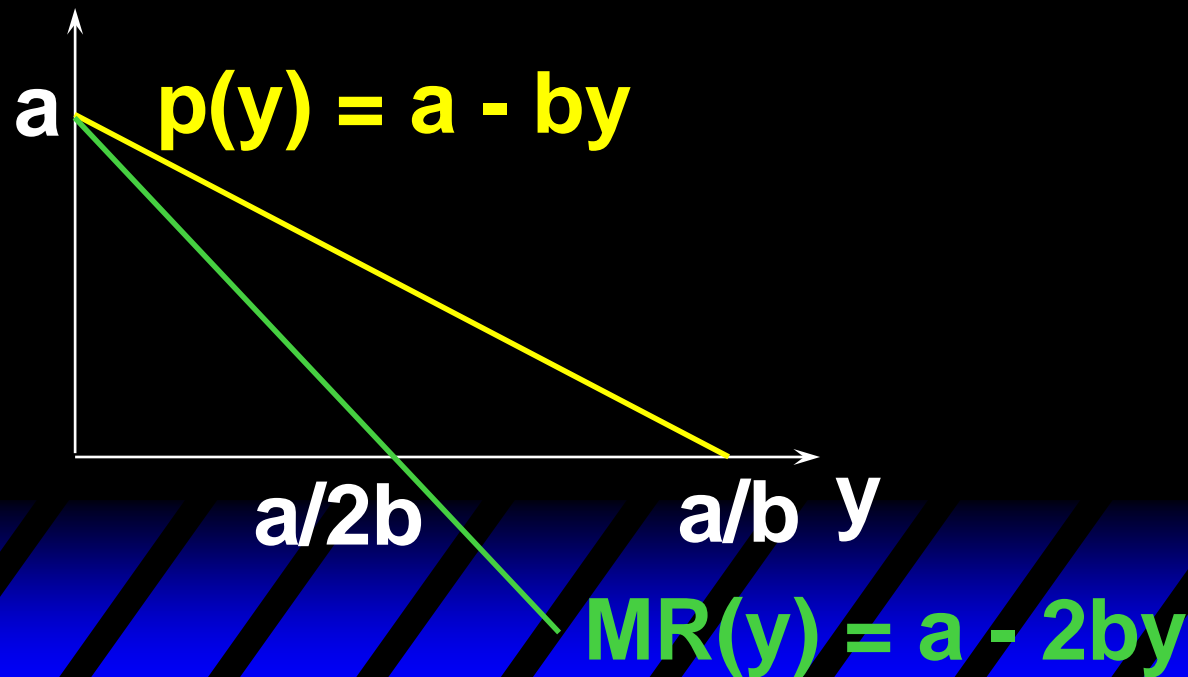
Marginal Revenue

E.g. if $p(y) = a - by$ then

$$R(y) = p(y)y = ay - by^2$$

and so

$$MR(y) = a - 2by < a - by = p(y) \text{ for } y > 0.$$



Marginal Cost

Marginal cost is the rate-of-change of total cost as the output level y increases;

$$\mathbf{MC(y) = \frac{dc(y)}{dy} .}$$

E.g. if $c(y) = F + \alpha y + \beta y^2$ then

$$\mathbf{MC(y) = \alpha + 2\beta y .}$$

Profit-Maximization; An Example

At the profit-maximizing output level y^* , $MR(y^*) = MC(y^*)$. So if $p(y) = a - by$ and if $c(y) = F + \alpha y + \beta y^2$ then

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

and the profit-maximizing output level is

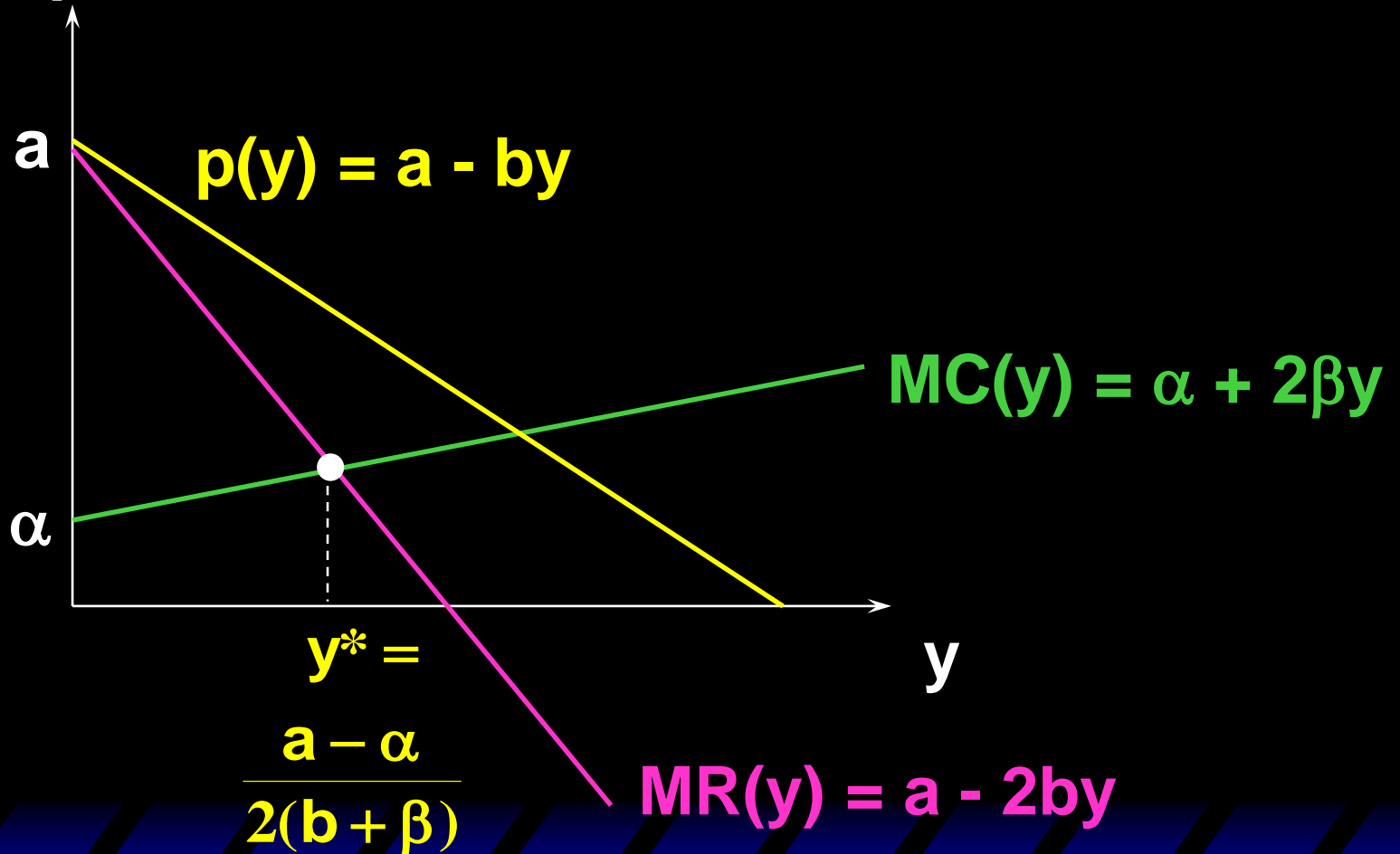
$$y^* = \frac{a - \alpha}{2(b + \beta)}$$

causing the market price to be

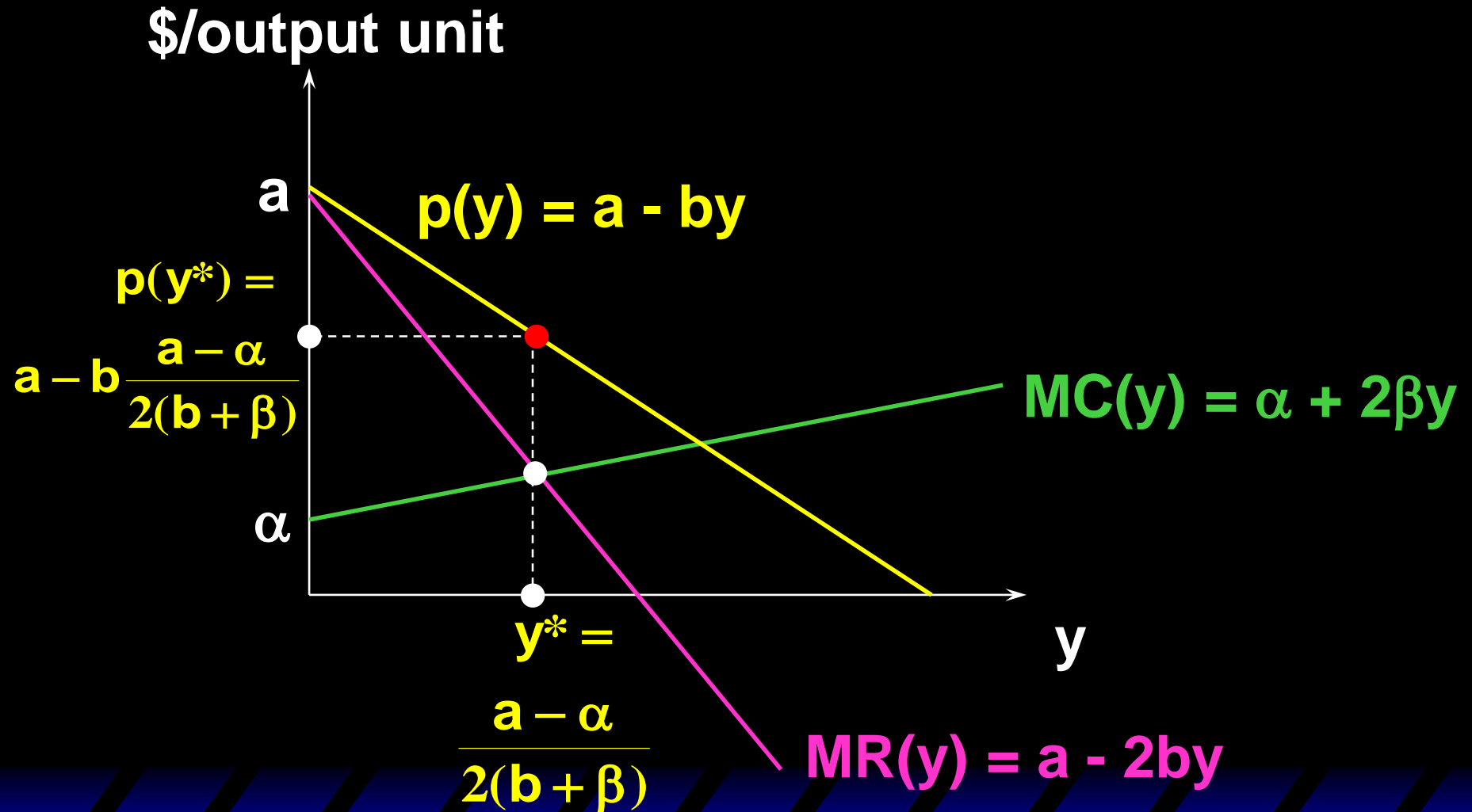
$$p(y^*) = a - by^* = a - b \frac{a - \alpha}{2(b + \beta)}.$$

Profit-Maximization; An Example

\$/output unit



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). Does the monopolist exploit this by causing the market price to rise?

当需求弹性下降时，垄断厂商的定价会如何改变？

Monopolistic Pricing & Own-Price Elasticity of Demand

$$\begin{aligned}\text{MR}(y) &= \frac{d}{dy}(p(y)y) = p(y) + y \frac{dp(y)}{dy} \\ &= p(y) \left[1 + \frac{y}{p(y)} \frac{dp(y)}{dy} \right].\end{aligned}$$

Monopolistic Pricing & Own-Price Elasticity of Demand

$$\begin{aligned} \text{MR}(y) &= \frac{d}{dy}(p(y)y) = p(y) + y \frac{dp(y)}{dy} \\ &= p(y) \left[1 + \frac{y}{p(y)} \frac{dp(y)}{dy} \right]. \end{aligned}$$

Own-price elasticity of demand is

$$\varepsilon = \frac{p(y)}{y} \frac{dy}{dp(y)} \quad \text{so} \quad \text{MR}(y) = p(y) \left[1 + \frac{1}{\varepsilon} \right].$$

Monopolistic Pricing & Own-Price Elasticity of Demand

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

Suppose the monopolist's marginal cost of production is **constant, at \$k/output unit**.
For a profit-maximum

$$MR(y^*) = p(y^*) \left[1 + \frac{1}{\varepsilon} \right] = k \quad \text{which is} \quad p(y^*) = \frac{k}{1 + \frac{1}{\varepsilon}}.$$

Monopolistic Pricing & Own-Price Elasticity of Demand

$$\mathbf{MR(y^*) = p(y^*) \left[1 + \frac{1}{\varepsilon} \right] = k}$$

Own-price elasticity of demand, ε , is **negative**.

$$\mathbf{MR(y^*) = p(y^*) \left[1 - \frac{1}{|\varepsilon|} \right] = k}$$

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

Monopolistic Pricing & Own-Price Elasticity of Demand

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

So as $|\varepsilon|$ decreases towards 1 the monopolist alters its output level to make the market price of its product to rise.

需求价格弹性下降，垄断价格上升。

E.g. if $\varepsilon = -3$ then $p(y^*) = 3k/2$,
and if $\varepsilon = -2$ then $p(y^*) = 2k$.

Monopolistic Pricing & Own-Price Elasticity of Demand

Notice that, since

$$\text{MR}(\mathbf{y}^*) = \mathbf{p}(\mathbf{y}^*) \left[\mathbf{1} - \frac{\mathbf{1}}{|\boldsymbol{\varepsilon}|} \right] = \textcolor{blue}{MC} > \mathbf{0}$$

$|\boldsymbol{\varepsilon}| > \mathbf{1}$

Monopolistic Pricing & Own-Price Elasticity of Demand

Notice that, since

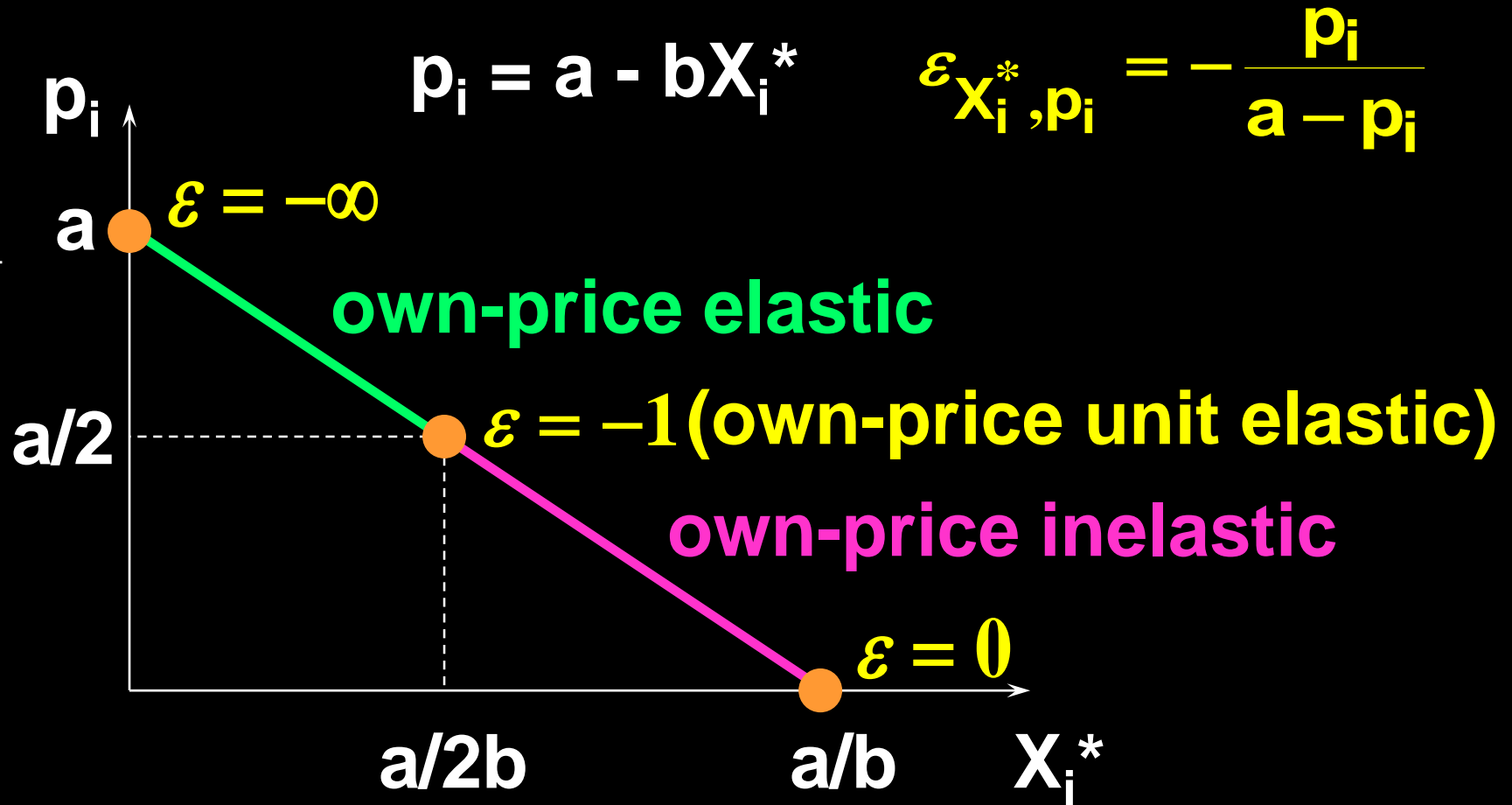
$$\text{MR}(y^*) = p(y^*) \left[1 - \frac{1}{|\epsilon|} \right] = \text{MC} > 0$$

$|\epsilon| > 1$

So a profit-maximizing monopolist always selects an output level for which market demand is own-price elastic.

利润最大化的垄断厂商只在富有弹性的那部分需求曲线上进行生产。

Own-Price Elasticity



Monopolistic Pricing: An Example

Suppose the market demand is given by

$$D(p) = 10p^{-3}$$

The cost function is $c(y) = 2y$

What is the optimal price and output level for a monopolist?

Monopolistic Pricing: An Example

Suppose the market demand is given by

$$D(p) = 10p^{-3}$$

The cost function is $c(y) = 2y$

What is the optimal price and output level for a monopolist?

$$P = 3, y = D(3) = 10 * 3^{-3}$$

Markup Pricing

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

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

$$(|\epsilon| > 1)$$

is the monopolist's price.

Markup Pricing

Markup pricing: Output price is the marginal cost of production plus a “markup.”

成本加成定价：利润最大化的垄断价格等于边际成本与“加成数”之和

The **markup** is

$$\begin{aligned} p(y^*) - MC &= \frac{|\varepsilon|}{|\varepsilon| - 1} MC - MC \\ &= \frac{1}{|\varepsilon| - 1} MC \end{aligned}$$

Markup Pricing

The markup is

$$\begin{aligned} p(y^*) - MC &= \frac{|\varepsilon|}{|\varepsilon| - 1} MC - MC \\ &= \frac{1}{|\varepsilon| - 1} MC \end{aligned}$$

E.g. if $\varepsilon = -4$ then the markup is $k/3$,
if $\varepsilon = -3$ then the markup is $k/2$,
and if $\varepsilon = -2$ then the markup is k .
加成数随 |需求价格弹性| 的减小而上升。

A Profits Tax Levied on a Monopoly

A profits tax levied at rate t reduces profit from $\Pi(y^*)$ to $(1-t)\Pi(y^*)$.

利润税

Q: How is after-tax profit, $(1-t)\Pi(y^*)$, maximized?

A Profits Tax Levied on a Monopoly

A **profits tax** levied at rate t reduces profit from $\Pi(y^*)$ to $(1-t)\Pi(y^*)$.

利润税

Q: How is after-tax profit, $(1-t)\Pi(y^*)$, maximized?

A: By maximizing before-tax profit, $\Pi(y^*)$.

$$\max_y (1 - t)[p(y)y - c(y)]$$

Is the same as

$$\max_y p(y)y - c(y)$$

A Profits Tax Levied on a Monopoly

So a **profits tax** has no effect on the monopolist's choices of output level, output price, or demands for inputs.

利润税不影响垄断厂商的产出、定价和要素需求，被称为**中性税**。

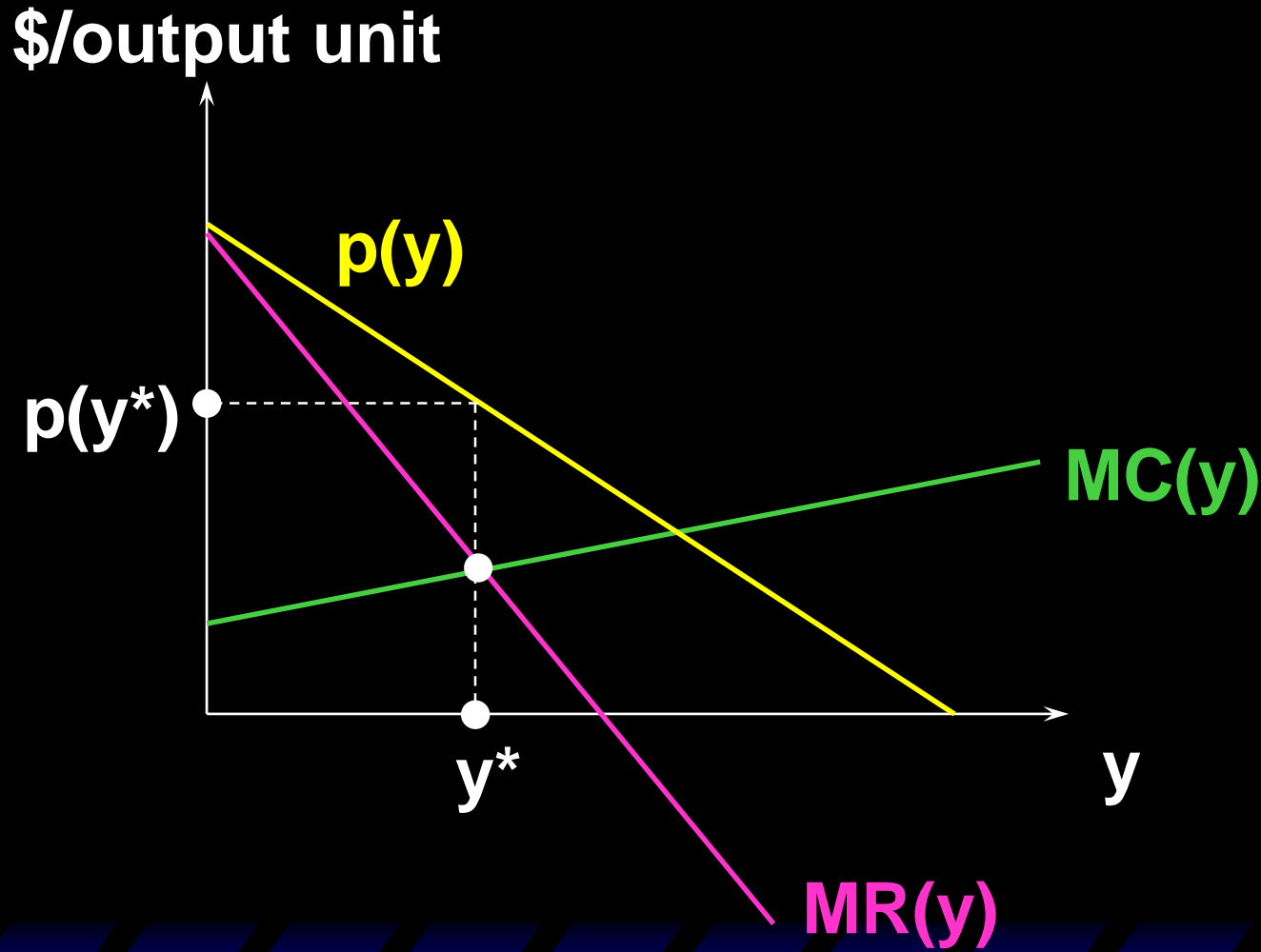
I.e. the profits tax is a **neutral tax**.

Quantity Tax Levied on a Monopolist

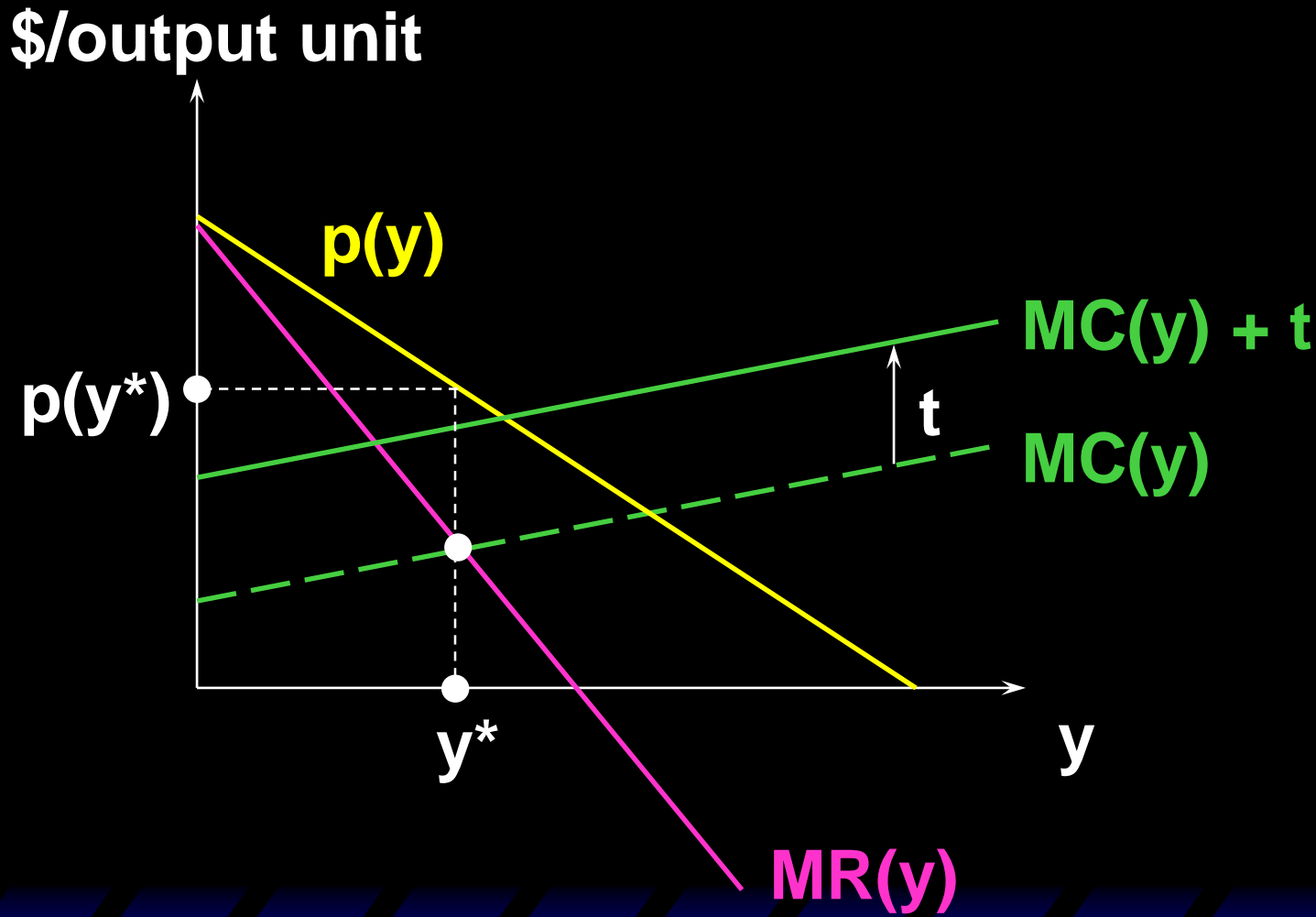
A **quantity tax** of \$t/output unit raises the marginal cost of production by \$t.

对于任一产量 y , **从量税**使得边际成本从 $MC(y)$ 上升为 $MC(y) + t$

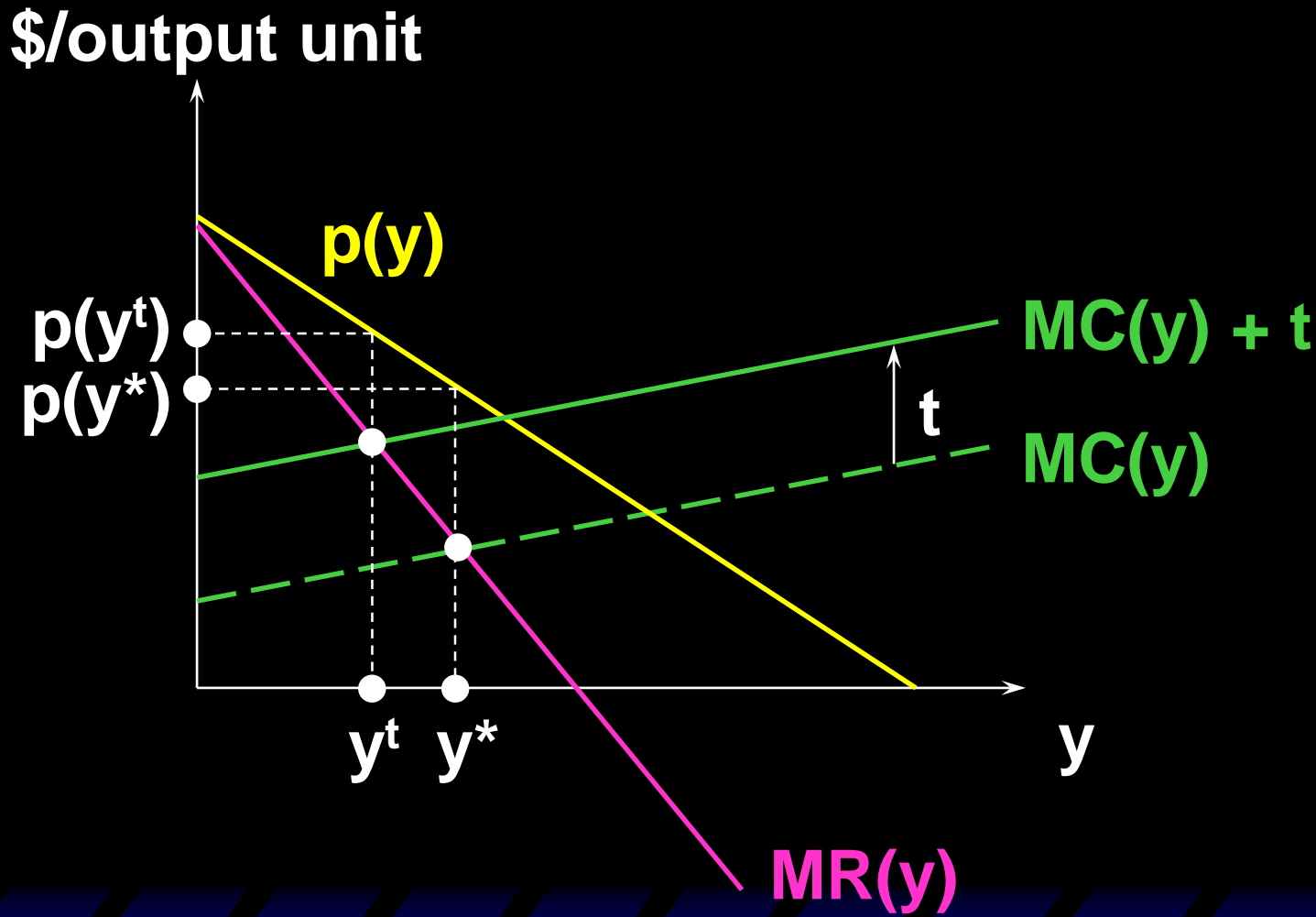
Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist

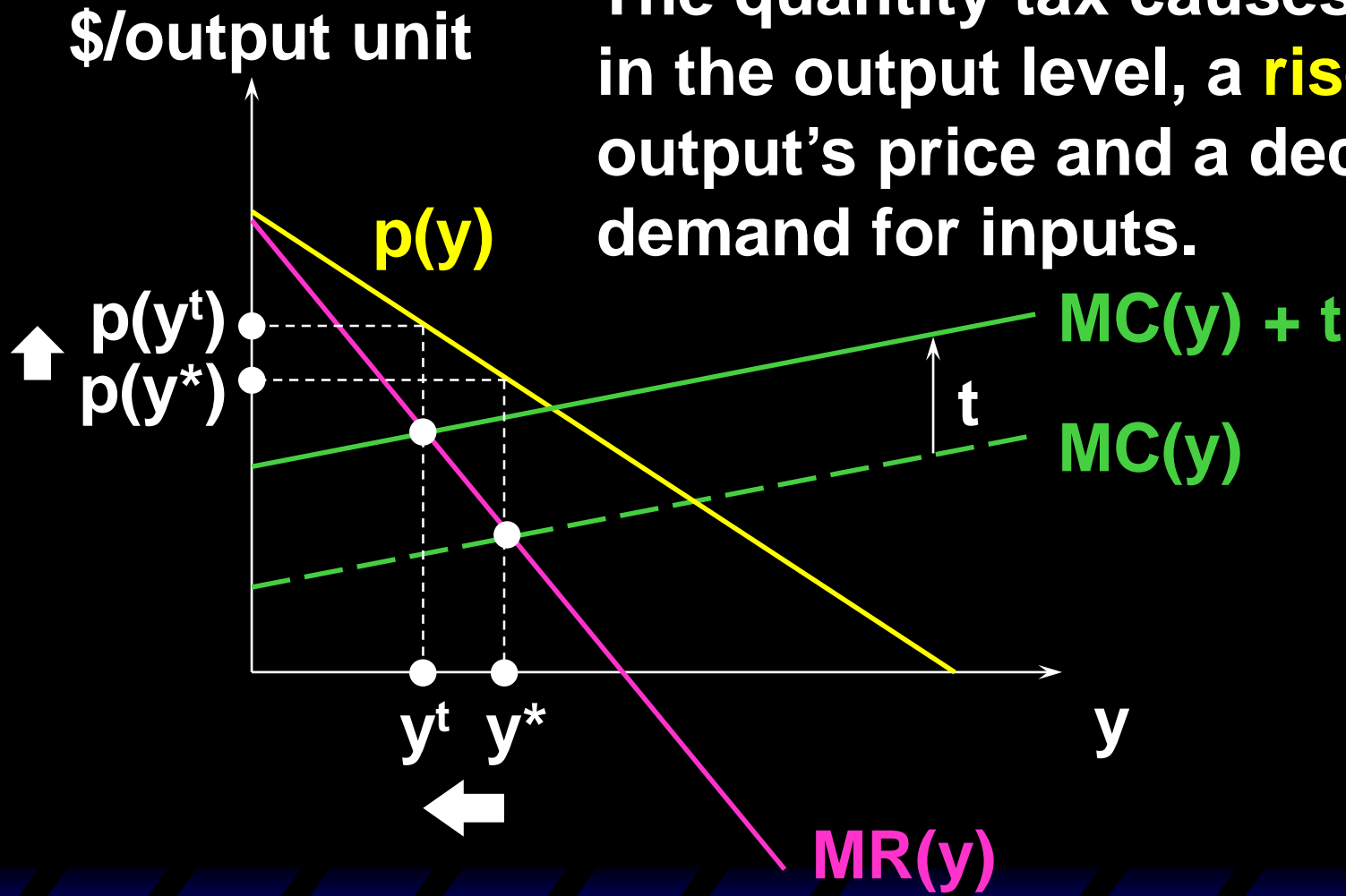


Quantity Tax Levied on a Monopolist



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

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**.

从量税减低了产出数量、提高了市场价格、降低了要素需求，因此是一种扭曲税

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 and $\varepsilon(y) = \varepsilon$.

With no tax, the monopolist's price is

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

Quantity Tax Levied on a Monopolist

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

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

The amount of the tax paid by buyers is

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

Quantity Tax Levied on a Monopolist

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

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

Because $|\varepsilon| > 1$, $\frac{|\varepsilon|}{|\varepsilon| - 1} > 1$ and so the monopolist passes on to consumers **more** than the tax!

Quantity Tax Levied on a Monopolist

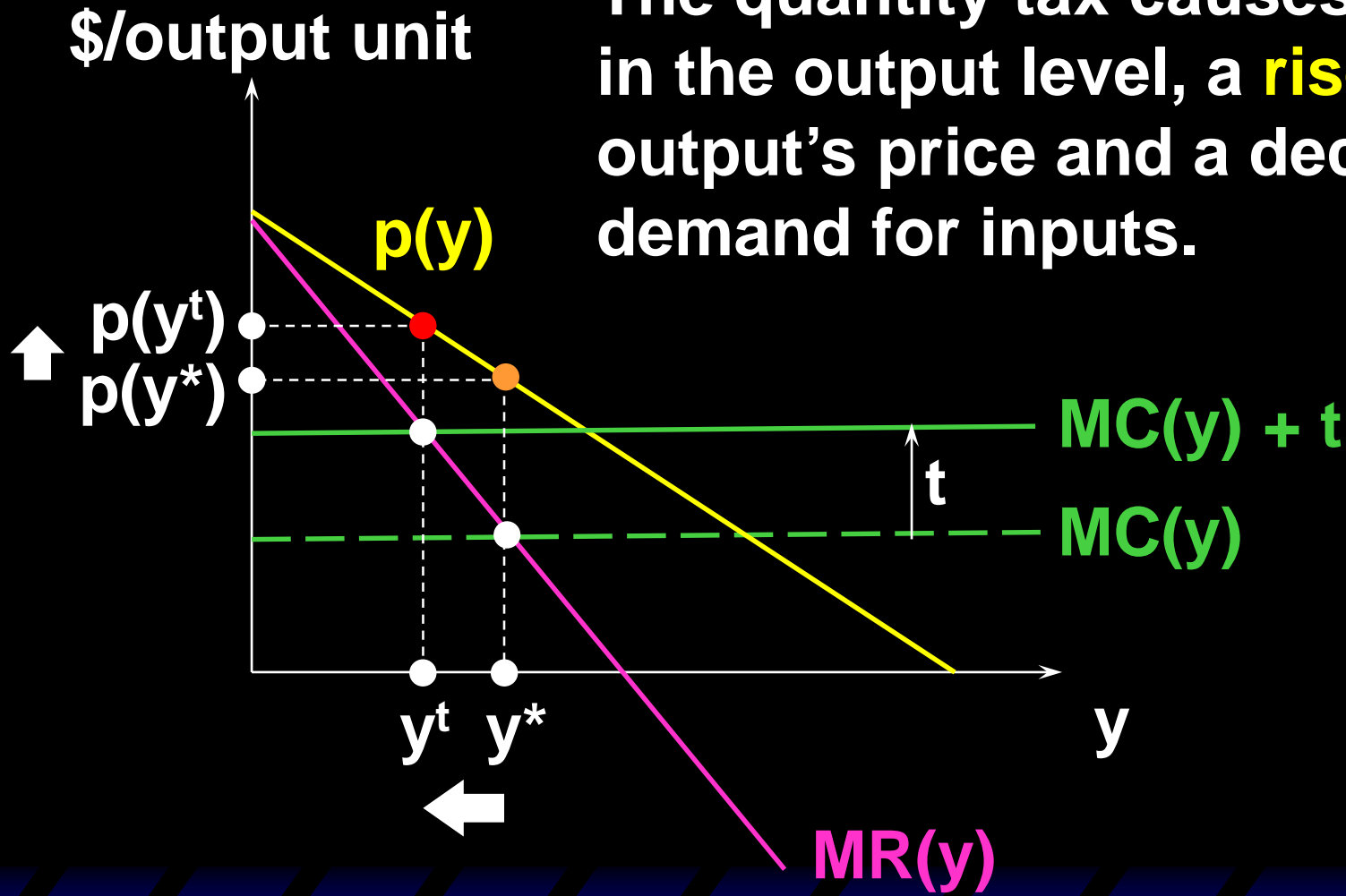
当需求弹性不变、边际成本不变时，税收带来价格上涨**高于**税收本身

当需求曲线为线性时，需求价格弹性随产量的改变而改变，我们不能用上式判断价格上涨的幅度

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

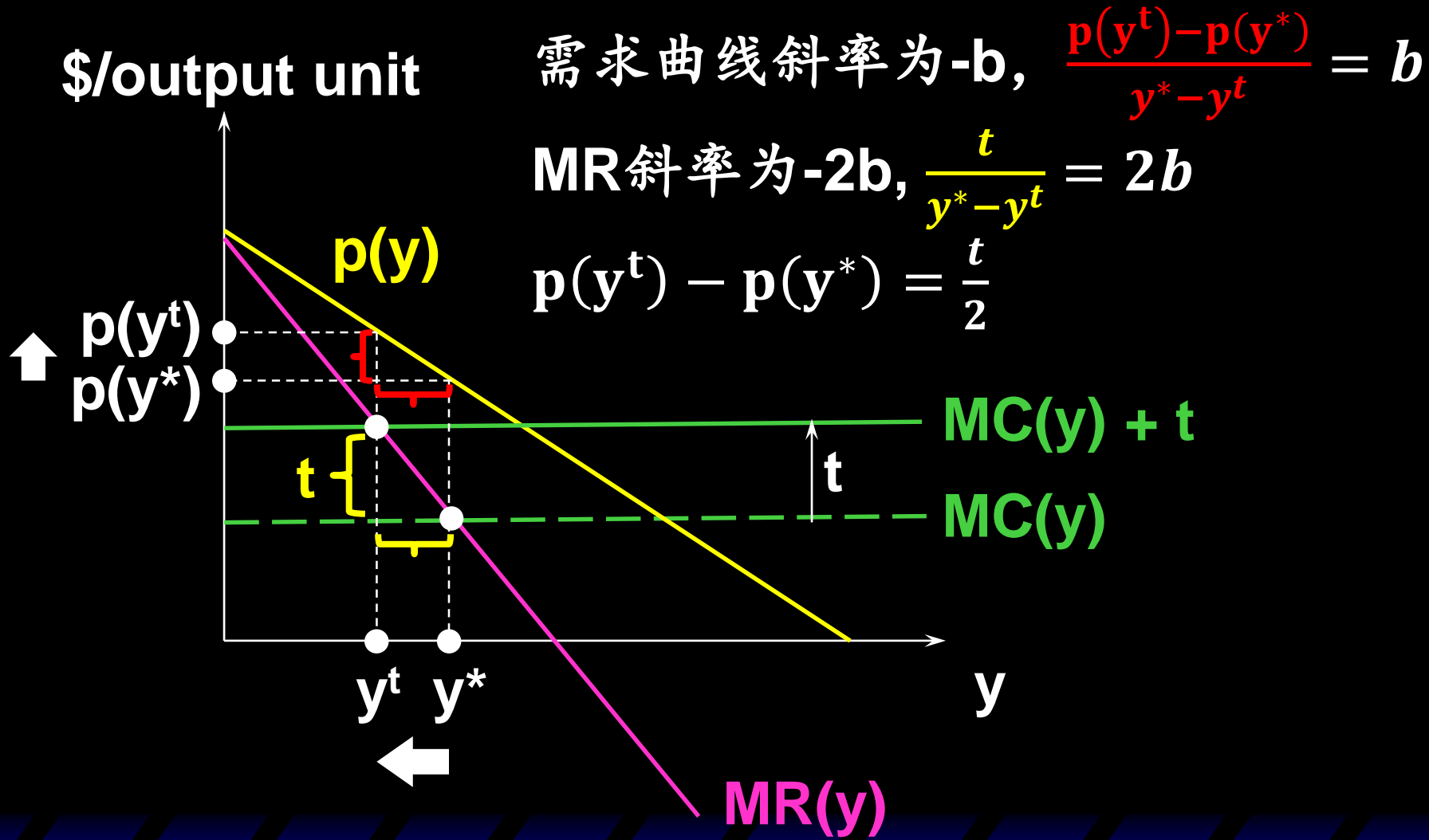
Quantity Tax Levied on a Monopolist

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

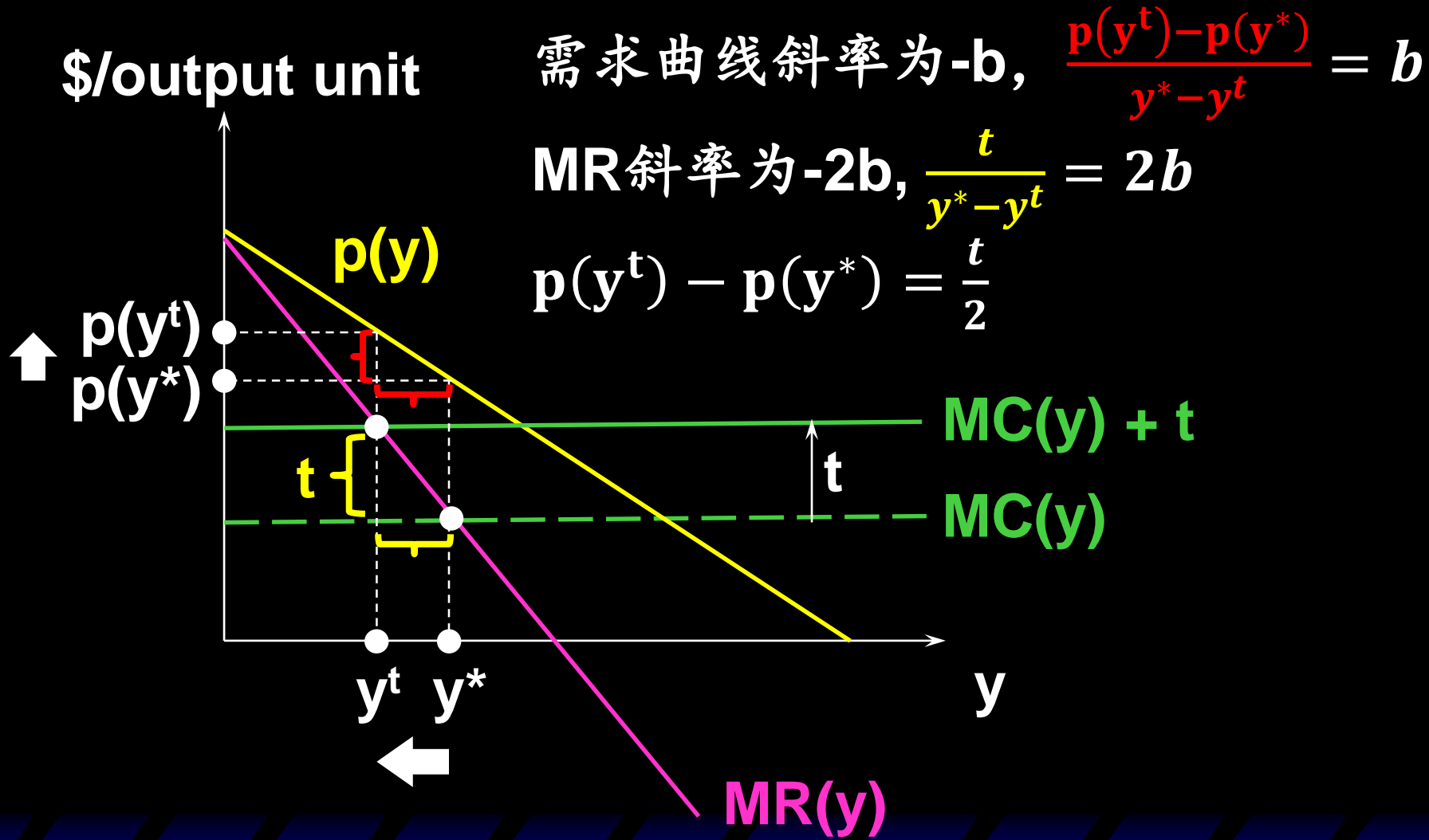


线性需求曲线在 $p(y^t)$ 和 $p(y^*)$ 处的弹性不同

Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist



线性需求曲线、边际成本不变时，价格上升幅度是税率的一半。

The Inefficiency of Monopoly

A market is Pareto **efficient** if no individuals can be made better off without making someone worse off.

帕累托最优是资源分配的一种状态，指在不使任何人境况变坏的情况下，无法再使某些人的境况变好。

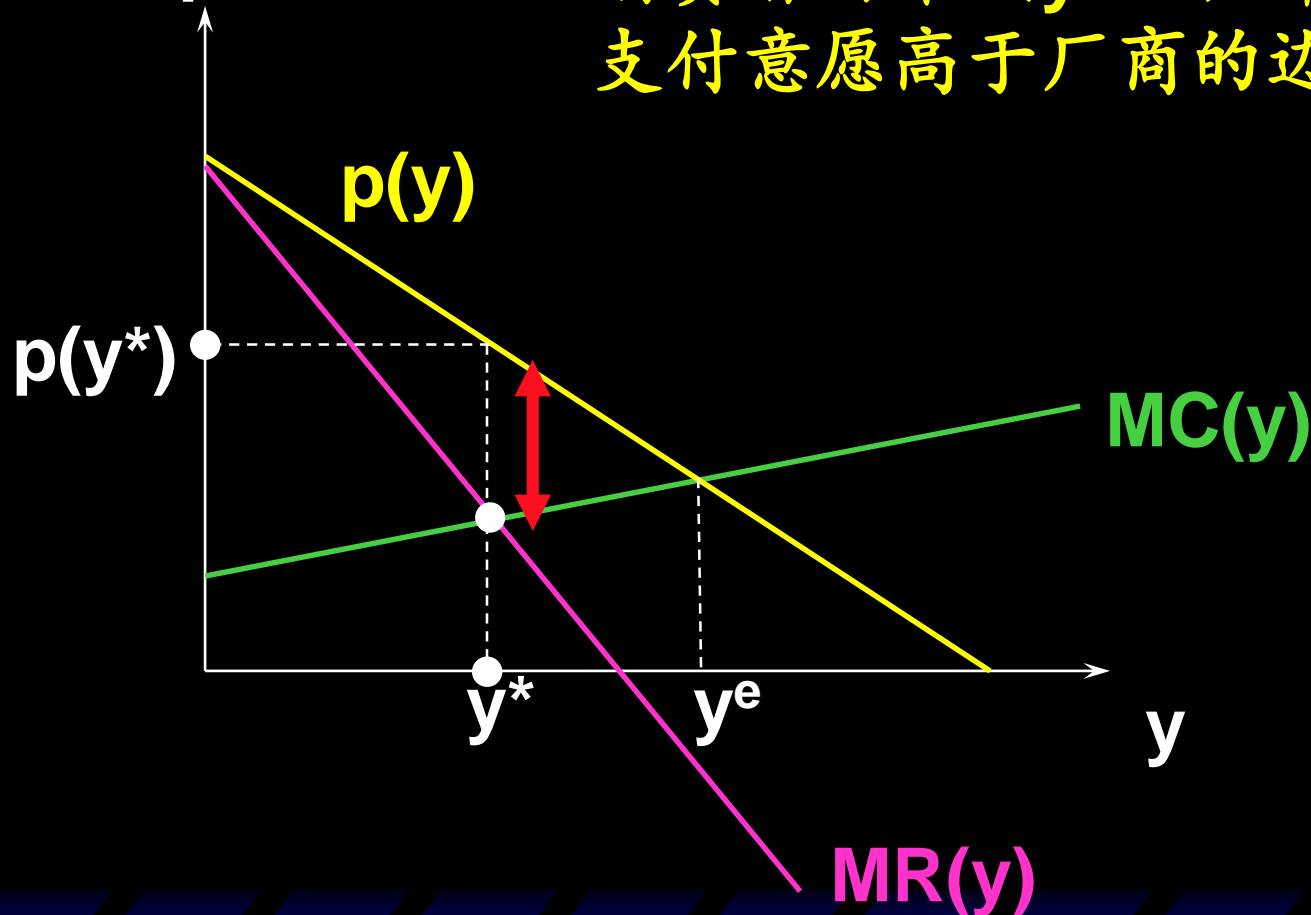
Otherwise a market is Pareto **inefficient**.

如果存在一种安排，能在不使任何人境况变坏的情况下使一部分人境况变好，那么当前状态就是帕累托无效率的。

The Inefficiency of Monopoly

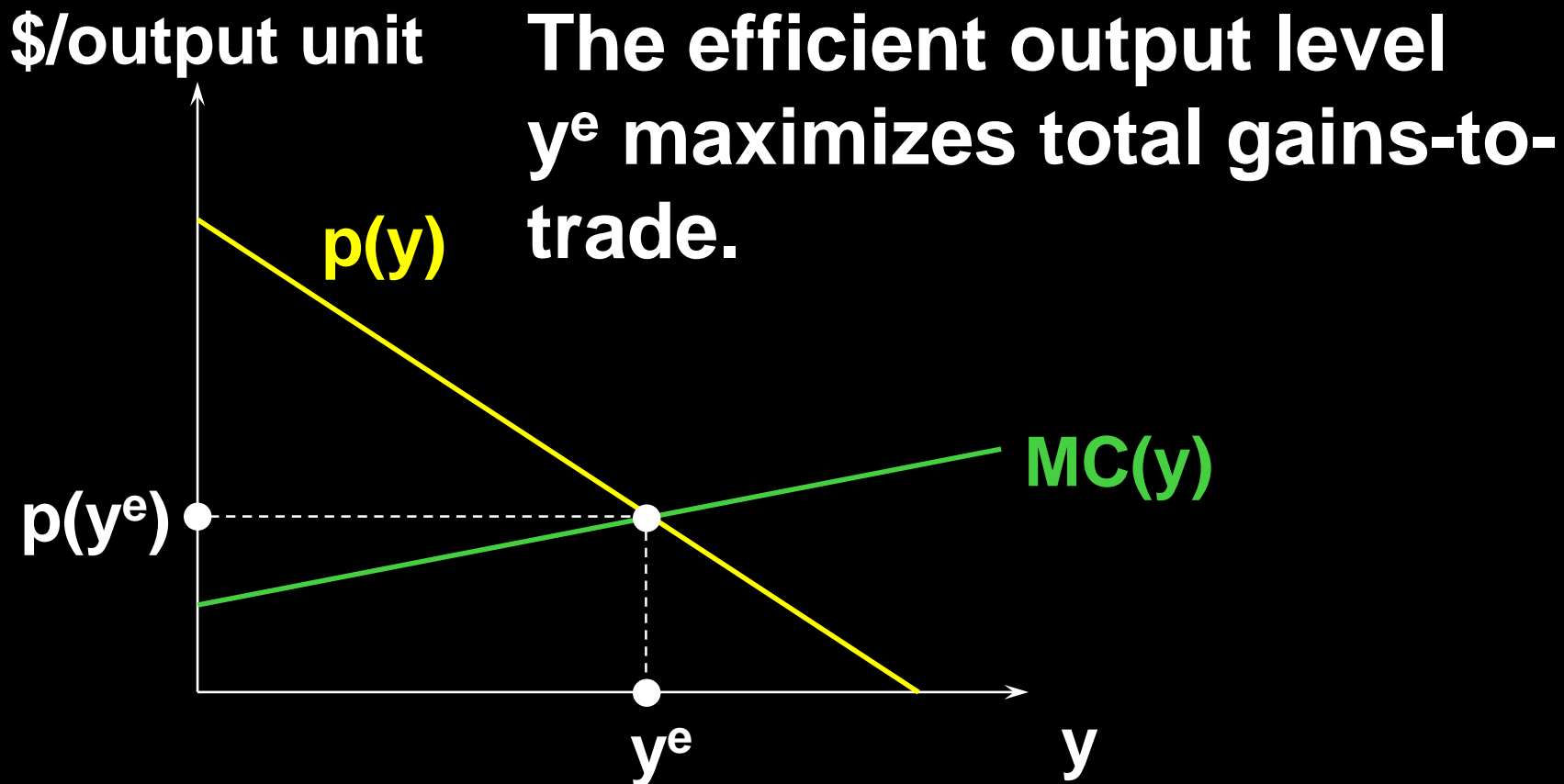
\$/output unit

消费者对第 (y^*+1) 单位商品的支付意愿高于厂商的边际成本



存在使所有人境况变好的可能性，因此垄断是帕累托无效率的。

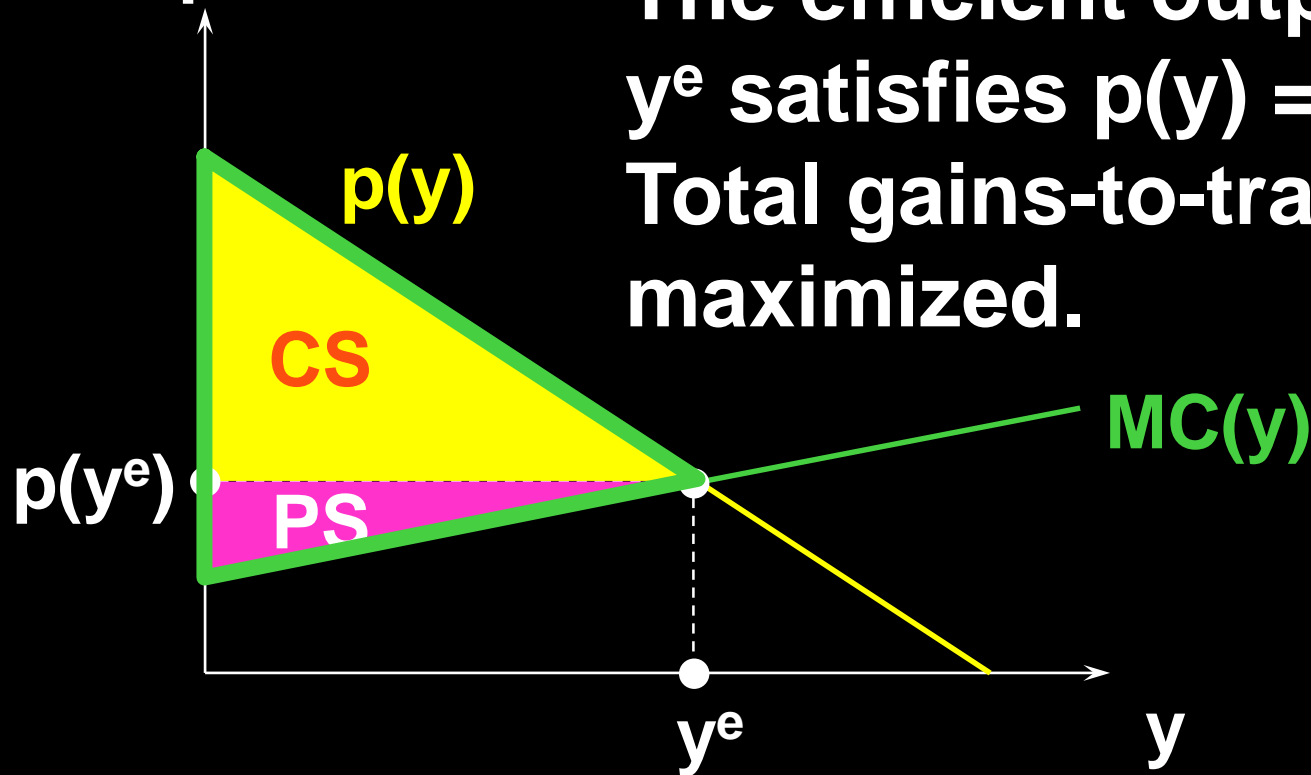
The Inefficiency of Monopoly



The efficient output level y^e satisfies $p(y) = MC(y)$.

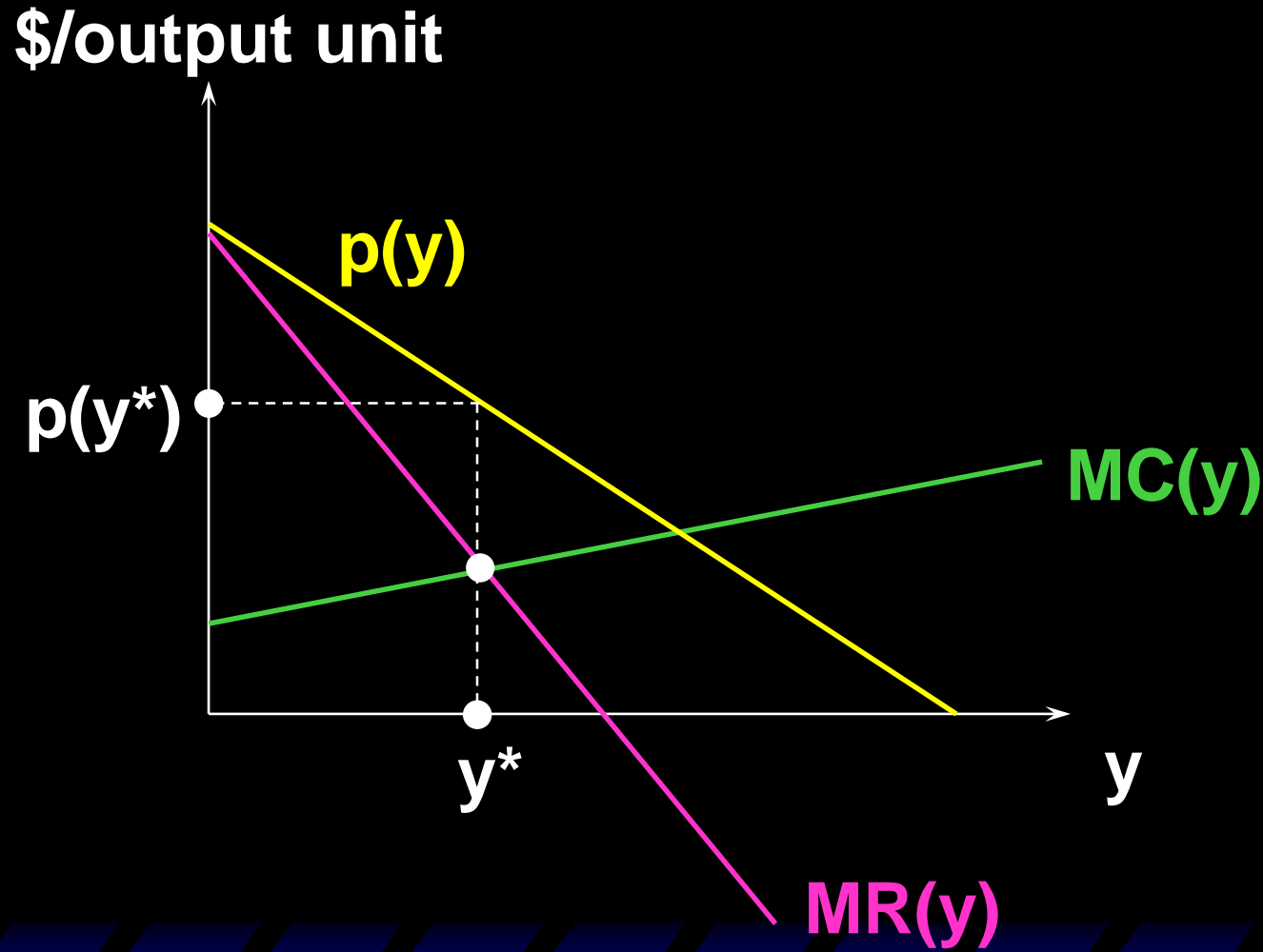
The Inefficiency of Monopoly

\$/output unit

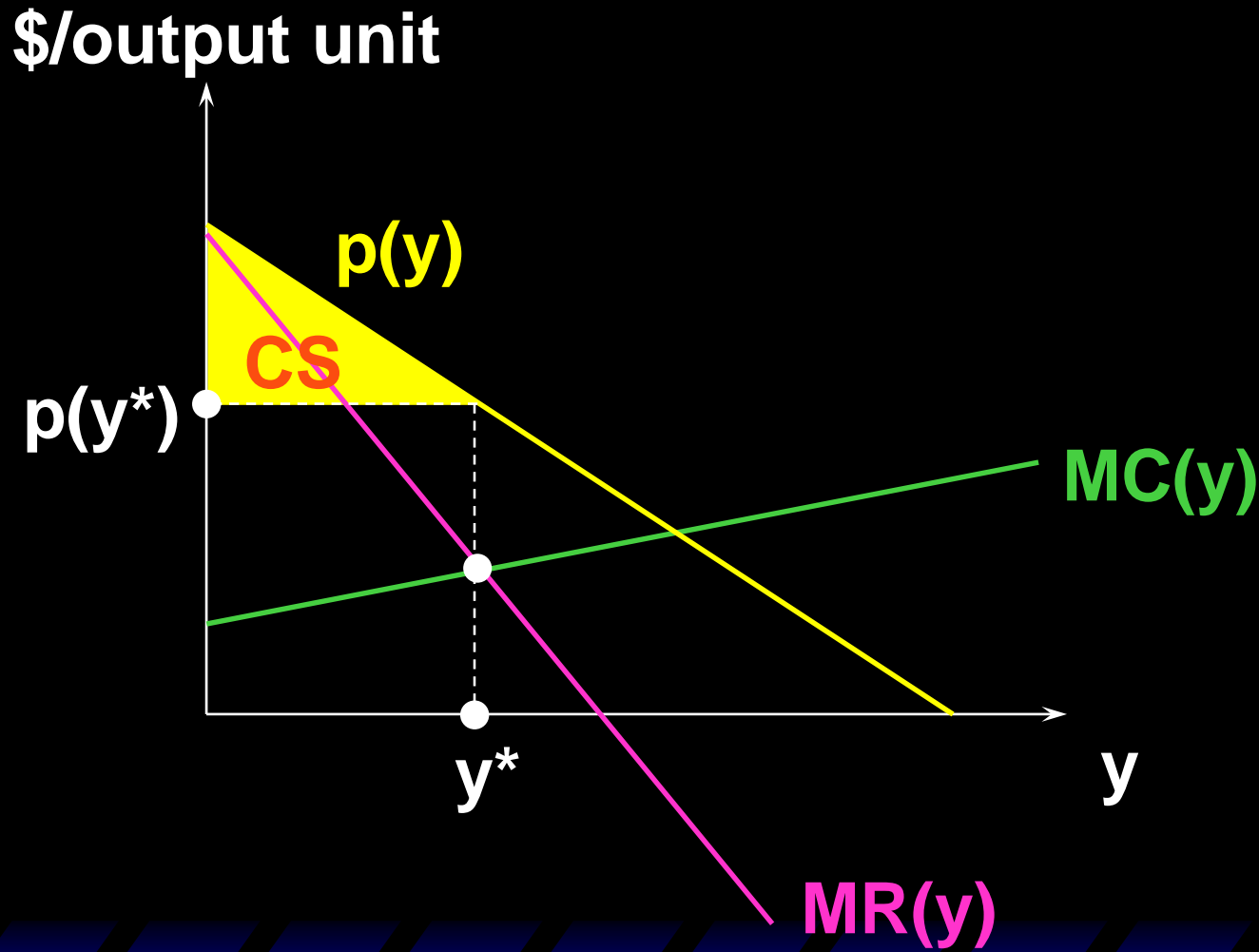


The efficient output level y^e satisfies $p(y) = MC(y)$. Total gains-to-trade is maximized.

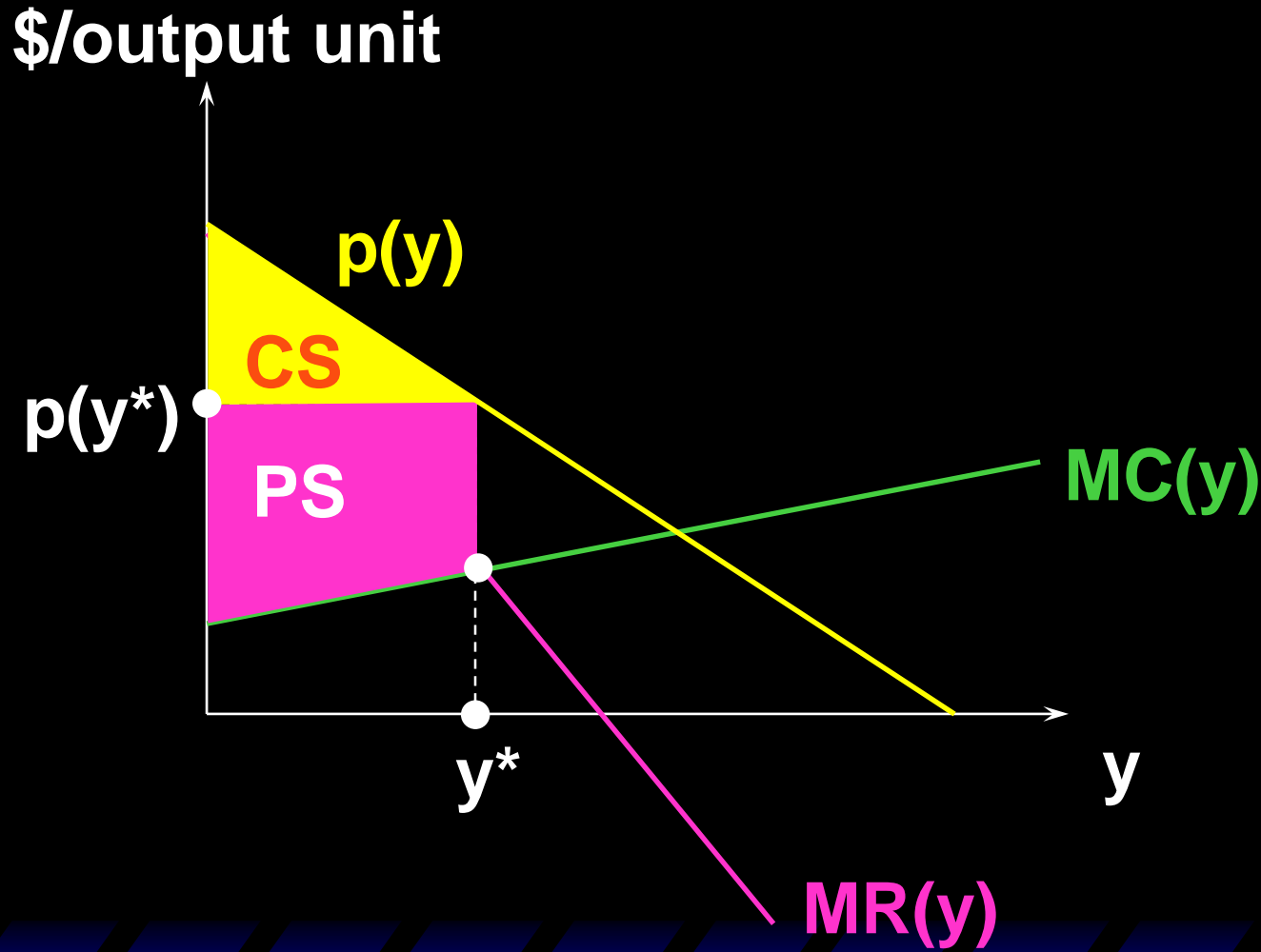
The Inefficiency of Monopoly



The Inefficiency of Monopoly

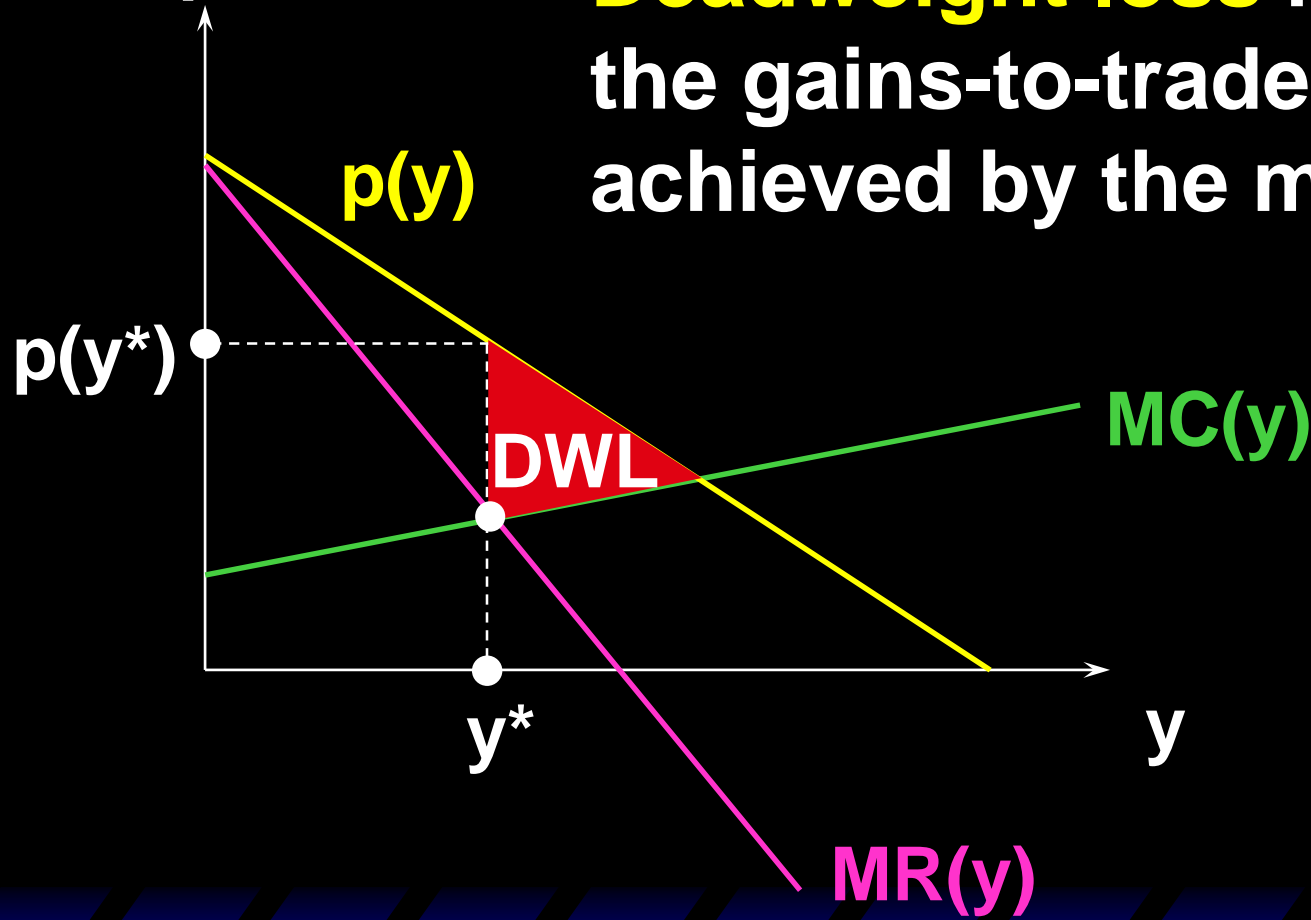


The Inefficiency of Monopoly



The Inefficiency of Monopoly

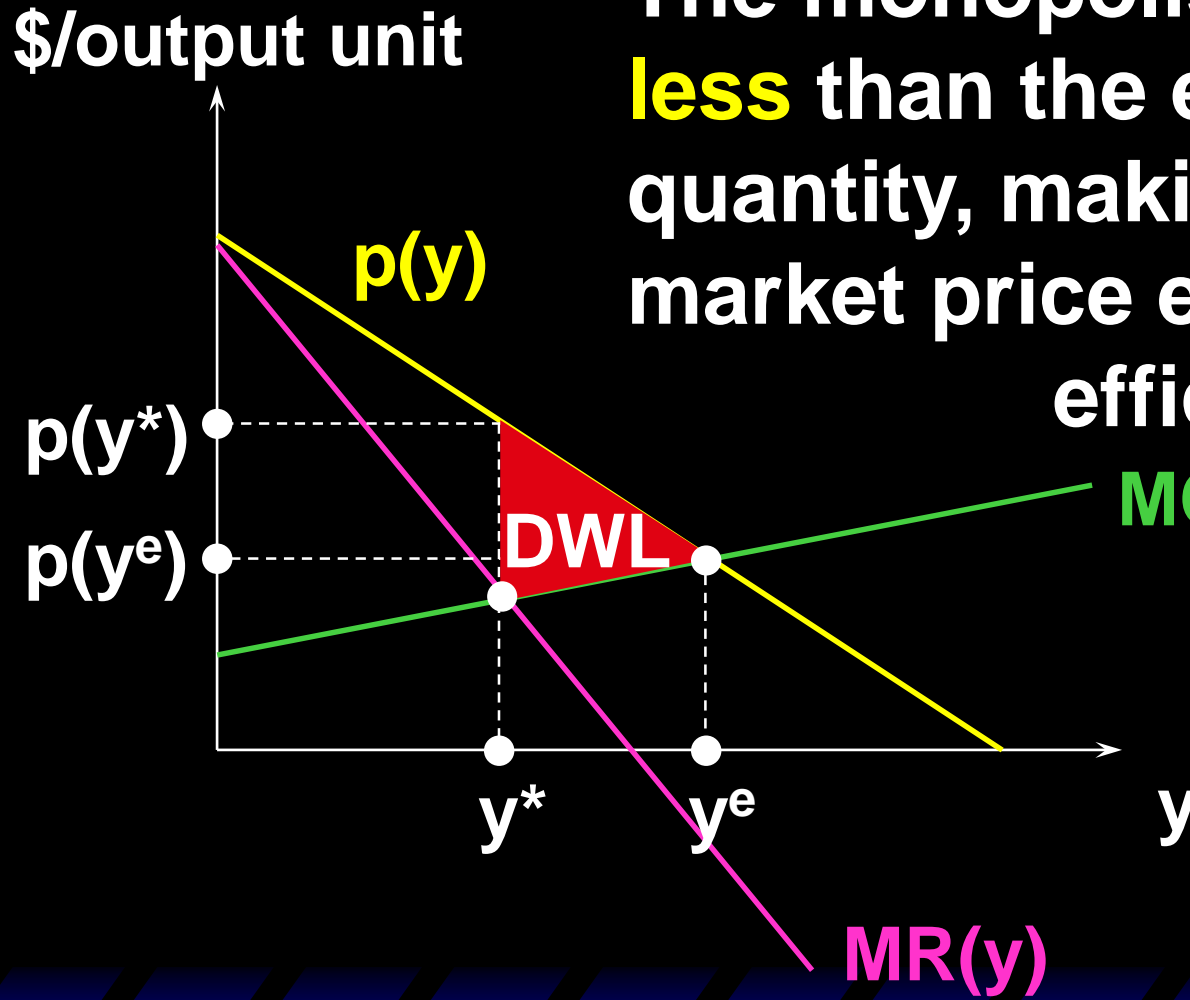
\$/output unit



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.

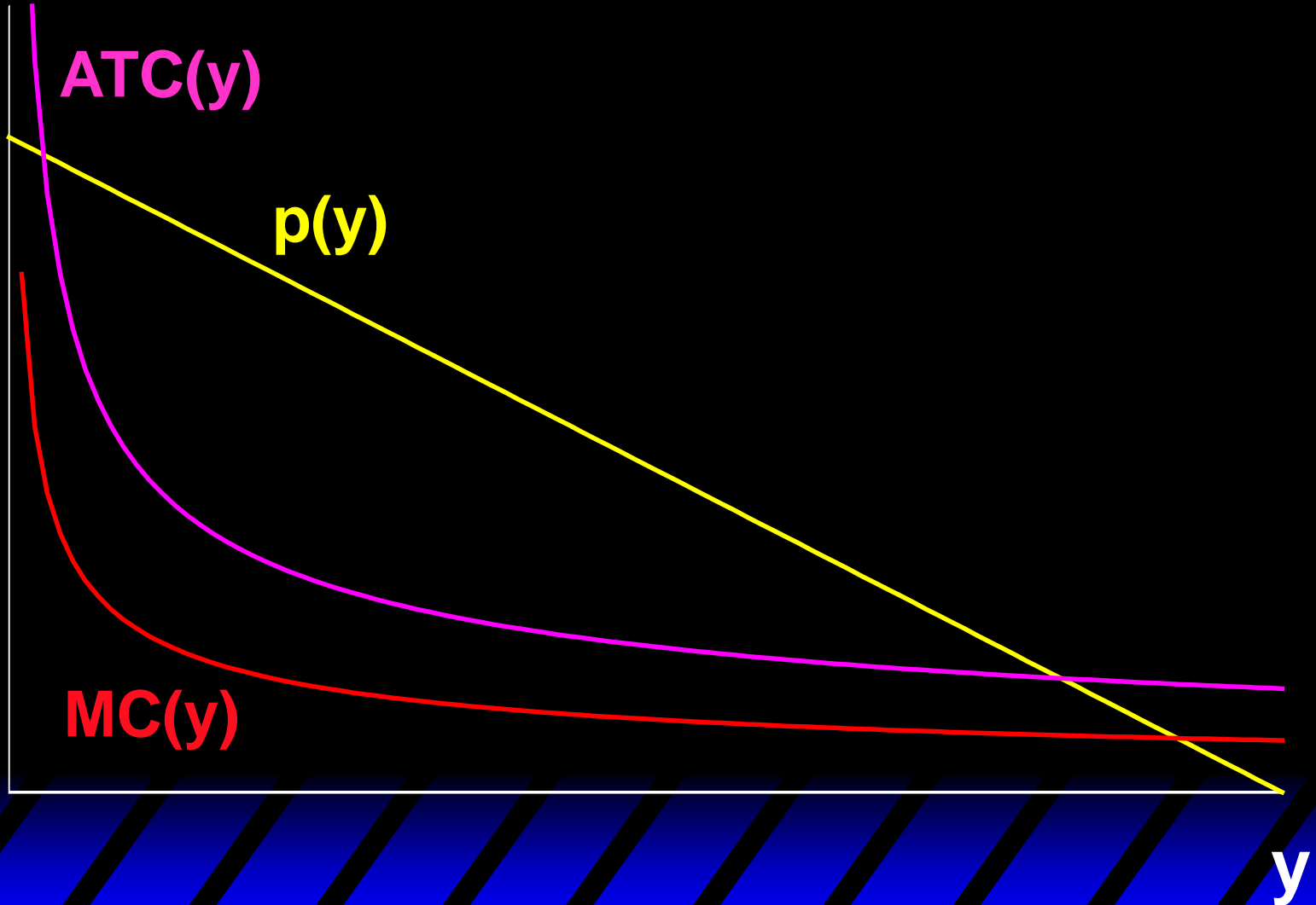


Natural Monopoly

A natural monopoly arises when the firm's technology has **economies-of-scale** large enough for it to supply the whole market at a lower average total production cost than is possible with more than one firm in the market.

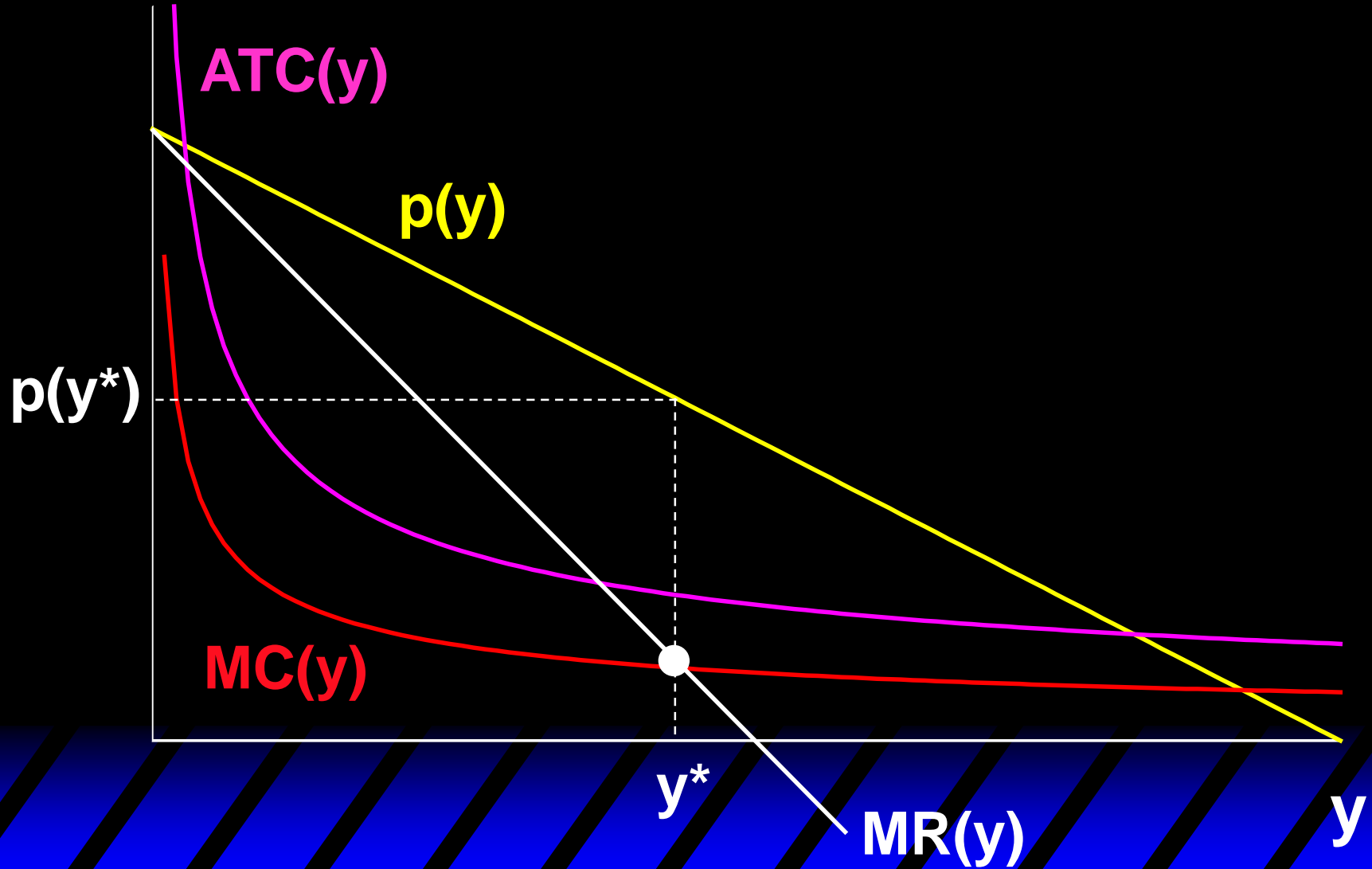
Natural Monopoly

\$/output unit



Natural Monopoly

\$/output unit



Entry Deterrence by a Natural Monopoly

A natural monopoly deters entry by threatening **predatory pricing** against an entrant.

掠夺性定价：以低价格排挤竞争对手、达到控制市场目的的定价行为。

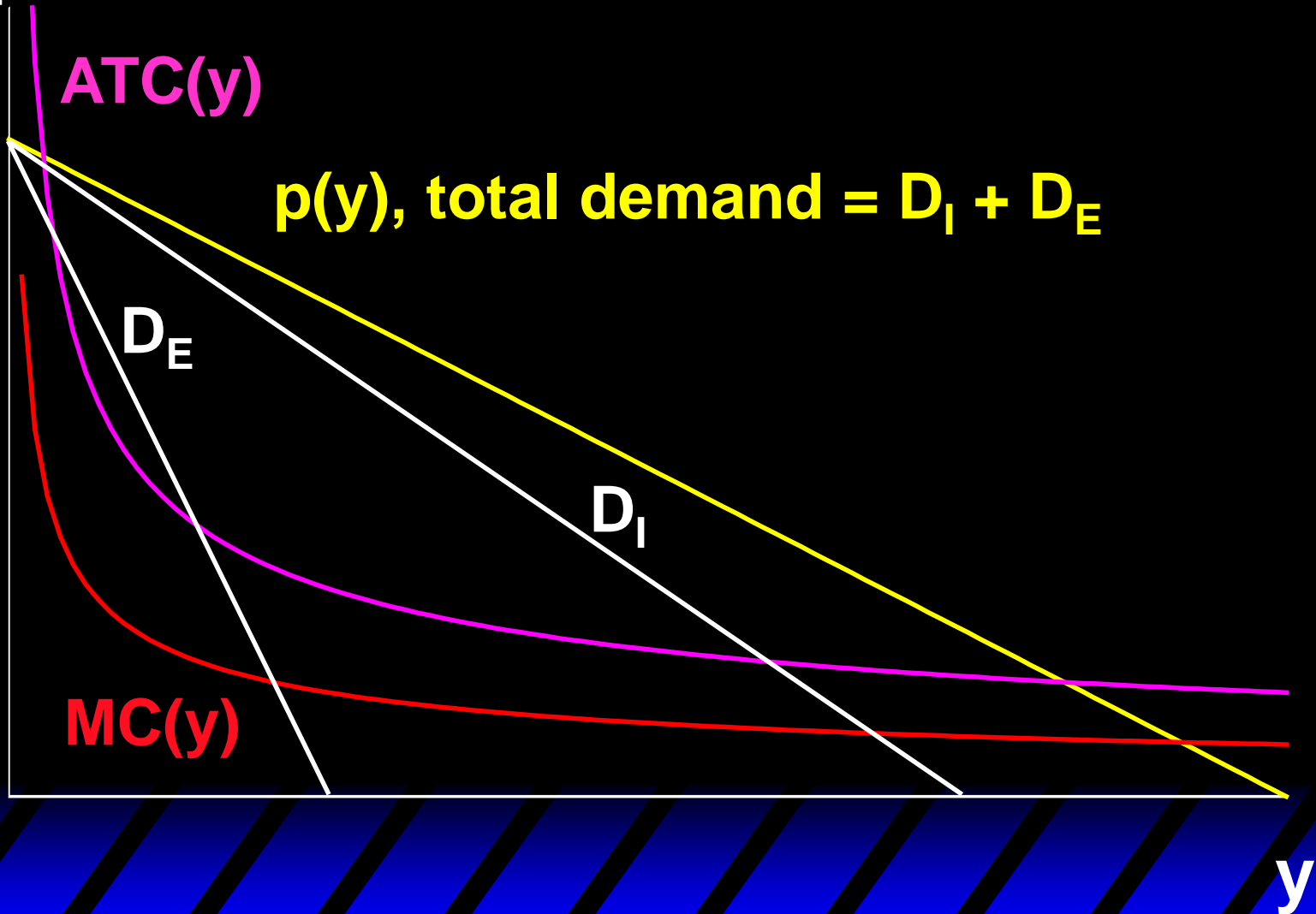
A predatory price is a low price set by the incumbent firm when an entrant appears, causing the entrant's economic profits to be negative and inducing its exit.

Entry Deterrence by a Natural Monopoly

E.g. suppose an entrant initially captures one-quarter of the market, leaving the incumbent firm the other three-quarters.

Entry Deterrence by a Natural Monopoly

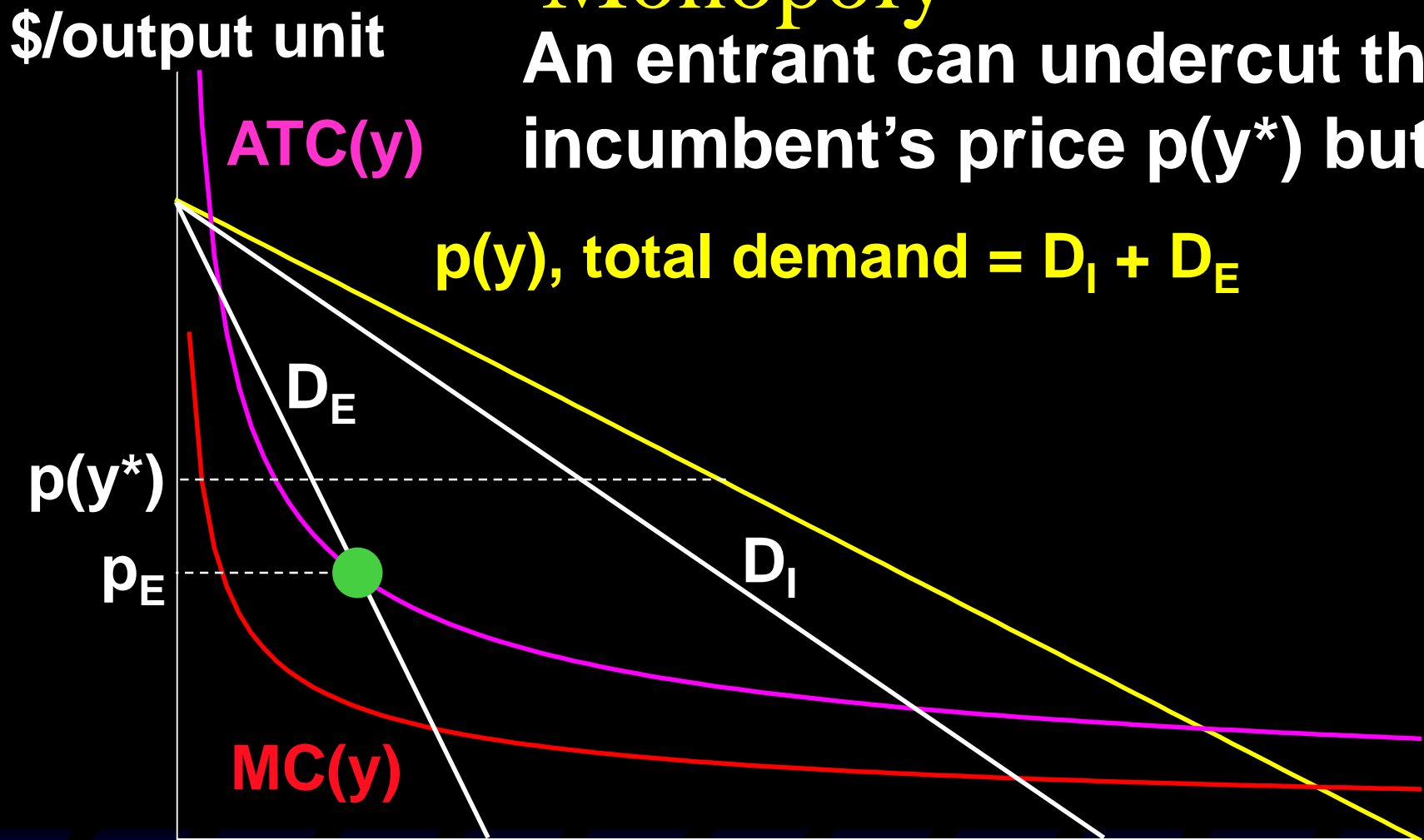
\$/output unit



Entry Deterrence by a Natural Monopoly

An entrant can undercut the incumbent's price $p(y^*)$ but ...

$p(y)$, total demand = $D_I + D_E$



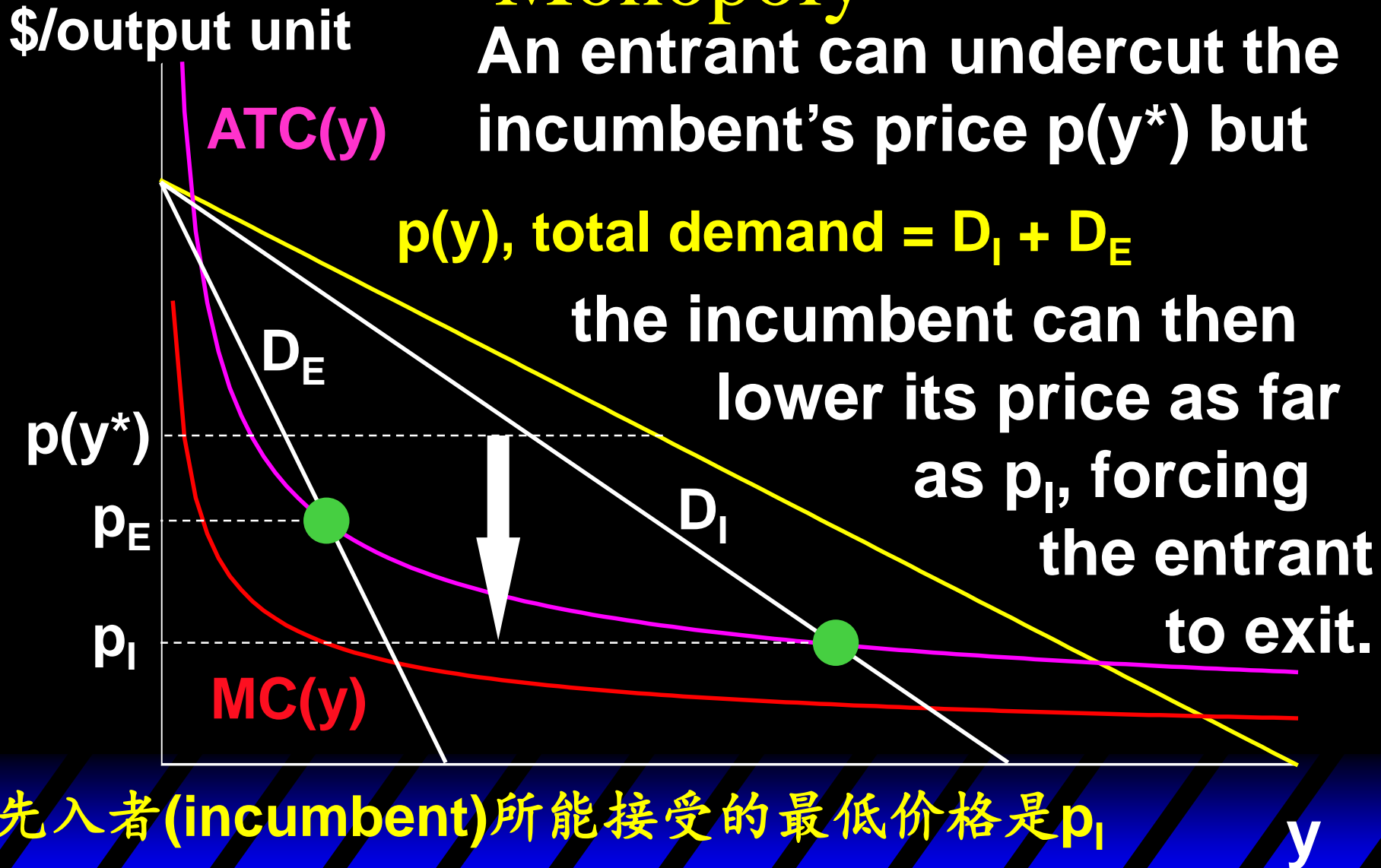
进入者(entrant)所能接受的最低价格是 p_E ，低于这一价格时利润为负。

Entry Deterrence by a Natural Monopoly

An entrant can undercut the incumbent's price $p(y^*)$ but

$p(y)$, total demand = $D_I + D_E$

the incumbent can then lower its price as far as p_I , forcing the entrant to exit.



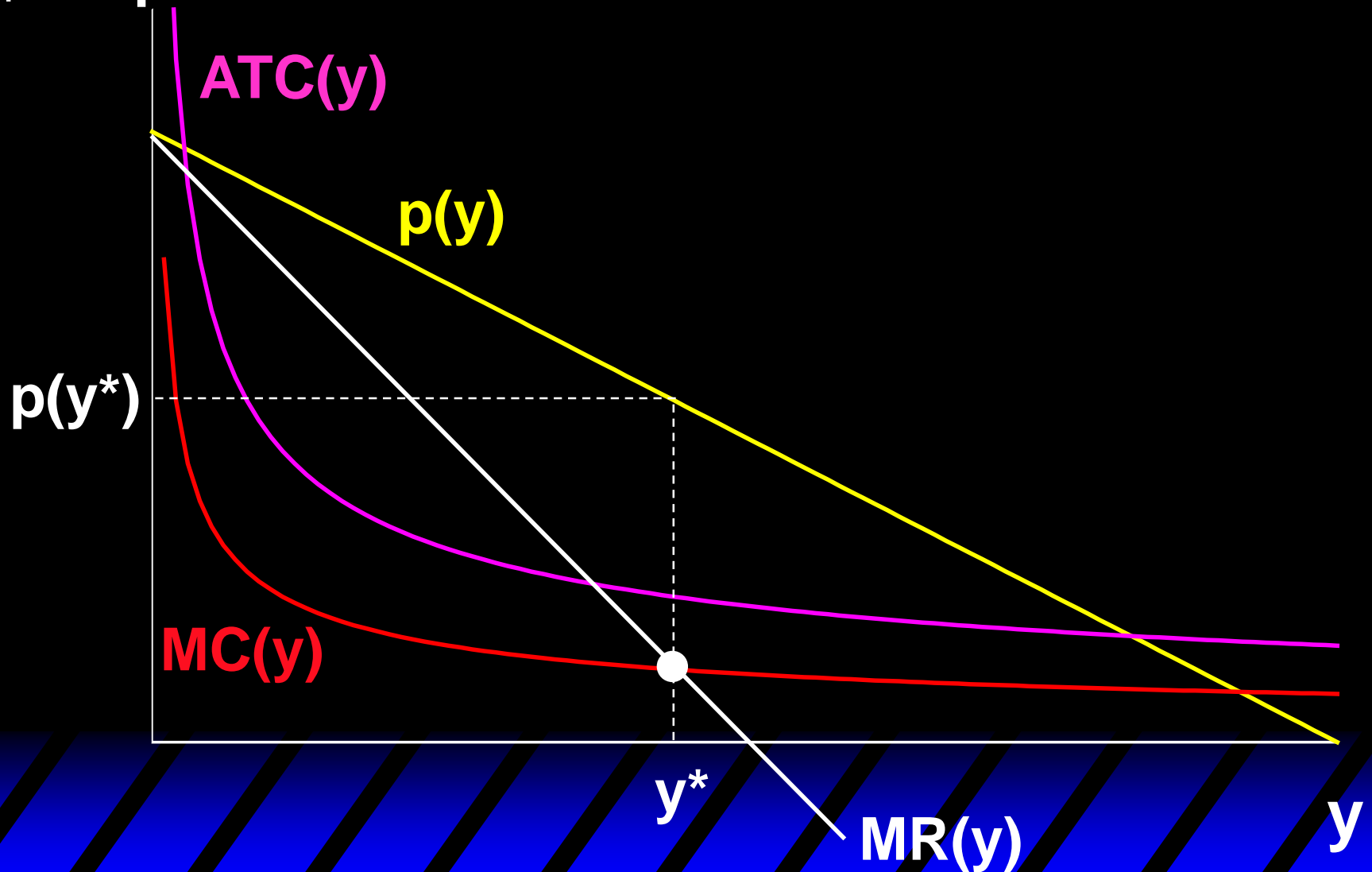
先入者(incumbent)所能接受的最低价格是 p_I

Inefficiency of a Natural Monopolist

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

Inefficiency of a Natural Monopoly

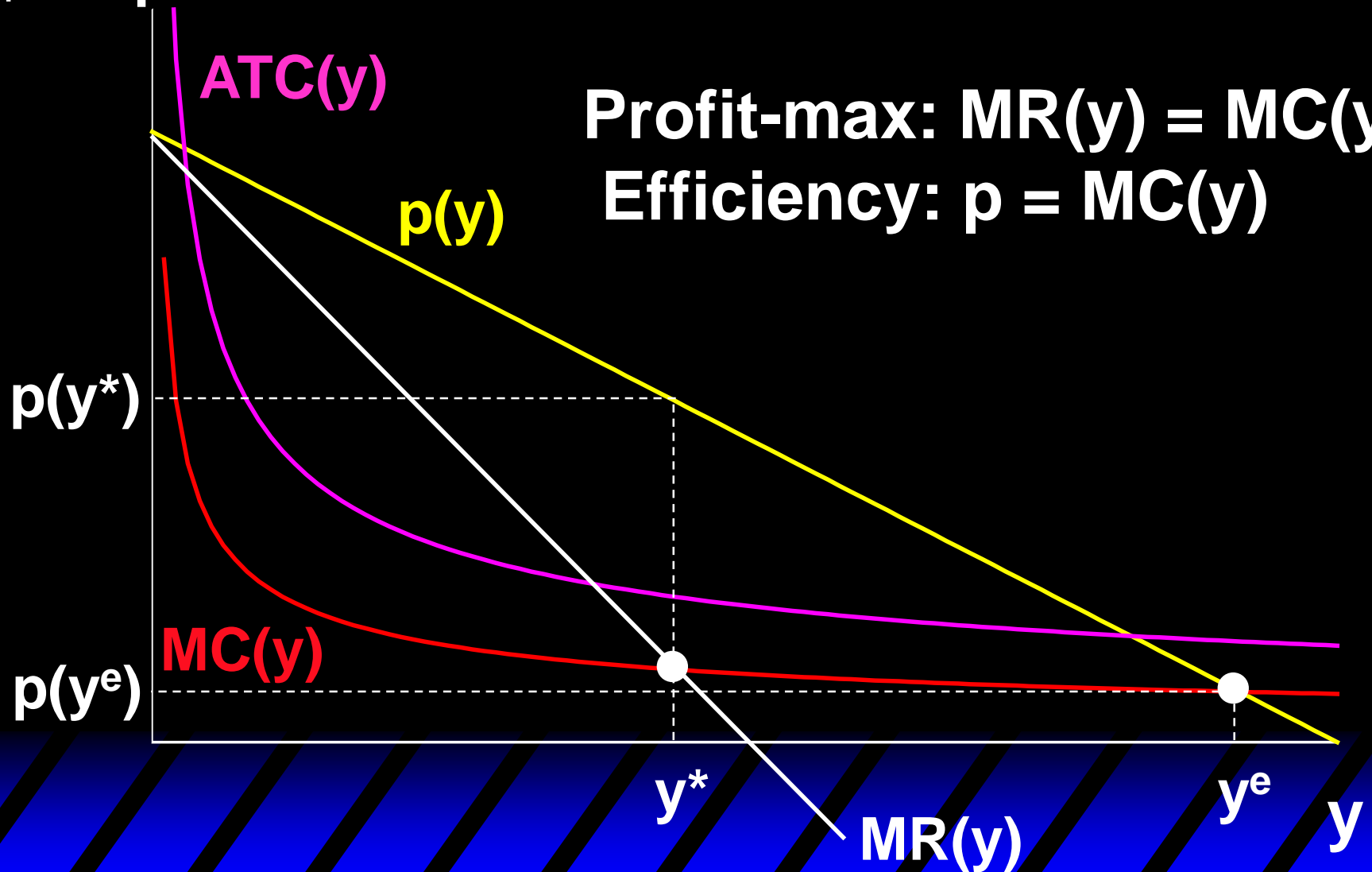
\$/output unit



Inefficiency of a Natural Monopoly

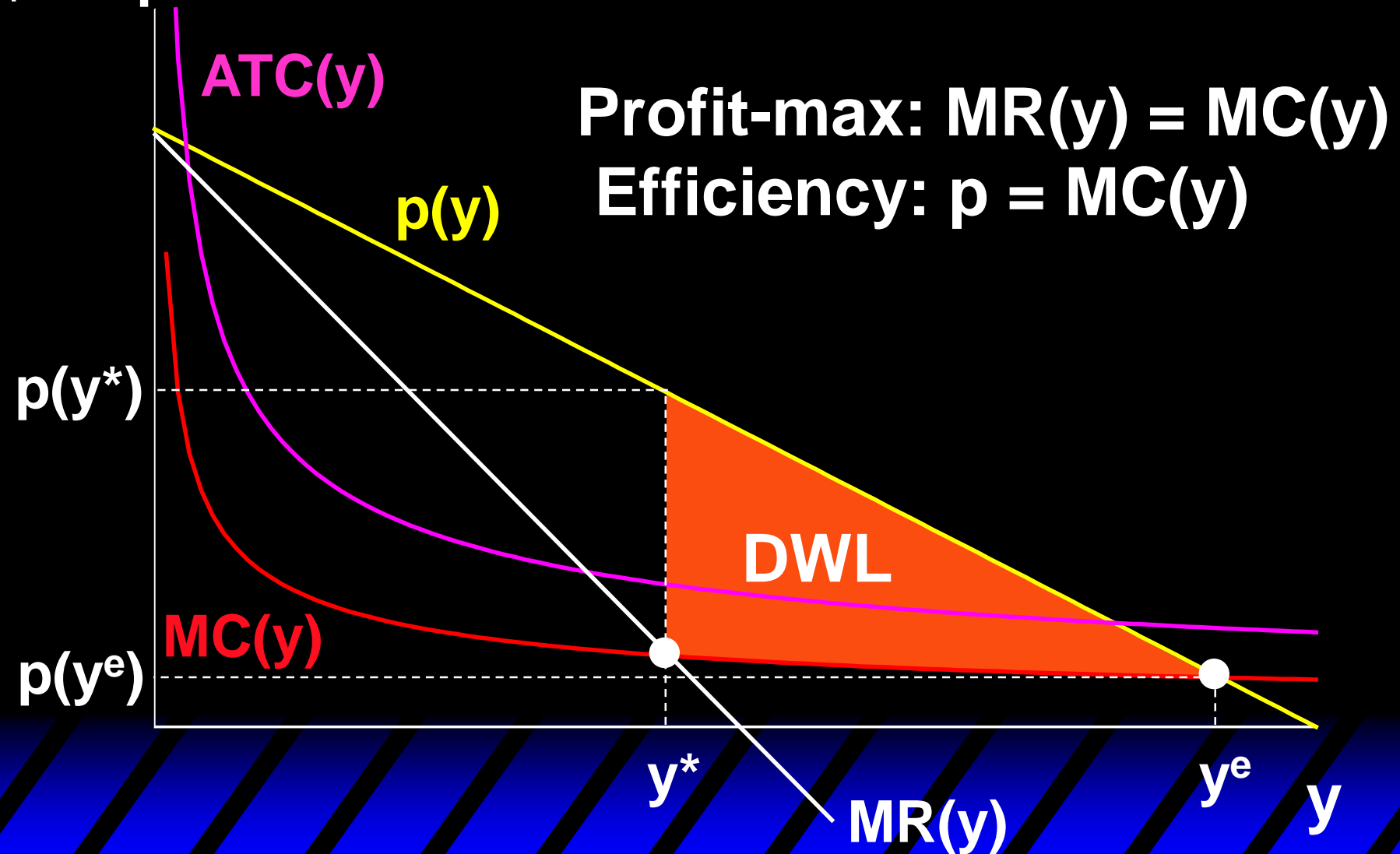
\$/output unit

Profit-max: $MR(y) = MC(y)$
Efficiency: $p = MC(y)$



Inefficiency of a Natural Monopoly

\$/output unit



Regulating a Natural Monopoly

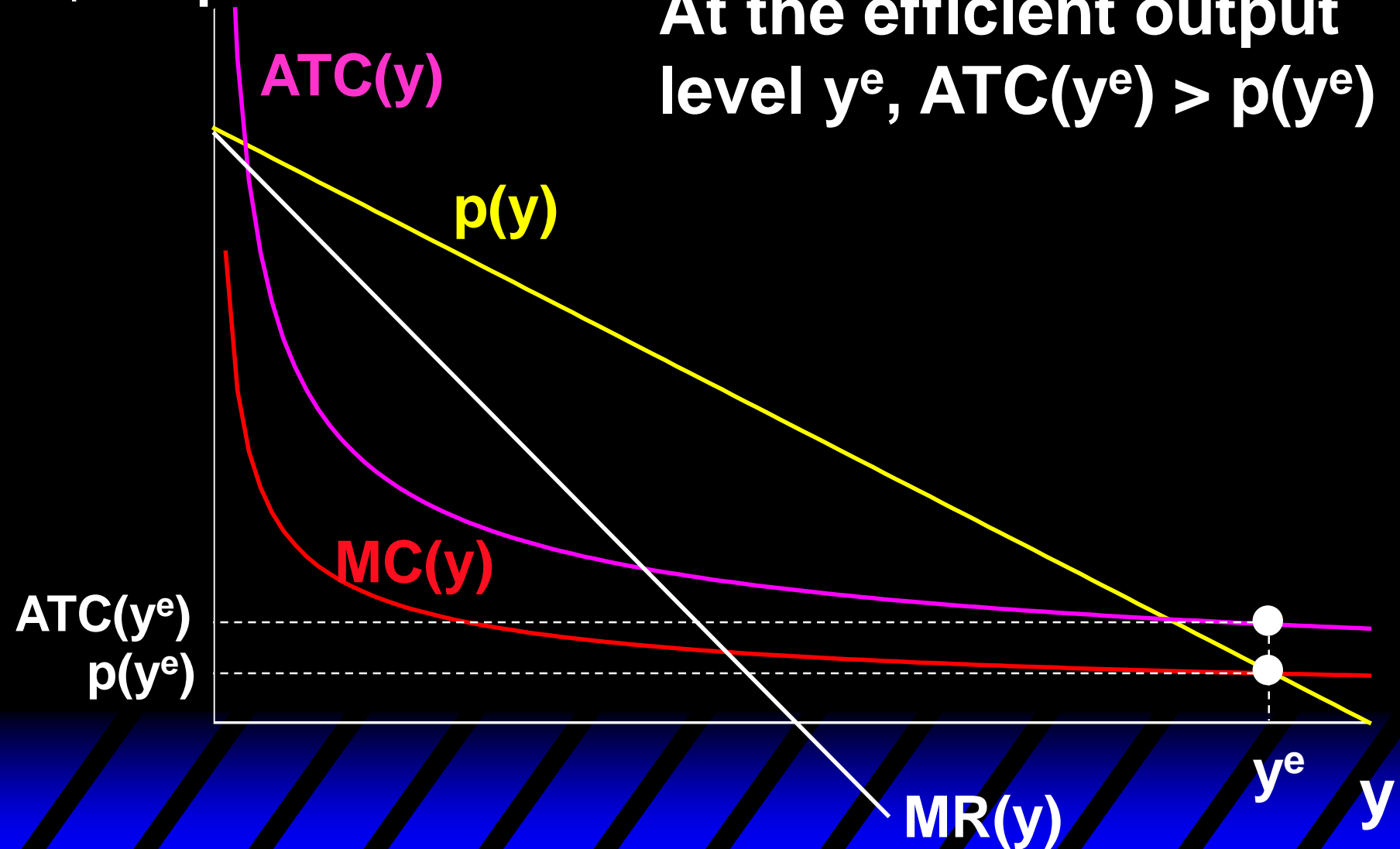
Why not command that a natural monopoly produce the efficient amount of output?

Then the deadweight loss will be zero, won't it?

Regulating a Natural Monopoly

\$/output unit

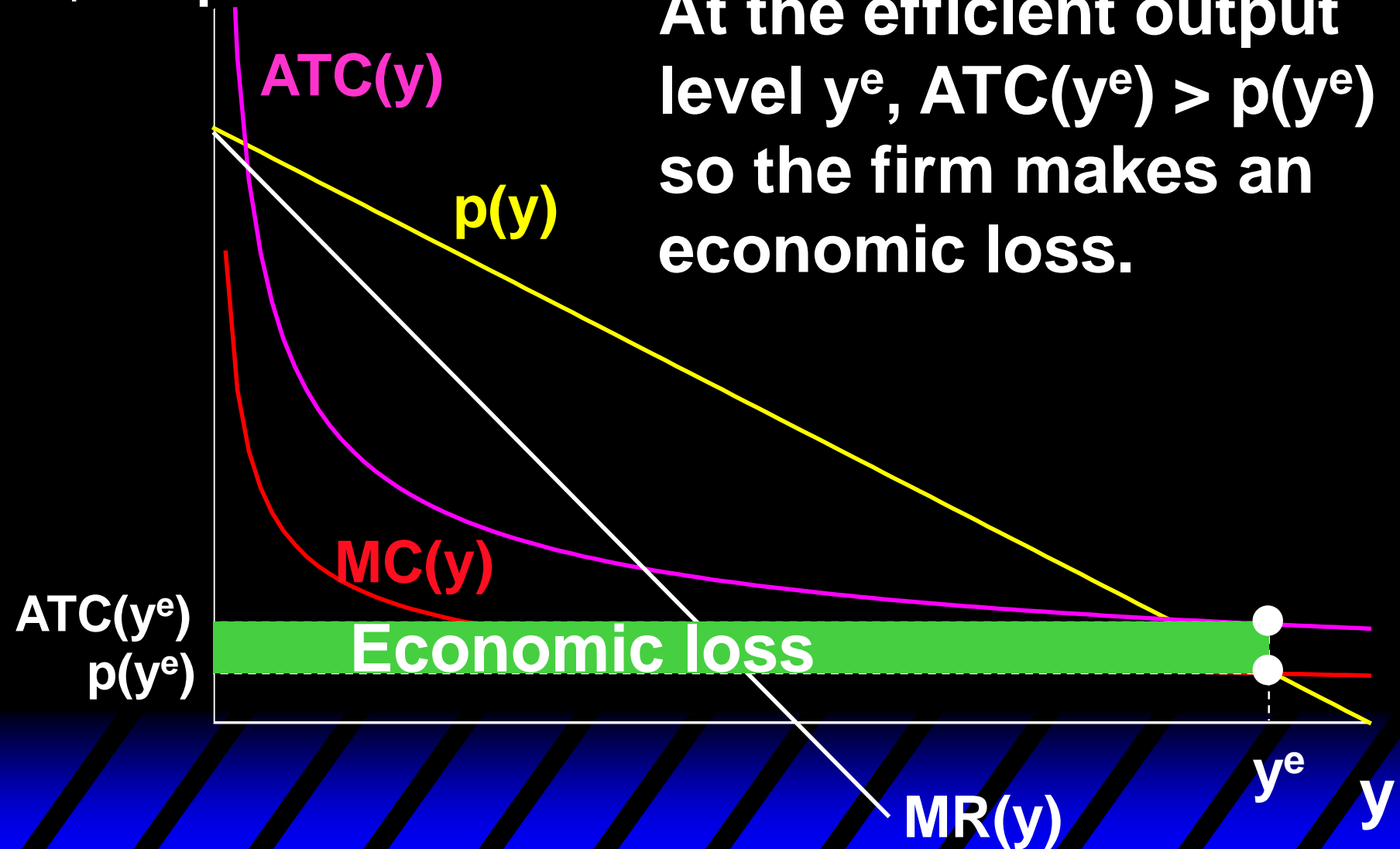
At the efficient output level y^e , $ATC(y^e) > p(y^e)$



Regulating a Natural Monopoly

\$/output unit

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



Regulating a Natural Monopoly

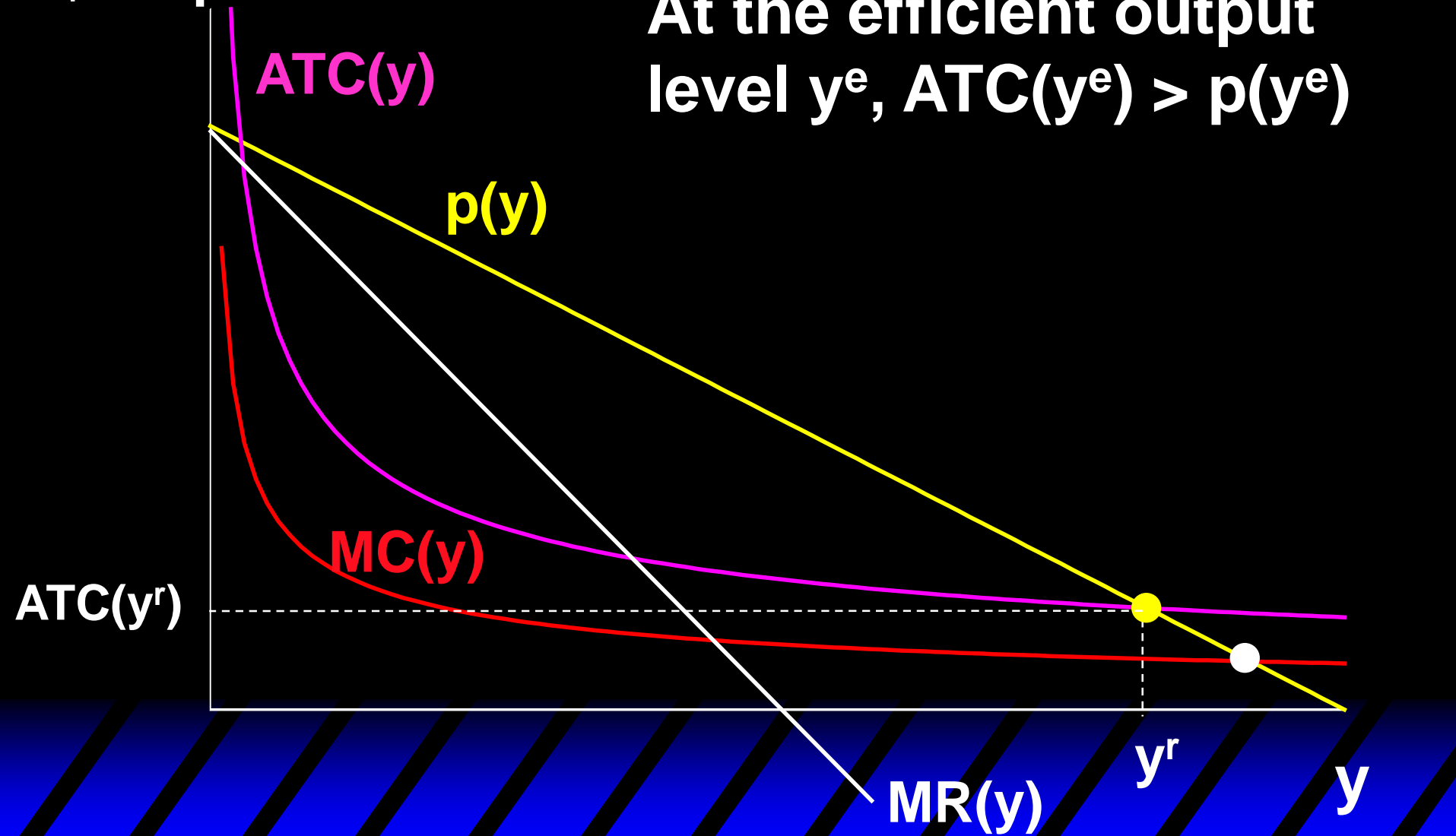
So a natural monopoly cannot be forced to use marginal cost pricing. Doing so makes the firm **exit**, destroying both the market and any gains-to-trade.

Regulatory schemes can induce the natural monopolist to produce the efficient output level without exiting.

Regulating a Natural Monopoly

\$/output unit

At the efficient output level y^e , $ATC(y^e) > p(y^e)$



Monopolistic Competition

Monopolistic Competition: Many firms each making a slightly different product, with free entry and exit.

垄断竞争

Monopolistic Competition

Different products \Rightarrow **price setters** instead of price takers (downward sloping demand curves)

Free entry and exit \Rightarrow **zero** economic profit in the long run, i.e. $ATC(y^*) = p(y^*)$

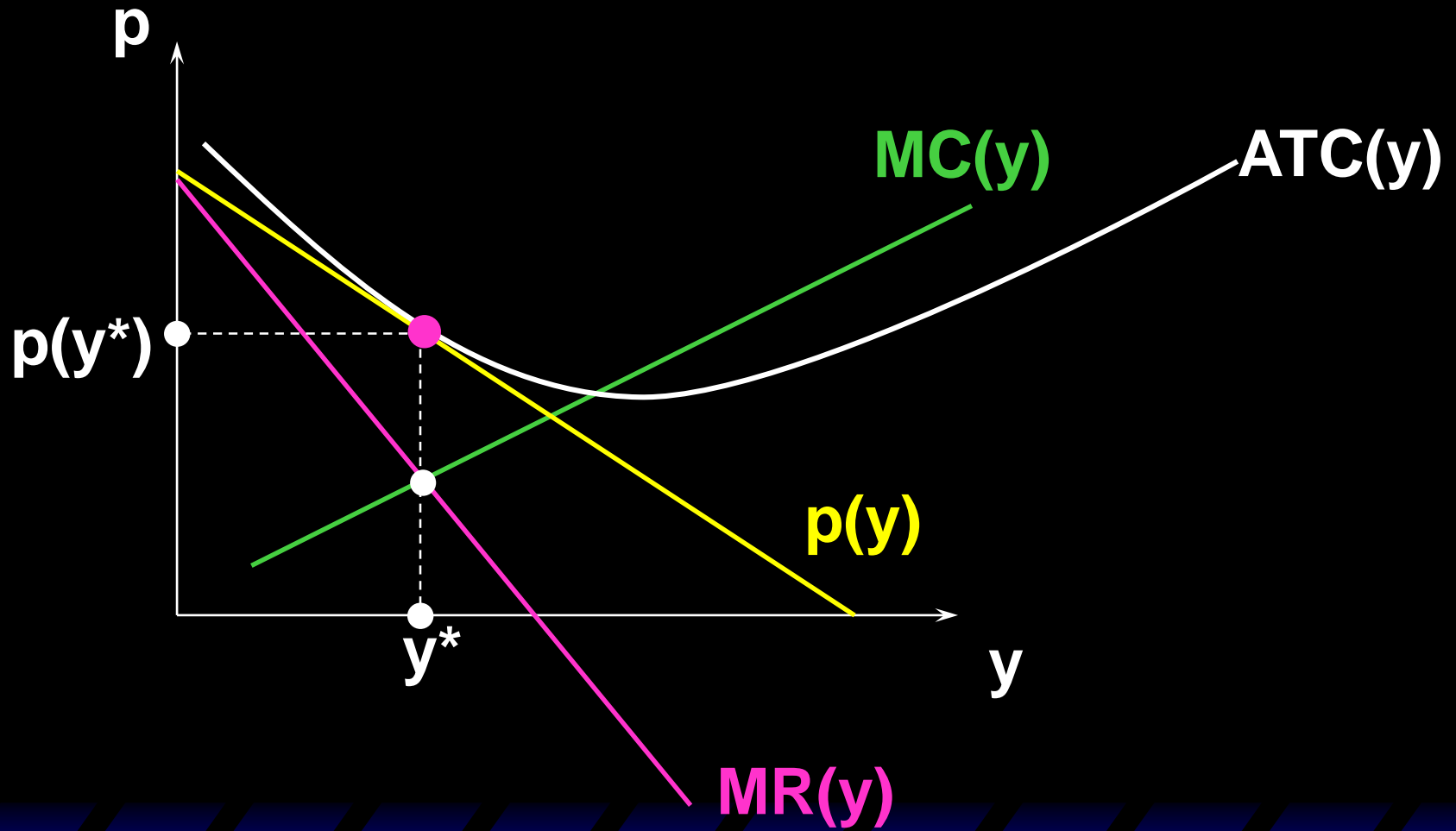
Monopolistic Competition

Different products \Rightarrow price setters instead of price takers (downward sloping demand curves)

Free entry and exit \Rightarrow zero economic profit in the long run, i.e. $ATC(y^*) = p(y^*)$

随着更多厂商的进入，替代品增加，单个厂商面临的产品需求曲线向内移动、且弹性上升

Monopolistic Competition



在最优产量水平处，需求曲线与平均成本曲线相切