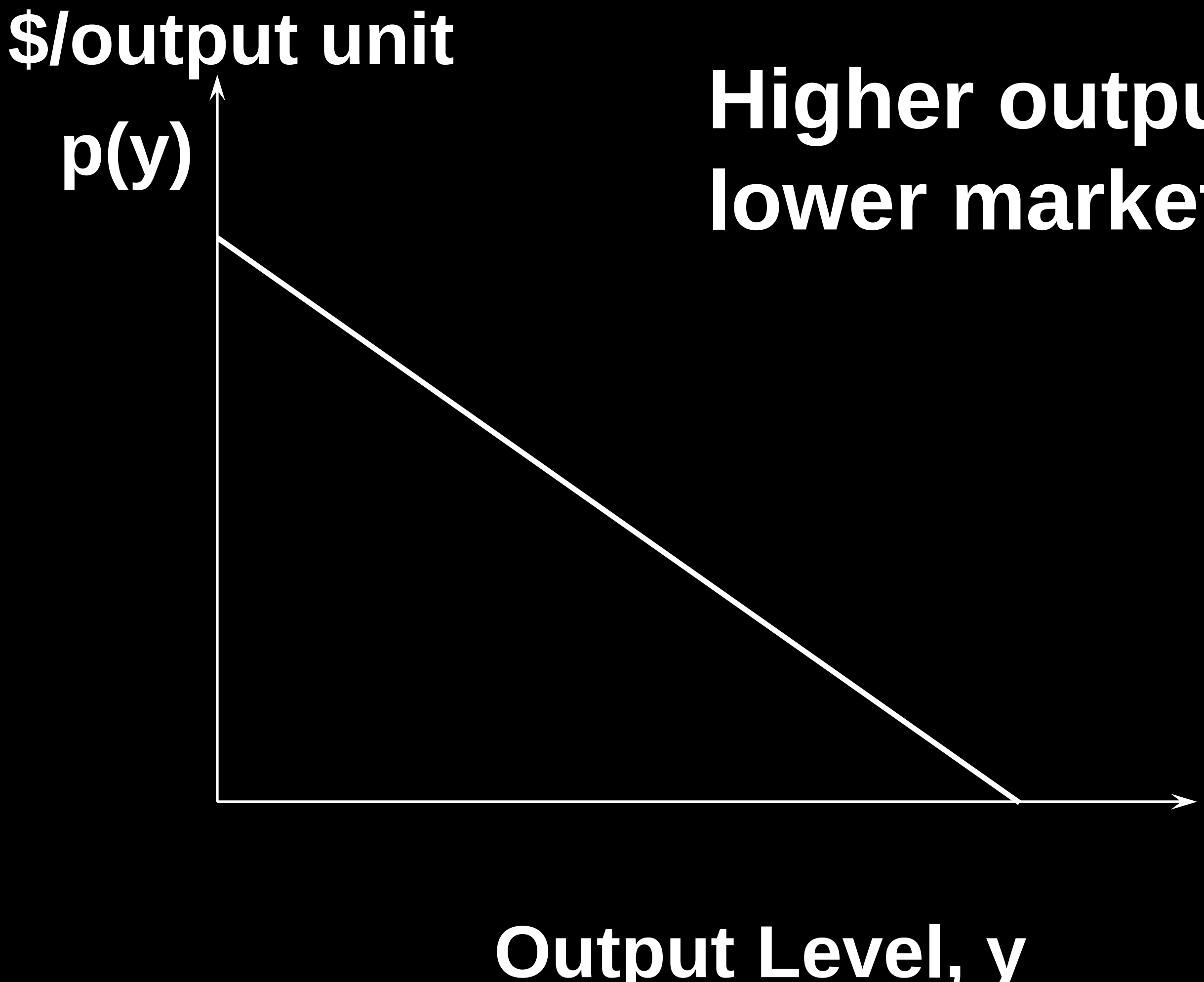
Chapter Twenty-Four

Monopoly

Pure Monopoly

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

Pure Monopoly



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

Why Monopolies?

What causes monopolies?

– **a legal fiat; e.g. US Postal Service**

Why Monopolies?

What causes monopolies?

- **a legal fiat; e.g. US Postal Service**
- **a patent; e.g. a new drug**

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**

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**

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

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

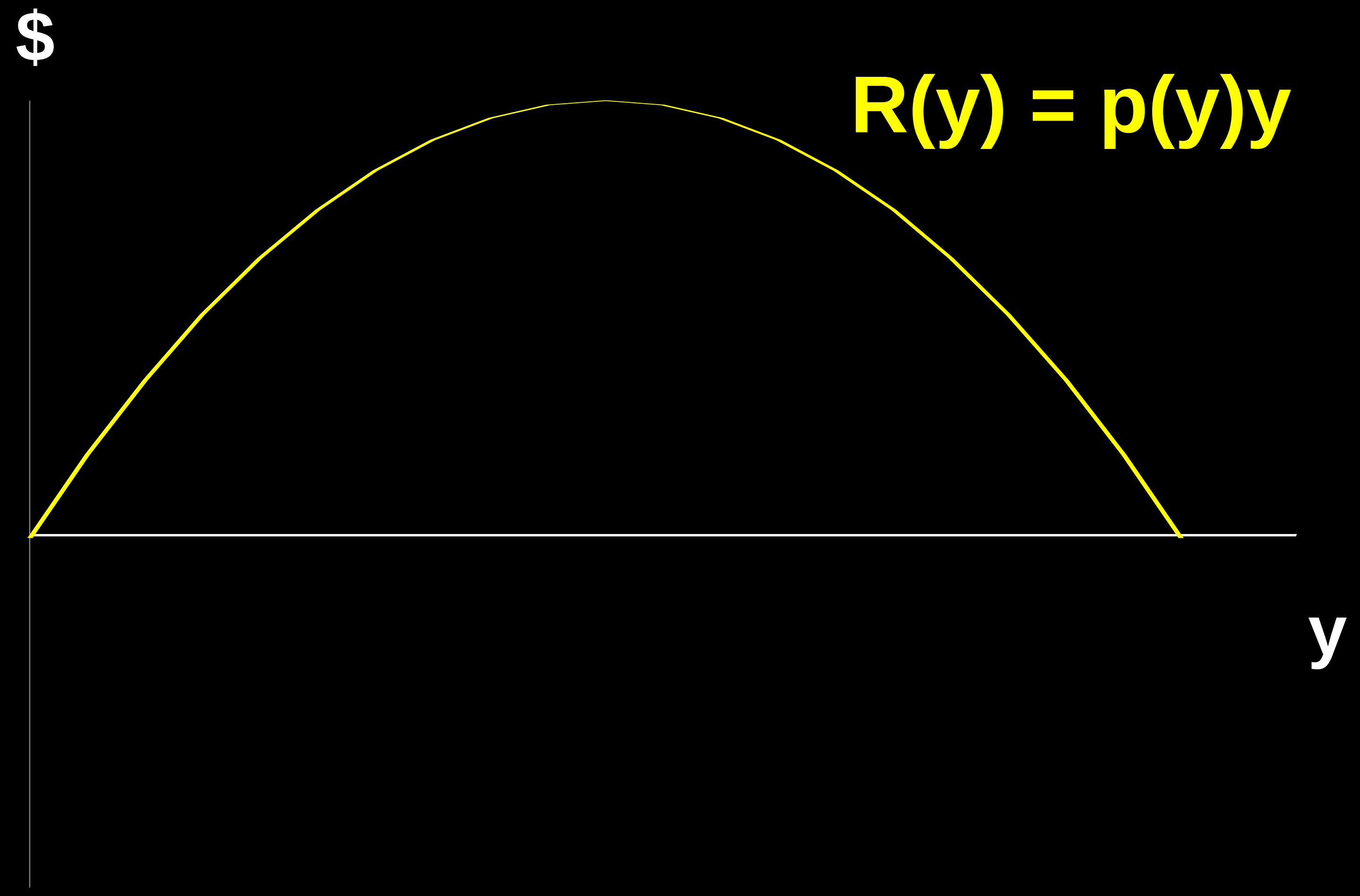
At the profit-maximizing output level y*

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

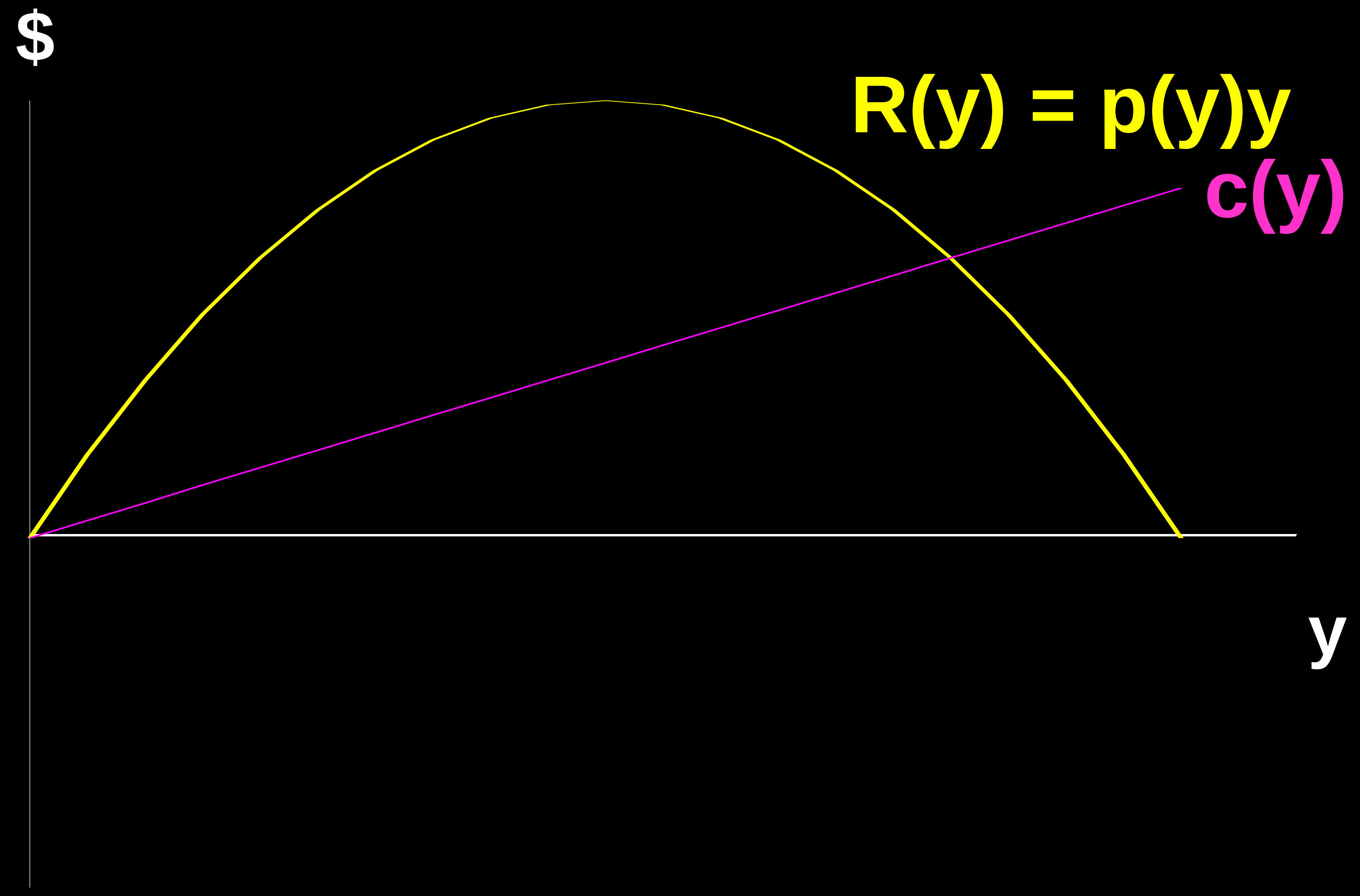
so, for y = y*,

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

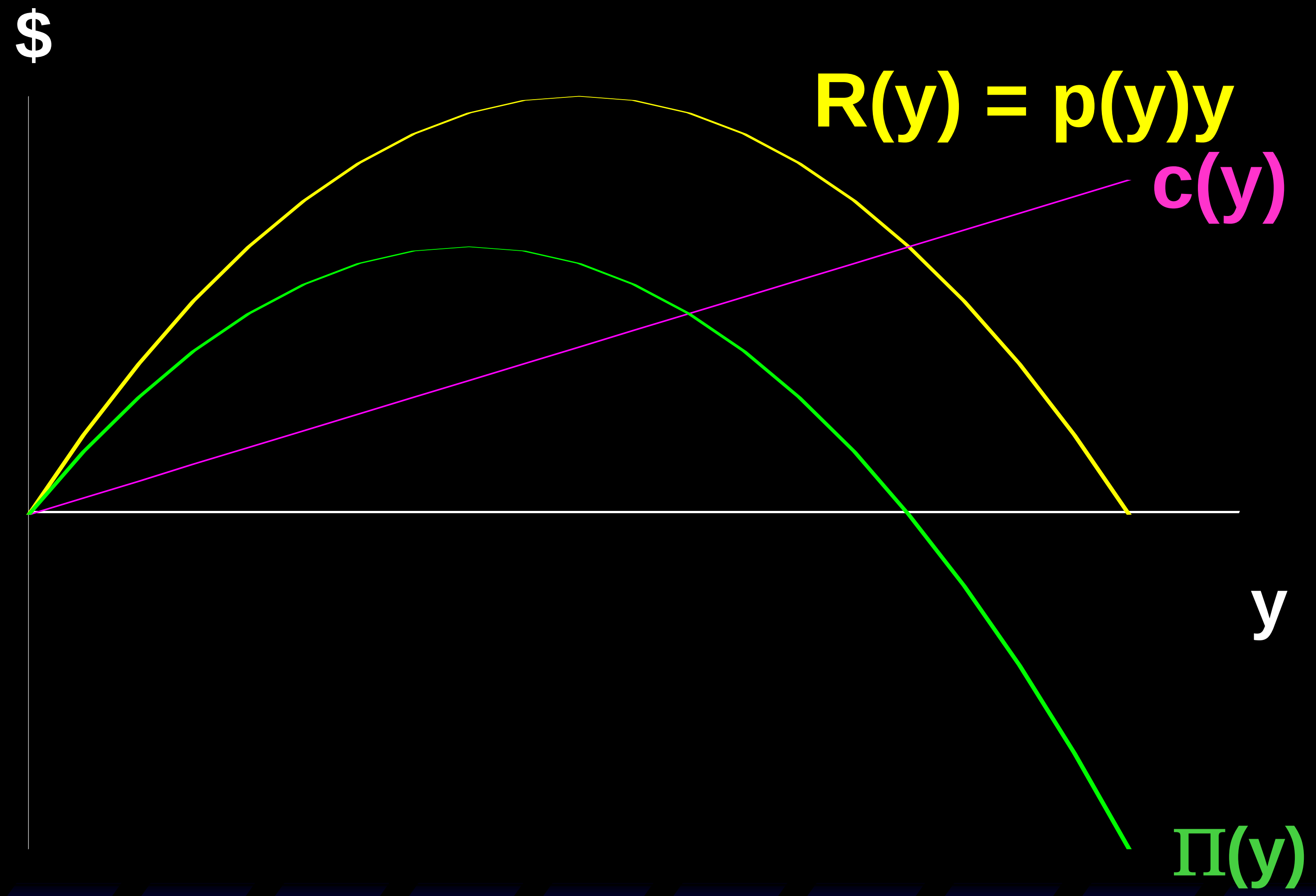
Profit-Maximization



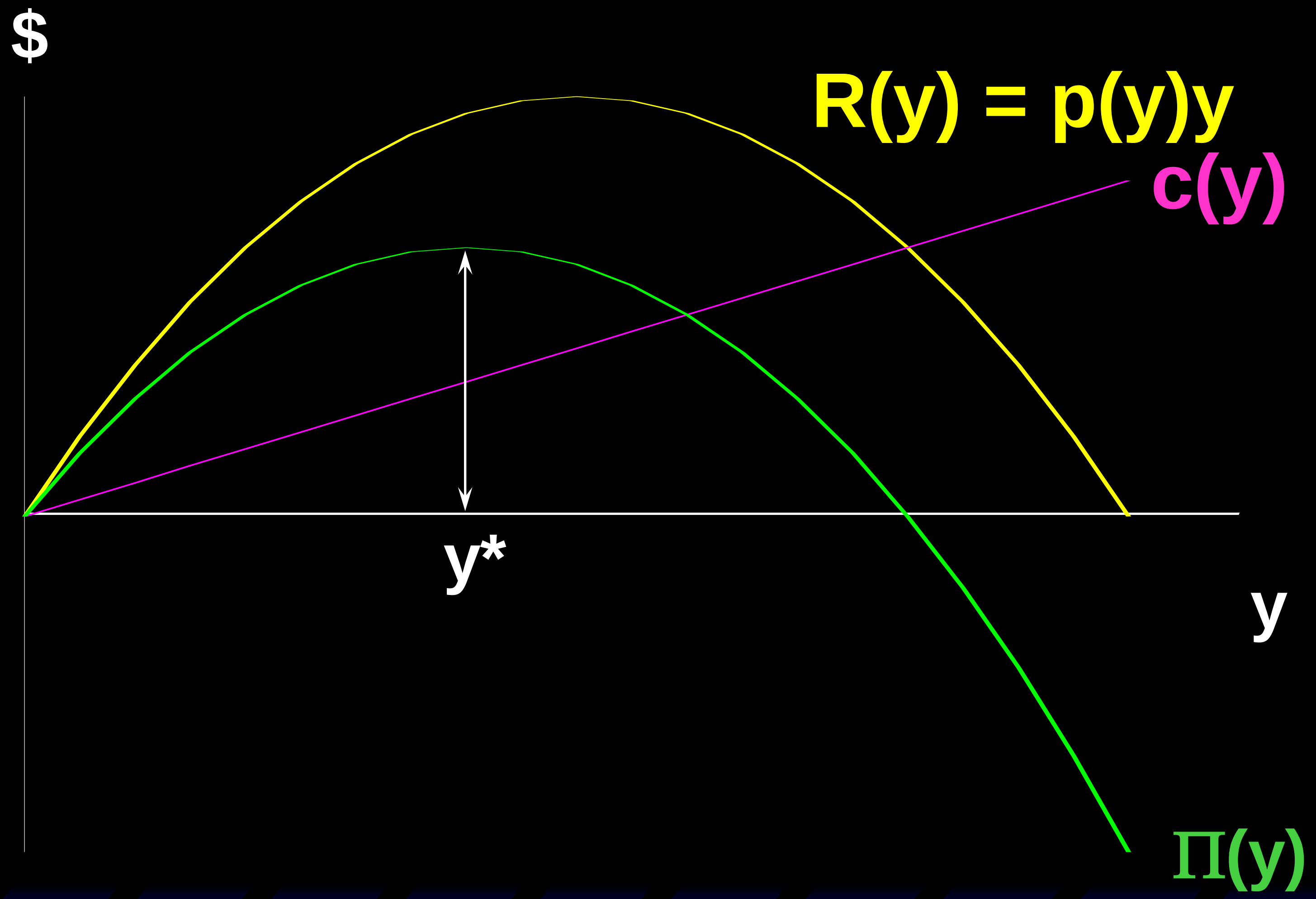
Profit-Maximization



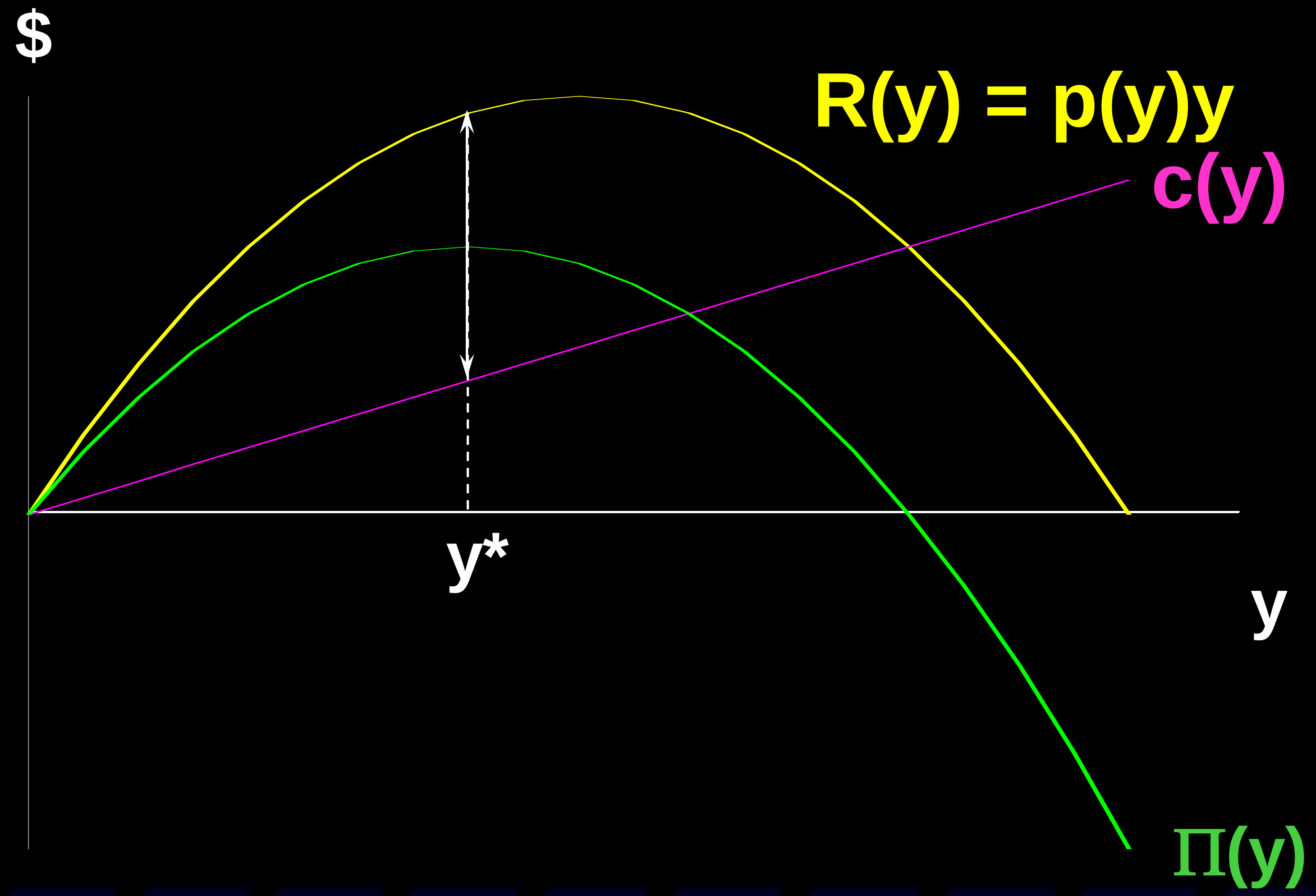
Profit-Maximization



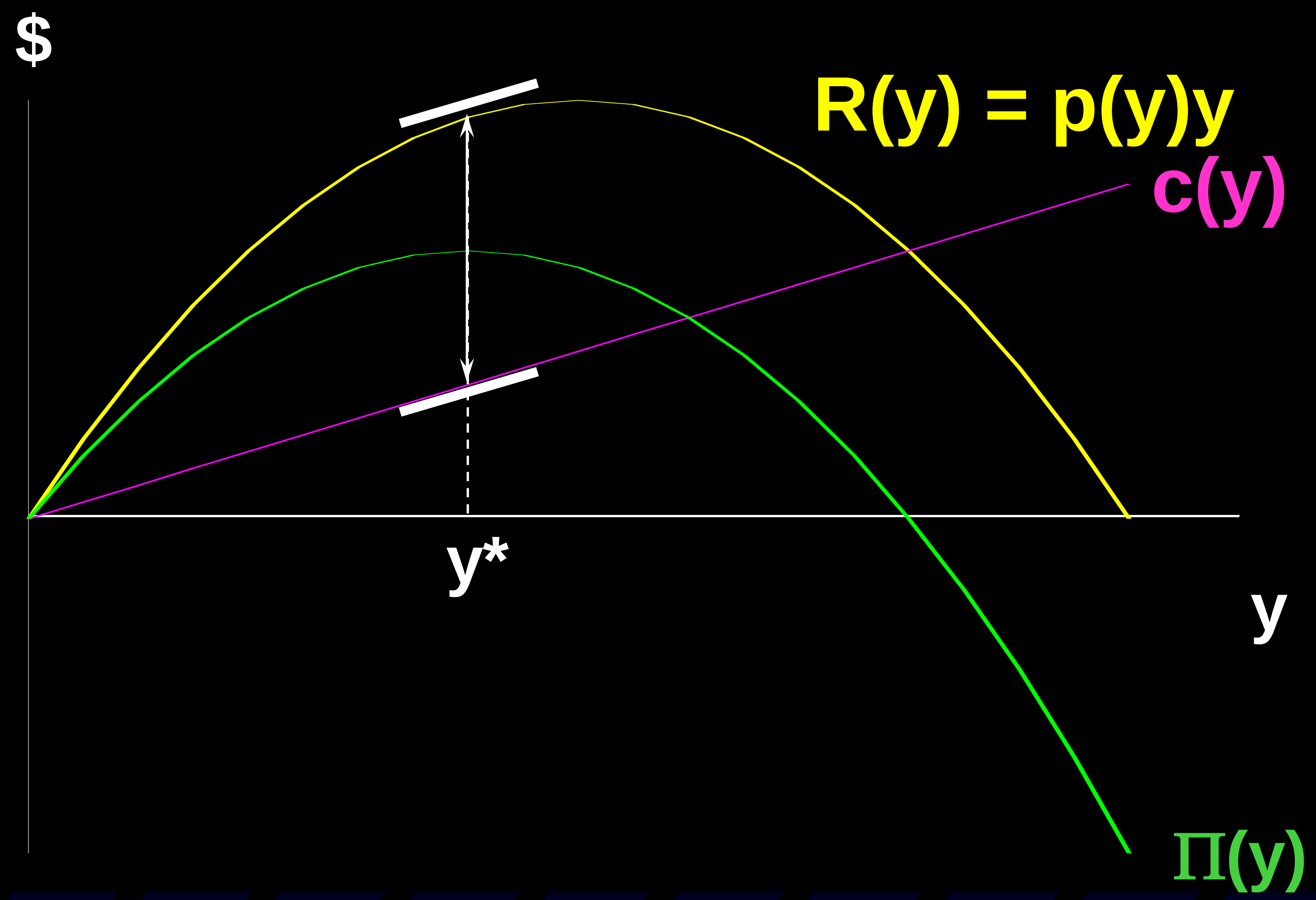
Profit-Maximization



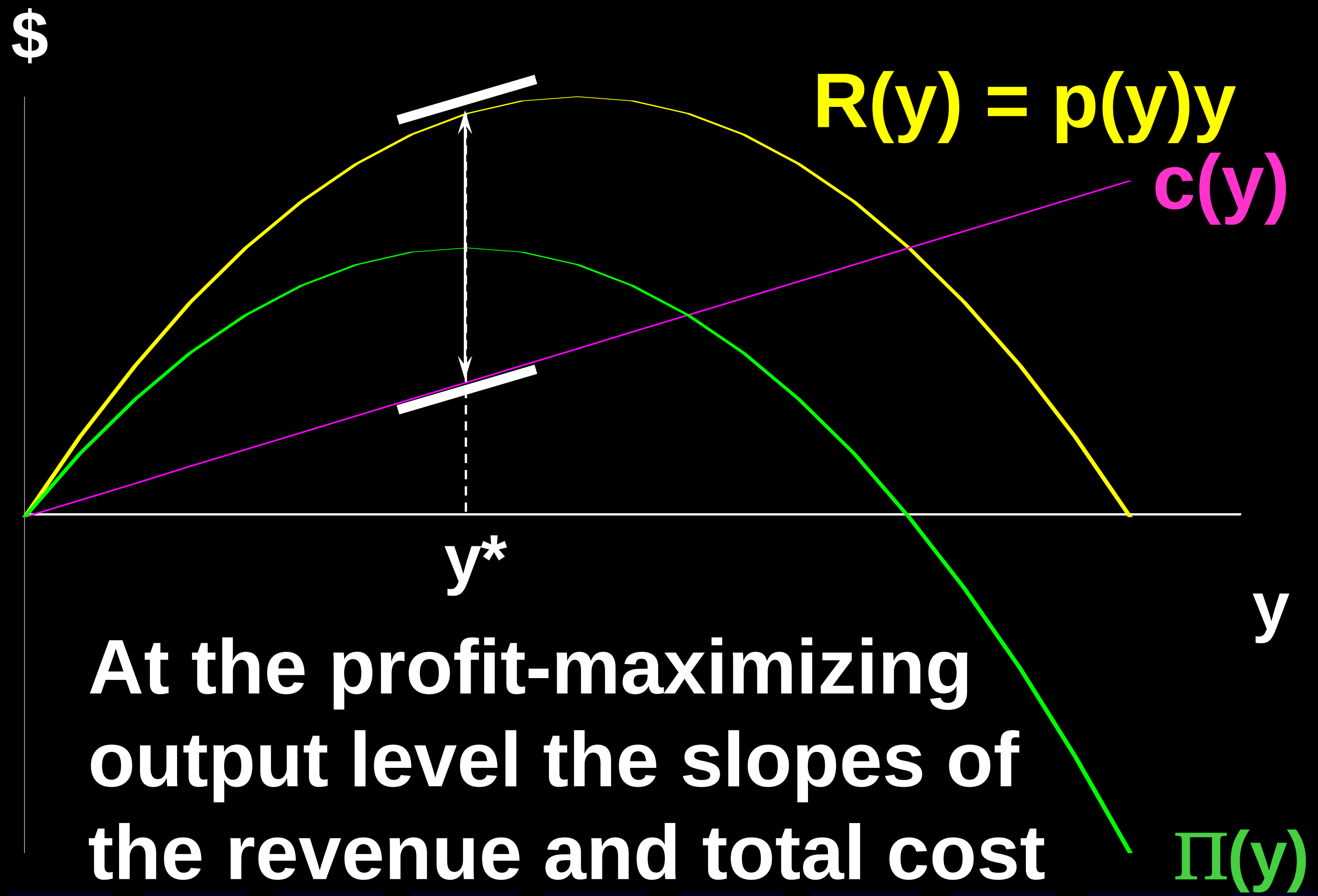
Profit-Maximization



Profit-Maximization



Profit-Maximization



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

Marginal Revenue

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

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

Marginal Revenue

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

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

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

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

for y > 0.

Marginal Revenue

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

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

and so

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

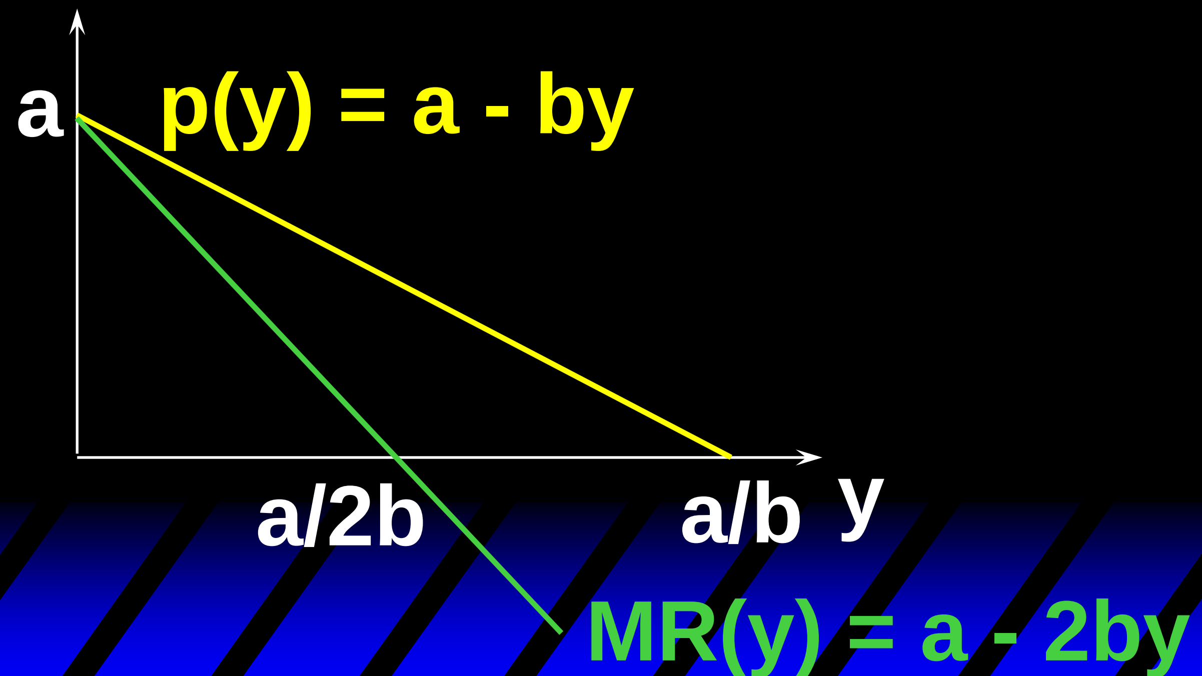
Marginal Revenue

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

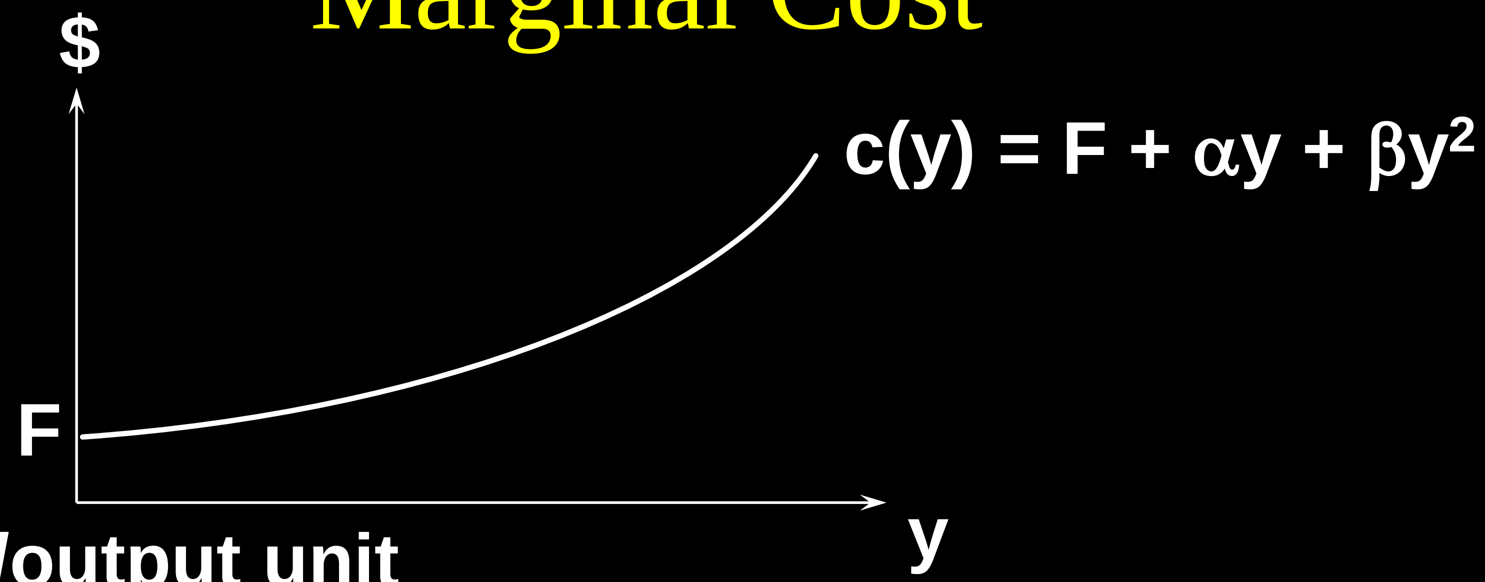
Marginal cost is the rate-of-change of total cost as the output level y increases;

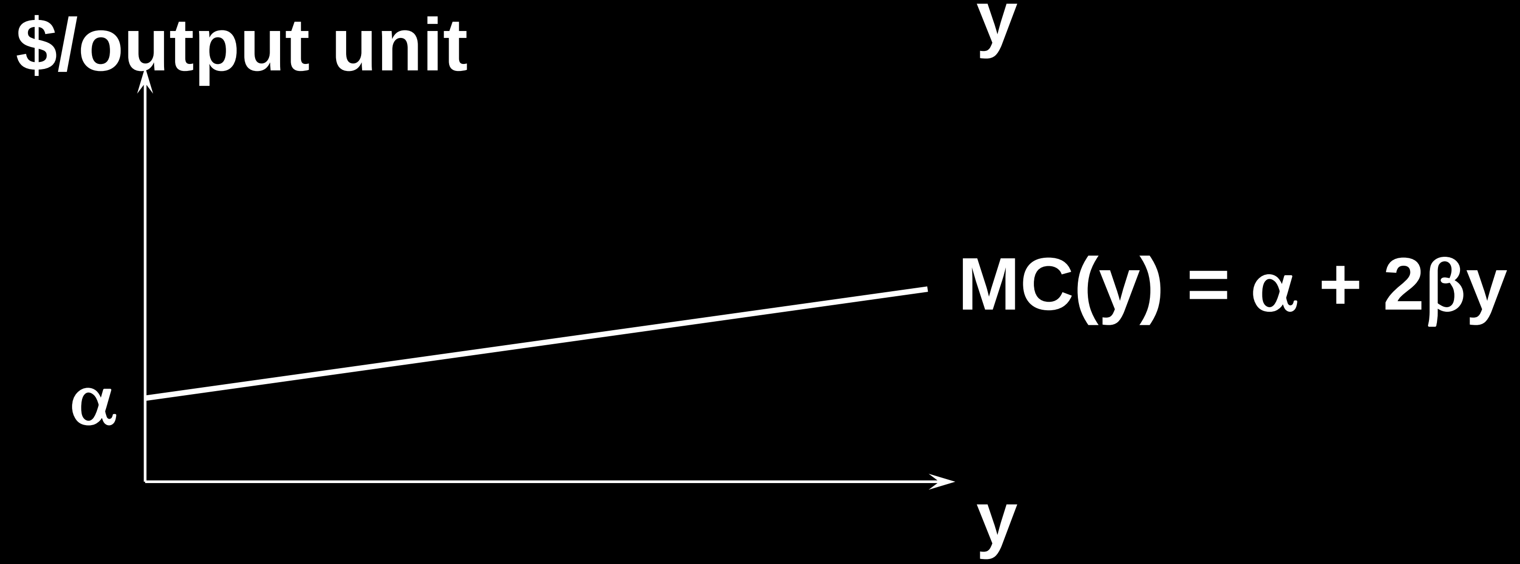
$$MC(y) = \frac{dc(y)}{dy}.$$

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

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

Marginal Cost





Profit-Maximization; An Example

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

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

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 + αy + βy^2 then

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

and the profit-maximizing output level is

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

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 + αy + βy^2 then

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

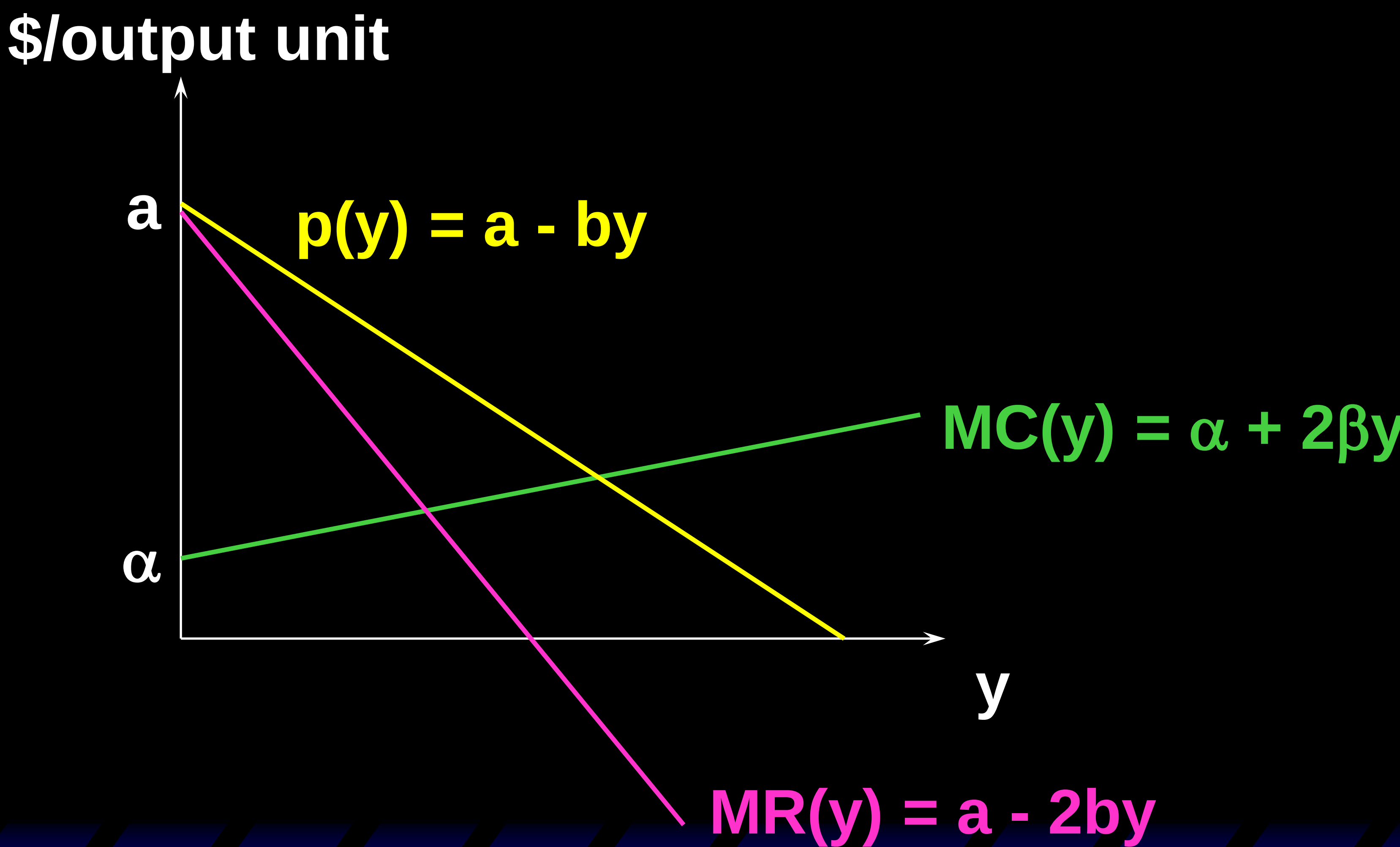
and the profit-maximizing output level is

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

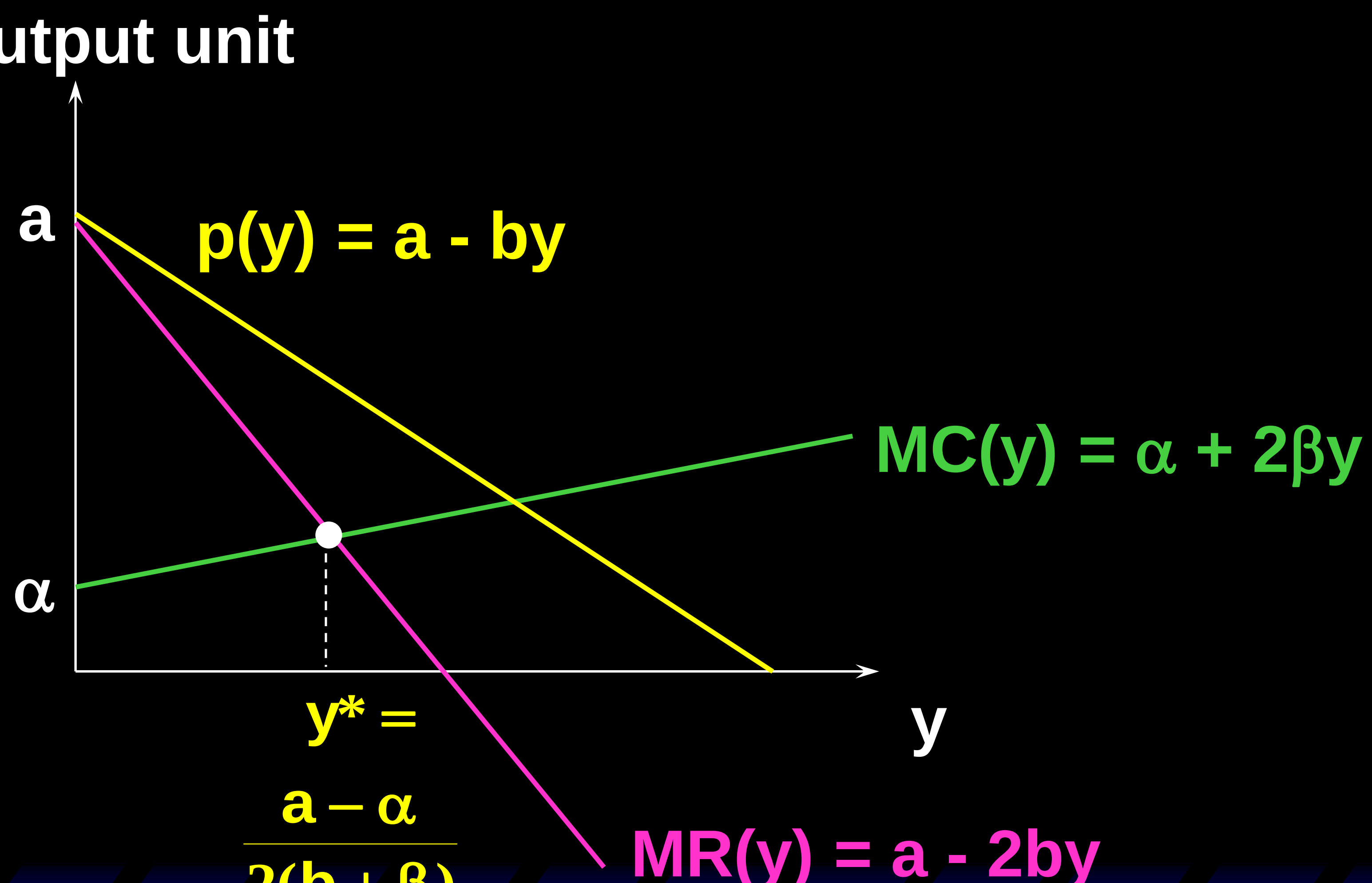
causing the market price to be

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

Profit-Maximization; An Example

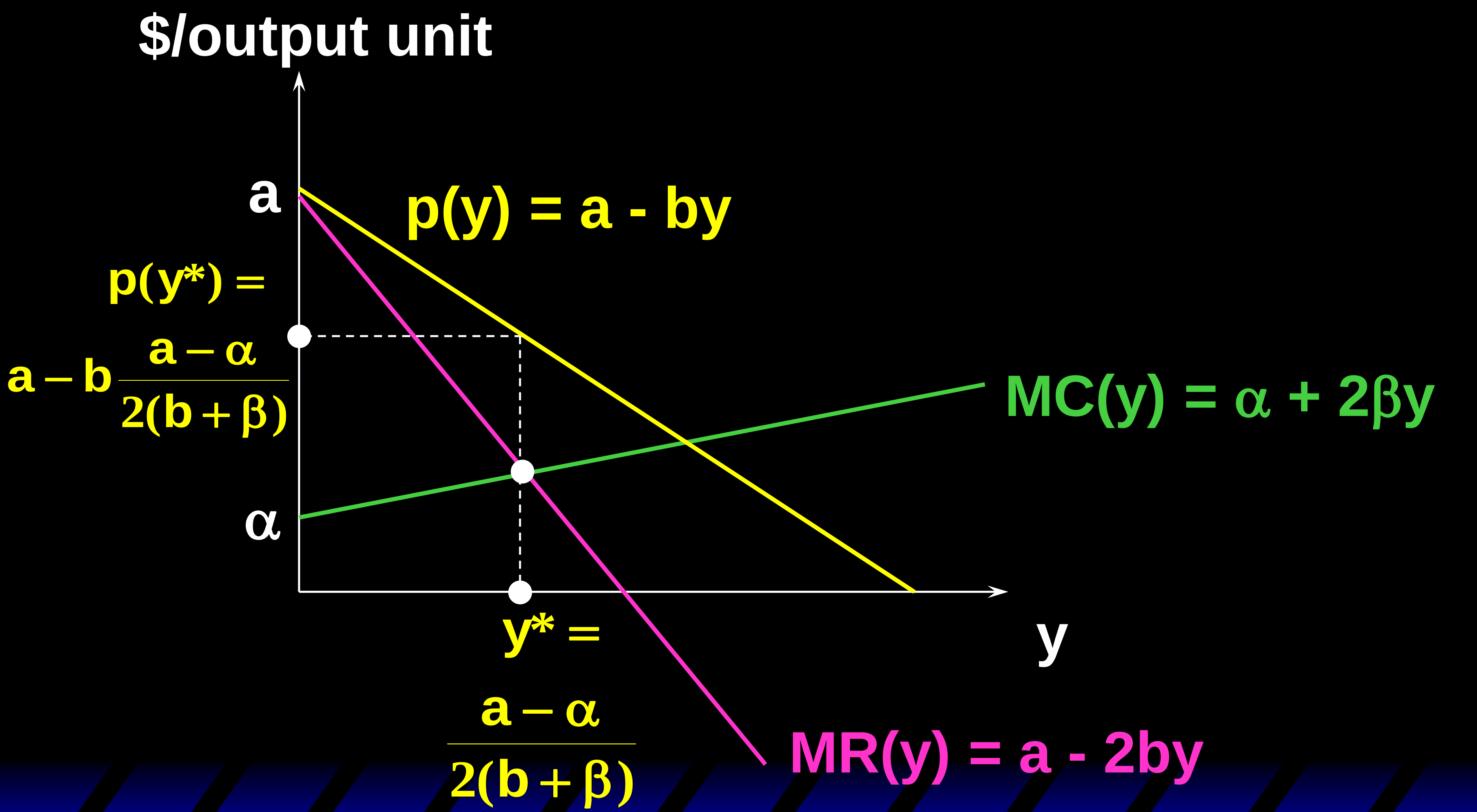


Profit-Maximization; An Example



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

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?

Monopolistic Pricing & Own-Price Elasticity of Demand

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

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

Monopolistic Pricing & Own-Price Elasticity of Demand

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

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

Own-price elasticity of demand is

$$\varepsilon = \frac{p(y)}{y}\frac{dy}{dp(y)}$$

Monopolistic Pricing & Own-Price Elasticity of Demand

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

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

Own-price elasticity of demand is

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

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

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

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

Monopolistic Pricing & Own-Price Elasticity of Demand

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

E.g. if $\varepsilon = -3$ then $p(y^*) = 3k/2$,
and if $\varepsilon = -2$ then $p(y^*) = 2k$.
So as ε rises towards -1 the monopolist alters its output level to make the market price of its product to rise.

Monopolistic Pricing & Own-Price Elasticity of Demand

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

$$p(y^*)\left[1 + \frac{1}{\varepsilon}\right] > 0$$

Monopolistic Pricing & Own-Price Elasticity of Demand

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

$$p(y^*)\left[1+\frac{1}{\varepsilon}\right] > 0 \quad \Rightarrow \quad 1+\frac{1}{\varepsilon} > 0$$

Monopolistic Pricing & Own-Price Elasticity of Demand

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

$$p(y^*)\left[1 + \frac{1}{\varepsilon}\right] > 0 \quad \Rightarrow \quad 1 + \frac{1}{\varepsilon} > 0$$

That is, $\frac{1}{\varepsilon} > -1$

Monopolistic Pricing & Own-Price Elasticity of Demand

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

$$p(y^*)\left[1 + \frac{1}{\varepsilon}\right] > 0 \quad \Rightarrow \quad 1 + \frac{1}{\varepsilon} > 0$$

That is, $\quad \frac{1}{\varepsilon} > -1 \quad \Rightarrow \quad \varepsilon < -1.$

Monopolistic Pricing & Own-Price Elasticity of Demand

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

$$p(y^*)\left[1 + \frac{1}{\varepsilon}\right] > 0 \quad \Rightarrow \quad 1 + \frac{1}{\varepsilon} > 0$$

That is, $\frac{1}{\varepsilon} > -1 \quad \Rightarrow \quad \varepsilon < -1.$

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

Markup Pricing

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

How big is a monopolist's markup and how does it change with the own-price elasticity of demand?

Markup Pricing

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

is the monopolist's price.

Markup Pricing

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

is the monopolist's price. The markup is

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

Markup Pricing

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

is the monopolist's price. The markup is

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

E.g. if ε = -3 then the markup is k/2, and if ε = -2 then the markup is k. The markup rises as the own-price elasticity of demand rises towards -1.

A Profits Tax Levied on a Monopoly

- A profits tax levied at rate t reduces profit from $\Pi(y^*)$ to $(1-t)\Pi(y^*)$.
- 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 $(1-t)\Pi(y^*)$.
- Q: How is after-tax profit, $(1-t)\Pi(y^*)$, maximized?
- A: By maximizing before-tax profit, $\Pi(y^*)$.

A Profits Tax Levied on a Monopoly

- A profits tax levied at rate t reduces profit from $\Pi(y^*)$ to $(1-t)\Pi(y^*)$.
- Q: How is after-tax profit, $(1-t)\Pi(y^*)$, maximized?
- A: By maximizing before-tax profit, $\Pi(y^*)$.
- So a profits tax has no effect on the monopolist's choices of output level, output price, or demands for inputs.
- I.e. the profits tax is a **neutral tax**.

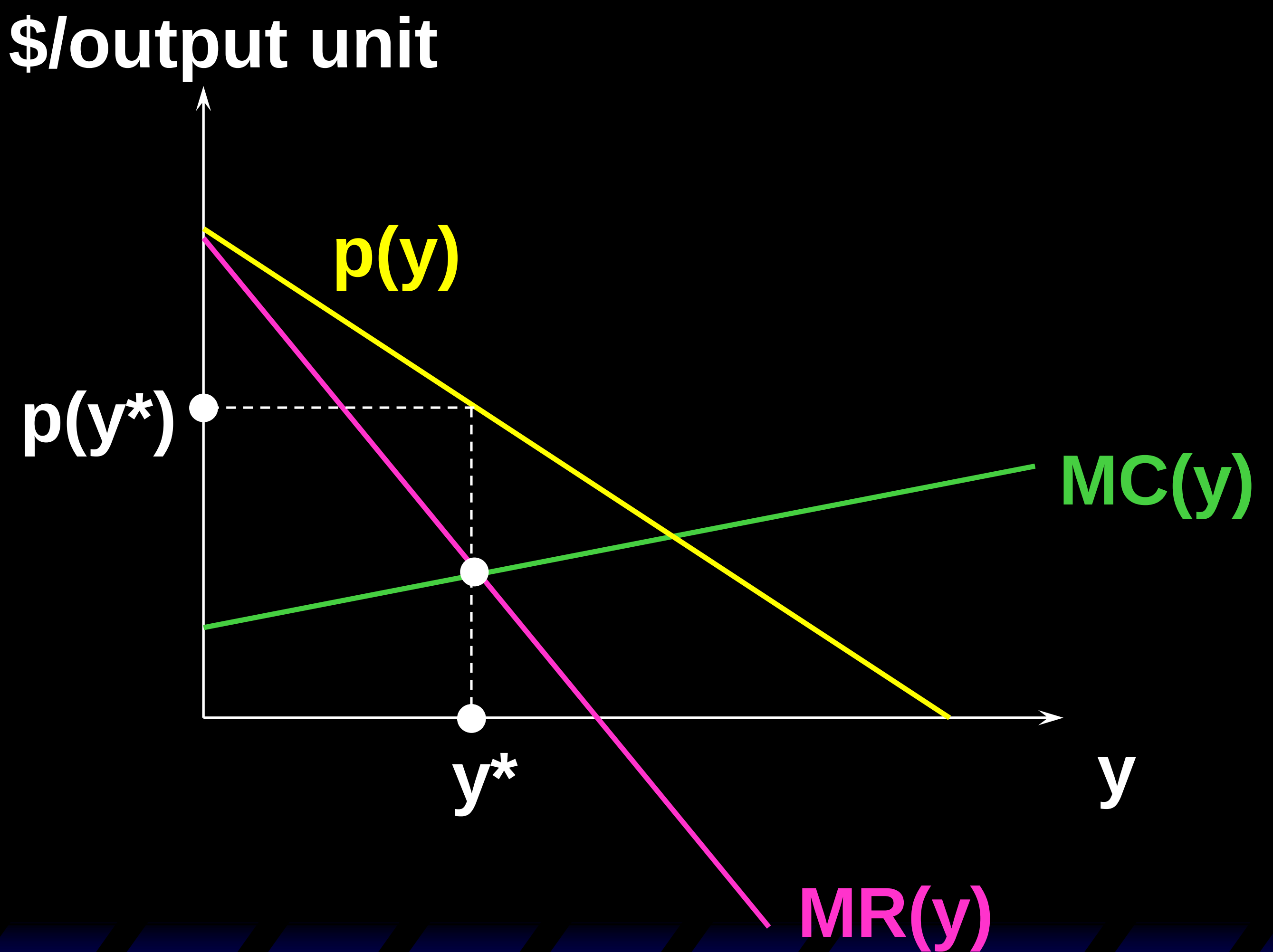
Quantity Tax Levied on a Monopolist

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

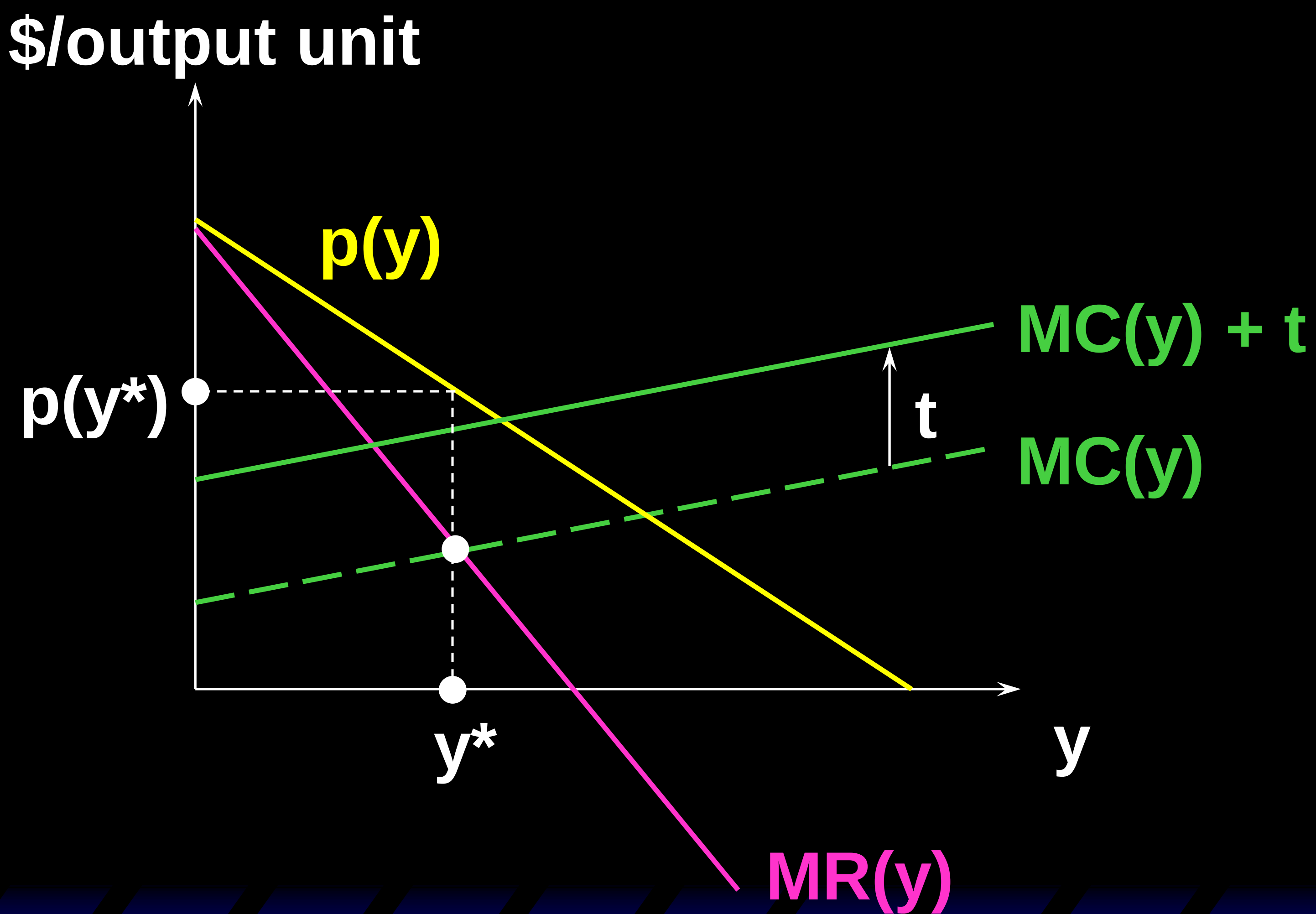
So the tax reduces the profit-maximizing output level, causes the market price to rise, and input demands to fall.

The quantity tax is distortionary.

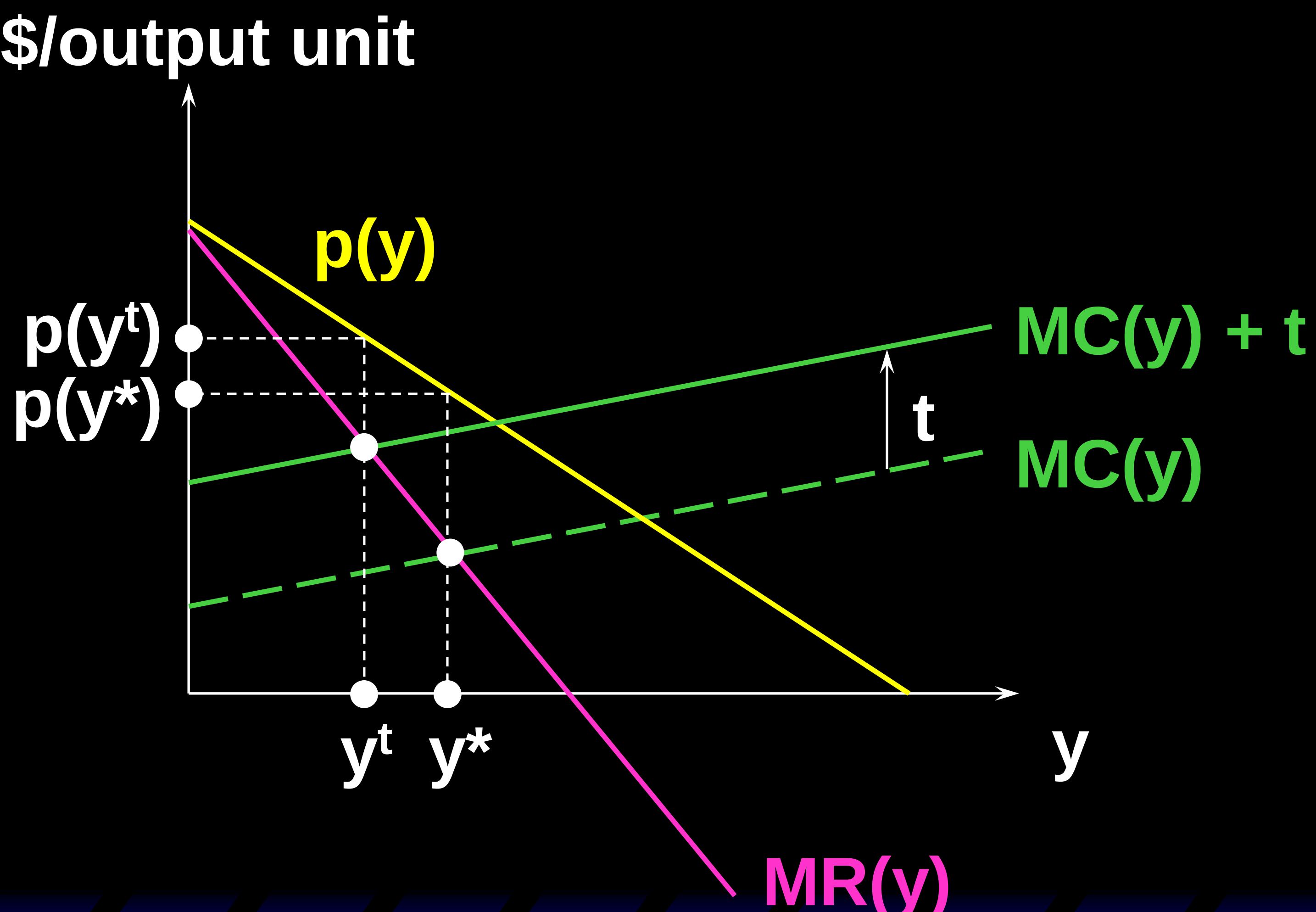
Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist

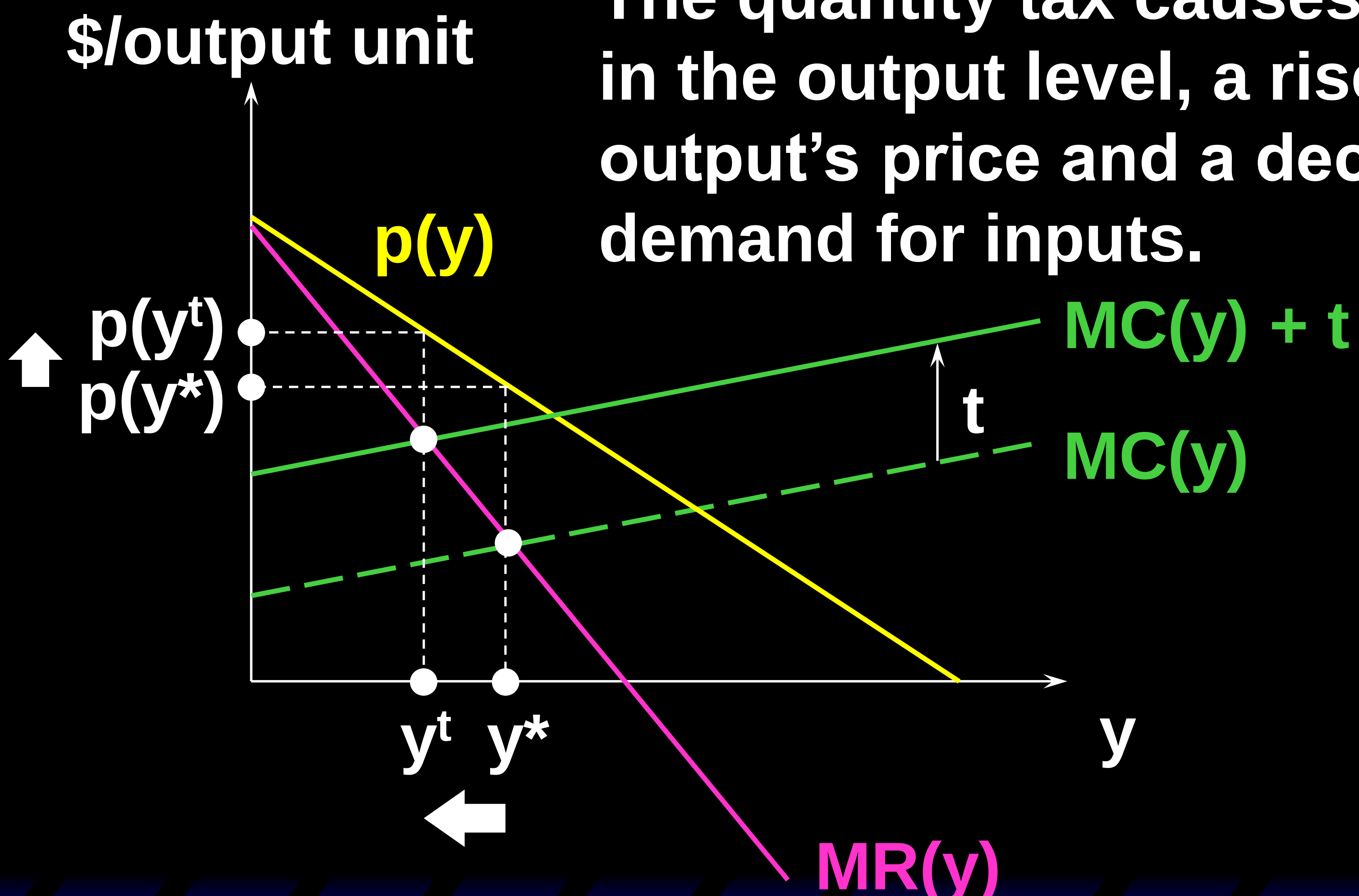


Quantity Tax Levied on a Monopolist



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.
- With no tax, the monopolist's price is

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

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 $\varepsilon = -2$, the amount of the tax passed on is 2t.

Because $\varepsilon < -1$, $\varepsilon/(1+\varepsilon) > 1$ and so the monopolist passes on to consumers more than the tax!

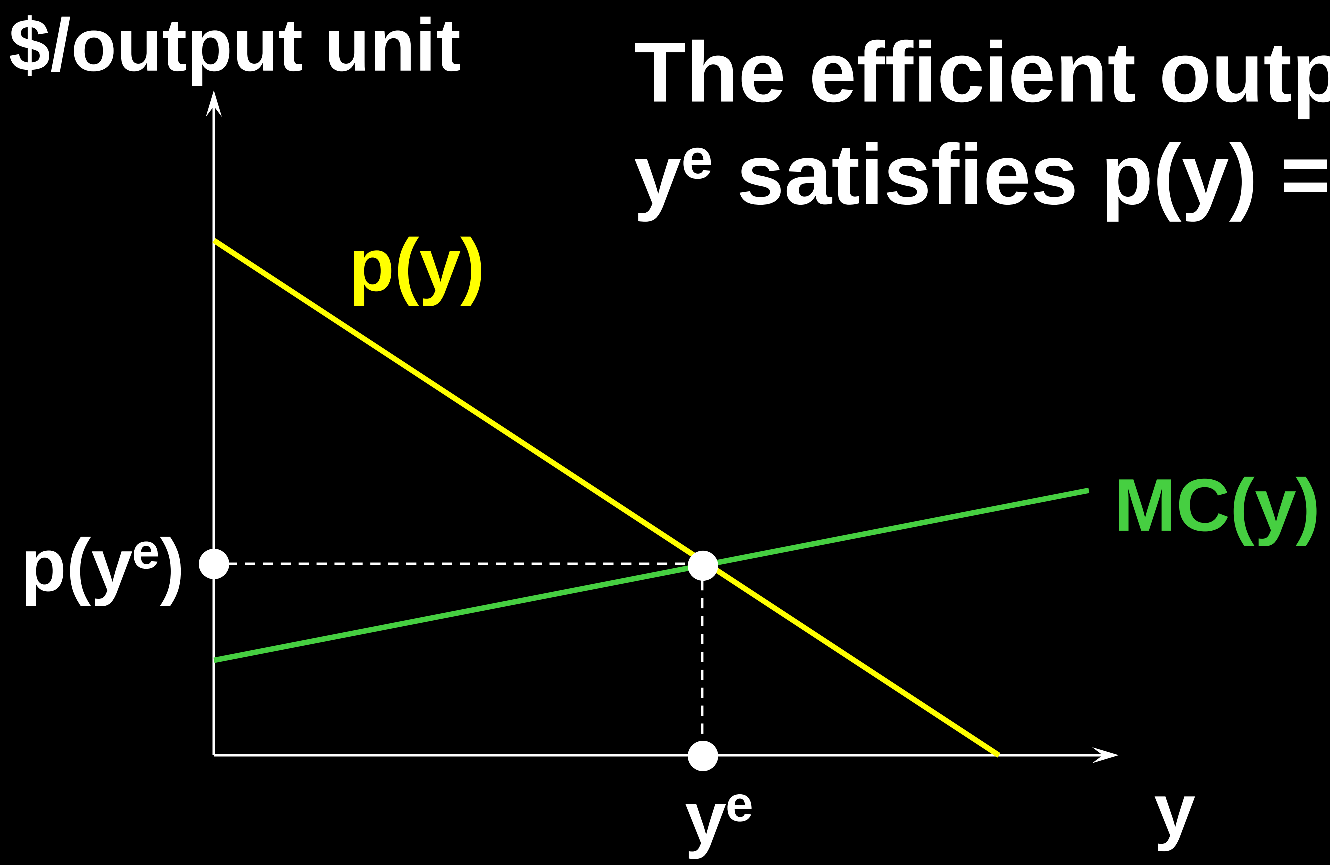
The Inefficiency of Monopoly

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

Otherwise a market is Pareto inefficient.

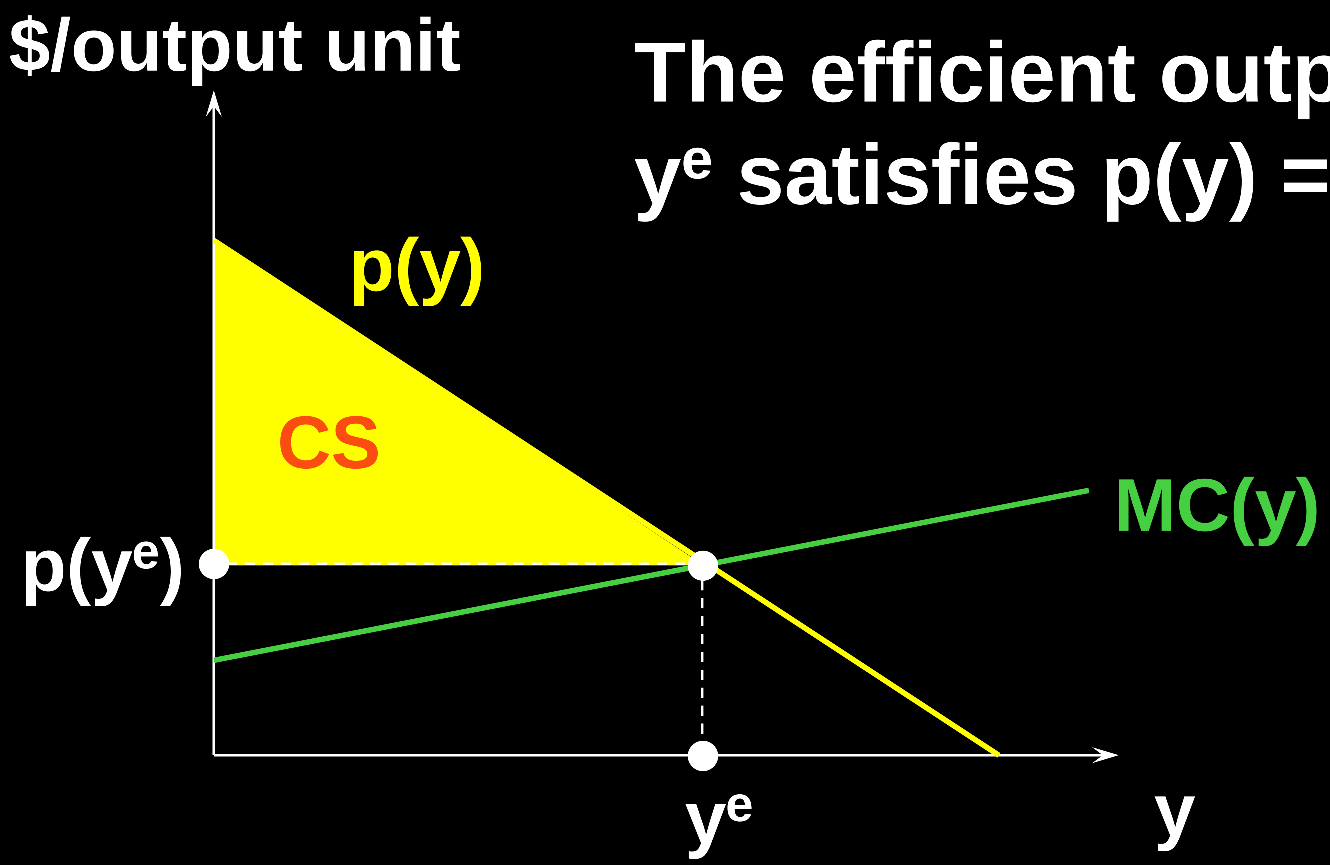
The Inefficiency of Monopoly

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



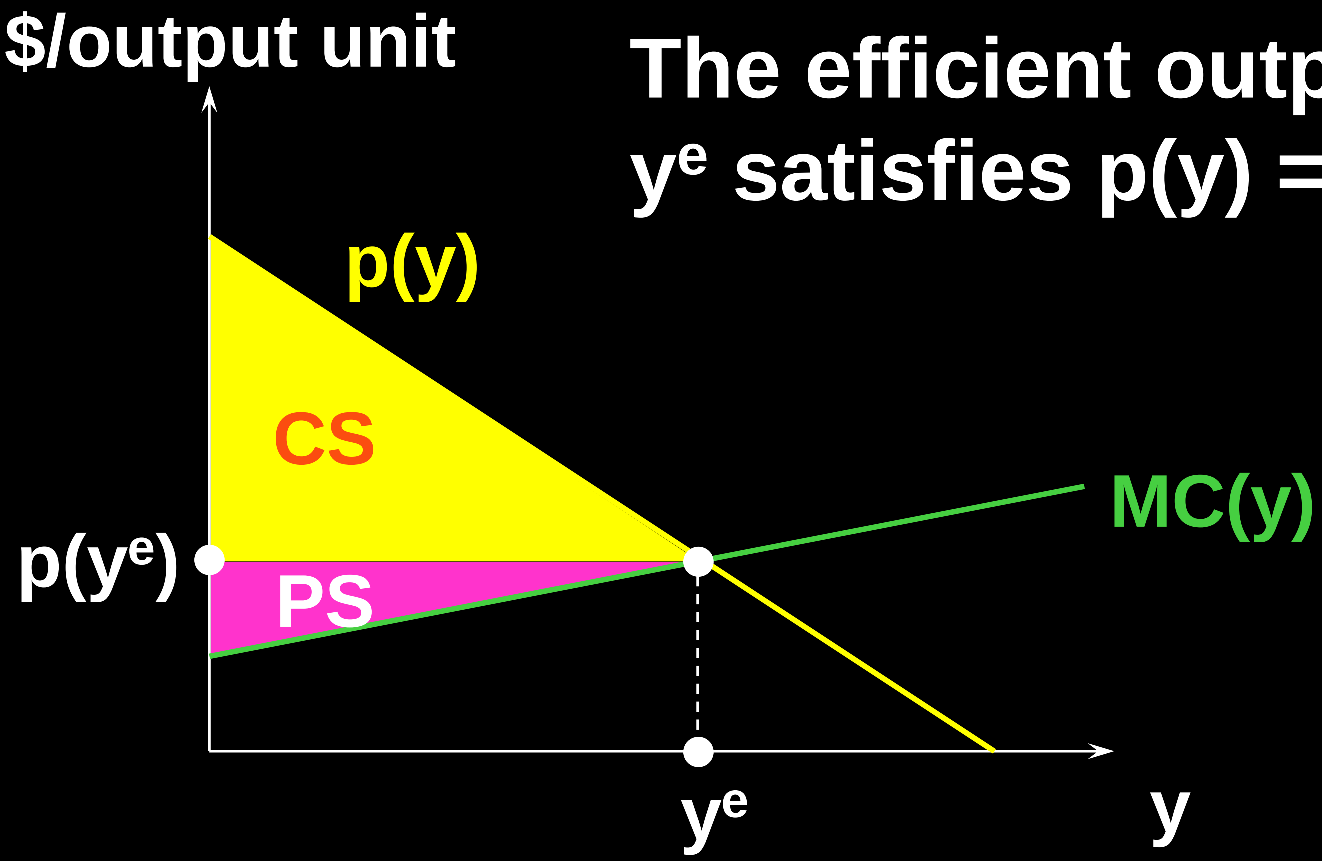
The Inefficiency of Monopoly

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

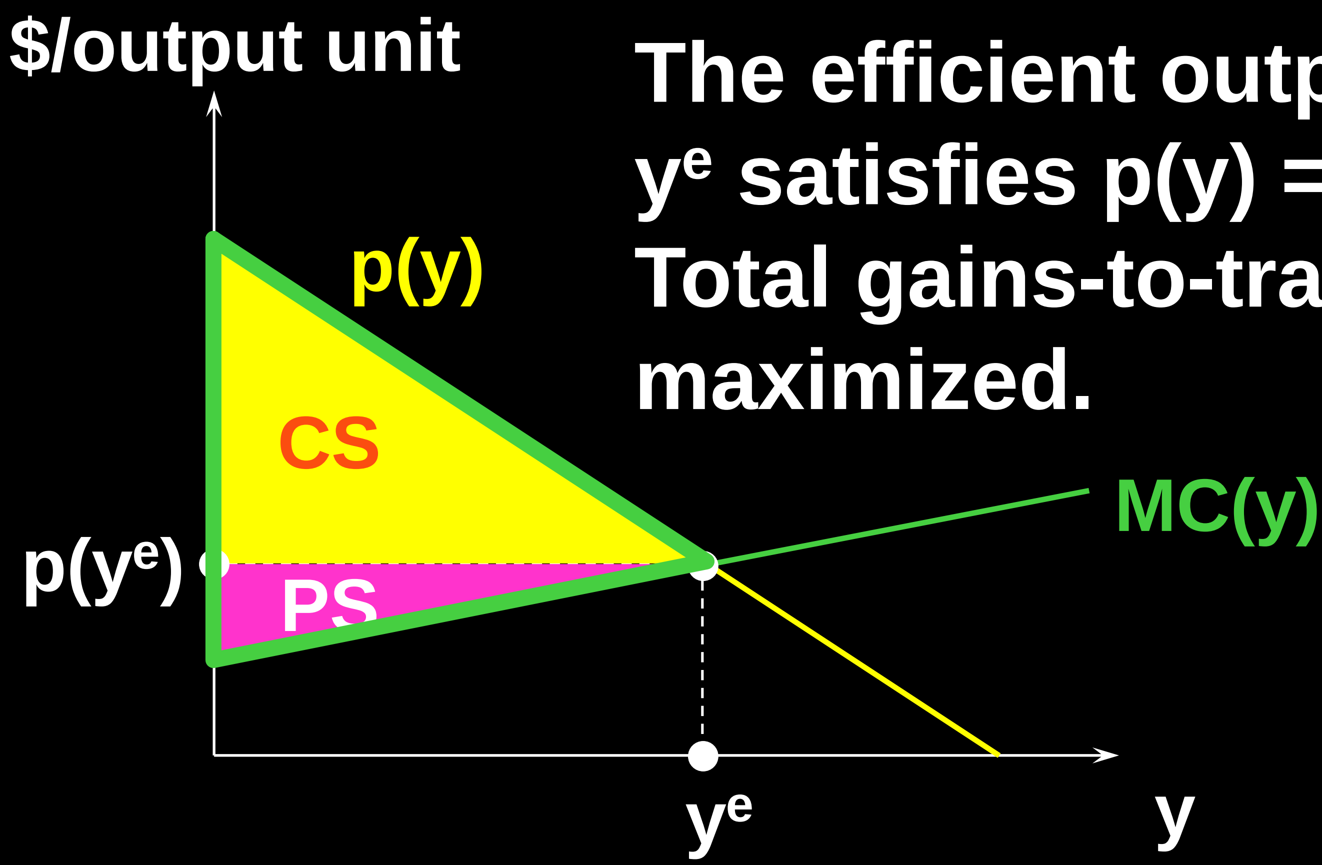


The Inefficiency of Monopoly

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

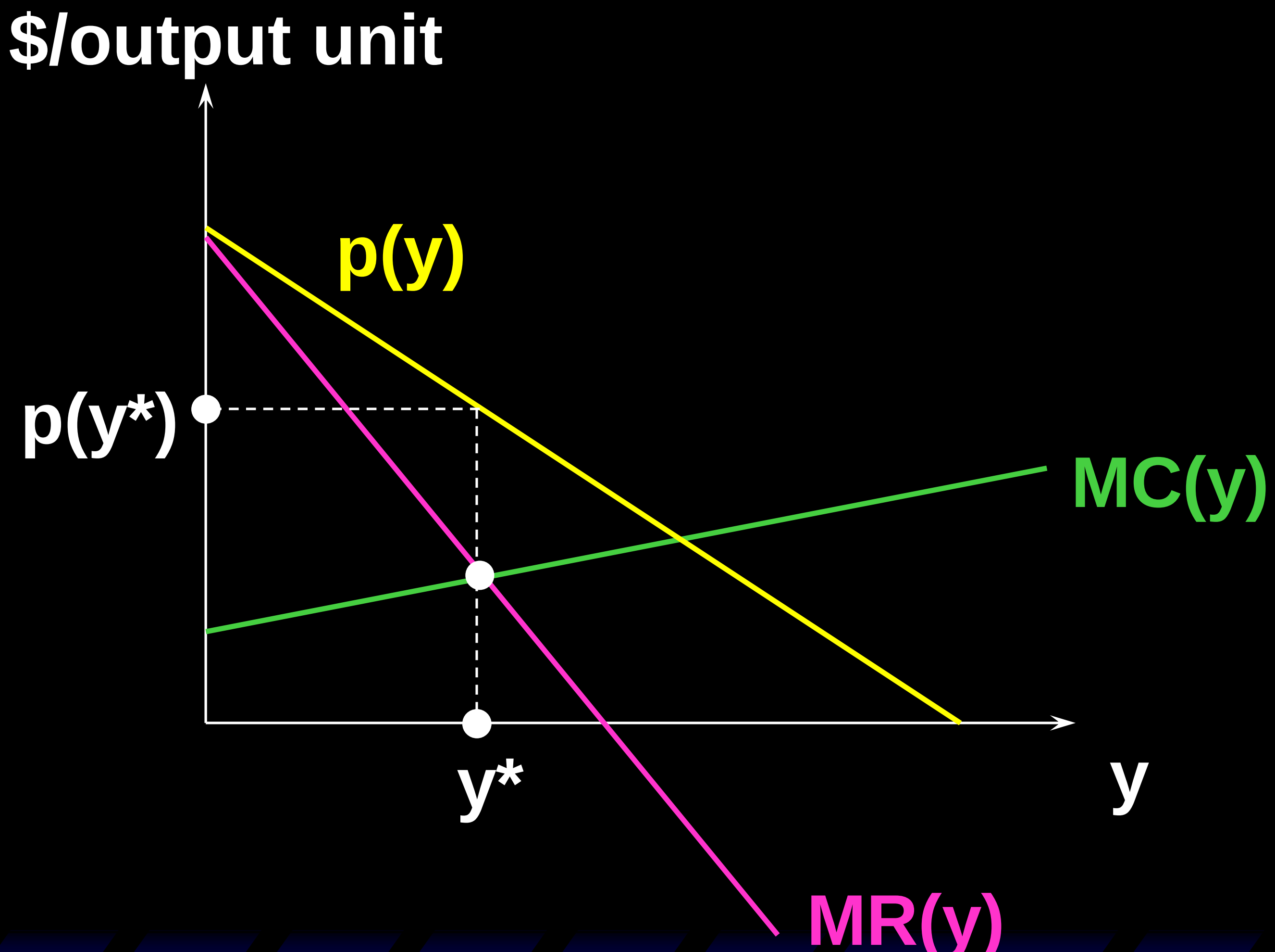


The Inefficiency of Monopoly

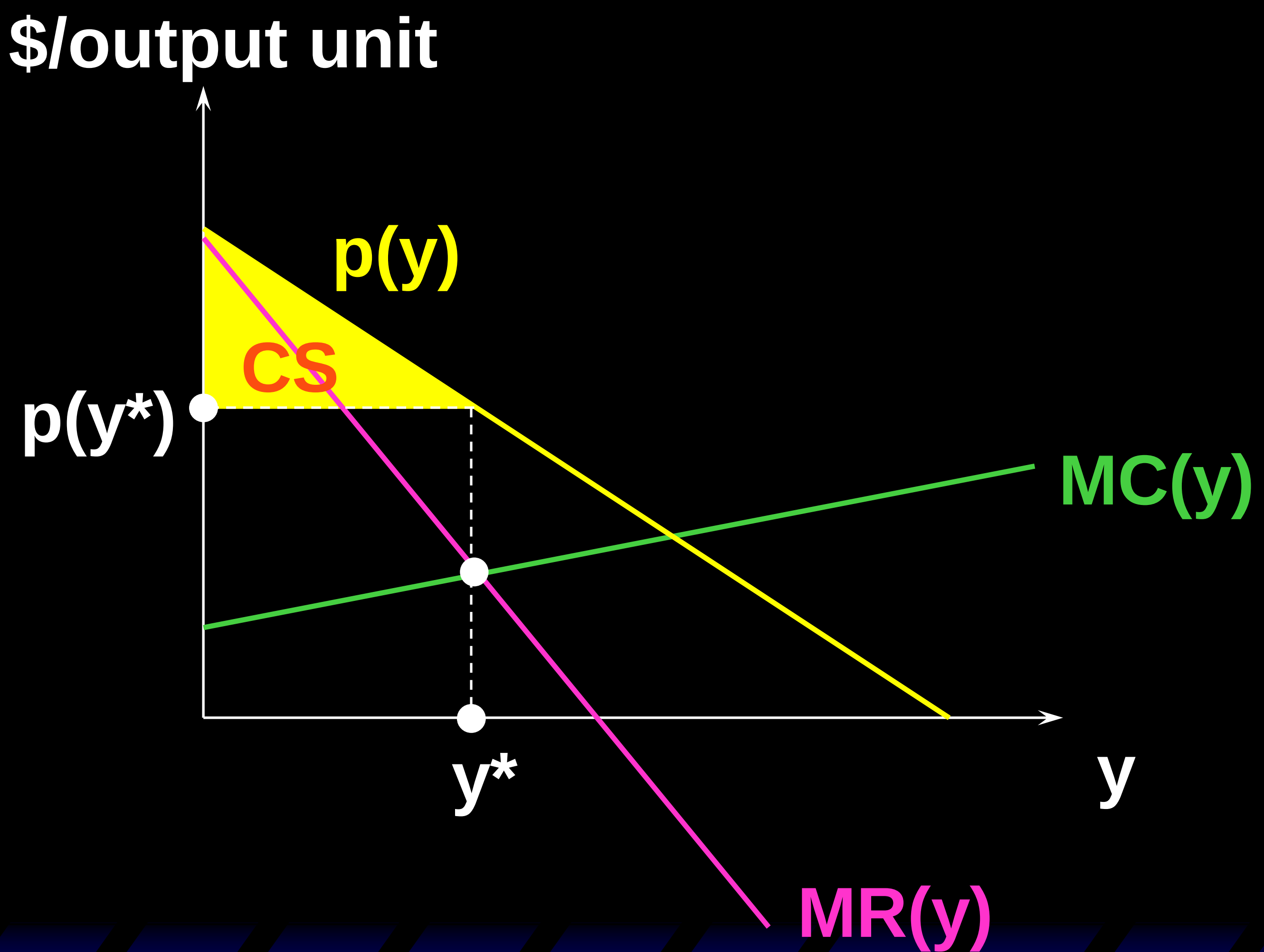


The efficient output level y^e satisfies p(y) = MC(y). Total gains-to-trade is maximized.

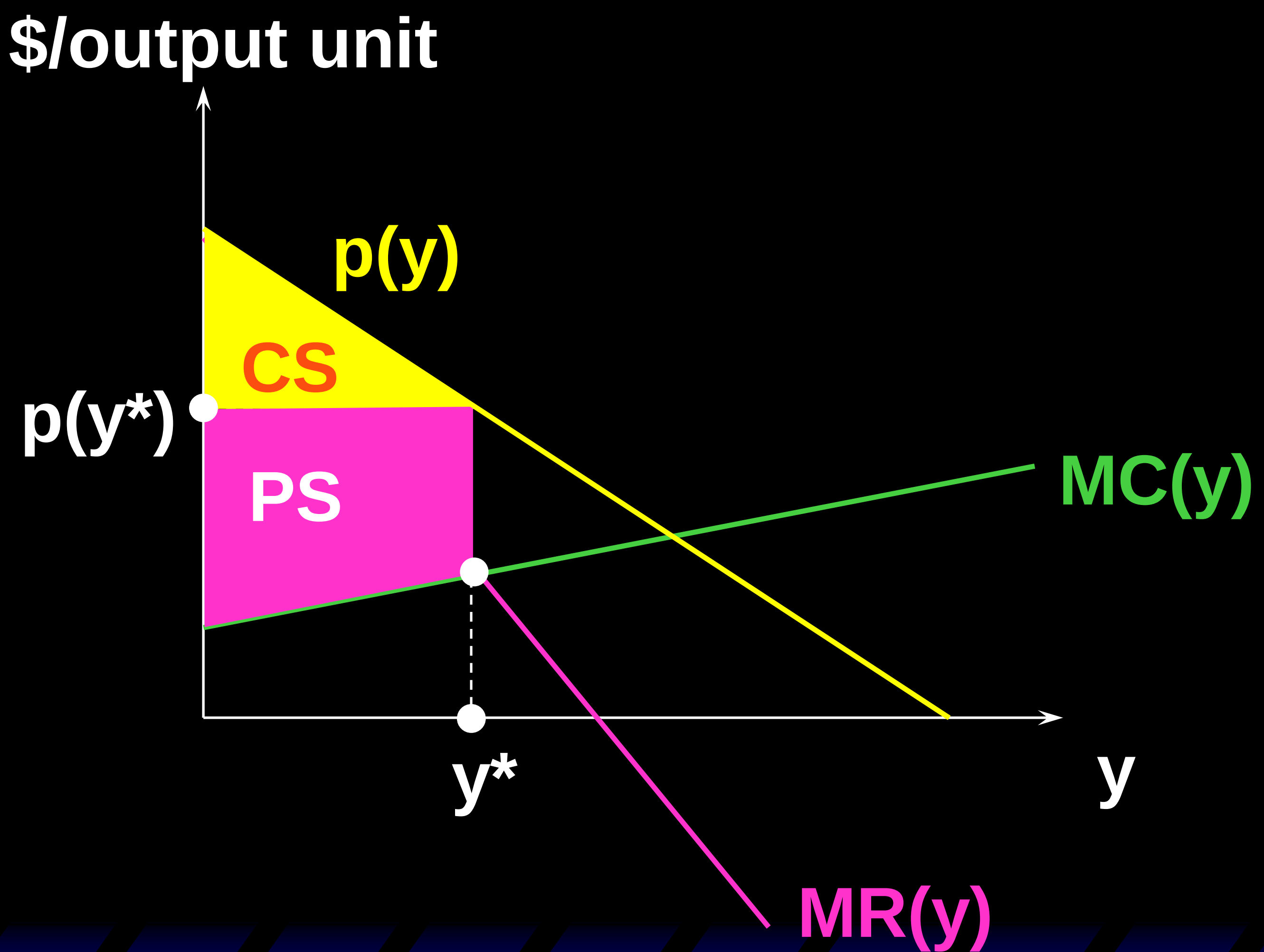
The Inefficiency of Monopoly



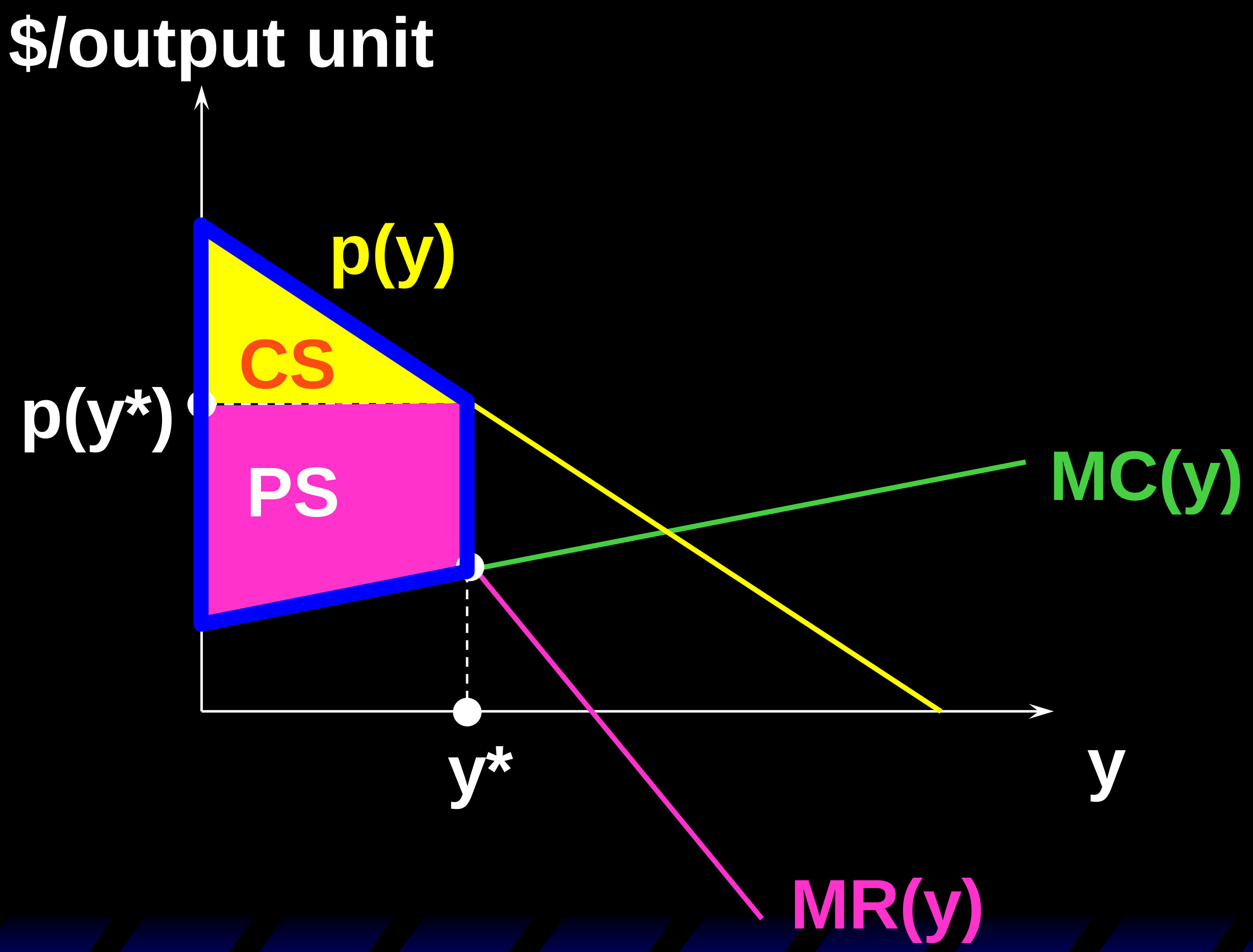
The Inefficiency of Monopoly



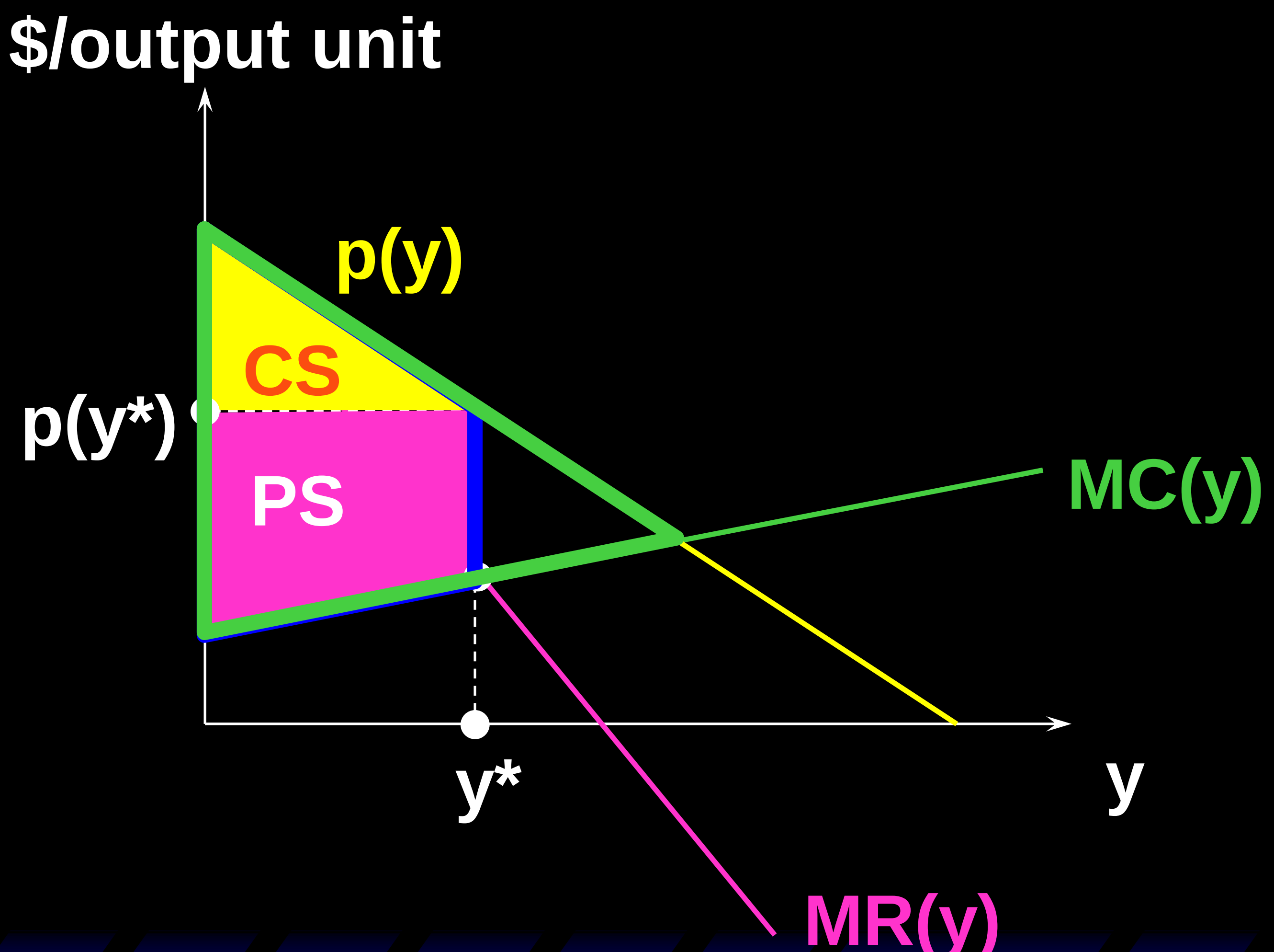
The Inefficiency of Monopoly



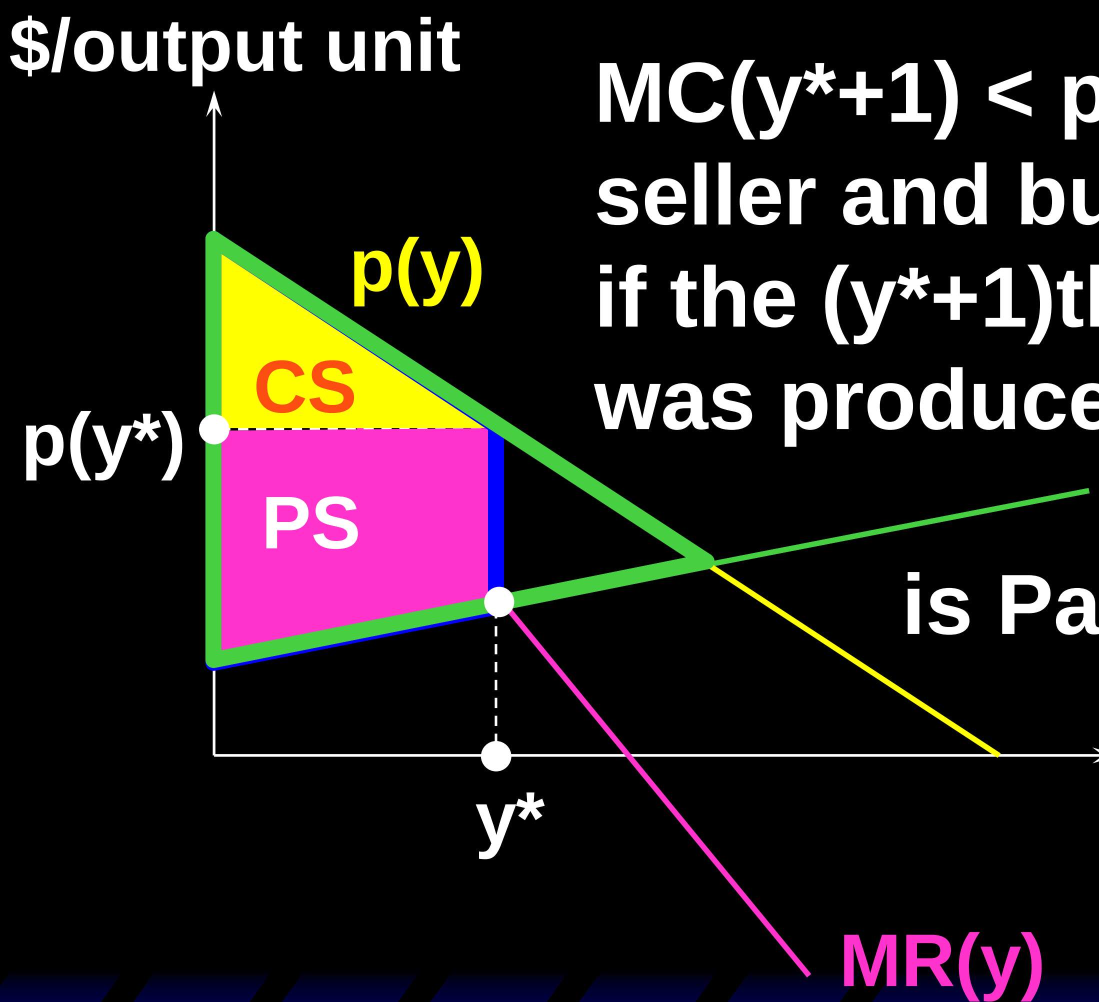
The Inefficiency of Monopoly



The Inefficiency of Monopoly

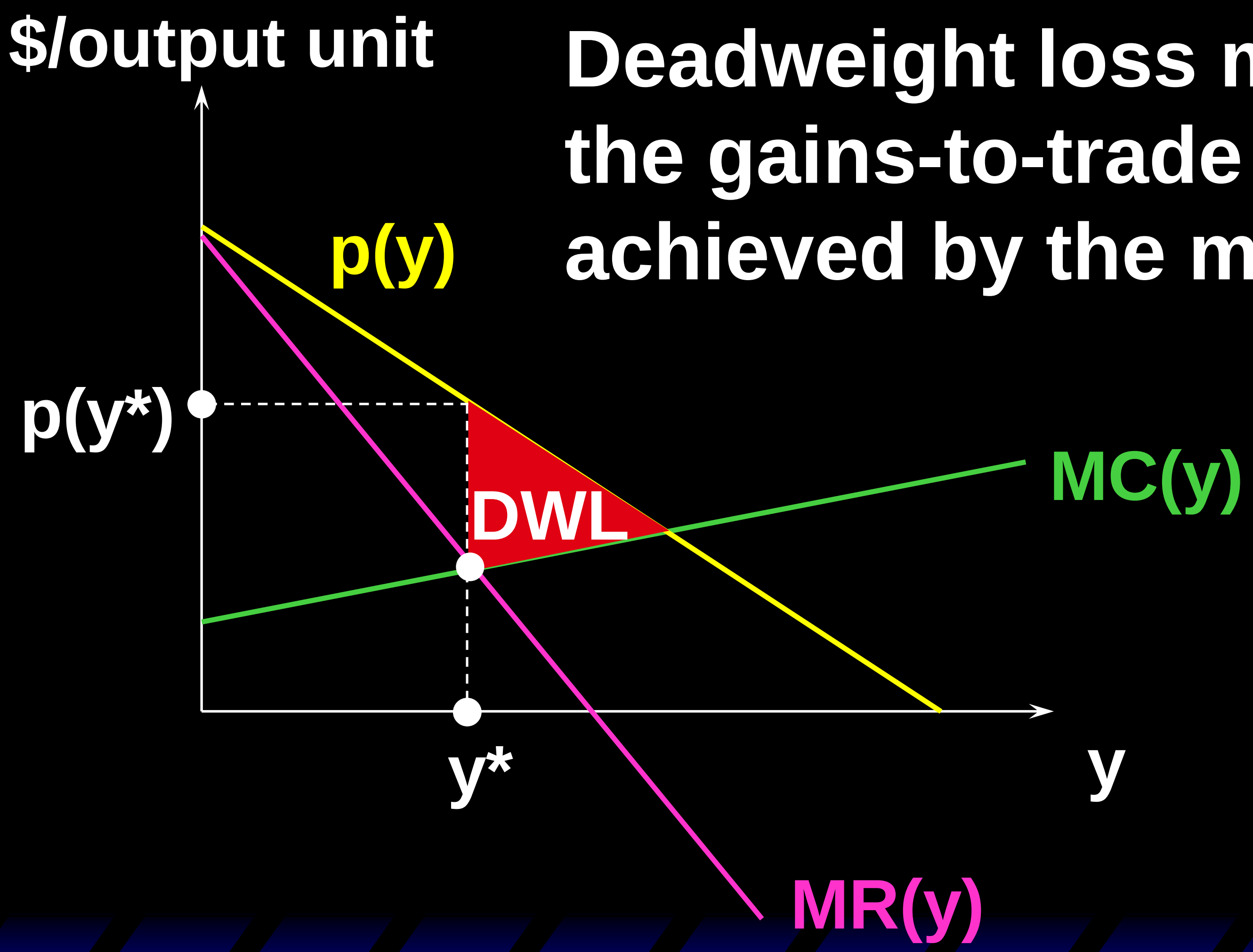


The Inefficiency of Monopoly



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.

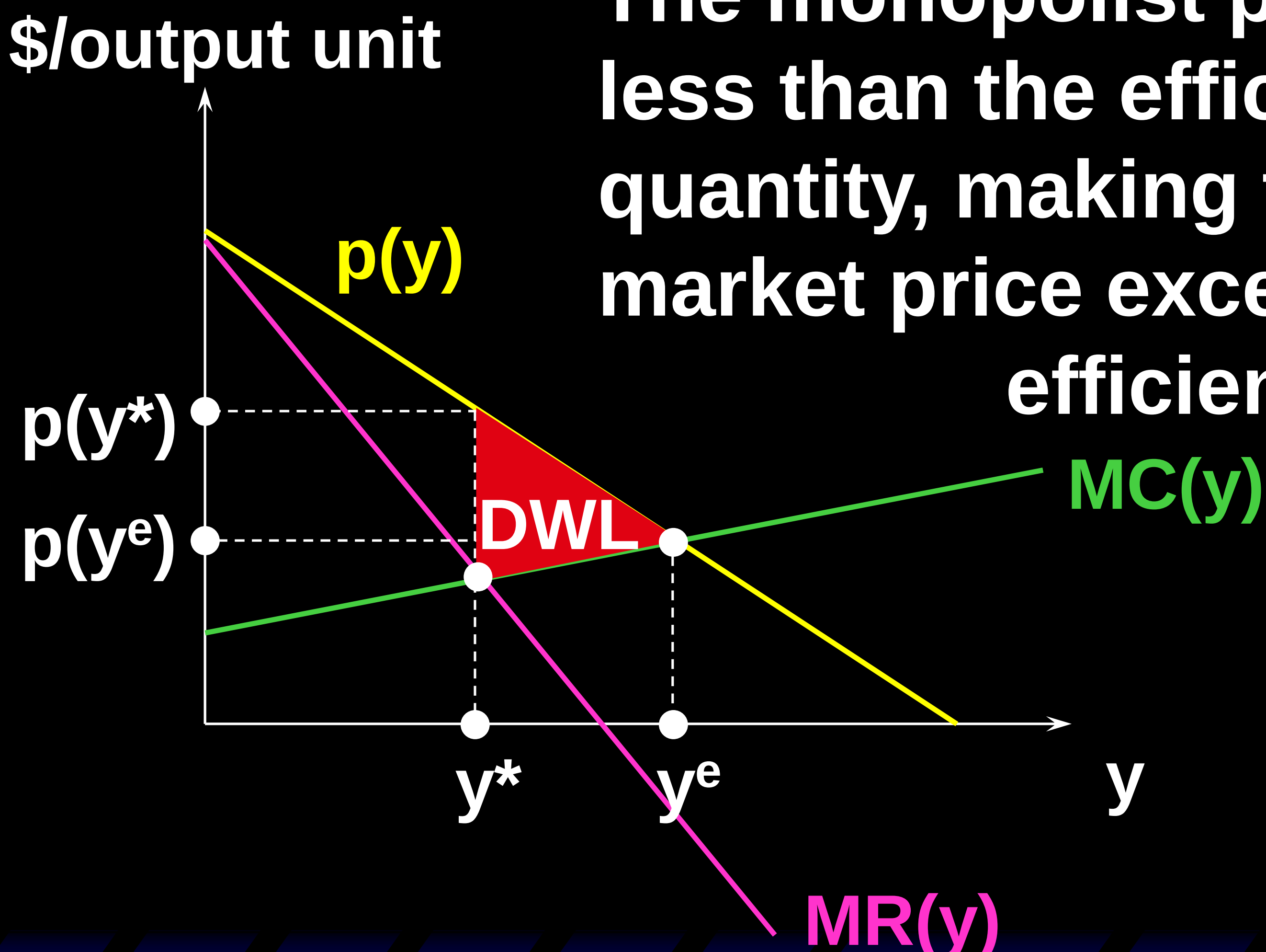
The Inefficiency of Monopoly



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

The Inefficiency of Monopoly

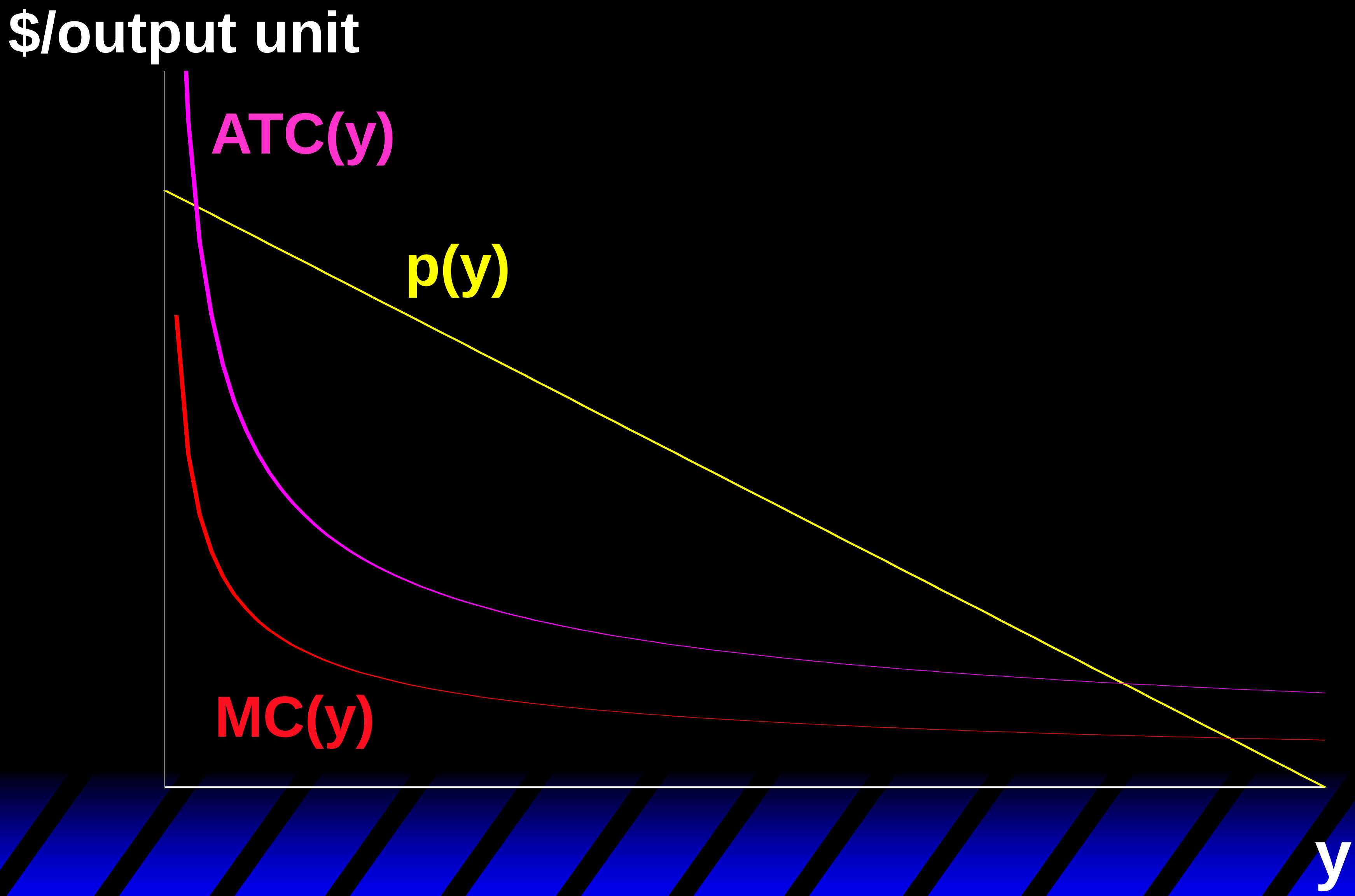
The monopolist produces less than the efficient quantity, making the market price exceed the efficient market price.



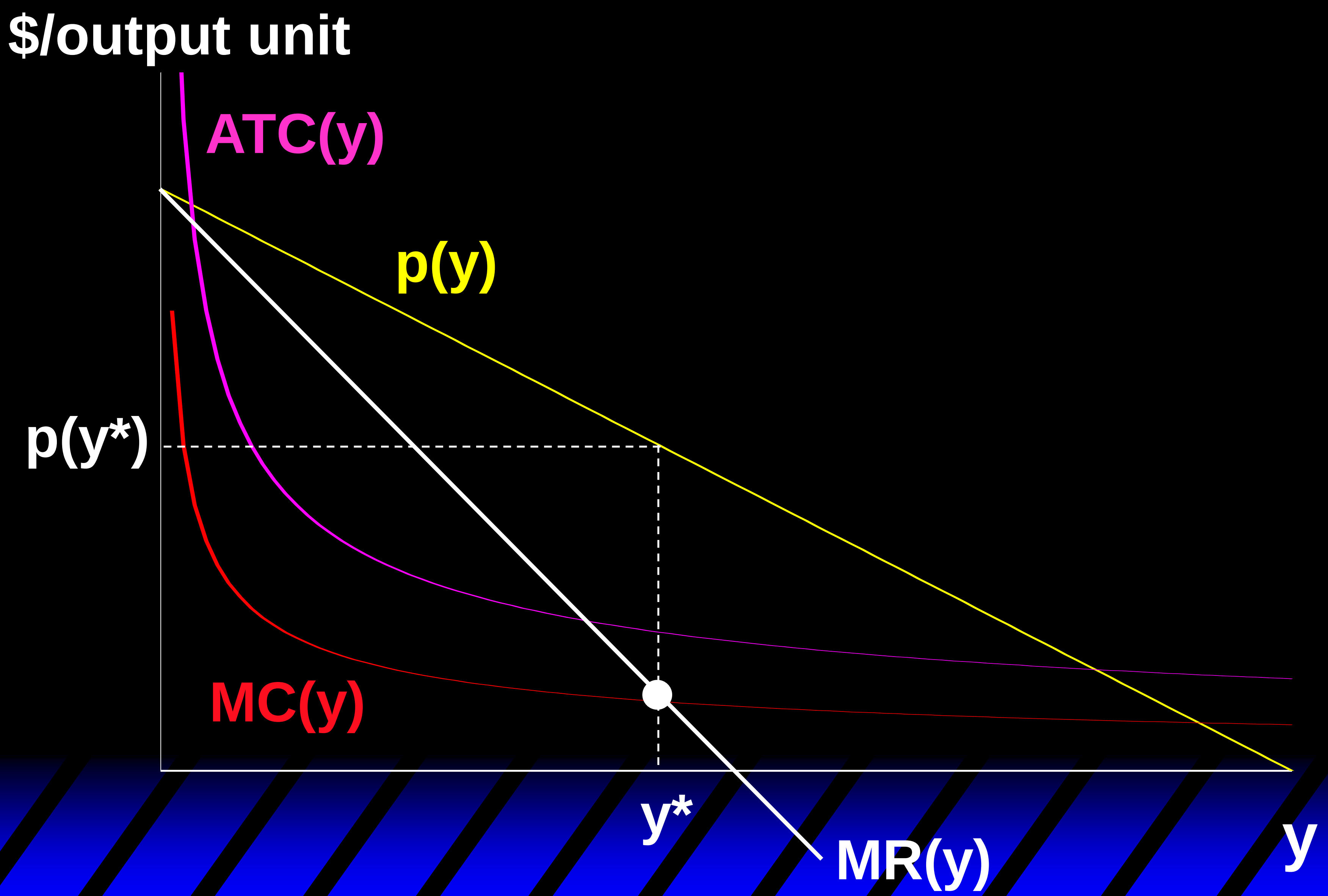
Natural Monopoly

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



Natural Monopoly



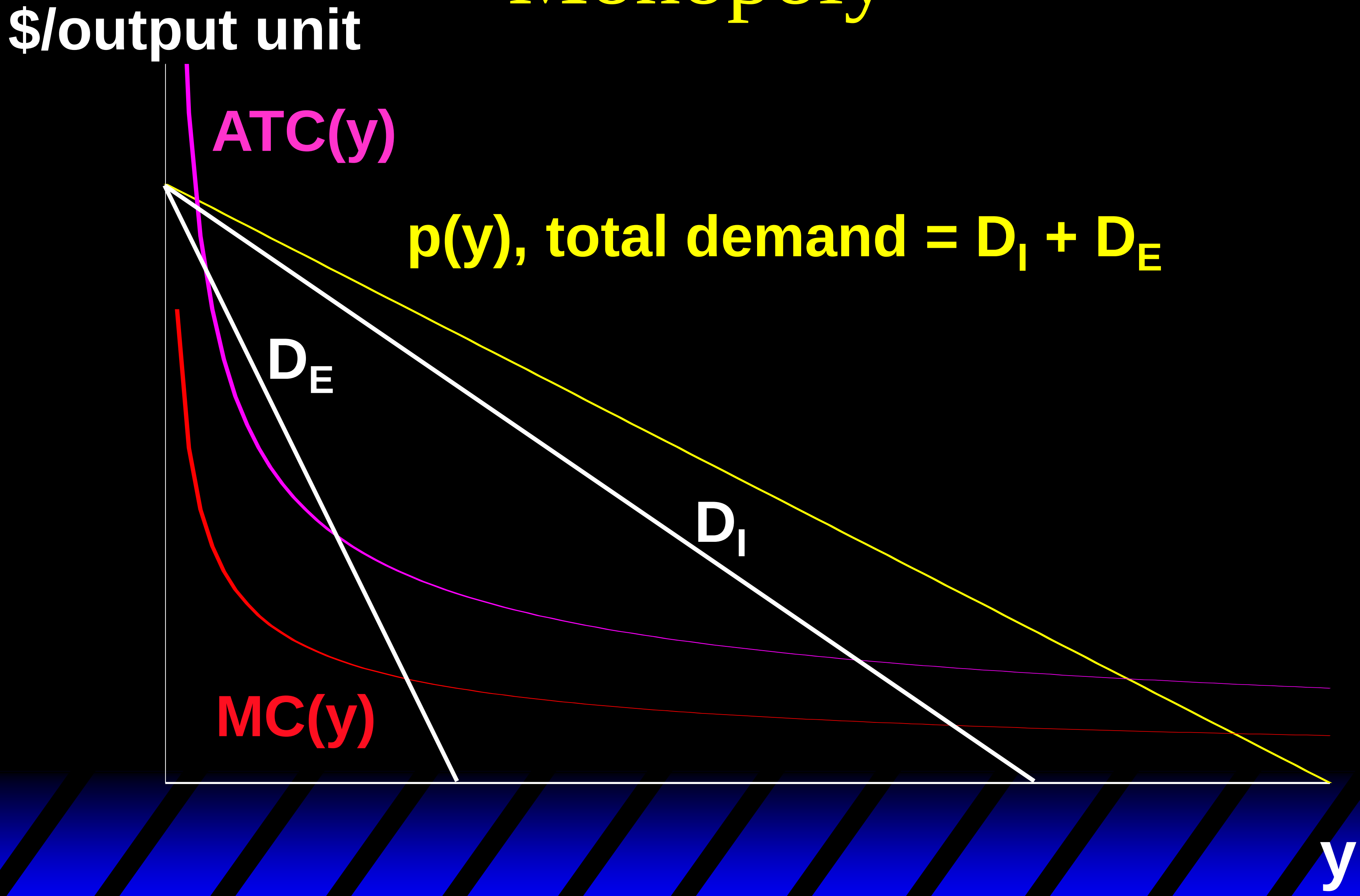
Entry Deterrence by a Natural Monopoly

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

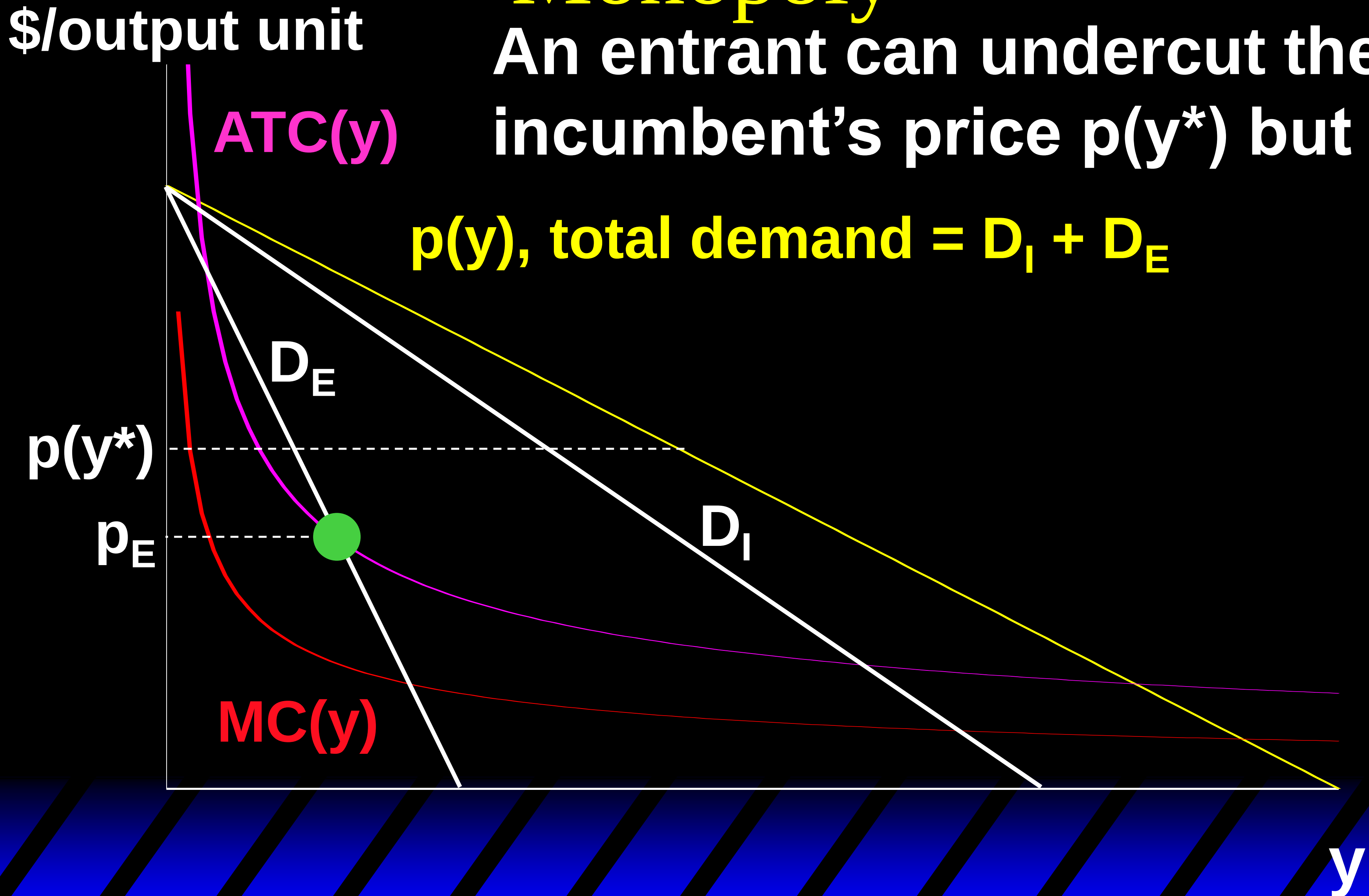
E.g. suppose an entrant initially captures one-quarter of the market, leaving the incumbent firm the other three-quarters.

Entry Deterrence by a Natural Monopoly



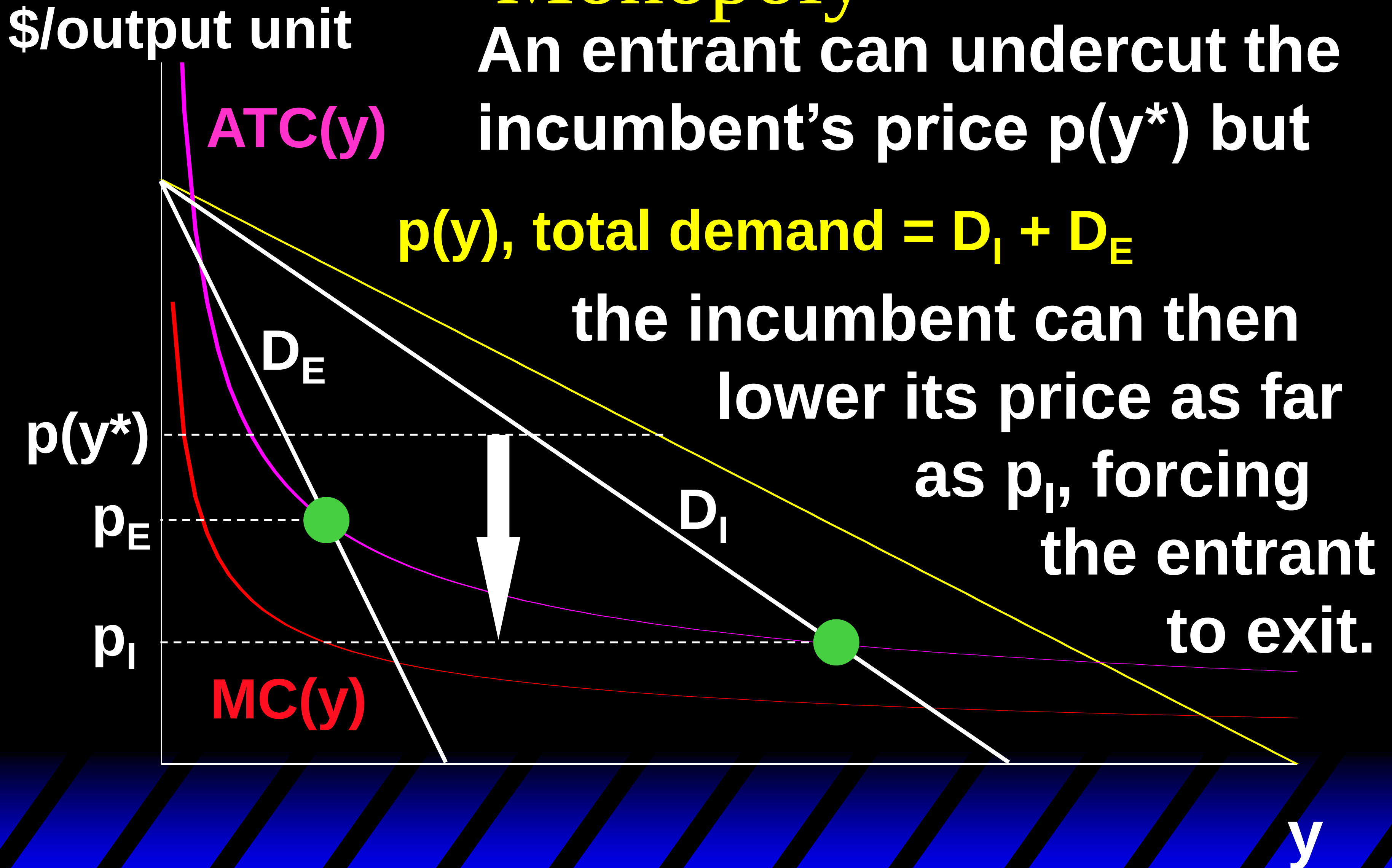
Entry Deterrence by a Natural Monopoly

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



Entry Deterrence by a Natural Monopoly

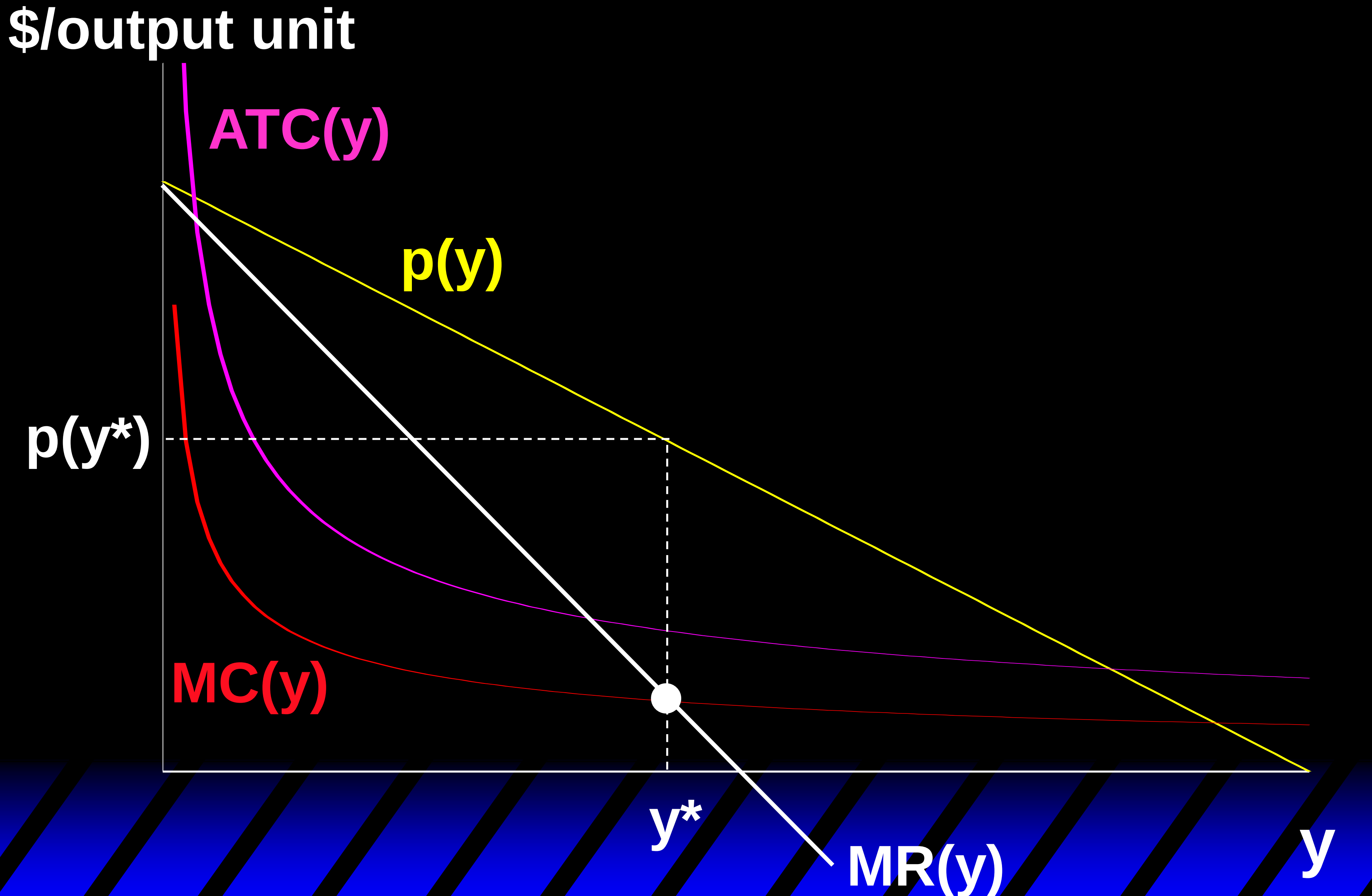
An entrant can undercut the incumbent's price p(y*) but the incumbent can then lower its price as far as p_I, forcing the entrant to exit.



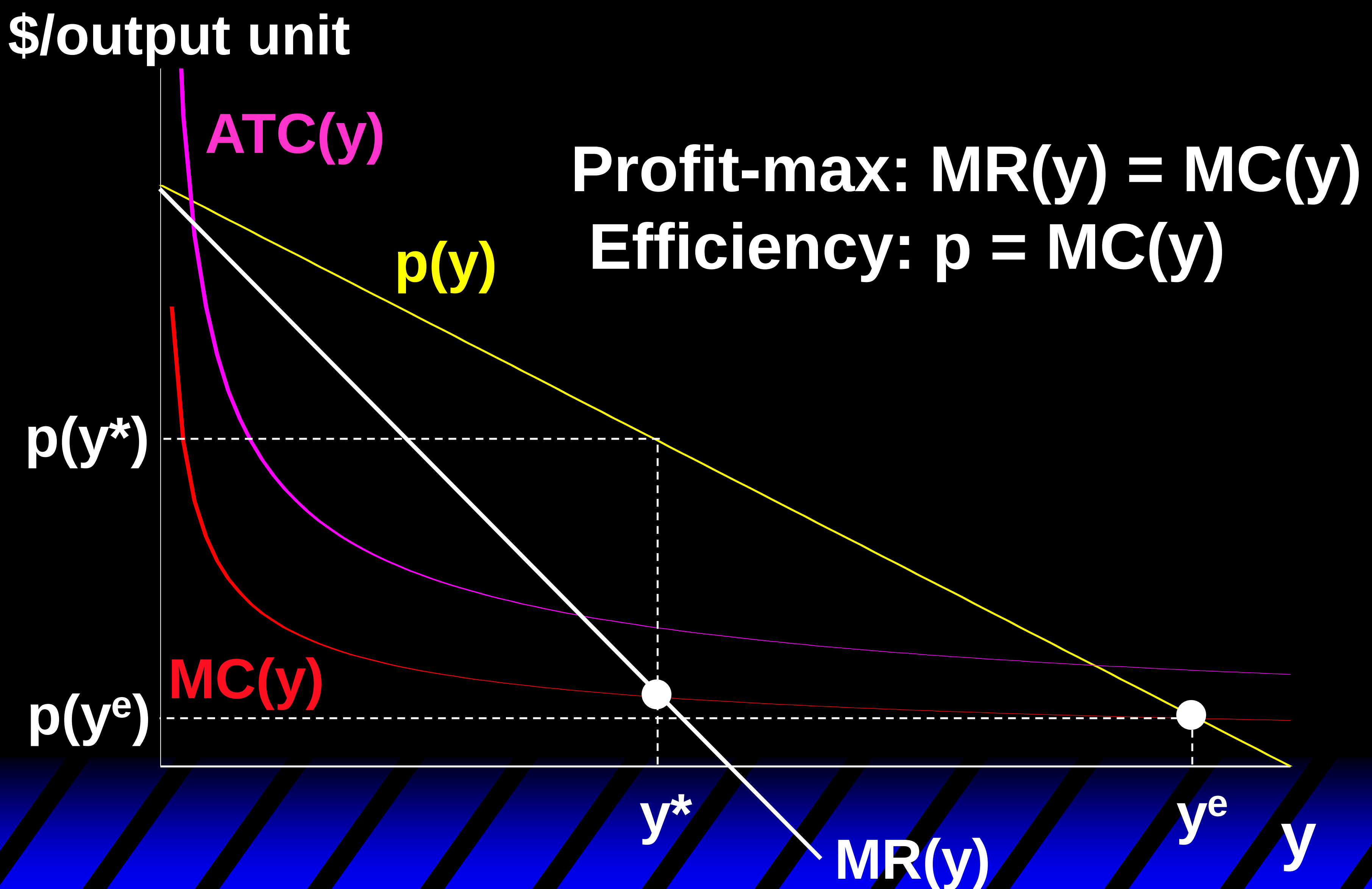
Inefficiency of a Natural Monopolist

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

Inefficiency of a Natural Monopoly



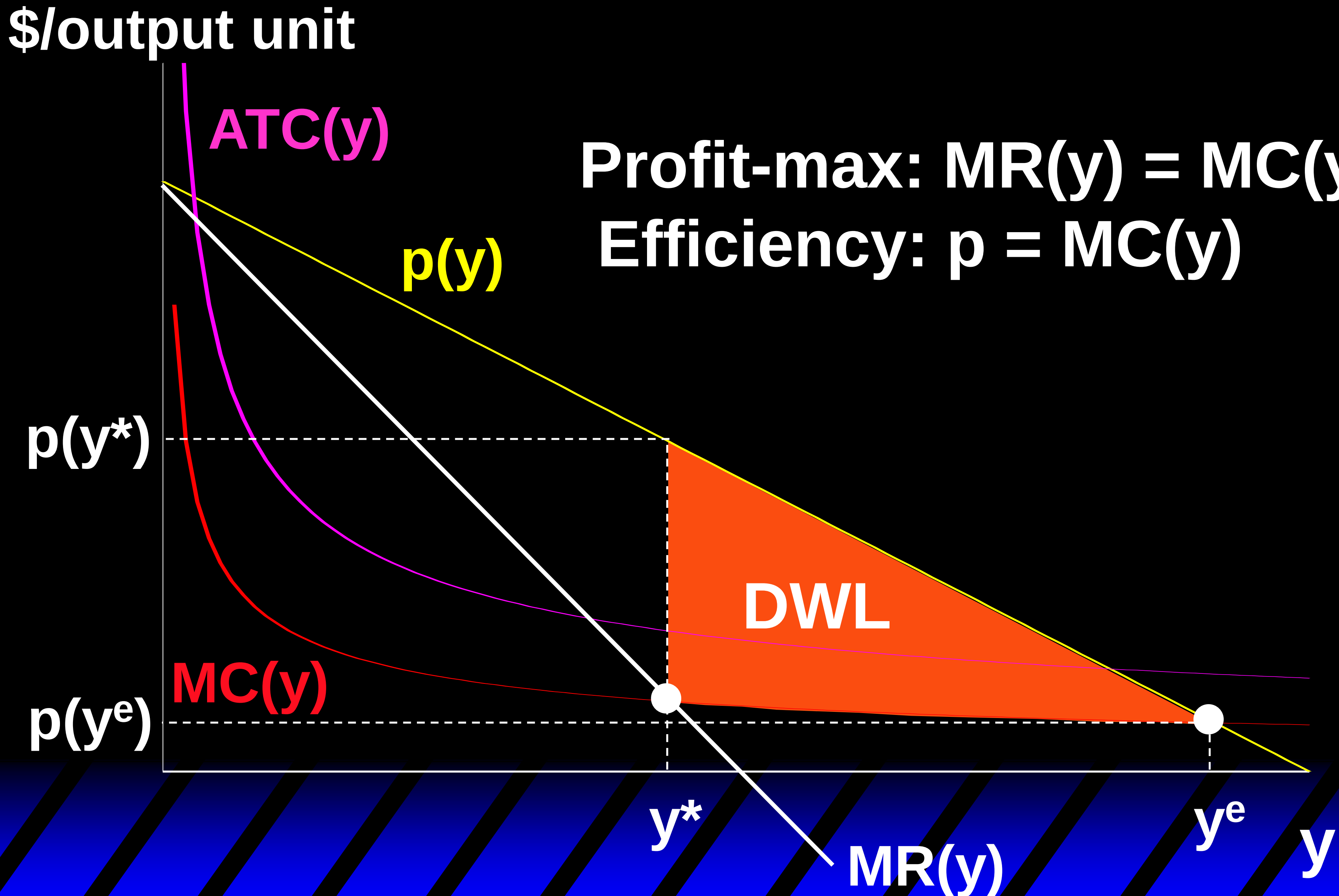
Inefficiency of a Natural Monopoly



Inefficiency of a Natural Monopoly

Profit-max: MR(y) = MC(y)

Efficiency: p = MC(y)



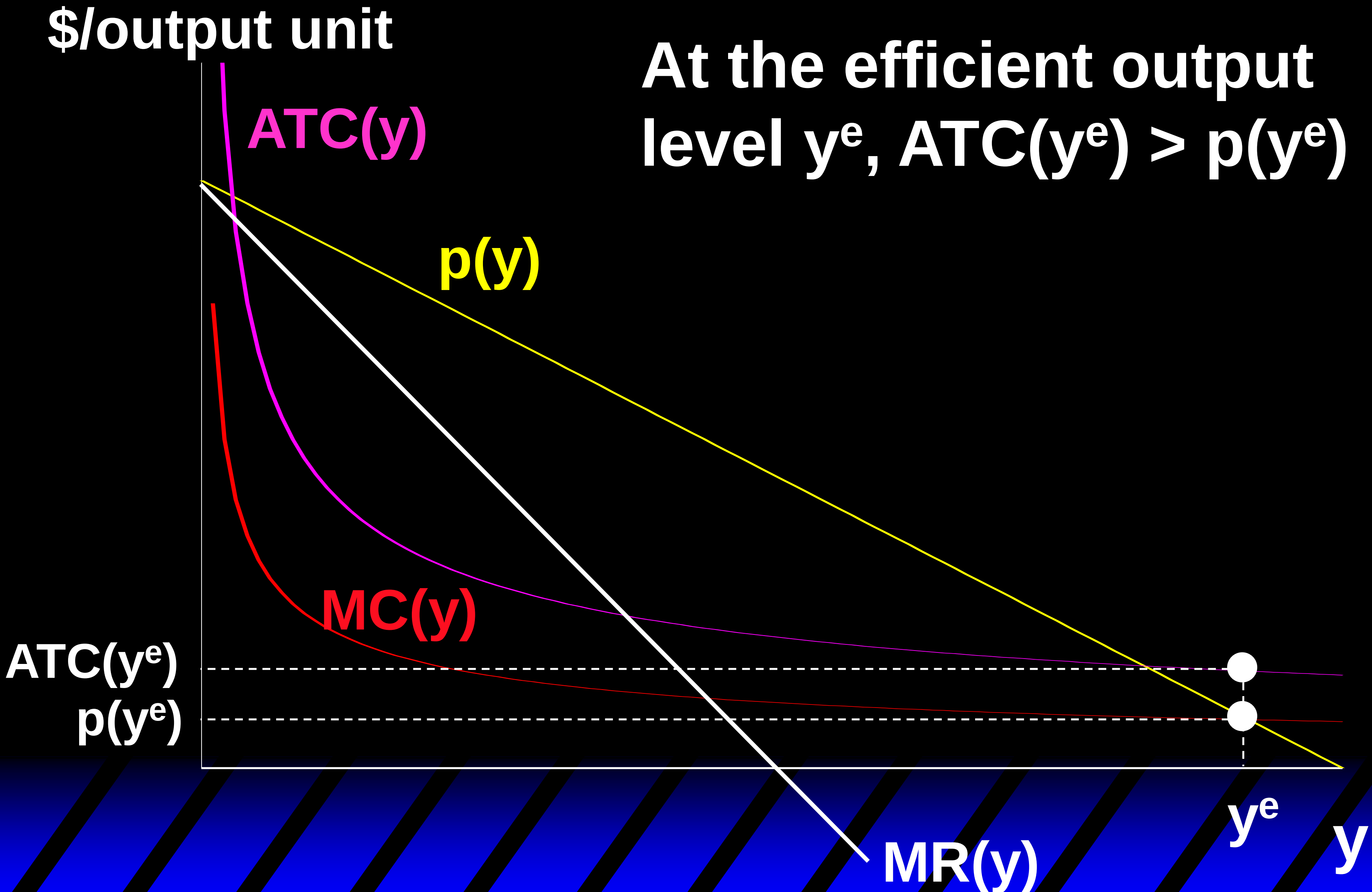
Regulating a Natural Monopoly

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

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

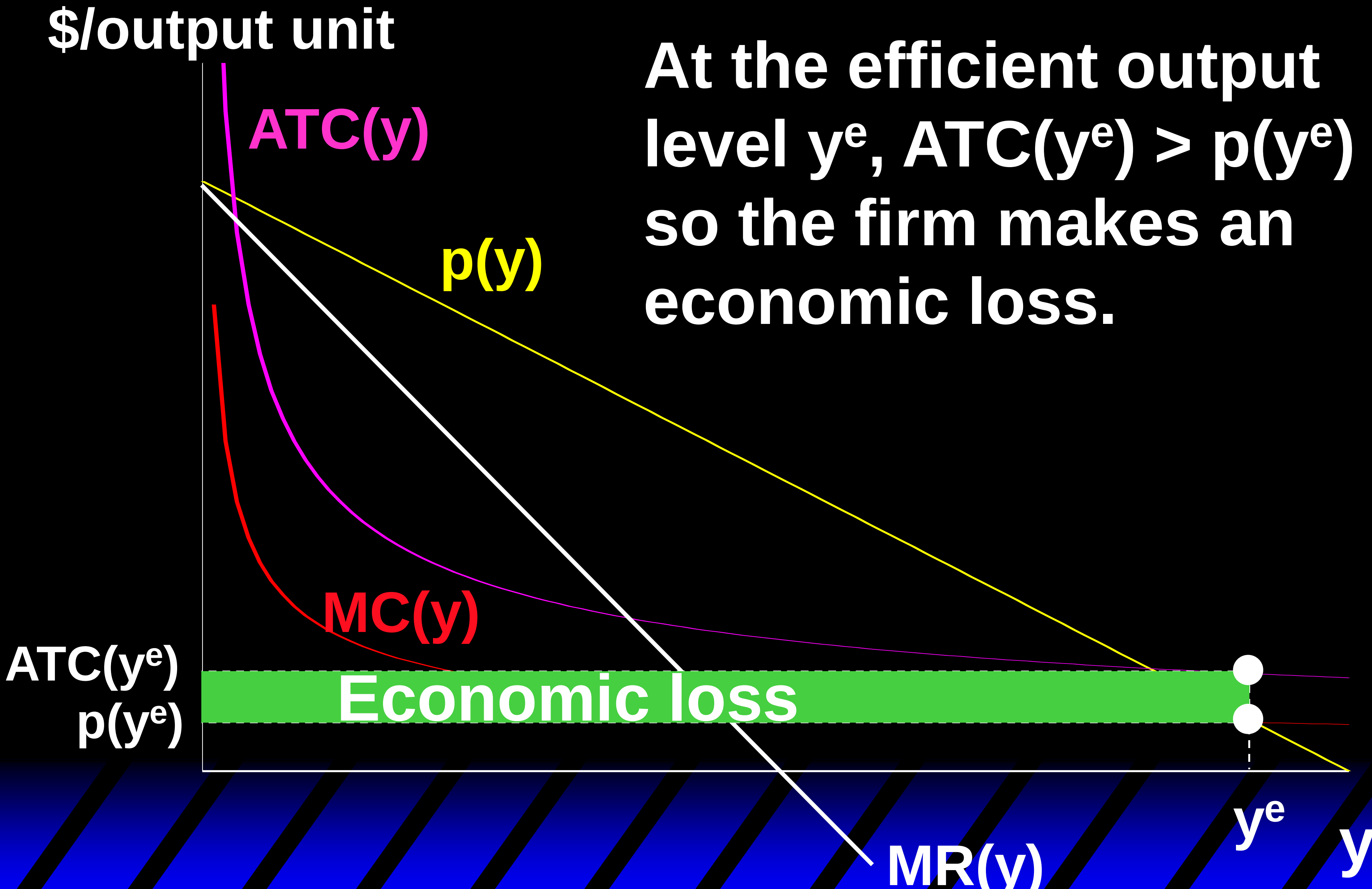
Regulating a Natural Monopoly

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



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.