8TH EDITION

INTERMEDIATE MICROECONOMICS

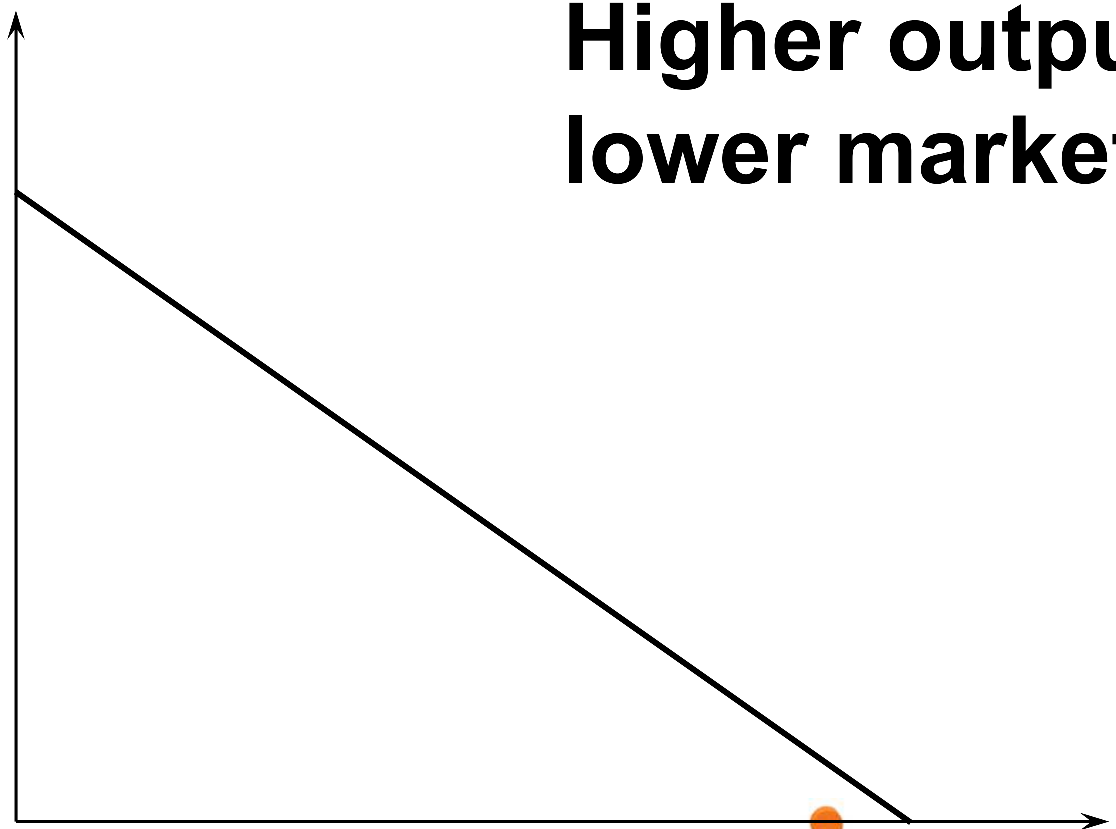
HAL R. VARIAN

24 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.

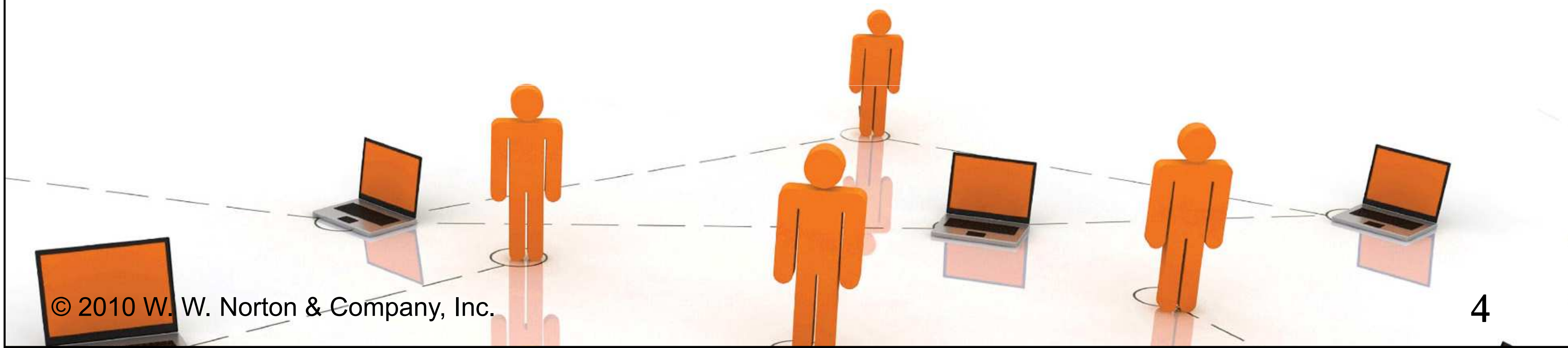
Pure Monopoly



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

Why Monopolies?

- **What causes monopolies?**
  - **a legal fiat; e.g. US Postal Service**

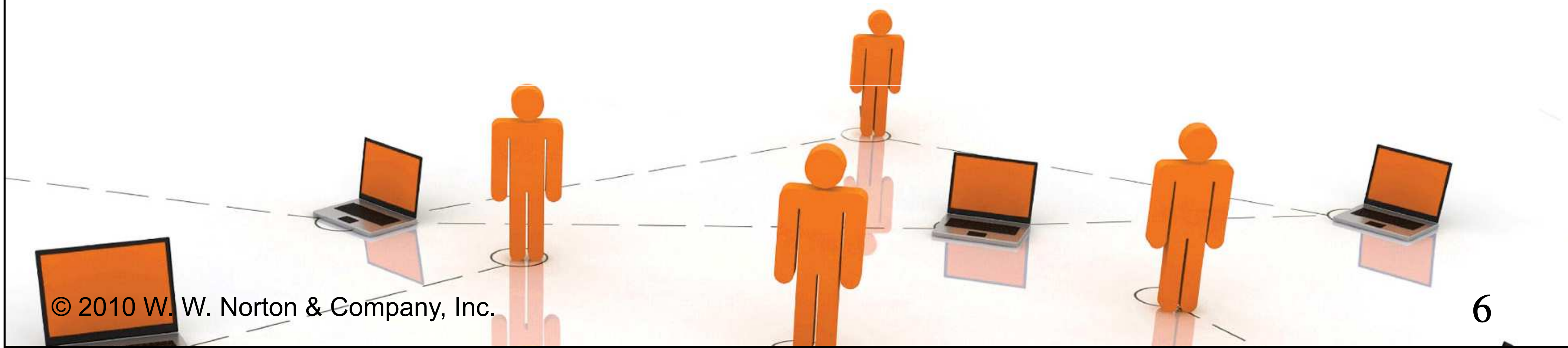


Why Monopolies?

- **What causes monopolies?**
  - **a legal fiat; e.g. US Postal Service**
  - **a patent; e.g. a new drug**

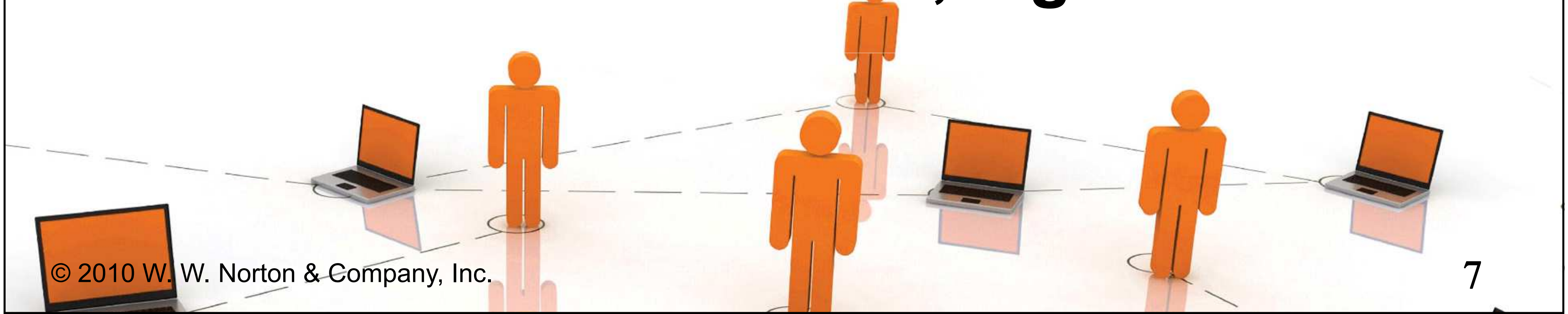
Why Monopolies?

- **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

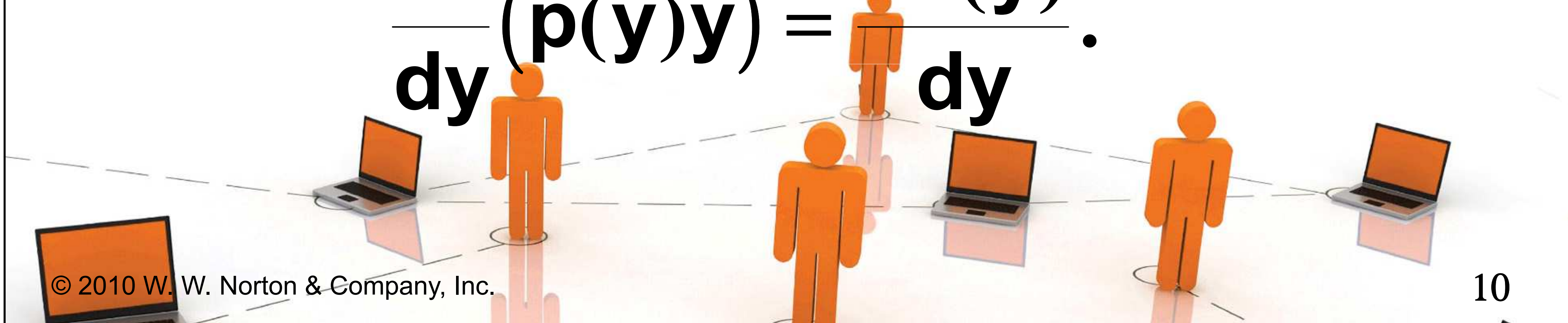
$$\Pi(y) = p(y)y - c(y).$$

At the profit-maximizing output level y*

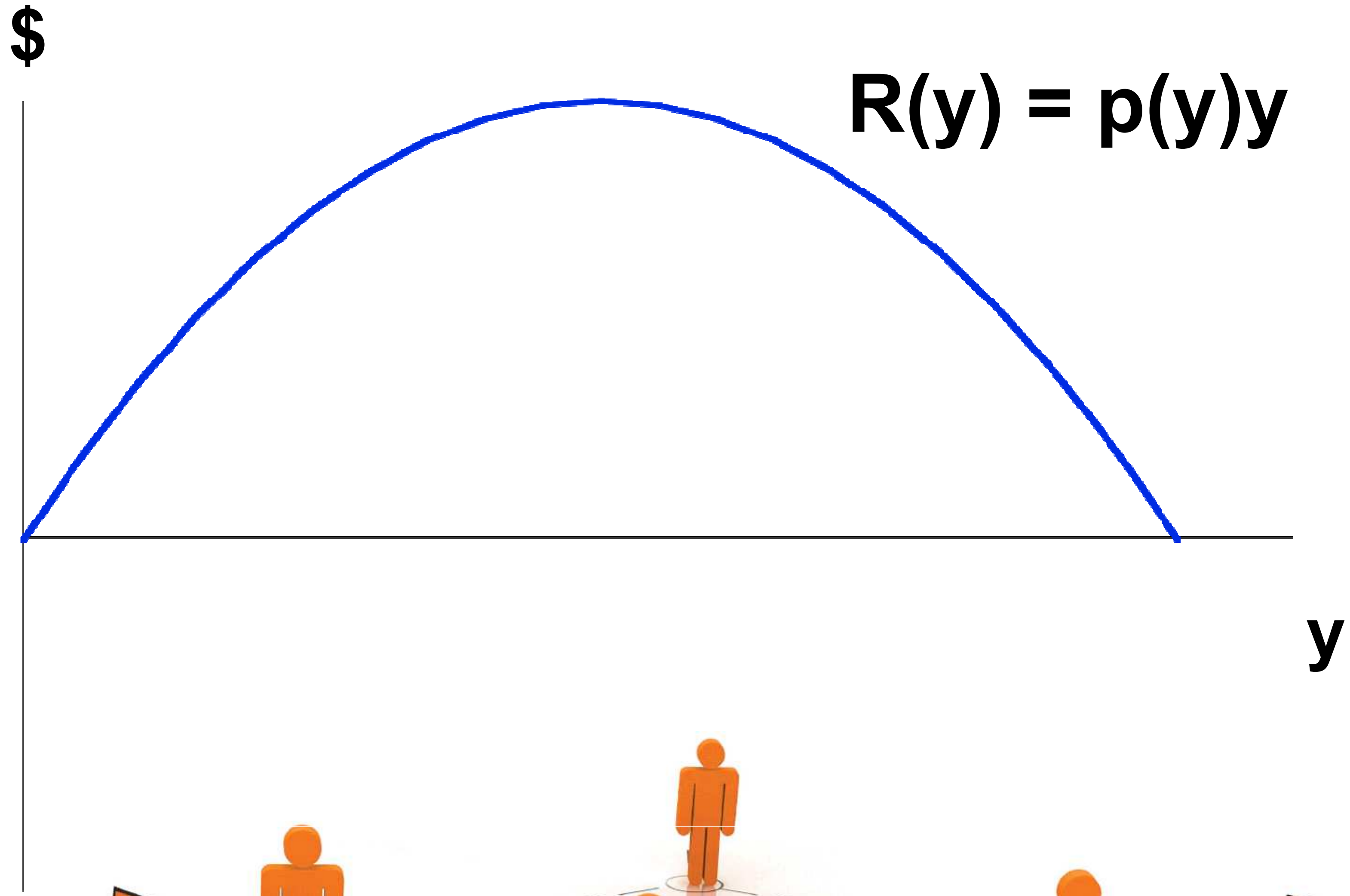
$$\frac{d\Pi(y)}{dy} = \frac{d}{dy}\left(p(y)y\right) - \frac{dc(y)}{dy} = 0$$

so, for y = y*,

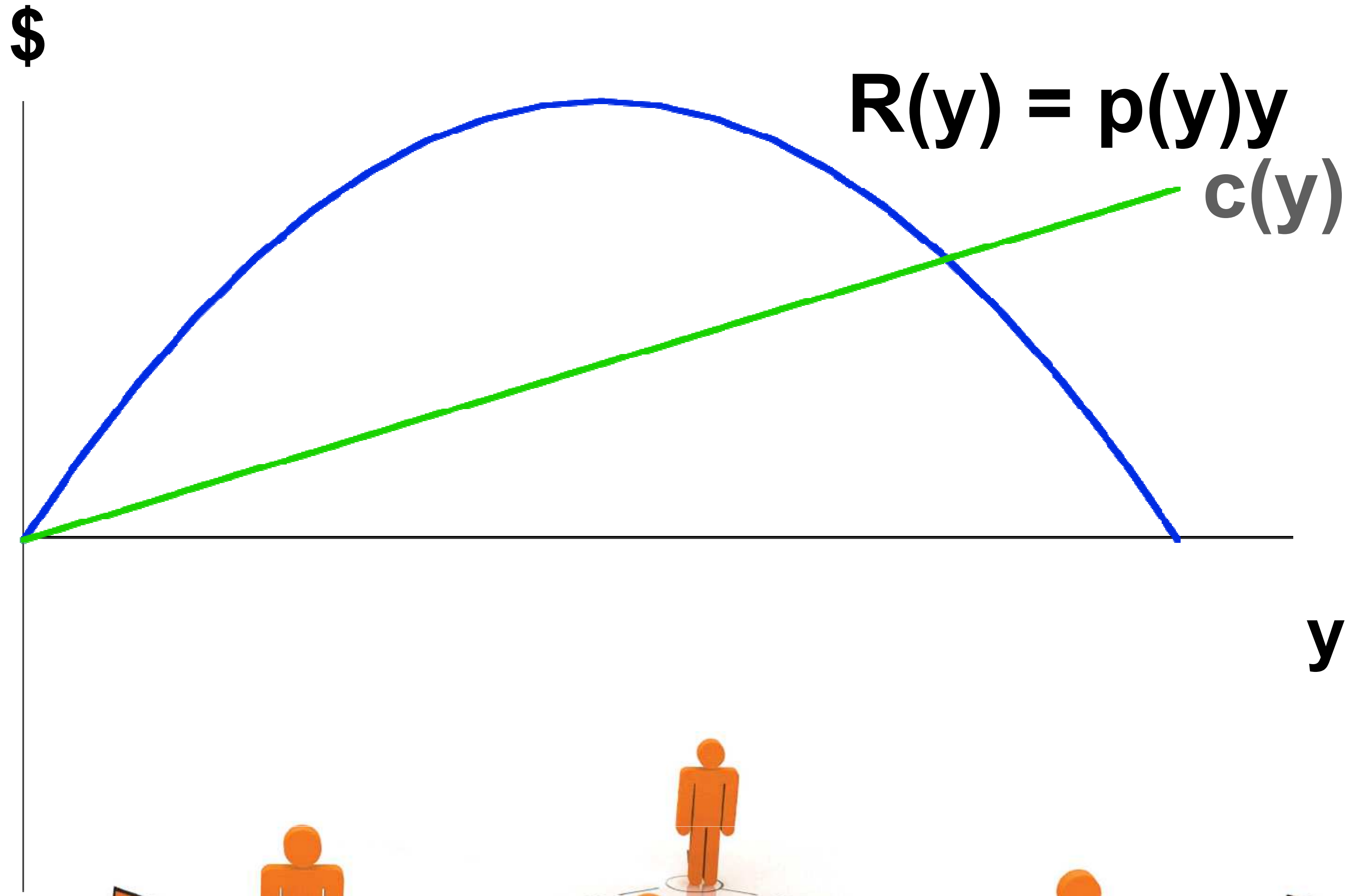
$$\frac{d}{dy}\left(p(y)y\right) = \frac{dc(y)}{dy}.$$



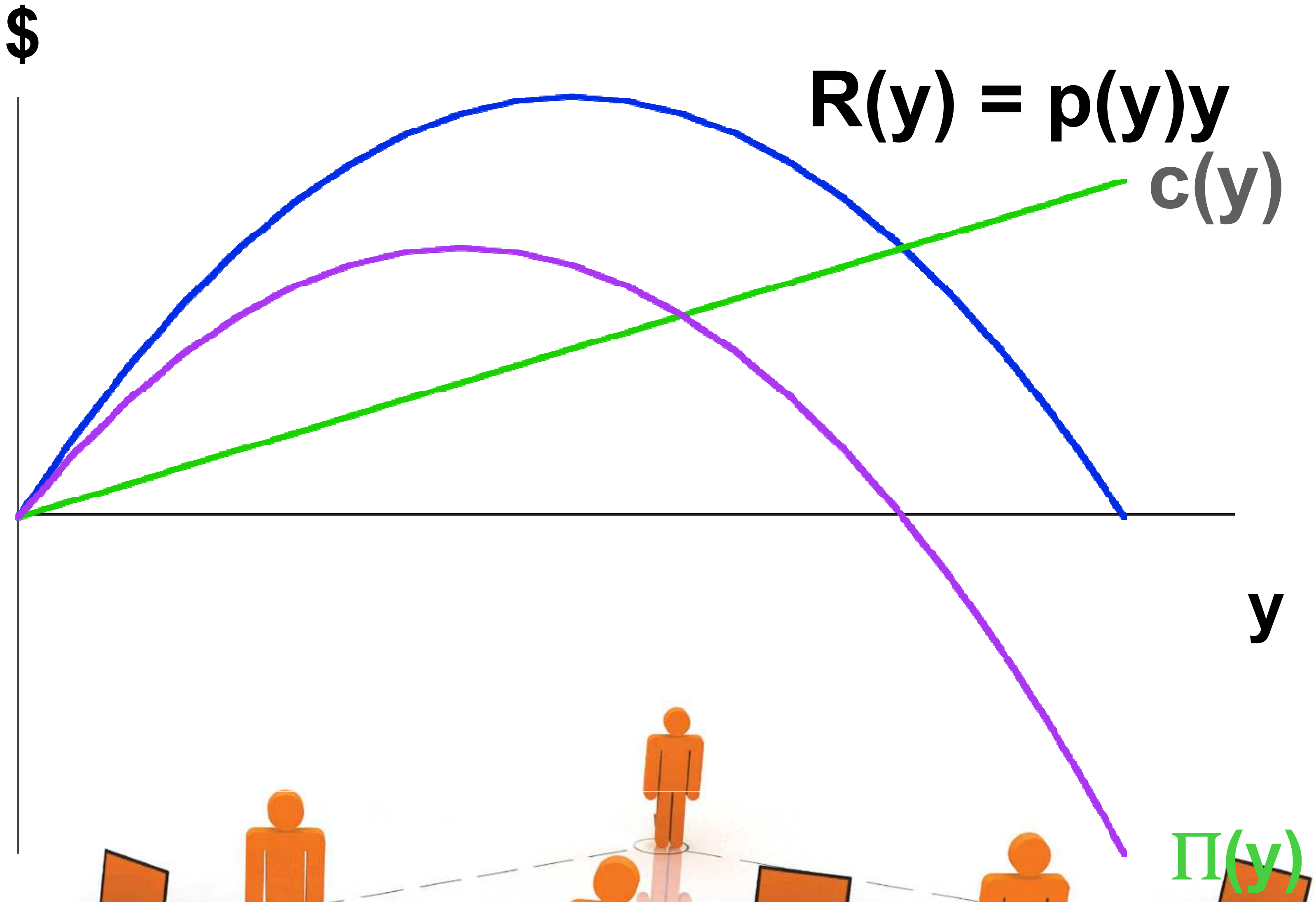
Profit-Maximization



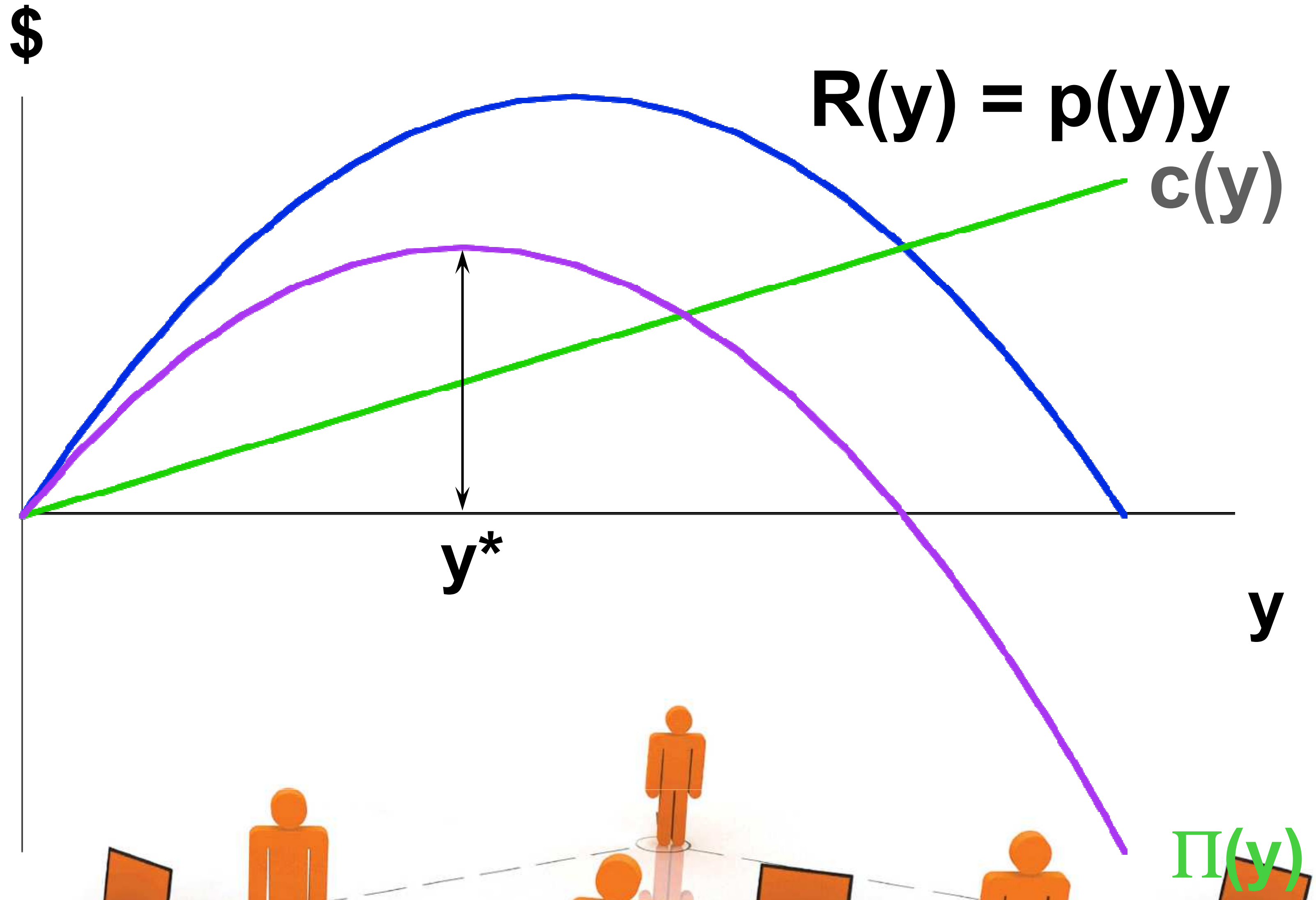
Profit-Maximization



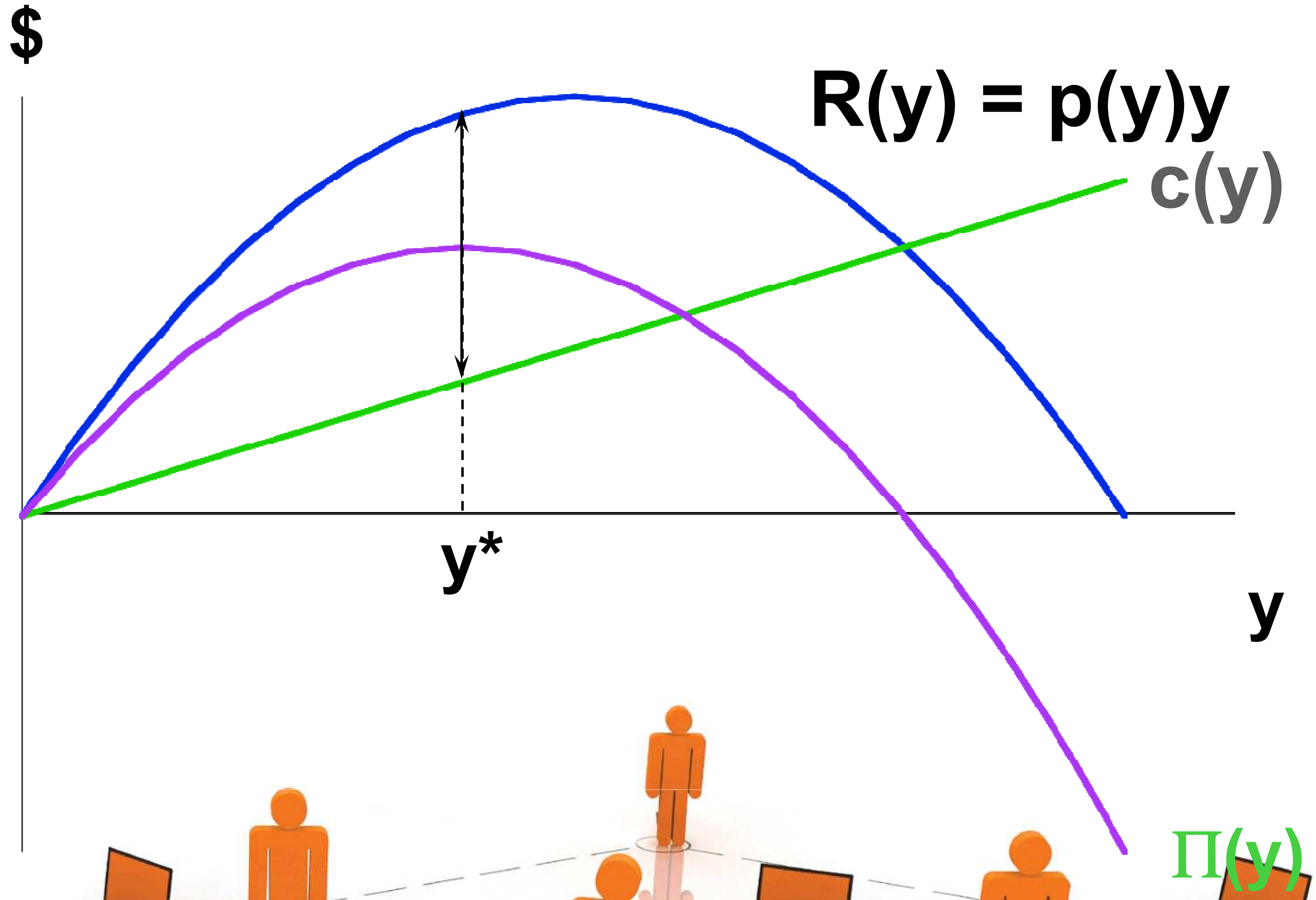
Profit-Maximization



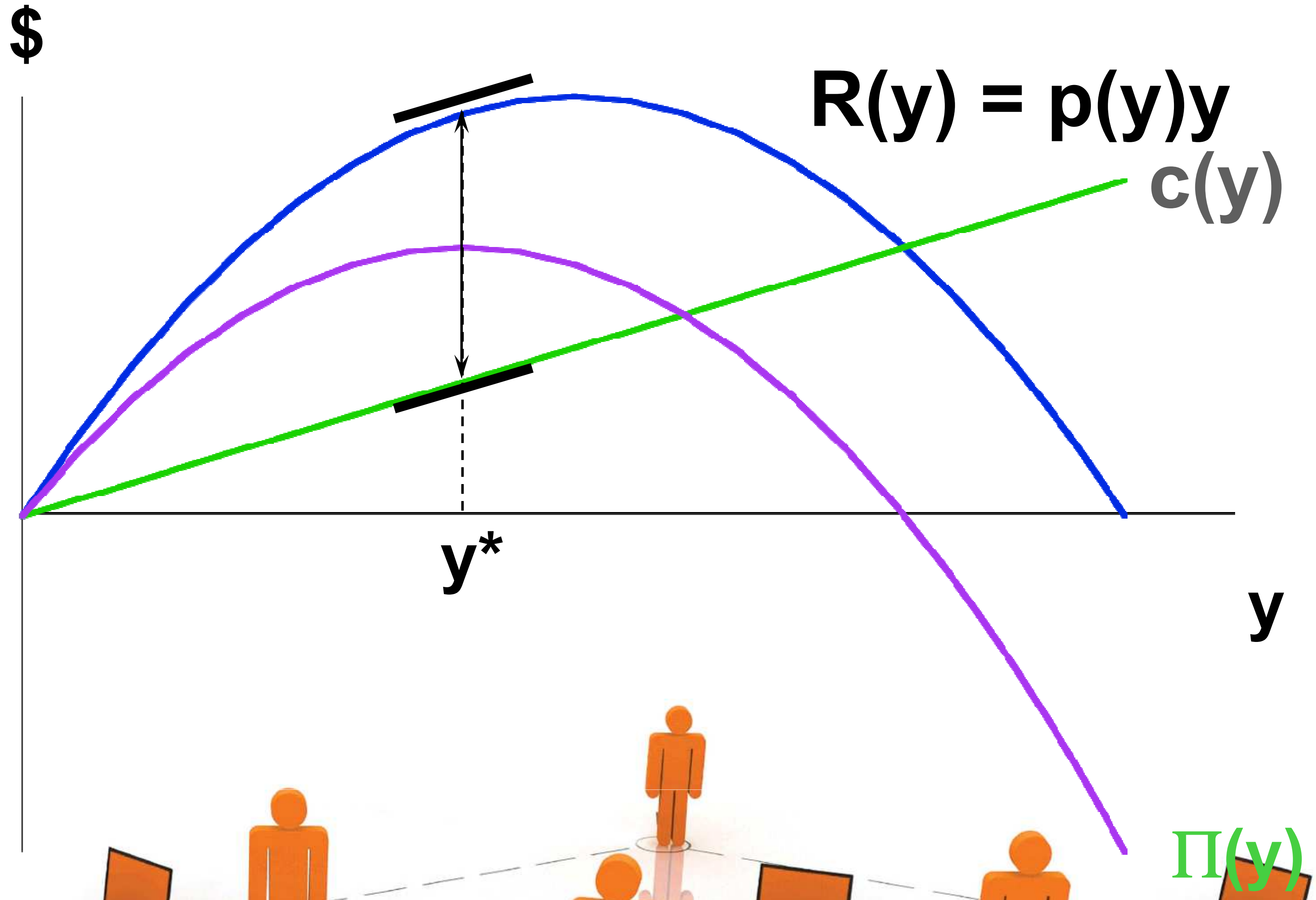
Profit-Maximization



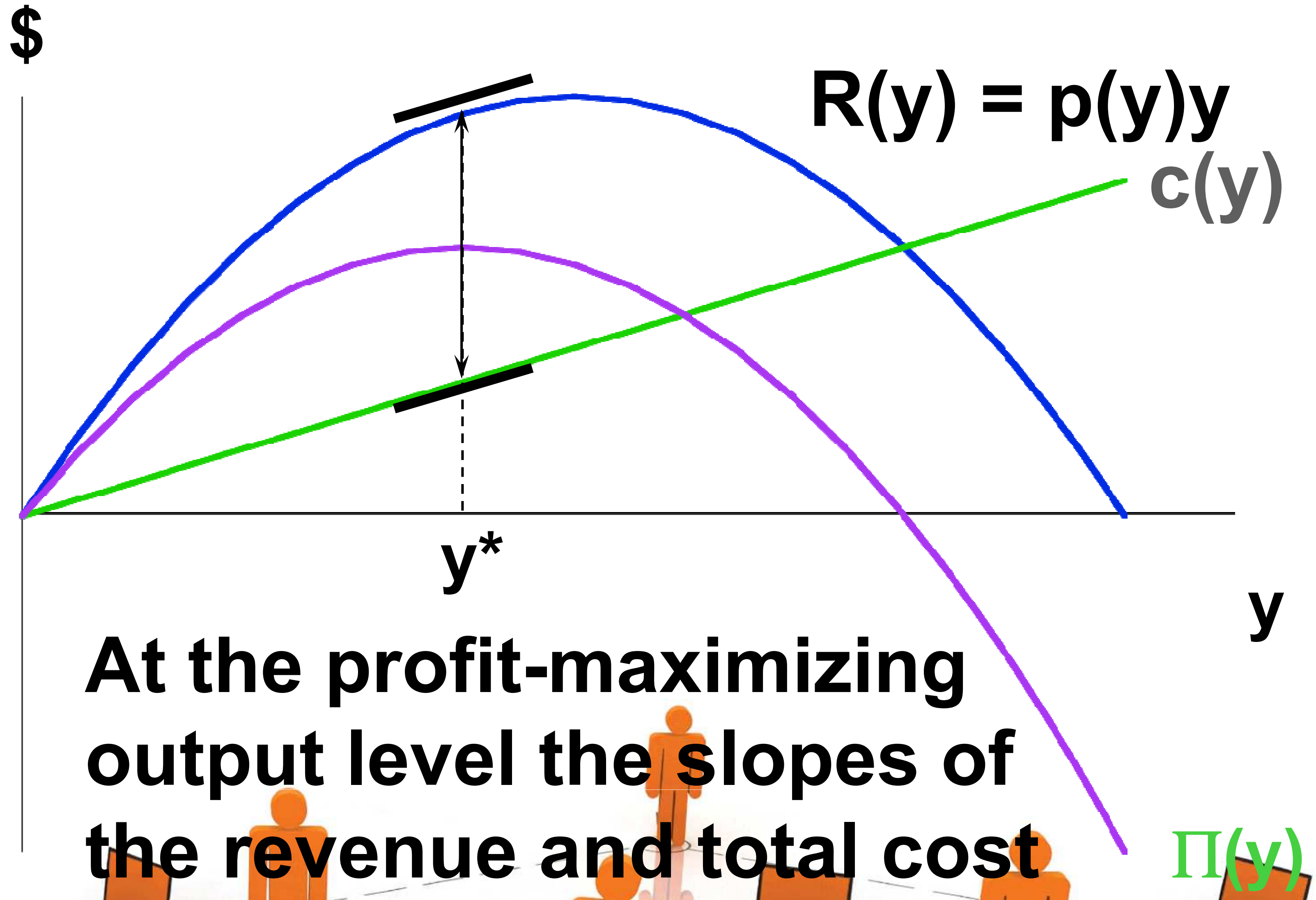
Profit-Maximization



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;

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

Marginal Revenue

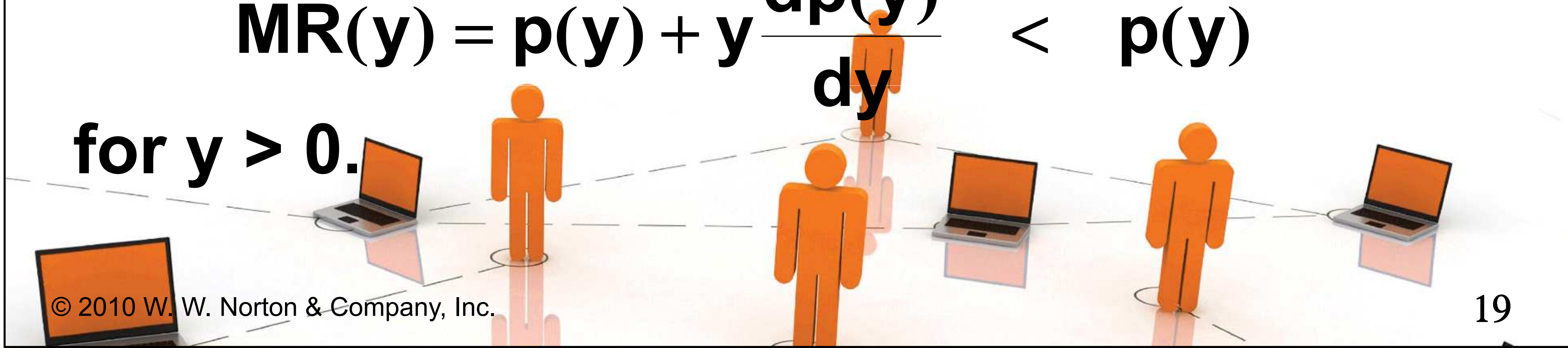
Marginal revenue is the rate-of-change of revenue as the output level y increases;

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

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

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

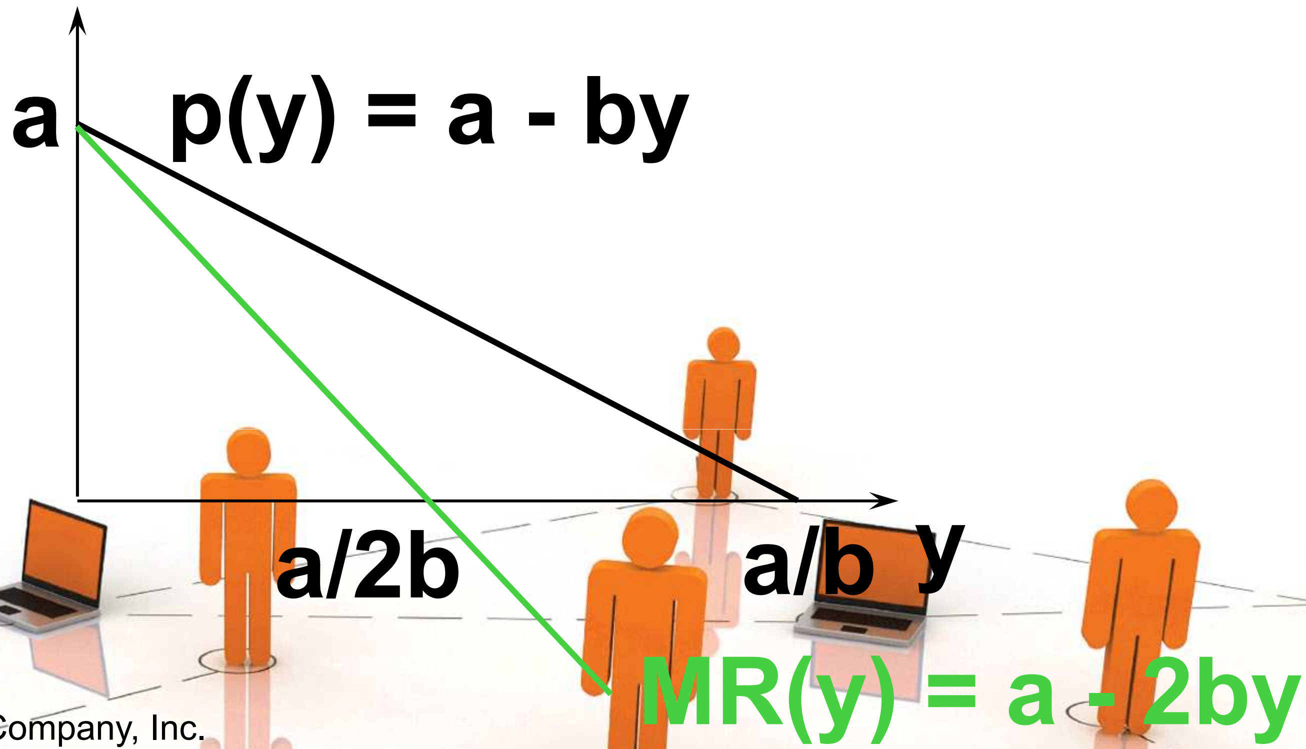
Marginal Revenue

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

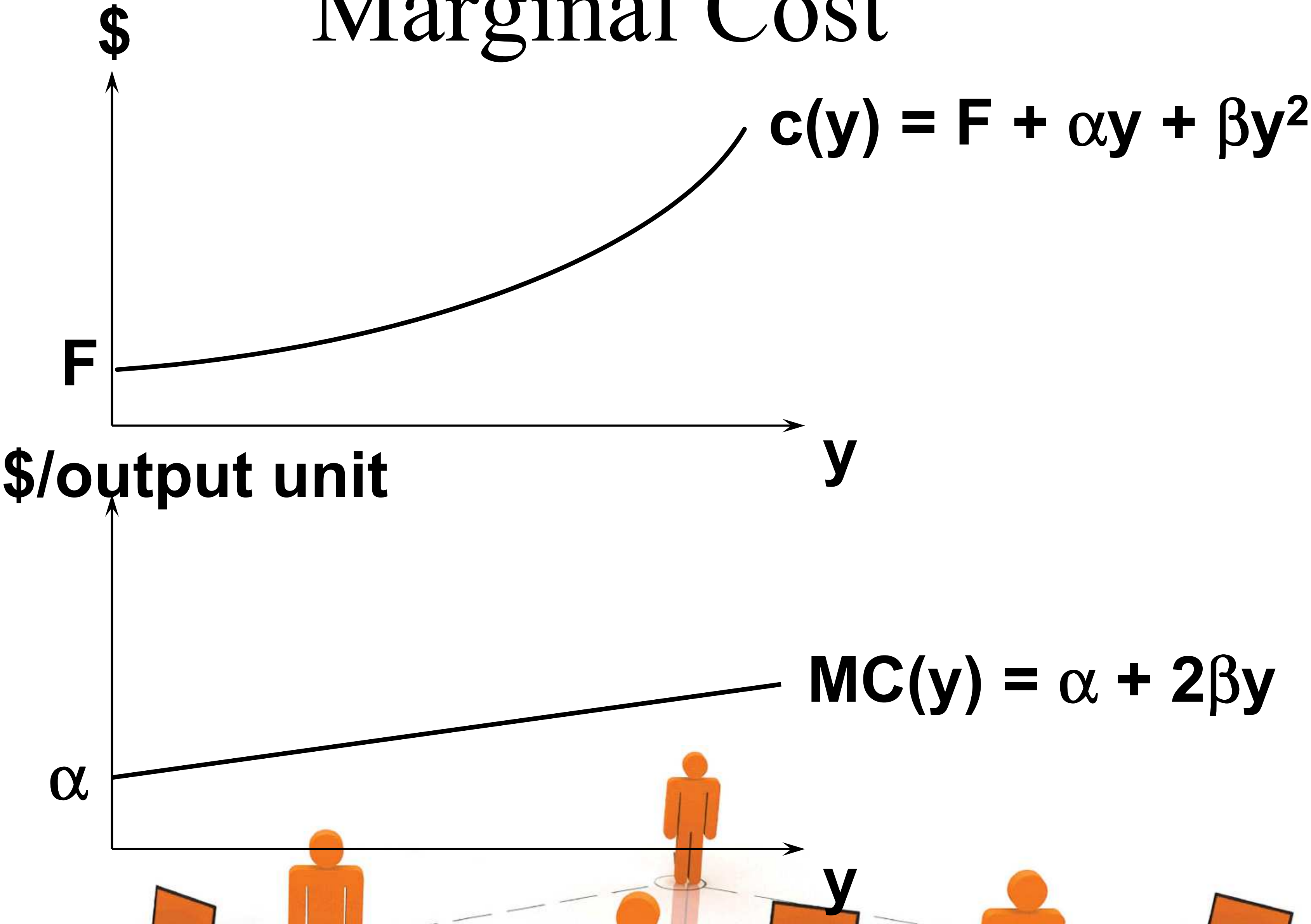
Marginal cost is the rate-of-change of total cost as the output level y increases;

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

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

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

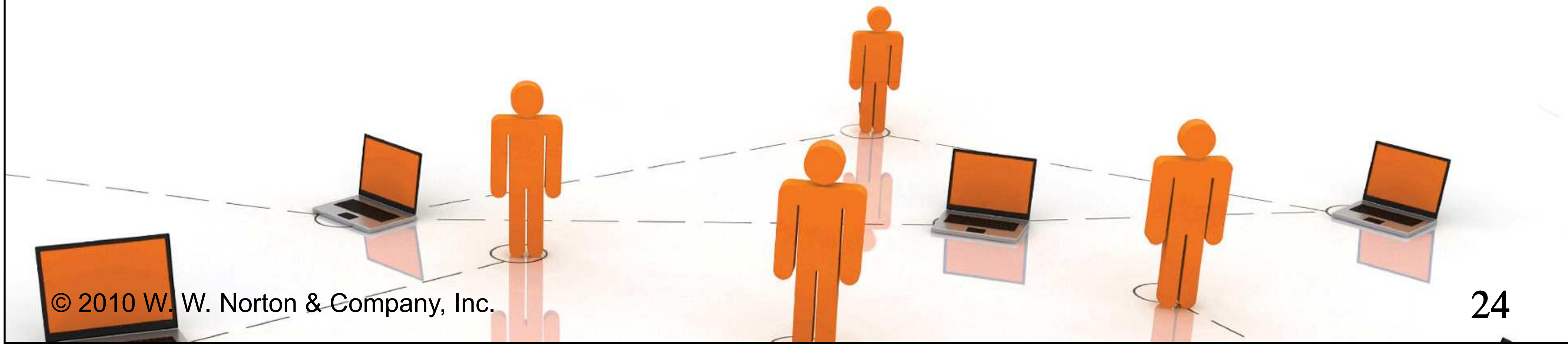
Marginal Cost



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

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



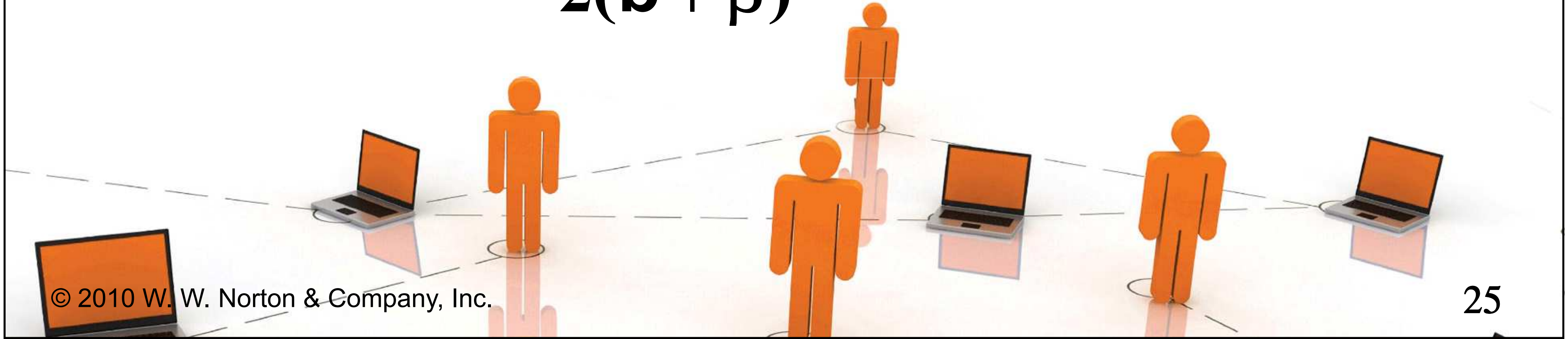
Profit-Maximization; An Example

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

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

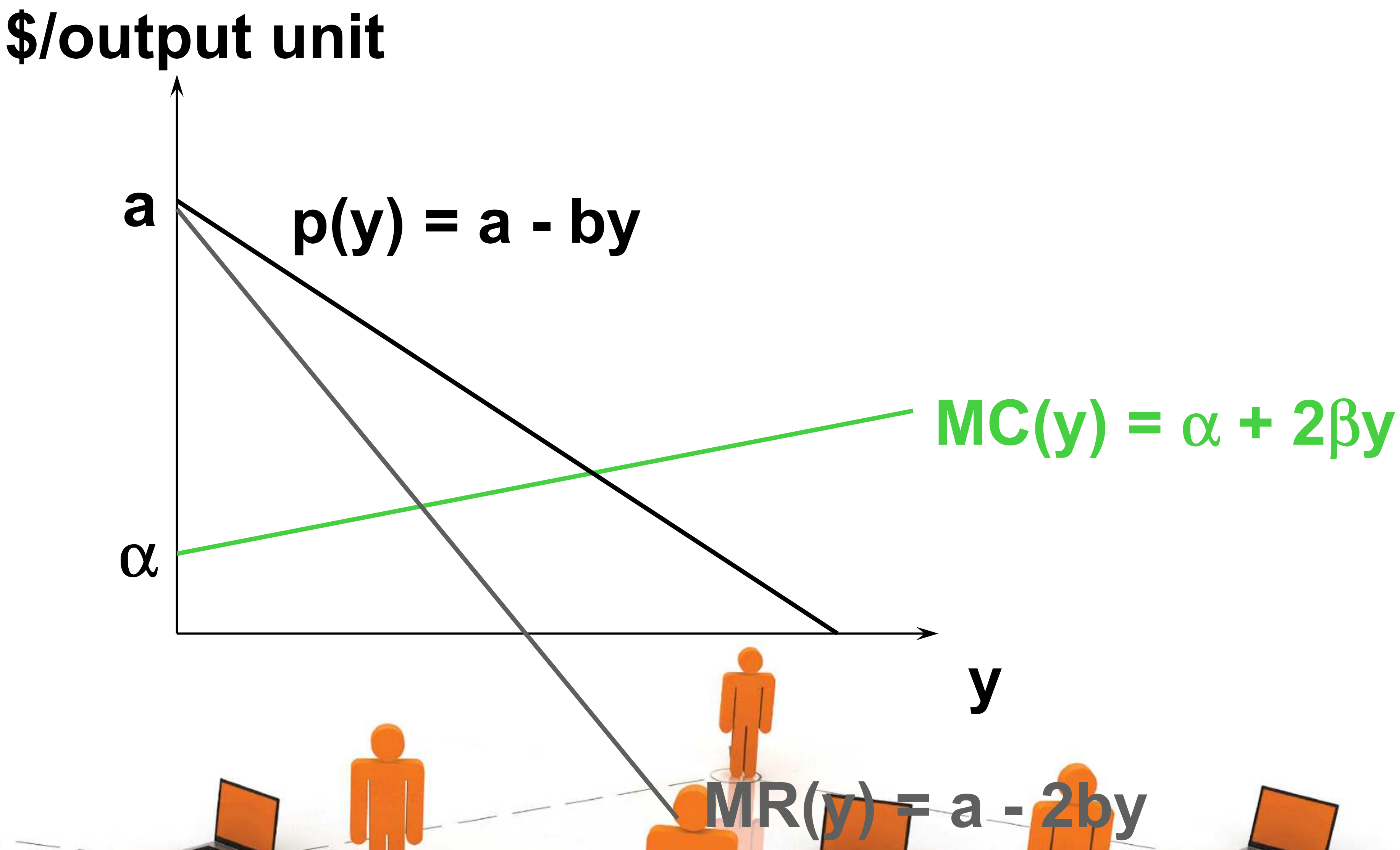
and the profit-maximizing output level is

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

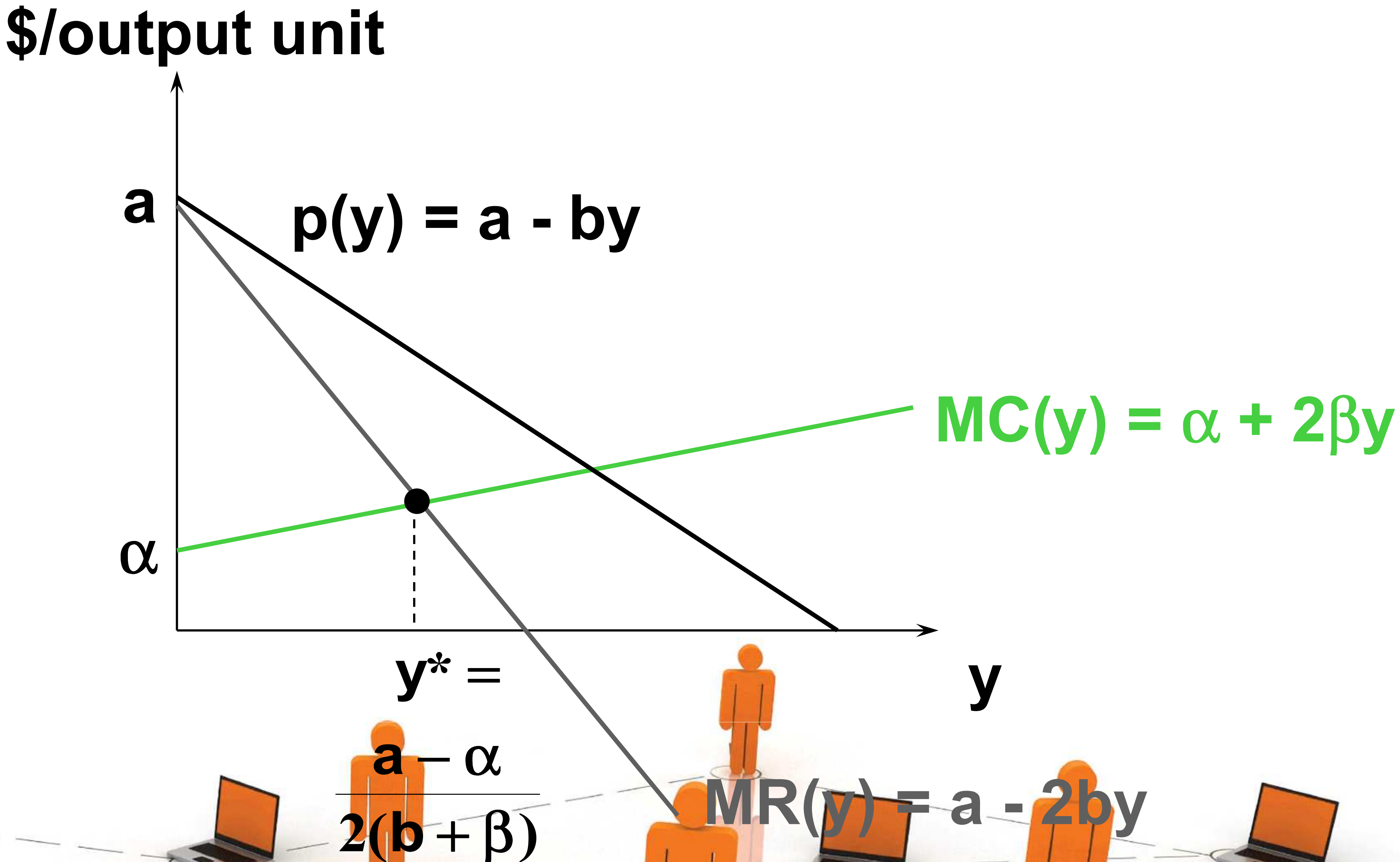
causing the market price to be

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

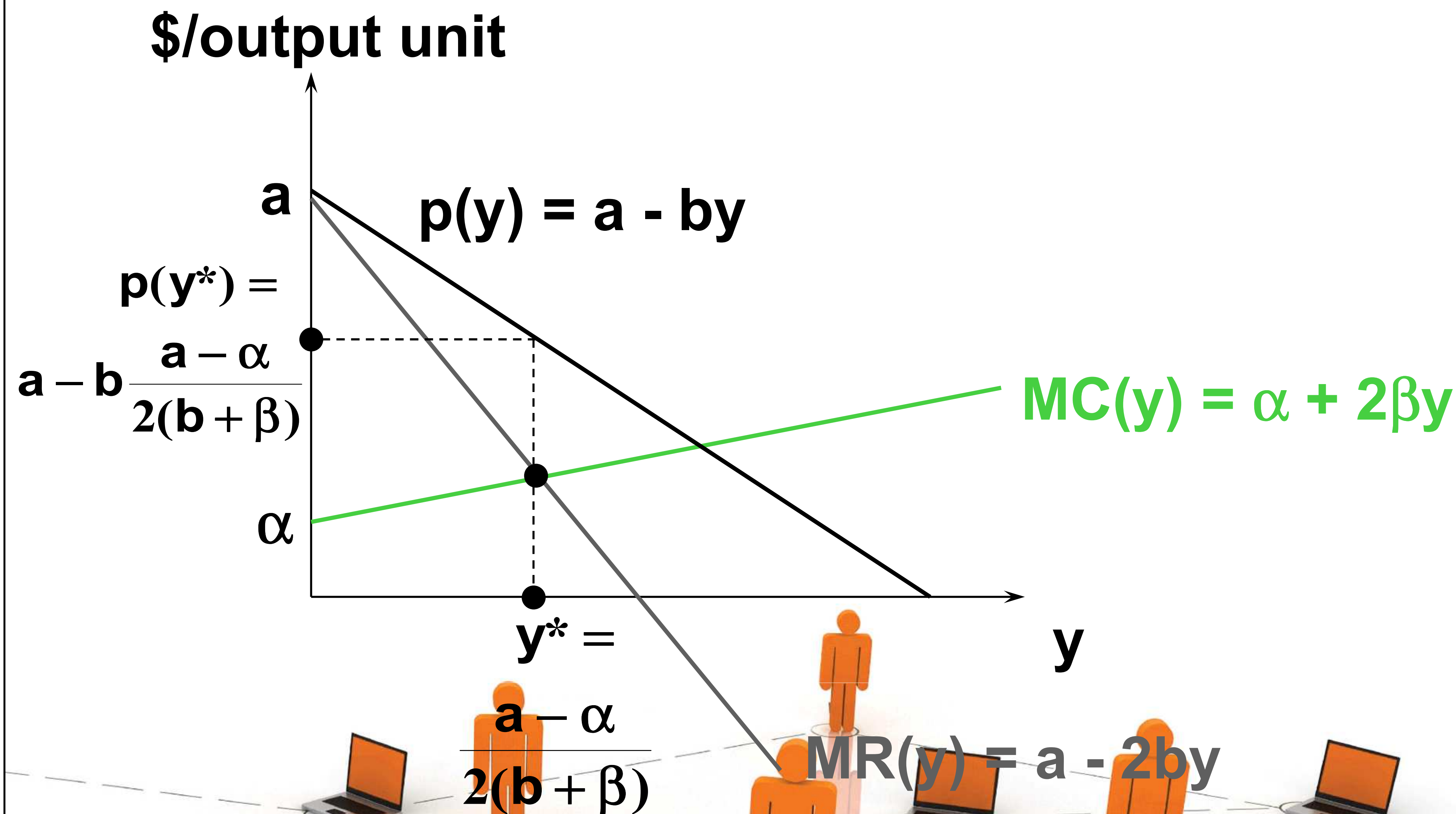
Profit-Maximization; An Example



Profit-Maximization; An Example

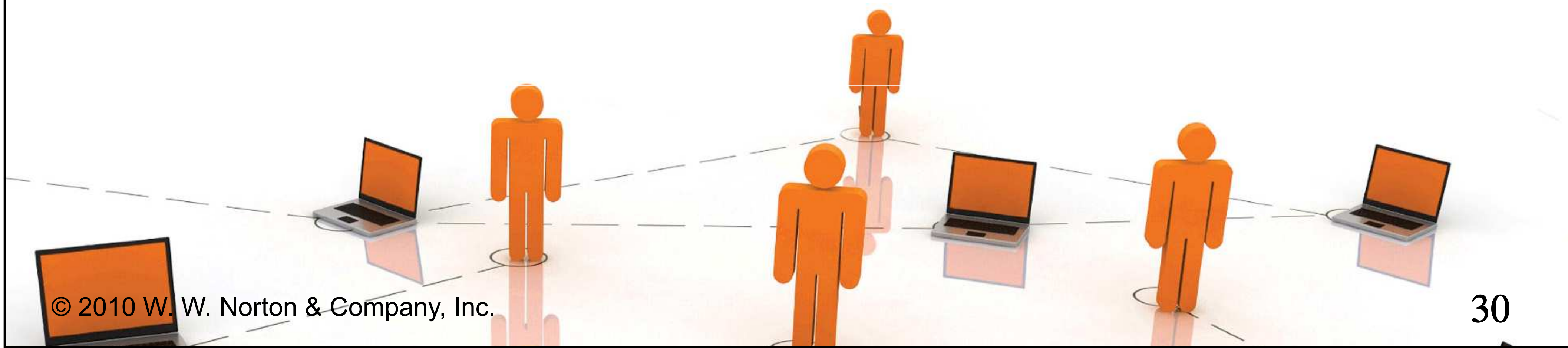


Profit-Maximization; An Example



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

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

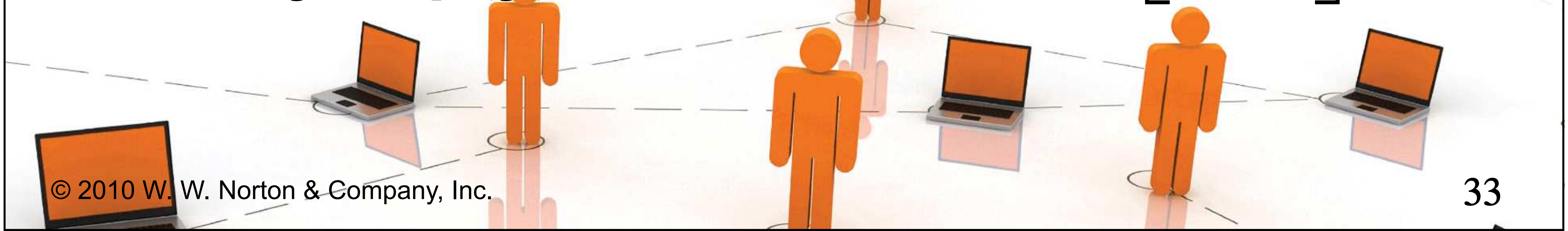
Monopolistic Pricing & Own-Price Elasticity of Demand

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

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

Own-price elasticity of demand is

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



Monopolistic Pricing & Own-Price Elasticity of Demand

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

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

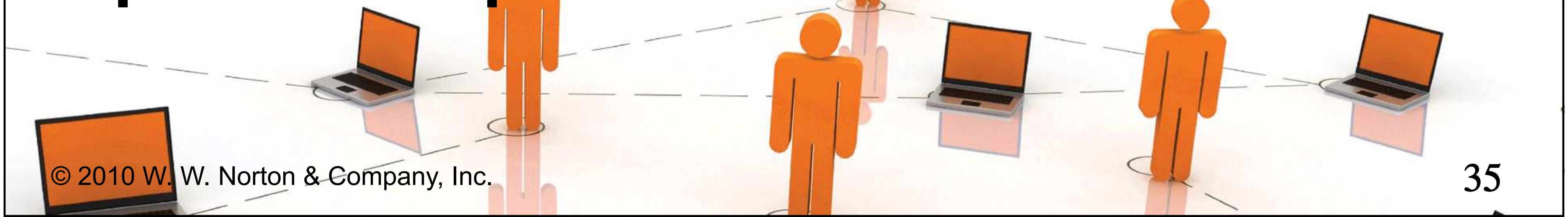
$$\mathbf{MR(y^*) = p(y^*)\left[1 + \frac{1}{\varepsilon}\right] = k}$$ **which is**

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

Monopolistic Pricing & Own-Price Elasticity of Demand

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

E.g. if ε = -3 then p(y*) = 3k/2,
and if ε = -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 $\mathrm{MR}(y^*) = p(y^*)\left[1 + \frac{1}{\varepsilon}\right] = k,$

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

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

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

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

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

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

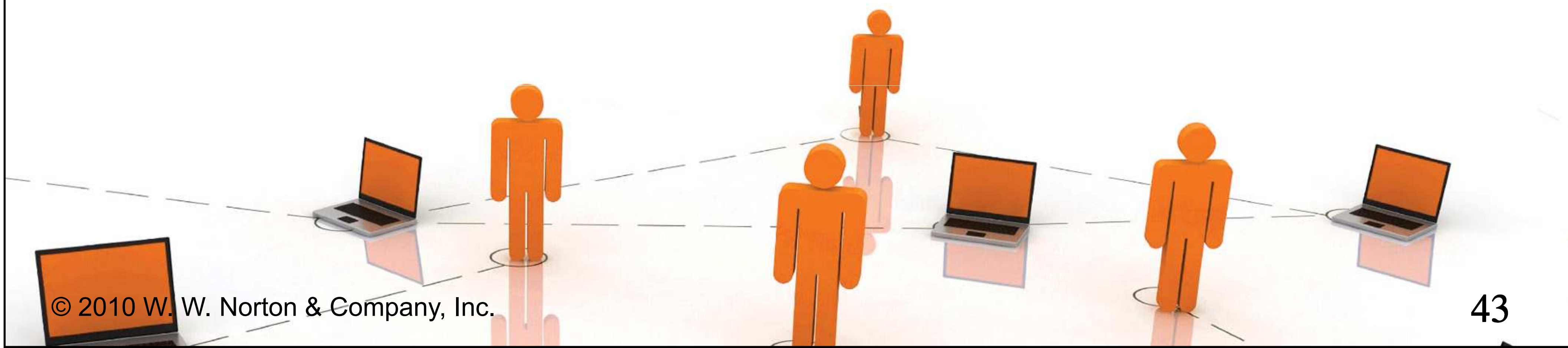
is the monopolist's price.

Markup Pricing

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

is the monopolist's price. The markup is

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



Markup Pricing

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

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

A Profits Tax Levied on a Monopoly

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

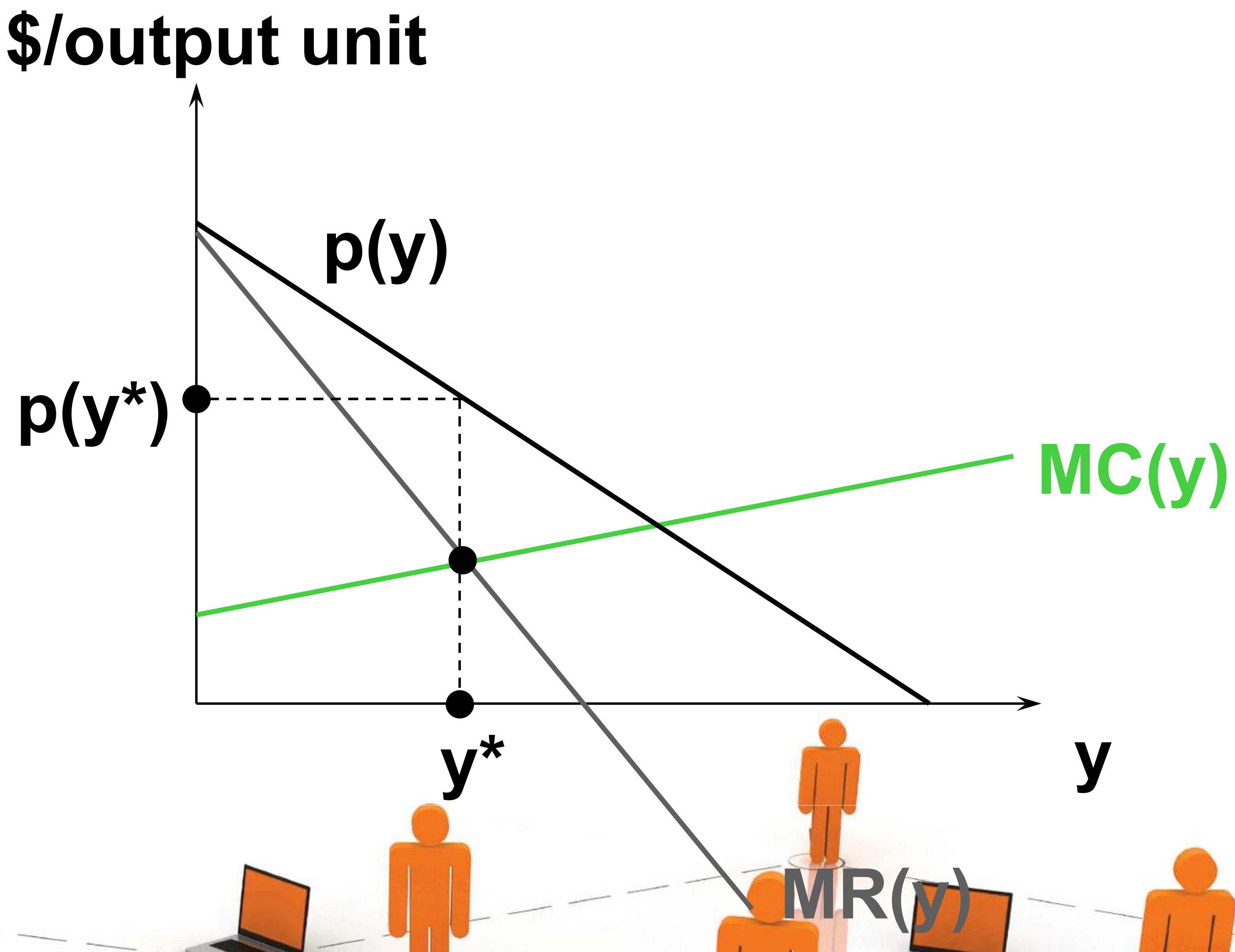
A Profits Tax Levied on a Monopoly

- **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.**

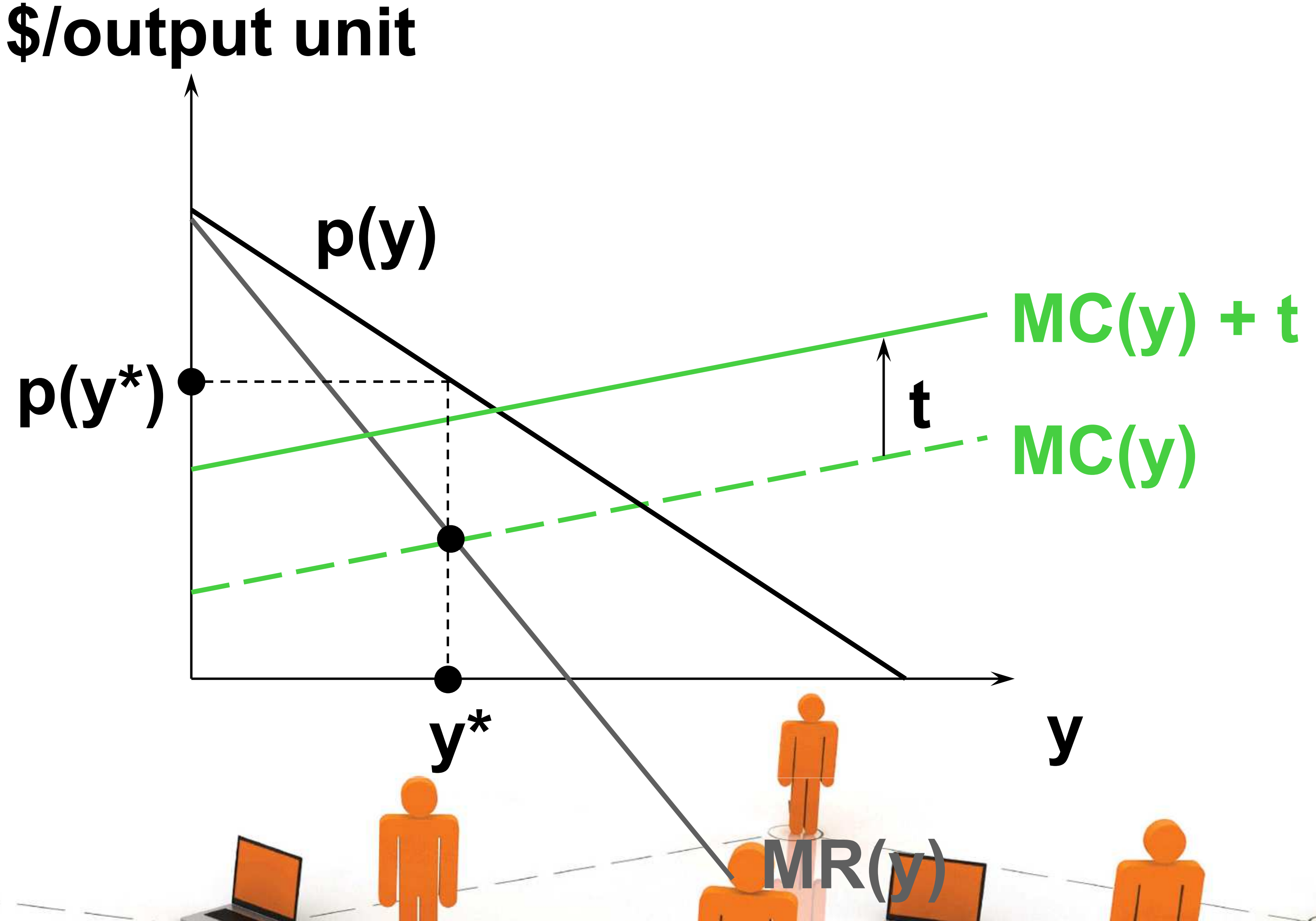
Quantity Tax Levied on a Monopolist

- **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.**

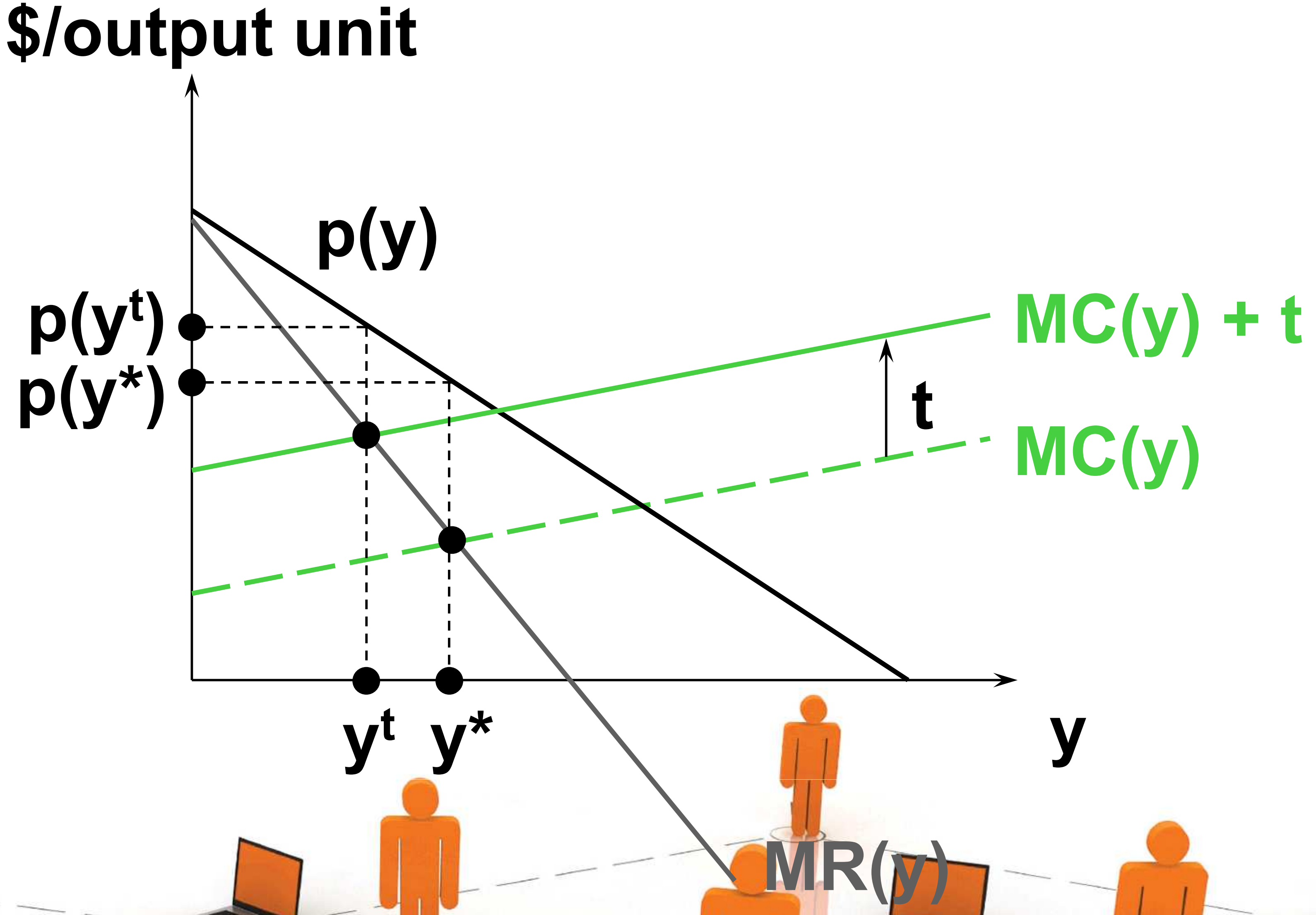
Quantity Tax Levied on a Monopolist



Quantity Tax Levied on a Monopolist

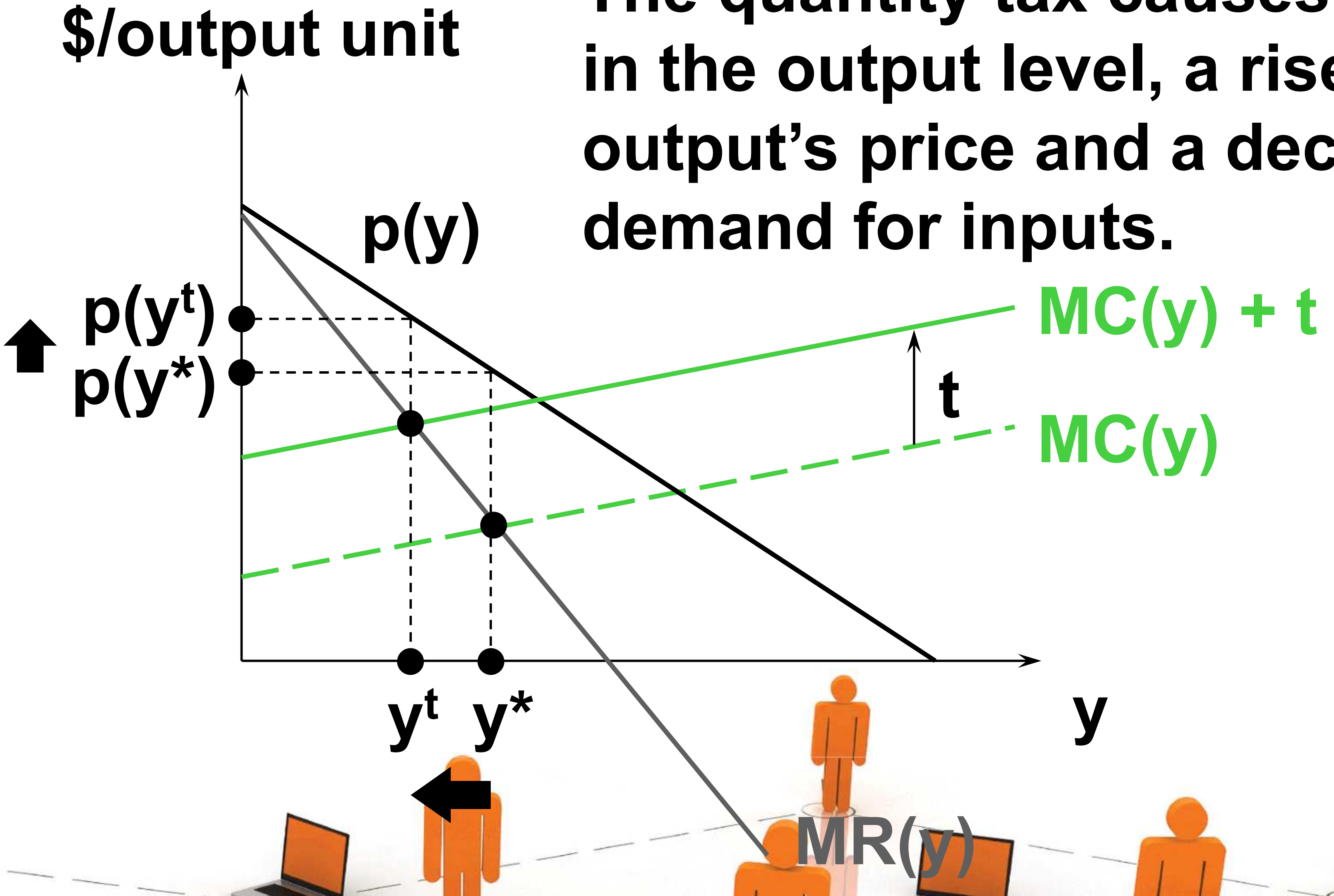


Quantity Tax Levied on a Monopolist



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**

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

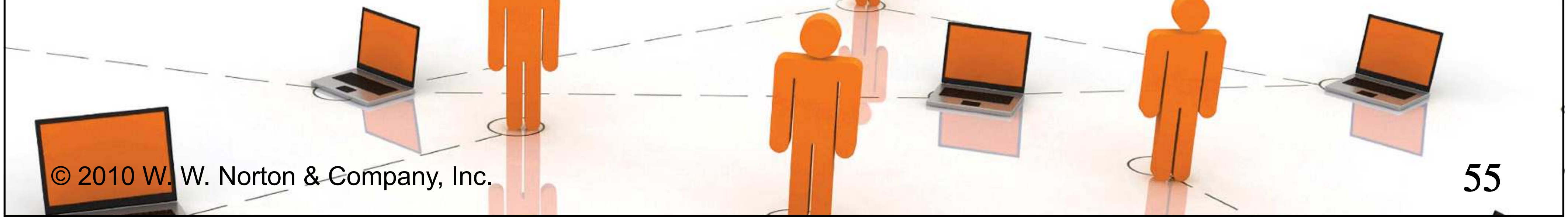
- **The amount of the tax paid by buyers is** $p(y^t) - p(y^*)$.

Quantity Tax Levied on a Monopolist

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

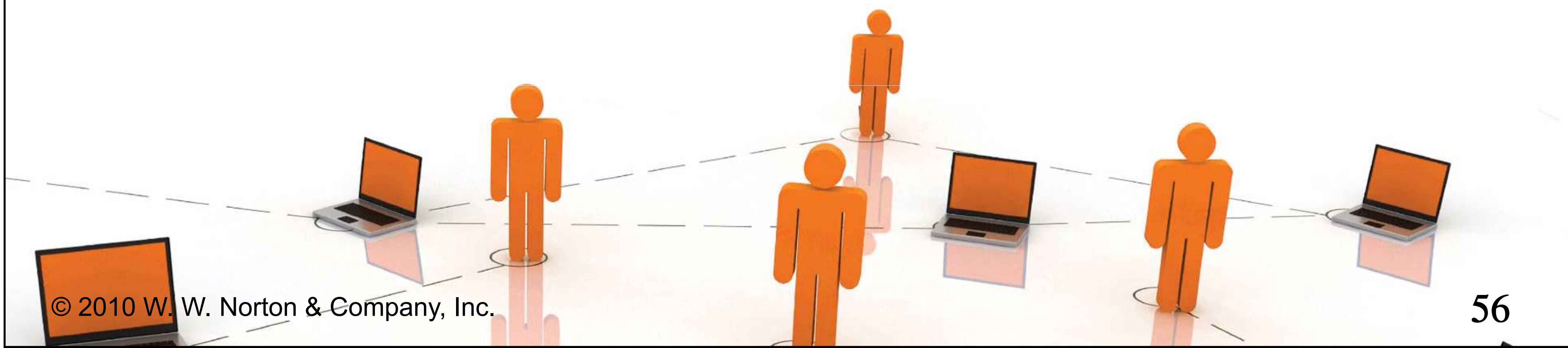
is the amount of the tax passed on to buyers. E.g. if $\varepsilon = -2$, the amount of the tax passed on is 2t.

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



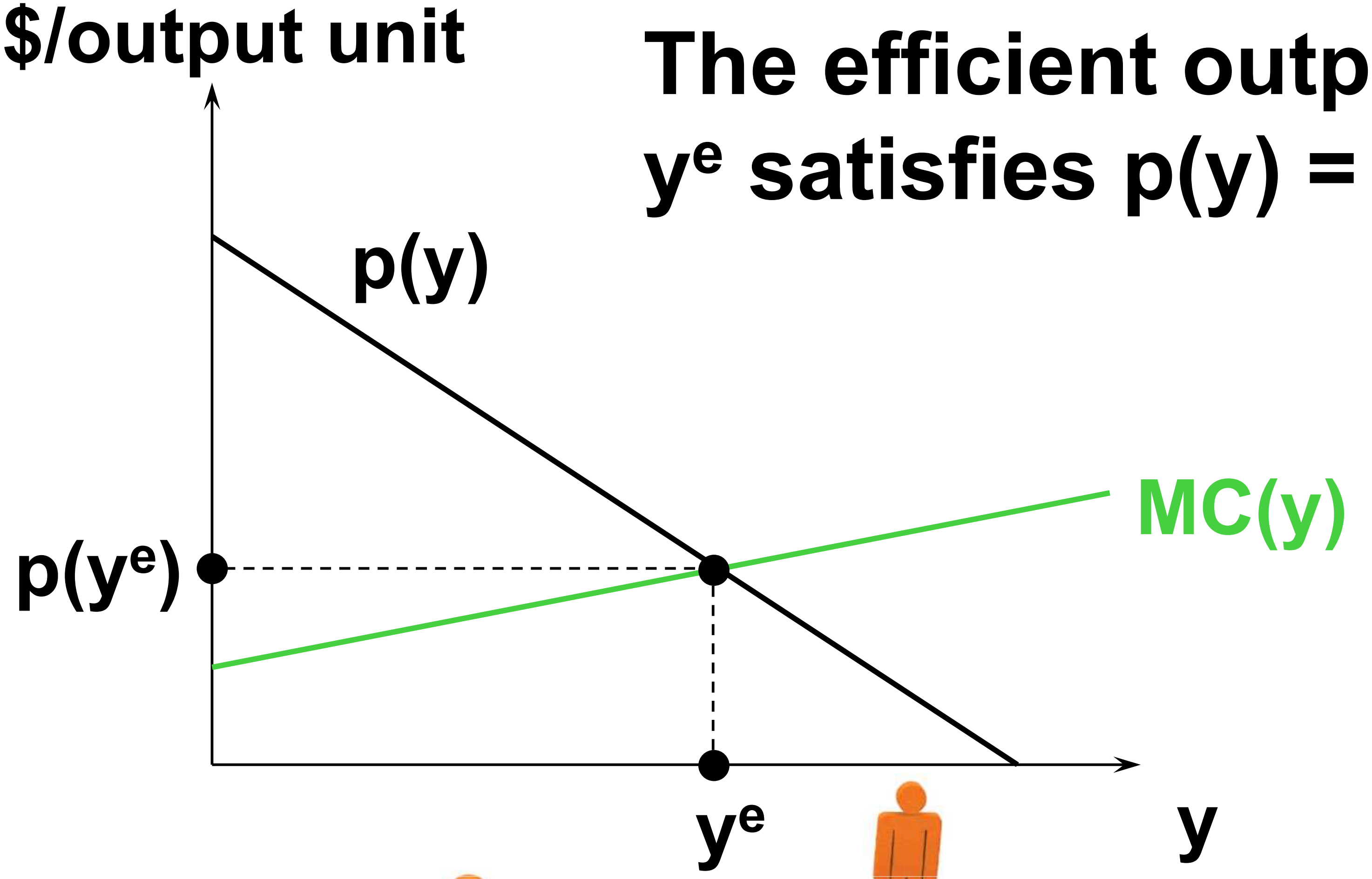
The Inefficiency of Monopoly

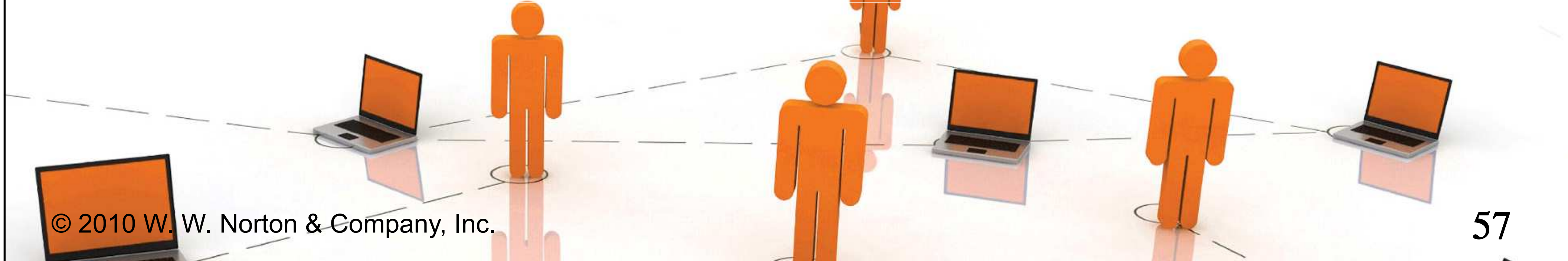
- **A market is Pareto efficient if it achieves the maximum possible total gains-to-trade.**
- **Otherwise a market is Pareto inefficient.**



The Inefficiency of Monopoly

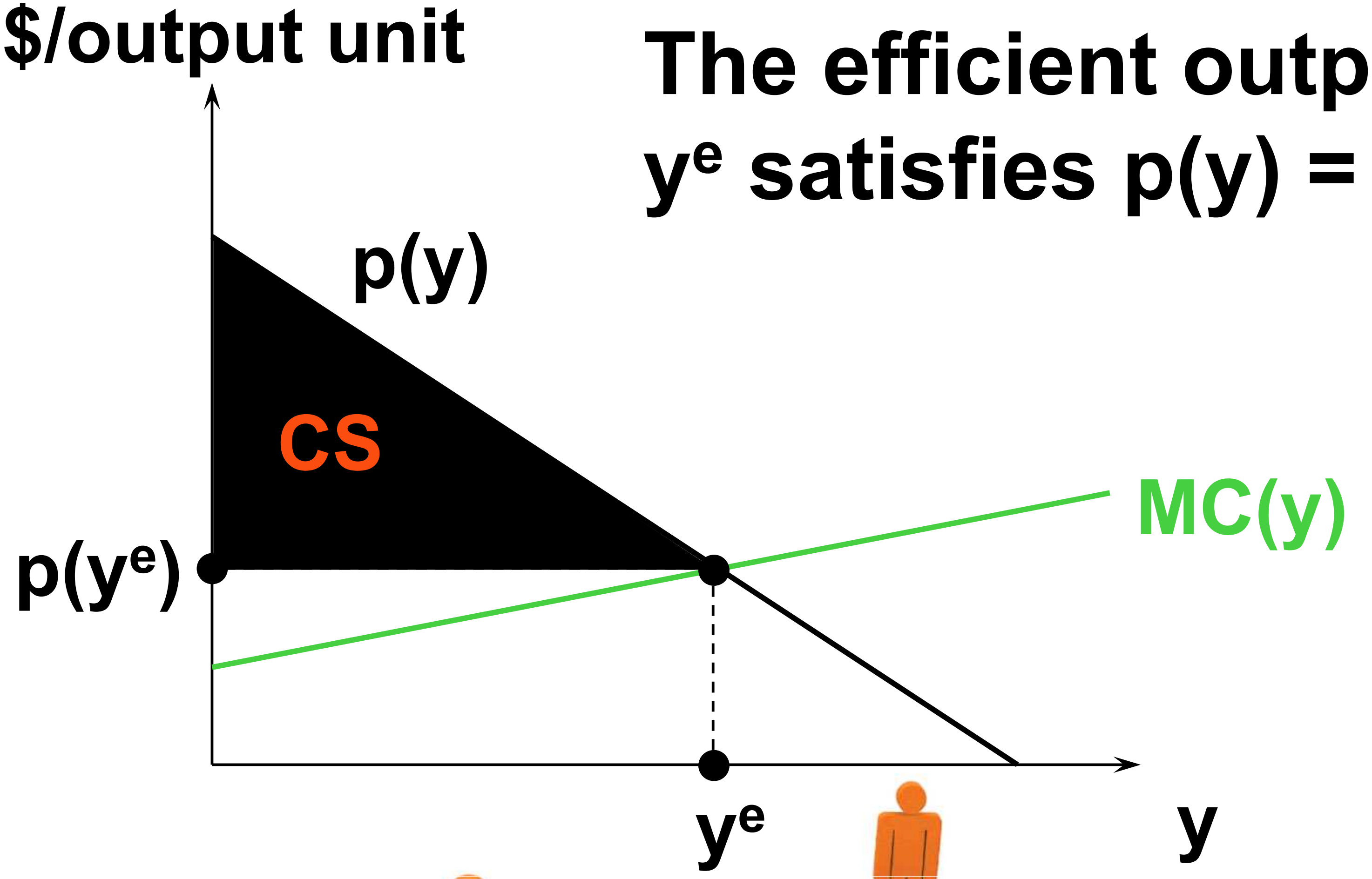
The efficient output level y^e satisfies $p(y) = MC(y)$.

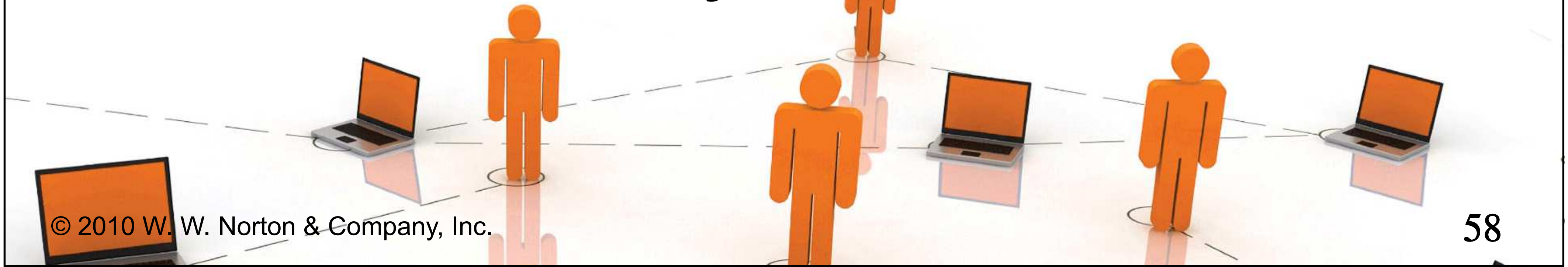




The Inefficiency of Monopoly

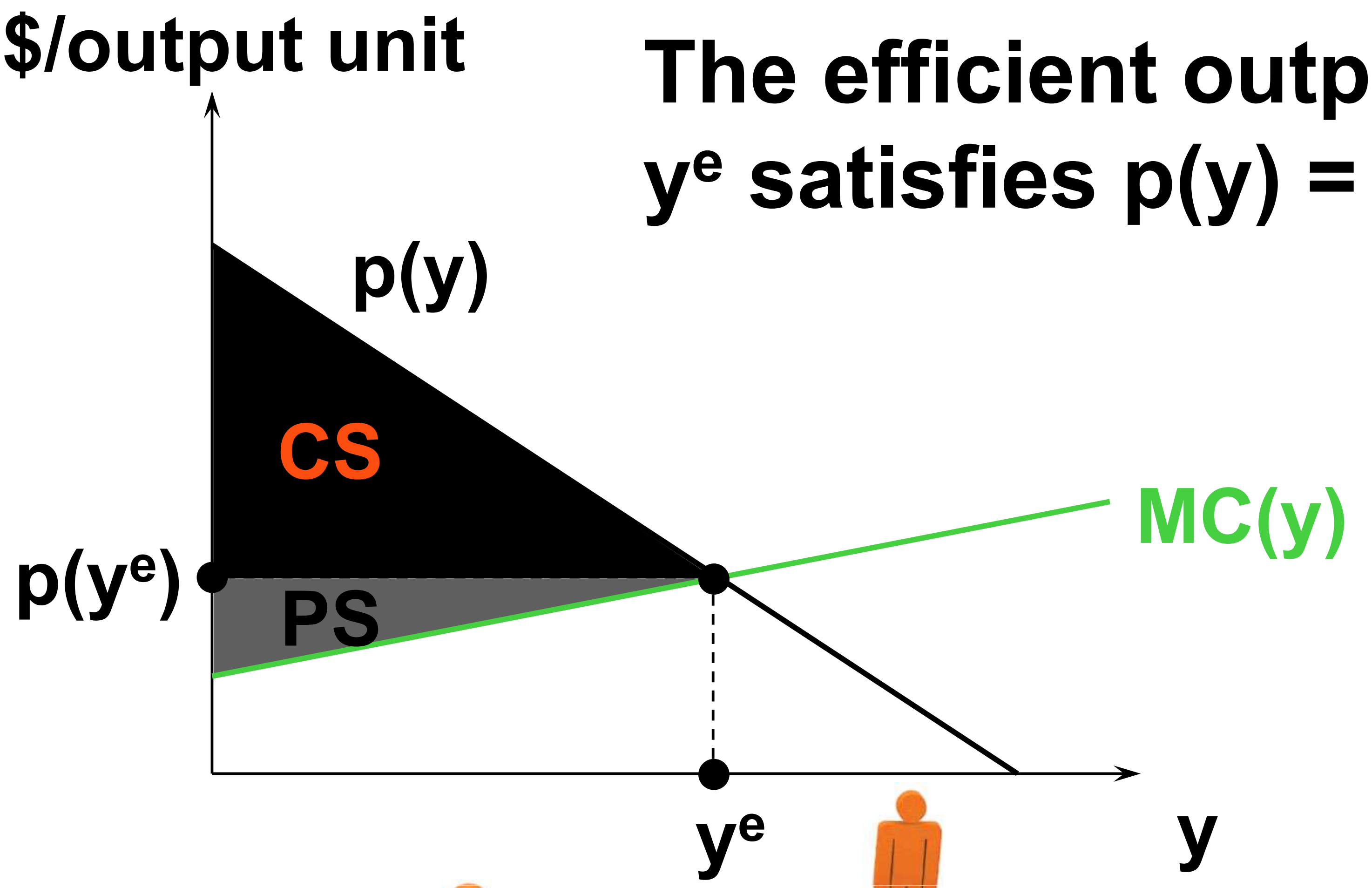
The efficient output level y^e satisfies $p(y) = MC(y)$.

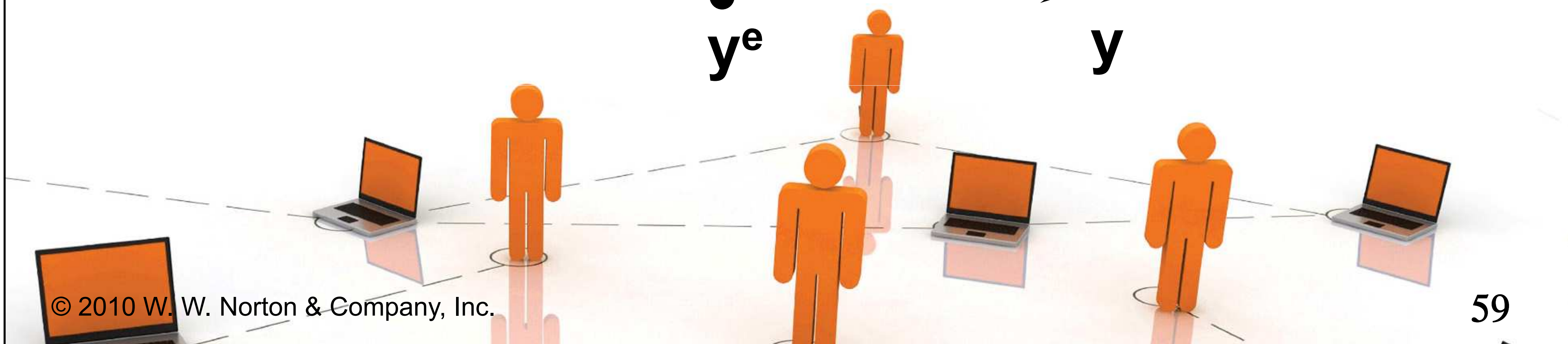




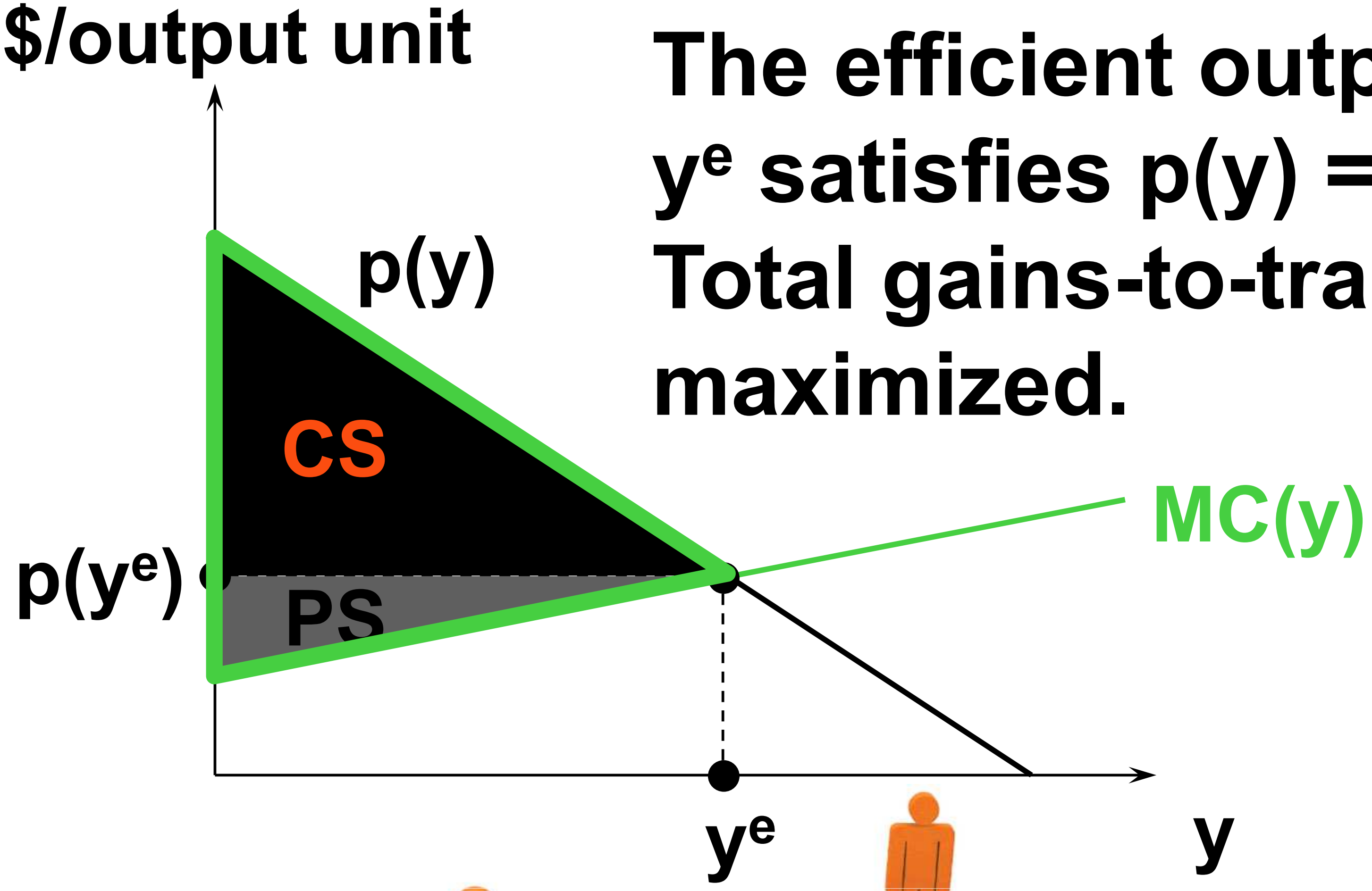
The Inefficiency of Monopoly

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



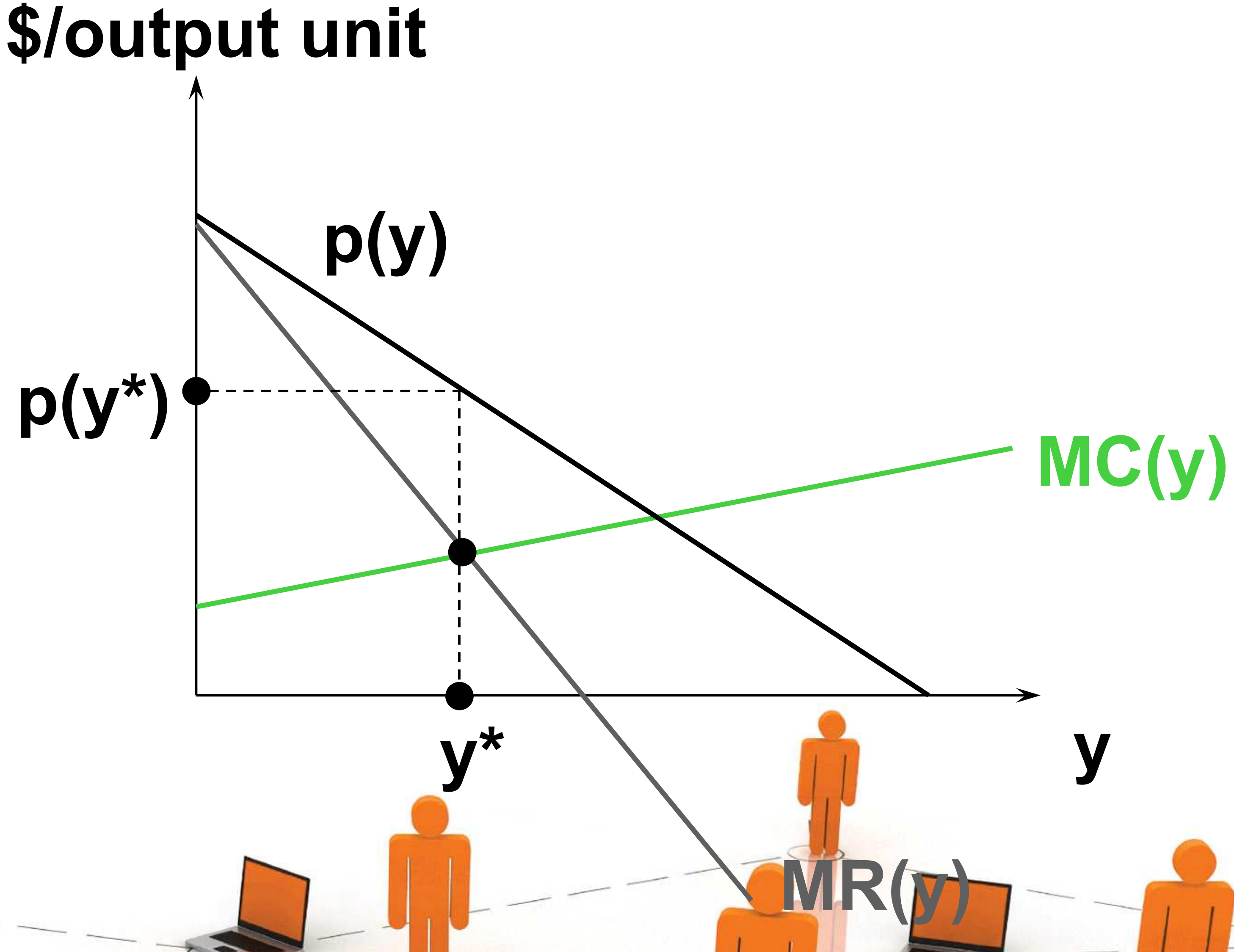


The Inefficiency of Monopoly

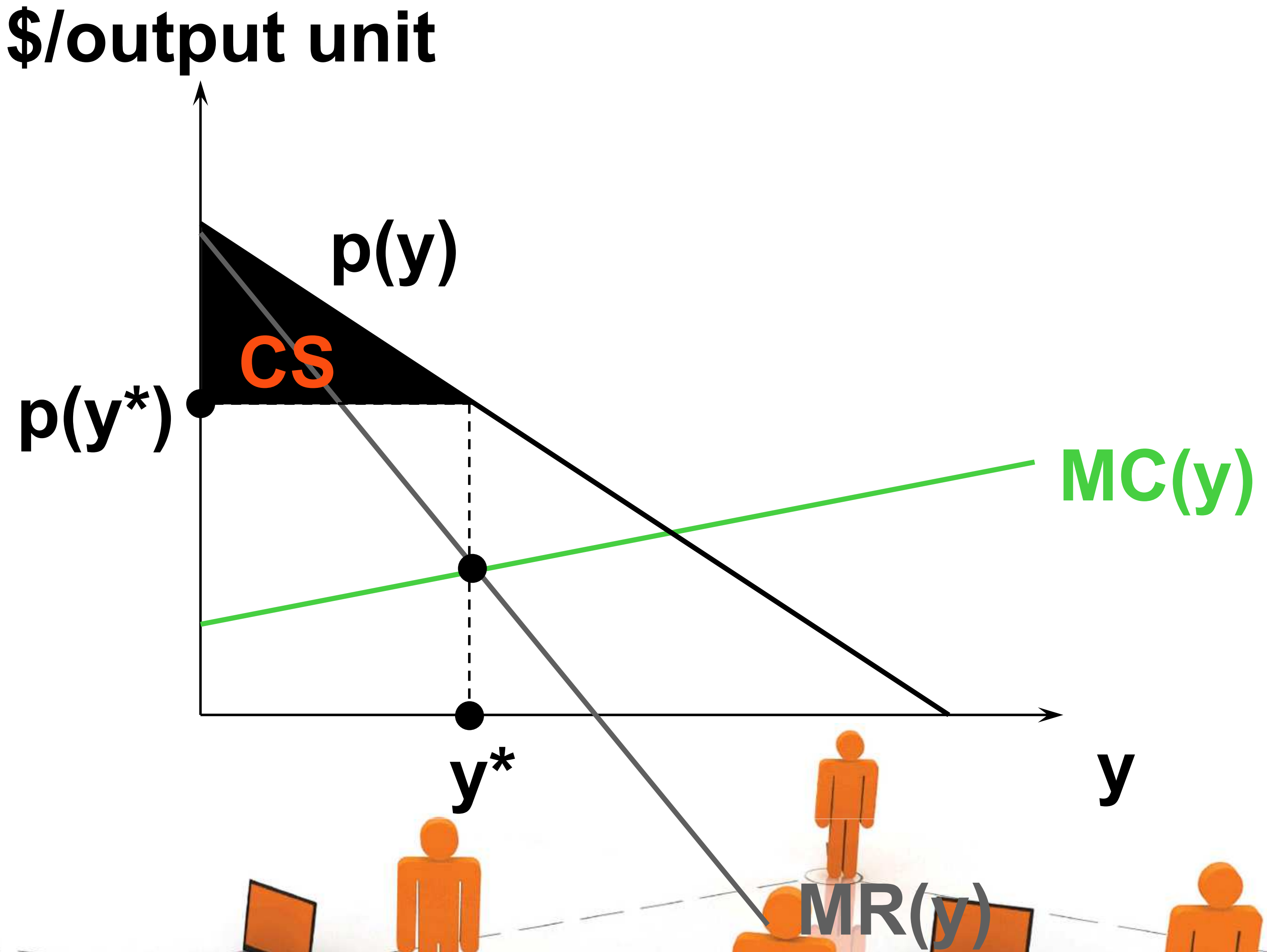


The efficient output level y^e satisfies p(y) = MC(y). Total gains-to-trade is maximized.

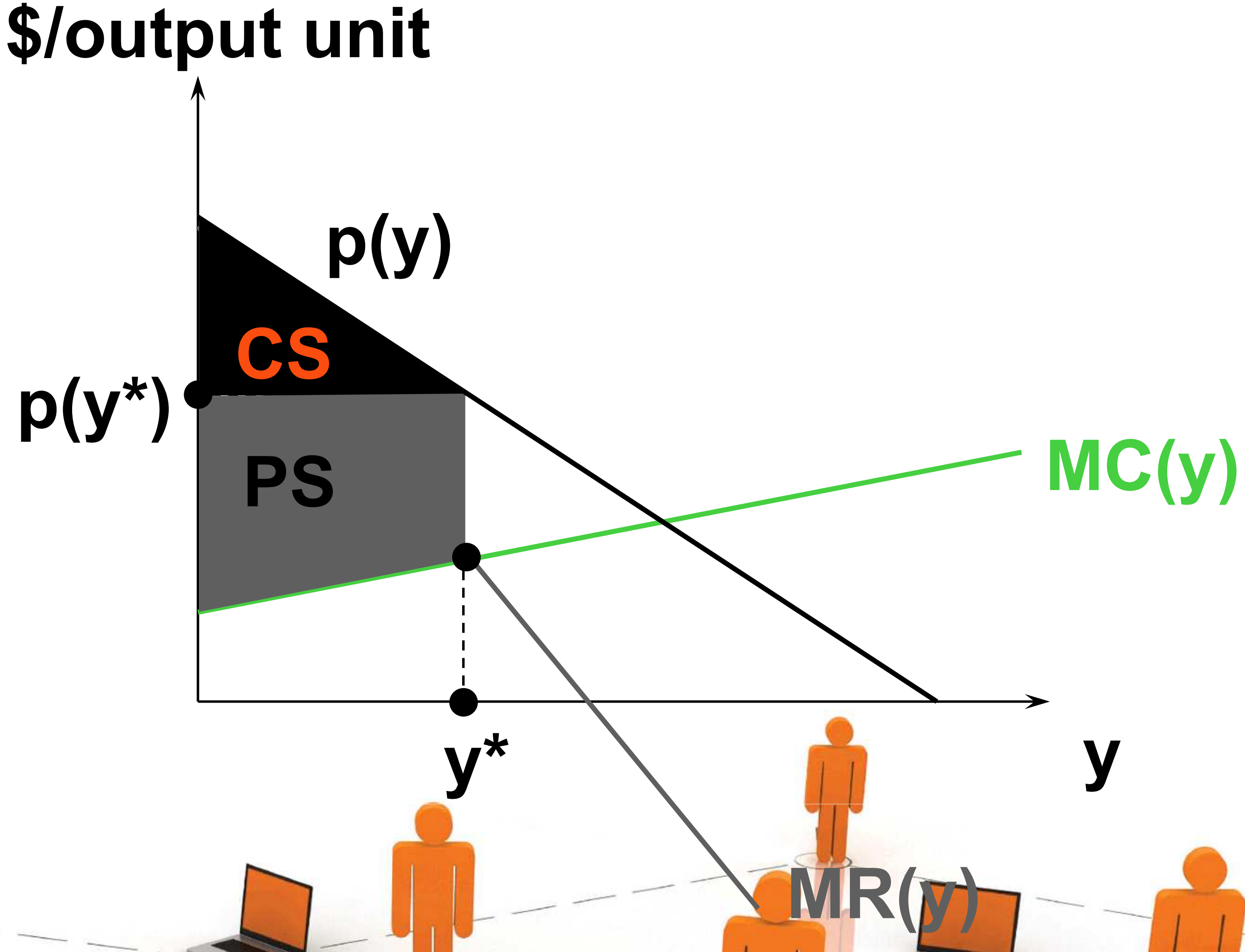
The Inefficiency of Monopoly



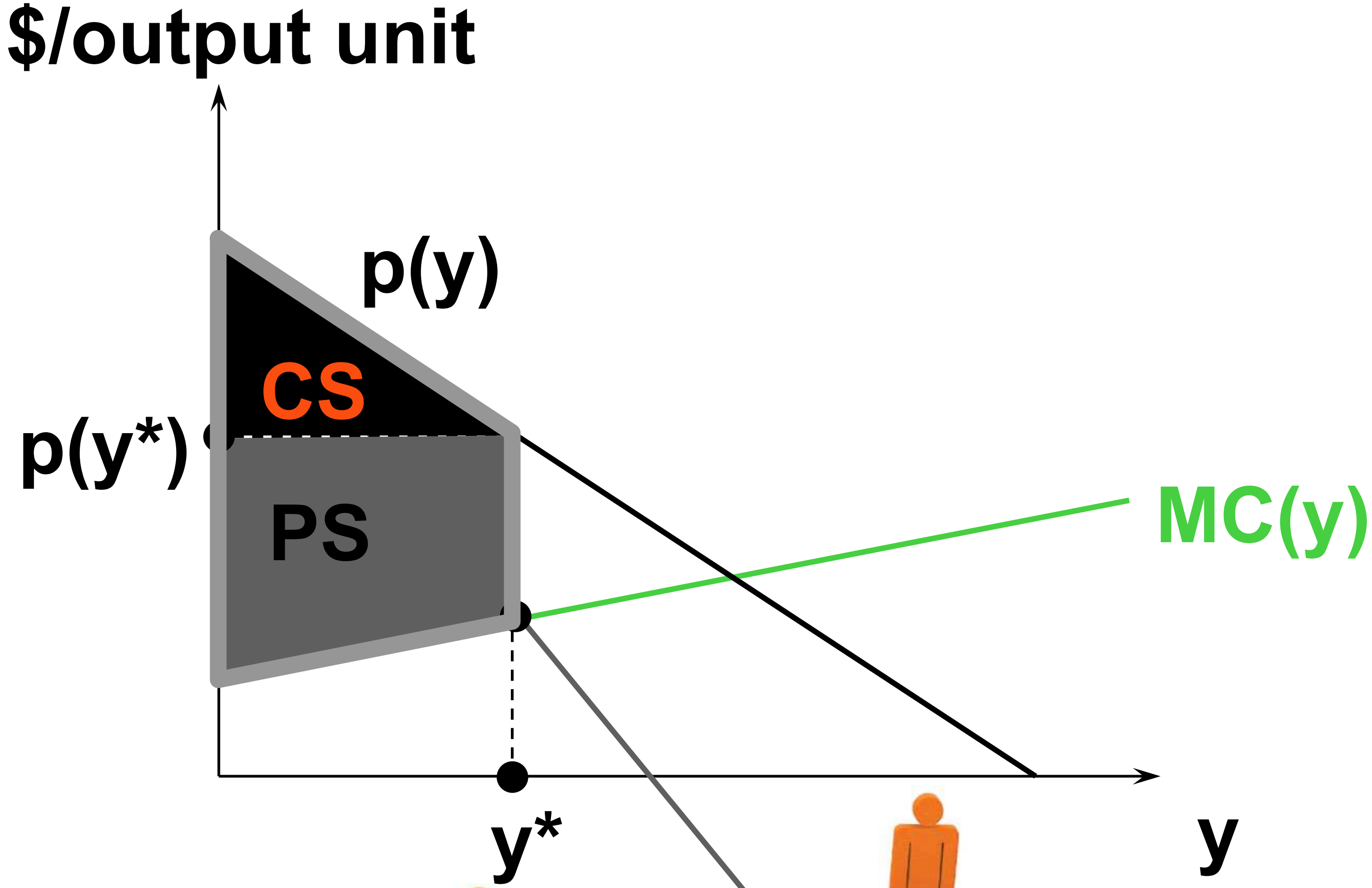
The Inefficiency of Monopoly



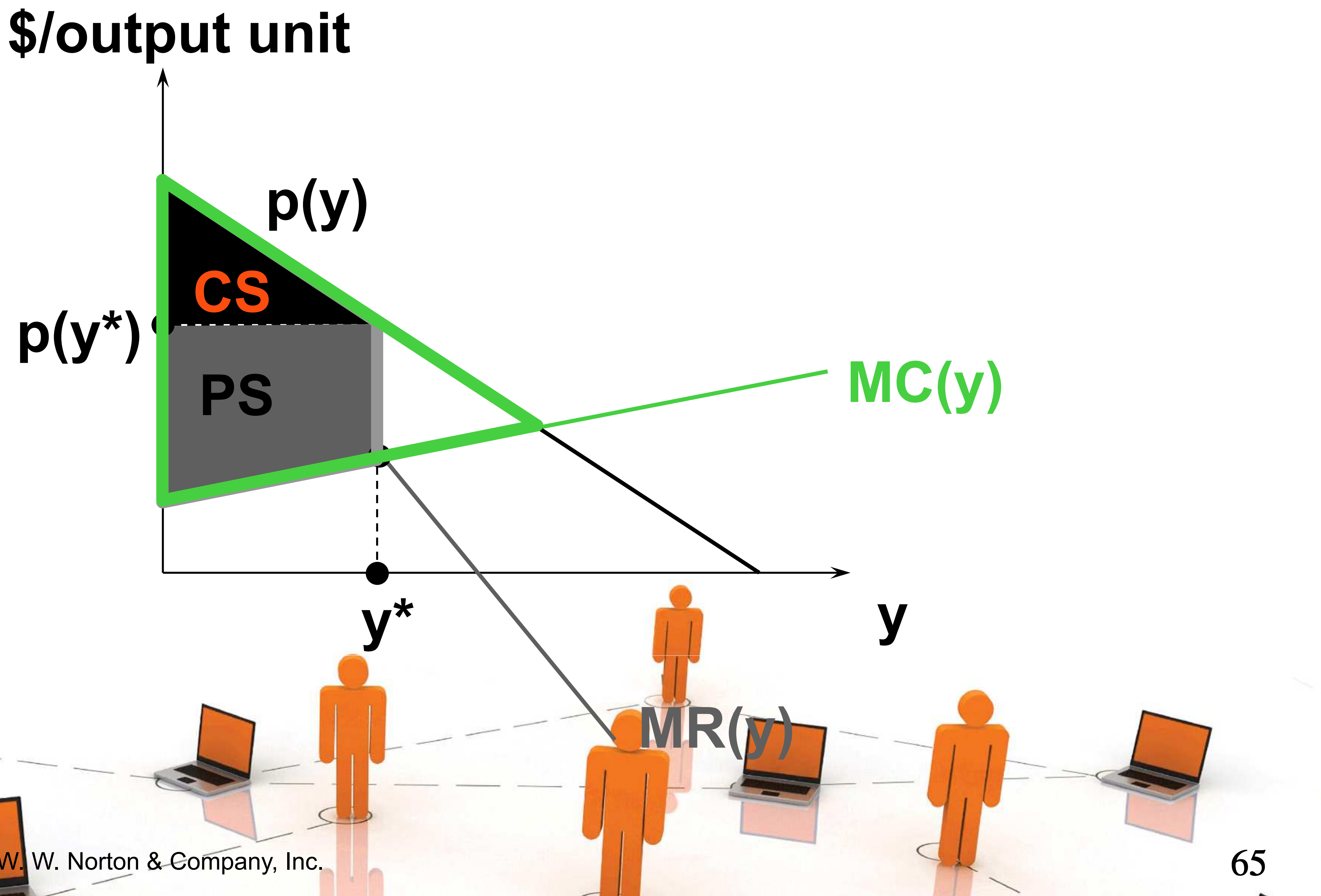
The Inefficiency of Monopoly



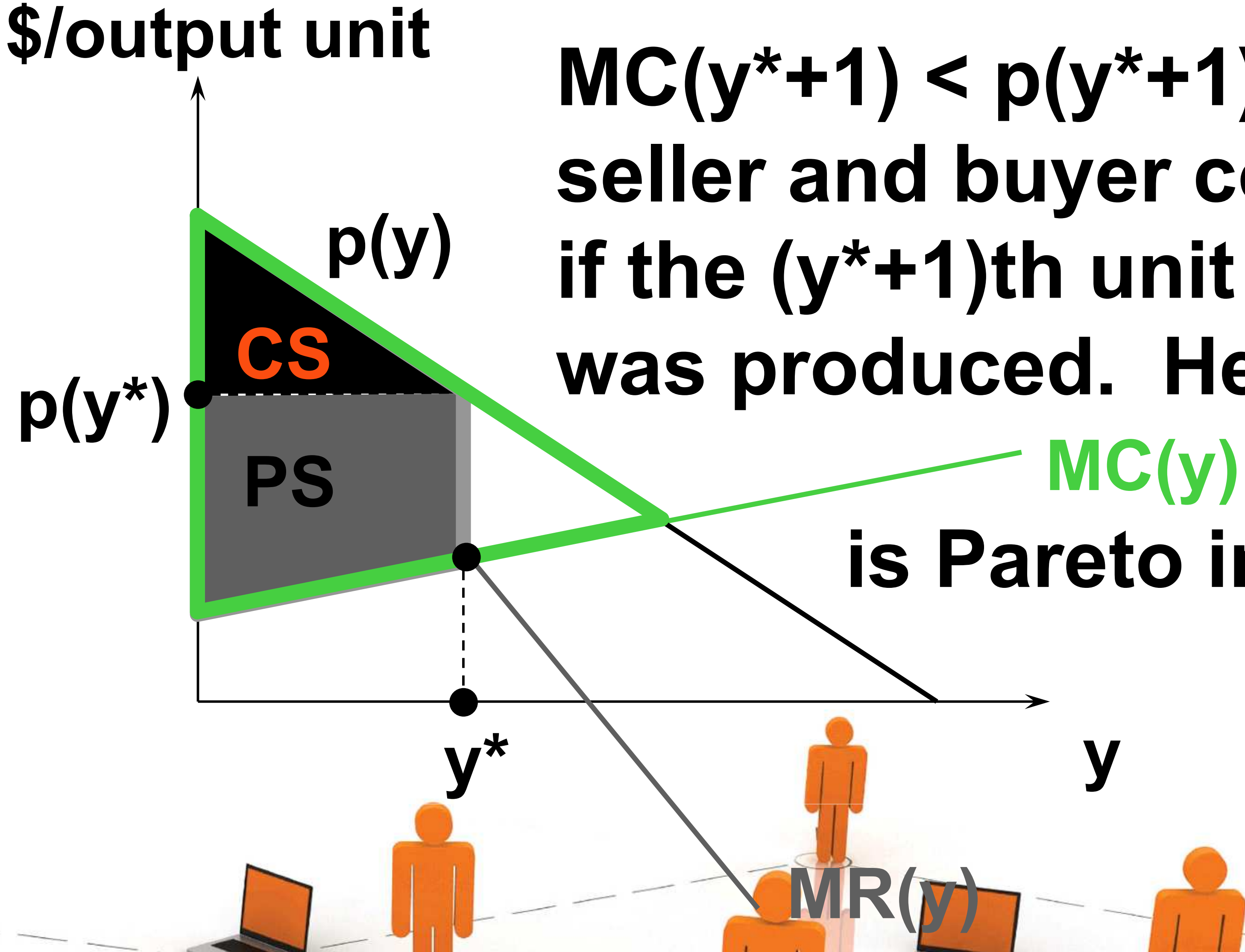
The Inefficiency of Monopoly



The Inefficiency of Monopoly

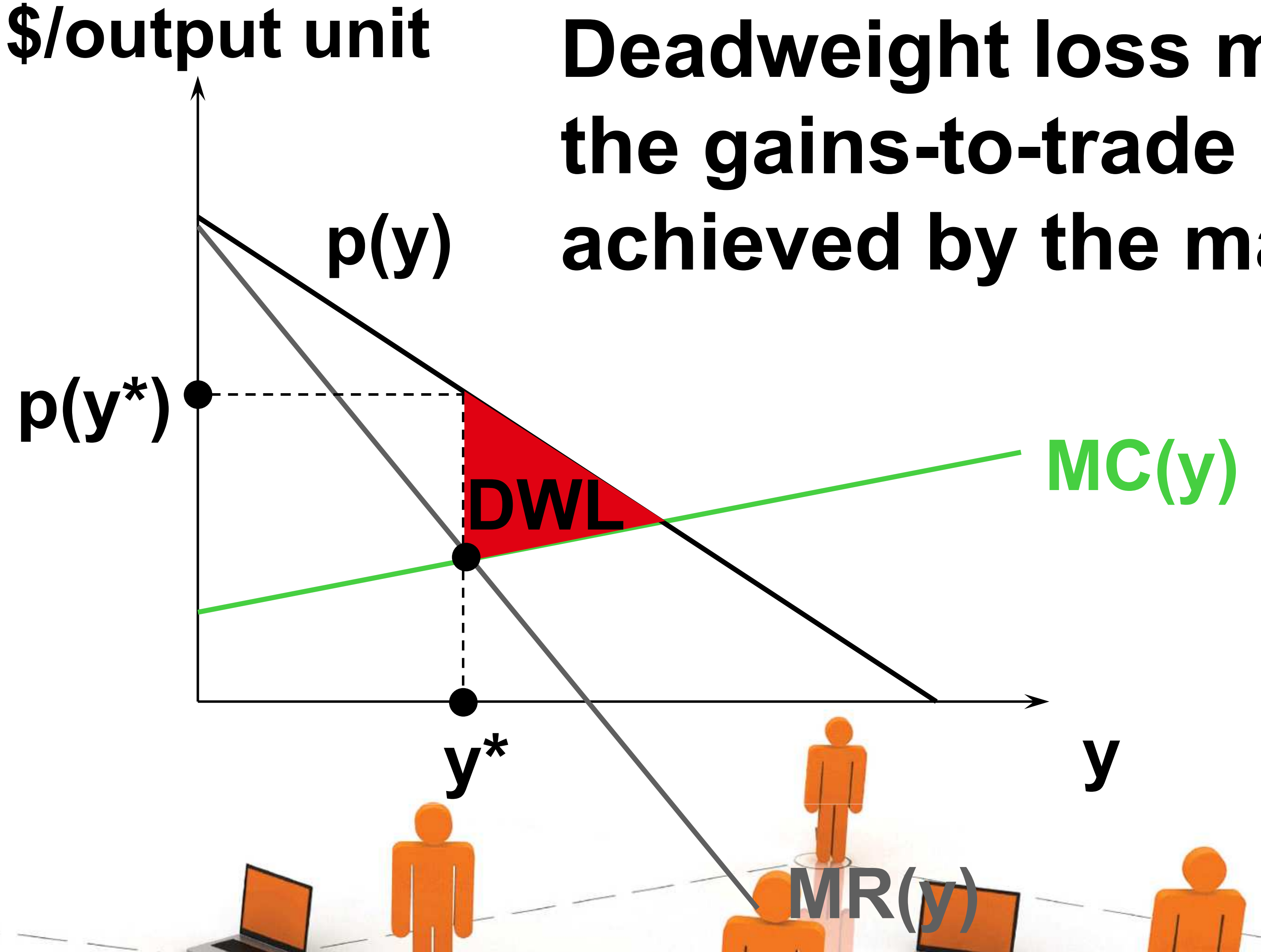


The Inefficiency of Monopoly



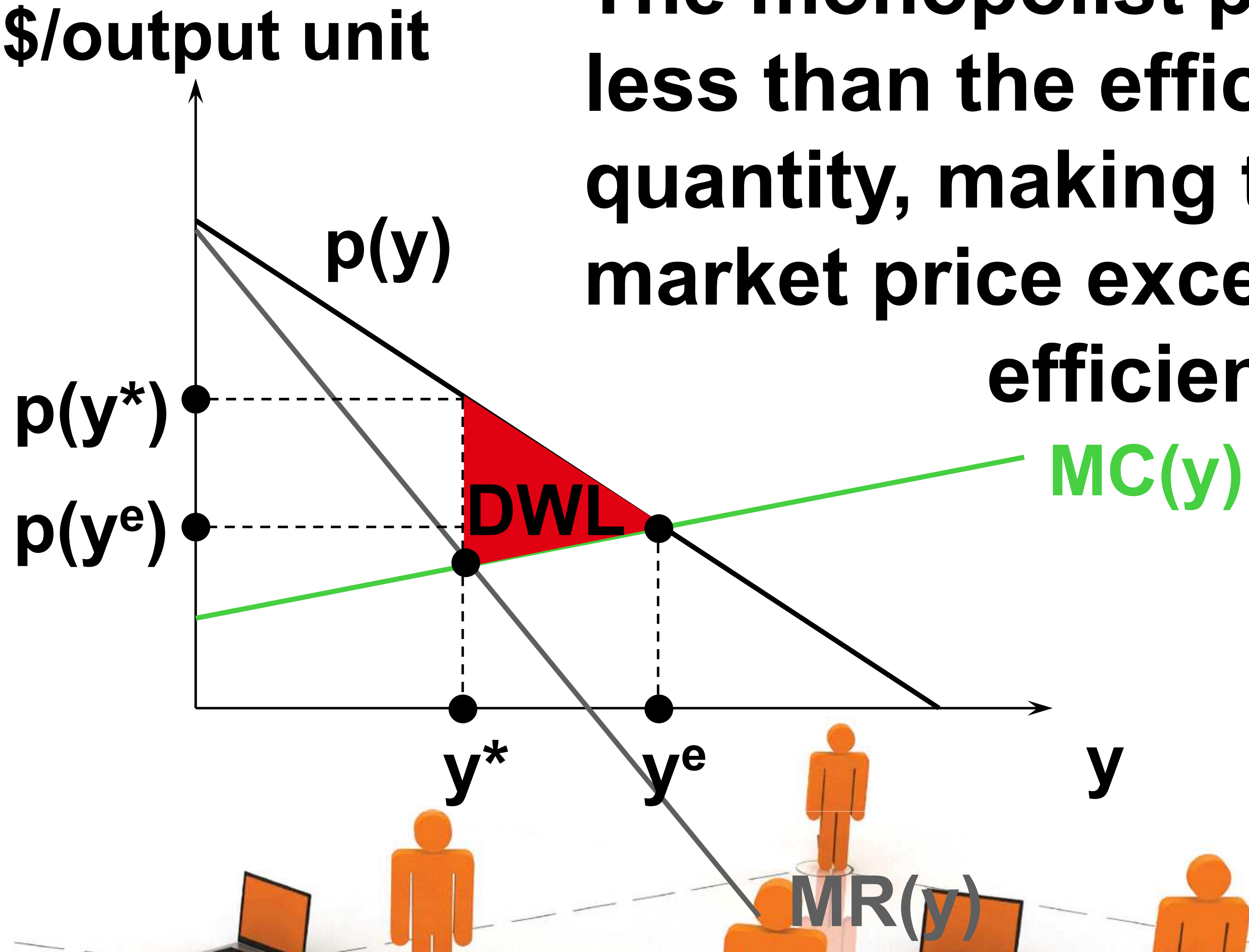
MC(y*+1) < p(y*+1) so both seller and buyer could gain if the (y*+1)th unit of output was produced. Hence the market is Pareto inefficient.

The Inefficiency of Monopoly



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

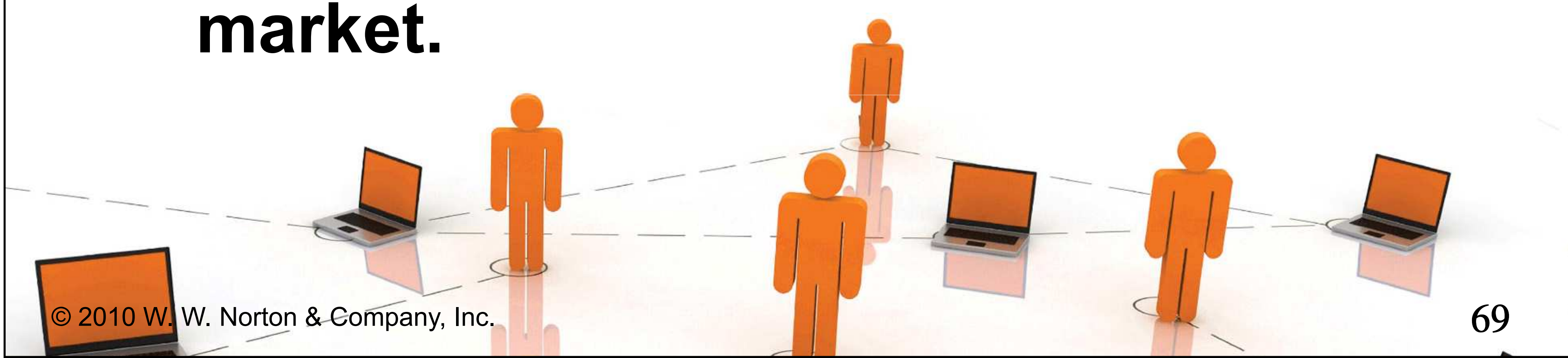
The Inefficiency of Monopoly



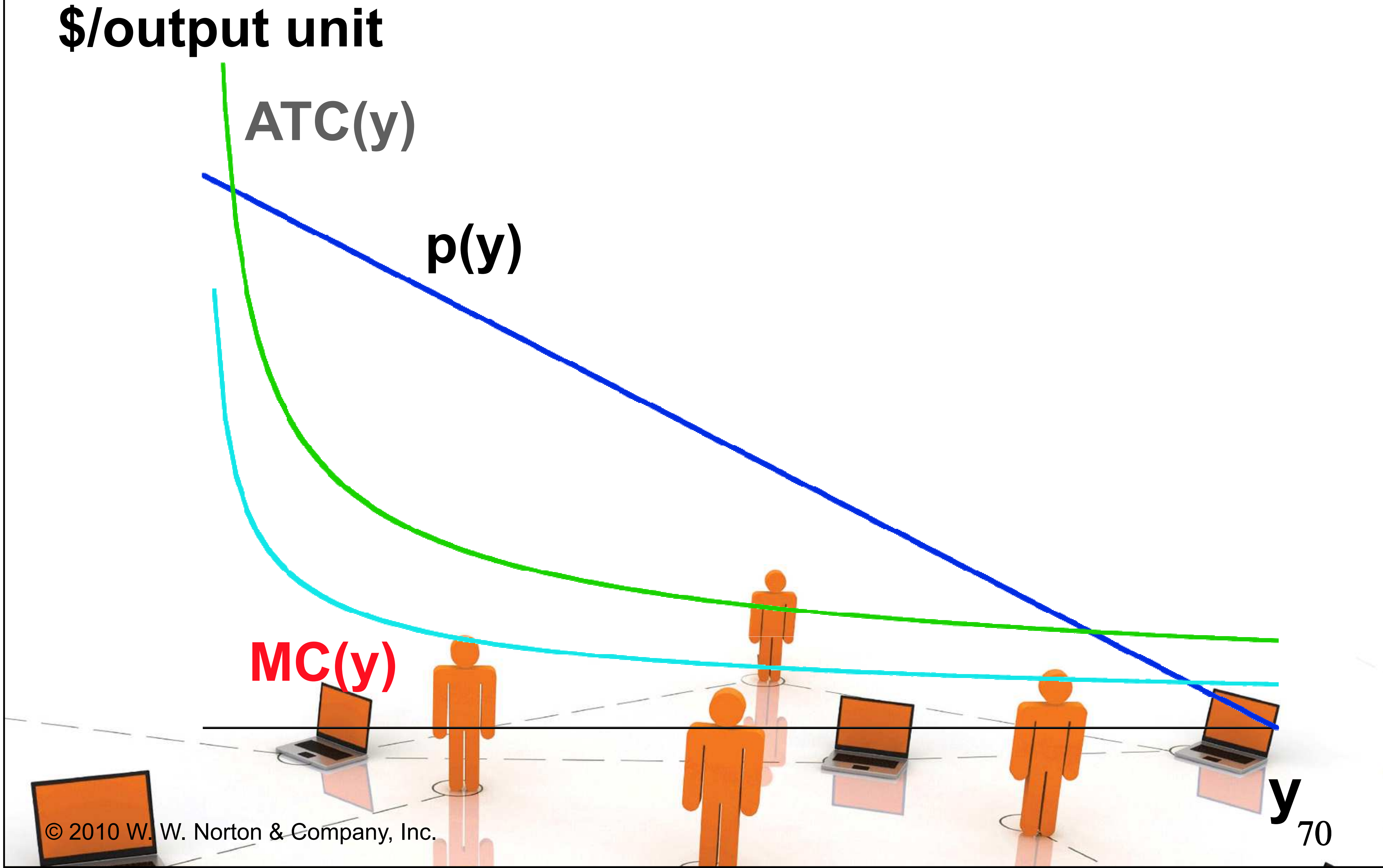
The monopolist produces less than the efficient quantity, making the market price exceed the efficient market price.

Natural Monopoly

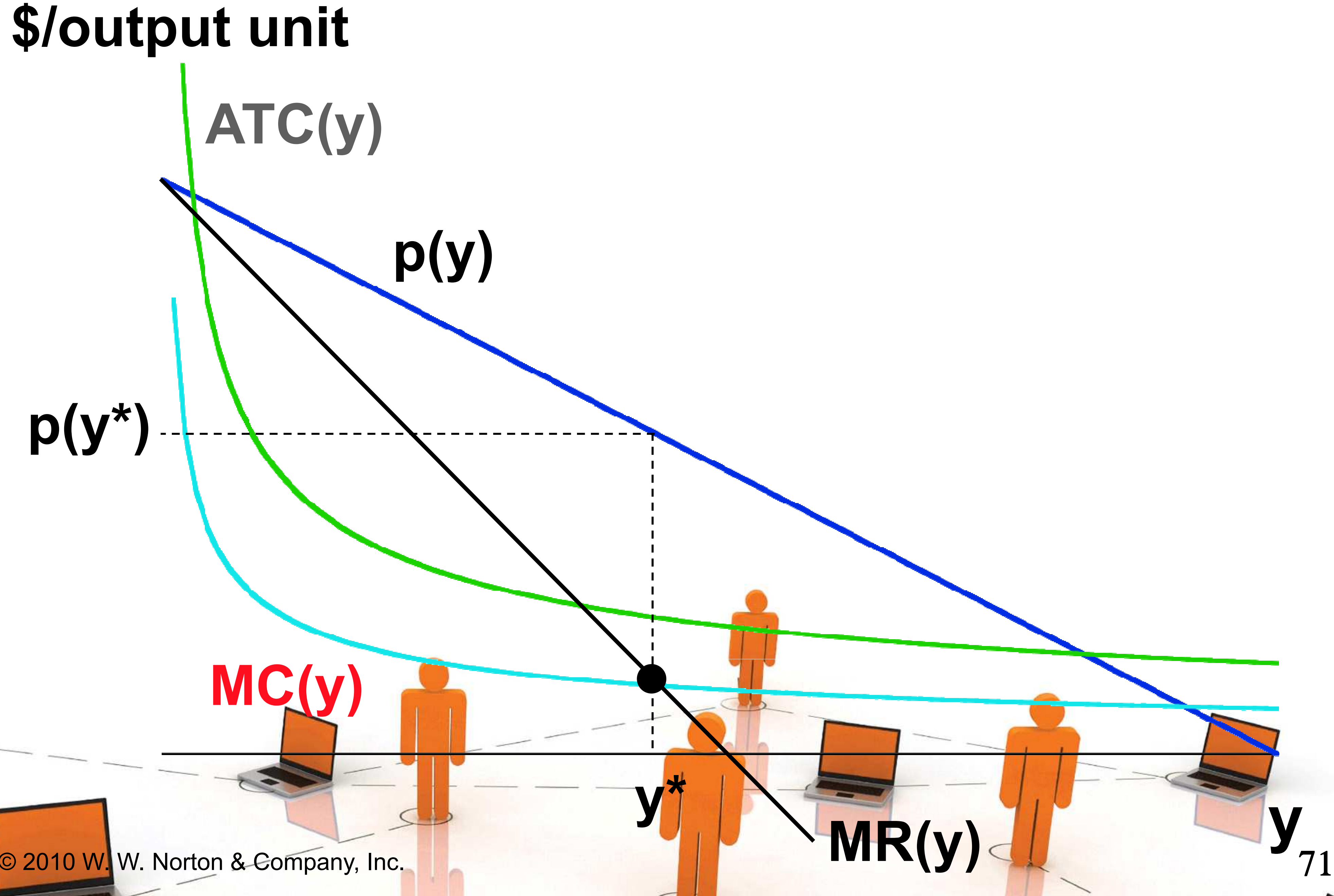
- A natural monopoly arises when the firm’s technology has economies-of-scale large enough for it to supply the whole market at a lower average total production cost than is possible with more than one firm in the market.



Natural Monopoly

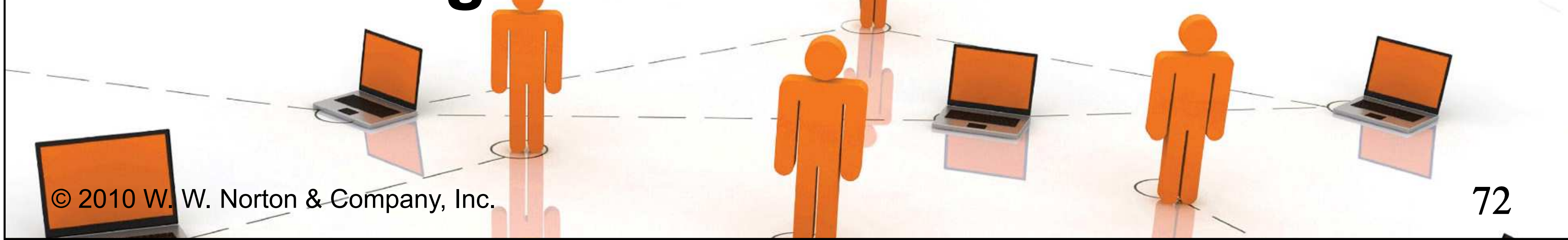


Natural Monopoly



Entry Deterrence by a Natural Monopoly

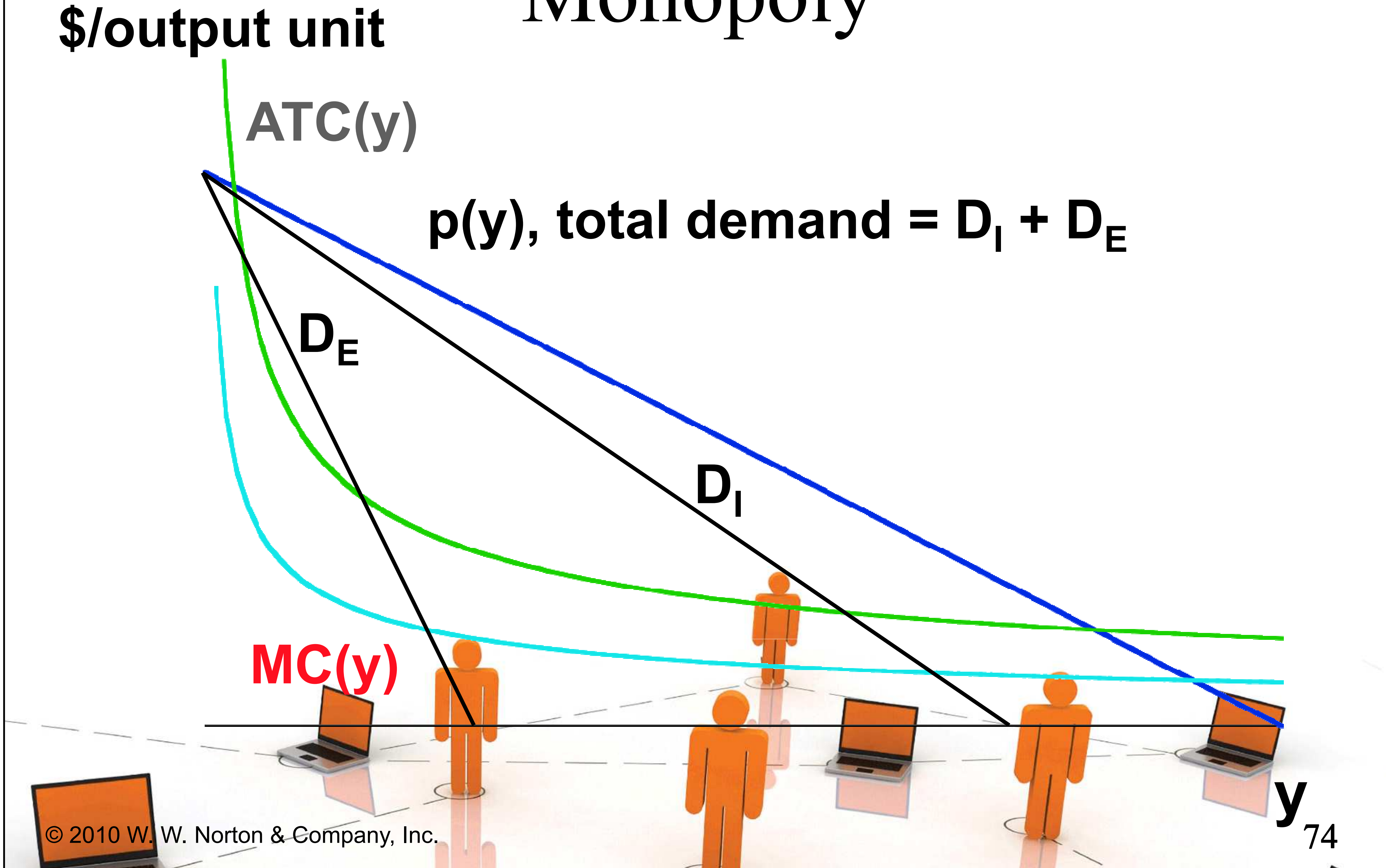
- **A natural monopoly deters entry by threatening predatory pricing against an entrant.**
- **A predatory price is a low price set by the incumbent firm when an entrant appears, causing the entrant's economic profits to be negative and inducing its exit.**



Entry Deterrence by a Natural Monopoly

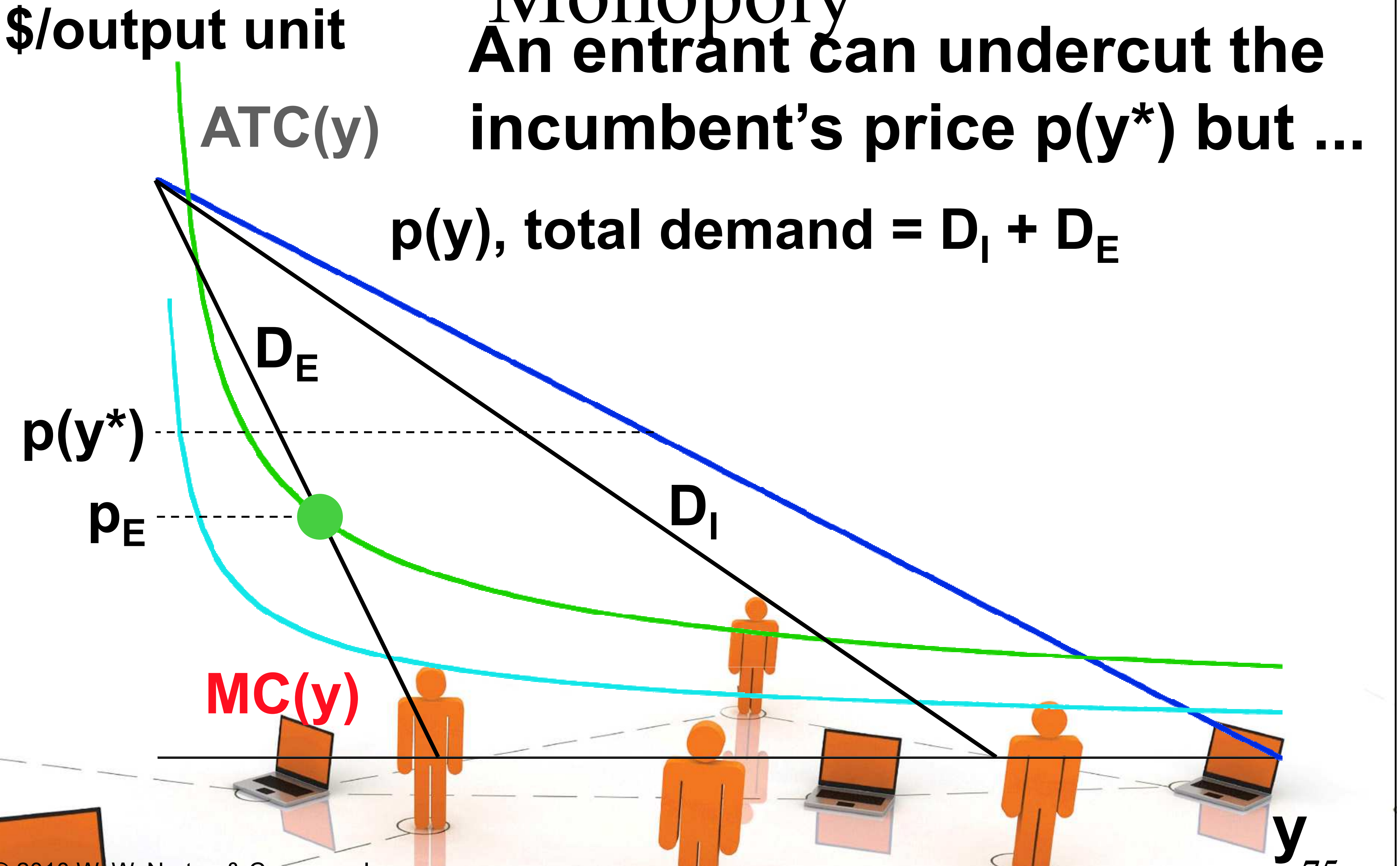
- **E.g. suppose an entrant initially captures one-quarter of the market, leaving the incumbent firm the other three-quarters.**

Entry Deterrence by a Natural Monopoly



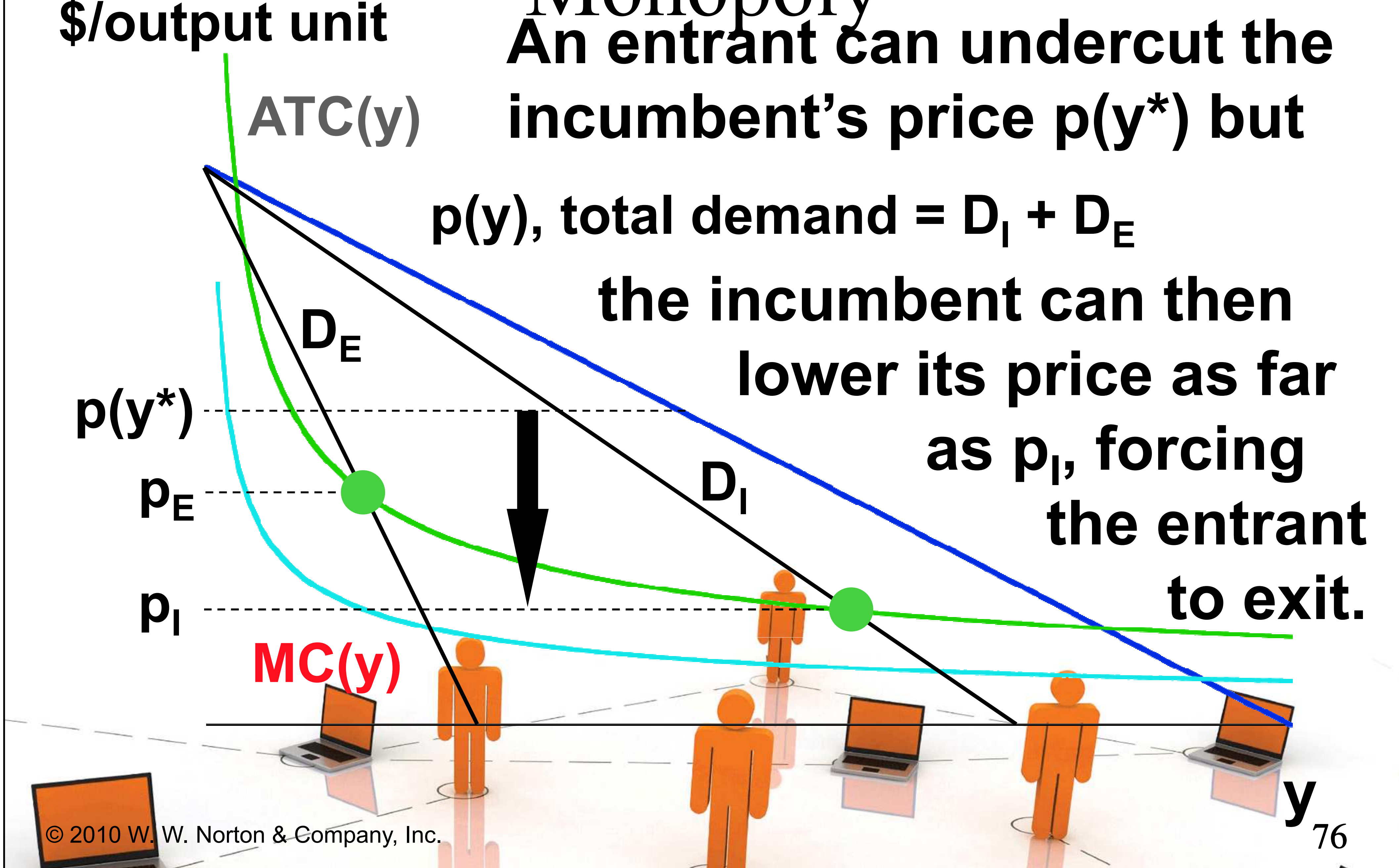
Entry Deterrence by a Natural Monopoly

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



Entry Deterrence by a Natural Monopoly

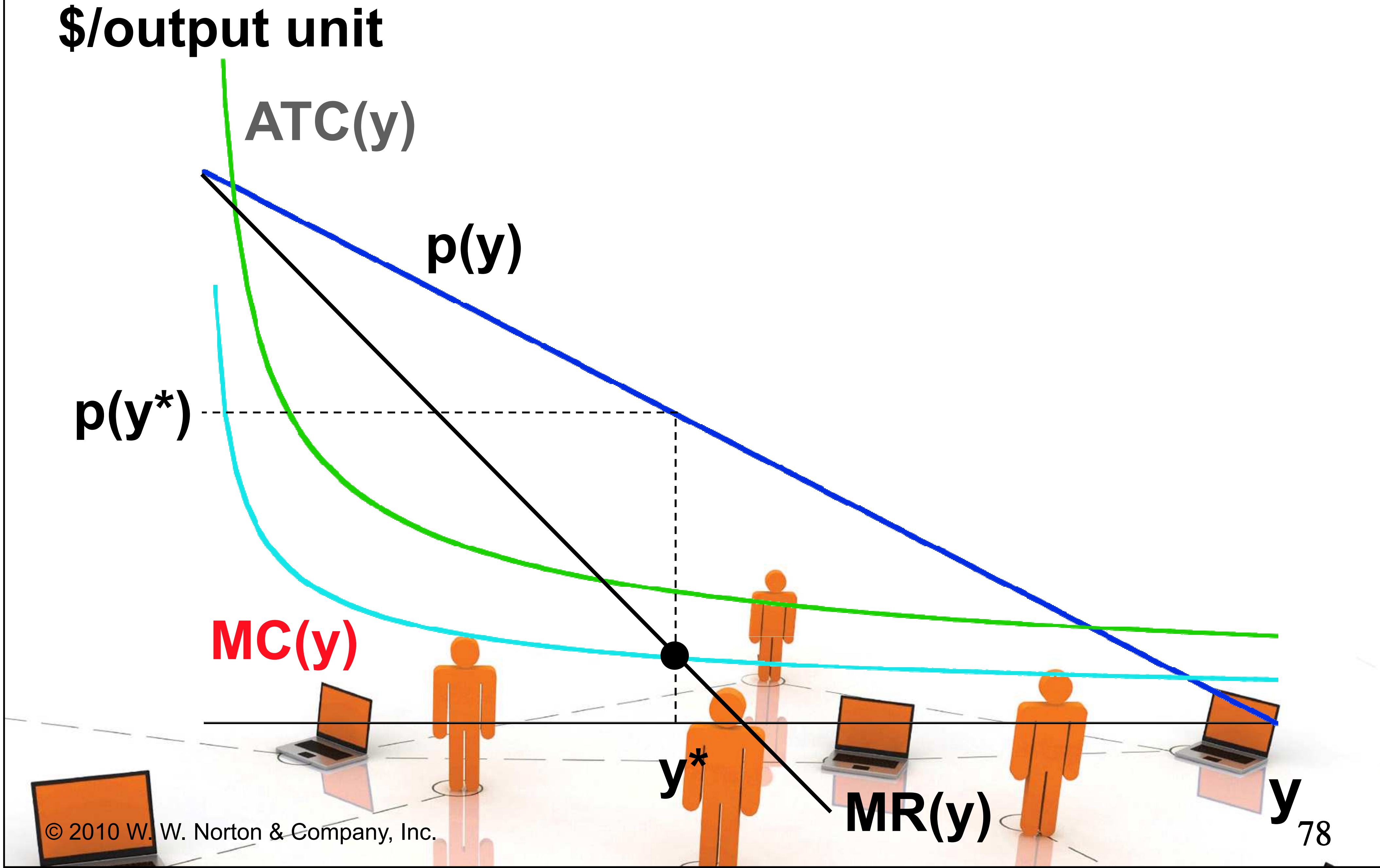
An entrant can undercut the incumbent's price p(y*) but the incumbent can then lower its price as far as p_I, forcing the entrant to exit.



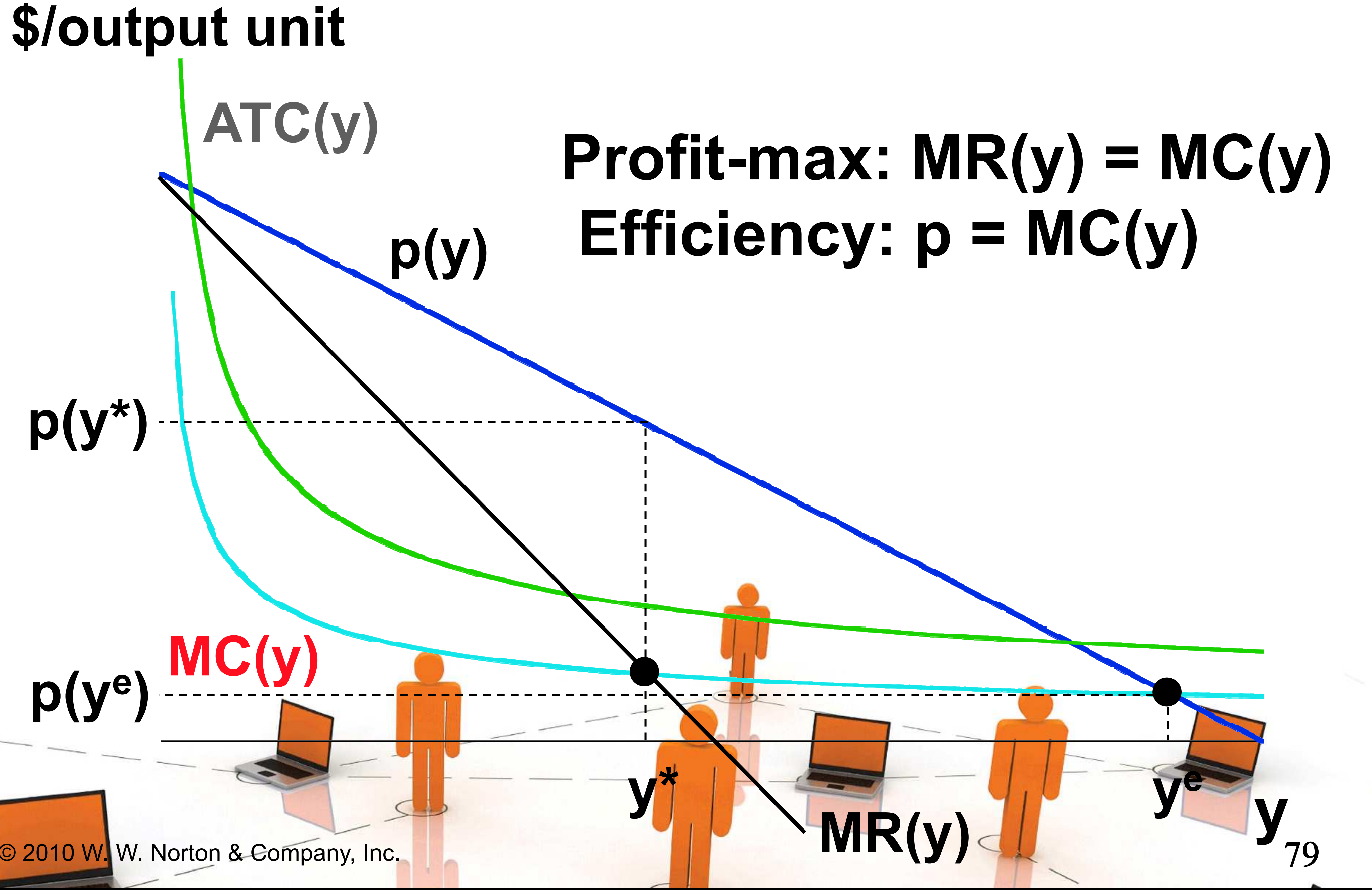
Inefficiency of a Natural Monopolist

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

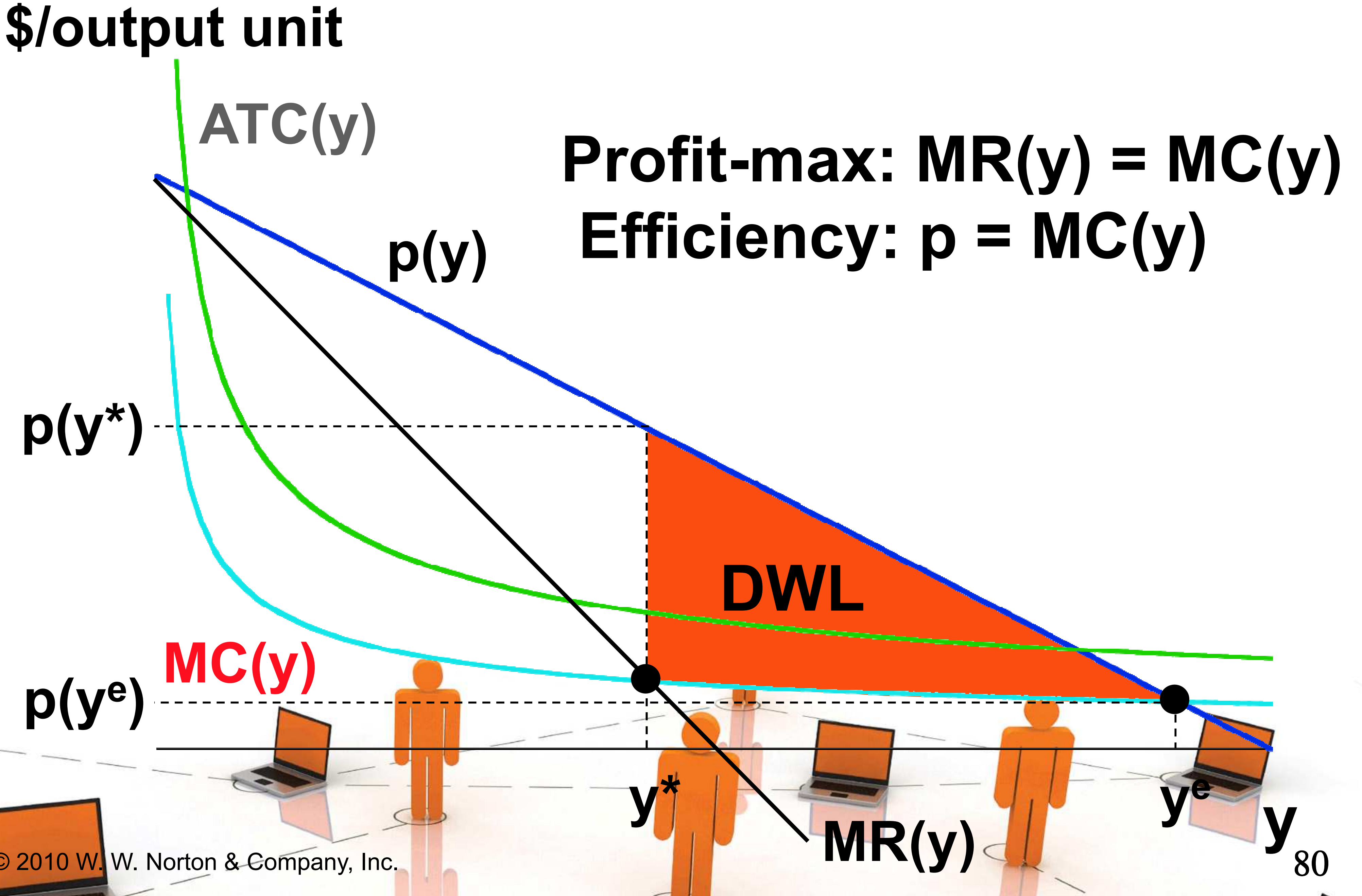
Inefficiency of a Natural Monopoly



Inefficiency of a Natural Monopoly



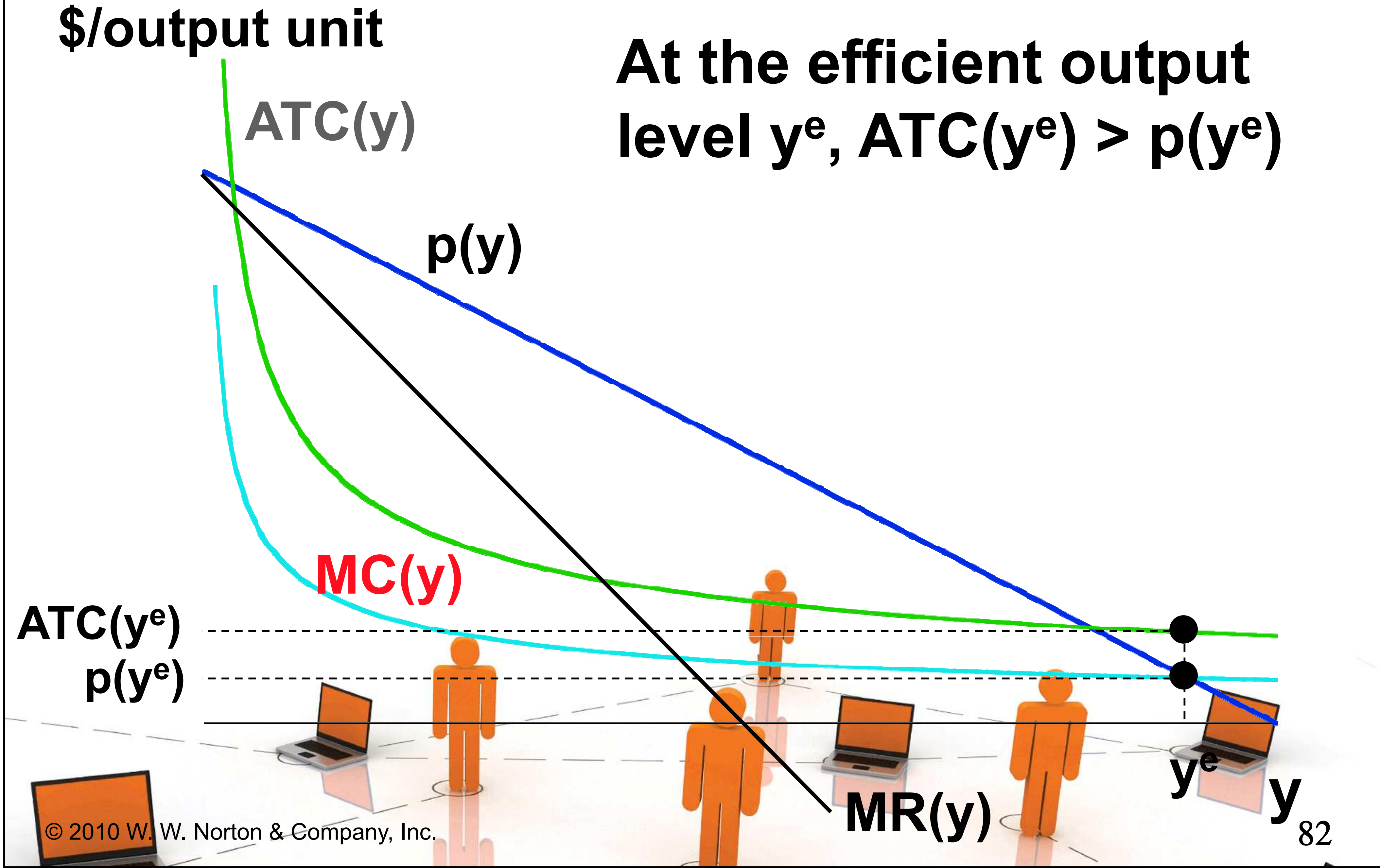
Inefficiency of a Natural Monopoly



Regulating a Natural Monopoly

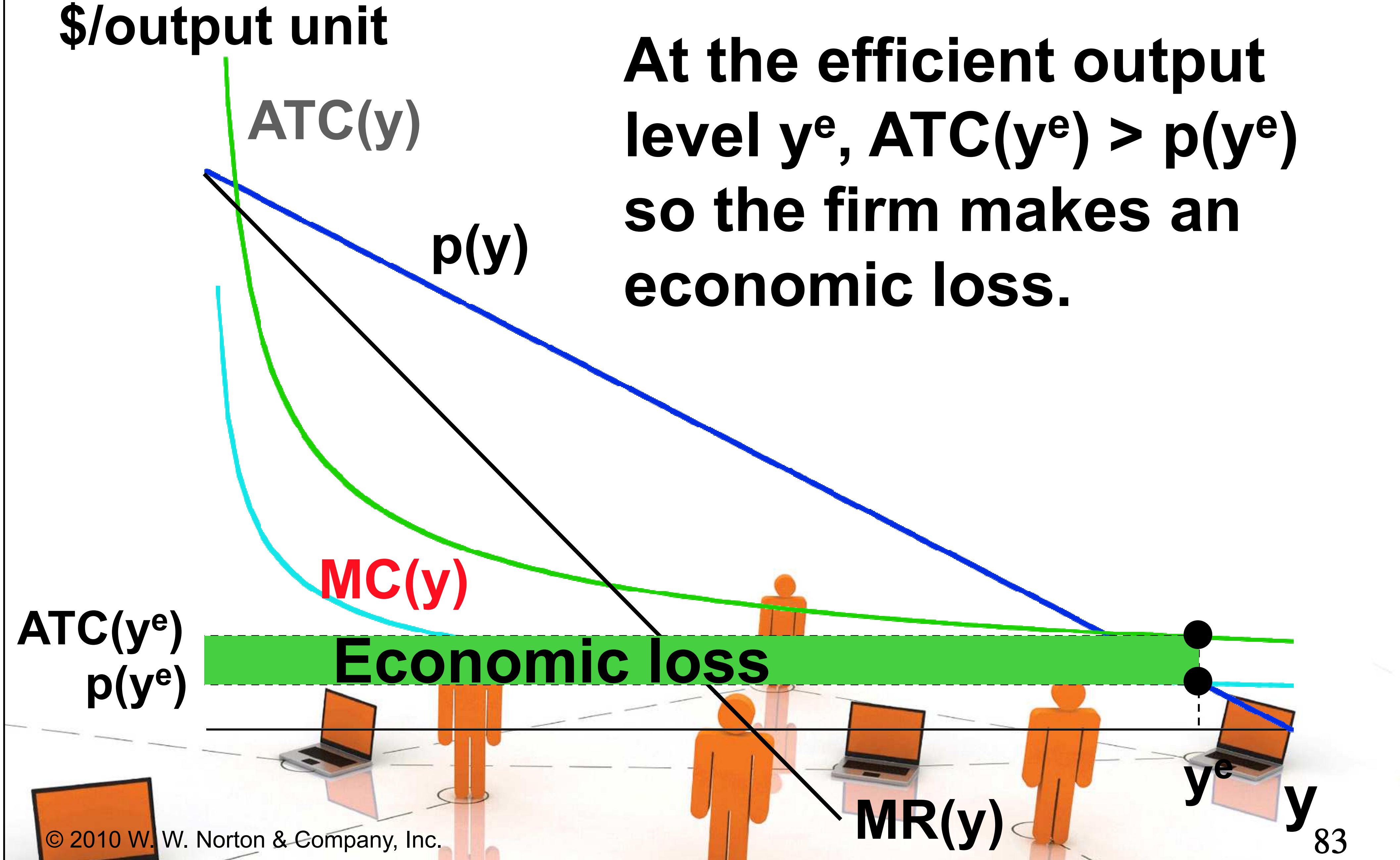
- **Why not command that a natural monopoly produce the efficient amount of output?**
- **Then the deadweight loss will be zero, won't it?**

Regulating a Natural Monopoly



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.**