Chapter 7

Profit Maximization and Supply

The Nature of Firms

- While firms are complex institutions, the typical approach taken by economists is to assume that the firm's decisions are made by a single dictatorial manager who rationally pursues some goal.

- The goal most often used is that the firm maximizes economic profit.

APPLICATION 7.1: Corporate Profits, Taxes, and Leveraged Buyout Craze

- The U.S. corporate profit tax was levied in was levied in 1909, four years before the personal income tax.

- Some economists believe that this tax seriously distorts the allocation of resources because

  - It fails to use the economic profit definition.

  - It taxes corporate income twice.

Definition of Profits

- Much of what is defined as corporate profits under the tax laws is a normal return to shareholders for the equity they have invested in the corporation.

- Shareholders expect return on their investment whether interest from bonds or returns on equity.

Definition of Profits

- Some portion of corporate profits reflects the owners forgone earnings by making equity investments.

- If this cost were added to corporate costs, profits would be substantially reduced.

Effects of the Double Tax

- The corporate profits tax is a tax on the equity returns of corporate shareholders.

- Two effects of this tax.

  - Corporations find it more attractive to finance new capital investments through loans and bond offerings whose interest is tax deductible.

Effects of the Double Tax

- Since corporate income is taxed twice--when it is earned by the corporation and when it is paid to shareholders as dividends--the total rate of tax applied to corporate equity capital is much higher than applied to other capital.

● Investors will be less willing to invest in corporate business than in other assets that are not taxed at as high a tax rate.

The Leveraged Buyout Craze

- Some suggest that these peculiarities are partly responsible for the wave of leveraged buyouts (LBOs) that swept financial markets in the 1980s.

  – The basic principle is to use borrowed funds to acquire most of the outstanding stock of a corporation which substitutes a less highly taxed source of capital (debt) for the highly taxed form (equity).

The Leveraged Buyout Craze

- The benefits of LBOs are larger when corporations can be purchased cheaply.

- The huge increases in stock prices in starting in 1991 made such deals less profitable.

- Most late 1990 buyouts came through the use of vastly appreciated share prices as high prices made equity finance cheaper.

Marginalism

- Firms as profit maximizers will make decisions in a marginal way.

- The manager looks, for example, at the marginal profit from producing one more unit of output or the additional profit from hiring one more unit of labor.

- When the incremental profit of an activity becomes zero, profits are maximized.

The Output Decision

● Economic profits (π) are defined as
$$\pi = R(q) - TC(q)$$

where *R(q)* is the amount of revenues received and *TC(q)* are the economic costs incurred, , both depending upon the level of output (q) produced.

● The firm will choose the level of output that generates the largest level of profit.

The Output Decision

- In Figure 7.1, (TC) is the total cost curve that is drawn consistent with the discussion in Chapter 6.

- The total revenues curve is labeled (R).

- As drawn in the figure, profits reach their maximum at the output level q^*.

FIGURE 7.1: Marginal Revenue Must Equal Marginal Cost for Profit Maximization
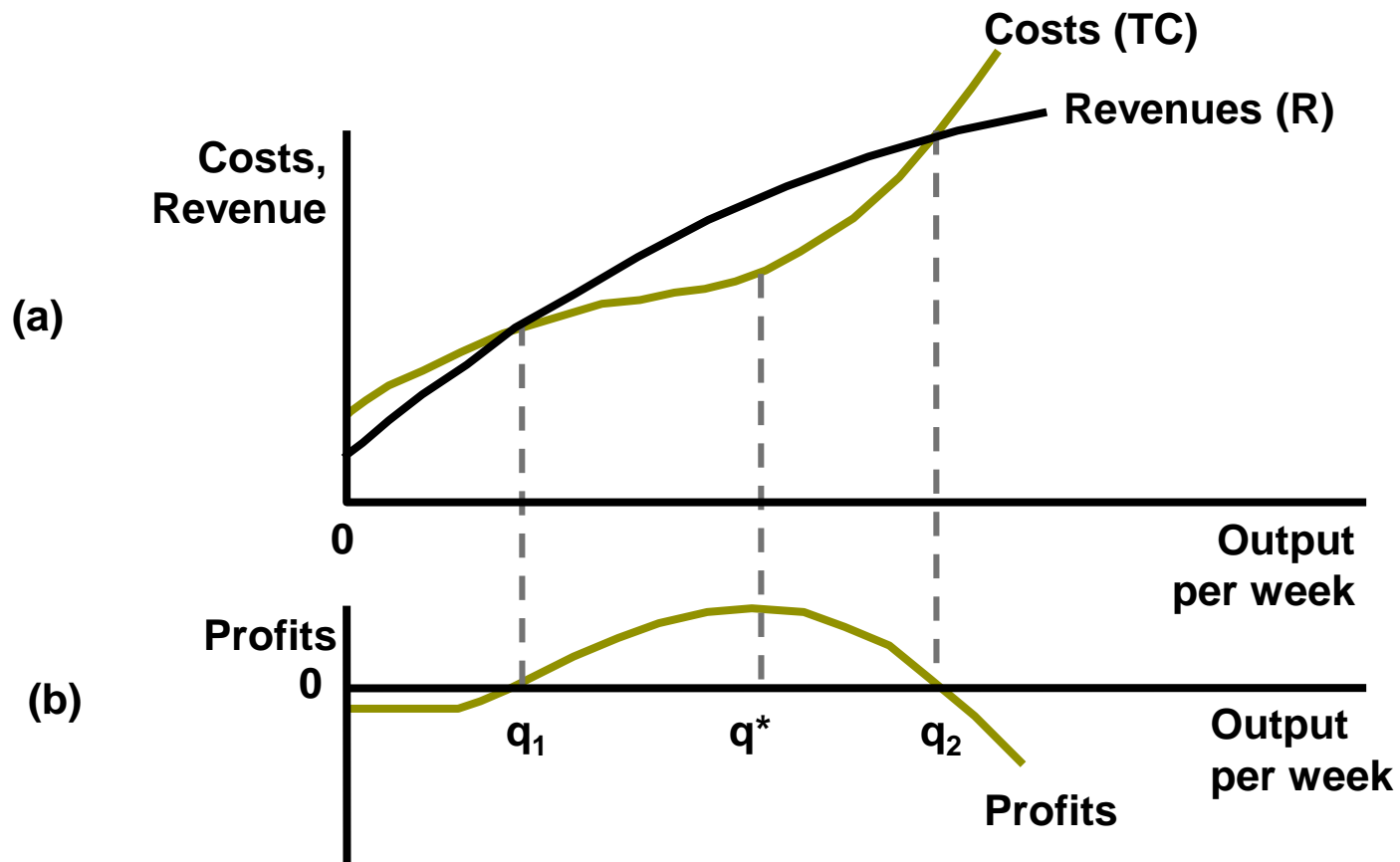
The Marginal Revenue/Marginal Cost Rule

- At output levels below q^* increasing output causes profits to increase, so profit maximizing firms would not stop short of q^*.

- Increasing output beyond q^* reduces profits, so profit maximizing firms would not produce more than q^*.

The Marginal Revenue/Marginal Cost Rule

- At q^* marginal cost equals marginal revenue, the extra revenue a firm receives when it sells one more unit of output.

- In order to maximize profits, a firm should produce that output level for which the marginal revenue from selling one more unit of output is exactly equal to the marginal cost of producing that unit of output.

The Marginal Revenue/Marginal Cost Rule

- At the profit maximizing level of output

  Marginal Revenue = Marginal Cost

  or

  MR = MC.

- Firms, starting at zero output, can expand output so long as marginal revenue exceeds marginal cost, but don't go beyond the point where these two are equal.

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Marginalism in Input Choices

- Both labor and capital should be hired up to the point where the additional revenue brought in by selling the output produced by the extra labor or capital equals the increase in costs brought on by hiring the additional inputs.

Marginal Revenue

- A **price taker** is a firm or individual whose decisions regarding buying or selling have no effect on the prevailing market price of a good or service.

- For a price taking firm
$$MR = P.$$

Marginal Revenue for a Downward-Sloping Demand Curve

● A firm that is not a price taker faces a downward sloping demand curve for its product.

● These firms must reduce their selling price in order to sell more goods or services.

● In this case marginal revenue is less than market price

$$MR < P.$$

A Numerical Example

- Assume the quantity demanded of tape cassettes from a particular store per week (q) is related to the price (P) by

$$q = 10 - P.$$

- Total revenue is (P·q) and marginal revenue (MR) is the change in total revenue due to a change in quantity demanded.

A Numerical Example

- This example demonstrates that MR < P as shown in Table 7.1.

- Total revenue reaches a maximum at q = 5, P = 5.

- For q > 5, total revenues decline causing marginal revenue to be negative.

TABLE 7.1: Total and Marginal Revenue for Cassette Tapes (q = 10 - P)

Price (P)	Quantity (q)	Total Revenue (P·q)	Marginal Revenue (MR)
$10	0	$0	
9	1	9	$ 9
8	2	16	7
7	3	21	5
6	4	24	3
5	5	25	1
4	6	24	-1
3	7	21	-3
2	8	16	-5
1	9	9	-7
0	10	0	-9

A Numerical Example

- This hypothetical demand curve is shown in Figure 7.2.

- When q = 3, P = $7 and total revenue equals $21 which is shown by the area of the rectangle P*Aq*0.

- If the firm wants to sell four tapes it must reduce the price to $6.

FIGURE 7.2: Illustration of Marginal Revenue for the Demand Curve for Cassette Tapes (q = 10 - P)
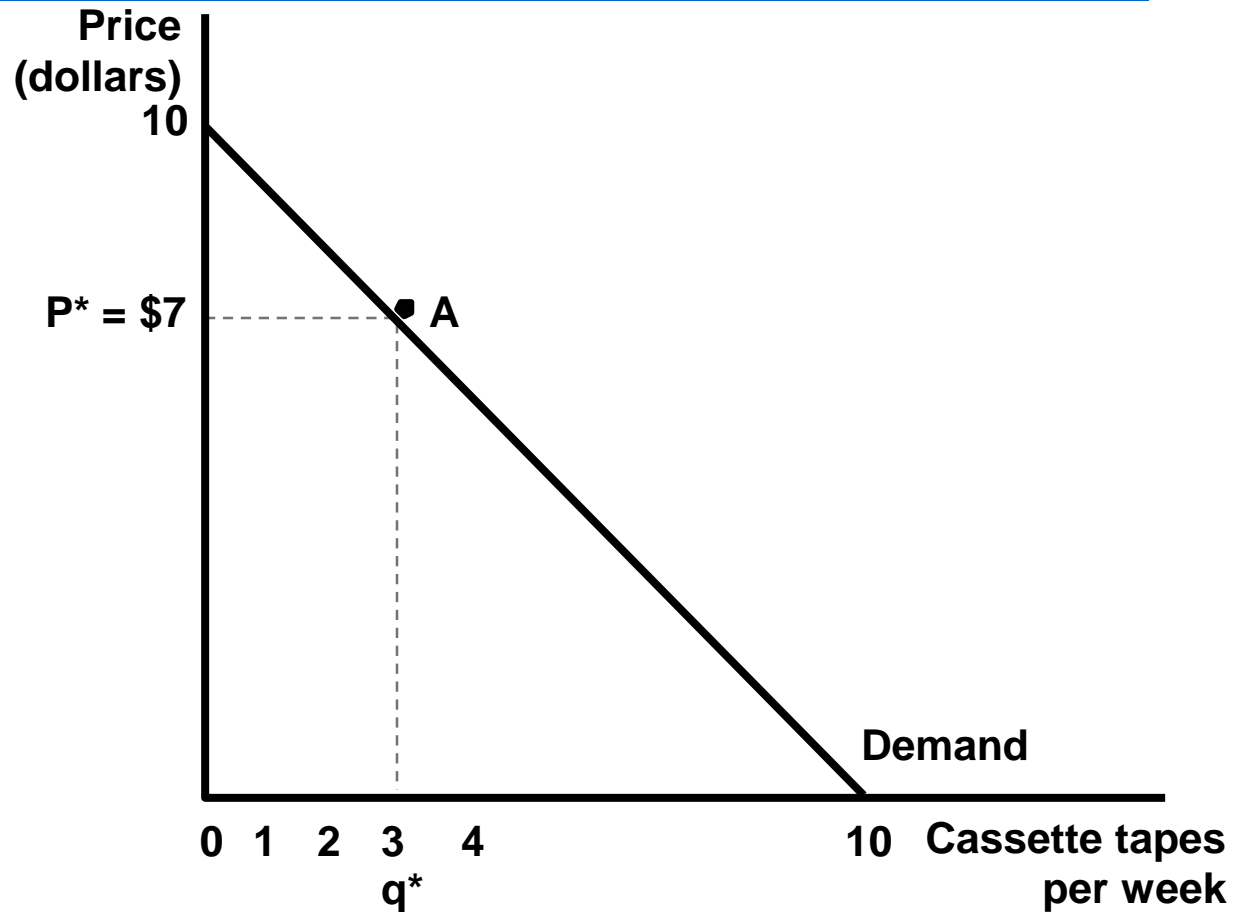
A Numerical Example

- Total revenue is not $24 as illustrated by the area of the rectangle P**Bq**0.

- The sale of one more tape increases revenue by the price at which it sells ($6).

- But, to sell the fourth tape, it must reduce its selling price on the first three tapes from $7 to $6 which reduces revenue by $3, which is shown in the lightly shaded rectangle.

FIGURE 7.2: Illustration of Marginal Revenue for the Demand Curve for Cassette Tapes (q = 10 - P)
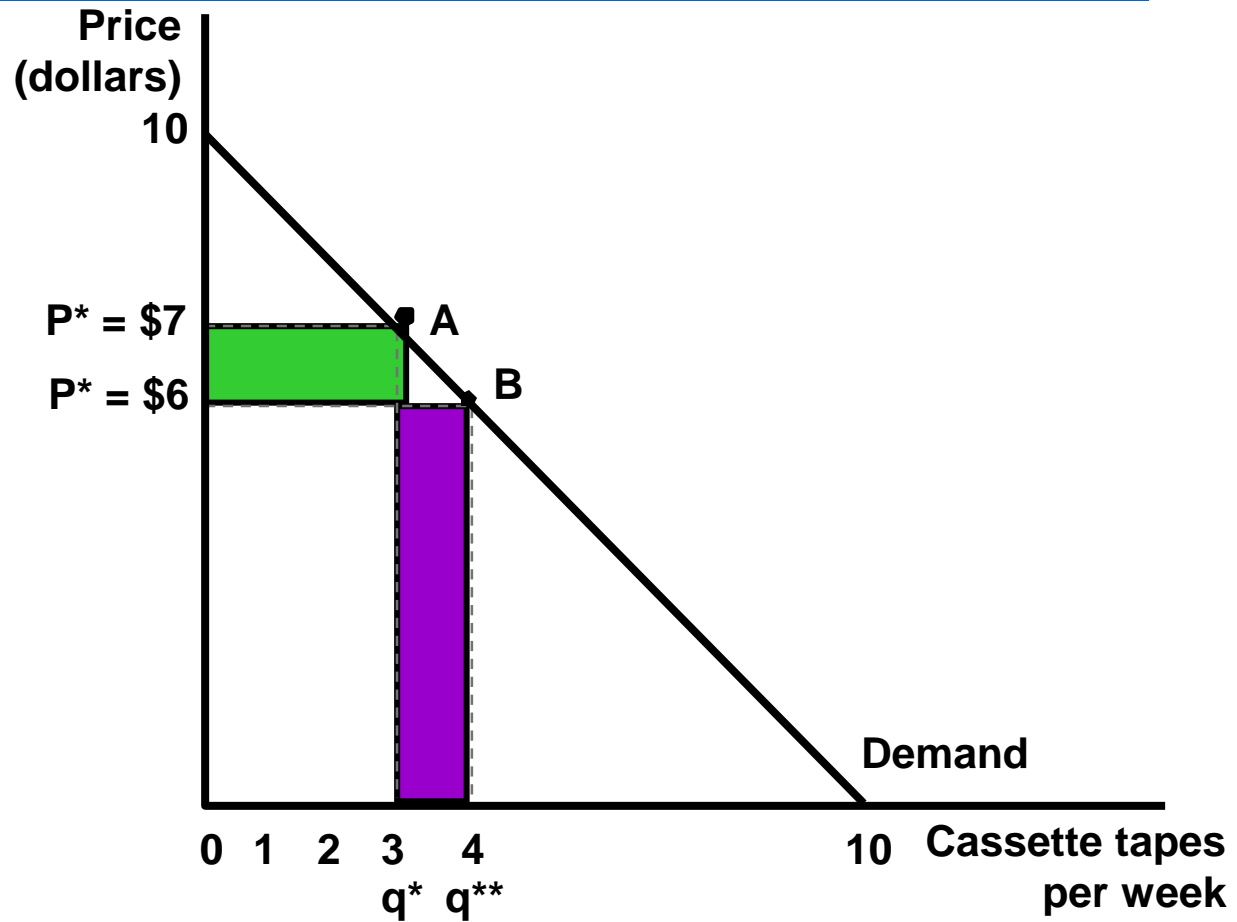
A Numerical Example

- The net result of this price decrease is total revenue increases by only $3 ($6 - $3).

- Thus, the marginal revenue of the fourth tape is $3.

- The sale of the sixth tape, instead of five, results in an increase in revenue of the price ($4), but a decrease for the five other tapes (-$5) with a net effect (MR) = -$1.

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Marginal Revenue and Price Elasticity

● As previously defined in Chapter 4, the price elasticity of demand for the market is

$$e_{q,P} = \frac{\text{Percentage change in Q}}{\text{Percentage change in P}}.$$

● This same concept can be defined for a single firm as

$$e_{q,P} = \frac{\text{Percentage change in q}}{\text{Percentage change in P}}.$$

Marginal Revenue and Price Elasticity

- If demand facing the firm is inelastic

  $(0 \geq e_{q,P} > -1)$, a rise in the price will cause total revenues to rise.

- If demand is elastic ($e_{q,P} < -1$), a rise in price will result in smaller total revenues.

- This relationship between the price elasticity and marginal revenue is summarized in Table 7.2.

TABLE 7.2: Relationship between Marginal Revenue and Elasticity

Demand Curve	*Marginal Revenue*
Elastic ($e_{q,p} < -1$)	$MR > 0$
Unit elastic ($e_{q,P} = -1$)	$MR = 0$
Inelastic ($e_{q,P} > -1$)	$MR < 0$

Marginal Revenue and Price Elasticity

- It can be shown that all of the relationships in Table 7.2 can be derived from the basic equation

$$MR = P\left(1 + \frac{1}{e_{q,P}}\right)$$

- For example, if $e_{q,P} < -1$ (elastic), this equation shows that MR is positive.

Marginal Revenue and Price Elasticity

- If demand is infinitely elastic ($e_{q,P} = -\infty$), MR will equal price, as was shown when the firm is a price taker.

- Suppose a non price taker firm knows elasticity = -2 and its current price is $10.

- Selling one more product will result in a marginal revenue of $5 [$10(1+1/-2)], which would be produced only if MC < $5.
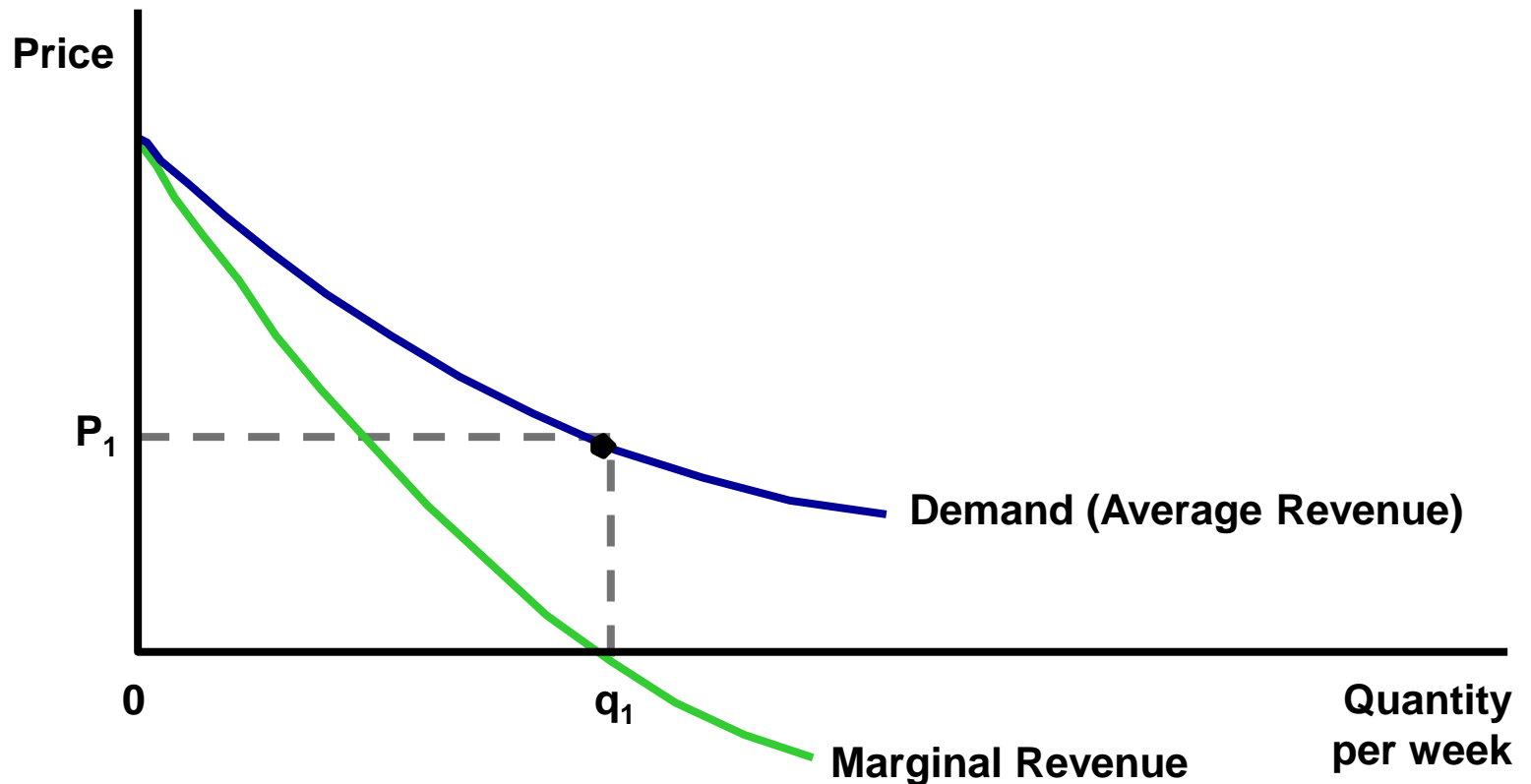
Marginal Revenue Curve

- It is sometimes useful to think of the demand curve as the *average revenue curve* since it shows the revenue per unit (price).

- The **marginal revenue curve** is a curve showing the relation between the quantity a firm sells and the revenue yielded by the last unit sold. It is derived from the demand curve.

Marginal Revenue Curve

- With a downward-sloping demand curve, the marginal revenue curve will lie below the demand curve since, at any level of output, marginal revenue is less than price.

- A demand and marginal revenue curve are shown in Figure 7.3.

- For output levels greater than q_1, marginal revenue is negative.

FIGURE 7.3: Marginal Revenue Curve Associated with a Demand Curve

Price

P_1

Demand (Average Revenue)

Marginal Revenue

0   q_1 Quantity per week

Shifts in Demand and Marginal Revenue Curves

- As previously discussed, changes in such factors as income, other prices, or preferences cause demand curves to shift.

- Since marginal revenue curves are derived from demand curves, whenever the demand curve shifts, the marginal revenue curve also shifts.

APPLICATION 7.2: How Did Airlines Respond to Deregulation?

- Due to the Airline Deregulation Act of 1978
    - Regulation of airline fares was reduced or eliminated entirely.
    - Rules governing the assignment of airline routes were relaxed
- The response of airlines was generally consistent with the profit-maximization hypothesis.

Marginal Revenue

- Businesspeople have relatively inelastic demands, so the prices for the type of seats they normally buy did not change much.

- Tourists and similar persons have relatively elastic demands, and large price reductions were targeted for these groups.

- Overall, these discount fares generated far more revenue than across-the-board cuts.

Marginal Cost

- While fleets of aircraft could not be changed in the short-run, airlines altered their route structure.

    – Service to many small communities, previously required by the Civil Aeronautics Board, were curtailed.

    – Hub-and-spoke procedures were adopted to allow firms to use different types of aircraft on different routes.
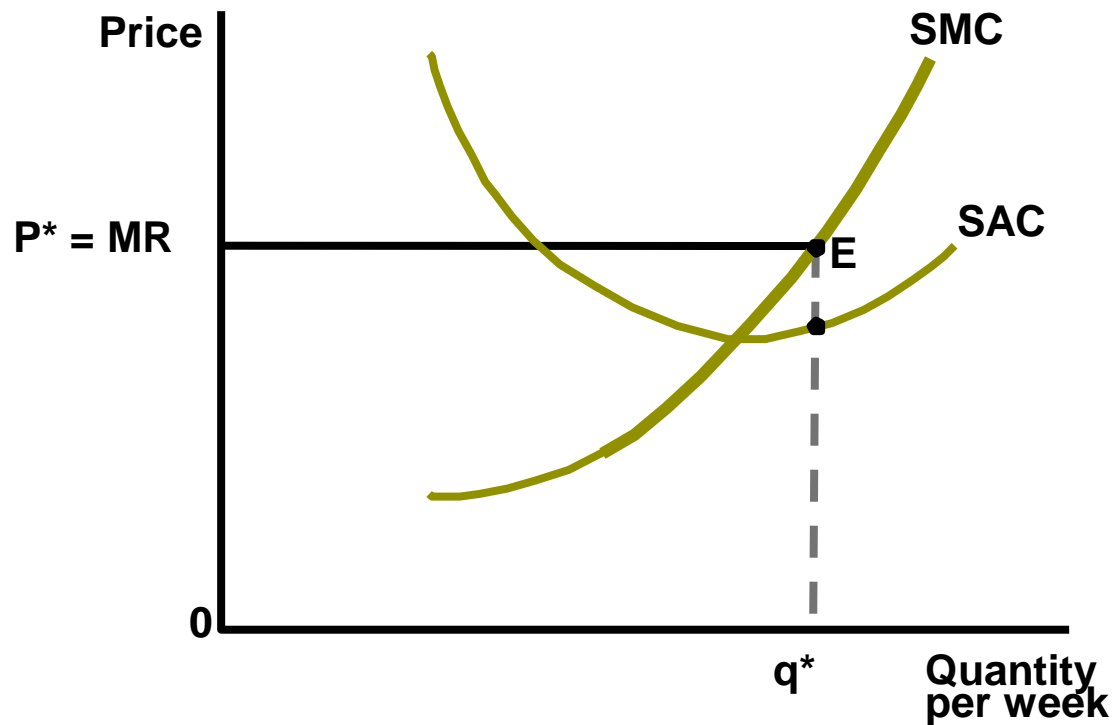
Marginal Cost

- Because the marginal cost associated with filling empty seats on a plane is essentially zero, profits from the last few passengers on a flight are very high.

- Airlines have tried very hard to reduce the losses they suffer from "no shows" by selling more space than is available--overbooking.

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Short-Run Profit Maximization

- Since the firm has no effect on the price it receives for its product, the goal of maximizing profits dictates that it should produce the quantity for which marginal cost equals price.

- At a given price, such as P^* in Figure 7.4, the firm's demand curve is a horizontal line through P^*.

FIGURE 7.4: Short-Run Supply Curve for a Price-Taking Firm

Short-Run Profit Maximization

- At $P^* = MR$, the firm maximizes profits by producing q^*, since this is where price equals short-run marginal costs.

- At P^* profits are positive since P > SAC, but at a price such as P^{***}, short-run profits would be negative.

- If price just equaled average cost (and marginal cost), short-run profits equal zero.

FIGURE 7.4: Short-Run Supply Curve for a Price-Taking Firm
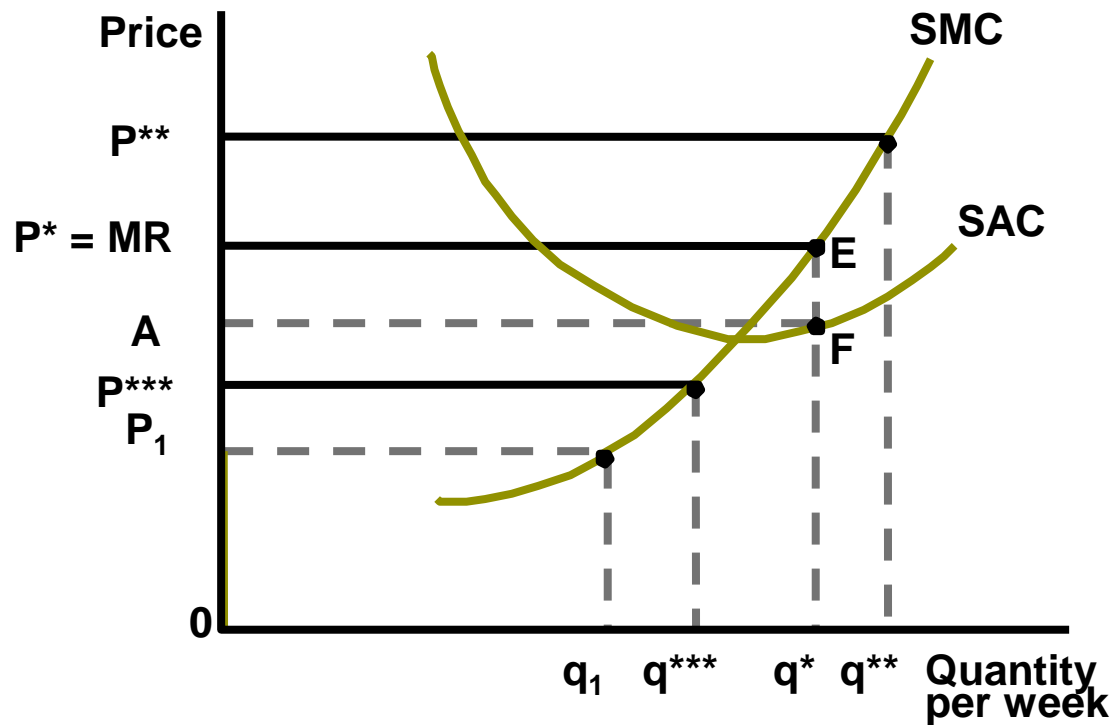
Short-Run Profit Maximization

- If, at P^* the firm produced less than q^*, profits could be increased by producing more since MR > SMC below q^*.

- Alternatively, if the firm produced more than q^* profits could be increased by producing less since MR < SMC beyond q^*.

- Thus, profits can only be maximized by producing q^* when price is P^*.

Short-Run Profit Maximization

- Total profits are given by the area P^*EFA which can be calculated by multiplying profits per unit $(P^* - A)$ times the firm's chosen output level q^*.

- For this situation to truly be a maximum profit, the marginal cost curve must also be be increasing (it would be a profit minimum if the marginal cost curve was decreasing).

The Firm's Short-Run Supply Curve

- The **firm's short-run supply curve** is the relationship between price and quantity supplied by a firm in the short-run.

- For a price-taking firm, this is the positively sloped portion of the short-run marginal cost curve.

- For all possible prices, the marginal cost curve shows how much output the firm should supply.

The Shutdown Decision

- For very low prices, the firm could also produce zero output.

- Since fixed costs are incurred whether or not the firm produces any goods, the decision to produce is based on short-run variable costs.

The Shutdown Decision

- The firm will opt for q > 0 providing

$$P \cdot q \geq SVC$$

$$\text{or, dividing by q,}$$

$$P \geq \frac{SVC}{q}.$$

- The price must exceed average variable cost.

The Shutdown Decision

- The **shutdown price** is the price below which the firm will choose to produce no output in the short-run. It is equal to minimum average variable costs.

- In Figure 7.4, the shutdown price is P_1.

- For all $P \geq P_1$ the firm will follow the $P = MC$ rule, so the supply curve will be the short-run marginal cost curve.

The Shutdown Decision

- Notice, the firm will still produce if P < SAC, so long as it can cover its fixed costs.

- However, if price is less than the shutdown price (P < P_1 in Figure 7.4), the firm will have smaller losses if it shuts down.

- This decision is illustrated by the colored segment $0P_1$ in Figure 7.4.

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FIGURE 7.4: Short-Run Supply Curve for a Price-Taking Firm
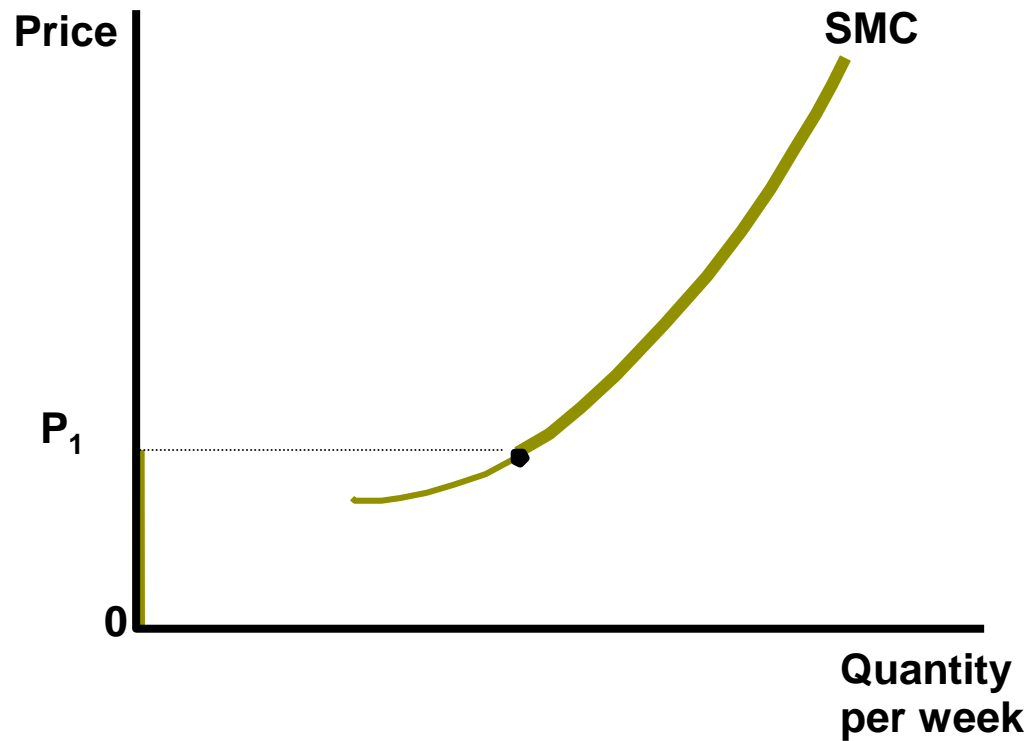
APPLICATION 7.3: Why Is Drilling for Crude Oil Such a Boom or Bust Business?

- Since prices for crude oil are set in international markets, oil drilling firms are price takers responding to price incentives.

  – Rising marginal costs reflect increased costs encountered as firms have to drill to greater depths or in less accessible areas.

- Table 1 shows U.S. oil well drilling activity over the past 27 years.

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TABLE 1: Wold Oil Prices and Oil-Well Drilling Activity in the United States

Year	World Price per Barrel	Real Price per Barrel	Number of Wells Drilled
1970	$3.18	$7.93	21,177
1980	$21.59	$25.16	70,610
1990	$20.03	$16.30	31,555
1997	$23.00	$16.40	26,981

APPLICATION 7.3: Why Is Drilling for Crude Oil Such a Boom or Bust Business?

- The table also shows average prices of crude oil in various years, adjusted for changing prices or drilling equipment.

  – Between 1970 and 1980 real oil prices tripled resulting in a tripling of drilling.

  – Many of these additional wells were drilled in the high cost areas like the Gulf of Mexico or the Arctic Slope of Alaska.

APPLICATION 7.3: Why Is Drilling for Crude Oil Such a Boom or Bust Business?

- By 1990 real crude oil prices had declined by 40 in response to recessions and increased supplies of crude oil from the such places as the North Sea and Mexico.

  – As the table shows, drilling declined in response to lower prices.

  – This continued throughout the 1990s with the number of wells falling below 20,000 by 1997.

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APPLICATION 7.3: Why Is Drilling for Crude Oil Such a Boom or Bust Business?

- The decline in oil prices caused several shutdowns of marginal operations; especially those that used pressurized steam or produced fewer than 10 barrels per day.

- Despite continued new drilling, by 1997 the number of operating wells had dropped by nearly 10 percent compared to the mid-1980s.

APPLICATION 7.3: Why Is Drilling for Crude Oil Such a Boom or Bust Business?

- This lead to problems with suppliers of oil exploration industry.

    – Producers of high-strength oil pipe suffered huge financial losses as they were unable to sell enough to keep their factories fully utilized.

    – Suppliers of other materials for the oil exploration industry had similar problems and many cities in Texas and Louisiana experienced sharp economic downturns.

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Profit Maximization and Managers' Incentives

- The **principal-agent relationship** is an economic actor (the principal) delegating decision-making authority to another party (the agent).

- As early as Adam Smith, it was understood that managers of a company may have different goals than are the goals of the owners of the company.

A Model of the Principal-Agent Relationship

- Figure 7.5 shows the indifference curve map of a manager's preferences between the firm's profits (the primary interest of the owners) and various benefits that accrue mainly to the manager.

- Assuming the manager is also the owner, if the manager chooses no special benefits, profits will be π_{max}.

A Model of the Principal-Agent Relationship

- Each dollar of benefits received by the manger reduces profits by one dollar.

- The slope of the budget constraint is -1, and profits will be zero when benefits equal π_{max}.

- The owner-manager maximizes utility at π^*, B* which, which is somewhat less than π_{max}.

FIGURE 7.5: Incentives for a Manager Acting as an Agent for a Firm's Owners
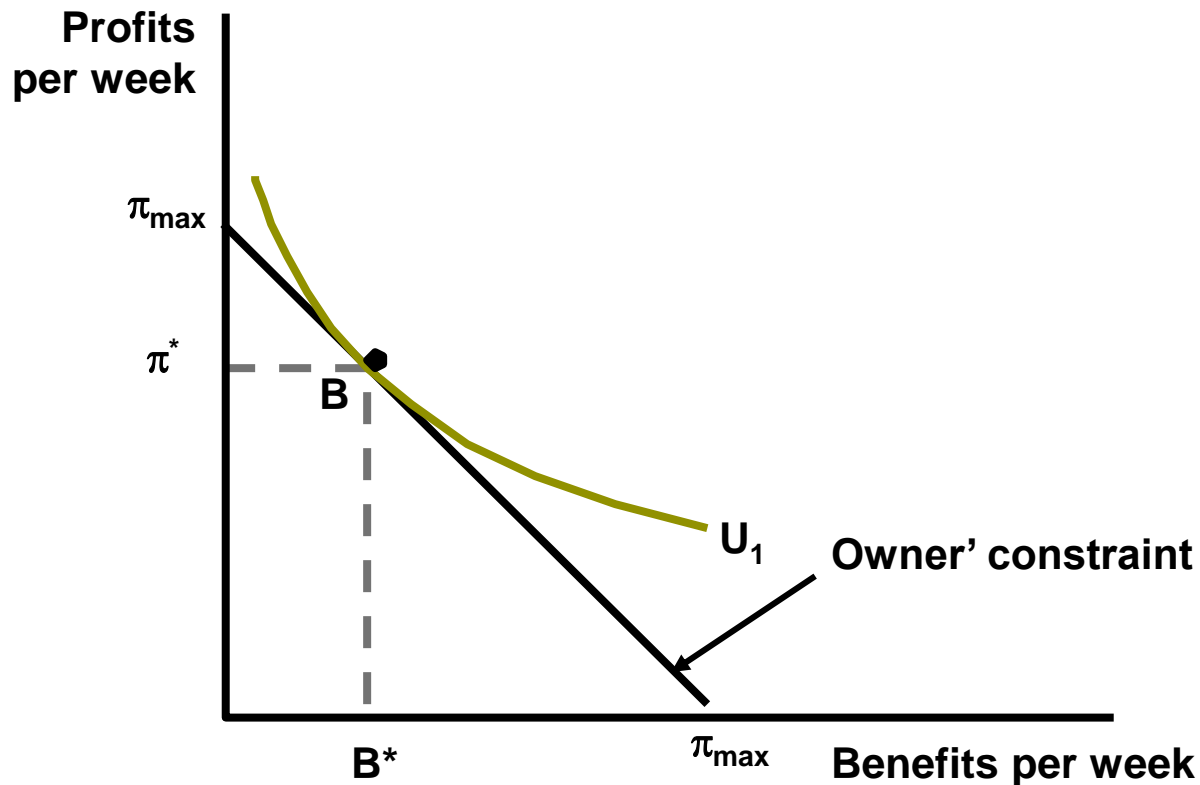
Conflicts in the Agent Relationship

● Now suppose that the manager owns only one-third of the capital with the other two-thirds owned by outside investors.

  – In this case, one dollar in benefits only costs the manager $0.33 in profits which is reflected in the Agent's constraint in Figure 7.6.

  – Now the manager will maximize profits by choosing π^{**}, B**, a lower level of profits and a higher level of benefits.

FIGURE 7.5: Incentives for a Manager Acting as an Agent for a Firm's Owners
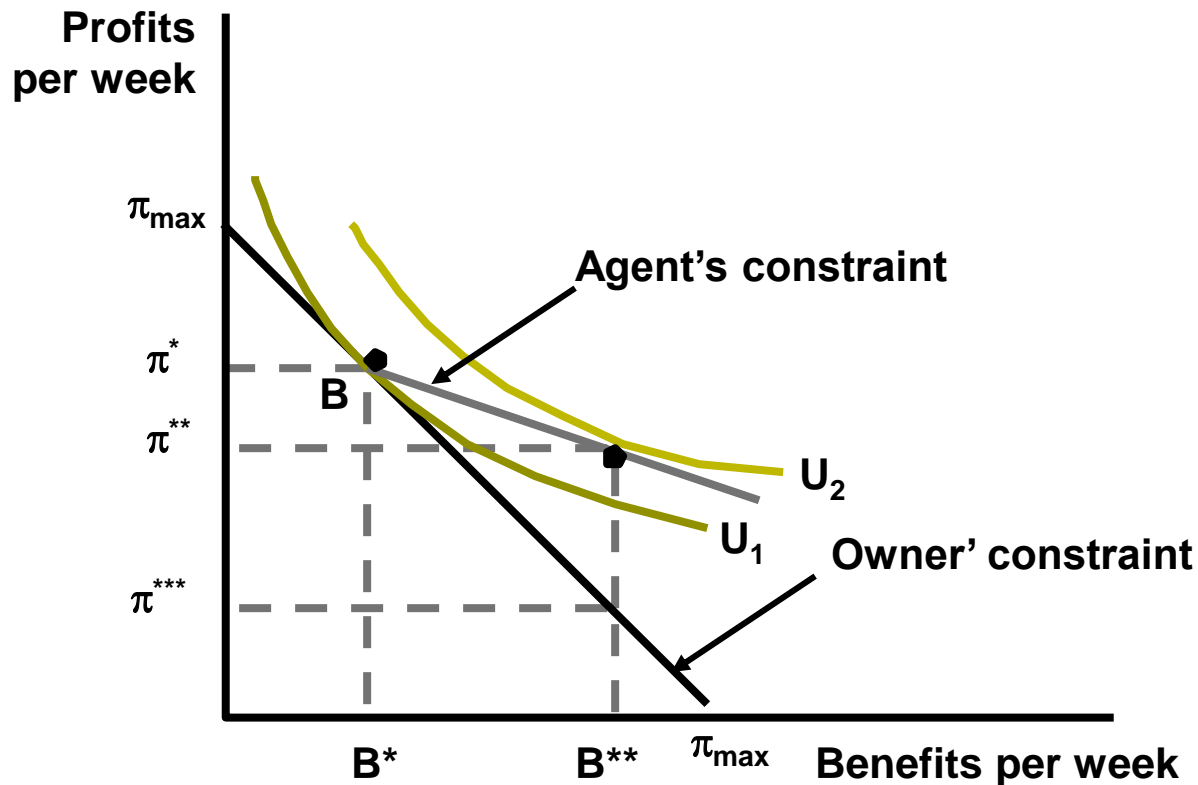
Conflicts in the Agent Relationship

- However, π^{**}, B** is not attainable by the firm, so profits will actually be π^{***}.
- The other owners have been harmed by relying on an agency relationship.
  - It appears that the smaller the ownership by the manager, the greater the reduction in profits.
- Other agent conflicts studied by economists include investment managers and automobile mechanics.

APPLICATION 7.4: Principals and Agents in Franchising and Medicine

- Many large business, such as McDonald's Corporation, operate their local retail outlets through franchise contracts.

  - For example, local McDonalds restaurants are usually owned by local groups of investors.

- The problem for the parent company is to ensure that their franchise agents operate in a proper manner.

APPLICATION 7.4: Principals and Agents in Franchising and Medicine

- Various provisions of franchise contracts help to assure proper behavior.
  - With McDonald's franchises, for example, must meet food-quality and service standards and must purchase supplies from firms that meet standards set by the parent company.
  - The franchisee, in return, gets some management assistance and national advertising and gets to keep a large share of the profits.

APPLICATION 7.4: Principals and Agents in Franchising and Medicine

- Physicians act as agents for patients who often lack knowledge of their illness or what treatments are warranted.

- There are several reasons why physicians might not chose exactly what a fully informed patient might choose.

    – Unlike the physician, the patient must pay the medical bills.

APPLICATION 7.4: Principals and Agents in Franchising and Medicine

- – Since the physician is usually the care provider, he or she may financially benefit from the services provided.

- – Studies find evidence of this physician induced demand, especially for patients with insurance.

- Doctors are "double agents" with insured patients since they represent both the patients and the insurance company.

APPLICATION 7.5: Principals and Agents in Franchising and Medicine

- Current controversies, such as the growth of managed care organizations arise from this dual relationship.

  – The rapid escalation of health costs have resulted in managed care organizations.

  – Alternatively, restrictions place by managed care organizations have resulted in a major backlash among patients.

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Incentive Contracts

- Owners, however, could refuse to invest in firms where managers behave this way.

- Managers would then have two options.

  - They could go it alone and finance the company solely with their funds.

    - This would return to the original case and result in π^*, B*.

  - A manger could work out some agreement with potential investors.

Incentive Contracts

- It would likely be too costly for other owners to have managers completely pay for their benefits.

- But owners could construct contracts that give managers incentives to economize on benefits and pursue more profit maximizing goals.

  - Incentives include stock options and profit sharing bonuses.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- Stock options grant the holder the ability to buy shares at a fixed price.

- If the market price of the shares increases, the holder will benefit by buying at the option price and selling at the higher price.

- Firms grand options to their executives as incentives to manage the firm in a way that leads to increases in stock value.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- While stock options were uncommon in the 1980s, by the 1990s top executives of the largest companies received more than half their total compensation in the form of stock options.

- Reasons for this increase in the use of options include

  – Rising stock prices made this option attractive.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

– Since options are often assigned a zero cost to the firm, they made a low-cost way to pay their executives.

– A special provision of the tax laws enacted in 1993 limited deductions of executive pay to no more than $1 million per year, unless pay was tied to company performance--which increased the incentive to use stock options.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- One estimate found that stock options provide more than 50 times the pay-to-performance ratio provided by conventional pay packages.

- Dollar for dollar, options also provide more pay-to-performance incentives than a simple grant of shares to the executives.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- The exact incentive effects of stock options are complex depending on how the options are granted and the ways in which the stock price for the firm performs.

  – Say a company grants an executive a fixed dollar value of options for each of the next five years.

  – If stock prices increase, the executive will be better off but the value of the options will not change.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- – Alternatively, if the firm grants the executive a fixed number of shares for five years, then increases in the share price will affect his or her future compensation.

- In general, options are less valuable when the firm pays large dividends to its shareholders, so executives with options have an incentive to not pay dividends.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- Options are more valuable when the company's stock price is more volatile, so executives with options have incentives to take greater risks.

- Given the complexity, there is little strong evidence about the actual effects of incentives on management behavior.

APPLICATION 7.5: The Good and Bad Effects of Stock Options

- Comparison between Europe (where options are rare) and the United States suggest that U.S. executives are more careful about how their decisions affect shareholders.

- The rise of "superstar" managers during the 1990s may mean that executives are now given a freer hand in running businesses.