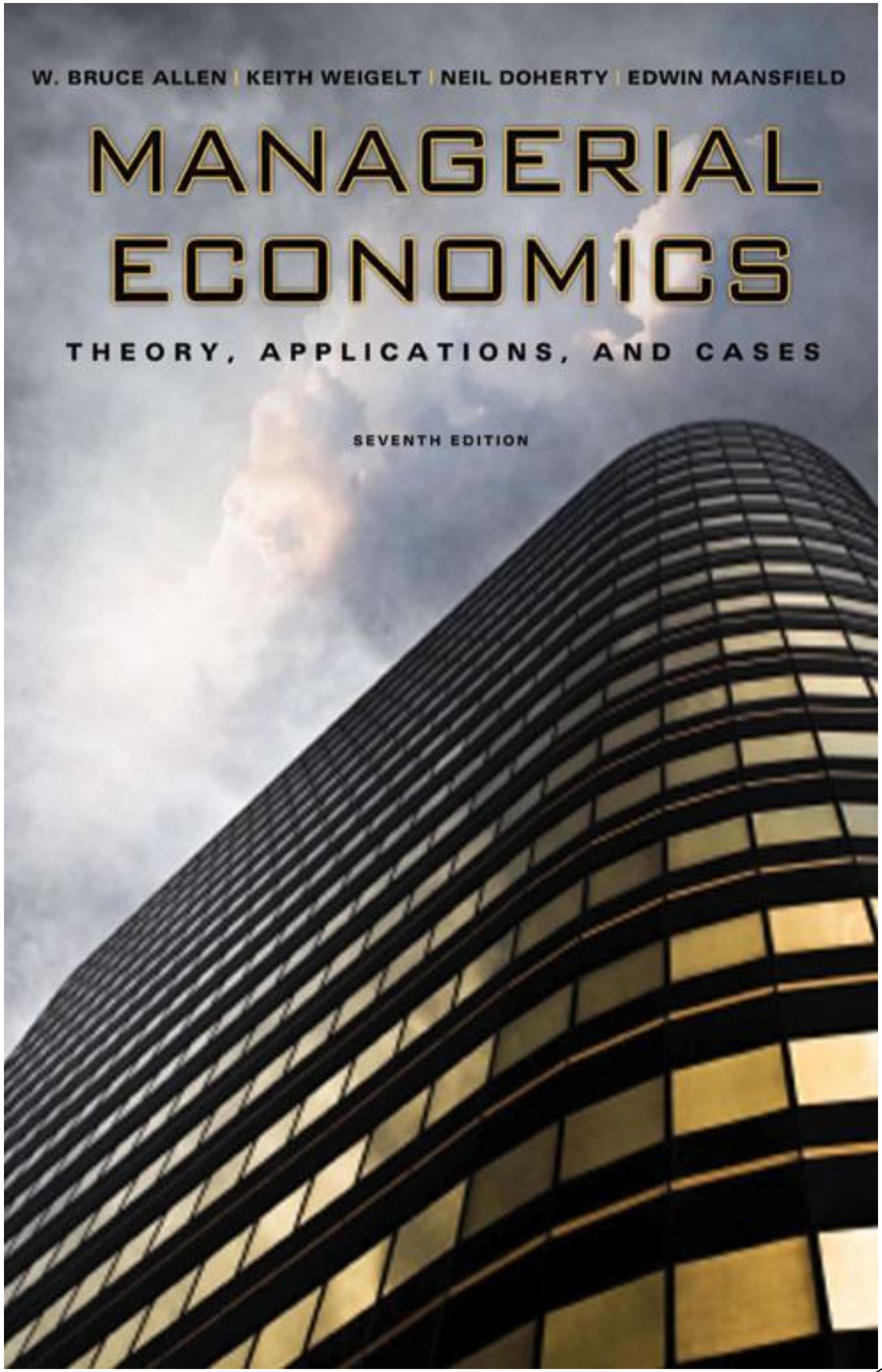
Lecture 1

Introduction to Managerial Economics

Professor Information

- Current and previous academic appointments
  - Hankamer School of Business, Baylor University: Professor of Finance and Insurance (2000-Present) and Frank S. Groner Memorial Chair of Finance (2002-Present)
  - The Wharton School of the University of Pennsylvania: Visiting Scholar (2007-present)
  - Previous faculty appointments at Penn State (1984-1989), UT-Austin (1989-1996), LSU (1998-2000), and Wharton (Spring 2006 Semester) Business Schools
- Research: Application of economics and finance to the analysis, pricing, and management of risk.
- Service: Associate editor of two journals: *Geneva Risk and Insurance Review* and *Journal of Risk and Insurance*; Past President of two academic associations: American Risk and Insurance Association and Risk Theory Society.

- **Textbook:** Allen, W. Bruce, Weigelt, Keith, Doherty, Neil A., and Edwin Mansfield, 2009, *Managerial Economics (7th edition)*, W. W. Norton (ISBN: 0393932249).



Course Goals

- Learn to use economic models to think critically about everyday problems.
- Know what conditions characterize competitive outcomes and efficient allocations of resources.
- Understand how firm cost structure and the nature of the market determine prices and production; learn how firms with pricing power can exploit variation in demand to price discriminate and maximize profits.
- Apply strategic thinking to decision-making and know how to use it to analyze firm and individual choices.
- Understand how risk influences decision-making and the design of real world contracts.

Grade Determination

- Final Grade = .30(Problem Sets) + .30(Midterm Exam 1) + .40(Final Exam)
- The midterm exam will occur in class on Thursday, November 5. The final exam will occur during the final class session on Monday, December 14.

Microeconomics and Macroeconomics

- Microeconomics represents the branch of economics which deals with the behavior of individual economic units—consumers, firms, workers, and investors—as well as the markets that these units comprise.
- Macroeconomics represents the branch of economics which deals with aggregate economic variables, such as the level and growth rate of national output, interest rates, unemployment, and inflation.

Managerial Economics

- Managerial economics involves the application of microeconomics to analyze managerial actions and their effect on firm performance.
  - The purpose of this analysis is to shed light on concepts such as cost, demand, profit, competition, pricing, compensation, and business strategy.
  - With its focus on *behavior*, managerial economics provides powerful tools and frameworks to guide managers to better decisions.

Business and the Social Sciences

- Economics, psychology, and sociology represent the "parent" social sciences upon which most business disciplines are based.
  - Managerial economics, finance and accounting draw primarily on economics (especially micro), whereas management and marketing tend to be based primarily upon psychology and sociology.
    - Counterexamples include behavioral economics and finance, use of econ-based pricing strategies in marketing, application of game theory in management strategy, etc.

Managerial Economics

- Where does managerial economics fit within the EMBA curriculum?
  - Managerial economics is a standard first-year course requirement in most EMBA programs.
  - This course differs conceptually from other first-year courses in that it (like QBA 5330) focuses upon the *analytic foundations* for decision-making that are subsequently applied in "core business foundations" courses such as accounting, finance, and marketing.

Internet Resources

- **Class website:** http://economics.garven.com
  - The source for readings, lecture notes, problem sets, etc.
  - For links requiring authentication, use “econ” as your username and “baylor” as your password (all lowercase).
- **Class weblog:** http://econblog.garven.com
  - I use the class blog to post important announcements and provide insights linking course topics with the “real” world.

Why all the math?

- Perspective from the great master, Alfred Marshall:

In a letter to his protégée, A.C. Pigou, he [Marshall] laid out the following system: "(1) Use mathematics as shorthand language, rather than as an engine of inquiry. (2) Keep to them till you have done. (3) Translate into English. (4) Then illustrate by examples that are important in real life (5) Burn the mathematics. (6) If you can't succeed in 4, burn 3. This I do often."

Source: Todd G. Buchholz, 1989, *New Ideas from Dead Economists*, New York: Penguin Group, p. 151.

Why all the math?

- Perspectives from the economics blogosphere:
  - Nobel laureate Paul Krugman notes that "Math in economics can be extremely useful", and that math can serve an essential analytic function by helping to clarify one's thoughts.
  - Greg Mankiw notes that "Math is good training for the mind. It makes you a more rigorous thinker."
  - Jason DeBacker observes that math helps to quantify tradeoffs, and that using math "…puts in plain sight the assumptions that lie behind a model and the mechanisms at work in the model".
- However, it is also important to remember that it is better to be vaguely right than precisely wrong!

Discrete (algebra) versus continuous (calculus) analysis

- In the textbook's preface (cf. pp. xx), the authors note that given the choice between algebra and calculus, the average student prefers algebra.
- The authors use both algebraic and calculus-based analytic approaches; however, so long as one understands *basic* calculus, the latter approach is often *easier* to grasp.
- For those students whose math skills may be a bit on the "rusty" side, I recommend reviewing Appendix A (pp. 597-626) of the textbook.

QBA 5330 Review: Calculating Derivatives

- The definition of the derivative of the function $y = f(x)$ with respect to x is:

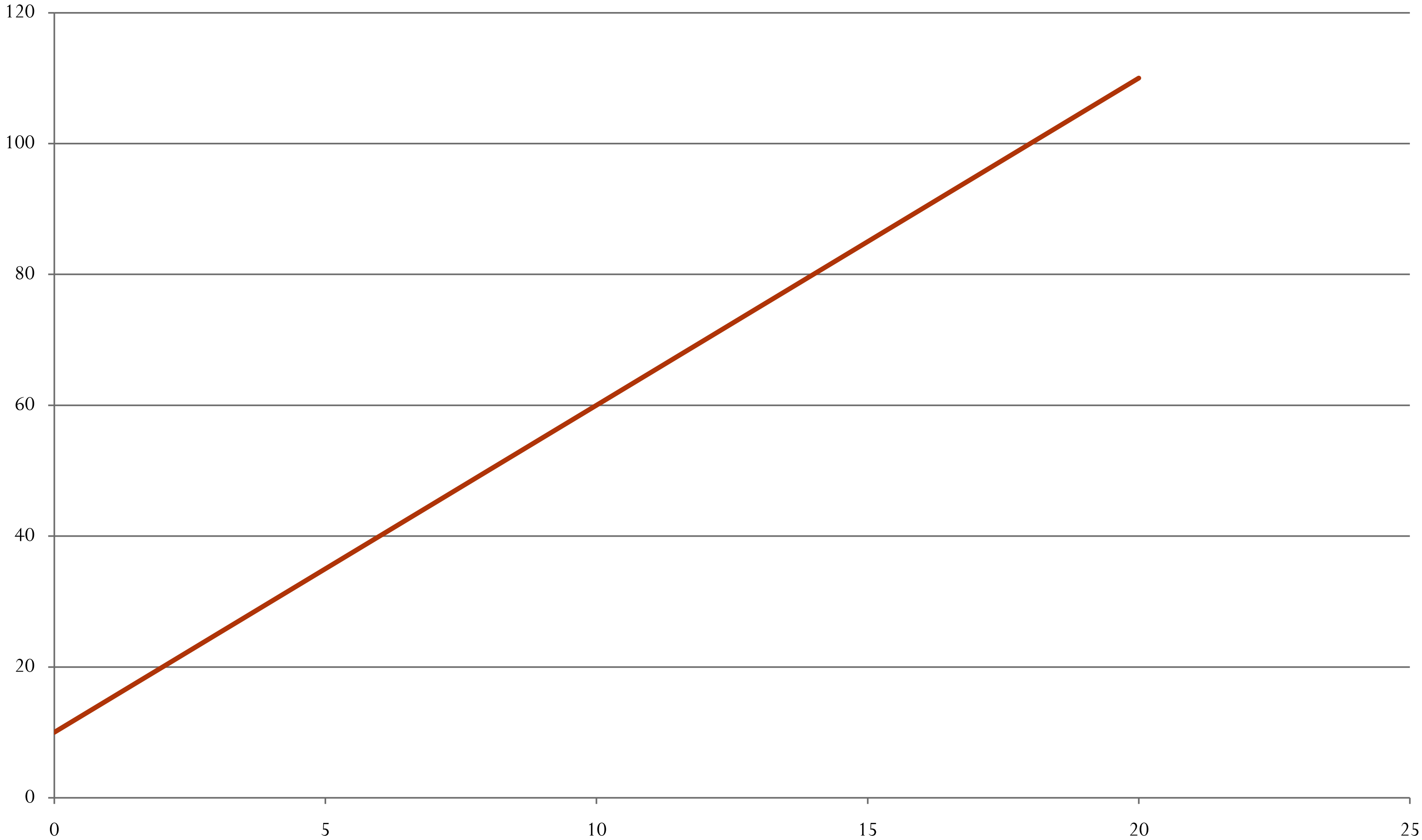
$$f'(x) = \frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

Example 1 (line): Suppose $y = 10+5x$. Then

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \left[\frac{(10 + 5x + 5\Delta x) - (10 + 5x)}{\Delta x} \right]$$

$$= \lim_{\Delta x \to 0} \left[\frac{5\Delta x}{\Delta x} \right] = 5.$$

QBA 5330 Review: Calculating Derivatives



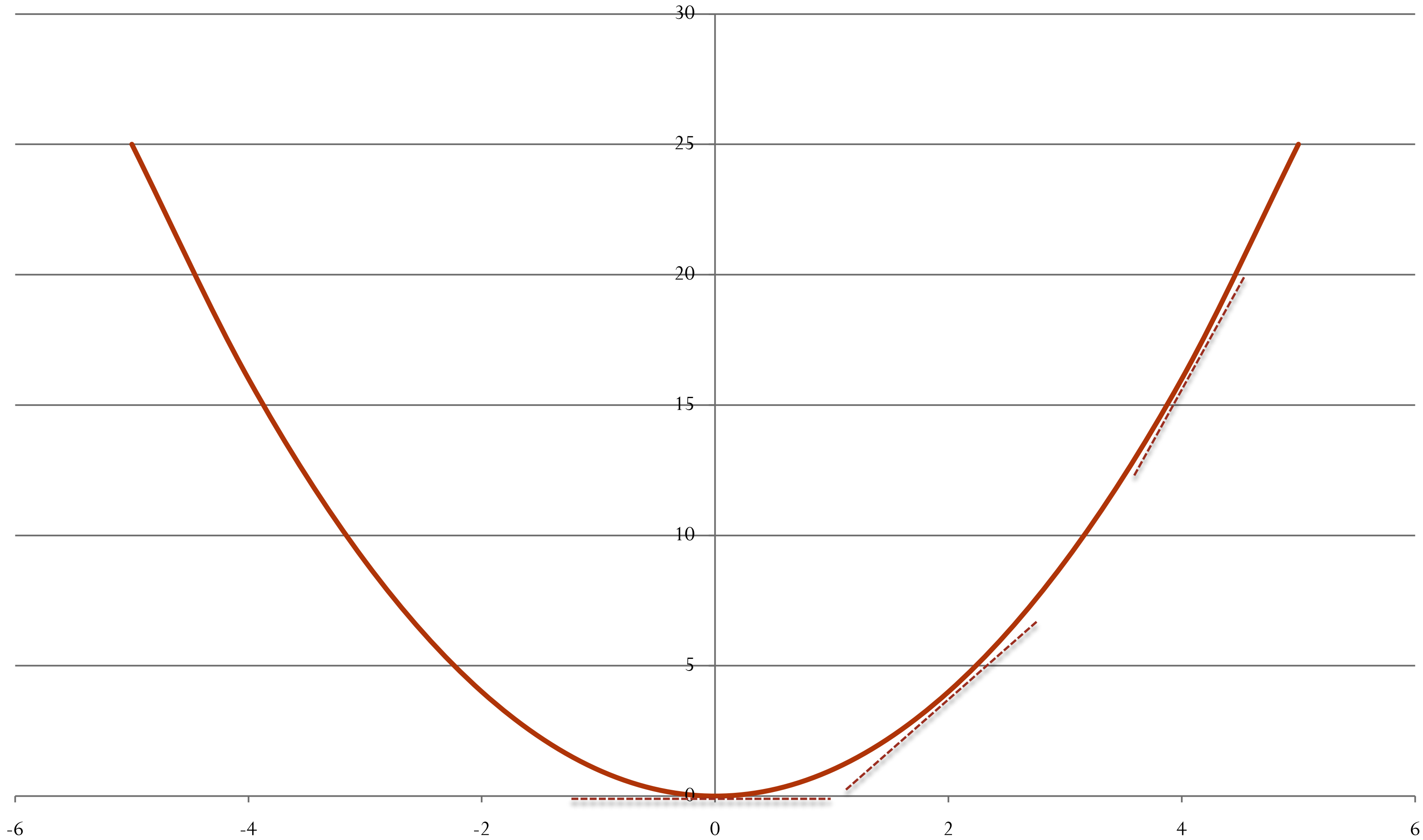
QBA 5330 Review: Calculating Derivatives

- **Example 2 (parabola):** Suppose $y = x^2$. Then

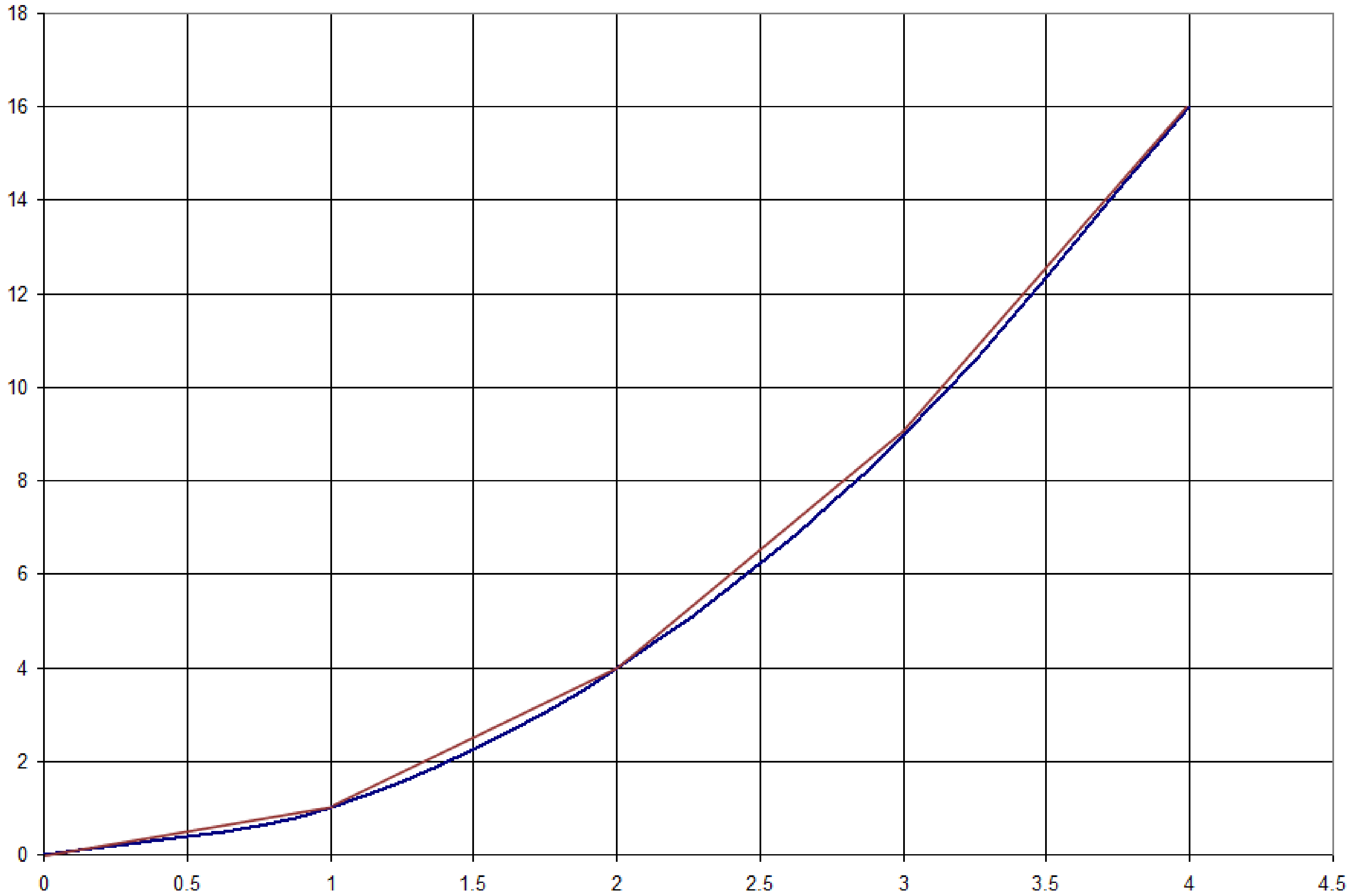
$$f'(x) = \frac{dy}{dx} = \lim_{\Delta x \to 0}\left[\frac{(x+\Delta x)^2 - x^2}{\Delta x}\right] = 2x.$$

The rate of change of the parabola depends upon the particular value of x; e.g., if this derivative is evaluated at $x = 0$, then $f'(0) = 2(0) = 0$, if it is evaluated at $x = 2$, then $f'(2) = 2(2) = 4$, and if it is evaluated at $x = 4$, then $f'(4) = 2(4) = 8$.

QBA 5330 Review: Calculating Derivatives



QBA 5330 Review: Calculating Derivatives



QBA 5330 Review: Calculating Derivatives

x	$\frac{\Delta y}{\Delta x} = \frac{(x+\Delta x)^2 - x^2}{\Delta x}$	$\frac{dy}{dx} = 2x$
0	$\frac{\Delta y}{\Delta x} = \frac{1^2 - 0^2}{1} = 1$	$\frac{dy}{dx} = 2(0) = 0$
1	$\frac{\Delta y}{\Delta x} = \frac{2^2 - 1^2}{1} = 3$	$\frac{dy}{dx} = 2(1) = 2$
2	$\frac{\Delta y}{\Delta x} = \frac{3^2 - 2^2}{1} = 5$	$\frac{dy}{dx} = 2(2) = 4$
3	$\frac{\Delta y}{\Delta x} = \frac{4^2 - 3^2}{1} = 7$	$\frac{dy}{dx} = 2(3) = 6$

QBA 5330 Review: Calculating Derivatives

- Suppose $z = f(x, y)$. Then the *partial derivative* of the function, f, with respect to x (denoted by $\partial f / \partial x$) is:

$$\frac{\partial f}{\partial x} = \lim_{\Delta x \to 0} \left[\frac{f(x + \Delta x, y) - f(x, y)}{\Delta x} \right]$$

Here, $\partial f / \partial x$ is simply the ordinary derivative of f with respect to x while holding y constant.

Example 4 (multivariable function): Suppose $z = f(x, y) = 2x^2 - 3x^2y + 5y + 1$. Then $\partial f / \partial x = 4x - 6xy$ and $\partial f / \partial y = -3x^2 + 5$.

QBA 5330 Review: Calculating Derivatives

Constant Rule	$Y = a + bX$	$dY/dX = b$
Power Rule	$Y = aX^b$	$dY/dX = baX^{b-1}$
Sum-Difference Rule	$Y = U(X) + W(X)$	$dY/dX = dU/dX + dW/dX$
Product Rule	$Y = U(X)W(X)$	$dY/dX = U\,dW/dX + W\,dU/dX$
Quotient Rule	$Y = U(X)/W(X)$	$dY/dX = \dfrac{W\,dU/dX - U\,dW/dX}{W^2}$
Chain Rule	$Y = U[W(X)]$	$dY/dX = dU/dW\,dW/dX$

QBA 5330 Review: Calculating Derivatives

- Differentiate each of the following functions with respect to X, using the methods on the previous slide:
  1. $Y = 3 + 10X + 5X^2$
  2. $Y = 2X(4 + X^3)$
  3. $Y = 4X/(X - 3)$
  4. $Y = (3 - X)^2$

QBA 5330 Review: Calculating Derivatives

1) $Y = 3 + 10X + 5X^2; \therefore dY/dX = 10 + 10X.$

2a) $Y = 2X(4 + X^3) = 8X + 2X^4; \therefore dY/dX = 8 + 8X^3.$

2b) $Y = \underset{U}{2X}\underbrace{(4 + X^3)}_{W} = \underset{U}{2X}\underset{dW/dX}{(3X^2)} + \underbrace{(4 + X^3)}_{W}\underset{dU/dX}{2} = 8 + 8X^3.$

3) $Y = \underset{U}{4X} / \underbrace{(X - 3)}_{W}; \therefore dY/dX = (\underbrace{(X - 3)}_{W}\underset{dU/dX}{4} - \underset{U}{4X}\underset{dW/dX}{1}) / \underbrace{(X - 3)}_{W^2}$

$$= \frac{4X - 12 - 4X}{(X - 3)^2} = \frac{-12}{(X - 3)^2}.$$

4) $Y = (3 - X)^2$; here, $W(X) = 3 - X$ and $U(W) = W^2$.

$\therefore dY/dX = \underset{dU/dW}{2W}\underset{dW/dX}{(-1)} = -2(3 - X) = 2X - 6.$

QBA 5330 Review: Interpreting Regression Models

- Single variable regression equation

  Suppose you are interested in determining the historical sensitivity of the returns on your company's stock (r_s) compared with returns on the Wilshire 5000 index U.S. stock market (r_w). The parameter a_1 in the equation $r_s = a_0 + a_1(r_w)$ provides this answer, and it corresponds to the derivative dr_s/dr_w (what is the expected sign for a_1?).

QBA 5330 Review: Interpreting Regression Models

- Multiple variable regression equation

  Suppose that product demand (Q) is a function of price P, per capita disposable income I, and the amount spent on advertising A; i.e., $Q = b_0 + b_1(P) + b_2(I) + b_3(A)$. Here, the parameter b_1 corresponds to the partial derivative $\partial Q / \partial P$; it indicates how product demand responds to changes in price, holding I and A constant (what are interpretations and expected signs for b_1, b_2, and b_3?).

QBA 5330 Review: Optimization

- As shown in QBA 5330, optimization (e.g., maximization or minimization) requires basic calculus.
- For example, suppose your firm produces only one product, and you are interested in determining the profit maximizing number of units (Q) to produce. The price per unit is \$30. Your fixed costs are \$40, and your variable costs are \$$3Q^2$. Thus, your profit equation is:

$$\pi = \underbrace{30Q}_{\text{total revenue}} \underbrace{-40}_{\text{fixed cost}} - \underbrace{3Q^2}_{\text{variable cost}} .$$

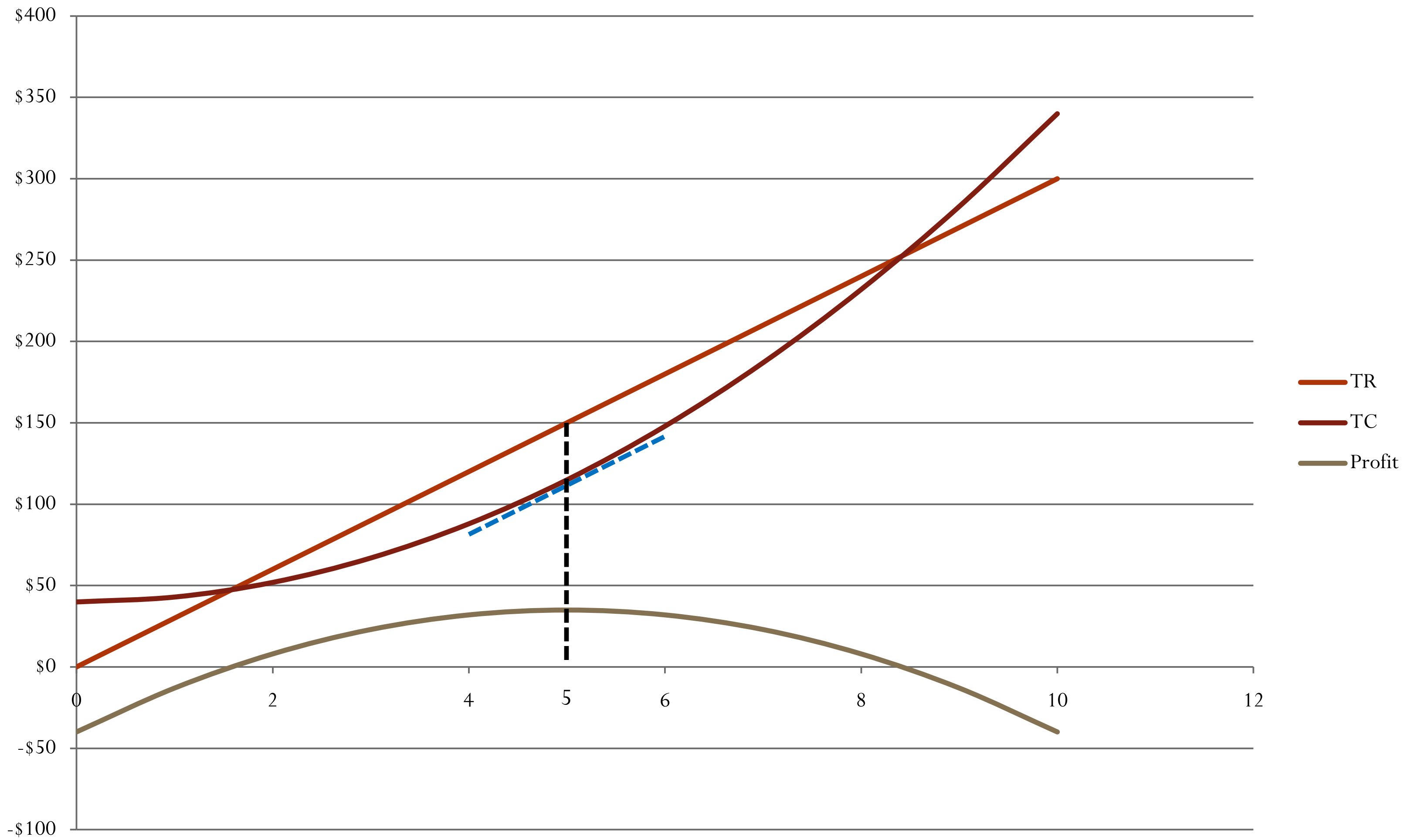
QBA 5330 Review: Optimization

- Next, we'll do the math. Since the slope of the profit function is zero at its maximum, we calculate the first derivative of profit (π) with respect to quantity (Q), set this derivative equal to zero, and then solve for Q^*:

$$\frac{d\pi}{dQ} = 30 - 6Q^* = 0 \Rightarrow Q^* = 5.$$

This is called the *first order condition* ; it is a *necessary* condition for a maximum or a minimum. In order to determine whether $Q^* = 5$ minimizes or maximizes π, we must determine whether the second deriva tive of profit (π) with respect to quantity (Q) is positive or negative; since $\frac{d^2\pi}{dQ^2} = -6 < 0$, $Q^* = 5$ maximizes π.

QBA 5330 Review: Optimization



QBA 5330 Review: Optimization

- When profit is maximized, the slope of the total cost curve (marginal cost, or *MC*) is equal to the slope of the total revenue line (marginal revenue, or *MR*). Here,

$$MR = \frac{dTR}{dQ} = P = \$30, \text{ and}$$

$$MC = \frac{dTC}{dQ} = 6Q.$$

Setting $MR = MC$, we find that $\$30 = 6Q \Rightarrow Q^* = 5!$

QBA 5330 Review: Optimization with Solver

- Class exercise: Using Excel, maximize the following function using Solver:

$$\pi = 30Q - 40 - 3Q^2.$$

- Profit Maximization Spreadsheet Model

The Optimal Size of a Nursing Home (Class exercise)

- The nursing home industry is growing rapidly because of the aging of the U.S. population. The average cost per patient-day of a nursing home (owned by a chain of for-profit homes) is

$$Y = A - 0.16X + 0.00137X^2,$$

where X is the nursing home's number of patient-days per year (in thousands) and A is a number that depends on the region in which the nursing home is located (and other such factors) but not on X.

(a) How big must a nursing home be (in terms of patient-days) to minimize the cost per patient-day? (b) Show that your result minimizes, rather than maximizes, the cost per patient-day.

- Optimal size of a nursing home spreadsheet

The Value of the Firm

- Owners (shareholders) of for-profit organizations expect managers to increase the value of expected future cash flows; i.e., maximize firm value.
- The value of the firm (*V*) is defined in equation (1.1) in the text as the present value of its expected cash flow, or profits:

$$V = \frac{\pi_1}{1+i} + \frac{\pi_2}{(1+i)^2} + \ldots + \frac{\pi_n}{(1+i)^n} = \sum_{t=1}^{n} \pi_t / (1+i)^t,$$

where $\pi_t = TR_t - TC_t$.

- Present Value Spreadsheet Model

The Value of the Firm (special cases)

- *Case 1 (Level Annuity): Constant cash flows from t =* 1,…,n

  Suppose that you expect to receive an annual cash payment of \$$\pi$ starting 1 year from today and ending in n years, and you have been promised an annual interest rate i on this investment. Then the present value of this annuity is:

$$V = \sum_{t=1}^{n} \pi / (1+i)^t = \pi(1 - 1/(1+i)^n)/i,$$

where $(1-1/(1+i)^n)/i$ represents the present value factor for a level annuity.

The Value of the Firm (special cases)

- *Case 2 (Level Perpetuity): Constant cash flows from* $t = 1,\ldots,\infty$

If we allow the value for *n* on the right hand side of equation (1) to become arbitrarily large, we find that

$$V = \lim_{n\to\infty} \pi(1-1/(1+i)^n)/i = \pi/i,$$

where $1/i$ represents the present value factor for a zero growth perpetuity.

The Value of the Firm (special cases)

- *Case 3*: (*Constant Growth Annuity*): *Constantly growing cash flows from* $t = 1, \ldots, n$

  Suppose that expected profits grow at a constant rate g from $t = 2, \ldots, n$; i.e., $\pi_2 = \pi_1(1+g)$, $\pi_3 = \pi_2(1+g)$, …, $\pi_n = \pi_{n-1}(1+g)$. Then the present value of this annuity is:

$$PV = \pi_1 \frac{1-(1+g)^n/(1+i)^n}{i-g},$$

where $i > g$.

The Value of the Firm (special cases)

- *Case 4*: (*Constant Growth Perpetuity*; AKA the "Gordon" Model): *Constantly growing cash flows from* $t = 1, \ldots, \infty$

  If we allow the value for *n* on the right hand side of the previous equation to become arbitrarily large, we find that

$$V = \lim_{n \to \infty} \pi_1 \frac{1 - (1+g)^n / (1+i)^n}{i - g} = \frac{\pi_1}{i - g},$$

  where $\dfrac{1}{i-g}$ represents the present value factor for a constant growth perpetuity.

The Value of the Firm

- Given $V = \pi_1 / (i\text{-}g)$,
  - $\partial V / \partial \pi_1 = 1 / (i\text{-}g) > 0$,
  - $\partial V / \partial i = -\pi_1 / (i\text{-}g)^2 < 0$, and
  - $\partial V / \partial g = \pi_1 / (i\text{-}g)^2 > 0$;
- I.e., the value of the firm is *positively related* to its expected profits and the rate of growth in expected profits, and *inversely related* to its cost of capital!

Rule of 72 – a brief digression…

- This a method for estimating how long it takes for a sum to double.
- Note that $FV = (1+r)^t PV$. Suppose $FV=2PV$. Then $2 = (1+r)^t$.
- To solve for t, take the natural logarithm of both sides: $\ln 2 = t\ln(1+r)$; since $\ln(1+r) \approx r$, we obtain $t \approx \dfrac{\ln 2}{r} = \dfrac{0.693147}{r}$.

The Value of the Firm: Profit is a Reward for:

- Innovation
  - Producing products that are better than existing products in terms of functionality, technology, and style
- Taking Risks
  - Risk takes many forms; e.g., future outcomes and their likelihoods are unknown, as are the reactions of rivals.
- Exploiting Market "Inefficiencies"
  - Building barriers to entry, employing sophisticated pricing strategies, etc.

Impact of Good & Bad News on Firm Value

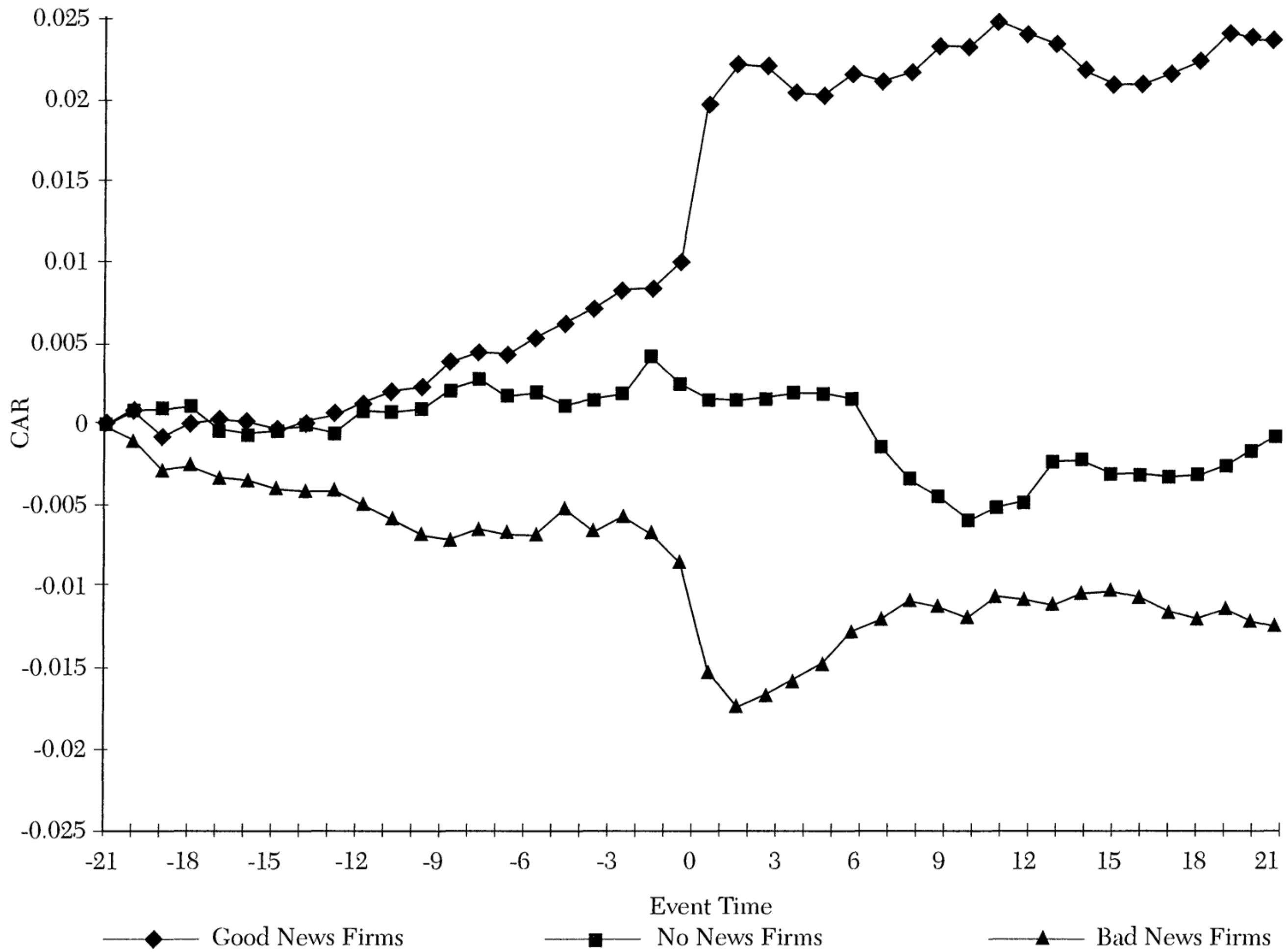


Figure 2a. Plot of cumulative abnormal return for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the market model as the normal return measure.

"Good" management can create value; "bad" management can destroy value

- See Value Destruction: The Cost to Companies That Engage in Deceptive Marketing:
  - "On September 2, Pfizer agreed to pay $2.3 billion to settle civil and criminal allegations that it violated federal rules governing drug sales. The pharmaceutical manufacturer was charged with illegally promoting its pain-killer Bextra and three other medications by offering doctors speaking fees and subsidized trips to resorts, among other benefits. The settlement was the largest ever levied against a U.S. company."
  - "While the amount of the settlement is significant, the indirect costs to the company may be even higher over time in terms of lost shareholder value."

The Principal-Agent Problem

- Managerial Interests and the Principal-Agent Problem
  - The interests of a firm's owners and those of its managers may diverge, unless the manager is the owner.
  - However, the *separation of ownership and control* is often necessary because the capital raising and risk bearing capabilities of entrepreneurs are limited.

The Principal-Agent Problem

- Separation of ownership and control
  - The principals are the owners.
    - They want managers to maximize firm value.
  - The agents are the managers.
    - Other things equal, they prefer more compensation and less accountability.
  - The divergence in goals is commonly referred to as the principal-agent problem.

Moral Hazard

- A moral hazard occurs when one party is responsible for the interests of another, but has an incentive to put his or her own interests first.
- If I can take risks that you have to bear, then I may as well take them; however, if I have to bear the consequences of my risky actions, this will motivate me to act more prudently.
- Managers who choose *not to* maximize firm value may act this way if compensation is not adequately sensitive to the fortunes of the firm's owners.

Solution: Moral Hazard

- Devise methods that lead to convergence of the interests of the firm's owners and its managers
- Examples: contract design which ties managerial compensation to shareholder welfare; e.g., via share/option ownership, bonuses linked to profits, etc.

Demand and Supply: a First Look

- A market exists when there is economic exchange; that is, individuals and organizations interact with each other to buy or sell goods and services.
- Markets typically function well so long as contracts are binding and enforceable, which in turn implies respect for the rule of law and private property rights.

The Demand Side of the Market

- Demand Function
  - Behavior of quantity demanded relative to price within a given period of time, holding other influences constant.
    - Other influences typically include factors such as income, product quality, prices and product quality of substitutes and complements, advertising expenditures, etc.
  - Negative slope; quantity demanded increases as price falls.

The Market Demand Curve for Copper, World Market

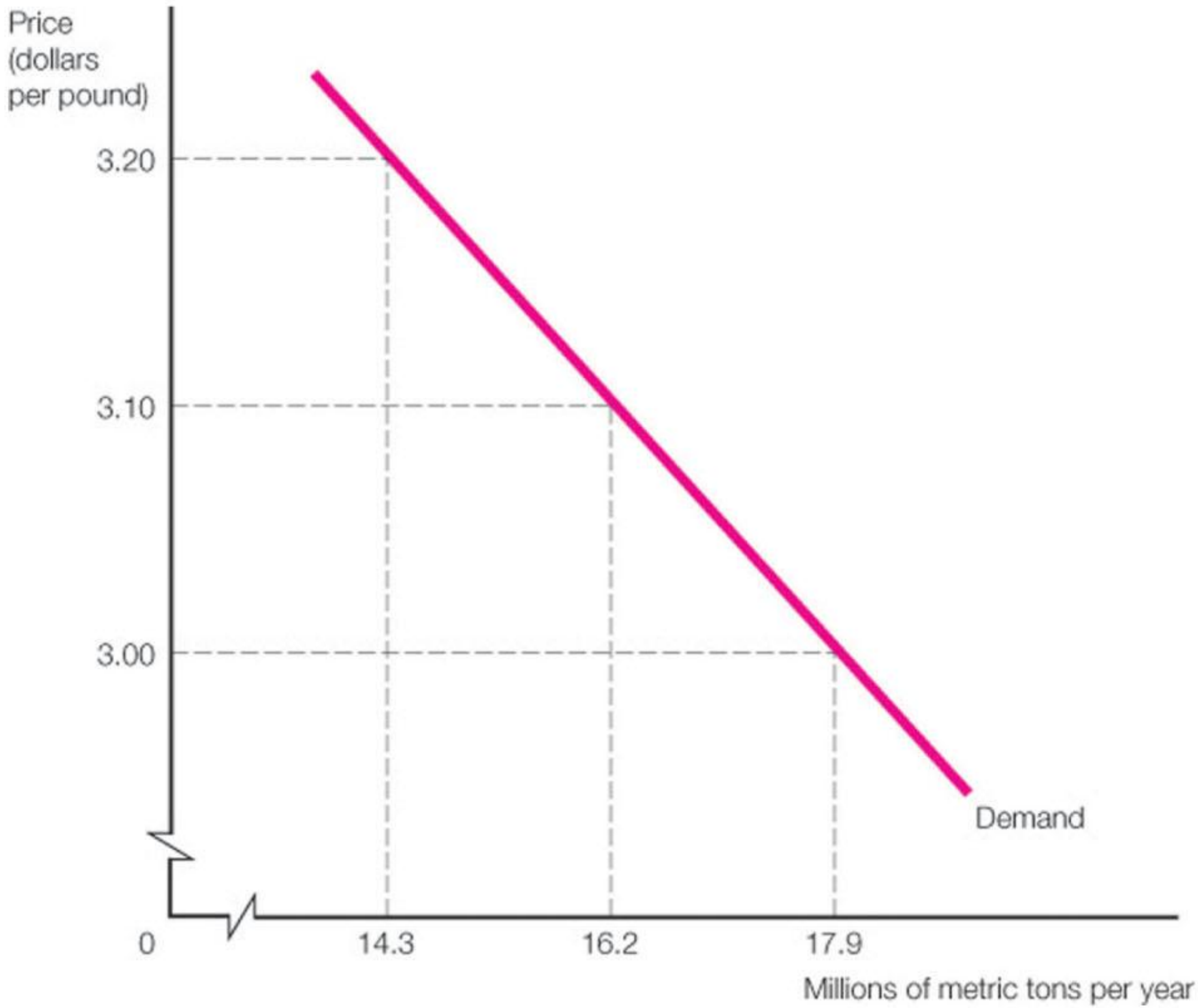


FIGURE 01-01

The Supply Side of a Market

- Supply Function
  - Quantity supplied relative to price within a given period of time, holding other influences (e.g., technology, costs of so-called "factors" of production such as labor and capital) constant
  - Positive slope; quantity supplied increases as price rises.

The Market Supply Curve for Copper, World Market

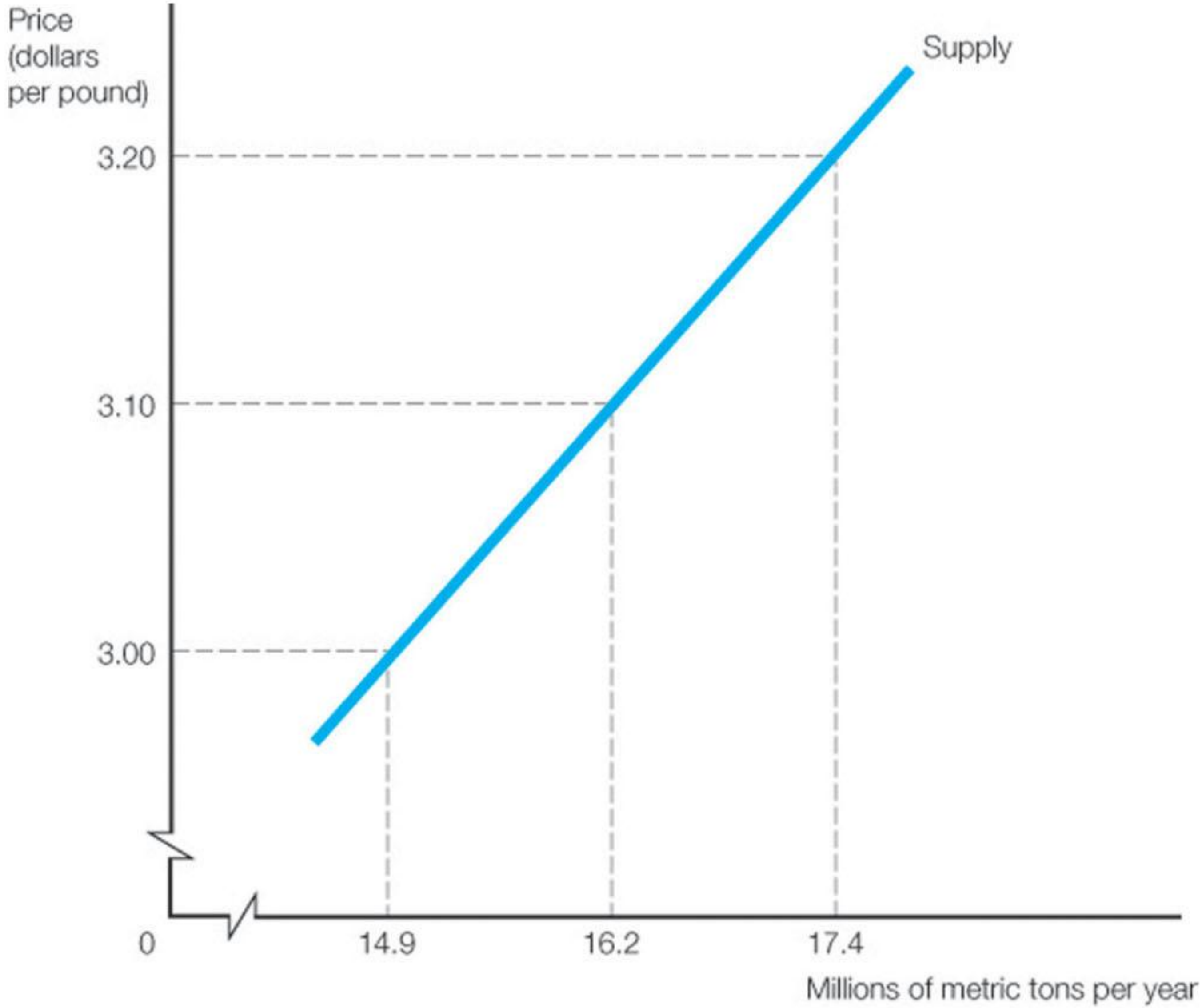


FIGURE 01-02

Equilibrium Price of Copper, World Market

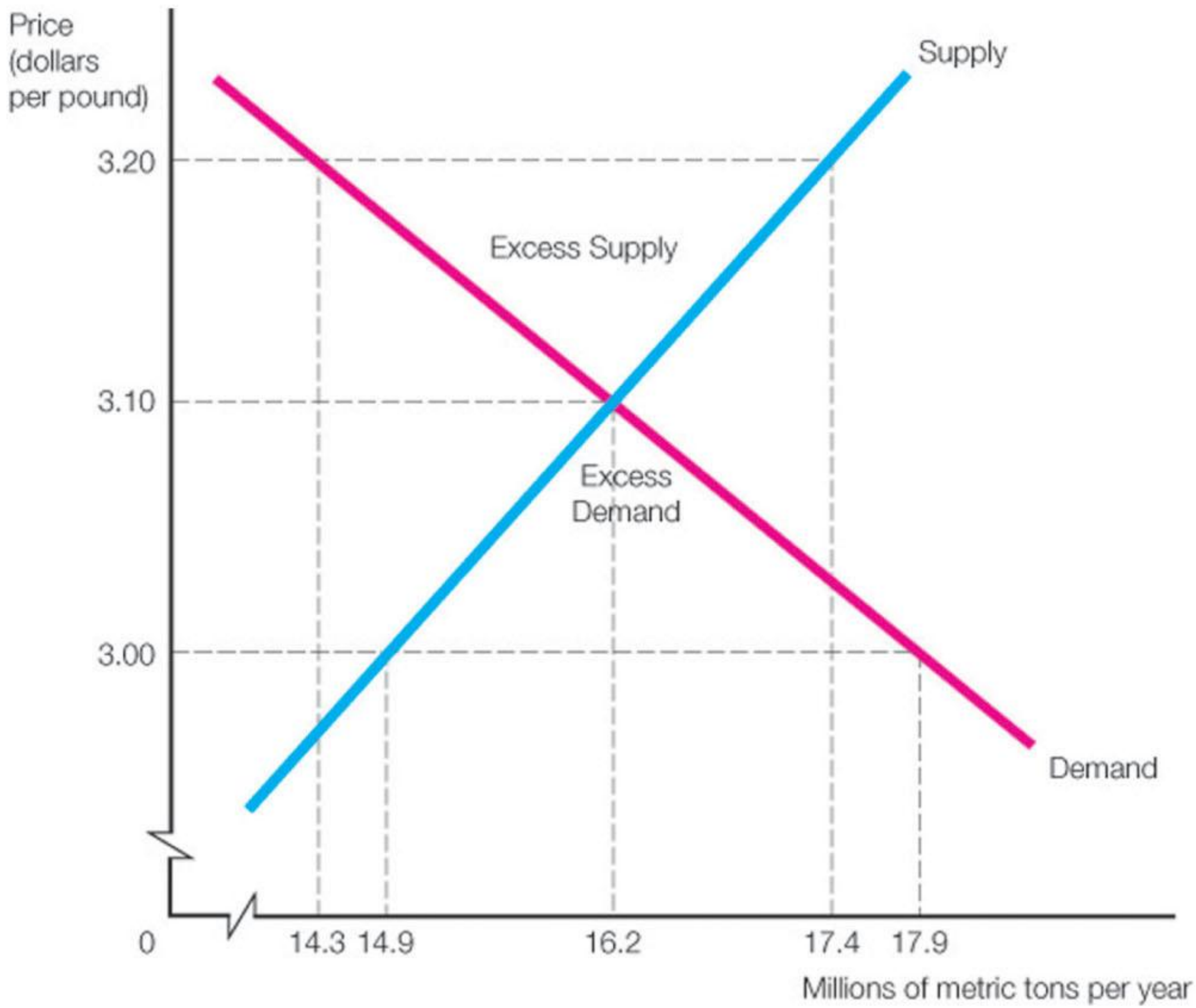


FIGURE 01-03

Actual Price

- If actual price is *above* (*below*) equilibrium price, there will be a supply surplus (deficit) that puts downward (upward) pressure on the actual price.
- If actual price is *equal* to equilibrium price, then there will be neither a shortage nor a surplus and price will be stable.

Effects of Leftward and Rightward Shifts of the Demand Curve on the Equilibrium Price of Copper

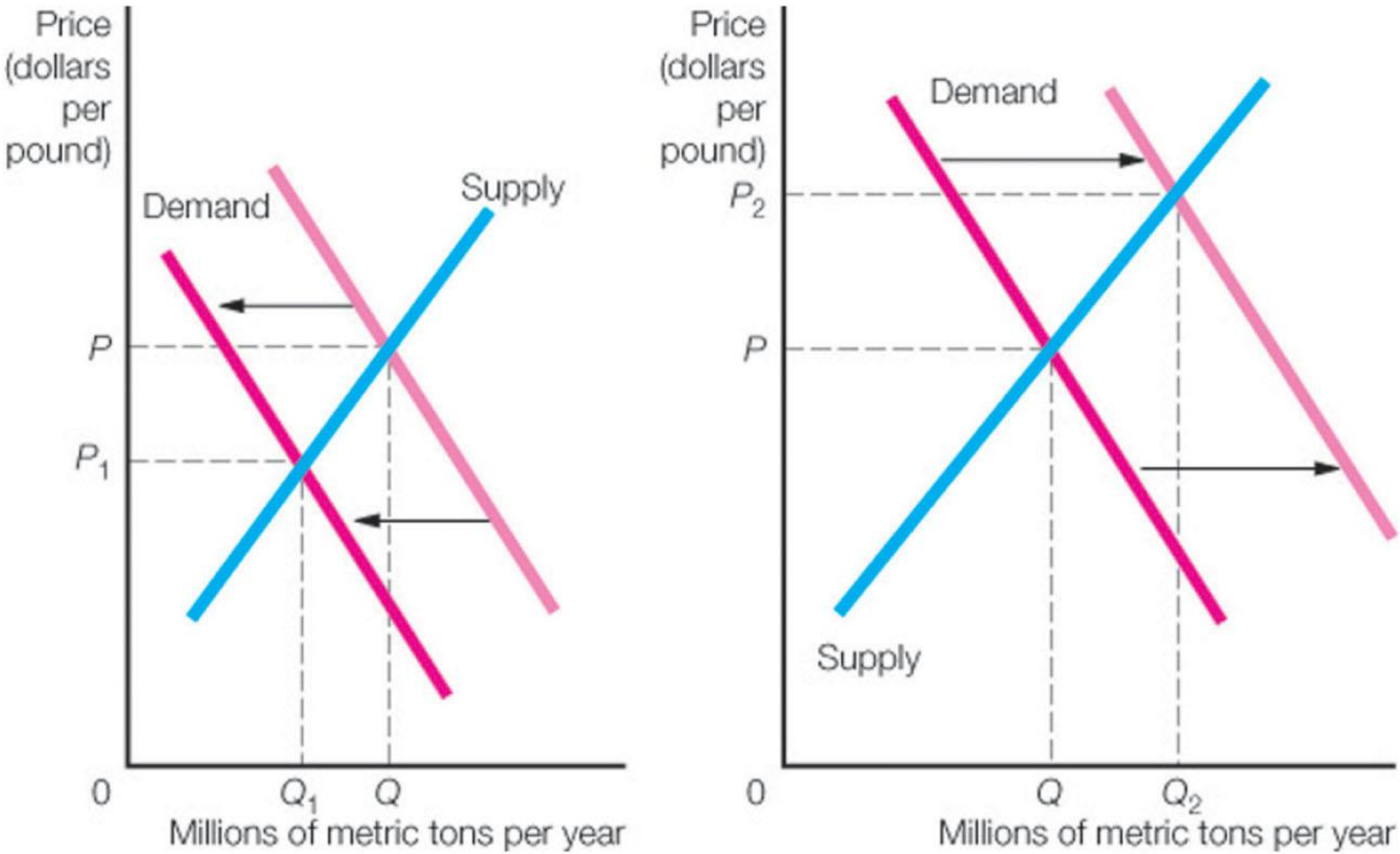


FIGURE 01-04

Effects of Leftward and Rightward Shifts of the Supply Curve on the Equilibrium Price of Copper

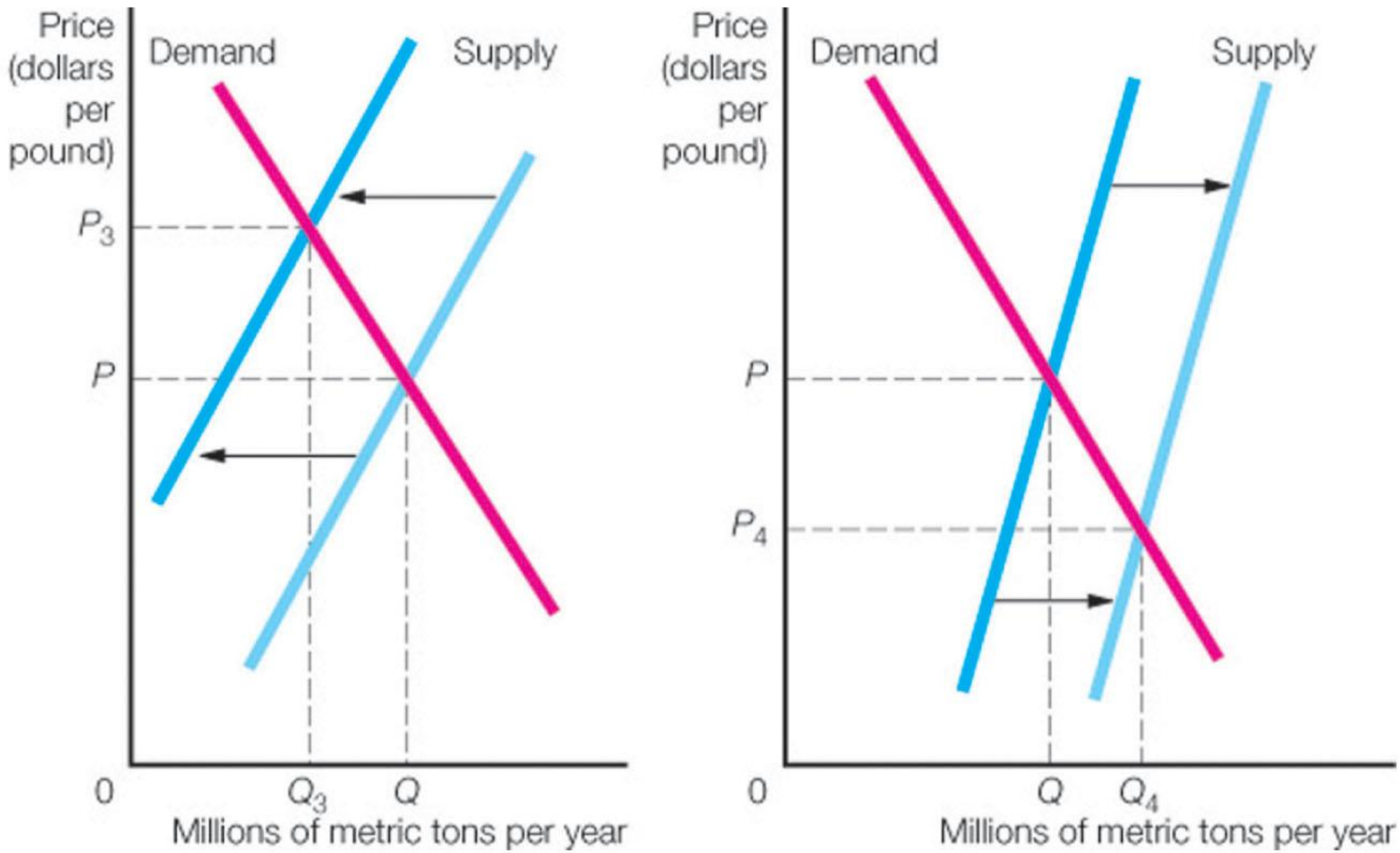


FIGURE 01-05

Managerial Economics, 7e