Principles of Managerial Finance Solution
Lawrence J. Gitman

CHAPTER 12

Leverage
And
Capital Structure

INSTRUCTOR'S RESOURCES

Overview

This chapter introduces the student to the concepts of operating and financial leverage and the associated business and financial risks. As a prerequisite to operating leverage, breakeven analysis is presented through graphic and algebraic methods. The limitations of breakeven analysis are also discussed. Financial leverage is presented graphically by comparing financial plans on a set of EBIT-EPS axes. The degree of operating, financial, and total leverage are presented to provide tools to measure the relative differences in risk of differing operating and financial structures within the firm. Capital structure is discussed with regard to a firm's optimal mix of debt and equity, and the EBIT-EPS and valuation model approaches to evaluate capital structure, as well as important qualitative factors, are presented.

PMF DISK

This chapter's topics are not covered on the *PMF Tutor* or the *PMF Problem-Solver*.

PMF Templates

A spreadsheet template is provided for the following problem:

Problem	Topic
12-2	Breakeven comparisons–Algebraic

Study Guide

The following *Study Guide* examples are suggested for classroom presentation:

Example	Topic
1	Degree of operating leverage
4	Breakeven analysis

ANSWERS TO REVIEW QUESTIONS

12-1 *Leverage* is the use of fixed-cost assets or funds to magnify the returns to owners. Leverage is closely related to the risk of being unable to meet operating and financial obligations when due. *Operating leverage* refers to the sensitivity of earnings before interest and taxes to changes in sales revenue. *Financial leverage* refers to the sensitivity of earnings available to common shareholders to changes in earnings before interest and taxes. *Total leverage* refers to the overall sensitivity of earnings available to common shareholders to changes in sales revenue.

12-2 The firm's *operating breakeven point* is the level of sales at which all fixed and variable operating costs are covered; i.e., EBIT equals zero. An increase in fixed operating costs and variable operating costs will increase the operating breakeven point and vice versa. An increase in the selling price per unit will decrease the operating breakeven point and vice versa.

12-3 *Operating leverage* is the ability to use fixed operating costs to magnify the effects of changes in sales on earnings before interest and taxes. Operating leverage results from the existence of fixed operating costs in the firm's income stream. The *degree of operating leverage (DOL)* is measured by dividing a percent change in EBIT by the percent change in sales. It can also be calculated for a base sales level using the following equation:

$$\text{DOL at base sales level } Q = \frac{Q \times (P - VC)}{Q \times (P - VC) - FC}$$

Where: Q = quantity of units
P = sales price per unit
VC = variable costs per unit
FC = fixed costs per period

12-4 *Financial leverage* is the use of fixed financial costs to magnify the effects of changes in EBIT on earnings per share. Financial leverage is caused by the presence of fixed financial costs such as interest on debt and preferred stock dividends. The *degree of financial leverage (DFL)* may be measured by either of two equations:

1. $$\text{DFL} = \frac{\%\text{ change in EPS}}{\%\text{ change in EBIT}}$$

2. $$\text{DFL at base level EBIT} = \frac{\text{EBIT}}{\text{EBIT} - I - \left[PD \times (1 \div (1 - T))\right]}$$

Where: EPS = Earnings per share
EBIT = Earnings before interest and taxes
I = Interest on debt
PD = Preferred stock dividends

12-5 The *total leverage* of the firm is the combined effect of fixed costs, both operating and financial, and is therefore directly related to the firm's operating and financial leverage. Increases in these types of leverage

will increase total risk and vice versa. Both types of leverage do complement each other in the sense that their effects are not additive but rather they are multiplicative. This means that the overall effect of the presence of these types of leverage on the firm is quite great, since their combined leverage more than proportionately magnifies the effects of changes in sales on earnings per share.

12-6 A firm's *capital structure* is the mix of long-term debt and equity it utilizes. The key differences between debt and equity capital are summarized in the table below.

Key Differences between Debt and Equity Capital

	Type of Capital	
Characteristic	Debt	Equity
Voice in management*	No	Yes
Claims on income and assets	Senior to equity	Subordinate to debt
Maturity	Stated	None
Tax treatment	Interest deduction	No deduction

* In default, debt holders and preferred stockholders may receive a voice in management; otherwise, only common stockholders have voting rights.

The ratios used to determine the degree of financial leverage in the firm's capital structure are the debt and the debt-equity ratios, which are direct measures; and the times interest earned and fixed-payment coverage ratios which are indirect measures. Higher direct ratios indicate a greater level of financial leverage. If coverage ratios are low, the firm is less able to meet fixed payments and will generally have high financial leverage.

12-7 The capital structure of non-U.S. companies can be quite different from that of U.S. corporations. These firms tend to have more debt than domestic companies. Several reasons contribute to this fact. U.S. capital markets are more developed than most other countries, providing U.S. firms with more alternative forms of financing. Also, large commercial banks take an active role in financing foreign corporations. Share ownership is more concentrated at foreign companies, which reduces or eliminates potential agency problems and permits companies to operate with higher leverage.

Similarities exist between non-U.S. and U.S. firms with regard to capital structure. Debt ratios within industry groupings generally follow similar patterns, as they do in the U.S., and large multinational companies (MNCs) headquartered outside of the U.S. share more similarities with other MNCs than with smaller firms based in their home country. In recent years, foreign firms have moved away from bank financing, leading to capital structures that are closer in form to that of U.S. corporations.

12-8 The tax-deductibility of interest is the major benefit of debt financing. In effect, the government subsidizes the cost of debt through the tax deduction. Because this reduces the amount of taxes paid, more earnings are available for investors.

12-9 *Business risk* is the risk that the firm will be unable to cover its operating costs. Three factors affecting business risk are the use of fixed operating costs (operating leverage), revenue stability, and cost stability. Revenue stability refers to the relative variability of the firm's sales revenues, which is a function of the demand for the firm's product. Cost stability refers to the relative predictability of the input prices such as labor and materials. The greater the revenue and cost stability, the lower the business risk. The capital structure decision is influenced by the level of business risk. Firms with high business risk tend toward less highly leveraged capital structures, and vice versa.

Financial risk is the risk that the firm will be unable to meet required financial obligations. The more fixed-cost components in a firm's capital structure (debt, leases, and preferred stock), the greater its financial leverage and financial risk. Therefore, financial risk is affected by management's capital structure decision, and that is affected by business risk.

12-10 The *agency problem* occurs because lenders provide funds to a firm based on their expectations for the firm's current and future capital expenditures and capital structure, which determine the firm's business and financial risk. Firm managers, as agents for the owners, have an incentive to "take advantage" of lenders. Lenders have an incentive to protect their own interests and have developed monitoring and controlling techniques to do so. Lenders protect themselves by means of loan covenants that limit the firm's ability to significantly change its business or financial risk. These covenants may include maintaining a minimum level of net working capital, restrictions on asset acquisitions and additional debt (through minimum coverage ratios), executive salaries, and dividend payments. The firm incurs agency costs when it agrees to the operating and financial provisions in the loan agreement. Since the firm's risk is somewhat controlled by the covenants, the lender can provide funds at a lower cost, which benefits the firm and its owners.

12-11 *Asymmetric information* results when a firm's managers have more information about operations and future prospects than do investors. This additional information will generally cause financial managers to raise funds using a pecking order (a hierarchy of financing beginning with retained earnings, followed by debt, and finally, equity) rather than maintaining a target capital structure. This might appear to be inconsistent with wealth maximization, but asymmetric information allows management to make capital structure decisions which do, in fact, lead to wealth maximization.

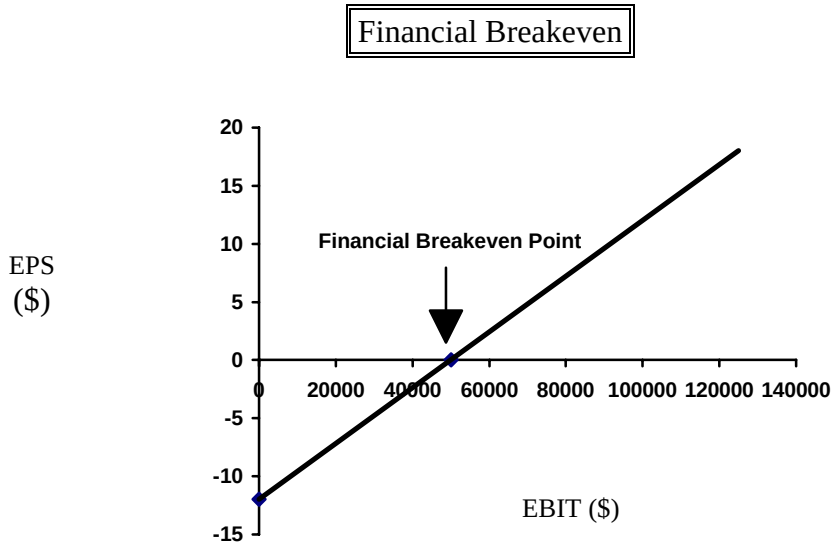
Because of management's access to asymmetric information, the firm's financing decisions can give signals to investors reflecting management's view of the stock value. The use of debt sends a positive signal that management believes its stock is undervalued. Conversely, issuing new stock may be interpreted as a negative signal that management believes the stock is overvalued. This leads to a decline in share price, making new equity financing very costly.

12-12 As financial leverage increases, both the cost of debt and the cost of equity increase, with equity rising at a faster rate. The overall cost of capital–with the addition of debt–first begins to decrease, reaches a minimum, and then begins to increase. There is an *optimal capital structure* under this approach, occurring at the minimum point of the cost of capital. This optimal capital structure allows management to invest in a larger number of profitable projects, maximizing the value of the firm.

12-13 The *EBIT-EPS approach* is based upon the assumption that the firm, by attempting to maximize earnings per share, will also maximize the owners' wealth. The theoretical approach described in 12-12 evaluates capital structure based upon the minimization of the overall cost of capital and maximizing value; the EBIT-EPS approach involves selecting the capital structure providing maximum earnings per share, which is assumed to be consistent with the maximization of share price. This approach is believed to indirectly be consistent with wealth maximization, since earnings per share and share price are believed to be closely related. It is used to select the best of a number of possible capital structures, rather than to determine an "optimal capital structure." The financial breakeven point is the level of EBIT at which the firm's earnings per share would equal zero. The financial breakeven point can be determined by finding the before-tax cost of interest and preferred dividends. Letting I = interest, PD = preferred dividends, and t = the tax rate, the expression for the financial break-even point is:

$$\text{Financial breakeven point} = I + \frac{PD}{(1 - \text{tax rate})}$$

The following graph illustrates this concept.



12-14 It is very unlikely that the two objectives of maximizing value and maximizing EPS would lead to the same conclusion about optimal capital structure. Generally, the optimal capital structure will have a lower percentage of debt under wealth maximization than with EPS maximization. This is because maximization of EPS fails to consider risk.

12-15 Basically, the firm should find the optimal capital structure that balances risk and return factors to maximize share value. This requires estimates of required rates of return under different levels of risk: the estimate of risk associated with each level of debt and the value of the firm under each level of debt given the risk. The firm should then choose the one that maximizes its value. In addition to quantitative considerations, the firm should take into account factors related to business risk, agency costs, and the asymmetric information. These include 1) revenue stability, 2) cash flow, 3) contractual obligations, 4) management preferences, 5) control, 6) external risk assessment, and 7) timing.

SOLUTION TO PROBLEMS

12-1 LG 1: Breakeven Point–Algebraic

Q = FC ÷ (P - VC)
Q = $12,350 ÷ ($24.95 - $15.45)
Q = 1,300

12-2 LG 1: Breakeven Comparisons–Algebraic

a. Q = FC ÷ (P - VC)

Firm F: $$Q = \frac{\$45{,}000}{(\$18.00 - \$6.75)} = 4{,}000 \text{ units}$$

Firm G: $$Q = \frac{\$30{,}000}{(\$21.00 - \$13.50)} = 4{,}000 \text{ units}$$

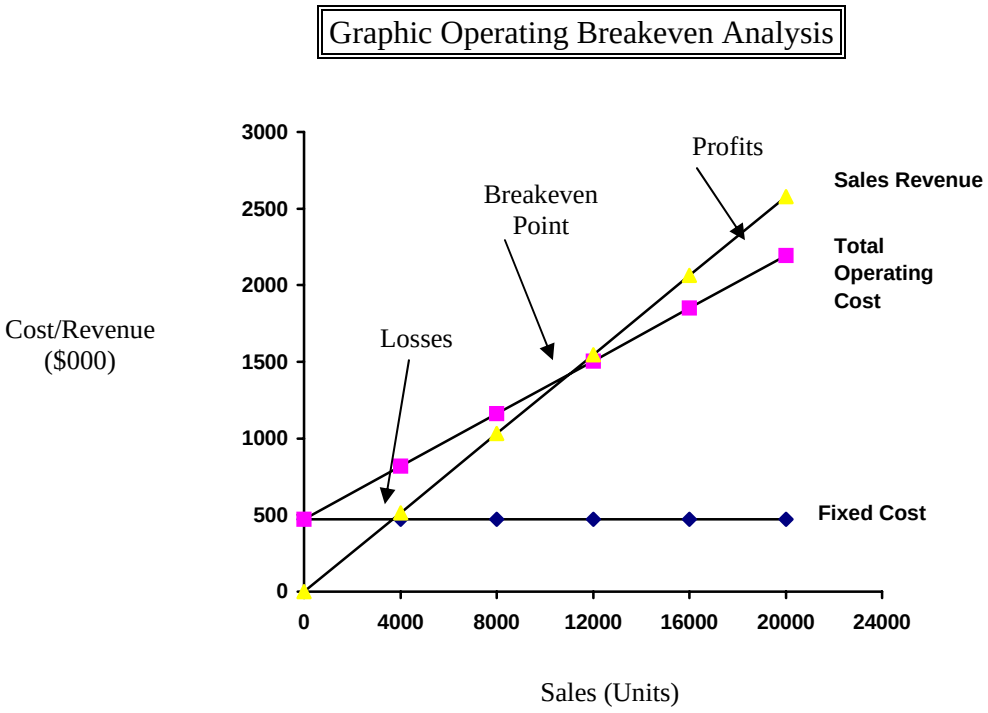
Firm H: $$Q = \frac{\$90{,}000}{(\$30.00 - \$12.00)} = 5{,}000 \text{ units}$$

b. From least risky to most risky: F and G are of equal risk, then H. It is important to recognize that operating leverage is only one measure of risk.

12-3 LG 1: Breakeven Point–Algebraic and Graphic

a. Q = FC ÷ (P - VC)
Q = $473,000 ÷ ($129 - $86)
Q = 11,000 units

b.



12-4 LG 1: Breakeven Analysis

a. $$Q = \frac{\$73{,}500}{(\$13.98 - \$10.48)} = 21{,}000 \text{ CDs}$$

b. Total operating costs = FC + (Q x VC)
Total operating costs = $73,500 + (21,000 x $10.48)
Total operating costs = $293,580

c. 2,000 x 12 = 24,000 CDs per year. 2,000 records per month exceeds the operating breakeven by 3,000 records per year. Barry should go into the CD business.

d. EBIT = (P x Q) - FC - (VC x Q)
EBIT = ($13.98 x 24,000) - $73,500 - ($10.48 x 24,000)
EBIT = $335,520 - $73,500 - $251,520
EBIT = $10,500

12-5 LG 1: Breakeven Point–Changing Costs/Revenues

a. Q = F ÷ (P - VC) Q = $40,000 ÷ ($10 - $8) = 20,000 books
b. Q = $44,000 ÷ $2.00 = 22,000 books

c. Q = \$40,000 ÷ \$2.50 = 16,000 books

d. Q = \$40,000 ÷ \$1.50 = 26,667 books

e. The operating breakeven point is directly related to fixed and variable costs and inversely related to selling price. Increases in costs raise the operating breakeven point, while increases in price lower it.

12-6 LG 1: Breakeven Analysis

a. $$Q = \frac{FC}{(P - VC)} = \frac{\$4{,}000}{\$8.00 - \$6.00} = 2{,}000 \text{ figurines}$$

b.

Sales	\$10,000
Less:	
Fixed costs	4,000
Variable costs (\$6 x 1,500)	9,000
EBIT	-\$ 3,000

c.

Sales	\$15,000
Less:	
Fixed costs	4,000
Variable costs (\$6 x 1,500)	9,000
EBIT	\$ 2,000

d. $$Q = \frac{EBIT + FC}{P - VC} = \frac{\$4{,}000 + \$4{,}000}{\$8 - \$6} = \frac{\$8{,}000}{\$2} = 4{,}000 \text{ units}$$

e. One alternative is to price the units differently based on the variable cost of the unit. Those more costly to produce will have higher prices than the less expensive production models. If they wish to maintain the same price for all units they may have to reduce the selection from the 15 types currently available to a smaller number which includes only those that have variable costs of \$6 or less.

12-7 LG 2: EBIT Sensitivity

a. and b.

	8,000 units	10,000 units	12,000 units
Sales	\$72,000	\$90,000	\$108,000
Less: Variable costs	40,000	50,000	60,000
Less: Fixed costs	20,000	20,000	20,000
EBIT	\$12,000	\$20,000	\$28,000

c. Unit Sales 8,000 10,000 12,000

Percentage Change in Unit sales	(8,000 - 10,000) ÷ 10,000 = - 20%	0	(12,000 - 10,000) ÷ 10,000 = + 20%
Percentage Change in EBIT	(12,000 - 20,000) ÷ 20,000 = -40%	0	(28,000 - 20,000) ÷ 20,000 = + 40%

d. EBIT is more sensitive to changing sales levels; it increases/decreases twice as much as sales.

12-8 LG 2: Degree of Operating Leverage

a. $$Q = \frac{FC}{(P - VC)} = \frac{\$380,000}{\$63.50 - \$16.00} = 8,000 \text{ units}$$

b.

	9,000 units	10,000 units	11,000 units
Sales	$571,500	$635,000	$698,500
Less: Variable costs	144,000	160,000	176,000
Less: Fixed costs	380,000	380,000	380,000
EBIT	$ 47,500	$ 95,000	$142,500

c.

	9,000 units	10,000 units	11,000 units
Change in Unit Sales	- 1,000	0	+ 1,000
% Change in Sales	-1,000 ÷ 10,000 = - 10%	0	1,000 ÷ 10,000 = + 10%
Change in EBIT	-$47,500	0	+$47,500
% Change in EBIT	-$47,500 ÷ 95,000 - 50%	0	$47,500 ÷ 95,000 + 50%

d.

	9,000 units'	11,000 units
$\frac{\% \text{ Change in EBIT}}{\% \text{ Change in Sales}}$	- 50 ÷ - 10 = 5	50 ÷ 10 = 5

e. $$DOL = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$

$$DOL = \frac{[10,000 \times (\$63.50 - \$16.00)]}{[10,000 \times (\$63.50 - \$16.00) - \$380,000]}$$

$$DOL = \frac{\$475,000}{\$95,000} = 5.00$$

12-9 LG 2: Degree of Operating Leverage–Graphic

a. $$Q = \frac{FC}{(P - VC)} = \frac{\$72{,}000}{\$9.75 - \$6.75} = 24{,}000 \text{ units}$$

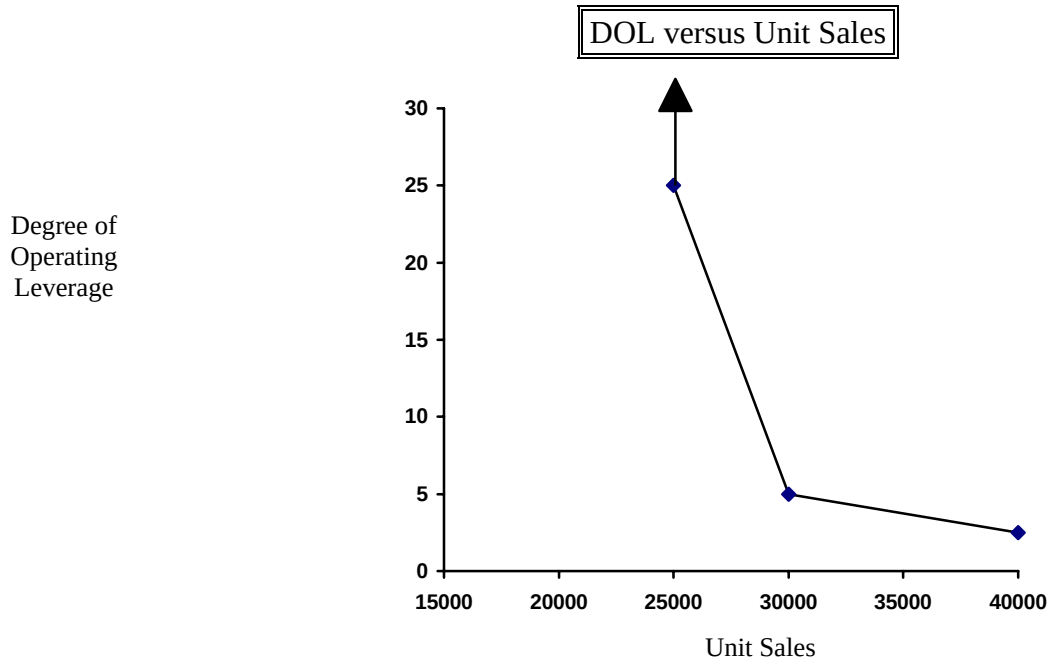
b. $$DOL = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$

$$DOL = \frac{[25{,}000 \times (\$9.75 - \$6.75)]}{[25{,}000 \times (\$9.75 - \$6.75)] - \$72{,}000} = 25.0$$

$$DOL = \frac{[30{,}000 \times (\$9.75 - \$6.75)]}{[30{,}000 \times (\$9.75 - \$6.75)] - \$72{,}000} = 5.0$$

$$DOL = \frac{[40{,}000 \times (\$9.75 - \$6.75)]}{[40{,}000 \times (\$9.75 - \$6.75)] - \$72{,}000} = 2.5$$

c.



d. $$\text{DOL} = \frac{[24{,}000 \times (\$9.75 - \$6.75)]}{[24{,}000 \times (\$9.75 - \$6.75)] - \$72{,}000} = \infty$$

At the operating breakeven point, the DOL is infinite.

e. DOL decreases as the firm expands beyond the operating breakeven point.

12-10 LG 2: EPS Calculations

	(a)	**(b)**	**(c)**
EBIT	$24,600	$30,600	$35,000
Less: Interest	9,600	9,600	9,600
Net profits before taxes	$15,000	$21,000	$25,400
Less: Taxes	6,000	8,400	10,160
Net profit after taxes	$9,000	$12,600	$15,240
Less: Preferred dividends	7,500	7,500	7,500
Earnings available to common shareholders	$1,500	$5,100	$7,740
EPS (4,000 shares)	$0.375	$1.275	$1.935

12-11 LG 2: Degree of Financial Leverage

a.

EBIT	$80,000	$120,000
Less: Interest	40,000	40,000

Net profits before taxes	$40,000	$80,000
Less: Taxes (40%)	16,000	32,000
Net profit after taxes	$24,000	$48,000
EPS (2,000 shares)	$12.00	$24.00

b. $$DFL = \frac{EBIT}{\left[EBIT - I - \left(PD \times \frac{1}{(1-T)}\right)\right]}$$

$$DFL = \frac{\$80,000}{[\$80,000 - \$40,000 - 0]} = 2$$

c.

EBIT	$80,000	$120,000
Less: Interest	16,000	16,000
Net profits before taxes	$64,000	$104,000
Less: Taxes (40%)	25,600	41,600
Net profit after taxes	$38,400	$62,400
EPS (3,000 shares)	$12.80	$20.80

$$DFL = \frac{\$80,000}{[\$80,000 - \$16,000 - 0]} = 1.25$$

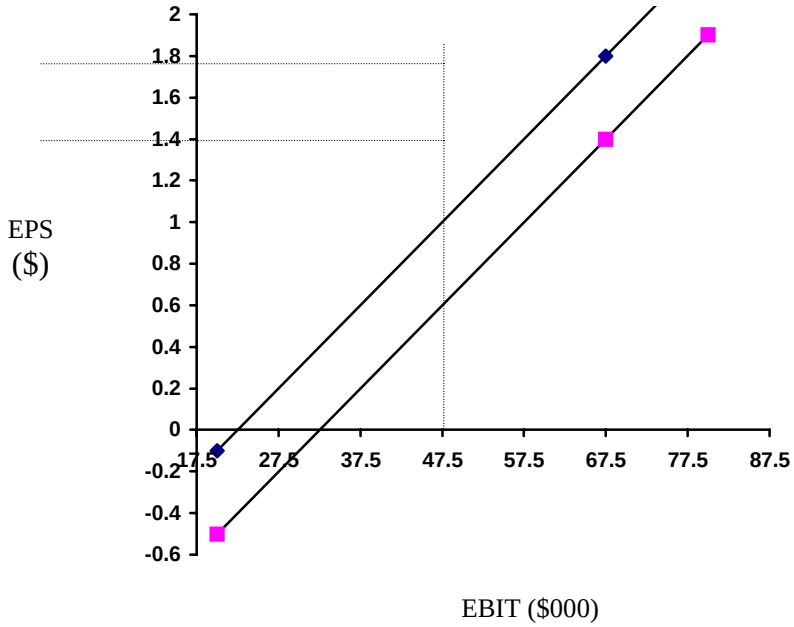
12-12 LG 2, 5: DFL and Graphic Display of Financing Plans

a. $$DFL = \frac{EBIT}{\left[EBIT - I - \left(PD \times \frac{1}{(1-T)}\right)\right]}$$

$$DFL = \frac{\$67,500}{[\$67,500 - \$22,500 - 0]} = 1.5$$

b.

Graphic Display of Financing Plans



c. $$\text{DFL} = \frac{\$67{,}500}{\left[\$67{,}500 - \$22{,}500 - \frac{\$6{,}000}{.6}\right]} = 1.93$$

d. See graph

e. The lines representing the two financing plans are parallel since the number of shares of common stock outstanding is the same in each case. The financing plan, including the preferred stock, results in a higher financial breakeven point and a lower EPS at any EBIT level.

12-13 LG 1, 2: Integrative–Multiple Leverage Measures

a. $$\text{Operating breakeven} = \frac{\$28{,}000}{\$0.16} = 175{,}000 \text{ units}$$

b. $$\text{DOL} = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$

$$\text{DOL} = \frac{[400{,}000 \times (\$1.00 - \$0.84)]}{[400{,}000 \times (\$1.00 - \$0.84)] - \$28{,}000} = \frac{\$64{,}000}{\$36{,}000} = 1.78$$

c.
EBIT = (P x Q) - FC - (Q x VC)
EBIT = ($1.00 x 400,000) - $28,000 - (400,000 x $0.84)
EBIT = $400,000 - $28,000 - $336,000
EBIT = $36,000

$$DFL = \frac{EBIT}{\left[EBIT - I - \left(PD \times \frac{1}{(1-T)}\right)\right]}$$

$$DFL = \frac{\$36,000}{\left[\$36,000 - \$6,000 - \left(\frac{\$2,000}{(1-.4)}\right)\right]} = 1.35$$

d. $$DTL = \frac{[Q \times (P - VC)]}{\left[Q \times (P - VC) - FC - I - \left(\frac{PD}{(1-T)}\right)\right]}$$

$$DTL = \frac{[400,000 \times (\$1.00 - \$0.84)]}{\left[400,000 \times (\$1.00 - \$0.84) - \$28,000 - \$6,000 - \left(\frac{\$2,000}{(1-.4)}\right)\right]}$$

$$DTL = \frac{\$64,000}{[\$64,000 - \$28,000 - \$9,333]} = \frac{\$64,000}{\$26,667} = 2.40$$

DTL = DOL x DFL
DTL = 1.78 x 1.35 = 2.40
The two formulas give the same result.

12-14 LG 2: Integrative–Leverage and Risk

a. $$DOL_R = \frac{[100,000 \times (\$2.00 - \$1.70)]}{[100,000 \times (\$2.00 - \$1.70)] - \$6,000} = \frac{\$30,000}{\$24,000} = 1.25$$

$$DFL_R = \frac{\$24,000}{[\$24,000 - \$10,000]} = 1.71$$

$DTL_R = 1.25 \times 1.71 = 2.14$

b. $$DOL_W = \frac{[100,000 \times (\$2.50 - \$1.00)]}{[100,000 \times (\$2.50 - \$1.00)] - \$62,500} = \frac{\$150,000}{\$87,500} = 1.71$$

$$DFL_W = \frac{\$87,500}{[\$87,500 - \$17,500]} = 1.25$$

$DTL_R = 1.71 \times 1.25 = 2.14$

c. Firm R has less operating (business) risk but more financial risk than Firm W.

d. Two firms with differing operating and financial structures may be equally leveraged. Since total leverage is the product of operating and financial leverage, each firm may structure itself differently and still have the same amount of total risk.

12-15 LG 1, 2: Integrative–Multiple Leverage Measures and Prediction

a. Q = FC ÷ (P - VC) Q = \$50,000 ÷ (\$6 - \$3.50) = 20,000 latches

b.

Sales (\$6 x 30,000)	\$180,000
Less:	
Fixed costs	50,000
Variable costs (\$3.50 x 30,000)	105,000
EBIT	25,000
Less interest expense	13,000
EBT	12,000
Less taxes (40%)	4,800
Net profits	\$7,200

c. $$\text{DOL} = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$

$$\text{DOL} = \frac{[30{,}000 \times (\$6.00 - \$3.50)]}{[30{,}000 \times (\$6.00 - \$3.50)] - \$50{,}000} = \frac{\$75{,}000}{\$25{,}000} = 3.0$$

d. $$\text{DFL} = \frac{\text{EBIT}}{\left[\text{EBIT} - I - \left(PD \times \frac{1}{(1 - T)}\right)\right]}$$

$$\text{DFL} = \frac{\$25{,}000}{\$25{,}000 - \$13{,}000 - [\$7{,}000 \times (1 \div .6)]} = \frac{\$25{,}000}{\$333} = 75.08$$

e. DTL = DOL x DFL = 3 x 75.08 = 225.24

f. $$\text{Change in sales} = \frac{15{,}000}{30{,}000} = 50\%$$

% Change in EBIT = % change in sales x DOL = 50% x 3 = 150%

New EBIT = \$25,000 + (\$25,000 x 150%) = \$62,500

% Change in net profit = % change in sales x DTL = 50% x 225.24 = 11,262%

New net profit = \$7,200 + (\$7,200 x 11,262%) = \$7,200 + \$810,864 =\$818,064

12-16 LG 3: Various Capital Structures

Debt Ratio	Debt	Equity

10%	$100,000	$900,000
20%	$200,000	$800,000
30%	$300,000	$700,000
40%	$400,000	$600,000
50%	$500,000	$500,000
60%	$600,000	$400,000
90%	$900,000	$100,000

Theoretically, the debt ratio cannot exceed 100%. Practically, few creditors would extend loans to companies with exceedingly high debt ratios (>70%).

12-17 LG 3: Debt and Financial Risk

a. EBIT Calculation

Probability	.20	.60	.20
Sales	$200,000	$300,000	$400,000
Less: Variable costs (70%)	140,000	210,000	280,000
Less: Fixed costs	75,000	75,000	75,000
EBIT	$(15,000)	$15,000	$45,000
Less Interest	12,000	12,000	12,000
Earnings before taxes	$(27,000)	$3,000	$33,000
Less: Taxes	(10,800)	1,200	13,200
Earnings after taxes	$(16,200)	$1,800	$19,800

b. EPS

Earnings after taxes	$(16,200)	$1,800	$19,800
Number of shares	10,000	10,000	10,000
EPS	$(1.62)	$0.18	$1.98

$$\text{Expected EPS} = \sum_{i=1}^{n} EPS_j \times Pr_j$$

Expected EPS = (-$1.62 x .20) + ($0.18 x .60) + ($1.98 x .20)
Expected EPS = -$.324 +$0.108 + $.396
Expected EPS = $0.18

$$\sigma_{EPS} = \sqrt{\sum_{i=1}^{n} (EPS_i - EPS)^2 \times Pr_i}$$

$$\sigma_{EPS} = \sqrt{\left[(-\$1.62 - \$0.18)^2 \times .20\right] + \left[(\$0.18 - \$0.18)^2 \times .60\right] + \left[(\$1.98 - \$0.18)^2 \times .20\right]}$$

$$\sigma_{EPS} = \sqrt{(\$3.24 \times .20) + 0 + (\$3.24 \times .20)}$$

$$\sigma_{EPS} = \sqrt{\$0.648 + \$0.648}$$

$\sigma_{EPS} = \sqrt{\$1.296} = \$1.138$

$$CV_{EPS} = \frac{\sigma_{EPS}}{\text{Expected EPS}} = \frac{1.138}{.18} = 6.32$$

c.

EBIT *	$(15,000)	$15,000	$45,000
Less: Interest	0	0	0
Net profit before taxes	$(15,000)	$15,000	$45,000
Less: Taxes	(6,000)	6,000	18,000
Net profits after taxes	$(9,000)	$9,000	$27,000
EPS (15,000 shares)	$(0.60)	$0.60	$1.80

* From part a.

Expected EPS = ($-0.60 x .20) + ($0.60 x .60) + ($1.80 x .20) = $0.60

$$\sigma_{EPS} = \sqrt{\left[(-\$0.60 - \$0.60)^2 \times .20\right] + \left[(\$0.60 - \$0.60)^2 \times .60\right] + \left[(\$1.80 - \$0.60)^2 \times .20\right]}$$

$$\sigma_{EPS} = \sqrt{(\$1.44 \times .20) + 0 + (\$1.44 \times .20)}$$

$$\sigma_{EPS} = \sqrt{\$0.576} = \$0.759$$

$$CV_{EPS} = \frac{\$0.759}{.60} = 1.265$$

d. Summary Statistics

	With Debt	All Equity
Expected EPS	$ 0.180	$ 0.600
σ_{EPS}	$1.138	$ 0.759
CV_{EPS}	6.320	1.265

Including debt in Tower Interiors' capital structure results in a lower expected EPS, a higher standard deviation, and a much higher coefficient of variation than the all-equity structure. Eliminating debt from the firm's capital structure greatly reduces financial risk, which is measured by the coefficient of variation.

12-18 LG 4: EPS and Optimal Debt Ratio

a.

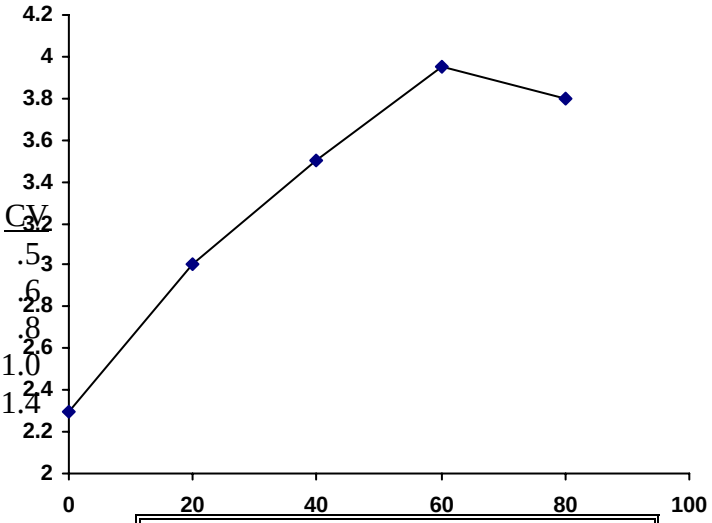
Debt Ratio vs. EPS

Earnings per share ($)

Maximum EPS appears to be at 60% debt ratio, with $3.95 per share earnings.

b. $CV_{EPS} = \frac{\sigma_{EPS}}{EPS}$

Debt Ratio	CV
0%	.5
20	.6
40	.8
60	1.0
80	1.4

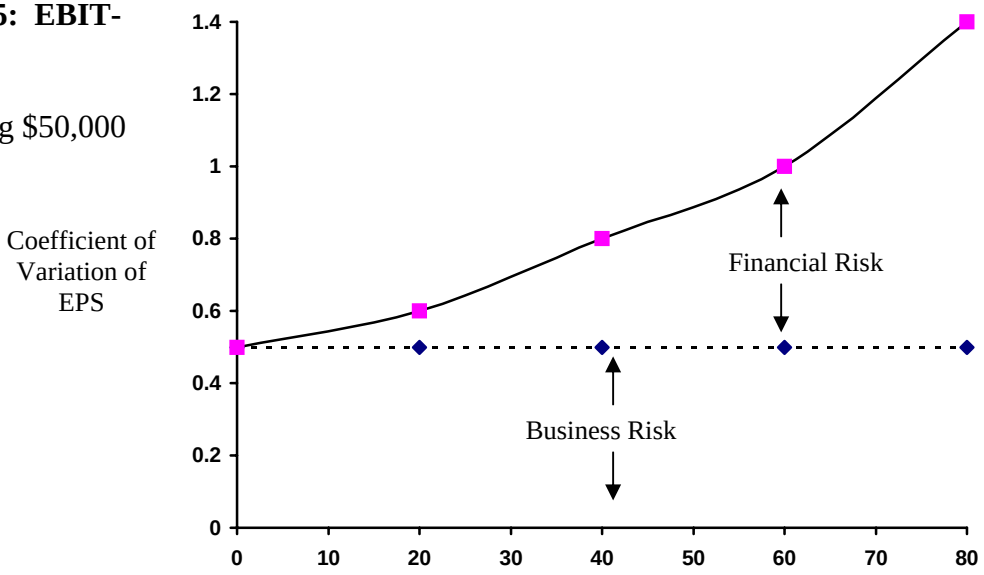


Debt Ratio vs. Coefficient of Variation

Debt Ratio (%)

12-19 LG 5: EBIT-EPS and Capital Structure

a. Using $50,000 and $60,000 EBIT:



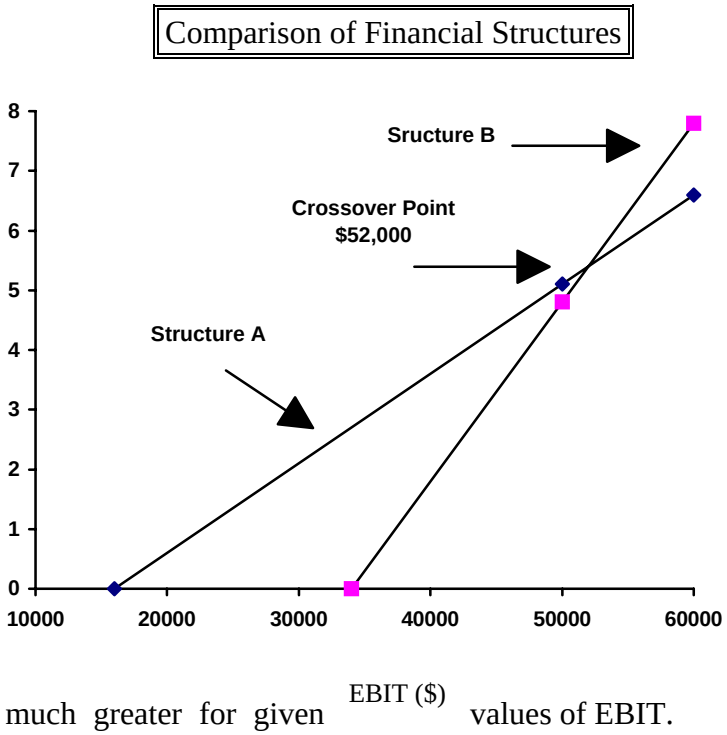
Debt Ratio (%)

	Structure A		Structure B	
EBIT	$50,000	$60,000	$50,000	$60,000
Less: Interest	16,000	16,000	34,000	34,000
Net profits before taxes	$34,000	$44,000	$16,000	$26,000
Less: Taxes	13,600	17,600	6,400	10,400
Net profit after taxes	$20,400	$26,400	$9,600	$15,600
EPS (4,000 shares)	$5.10	$6.60		
EPS (2,000 shares)			$4.80	$7.80

Financial breakeven points:

Structure A	Structure B
$16,000	$34,000

b.



c. If EBIT is expected to be below $52,000, Structure A is preferred. If EBIT is expected to be above $52,000, Structure B is preferred.

d. Structure A has less risk and promises lower returns as EBIT increases. B is more risky since it has a higher financial breakeven point. The steeper slope of the line for Structure B also indicates greater financial leverage.

e. If EBIT is greater than $75,000, Structure B is recommended since changes in EPS are much greater for given values of EBIT.

12-20 LG 5: EBIT-EPS and Preferred Stock

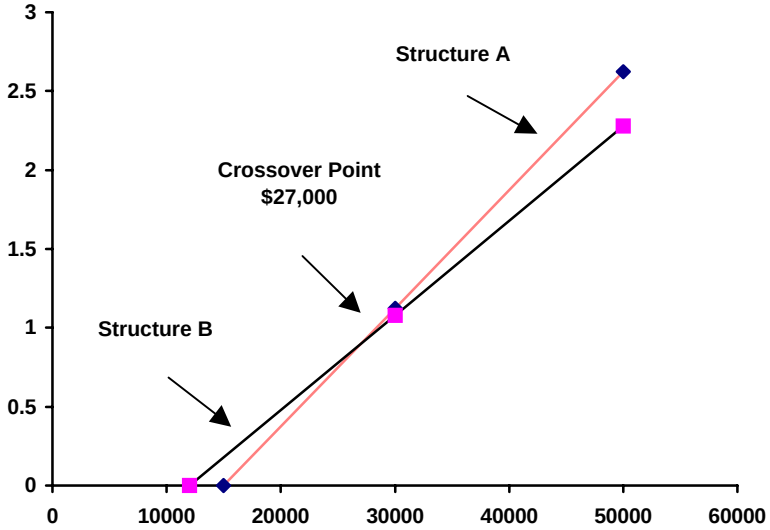
a.

	Structure A		Structure B	
EBIT	$30,000	$50,000	$30,000	$50,000
Less: Interest	12,000	12,000	7,500	7,500
Net profits before taxes	$18,000	$38,000	$22,500	$42,500
Less: Taxes	7,200	15,200	9,000	17,000
Net profit after taxes	$10,800	$22,800	$13,500	$25,500
Less: Preferred dividends	1,800	1,800	2,700	2,700
Earnings available for common shareholders	$9,000	$21,000	$10,800	$22,800
EPS (8,000 shares)	$1.125	$2.625		
EPS (10,000 shares)			$1.08	$2.28

b.

c. Structure A has greater financial leverage, hence greater financial risk.

d. If EBIT is expected to be below \$27,000, Structure B preferred. If EBIT is expected to be above \$27,000, Structure A is preferred.



e. If EBIT is expected to be \$35,000, Structure A is recommended since changes in EPS are much greater for given values of EBIT.

12-21 LG 3, 4, 6: Integrative–Optimal Capital Structure

a.

Debt ratio	0%	15%	30%	45%	60%
EBIT	\$2,000,000	\$2,000,000	\$2,000,000	\$2,000,000	\$2,000,000
Less interest	0	120,000	270,000	540,000	900,000
EBT	\$2,000,000	\$1,880,000	1,730,000	\$1,460,000	\$1,100,000
Taxes @40%	800,000	752,000	692,000	584,000	440,000
Net profit	\$1,200,000	\$1,128,000	\$1,038,000	\$ 876,000	\$660,000
Less preferred dividends	200,000	200,000	200,000	200,000	200,000
Profits available to common stock	\$1,000,000	\$ 928,000	\$ 838,000	\$ 676,000	\$ 460,000
# shares outstanding	200,000	170,000	140,000	110,000	80,000
EPS	\$5.00	\$5.46	\$5.99	\$6.15	\$5.75

b. $P_0 = \frac{EPS}{k_s}$

Debt: 0%

$P_0 = \frac{\$5.00}{.12} = \$41.67$

Debt: 15%

$P_0 = \frac{\$5.46}{.13} = \$42.00$

Debt: 30%

$P_0 = \frac{\$5.99}{.14} = \$42.79$

Debt: 45%

$P_0 = \frac{\$6.15}{.16} = \$38.44$

Debt: 60%

$P_0 = \frac{\$5.75}{.20} = \$28.75$

c. The optimal capital structure would be 30% debt and 70% equity because this is the debt/equity mix that maximizes the price of the common stock.

12-22 LG 3, 4, 6: Integrative–Optimal Capital Structures

a.

0% debt ratio	Probability		
Probability	.20	.60	.20
Sales	$200,000	$300,000	$400,000
Less: Variable costs (70%)	80,000	120,000	160,000
Less: Fixed costs	100,000	100,000	100,000
EBIT	$20,000	$80,000	$140,000
Less Interest	0	0	0
Earnings before taxes	$20,000	$80,000	$140,000
Less: Taxes	8,000	32,000	56,000
Earnings after taxes	$12,000	$48,000	$84,000
EPS (25,000 shares)	$0.48	$1.92	$3.36

20 % debt ratio:

Total capital=$250,000 (100% equity = 25,000 shares x $10 book value)

Amount of debt = 20% x $250,000 = $50,000

Amount of equity = 80% x 250,000 = $200,000

Number of shares = $200,000 ÷ $10 book value = 20,000 shares

	Probability		
	.20	.60	.20
EBIT	$20,000	$80,000	$140,000
Less Interest	5,000	5,000	5,000
Earnings before taxes	$15,000	$75,000	$135,000
Less: Taxes	6,000	30,000	54,000
Earnings after taxes	$9,000	$45,000	$81,000
EPS (20,000 shares)	$0.45	$2.25	$4.05

40% debt ratio:

Amount of debt = 40% x $250,000: = total debt capital = $100,000

Number of shares = $150,000 equity ÷ $10 book value = 15,000 shares

	Probability		
	.20	.60	.20
EBIT	$20,000	$80,000	$140,000
Less Interest	12,000	12,000	12,000
Earnings before taxes	$8,000	$68,000	$128,000
Less: Taxes	3,200	27,200	51,200
Earnings after taxes	$4,800	$40,800	$76,800
EPS (15,000 shares)	$0.32	$2.72	$5.12

60% debt ratio:

Amount of debt = 60% x $250,000 = total debt capital = $150,000

Number of shares = $100,000 equity ÷ $10 book value = 10,000 shares

	Probability		
	.20	.60	.20
EBIT	$20,000	$80,000	$140,000
Less Interest	21,000	21,000	21,000
Earnings before taxes	$(1,000)	$59,000	$119,000
Less: Taxes	(400)	23,600	47,600
Earnings after taxes	$(600)	$35,400	$71,400
EPS (10,000 shares)	$ (0.06)	$3.54	$7.14

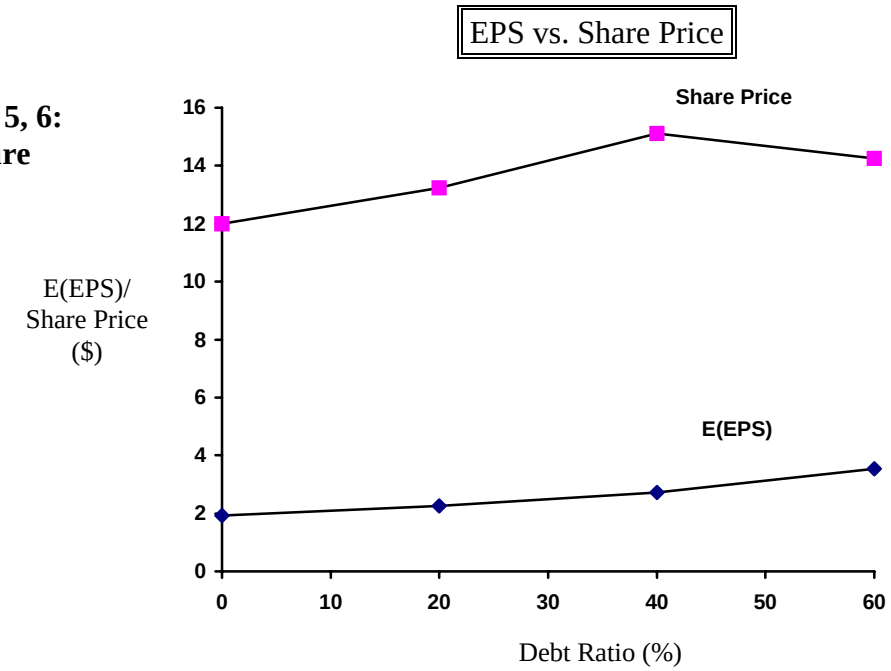
Debt Ratio	E(EPS)	σEPS	CV (EPS)	Number of Common Shares	Dollar Amount of Debt	Share Price *
0%	$1.92	.9107	.4743	25,000	0	$1.92/.16 = $12.00
20%	$2.25	1.1384	.5060	20,000	$50,000	$2.25/.17 = $13.24
40%	$2.72	1.5179	.5581	15,000	$100,000	$2.72/.18 = $15.11
60%	$3.54	2.2768	.6432	10,000	$150,000	$3.54/.24 = $14.75

* Share price: E(EPS) ÷ required return for CV for E(EPS), from table in problem.

b. **(1)** Optimal capital structure to maximize EPS: 60% debt, 40% equity

(2) Optimal capital structure to maximize share price: 40% debt, 60% equity

c.



12-23 LG 3, 4, 5, 6: Integrative–Optimal Capital Structure

a.

% Debt	Total Assets	$ Debt	$ Equity	No. of shares @ $25
0	$40,000,000	$ 0	$40,000,000	1,600,000
10	40,000,000	4,000,000	36,000,000	1,440,000
20	40,000,000	8,000,000	32,000,000	1,280,000
30	40,000,000	12,000,000	28,000,000	1,120,000
40	40,000,000	16,000,000	24,000,000	960,000
50	40,000,000	20,000,000	20,000,000	800,000
60	40,000,000	24,000,000	16,000,000	640,000

b.

% Debt	$ Total Debt	Before Tax Cost of Debt, k_d	$ Interest Expense
0	$ 0	0.0%	$ 0
10	4,000,000	7.5	300,000
20	8,000,000	8.0	640,000
30	12,000,000	9.0	1,080,000
40	16,000,000	11.0	1,760,000
50	20,000,000	12.5	2,500,000
60	24,000,000	15.5	3,720,000

c.

% Debt	$ Interest Expense	EBT	Taxes @40%	Net Income	# of Shares	EPS
0	$ 0	$8,000,000	$3,200,000	$4,800,000	1,600,000	$3.00
10	300,000	7,700,000	3,080,000	4,620,000	1,440,000	3.21
20	640,000	7,360,000	2,944,000	4,416,000	1,280,000	3.45
30	1,080,000	6,920,000	2,768,000	4,152,000	1,120,000	3.71
40	1,760,000	6,240,000	2,496,000	3,744,000	960,000	3.90
50	2,500,000	5,500,000	2,200,000	3,300,000	800,000	4.13

60	3,720,000	4,280,000	1,712,000	2,568,000	640,000	4.01

d.

% Debt	EPS	k_S	P_0
0	$3.00	10.0%	$30.00
10	3.21	10.3	31.17
20	3.45	10.9	31.65
30	3.71	11.4	32.54
40	3.90	12.6	30.95
50	4.13	14.8	27.91
60	4.01	17.5	22.91

e. The optimal proportion of debt would be 30% with equity being 70%. This mix will maximize the price per share of the firm's common stock and thus maximize shareholders' wealth. Beyond the 30% level, the cost of capital increases to the point that it offsets the gain from the lower-costing debt financing.

12-24 LG 4, 5, 6: Integrative–Optimal Capital Structure

a.

	Probability		
	.30	.40	.30
Sales	$600,000	$900,000	$1,200,000
Less: Variable costs (40%)	240,000	360,000	480,000
Less: Fixed costs	300,000	300,000	300,000
EBIT	$ 60,000	$240,000	$ 420,000

b.

Debt Ratio	Amount of Debt	Amount of Equity	Number of Shares of Common Stock *
0%	$ 0	$1,000,000	40,000
15%	150,000	850,000	34,000
30%	300,000	700,000	28,000
45%	450,000	550,000	22,000
60%	600,000	400,000	16,000

* Dollar amount of equity ÷ $25 per share = Number of shares of common stock.

c.

Debt Ratio	Amount of Debt	Before tax cost of debt	Annual Interest
0%	$ 0	0.0%	$ 0
15%	150,000	8.0	12,000
30%	300,000	10.0	30,000
45%	450,000	13.0	58,500
60%	600,000	17.0	102,000

d. **EPS = [(EBIT - Interest) (1- T)] ÷ Number of common shares outstanding.**

Debt Ratio	Calculation	EPS
0%	($ 60,000 - $0) x (.6) ÷ 40,000 shares	= $0.90

	($240,000 - $0) x (.6) ÷ 40,000 shares	= 3.60
	($420,000 - $0) x (.6) ÷ 40,000 shares	= 6.30
15%	($ 60,000 - $12,000) x (.6) ÷ 34,000 shares	= $0.85
	($240,000 - $12,000) x (.6) ÷ 34,000 shares	= 4.02
	($420,000 - $12,000) x (.6) ÷ 34,000 shares	= 7.20
30%	($ 60,000 - $30,000) x (.6) ÷ 28,000 shares	= $0.64
	($240,000 - $30,000) x (.6) ÷ 28,000 shares	= 4.50
	($420,000 - $30,000) x (.6) ÷ 28,000 shares	= 8.36
45%	($ 60,000 - $58,500) x (.6) ÷ 22,000 shares	= $0.04
	($240,000 - $58,500) x (.6) ÷ 22,000 shares	= 4.95
	($420,000 - $58,500) x (.6) ÷ 22,000 shares	= 9.86
60%	($ 60,000 - $102,000) x (.6) ÷ 16,000 shares	= - $1.58
	($240,000 - $102,000) x (.6) ÷ 16,000 shares	= 5.18
	($420,000 - $102,000) x (.6) ÷ 16,000 shares	= 11.93

e. (1) $E(EPS) = .30(EPS_1) + .40(EPS_2) + .30(EPS_3)$

Debt Ratio	Calculation	E(EPS)
0%	.30 x (0.90) + .40 x (3.60) + .30 x (6.30) .27 + 1.44 + 1.89	= $3.60
15%	.30 x (0.85) + .40 x (4.02) + .30 x (7.20) .26 + 1.61 + 2.16	= $4.03
30%	.30 x (0.64) + .40 x (4.50) + .30 x (8.36) .19 + 1.80 + 2.51	= $4.50
45%	.30 x (0.04) + .40 x (4.95) + .30 x (9.86) .01 + 1.98 + 2.96	= $4.95
60%	.30 x (-1.58) + .40 x (5.18) + .30 x (11.93) - .47 + 2.07 + 3.58	= $5.18

(2) σ_{EPS}

Debt Ratio — Calculation

0%
$$\sigma_{EPS} = \sqrt{\left[(.90 - 3.60)^2 \times .3\right] + \left[(3.60 - 3.60)^2 \times .4\right] + \left[(6.30 - 3.60)^2 \times .3\right]}$$
$$\sigma_{EPS} = \sqrt{2.187 + 0 + 2.187}$$
$$\sigma_{EPS} = \sqrt{4.374}$$
$$\sigma_{EPS} = 2.091$$

15%
$$\sigma_{EPS} = \sqrt{\left[(.85 - 4.03)^2 \times .3\right] + \left[(4.03 - 4.03)^2 \times .4\right] + \left[(7.20 - 4.03)^2 \times .3\right]}$$
$$\sigma_{EPS} = \sqrt{3.034 + 0 + 3.034}$$
$$\sigma_{EPS} = \sqrt{6.068}$$
$$\sigma_{EPS} = 2.463$$

30%
$$\sigma_{EPS} = \sqrt{\left[(.64 - 4.50)^2 \times .3\right] + \left[(4.50 - 4.50)^2 \times .4\right] + \left[(8.36 - 4.50)^2 \times .3\right]}$$
$$\sigma_{EPS} = \sqrt{4.470 + 0 + 4.470}$$
$$\sigma_{EPS} = \sqrt{8.94}$$
$$\sigma_{EPS} = 2.99$$

45%
$$\sigma_{EPS} = \sqrt{\left[(.04 - 4.95)^2 \times .3\right] + \left[(4.95 - 4.95)^2 \times .4\right] + \left[(9.86 - 4.95)^2 \times .3\right]}$$
$$\sigma_{EPS} = \sqrt{7.232 + 0 + 7.187232}$$
$$\sigma_{EPS} = \sqrt{14.464}$$
$$\sigma_{EPS} = 3.803$$

60% $\sigma_{EPS} = \sqrt{\left[(-1.58 - 5.18)^2 \times .3\right] + \left[(5.18 - 5.18)^2 \times .4\right] + \left[(11.930 - 5.18)^2 \times .3\right]}$

$\sigma_{EPS} = \sqrt{13.669 + 0 + 13.669}$

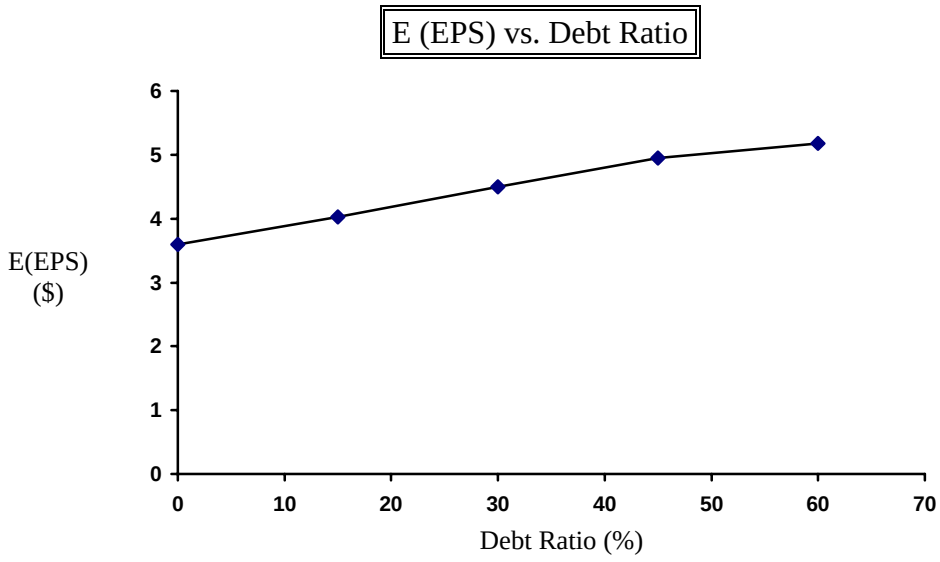
$\sigma_{EPS} = \sqrt{27.338}$

$\sigma_{EPS} = 5.299$

(3)

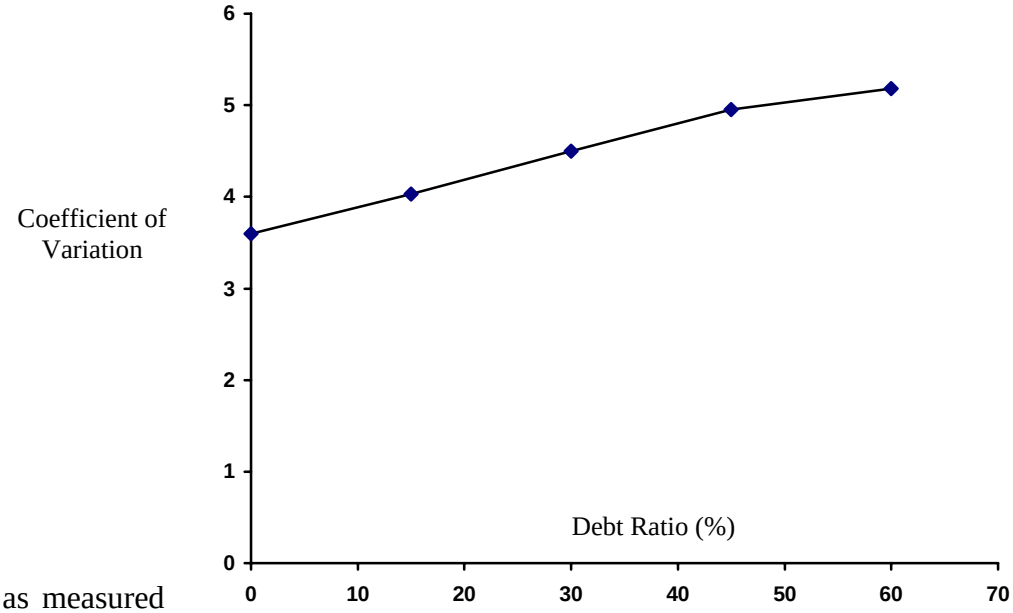
Debt Ratio	σ_{EPS} ÷ E(EPS)	= CV
0%	2.091 ÷ 3.60	= .581
15%	2.463 ÷ 4.03	= .611
30%	2.990 ÷ 4.50	= .664
45%	3.803 ÷ 4.95	= .768
60%	5.229 ÷ 5.18	= 1.009

f. **(1)**



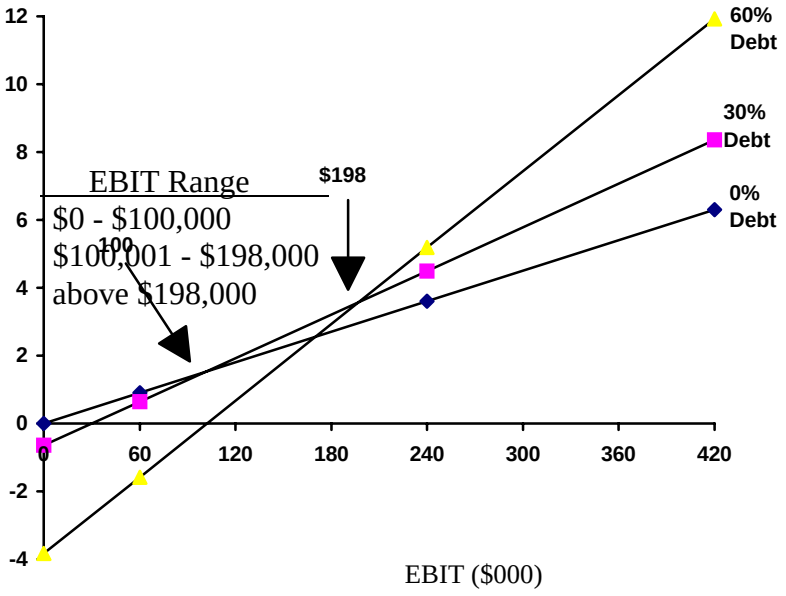
(2)

Coefficient of Variation vs. Debt Ratio



The return, as measured by the E(EPS), as shown in part **d**, continually increases as the debt ratio increases, although at some point the rate of increase of the EPS begins to decline (the law of diminishing returns). The risk as measured by the CV also increases as the debt ratio increases, but at a more rapid rate.

g.



The EBIT ranges over which each capital structure is preferred are as follows:

Debt ratio	EBIT Range
0%	$0 - $100,000
30%	$100,001 - $198,000
60%	above $198,000

To calculate the intersection points on the graphic representation of the EBIT-EPS approach to capital structure, the EBIT level which equates EPS for each capital structure must be found, using the formula in Footnote 22.

$$EPS = \frac{(1-T)\times(EBIT-I)-PD}{\text{number of common shares outstanding}}$$

Set EPS 0% = EPS 30%
EPS 30% = EPS 60%

The first calculation, EPS 0% = EPS 30%, is illustrated:

$$EPS_{0\%} = \frac{[(1-.4)(EBIT-\$0)-0]}{40{,}000 \text{ shares}}$$

$$EPS_{30\%} = \frac{[(1-.4)(EBIT-\$30{,}000)-0]}{28{,}000 \text{ shares}}$$

$$16{,}800\ EBIT = 24{,}000\ EBIT - 720{,}000{,}000$$

$$EBIT = \frac{720{,}000{,}000}{7{,}200} = \$100{,}000$$

The major problem with this approach is that is does not consider maximization of shareholder wealth (i.e., share price).

h.

Debt Ratio	EPS ÷ k_s	Share Price

0%	$3.60 ÷ .100	$36.00
15%	$4.03 ÷ .105	$38.38
30%	$4.50 ÷ .116	$38.79
45%	$4.95 ÷ .140	$35.36
60%	$5.18 ÷ .200	$25.90

i. To maximize EPS, the 60% debt structure is preferred.
To maximize share value, the 30% debt structure is preferred.

A capital structure with 30% debt is recommended because it maximizes share value and satisfies the goal of maximization of shareholder wealth.

CHAPTER 12 CASE
Evaluating Tampa Manufacturing's Capital Structure

This case asks the student to evaluate Tampa's current and proposed capital structures in terms of maximization of earnings per share and financial risk before recommending one. It challenges the student to go beyond just the numbers and consider the overall impact of his or her choices on the firm's financial policies.

a. Times Interest Earned Calculations

	Current 10% Debt	Alternative A 30% Debt	Alternative B 50% Debt
Debt	$1,000,000	$3,000,000	$5,000,000
Coupon rate	.09	.10	.12
Interest	$ 90,000	$ 300,000	$ 600,000
EBIT	$1,200,000	$1,200,000	$1,200,000
Interest	$90,000	$300,000	$600,000
Times interest earned =	13.33	4	2

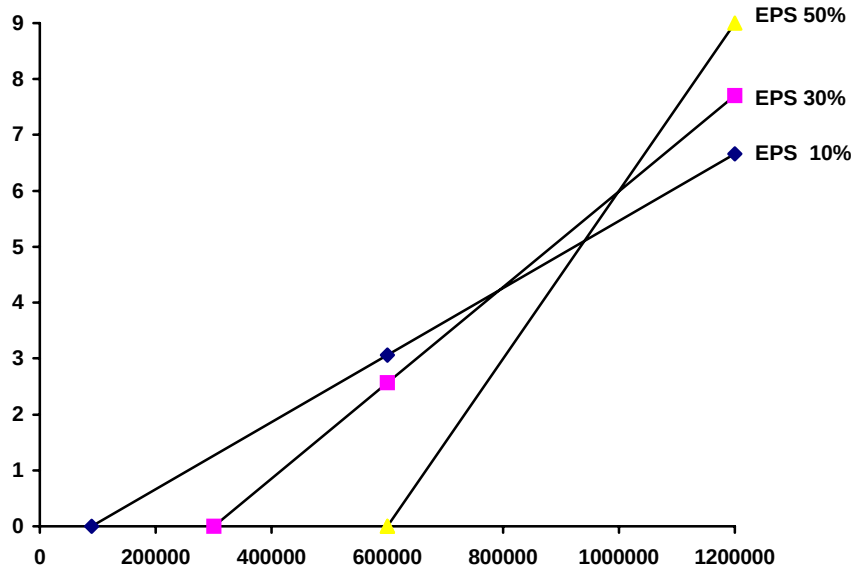
As the debt ratio increases from 10% to 50%, so do both financial leverage and risk. At 10% debt and $1,200,000 EBIT, the firm has over 13 times coverage of interest payments; at 30%, it still has 4 times coverage. At 50% debt, the highest financial leverage, coverage drops to 2 times, which may not provide enough cushions. Both the times interest earned and debt ratios should be compared to those of the printing equipment industry.

b. EBIT-EPS Calculations (using any two EBIT levels)

	Current 10% Debt 100,000 Shares		Alternative A 30% Debt 70,000 Shares		Alternative B 50% Debt 40,000 Shares	
EBIT	$ 600,000	$1,200,000	$ 600,000	$1,200,000	$ 600,000	$1,200,000
Interest	90,000	90,000	300,000	300,000	600,000	600,000
PBT	$ 510,000	$1,110,000	$ 300,000	$ 900,000	$ 0	$ 600,000
Taxes	204,000	444,000	120,000	360,000	0	240,000
PAT	$ 306,000	$ 666,000	$ 180,000	$ 540,000	$ 0	$ 360,000
EPS	$3.06	$6.66	$2.57	$7.71	0	$9.00

Comparison of Capital Structures

c. If Tampa's EBIT is $1,200,000, EPS is highest with the 50% debt ratio. The steeper slope of the lines representing higher debt levels demonstrates that financial leverage increases as the debt ratio increases. Although EPS is highest at 50%, the company must also take into consideration the financial risk of each alternative. The drawback to the EBIT-EPS approach is its emphasis on maximizing EPS rather than owner's wealth. It does not take risk into account. Also, if EBIT falls below about $750,000 (intersection of 10% and 30% debt), EPS is higher with a capital structure of 10%.



d. Market value: $P_0 = EPS \div ks$

Current:	$6.66 ÷ .12	=	$55.50
Alternative A-30%:	$7.71 ÷ .13	=	$59.31
Alternative B-50%:	$9.00 ÷ .18	=	$50.00

e. Alternative A, 30% debt, appears to be the best alternative. Although EPS is higher with Alternative B, the financial risk is high; times interest earned is only 2 times. Alternative A has a moderate risk level, with 4 times coverage of interest earned, and provides increased market value. Choosing this capital structure allows the firm to benefit from financial leverage while not taking on too much financial risk.