## Answers to Warm-Up Exercises

E13-1. Breakeven analysis

**Answer:** The operating breakeven point is the level of sales at which all fixed and variable operating costs are covered and EBIT is equal to $0.

$Q = FC \div (P - VC)$

$Q = \$12{,}500 \div (\$25 - \$10) = 833.33$, or 834 units

E13-2. Changing costs and the operating breakeven point

**Answer:** Calculate the breakeven point for the current process and the breakeven point for the new process, and compare the two.

Current breakeven: $Q_1 = \$15{,}000 \div (\$6.00 - \$2.50) = 4{,}286$ boxes

New breakeven: $Q_2 = \$16{,}500 \div (\$6.50 - \$2.50) = 4{,}125$ boxes

If Great Fish Taco Corporation makes the investment, it can lower its breakeven point by 161 boxes.

E13-3. Risk-adjusted discount rates

**Answer:** Use Equation 13.5 to find the DOL at 15,000 units.

$$Q = 15{,}000$$
$$P = \$20$$
$$VC = \$12$$
$$FC = \$30{,}000$$

$$\text{DOL at 15,000 units} = \frac{15{,}000 \times (\$20 - \$12)}{15{,}000 \times (\$20 - \$12) - \$30{,}000} = \frac{\$120{,}000}{\$90{,}000} = 1.33$$

E13-4. DFL

**Answer:** Substitute EBIT = $20,000, $I$ = $3,000, $PD$ = $4,000, and the tax rate ($T$ = 0.38) into Equation 12.7.

$$\text{DFL at \$20,000 EBIT} = \frac{\$20{,}000}{\$20{,}000 - \$3{,}000 - [\$4{,}000 \times (1 \div (1 - 0.38)]}$$
$$= \frac{\$20{,}000}{\$10{,}548} = 1.90$$

E13-5. Net operating profits after taxes (NOPAT)

**Answer:** Calculate EBIT, then NOPAT and the weighted average cost of capital (WACC) for Cobalt Industries.

EBIT = (150,000 × $10) − $250,000 − (150,000 × $5) = $500,000

NOPAT = EBIT × (1 − $T$) = $500,000 × (1 − 0.38) = $310,000

$$\text{Value of the firm} = \frac{\text{NOPAT}}{r_a} = \frac{\$310{,}000}{0.085} = \$3{,}647{,}059$$

## ■ Solutions to Problems

P13-1. Breakeven point—algebraic

**LG1; Basic**

$$Q = \frac{FC}{(P - VC)}$$

$$Q = \frac{\$12{,}350}{(\$24.95 - \$15.45)} = 1{,}300$$

P13-2. Breakeven comparisons—algebraic

**LG 1; Basic**

a. $$Q = \frac{FC}{(P - VC)}$$

**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.

P13-3. Breakeven point—algebraic and graphical

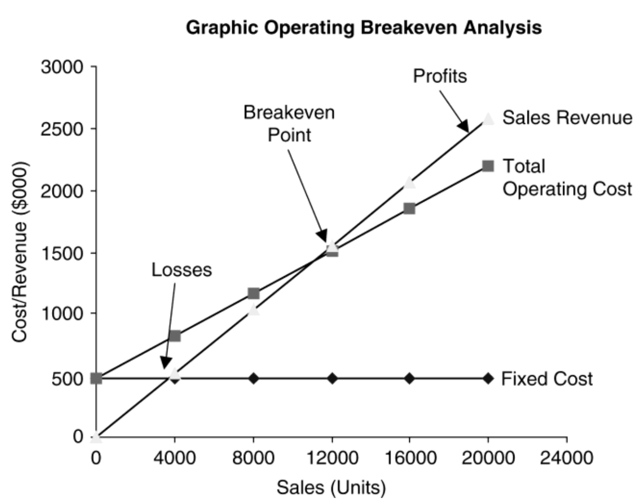
**LG 1; Intermediate**

a. $Q = FC \div (P - VC)$

$Q = \$473{,}000 \div (\$129 - \$86)$

$Q = 11{,}000$ units

b.



P13-4. Breakeven analysis

**LG 1; Intermediate**

a. $Q = \dfrac{\$73{,}500}{\$13.98 - \$10.48} = 21{,}000$ CDs

b. Total operating costs = $FC + (Q \times VC)$

Total operating costs = $73,500 + (21,000 × $10.48)

Total operating costs = $293,580

c. 2,000 × 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 = $(P \times Q) - FC - (VC \times Q)$

EBIT = ($13.98 × 24,000) – $73,500 – ($10.48 × 24,000)

EBIT = $335,520 – $73,500 – $251,520

EBIT = $10,500

P13-5. Personal finance: Breakeven analysis

**LG 1; Easy**

a. Breakeven point in months = fixed cost ÷ (monthly benefit – monthly variable costs)
$500 ÷ ($35 – $20) = $500 ÷ $15 = 33 1/3 months

b. Install the Geo-Tracker because the device pays for itself over 33.3 months, which is less than the 36 months that Paul is planning on owning the car.

P13-6. Breakeven point—changing costs/revenues

**LG 1; Intermediate**

| | | | |
|---|---|---|---|
| a. | $Q = F \div (P - VC)$ | $Q$ = $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.

P13-7. Breakeven analysis

**LG 1; Challenge**

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

b.

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

c.

| | |
|---|---|
| Sales | $15,000 |
| Less: | |
| Fixed costs | 4,000 |

| | |
|---|---|
| Variable costs ($6 × 1,500) | 9,000 |
| EBIT | $2,000 |

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

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 need to reduce the selection from the 15 types currently available to a smaller number that includes only those that have an average variable cost below $5.33 ($8 – $4,000/1,500 units).

P13-8. EBIT sensitivity

**LG 2; Intermediate**

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.

P13-9. DOL

**LG 2; Intermediate**

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 | 10,000 Units | 11,000 Units |
|---|---|---|---|
| $\frac{\text{\% change in EBIT}}{\text{\% change in sales}}$ | –50 ÷ –10 = 5 | | 50 ÷ 10 = 5 |

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

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

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

P13-10. DOL—graphic

**LG 2; Intermediate**

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

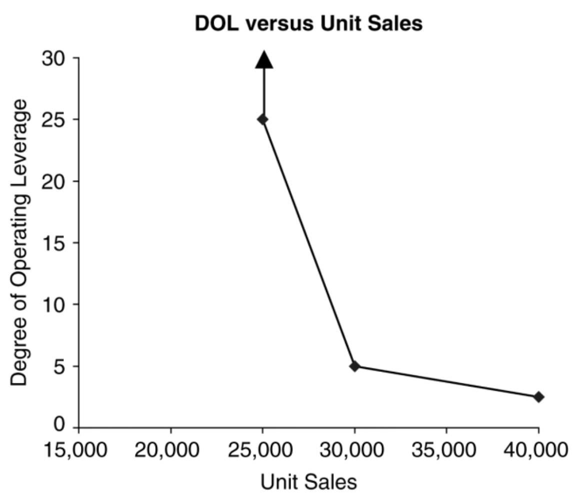
b. $\text{DOL} = \dfrac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$

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

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

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

c.




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

At the operating breakeven point, the DOL is infinite.

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

P13-11. EPS calculations

**LG 2; Intermediate**

| | (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 |

P13-12. Degree of financial leverage

**LG 2; Intermediate**

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

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

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 |

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

P13-13. Personal finance: Financial leverage

**LG 2; Challenge**

a.

| **Current DFL** | **Initial Values** | **Future Value** | **Percentage Change** |
|---|---|---|---|
| Available for making loan payment | $3,000 | $3,300 | 10.0% |
| Less: Loan payments | $1,000 | $1,000 | 0.0% |
| Available after loan payments | $2,000 | $2,300 | 15.0% |
| DFL | | | 15% ÷ 10% = 1.50 |

| **Proposed DFL** | **Initial Values** | **Future Value** | **Percentage Change** |
|---|---|---|---|
| Available for making loan payment | $3,000 | $3,300 | 10.0% |
| Less: Loan payments | $1,350 | $1,350 | 0.0% |
| Available after loan payments | $1,650 | $1,950 | 18.2% |
| DFL | | | 18.2% ÷ 10% = 1.82 |

b. Based on his calculations, the amount that Max will have available after loan payments with his current debt changes by 1.5% for every 1% change in the amount he will have available for making the loan payment. This is less responsive and therefore less risky than the 1.82% change in the amount available after making loan payments with the proposed $350 in monthly debt payments. Although it appears that Max can afford the additional loan payments, he must decide if, given the variability of Max's income, he would feel comfortable with the increased financial leverage and risk.

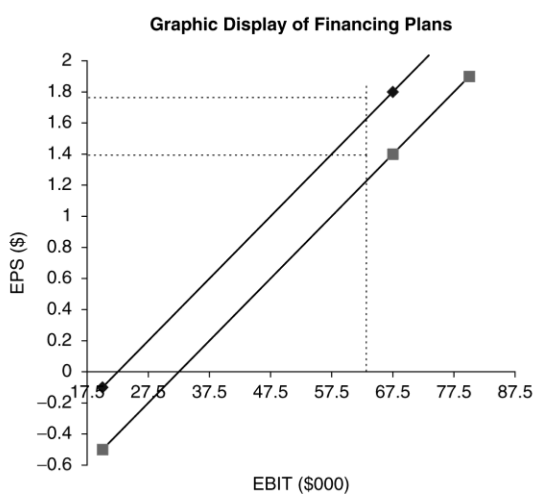
P13-14. DFL and graphic display of financing plans

**LG 2, 5; Challenge**

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

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

b.



c. $\text{DFL} = \dfrac{\$67{,}500}{\left[\$67{,}500 - \$22{,}500 - \dfrac{\$6{,}000}{0.6}\right]} = 1.93$

d. See graph, which is based on the following equation and data points.

| Financing | EBIT | EPS |
|---|---|---|
| Original financing plan | \$67,500 | $\dfrac{(\$67{,}000 - \$22{,}500)(1-0.4)}{15{,}000} = \$1.80$ |
| | \$17,500 | $\dfrac{(\$67{,}000 - \$22{,}500)(1-0.4)}{15{,}000} = -\$0.20$ |
| Revised financing plan | \$67,500 | $\dfrac{(\$67{,}000 - \$22{,}500)(1-0.4) - 6{,}000}{15{,}000} = \$1.40$ |
| | \$17,500 | $\dfrac{(\$17{,}000 - \$22{,}500)(1-0.4) - 6{,}000}{15{,}000} = -\$0.60$ |

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.

P13-15. Integrative—multiple leverage measures

**LG 1, 2; Intermediate**

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

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

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

c. EBIT = $(P \times Q) - FC - (Q \times VC)$

EBIT = (\$1.00 × 400,000) − \$28,000 − (400,000 × \$0.84)

EBIT = \$400,000 − \$28,000 − \$336,000

EBIT = \$36,000

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

$$\text{DFL} = \frac{\$36{,}000}{\left[\$36{,}000 - \$6{,}000 - \left(\dfrac{\$2{,}000}{(1-0.4)}\right)\right]} = 1.35$$

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

$$\text{DTL} = \frac{[400{,}000 \times (\$1.00 - \$0.84)]}{\left[400{,}000 \times (\$1.00 - \$0.84) - \$28{,}000 - \$6{,}000 - \left(\dfrac{\$2{,}000}{(1-0.4)}\right)\right]}$$

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

DTL = DOL × DFL

DTL = 1.78 × 1.35 = 2.40

The two formulas give the same result.

*Degree of total leverage.

P13-16. Integrative—leverage and risk

**LG 2; Intermediate**

a. $\text{DOL}_R = \dfrac{[100{,}000 \times (\$2.00 - \$1.70)]}{[100{,}000 \times (\$2.00 - \$1.70)] - \$6{,}000} = \dfrac{\$30{,}000}{\$24{,}000} = 1.25$

$$\text{DFL}_R = \frac{\$24{,}000}{[\$24{,}000 - \$10{,}000]} = 1.71$$

$$\text{DTL}_R = 1.25 \times 1.71 = 2.14$$

b. $\text{DOL}_W = \dfrac{[100{,}000 \times (\$2.50 - \$1.00)]}{[100{,}000 \times (\$2.50 - \$1.00)] - \$62{,}500} = \dfrac{\$150{,}000}{\$87{,}500} = 1.71$

$$\text{DFL}_W = \frac{\$87{,}500}{[\$87{,}500 - \$17{,}500]} = 1.25$$

$$\text{DTL}_R = 1.71 \times 1.25 = 2.14$$

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.

P13-17. Integrative—multiple leverage measures and prediction

**LG 1, 2; Challenge**

a. $Q = FC \div (P - VC)$ $\quad Q = \$50{,}000 \div (\$6 - \$3.50) = 20{,}000$ latches

b.

| | |
|---|---|
| Sales ($6 × 30,000) | $180,000 |
| Less: | |
| Fixed costs | 50,000 |
| Variable costs ($3.50 × 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. $\text{DOL} = \dfrac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$

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

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

$$\text{DFL} = \frac{\$25{,}000}{\$25{,}000 - \$13{,}000 - [\$7{,}000 \times (1 \div 0.6)]} = \frac{\$25{,}000}{\$333.33} = 75.00$$

e. DTL = DOL × DFL = 3 × 75.00 = 225 (or 22,500%)

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

Percentage change in EBIT = % change in sales × DOL = 50% × 3 = 150%

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

Percentage change in earnings available for common = % $\text{change}_{\text{sales}}$ × DTL = 50% × 225% = 11,250%

New earnings available for common = $200 + ($200 × 11,250%) = $$22,700,064

P13-18. Capital structures

**LG 3; Intermediate**

a. Monthly mortgage payment ÷ Monthly gross income = $1,100 ÷ $4,500 = 24.44%
Kirsten's ratio is less than the bank maximum of 28%.

b. Total monthly installment payment ÷ Monthly gross income = ($375 + $1,100) ÷ $4,500 = 32.8%.

Kirsten's ratio is less than the bank maximum of 37.0%. Since Kirsten's debt-related expenses as a percentage of her monthly gross income are less than bank-specified maximums, her loan application should be accepted.

P13-19. Various capital structures

**LG 3; Basic**

| **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%).

P13-20. Debt and financial risk

**LG 3; Challenge**

a. **EBIT Calculation**

| **Probability** | **0.20** | **0.60** | **0.20** |
|---|---|---|---|
| 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 |

$$\text{Expected EPS} = \sum_{i=1}^{n} \text{EPS}_j \times \text{Pr}_j$$

Expected EPS = (–$1.62 × 0.20) + ($0.18 × 0.60) + ($1.98 × 0.20)

Expected EPS = –$0.324 + $0.108 + $0.396

Expected EPS = $0.18

$$\sigma_{\text{EPS}} = \sqrt{\sum_{i=1}^{n} (\text{EPS}_i - \text{EPS})^2 \times \text{Pr}_i}$$

$$\sigma_{\text{EPS}} = \sqrt{[(-\$1.62 - \$0.18)^2 \times 0.20] + [(\$0.18 - \$0.18)^2 \times 0.60] + [(\$1.98 - \$0.18)^2 \times 0.20]}$$

$$\sigma_{\text{EPS}} = \sqrt{(\$3.24 \times 0.20) + 0 + (\$3.24 \times 0.20)}$$

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

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

$$CV_{\text{EPS}} = \frac{\sigma_{\text{EPS}}}{\text{Expected EPS}} = \frac{1.138}{0.18} = 6.32$$

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

$$\text{Expected EPS} = (-\$0.60 \times 0.20) + (\$0.60 \times 0.60) + (\$1.80 \times 0.20) = \$0.60$$

$$\sigma_{\text{EPS}} = \sqrt{[(-\$0.60 - \$0.60)^2 \times 0.20] + [(\$0.60 - \$0.60)^2 \times 0.60] + [(\$1.80 - \$0.60)^2 \times 0.20]}$$

$$\sigma_{\text{EPS}} = \sqrt{(\$1.44 \times 0.20) + 0 + (\$1.44 \times 0.20)}$$

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

$$CV_{\text{EPS}} = \frac{\$0.759}{0.60} = 1.265$$

d. **Summary statistics**

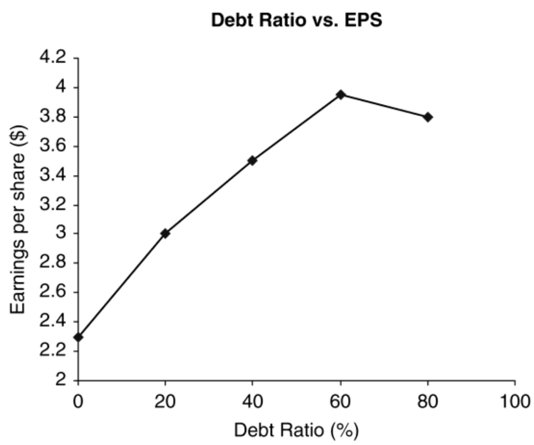
| | **With Debt** | **All Equity** |
|---|---|---|
| Expected EPS | \$0.180 | \$0.600 |
| $\sigma_{\text{EPS}}$ | \$1.138 | \$0.759 |
| $CV_{\text{EPS}}$ | 6.320 | 1.265 |

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.

P13-21. EPS and optimal debt ratio

**LG 4; Intermediate**

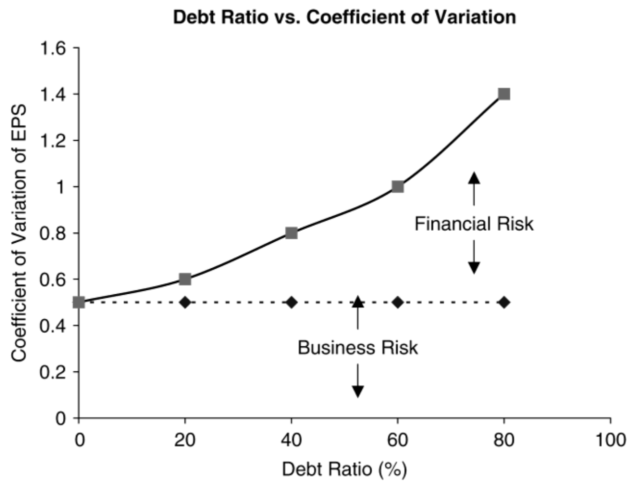
a.




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

b. $CV_{\text{EPS}} = \dfrac{\sigma_{\text{EPS}}}{\text{EPS}}$

| **Debt Ratio** | ***CV*** |
|---|---|
| 0% | 0.5 |
| 20 | 0.6 |
| 40 | 0.8 |
| 60 | 1.0 |
| 80 | 1.5 |




P13-22. EBIT-EPS and capital structure

**LG 5; Intermediate**

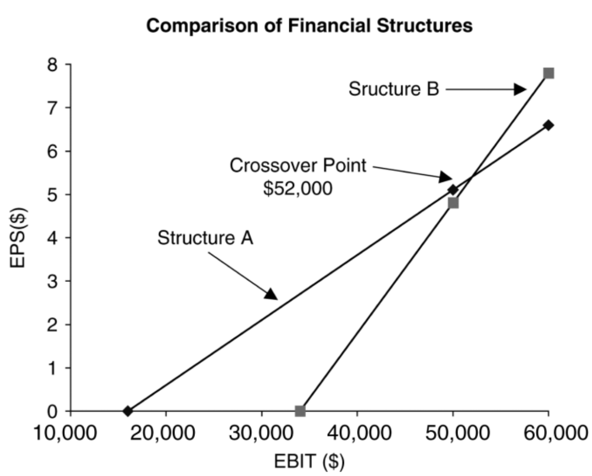
a. Using $50,000 and $60,000 EBIT:

| | **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.

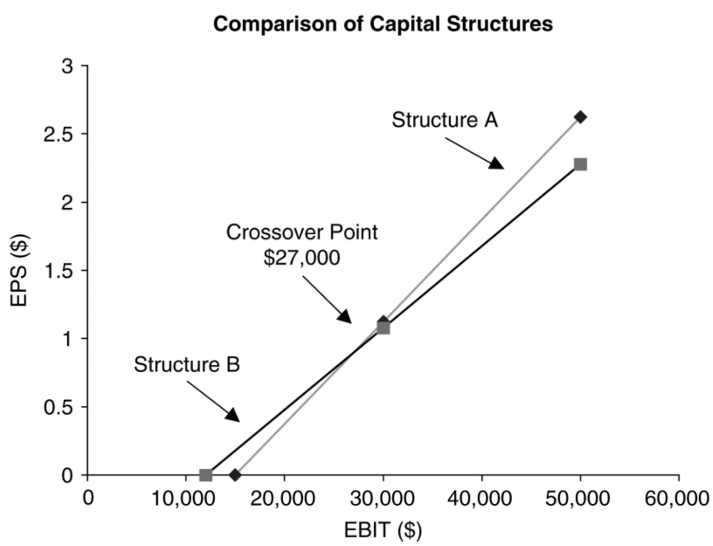
P13-23. EBIT-EPS and preferred stock

**LG 5: Intermediate**

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 is 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.

P13-24. Integrative—optimal capital structure

**LG 3, 4, 6; Intermediate**

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. $P_0 = \dfrac{\text{EPS}}{r_s}$

**Debt: 0%**

$$P_0 = \frac{\$5.00}{0.12} = \$41.67$$

**Debt: 15%**

$$P_0 = \frac{\$5.46}{0.13} = \$42.00$$

**Debt: 30%**

$$P_0 = \frac{\$5.99}{0.14} = \$42.79$$

**Debt: 45%**

$$P_0 = \frac{\$6.15}{0.16} = \$38.44$$

**Debt: 60%**

$$P_0 = \frac{\$5.75}{0.20} = \$28.75$$

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.

P13-25. Integrative—Optimal capital structures

**LG 3, 4, 6; Challenge**

a. **0% debt ratio**

| | Probability | | |
|---|---|---|---|
| | **0.20** | **0.60** | **0.20** |
| Sales | $200,000 | $300,000 | $400,000 |
| Less: Variable costs (40%) | 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 × $10 book value)
Amount of debt = 20% × $250,000 = $50,000
Amount of equity = 80% × 250,000 = $200,000
Number of shares = $200,000 ÷ $10 book value = 20,000 shares

| | Probability | | |
|---|---|---|---|
| | **0.20** | **0.60** | **0.20** |
| 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% × $250,000 = total debt capital = $100,000
Number of shares = $150,000 equity ÷ $10 book value = 15,000 shares

| | Probability | | |
|---|---|---|---|
| | **0.20** | **0.60** | **0.20** |
| 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% × $250,000 = total debt capital = $150,000
Number of shares = $100,000 equity ÷ $10 book value = 10,000 shares

| | Probability | | |
|---|---|---|---|
| | **0.20** | **0.60** | **0.20** |
| 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 |

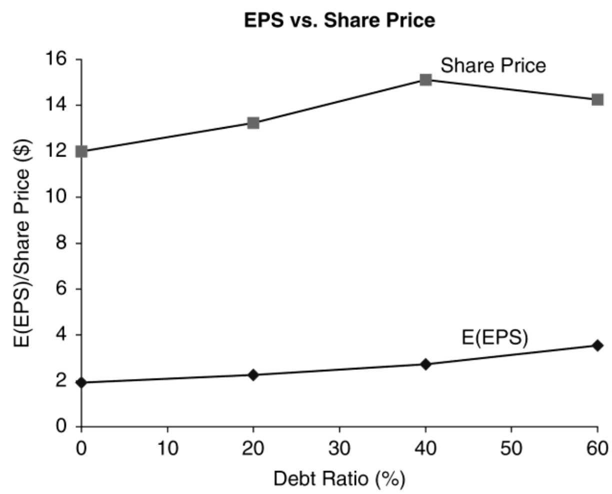
| Debt Ratio | E(EPS) | $\sigma$(EPS) | CV (EPS) | Number of Common Shares | Dollar Amount of Debt | Share Price* |
|---|---|---|---|---|---|---|
| 0% | $1.92 | 0.9107 | 0.4743 | 25,000 | 0 | $1.92/0.16 = $12.00 |
| 20% | $2.25 | 1.1384 | 0.5060 | 20,000 | $ 50,000 | $2.25/0.17 = $13.24 |
| 40% | $2.72 | 1.5179 | 0.5581 | 15,000 | $100,000 | $2.72/0.18 = $15.11 |
| 60% | $3.54 | 2.2768 | 0.6432 | 10,000 | $150,000 | $3.54/0.24 = $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.




P13-26. Integrative—optimal capital structure

**LG 3, 4, 5, 6; Challenge**

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 | $r_S$ | $P_0$ |
|---|---|---|---|
| 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.

P13-27. Integrative—optimal capital structure

**LG 3, 4, 5, 6; Challenge**

a.

| | Probability | | |
|---|---|---|---|
| | **0.30** | **0.40** | **0.30** |
| 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) × (0.6) ÷ 40,000 shares | = $0.90 |
| | ($240,000 – $0) × (0.6) ÷ 40,000 shares | = 3.60 |
| | ($420,000 – $0) × (0.6) ÷ 40,000 shares | = 6.30 |
| 15% | ($60,000 – $12,000) × (0.6) ÷ 34,000 shares | = $0.85 |
| | ($240,000 – $12,000) × (0.6) ÷ 34,000 shares | = 4.02 |
| | ($420,000 – $12,000) × (0.6) ÷ 34,000 shares | = 7.20 |
| 30% | ($60,000 – $30,000) × (0.6) ÷ 28,000 shares | = $0.64 |
| | ($240,000 – $30,000) × (0.6) ÷ 28,000 shares | = 4.50 |
| | ($420,000 – $30,000) × (0.6) ÷ 28,000 shares | = 8.36 |
| 45% | ($60,000 – $58,500) × (0.6) ÷ 22,000 shares | = $0.04 |
| | ($240,000 – $58,500) × (0.6) ÷ 22,000 shares | = 4.95 |
| | ($420,000 – $58,500) × (0.6) ÷ 22,000 shares | = 9.86 |
| 60% | ($60,000 – $102,000) × (0.6) ÷ 16,000 shares | =–$1.58 |
| | ($240,000 – $102,000) × (0.6) ÷ 16,000 shares | = 5.18 |
| | ($420,000 – $102,000) × (0.6) ÷ 16,000 shares | = 11.93 |

e. (1) **E(EPS) = 0.30($EPS_1$) + 0.40($EPS_2$) + 0.30($EPS_3$)**

| **Debt Ratio** | **Calculation** | | **E(EPS)** |
|---|---|---|---|
| 0% | 0.30 × (0.90) + 0.40 × (3.60) + 0.30 × (6.30)<br>0.27 + 1.44 + 1.89 | = | $3.60 |
| 15% | 0.30 × (0.85) + 0.40 × (4.02) + 0.30 × (7.20)<br>0.26 + 1.61 + 2.16 | = | $4.03 |
| 30% | 0.30 × (0.64) + 0.40 × (4.50) + 0.30 × (8.36)<br>0.19 + 1.80 + 2.51 | = | $4.50 |
| 45% | 0.30 × (0.04) + 0.40 × (4.95) + 0.30 × (9.86)<br>0.01 + 1.98 + 2.96 | = | $4.95 |
| 60% | 0.30 × (−1.58) + 0.40 × (5.18) + 0.30 × (11.93)<br>−0.47 + 2.07 + 3.58 | = | $5.18 |

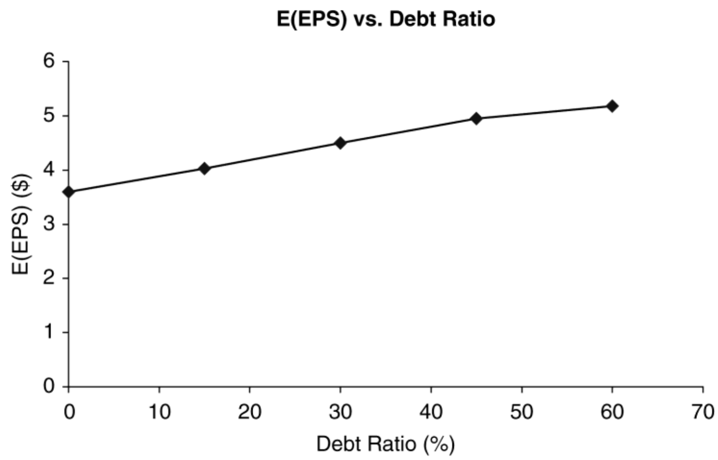
(2) $\sigma_{EPS}$

| **Debt Ratio** | **Calculation** |
|---|---|
| 0% | $\sigma_{EPS} = \sqrt{[(0.90-3.60)^2 \times 0.3]+[(3.60-3.60)^2 \times 0.4]+[(6.30-3.60)^2 \times 0.3]}$<br>$\sigma_{EPS} = \sqrt{2.187+0+2.187}$<br>$\sigma_{EPS} = \sqrt{4.374}$<br>$\sigma_{EPS} = 2.091$ |
| 15% | $\sigma_{EPS} = \sqrt{[(0.85-4.03)^2 \times 0.3]+[(4.03-4.03)^2 \times 0.4]+[(7.20-4.03)^2 \times 0.3]}$<br>$\sigma_{EPS} = \sqrt{3.034+0+3.034}$<br>$\sigma_{EPS} = \sqrt{6.068}$<br>$\sigma_{EPS} = 2.463$ |
| 30% | $\sigma_{EPS} = \sqrt{[(0.64-4.50)^2 \times 0.3]+[(4.50-4.50)^2 \times 0.4]+[(8.36-4.50)^2 \times 0.3]}$<br>$\sigma_{EPS} = \sqrt{4.470+0+4.470}$<br>$\sigma_{EPS} = \sqrt{8.94}$<br>$\sigma_{EPS} = 2.99$ |
| 45% | $\sigma_{EPS} = \sqrt{[(0.04-4.95)^2 \times 0.3]+[(4.95-4.95)^2 \times 0.4]+[(9.86-4.95)^2 \times 0.3]}$<br>$\sigma_{EPS} = \sqrt{7.232 + 0 + 7.187232}$<br>$\sigma_{EPS} = \sqrt{14.464}$<br>$\sigma_{EPS} = 3.803$ |
| 60% | $\sigma_{EPS} = \sqrt{[(-1.58-5.18)^2 \times 0.3]+[(5.18-5.18)^2 \times 0.4]+[(11.930-5.18)^2 \times 0.3]}$<br>$\sigma_{EPS} = \sqrt{13.669+0+13.669}$<br>$\sigma_{EPS} = \sqrt{27.338}$<br>$\sigma_{EPS} = 5.299$ |

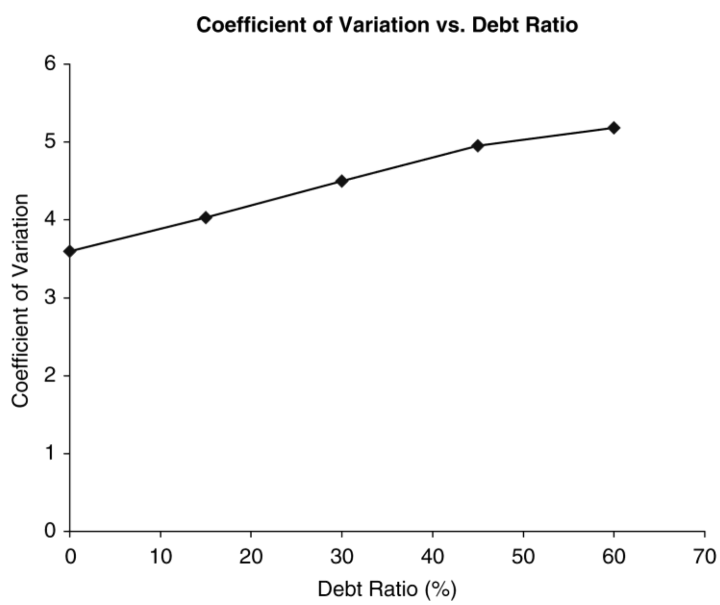
(3)

| Debt Ratio | $\sigma_{EPS} \div E(\text{EPS})$ | = | *CV* |
|---|---|---|---|
| 0% | 2.091 ÷ 3.60 | = | 0.581 |
| 15% | 2.463 ÷ 4.03 | = | 0.611 |
| 30% | 2.990 ÷ 4.50 | = | 0.664 |
| 45% | 3.803 ÷ 4.95 | = | 0.768 |
| 60% | 5.229 ÷ 5.18 | = | 1.009 |

f. (1)

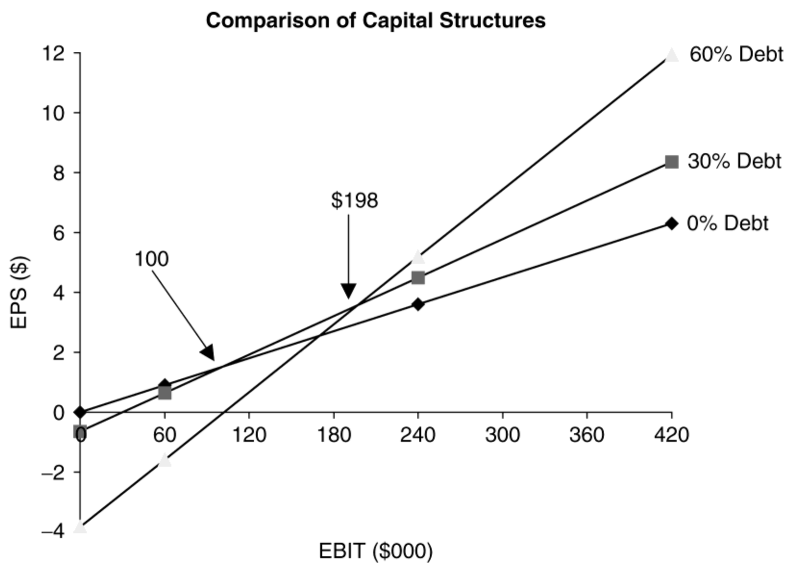



(2)



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 of the text.

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

Set EPS 0% = EPS 30%

EPS 30% = EPS 60%

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

$$\text{EPS}_{0\%} = \frac{[(1-0.4)(\text{EBIT}-\$0)-0]}{40{,}000\text{ shares}}$$

$$\text{EPS}_{30\%} = \frac{[(1-0.4)(\text{EBIT}-\$30{,}000)-0]}{28{,}000\text{ shares}}$$

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

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

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

h.

| Debt Ratio | EPS ÷ $r_s$ | Share Price |
|---|---|---|
| 0% | \$3.60 ÷ 0.100 | \$36.00 |
| 15% | \$4.03 ÷ 0.105 | \$38.38 |
| 30% | \$4.50 ÷ 0.116 | \$38.79 |
| 45% | \$4.95 ÷ 0.140 | \$35.36 |
| 60% | \$5.18 ÷ 0.200 | \$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.

P13-28. Ethics problem

**LG 3; Intermediate**

Information asymmetry applies to situations in which one party has more and better information than the other interested party(ies). This appears to be exactly the situation in which managers overleverage or lead a buyout of the company. Existing bondholders and possibly stockholders are harmed by the financial risk of overleveraging, and existing stockholders are harmed if they accept a buyout price less than that warranted by accurate and incomplete information.

The board of directors has a fiduciary duty toward stockholders, and hopefully bears an ethical concern toward bondholders as well. The board can and should insist that management divulge all information it possesses on the future plans and risks the company faces (although caution to keep this out of the hands of competitors is warranted). The board should be cautious to select and retain chief executive officers (CEOs) with high integrity, and continue to emphasize an ethical tone "at the top." (Students will no doubt think of other creative mechanisms to deal with this situation.)