

## R32 Measures of Leverage

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## 1. Introduction

The total costs of a company can be broken down into two parts: fixed costs and variable costs. Fixed costs do not vary with output (the number of units produced and sold), whereas variable costs vary with output.

**Leverage** is the use of fixed costs in a company's cost structure. It has two components:

- Operating leverage: Fixed operating costs such as depreciation and rent create operating leverage.
- Financial leverage: Fixed financial costs such as interest expense create financial leverage.

For highly leveraged firms, that is firms with a high proportion of fixed costs relative to total costs, a small change in sales will have a big impact on earnings.

## 2. Leverage

Let's look at an example to understand the impact of leverage.

### Example

Consider two companies, HL (high leverage) and LL (low leverage), with the same revenue and net income but a different cost structure.

Operating Performance		Income Statement			
	HL	LL		HL	LL
No. of units sold	100	100	Revenue	100	100
Sales price per unit	1	1	Operating costs	70	75
Variable cost per unit	0.2	0.6	Operating Income	30	25
Fixed operating cost	50	15	Financing Expense	10	5
Fixed financing cost	10	5	Net Income	20	20

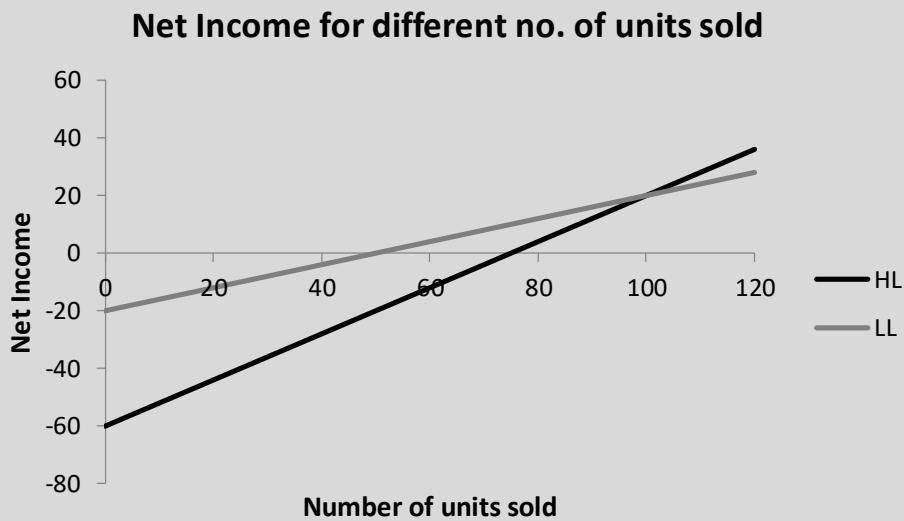
How is the cost structure different?

What is the impact on net income if sales numbers change?

### Solution:

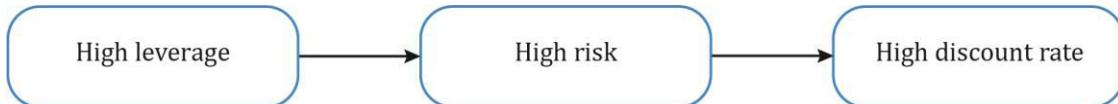
Net income for different units of sold						
	HL	LL	HL	LL	HL	LL
No. of units sold	100	100	0	0	120	120
Fixed operating costs	50	15	50	15	50	15
Variable costs	20	60	0	0	24	72
Operating costs	70	75	50	15	74	87
Operating Income	30	25	-50	-15	46	33
Interest expense	10	5	10	5	10	5
Net Income	20	20	-60	-20	36	28

Let us plot the net income for different levels of sales (units sold) for HL and LL.



As you can see, the loss is magnified when revenue is zero and the profit is also magnified when revenue increases by a marginal amount for HL relative to LL. When 100 units are sold, the net income is the same for both the companies. The effect of both loss and profit is higher for a high leverage firm.

Leverage increases volatility of a company's earnings and cash flows and also increases the risk of lending to or owning a company. The valuation of a company and its equity is affected by the degree of leverage. The higher a company's leverage, the higher is its risk, which requires a higher discount rate to be applied in valuation.

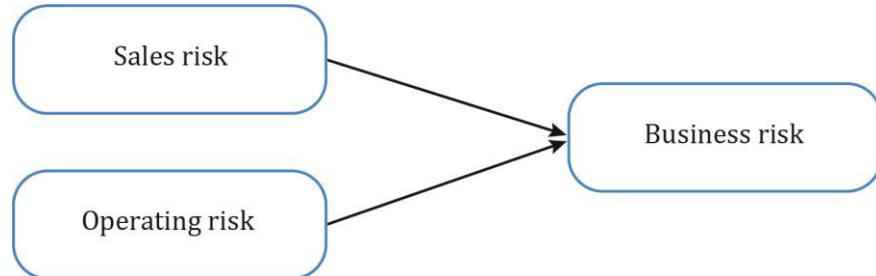


### 3. Business and Sales Risks

#### 3.1 Business Risk and Its Components

Business risk is the risk associated with operating earnings. All firms face the risk that revenues will decline, which will, in turn, affect operating earnings. Business risk consists of two components: sales risk and operating risk.

Business risk and its two components are depicted in the picture below:



### 3.2 Sales Risk

Sales risk is the variability in profits due to uncertainty of sales price and volume (product demand and revenue uncertainty).

## 4. Operating Risk and the Degree of Operating Leverage

Operating risk is the risk due to operating cost structure. It is greater when fixed operating costs are higher relative to variable operating costs.

**Degree of operating leverage** is a quantitative measure of operating risk. It is the ratio of the percentage change in operating income to the percentage change in units sold. It measures how sensitive a company's operating income is to changes in sales. For example, a DOL of 2 means that a 1 percent change in units sold results in a 2 percent change in operating income.

$$DOL = \frac{\text{Percentage change in operating income}}{\text{Percentage change in units sold}}$$

$$\text{It can be shown that } DOL = \frac{Q(P-V)}{Q(P-V)-F}$$

where:

Q = number of units

P = price per unit

V = variable operating cost per unit

F = fixed operating cost

P - V = per unit contribution margin

Q (P - V) = contribution margin

### Example

Given the following data, compute DOL for HL and LL.

	<b>HL</b>	<b>LL</b>
Number of units sold	100	100
Sales price per unit	1	1
Variable cost per unit	0.2	0.6
Fixed operating cost	50	15
Fixed financing cost	10	5

### Solution:

For HL:

$$Q = 100; P = 1; V = 0.2; F = 50$$

$$\text{DOL for HL: } \frac{100 * 0.8}{100 * 0.8 - 50} = 2.67$$

For LL:

$$Q = 100; P = 1; V = 0.6; F = 15$$

$$\text{DOL for LL: } \frac{100 * 0.4}{100 * 0.4 - 15} = 1.6$$

## 5. Financial Risk, the Degree of Financial Leverage and the Leveraging Role of Debt

Financial risk is the risk associated with how a company finances its operations. A company may choose to finance using debt or equity. The greater the use of debt, the greater is the company's financial risk. This is because the company takes on fixed expenses in the form of interest payments.

**Degree of financial leverage** is a quantitative measure of financial risk. For example, if DFL is 2, then a 5 percent increase in operating income will most likely result in a 10 percent increase in net income.

$$\text{DFL} = \frac{\text{Percentage change in net income}}{\text{Percentage change in operating income}}$$

$$\text{It can be shown that DFL} = \frac{Q(P-V)-F}{Q(P-V)-F-C}$$

where

Q = number of units

P = price per unit

V = variable operating cost per unit

F = fixed operating cost

C = fixed financial cost

P-V = per unit contribution margin

Q (P - V) = contribution margin

### Example

Given the following data, compute DFL for HL and LL.

	<b>HL</b>	<b>LL</b>
Number of units sold	100	100
Sales price per unit	1	1
Variable cost per unit	0.2	0.6
Fixed operating cost	50	15
Fixed financing cost	10	5

### Solution:

For HL:

$$Q = 100; P = 1; V = 0.2; F = 50; C = 10$$

$$\text{DFL for HL: } \frac{100 * 0.8 - 50}{100 * 0.8 - 50 - 10} = 1.5$$

For LL:

$$Q = 100; P = 1; V = 0.6; F = 15; C = 5$$

$$\text{DFL for LL: } \frac{100 * 0.4 - 15}{100 * 0.4 - 15 - 5} = 1.25$$

### Effect of Financial Leverage on NI and ROE

Higher leverage leads to higher ROE volatility and potentially higher ROE levels. This is illustrated through a simple example. Consider two firms with the same operating income (EBIT), but different capital structures. While Firm 1 has no debt, the capital structure of Firm 2 comprises 50% debt and 50% equity. The table below computes ROE for different levels of EBIT.

$$\text{ROE} = \text{NI} / \text{equity}$$

	<b>Firm 1: Assets = 200; Equity = 200 Debt = 0; Tax = 0%</b>		<b>Firm 2: Assets = 200; Equity = 100; Debt = 100, Interest = 10%</b>	
EBIT	NI	ROE	NI	ROE
0	0	0	-10	-10%
20	20	10%	10	10%
40	40	20%	30	30%
60	60	30%	50	50%
80	80	40%	70	70%

Some inferences about the effect of financial leverage on NI and ROE:

- For lower levels of EBIT, NI and ROE are negative for the high leverage firm.
- Higher EBIT leads to potentially higher ROE levels, as seen in Firm 2 (high leverage firm).
- ROE of firm 2 (high leverage firm) has a higher volatility and variability (-10% to 70%) relative to firm 1 (0 to 40%).

## 6. Total Leverage and the Degree of Total Leverage

Total leverage gives us the combined effect of both operating leverage and financial leverage. Degree of total leverage (DTL) measures the sensitivity of net income to changes in the number of units produced and sold.

$$\text{DTL} = \frac{\text{Percentage change in net income}}{\text{Percentage change in units sold}}$$

$$\text{It can be shown that DTL} = \text{DOL} * \text{DFL} = \frac{Q(P-V)}{Q(P-V)-F-C}$$

where

Q = number of units

P = price per unit

V = variable operating cost per unit

F = fixed operating cost

C = fixed financial cost

P-V = per unit contribution margin

$Q (P - V) = \text{contribution margin}$

### Example

Given the following data, compute DTL for HL and LL.

	<b>HL</b>	<b>LL</b>
Number of units sold	100	100
Sales price per unit	1	1
Variable cost per unit	0.2	0.6
Fixed operating cost	50	15
Fixed financing cost	10	5

### Solution:

For HL:

$$Q = 100; P = 1; V = 0.2; F = 50; C = 10$$

$$\text{DTL for HL: } \frac{100 * 0.8}{100 * 0.8 - 50 - 10} = 4$$

For LL:

$$Q = 100; P = 1; V = 0.6; F = 15; C = 5$$

$$\text{DTL for LL: } \frac{100 * 0.4}{100 * 0.4 - 15 - 5} = 2$$

## 7. Breakeven Points and Operating Breakeven Points

### Breakeven point

Breakeven point is the number of units produced and sold at which net income is zero, the point at which revenues are equal to costs.

$$\text{Breakeven point } Q_{BE} = \frac{F+C}{P-V}$$

where:

F = fixed operating costs

C = fixed financial cost

V = variable cost per unit

P = the price per unit

### Operating breakeven point

Operating breakeven point is the number of units produced and sold at which operating income is zero.

$$\text{Operating breakeven point } Q_{OBE} = \frac{F}{P-V}$$

All else equal companies that have high operating and financial leverage will have high break even points as compared to companies with low leverage. This is demonstrated in the

following example.

The further away unit sales are from the breakeven point for high leverage companies, the greater the magnifying effect of this leverage.

### Example

Given the following data, compute the breakeven and operating breakeven points for HL (high leverage) and LL (low leverage) companies.

	<b>HL</b>	<b>LL</b>
Number of units sold	100	100
Sales price per unit	1	1
Variable cost per unit	0.2	0.6
Fixed operating cost	50	15
Fixed financing cost	10	5

### Solution:

For HL:

$$F = 50; C = 10; P = 1; V = 0.2$$

$$Q_{BE} = \frac{F + C}{P - V} = \frac{50 + 10}{1 - 0.2} = 75$$

$$Q_{OBE} = \frac{F}{P-V} = 50/0.8 = 62.5$$

For LL:

$$F = 15; C = 5; P = 1; V = 0.6$$

$$Q_{BE} = \frac{F + C}{P - V} = \frac{15 + 5}{1 - 0.6} = 50$$

$$Q_{OBE} = \frac{F}{P-V} = 15/0.4 = 37.5$$

**Instructor's Note:** Section 8 'The Risks of Creditors and Owners' is not testable and hence not covered.

## Summary

**LO.a: Define and explain leverage, business risk, sales risk, operating risk, and financial risk, and classify a risk, given a description.**

Leverage is the use of fixed costs in a company's cost structure. Leverage has two components: operating leverage and financial leverage. Fixed operating costs such as depreciation and rent create operating leverage. Fixed financial costs such as interest expense create financial leverage.

Business risk is the risk associated with operating earnings. All firms face the risk that revenues will decline, which in turn will affect operating earnings. Business risk consists of two components: Sales risk and operating risk.

Sales risk is the variability in profits due to uncertainty of sales price and volume.

Operating risk is the risk due to the operating cost structure. Operating risk is greater when fixed operating costs are higher relative to variable operating costs.

Financial risk is the risk due to debt financing.

**LO.b: Calculate and interpret the degree of operating leverage, the degree of financial leverage, and the degree of total leverage.**

Degree of operating leverage (DOL) is a measure of operating risk. It is the ratio of the percentage change in operating income to the percentage change in units sold. It can be calculated using the following formula:

$$DOL = \frac{Q(P - V)}{Q(P - V) - F}$$

Degree of financial leverage (DFL) is a quantitative measure of financial risk. It is the ratio of percentage change in net income to percentage change in operating income.

$$DFL = \frac{Q(P - V) - F}{Q(P - V) - F - C}$$

Degree of total leverage (DTL) measures the sensitivity of net income to changes in the number of units produced and sold. It is the ratio of percentage change in the net income to the percentage change in the number of units sold.

$$DTL = \frac{Q(P - V)}{Q(P - V) - F - C} = DOL * DFL$$

Where Q is the number of units, P is the price per unit, V is the variable cost per unit, F is the fixed operating cost, and C is the fixed financial cost.

**LO.c: Describe the effect of financial leverage on a company's net income and return on equity.**

Higher leverage leads to higher ROE volatility and potentially higher ROE levels:

- For lower levels of EBIT, NI and ROE are negative for the firm with the higher leverage.
- Higher EBIT leads to potentially higher ROE levels.
- ROE of a high leverage firm has higher volatility and variability.

**LO.d: Calculate the breakeven quantity of sales and determine the company's net income at various sales levels.**

Breakeven quantity of sales is the quantity of units sold to earn revenue equal to the fixed and variable costs, i.e., for net income to be 0.

$$Q(BE) = \frac{F + C}{P - V}$$

Where F is the fixed cost, C is the financial cost, V is the variable cost per unit, and P is the price per unit.

**LO.e: Calculate and interpret the operating breakeven quantity of sales.**

Operating breakeven quantity of sales ignores the fixed financing costs, i.e., quantity sold for operating income to be 0.

$$Q(OBE) = \frac{F}{P - V}$$

Where F is the fixed cost, V is the variable cost per unit, and P is the price per unit.

## Practice Questions

1. Business risk is *best* described as a combination of:
  - A. operating risk and sales risk.
  - B. financial risk and sales risk.
  - C. financial risk and operating risk.
  
2. Apex Industries has a unit contribution margin for a product of \$10. Apex has fixed operating cost of \$400,000. The degree of operating leverage (DOL) is *most likely* the lowest at which of the following production levels (in units)?
  - A. 200,000.
  - B. 300,000.
  - C. 400,000.
  
3. Nancy Scott, CFA is analyzing the income statement for Matrix Corporation.

	<b>\$ millions</b>
Revenues	28.6
Variable operating expenses	19.2
Fixed operating expenses	7.1
Operating income (EBIT)	2.3
Interest	0.7
Taxable income	1.6
Tax	0.7
Net income	0.9

Its degree of financial leverage is *closest* to:

- A. 1.44.
- B. 1.78.
- C. 1.59.
  
4. Donald Hall has gathered the following information for Orion Enterprises.

EBIT	\$240,000
EBT	\$198,000
Tax rate	35%

Given that the degree of total leverage is 2.51, the degree of operating leverage is *closest* to:

- A. 1.21.
- B. 2.07.
- C. 2.86.

5. Michael Carter has gathered the following information for two companies.

Company A		Company B	
DOL	1.30	DOL	1.30
DFL	2.50	DFL	1.10
DTL	3.25	DTL	1.43

Which of the following combinations is *most accurate* for a 10 percent increase in unit sales?

- A. Operating income and net income for both companies will increase by 10%.
  - B. Operating income for both companies will remain the same, while net income for Company A will increase by 25% and for Company B by 11%.
  - C. Operating income for both companies will increase by 13%, while net income for Company A will increase by 32.5% and for Company B by 14.3%.
6. Andrew Smith has collected the following information on a company that manufactures tires:

Retail price of tires	\$115
Variable cost per tire	\$75
Operating fixed costs	\$380,000
Fixed interest charges	\$58,000
Marginal tax rate	35%

The quantity of items that the company should manufacture and sell to break even is *closest to*:

- A. 11,200.
  - B. 9,200.
  - C. 10,200.
7. Atlanta Manufacturing has a unit contribution margin for a product of \$25. The company has fixed costs of \$45,000, interest costs of \$11,000, and a tax rate of 35%. The operating breakeven point (in units) for the company is *closest to*:
- A. 2,240.
  - B. 1,800.
  - C. 1,360.

## Solutions

1. A is correct. Business risk is linked with a firm's operating income. It is a combination of sales risk and operating risk. It reflects the uncertainty in the firm's total revenue and the expenditures incurred to produce those revenues.
2. C is correct. The degree of operating leverage measures the elasticity of operating earnings with respect to the number of units produced and sold.  

$$\text{DOL} = (\text{quantity} \times \text{contribution margin}) / (\text{quantity} \times \text{contribution margin} - \text{fixed costs})$$

Using the trial and error method, we find DOL for all the options:

$$\text{DOL (200,000 units)} = (\$10 \times 200,000) / (\$10 \times 200,000 - 400,000) = 1.25$$

$$\text{DOL (300,000 units)} = (\$10 \times 300,000) / (\$10 \times 300,000 - 400,000) = 1.15$$

$$\text{DOL (400,000 units)} = (\$10 \times 400,000) / (\$10 \times 400,000 - 400,000) = 1.11$$

The DOL is lowest at the 400,000 unit production level.
3. A is correct.  $\text{DFL} = (\text{Operating income}) / (\text{Operating income} - \text{Interest expense})$  or operating income divided by pretax earnings  $= \$2.3 / \$1.6 = 1.44$ .
4. B is correct.

**Step 1:** Compute the degree of financial leverage.

$$\text{Degree of financial leverage} = \frac{\text{EBIT}}{\text{EBIT} - \text{I}} = \frac{\text{EBIT}}{\text{EBT}} = \frac{240,000}{198,000} = 1.21$$

**Step 2:** Compute the degree of operating leverage

$\text{Degree of total leverage} = \text{Degree of financial leverage} \times \text{Degree of operational leverage}$

$2.51 = 1.21 \times \text{Degree of operational leverage}$

$\text{Degree of operational leverage} = 2.07$

5. C is correct. The degree of operating leverage shows the sensitivity of operating income to the change in units sold, while the degree of total leverage shows the change in the net income to changes in unit sold. Since both the companies have the same DOL at 1.30, their operating income will increase by 13% for a 10% increase in unit sales. DTL for Company A is 3.25 hence its net income will increase by 32.5% for a 10% increase in unit sales. DTL for Company B is 1.43 hence its net income will increase by 14.3% for a 10% increase in unit sales.
6. C is correct. Breakeven quantity  $= (\text{Fixed operating costs} + \text{fixed financial costs}) / (\text{price per unit} - \text{variable cost per unit})$   
 $= (350,000 + 58,000) / (115 - 75) = 10,200$
7. B is correct. The operating breakeven point is:  
 $\text{fixed costs} / \text{contribution margin} = \$45,000 / \$25 = 1,800$