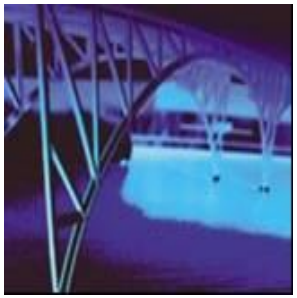
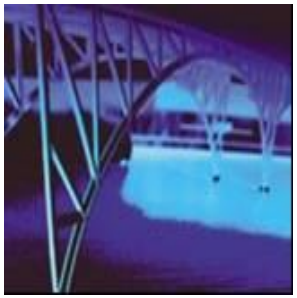


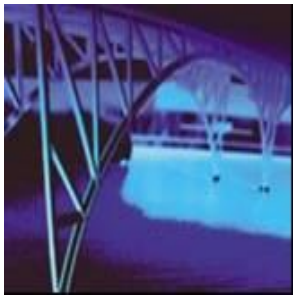
Chapter 16

Operating and Financial Leverage



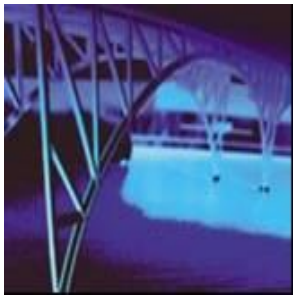
After studying Chapter 16, you should be able to:

- **Define operating and financial leverage and identify causes of both.**
- **Calculate a firm's operating break-even (quantity) point and break-even (sales) point .**
- **Define, calculate, and interpret a firm's degree of operating, financial, and total leverage.**
- **Understand EBIT-EPS break-even, or indifference, analysis, and construct and interpret an EBIT-EPS chart.**
- **Define, discuss, and quantify "total firm risk" and its two components, "business risk" and "financial risk."**
- **Understand what is involved in determining the appropriate amount of financial leverage for a firm.**



Operating and Financial Leverage

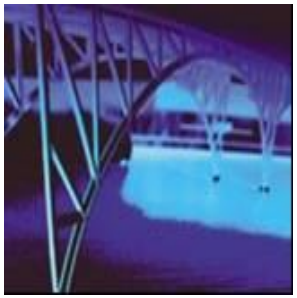
- Operating Leverage
- Financial Leverage
- Total Leverage
- Cash-Flow Ability to Service Debt
- Other Methods of Analysis
- Combination of Methods



Operating Leverage

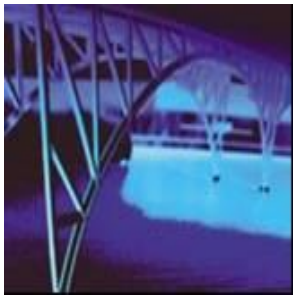
Operating Leverage -- The use of fixed operating costs by the firm.

- **One potential "effect" caused by the presence of operating leverage is that a change in the volume of sales results in a "more than proportional" change in operating profit (or loss).**



Impact of Operating Leverage on Profits

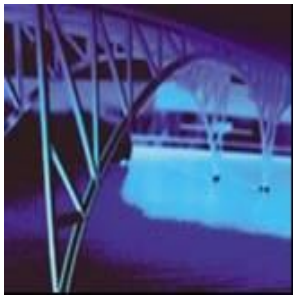
(in thousands)	Firm F	Firm V	Firm 2F
Sales	$10	$11	$19.5
Operating Costs			
Fixed	7	2	14
Variable	2	7	3
Operating Profit	$ 1	$ 2	$ 2.5
FC/total costs	.78	.22	.82
FC/sales	.70	.18	.72



Impact of Operating Leverage on Profits

- Now, subject each firm to a 50% increase in sales for next year.
- Which firm do you think will be more "sensitive" to the change in sales (i.e., show the largest percentage change in operating profit, EBIT)?

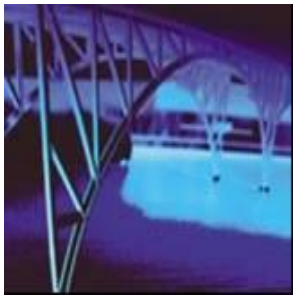
[ ] Firm F; [ ] Firm V; [ ] Firm 2F.



Impact of Operating Leverage on Profits

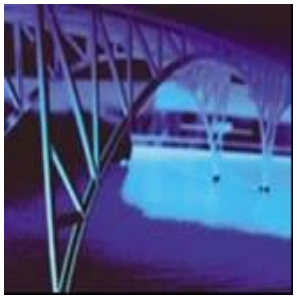
(in thousands)	Firm F	Firm V	Firm 2F	
Sales	$15	$16.5	$29.25	
Operating Costs				
Fixed	7	2	14	
Variable	3	10.5	4.5	
Operating Profit	$ 5	$ 4	$10.75	
Percentage Change in EBIT*				
	400%	100%	330%	

$$* (EBIT_t - EBIT_{t-1}) / EBIT_{t-1}$$



Impact of Operating Leverage on Profits

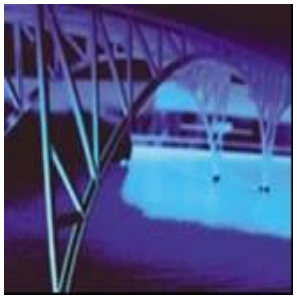
- Firm F is the most "sensitive" firm -- for it, a 50% increase in sales leads to a 400% increase in EBIT.
- Our example reveals that it is a mistake to assume that the firm with the largest absolute or relative amount of fixed costs automatically shows the most dramatic effects of operating leverage.
- Later, we will come up with an easy way to spot the firm that is most sensitive to the presence of operating leverage.



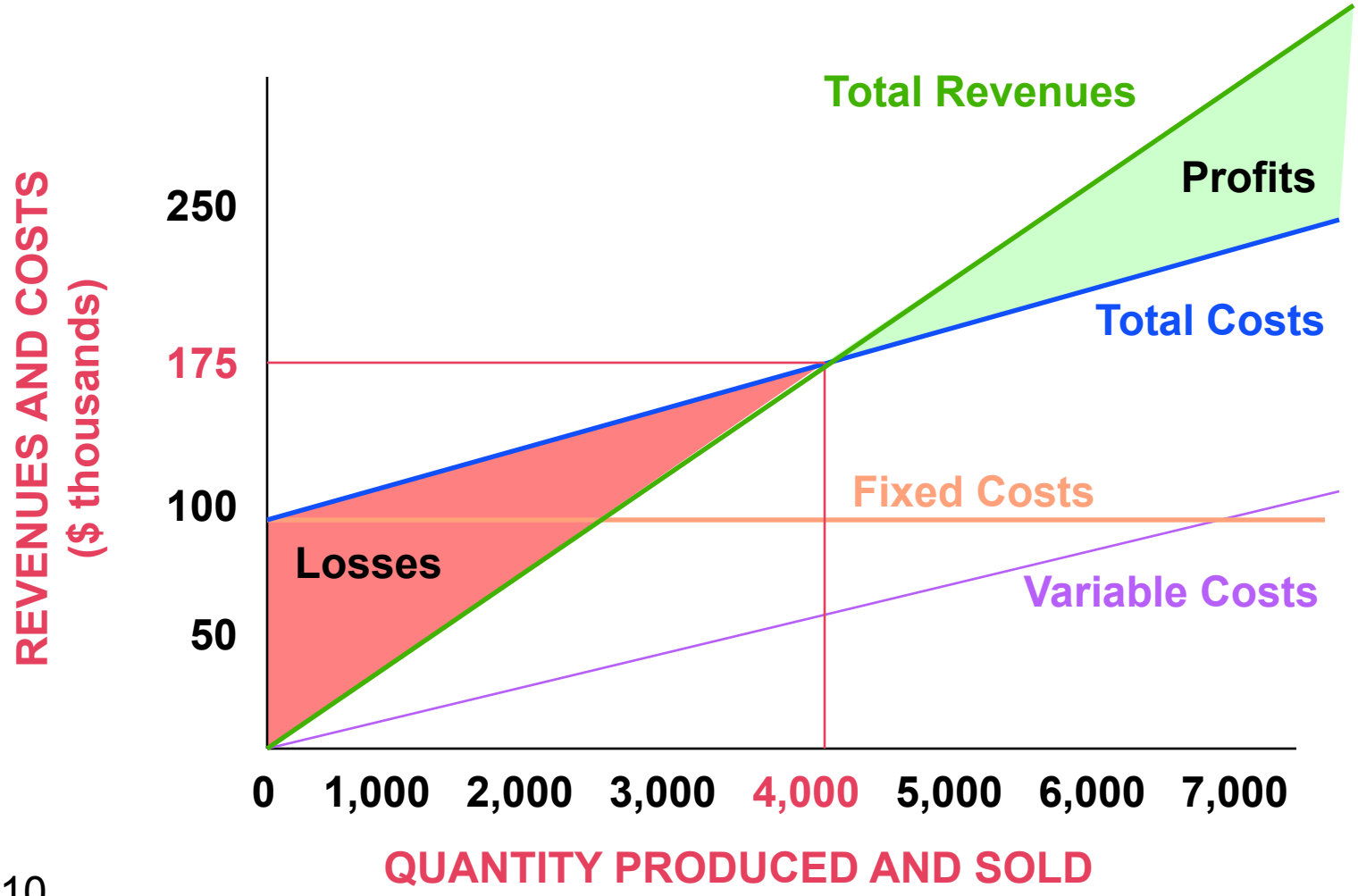
Break-Even Analysis

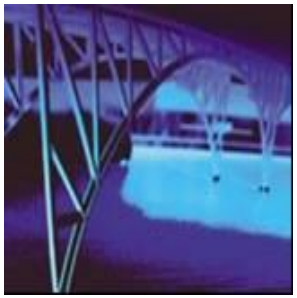
Break-Even Analysis -- A technique for studying the relationship among fixed costs, variable costs, sales volume, and profits. Also called cost/volume/profit (C/V/P) analysis.

- **When studying operating leverage, "profits" refers to operating profits before taxes (i.e., EBIT) and excludes debt interest and dividend payments.**



Break-Even Chart





Break-Even (Quantity) Point

Break-Even Point -- The sales volume required so that total revenues and total costs are equal; may be in units or in sales dollars.

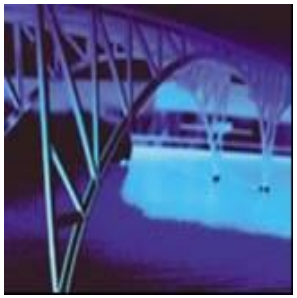
How to find the quantity break-even point:

$$EBIT = P(Q) - V(Q) - FC$$

$$EBIT = Q(P - V) - FC$$

P = Price per unit V = Variable costs per unit

FC = Fixed costs Q = Quantity (units) produced and sold



Break-Even (Quantity) Point

Breakeven occurs when EBIT = 0

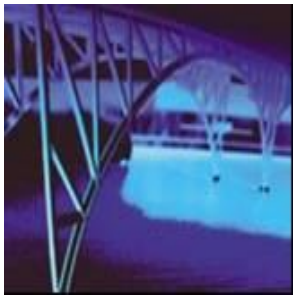
$$Q\,(P - V) - FC = EBIT$$

$$Q_{BE}\,(P - V) - FC = 0$$

$$Q_{BE}\,(P - V) = FC$$

$$Q_{BE} = FC / (P - V)$$

a.k.a. *Unit Contribution Margin*



Break-Even (Sales) Point

How to find the sales break-even point:

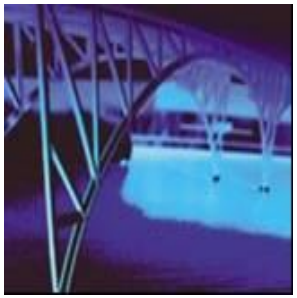
$$S_{BE} = FC + (VC_{BE})$$

$$S_{BE} = FC + (Q_{BE})(V)$$

or

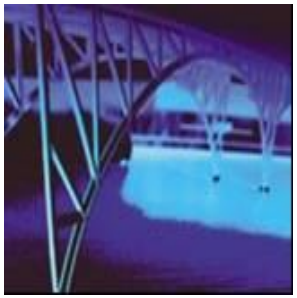
$$S_{BE}^{*} = FC / [1 - (VC / S)]$$

* Refer to text for derivation of the formula



Break-Even Point Example

Basket Wonders (BW) wants to determine both the quantity and sales break-even points when:
• Fixed costs are $100,000 • Baskets are sold for $43.75 each • Variable costs are $18.75 per basket

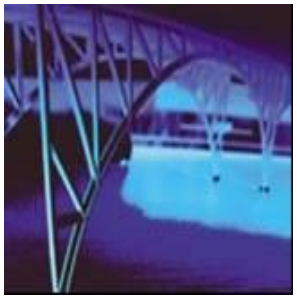


Break-Even Point (s)

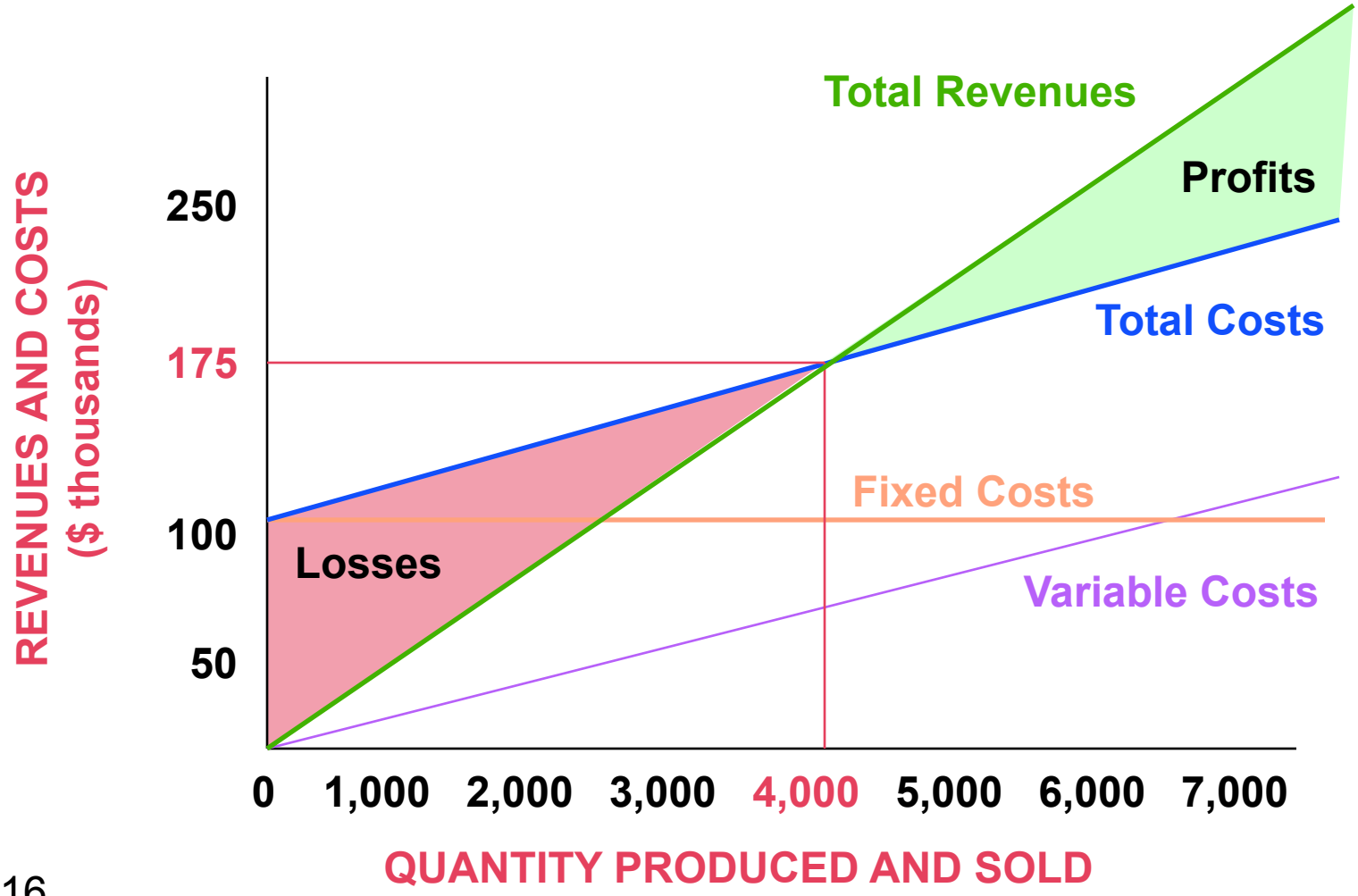
Breakeven occurs when:

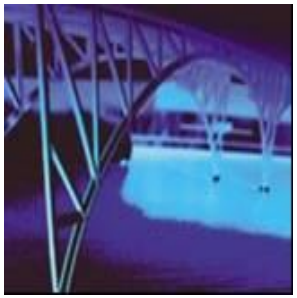
$$Q_{BE} = FC / (P - V)$$
$$Q_{BE} = \$100{,}000 / (\$43.75 - \$18.75)$$
$$Q_{BE} = 4{,}000 \text{ Units}$$

$$S_{BE} = (Q_{BE})(V) + FC$$
$$S_{BE} = (4{,}000)(\$18.75) + \$100{,}000$$
$$S_{BE} = \$175{,}000$$



Break-Even Chart

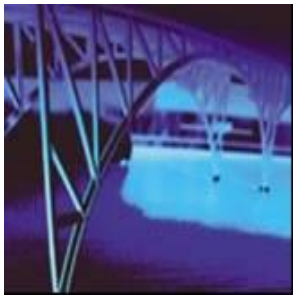




Degree of Operating Leverage (DOL)

Degree of Operating Leverage -- The percentage change in a firm's operating profit (EBIT) resulting from a 1 percent change in output (sales).

$$\text{DOL at Q units of output (or sales)} = \frac{\text{Percentage change in operating profit (EBIT)}}{\text{Percentage change in output (or sales)}}$$

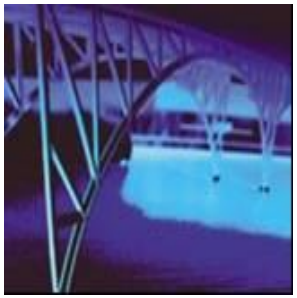


Computing the DOL

Calculating the DOL for a single product or a single-product firm.

$$DOL_{Q\ units} = \frac{Q\ (P - V)}{Q\ (P - V) - FC}$$

$$= \frac{Q}{Q - Q_{BE}}$$

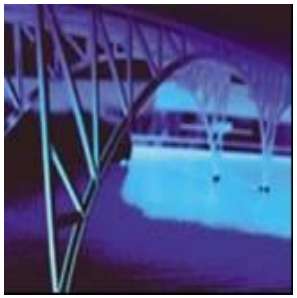


Computing the DOL

Calculating the DOL for a multiproduct firm.

$$DOL_{S \text{ dollars of sales}} = \frac{S - VC}{S - VC - FC}$$

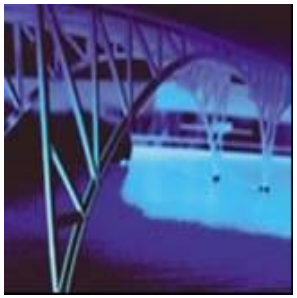
$$= \frac{EBIT + FC}{EBIT}$$



Break-Even Point Example

Lisa Miller wants to determine the degree of operating leverage at sales levels of 6,000 and 8,000 units. As we did earlier, we will assume that:

- **Fixed costs are $100,000**
- **Baskets are sold for $43.75 each**
- **Variable costs are $18.75 per basket**

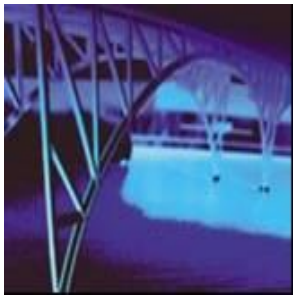


Computing BW's DOL

Computation based on the previously calculated break-even point of 4,000 units

$$DOL_{6,000\ units} = \frac{6,000}{6,000 - 4,000} = 3$$

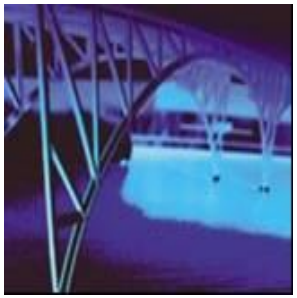
$$DOL_{8,000\ units} = \frac{8,000}{8,000 - 4,000} = 2$$



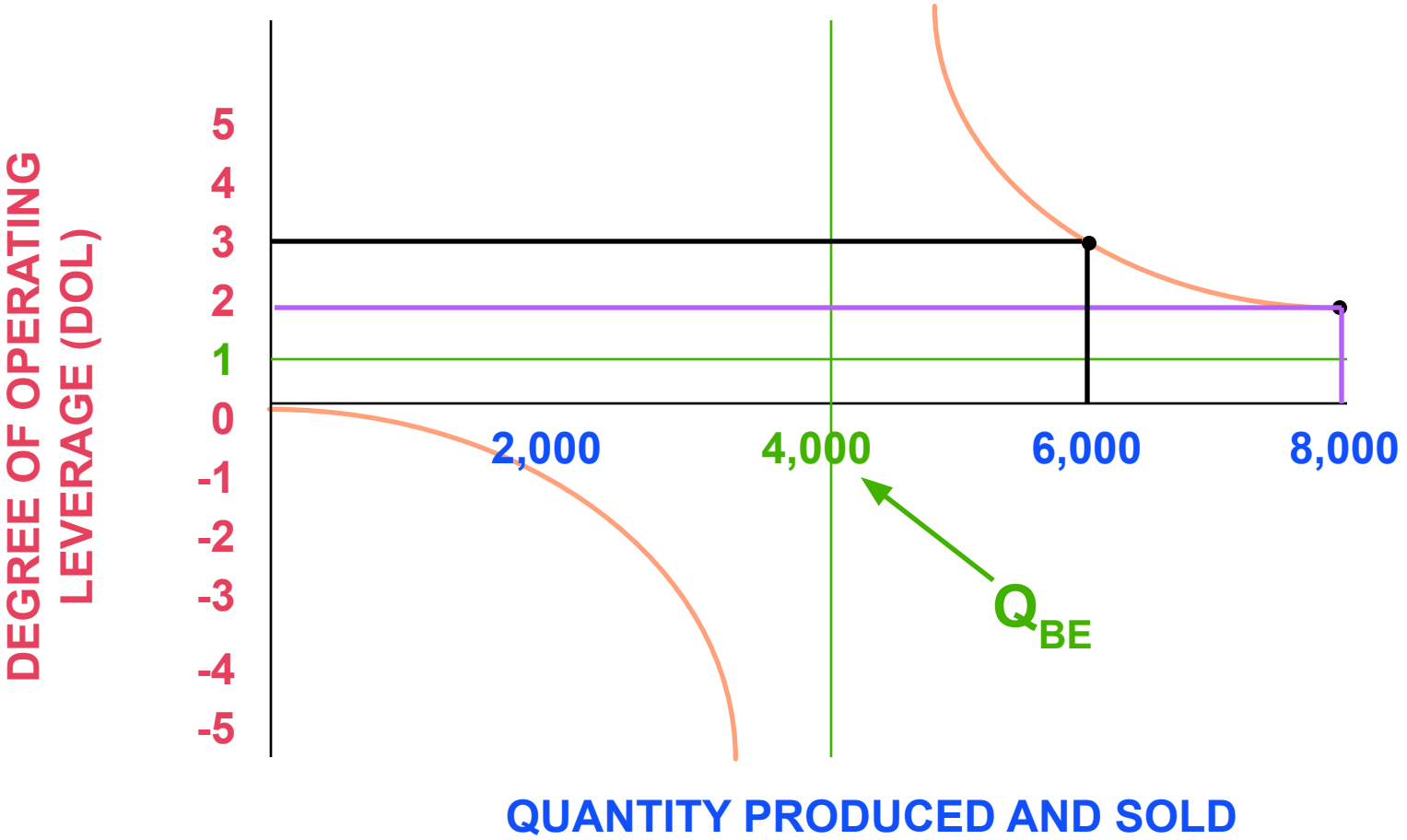
Interpretation of the DOL

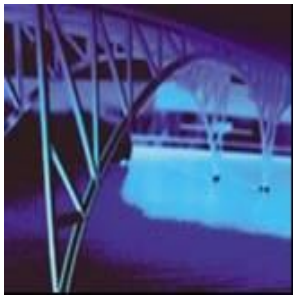
A 1% increase in sales above the 8,000 unit level increases EBIT by 2% because of the existing operating leverage of the firm.

$$DOL_{8,000\ units} = \frac{8,000}{8,000 - 4,000} = 2$$



Interpretation of the DOL

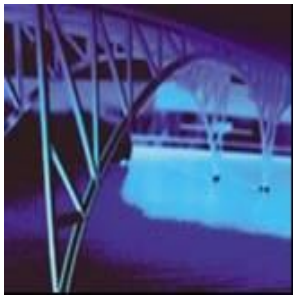




Interpretation of the DOL

Key Conclusions to be Drawn from the previous slide and our Discussion of DOL

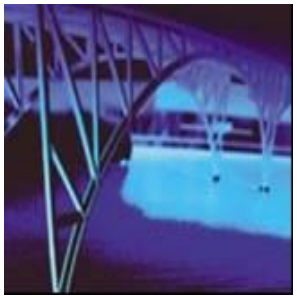
- **DOL is a quantitative measure of the "sensitivity" of a firm's operating profit to a change in the firm's sales.**
- **The closer that a firm operates to its break-even point, the higher is the absolute value of its DOL.**
- **When comparing firms, the firm with the highest DOL is the firm that will be most "sensitive" to a change in sales.**



DOL and Business Risk

Business Risk -- The inherent uncertainty in the physical operations of the firm. Its impact is shown in the variability of the firm's operating income (EBIT).

- DOL is only one component of business risk and becomes "active" only in the presence of sales and production cost variability.
- DOL magnifies the variability of operating profits and, hence, business risk.

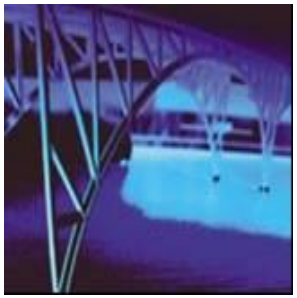


Application of DOL for Our Three Firm Example

Use the data in Slide 16-5 and the following formula for Firm F:

$$DOL = [(EBIT + FC)/EBIT]$$

$$DOL_{\$10,000\ sales} = \frac{1,000 + 7,000}{1,000} = 8.0$$

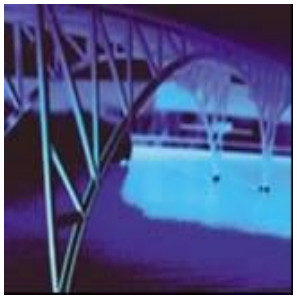


Application of DOL for Our Three Firm Example

Use the data in Slide 16-5 and the following formula for Firm V:

DOL = [(EBIT + FC)/EBIT]

$$DOL_{\$11,000\ sales} = \frac{2{,}000 + 2{,}000}{2{,}000} = 2.0$$

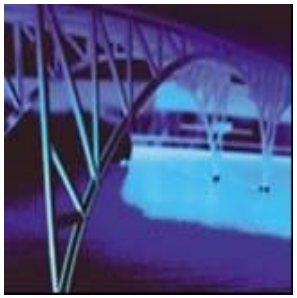


Application of DOL for Our Three-Firm Example

Use the data in Slide 16-5 and the following formula for Firm 2F:

DOL = [(EBIT + FC)/EBIT]

$$DOL_{\$19,500\ sales} = \frac{2,500 + 14,000}{2,500} = 6.6$$

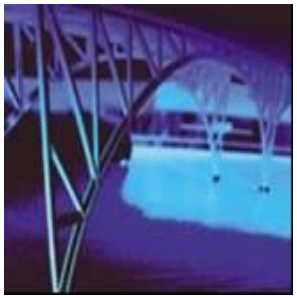


Application of DOL for Our Three-Firm Example

The ranked results indicate that the firm most sensitive to the presence of operating leverage is Firm F.

Firm F DOL = 8.0
Firm V DOL = 6.6
Firm 2F DOL = 2.0

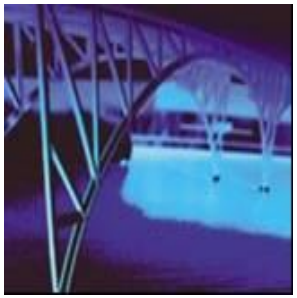
Firm F will expect a 400% increase in profit from a 50% increase in sales (see Slide 16-7 results).



Financial Leverage

Financial Leverage -- The use of fixed financing costs by the firm. The British expression is *gearing*.

- **Financial leverage is acquired by choice.**
- **Used as a means of increasing the return to common shareholders.**

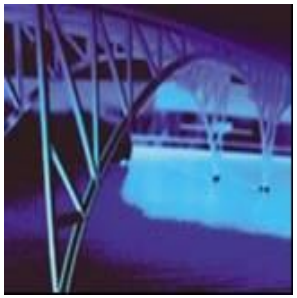


EBIT-EPS Break-Even, or Indifference, Analysis

EBIT-EPS Break-Even Analysis -- Analysis of the effect of financing alternatives on earnings per share. The break-even point is the EBIT level where EPS is the same for two (or more) alternatives.

Calculate EPS for a given level of EBIT at a given financing structure.

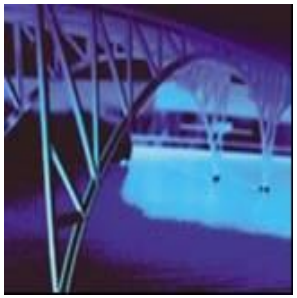
$$EPS = \frac{(EBIT - I)(1 - t) - \text{Pref. Div.}}{\text{\# of Common Shares}}$$



EBIT-EPS Chart

Basket Wonders has $2 million in LT financing (100% common stock equity).

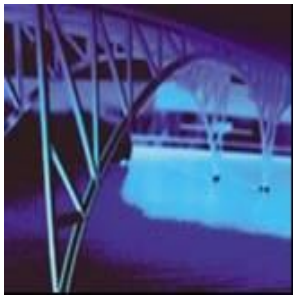
- Current common equity shares = 50,000
- $1 million in new financing of either:
  - All C.S. sold at $20/share (50,000 shares)
  - All debt with a coupon rate of 10%
  - All P.S. with a dividend rate of 9%
- Expected EBIT = $500,000
- Income tax rate is 30%



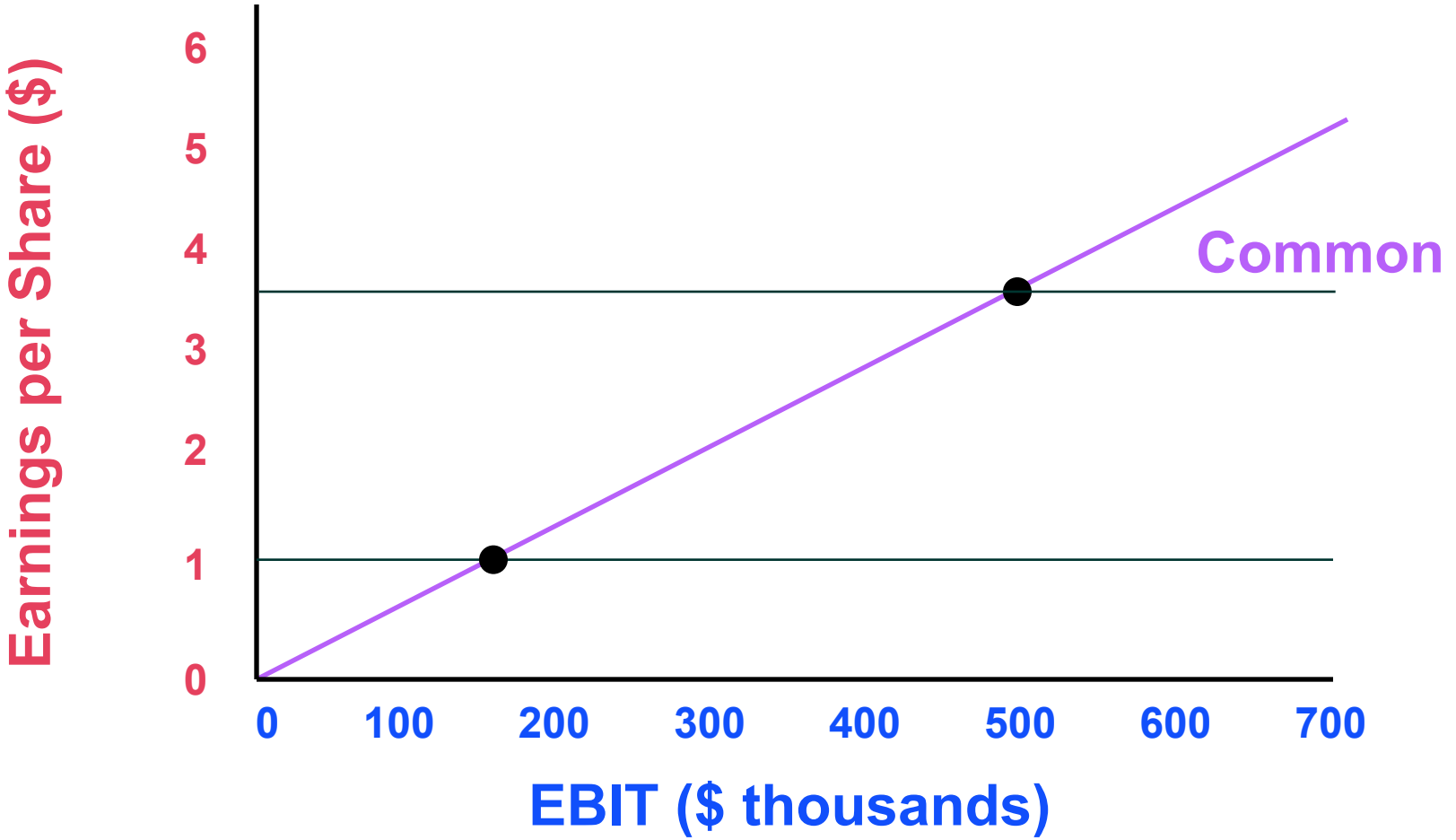
EBIT-EPS Calculation with New Equity Financing

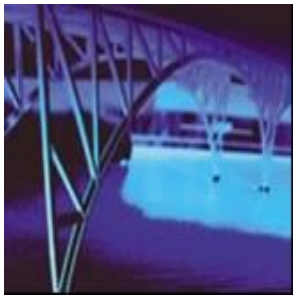
Common Stock Equity Alternative		
EBIT	$500,000	$150,000*
Interest	0	0
EBT	$500,000	$150,000
Taxes (30% x EBT)	150,000	45,000
EAT	$350,000	$105,000
Preferred Dividends	0	0
EACS	$350,000	$105,000
# of Shares	100,000	100,000
EPS	$3.50	$1.05

* A second analysis using $150,000 EBIT rather than the expected EBIT.



EBIT-EPS Chart

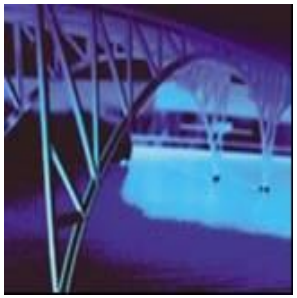




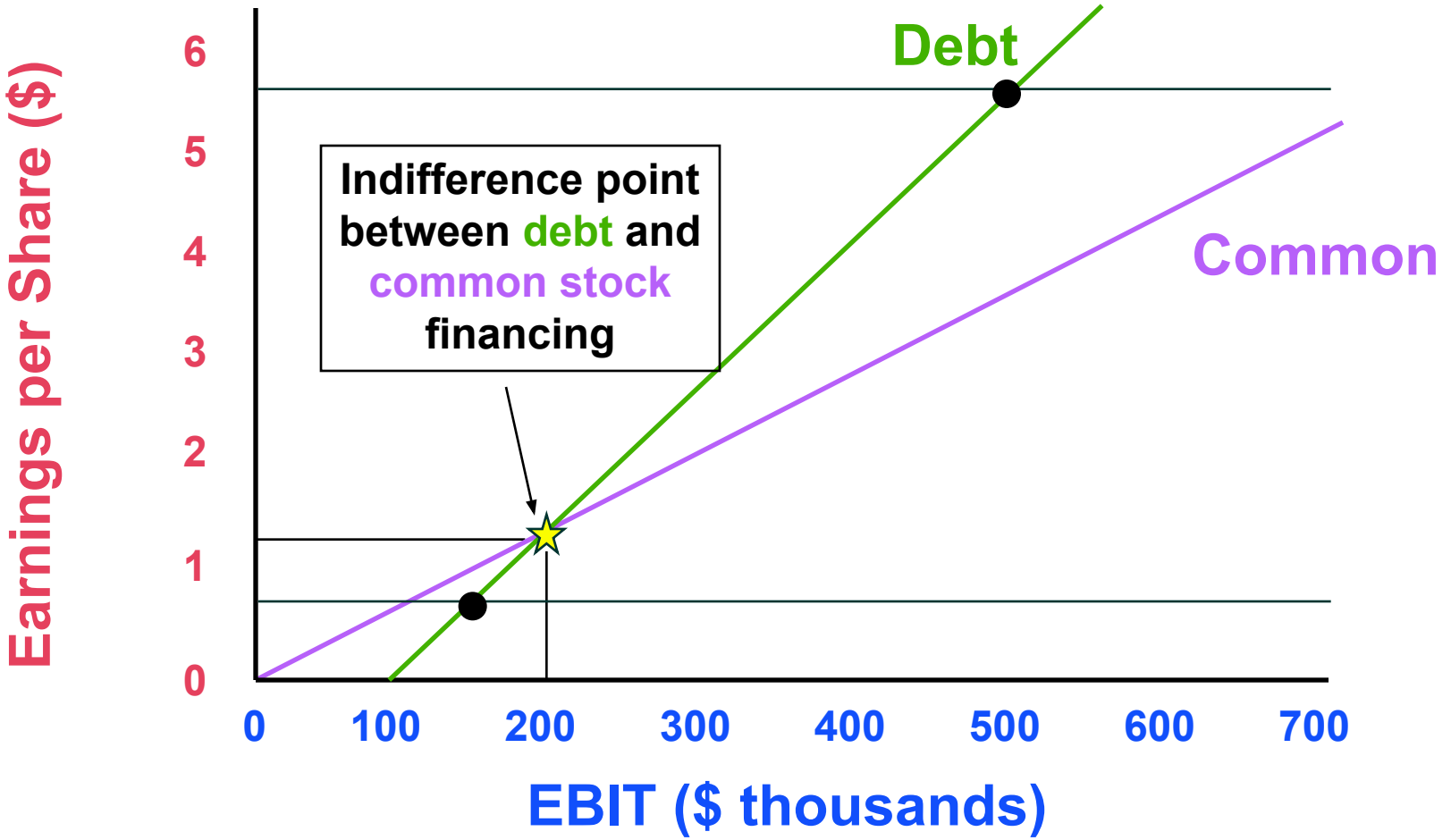
EBIT-EPS Calculation with New Debt Financing

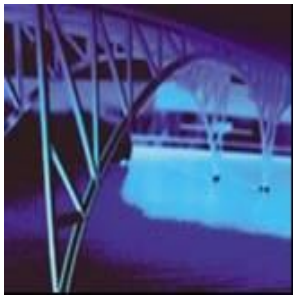
Long-term Debt Alternative		
EBIT	$500,000	$150,000*
Interest	100,000	100,000
EBT	$400,000	$ 50,000
Taxes (30% x EBT)	120,000	15,000
EAT	$280,000	$ 35,000
Preferred Dividends	0	0
EACS	$280,000	$ 35,000
# of Shares	50,000	50,000
EPS	$5.60	$0.70

* A second analysis using $150,000 EBIT rather than the expected EBIT.



EBIT-EPS Chart

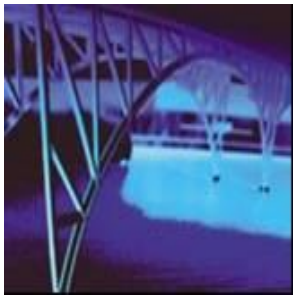




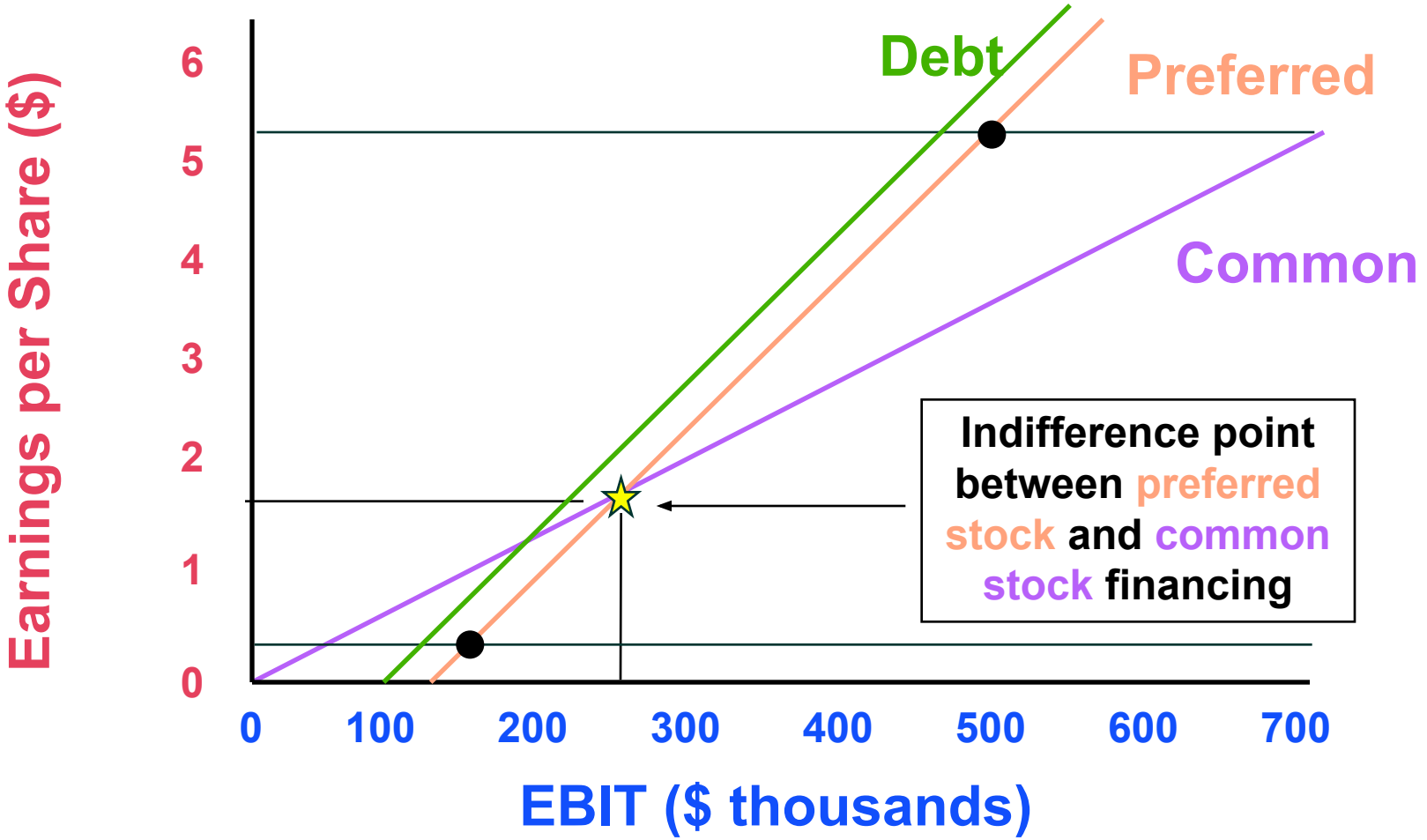
EBIT-EPS Calculation with New Preferred Financing

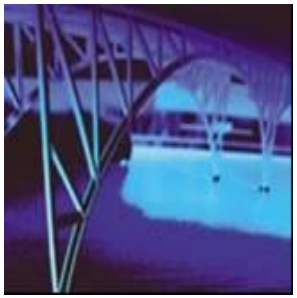
Preferred Stock Alternative		
EBIT	$500,000	$150,000*
Interest	0	0
EBT	$500,000	$150,000
Taxes (30% x EBT)	150,000	45,000
EAT	$350,000	$105,000
Preferred Dividends	90,000	90,000
EACS	$260,000	$ 15,000
# of Shares	50,000	50,000
EPS	$5.20	$0.30

* A second analysis using $150,000 EBIT rather than the expected EBIT.

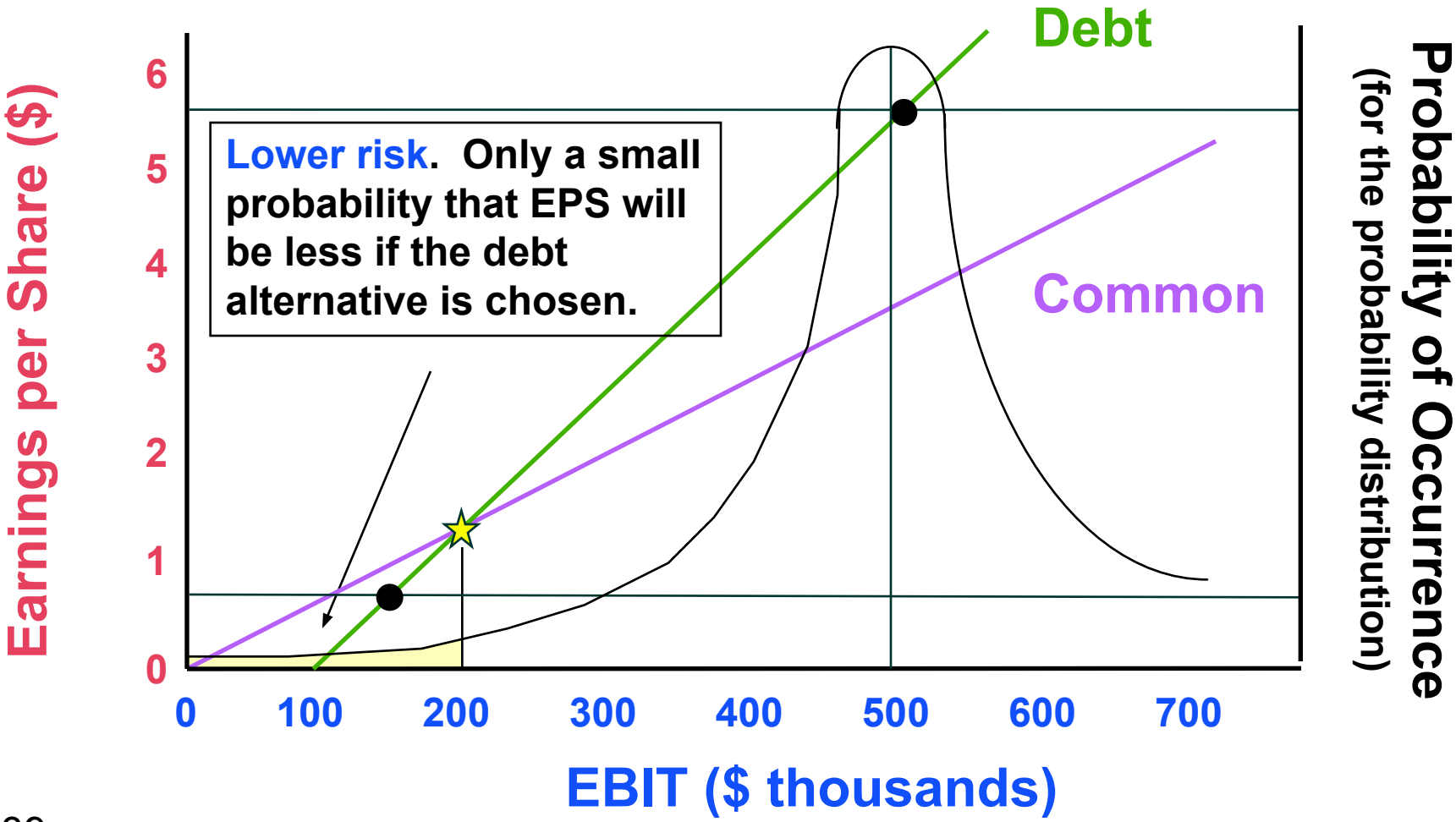


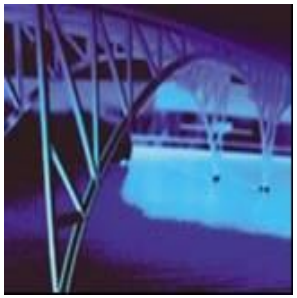
EBIT-EPS Chart



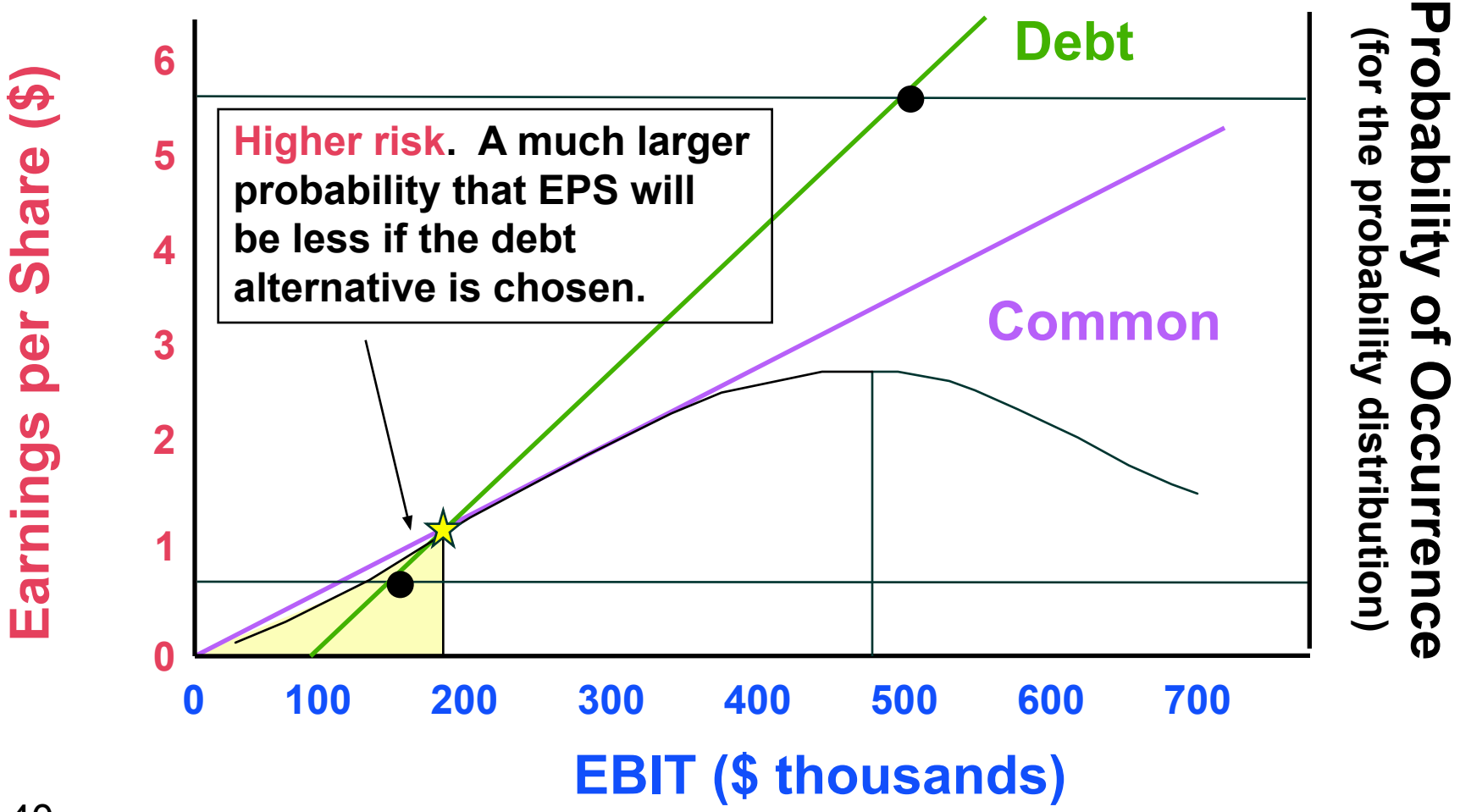


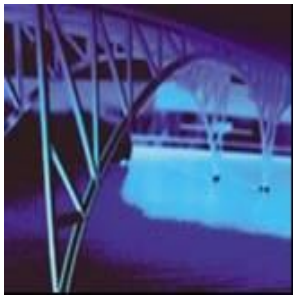
What About Risk?





What About Risk?

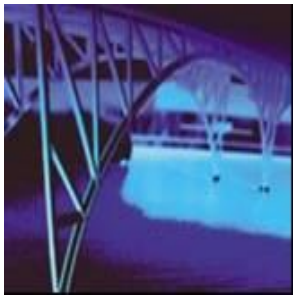




Degree of Financial Leverage (DFL)

Degree of Financial Leverage -- The percentage change in a firm's earnings per share (EPS) resulting from a 1 percent change in operating profit.

$$\text{DFL at EBIT of X dollars} = \frac{\text{Percentage change in earnings per share (EPS)}}{\text{Percentage change in operating profit (EBIT)}}$$

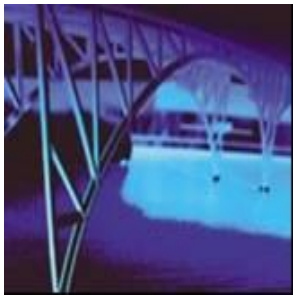


Computing the DFL

Calculating the DFL

$$DFL_{\text{EBIT of \$X}} = \frac{EBIT}{EBIT - I - [\, PD / (1 - t) \,]}$$

EBIT = Earnings before interest and taxes
I = Interest
PD = Preferred dividends
t = Corporate tax rate



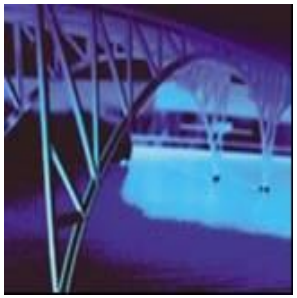
What is the DFL for Each of the Financing Choices?

Calculating the DFL for *NEW* equity* alternative

$$DFL_{\$500,000} = \frac{\$500,000}{\$500,000 - 0 - [0 / (1 - 0)]}$$

$$= 1.00$$

* The calculation is based on the expected EBIT



What is the DFL for Each of the Financing Choices?

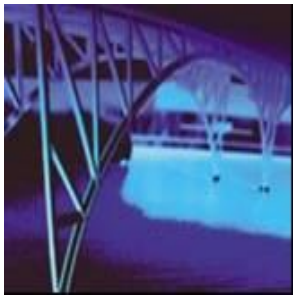
Calculating the DFL for *NEW* debt * alternative

$$DFL_{\$500,000} = \frac{\$500,000}{\{\$500,000 - 100,000 - [0 / (1 - 0)]\}}$$

$$= \$500,000 / \$400,000$$

$$= 1.25$$

* The calculation is based on the expected EBIT



What is the DFL for Each of the Financing Choices?

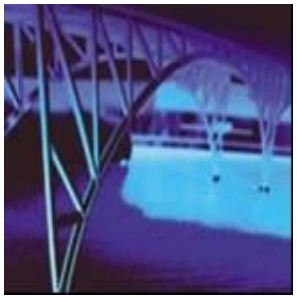
Calculating the DFL for *NEW* preferred * alternative

$$DFL_{\$500,000} = \frac{\$500,000}{\{\$500,000 - 0 - [90,000 / (1 - .30)]\}}$$

$$= \$500,000 / \$400,000$$

$$= 1.35$$

* The calculation is based on the expected EBIT



Variability of EPS

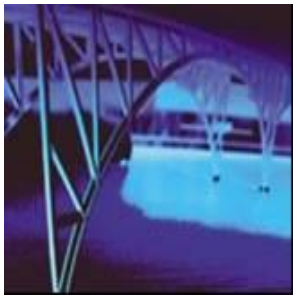
$DFL_{Equity} = 1.00$

$DFL_{Debt} = 1.25$

$DFL_{Preferred} = 1.35$

Which financing method will have the greatest relative variability in EPS?

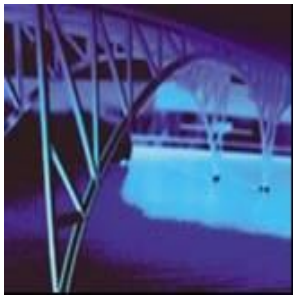
- **Preferred stock financing will lead to the greatest variability in earnings per share based on the DFL.**
- **This is due to the tax deductibility of interest on debt financing.**



Financial Risk

Financial Risk -- The added variability in earnings per share (EPS) -- plus the risk of possible insolvency -- that is induced by the use of financial leverage.

- **Debt increases the probability of cash insolvency over an all-equity-financed firm. For example, our example firm must have EBIT of at least $100,000 to cover the interest payment.**
- **Debt also increased the variability in EPS as the DFL increased from 1.00 to 1.25.**

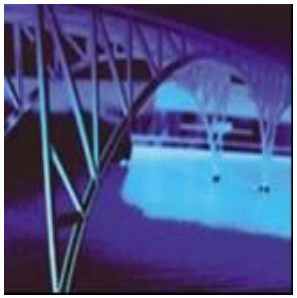


Total Firm Risk

Total Firm Risk -- The variability in earnings per share (EPS). It is the sum of business plus financial risk.

Total firm risk = business risk + financial risk

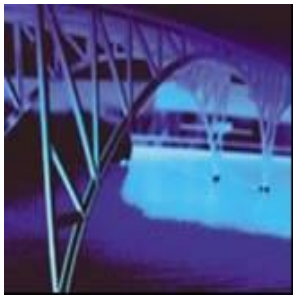
- CV_{EPS} is a measure of relative total firm risk
- CV_{EBIT} is a measure of relative business risk
- The difference, $CV_{EPS} - CV_{EBIT}$, is a measure of relative financial risk



Degree of Total Leverage (DTL)

Degree of Total Leverage -- The percentage change in a firm's earnings per share (EPS) resulting from a 1 percent change in output (sales).

$$\text{DTL at Q units (or S dollars) of output (or sales)} = \frac{\text{Percentage change in earnings per share (EPS)}}{\text{Percentage change in output (or sales)}}$$

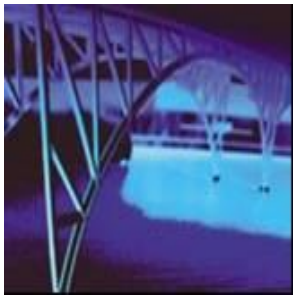


Computing the DTL

$$DTL_{\text{Q units (or S dollars)}} = \left(DOL_{\text{Q units (or S dollars)}} \right) \times \left(DFL_{\text{EBIT of X dollars}} \right)$$

$$DTL_{\text{S dollars of sales}} = \frac{EBIT + FC}{EBIT - I - [\, PD / (1 - t) \,]}$$

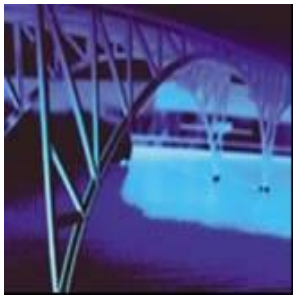
$$DTL_{\text{Q units}} = \frac{Q\,(P - V)}{Q\,(P - V) - FC - I - [\, PD / (1 - t) \,]}$$



DTL Example

Lisa Miller wants to determine the Degree of Total Leverage at EBIT=$500,000. As we did earlier, we will assume that:

- **Fixed costs are $100,000**
- **Baskets are sold for $43.75 each**
- **Variable costs are $18.75 per basket**



Computing the DTL for All-Equity Financing

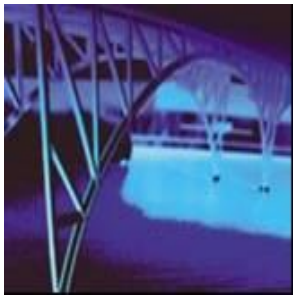
$$DTL_{\text{S dollars}} = (DOL_{\text{S dollars}}) \times (DFL_{\text{EBIT of \$S}})$$

$$DTL_{\text{S dollars}} = (1.2) \times (1.0^{*}) = 1.20$$

$$DTL_{\text{S dollars of sales}} = \frac{\$500{,}000 + \$100{,}000}{\$500{,}000 - 0 - [\,0 / (1 - .3)\,]}$$

$$= 1.20$$

*Note: No financial leverage.



Computing the DTL for Debt Financing

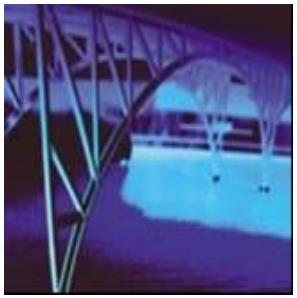
$$DTL_{S\ dollars} = (DOL_{S\ dollars}) \times (DFL_{EBIT\ of\ \$S})$$

$$DTL_{S\ dollars} = (1.2) \times (1.25^{*}) = 1.50$$

$$DTL_{S\ dollars\ of\ sales} = \frac{\$500{,}000 + \$100{,}000}{\{\ \$500{,}000 - \$100{,}000 - [\ 0 / (1 - .3)\ ]\ \}}$$

$$= 1.50$$

*Note: Calculated on Slide 16-44.

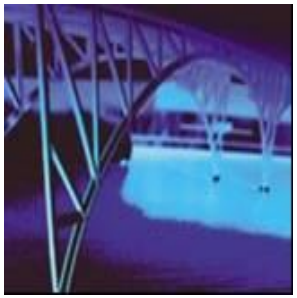


Risk versus Return

Compare the expected EPS to the DTL for the common stock equity financing approach to the debt financing approach.

Financing	E(EPS)	DTL
Equity	$3.50	1.20
Debt	$5.60	1.50

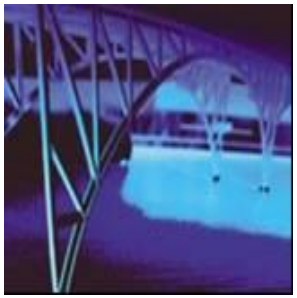
Greater expected return (higher EPS) comes at the expense of greater potential risk (higher DTL)!



What is an Appropriate Amount of Financial Leverage?

Debt Capacity -- The maximum amount of debt (and other fixed-charge financing) that a firm can adequately service.

- Firms must first analyze their expected future cash flows.
- The greater and more stable the expected future cash flows, the greater the debt capacity.
- Fixed charges include: debt principal and interest payments, lease payments, and preferred stock dividends.



Coverage Ratios

Income Statement Ratios

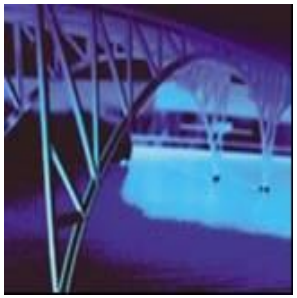
Coverage Ratios

Interest Coverage

$$\frac{\text{EBIT}}{\text{Interest expenses}}$$

Indicates a firm's ability to cover interest charges.

A ratio value equal to 1 indicates that earnings are just sufficient to cover interest charges.



Coverage Ratios

Income Statement Ratios

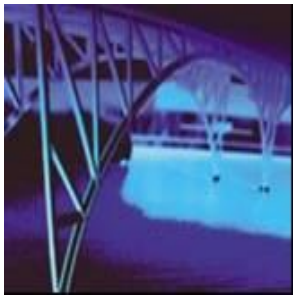
Coverage Ratios

Indicates a firm's ability to cover interest expenses and principal payments.

Debt-service Coverage

$$\frac{\text{EBIT}}{\{\text{Interest expenses} + [\text{Principal payments} / (1-t)]\}}$$

Allows us to examine the ability of the firm to meet all of its debt payments. Failure to make principal payments is also default.

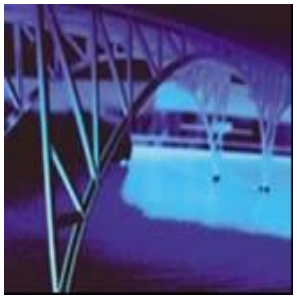


Coverage Example

Make an examination of the coverage ratios for Basket Wonders when EBIT=$500,000. Compare the equity and the debt financing alternatives.

Assume that:

- Interest expenses remain at $100,000
- Principal payments of $100,000 are made yearly for 10 years

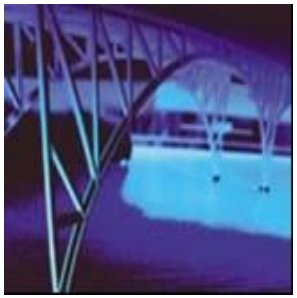


Coverage Example

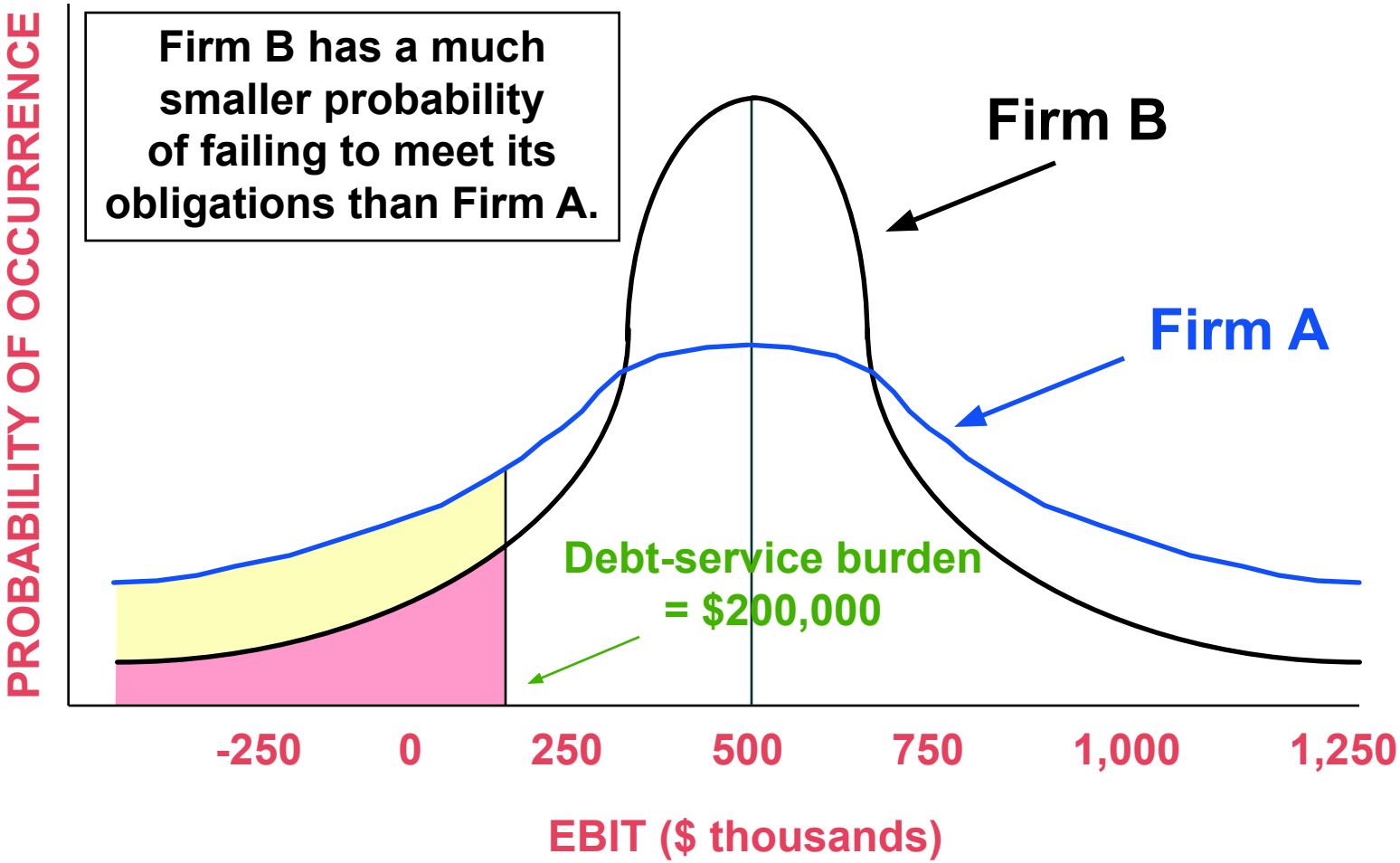
Compare the interest coverage and debt burden ratios for equity and debt financing.

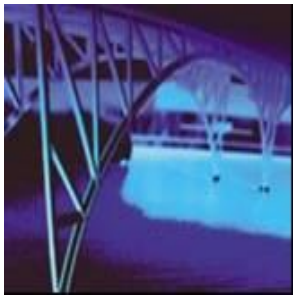
Financing	Interest Coverage	Debt-service Coverage
Equity	Infinite	Infinite
Debt	5.00	2.50

The firm actually has greater risk than the interest coverage ratio initially suggests.



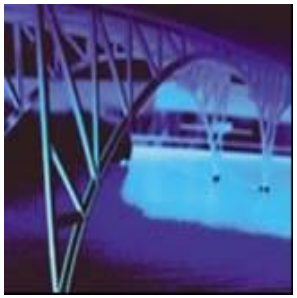
Coverage Example





Summary of the Coverage Ratio Discussion

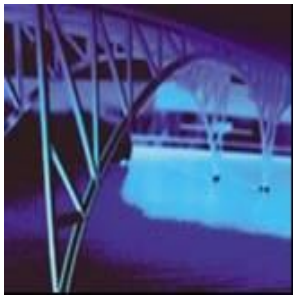
- The debt-service coverage ratio accounts for required annual principal payments.
- A single ratio value cannot be interpreted identically for all firms as some firms have greater debt capacity.
- Annual financial lease payments should be added to both the numerator and denominator of the debt-service coverage ratio as financial leases are similar to debt.



Other Methods of Analysis

Capital Structure -- The mix (or proportion) of a firm's permanent long-term financing represented by debt, preferred stock, and common stock equity.

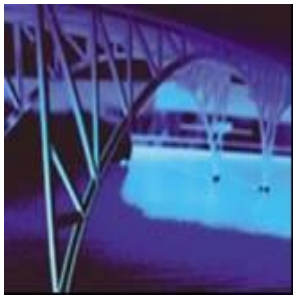
- Often, firms are compared to peer institutions in the same industry.
- Large deviations from norms must be justified.
- For example, an industry's median debt-to-net-worth ratio might be used as a benchmark for financial leverage comparisons.



Other Methods of Analysis

Surveying Investment Analysts and Lenders

- Firms may gain insight into the financial markets' evaluation of their firm by talking with:
  - Investment bankers
  - Institutional investors
  - Investment analysts
  - Lenders



Other Methods of Analysis

Security Ratings

- Firms must consider the impact of any financing decision on the firm's security rating(s).