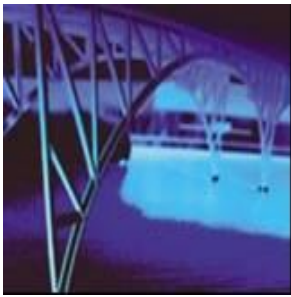


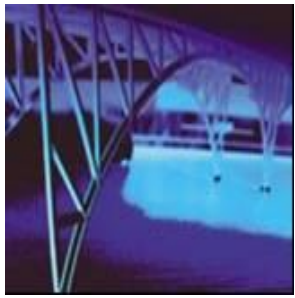
Chapter 16

Operating and Financial Leverage



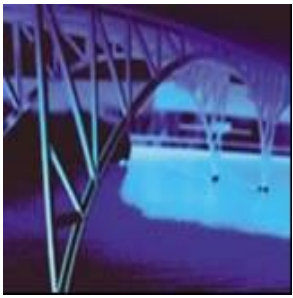
After studying Chapter 16, you should be able to:

- **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

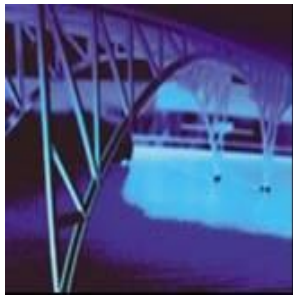
- **Operating Leverage**
- **Financial Leverage**
- **Total Leverage**
- **Cash-Flow Ability to Service Debt**
- **Other Methods of Analysis**
- **Combination of Methods**



Operating Leverage

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

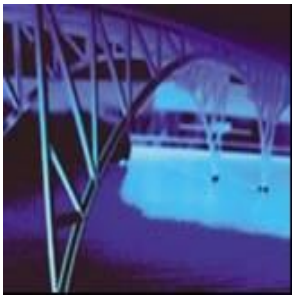
- **One potential “effect” caused by the presence of operating leverage is that a change in the volume of sales results in a “more than proportional” change in operating profit (or loss).**



Impact of Operating Leverage on Profits

(in thousands) **Firm F Firm V Firm 2F**

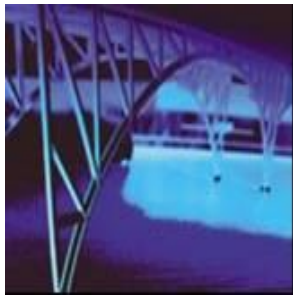
Sales	\$10	\$11	\$19.5
Operating Costs			
Fixed	7	2	14
Variable	2	7	3
Operating Profit	\$ 1	\$ 2	\$ 2.5
FC/total costs	.78	.22	.82
FC/sales	.70	.18	.72



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.**

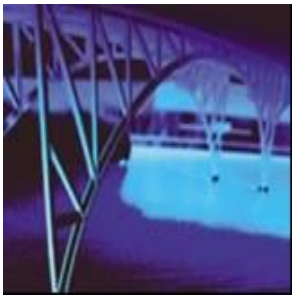


Impact of Operating Leverage on Profits

	(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
Percentage				
400%	100%	330%		

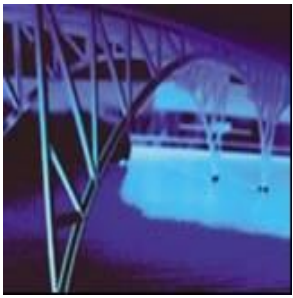
Change in EBIT*

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



Impact of Operating Leverage on Profits

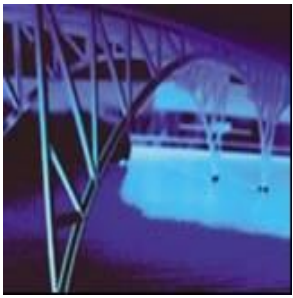
- **Firm F is the most “sensitive” firm** -- for it, a 50% increase in sales leads to a **400% increase in EBIT**.
- Our example reveals that it is a mistake to assume that the firm with the largest absolute or relative amount of fixed costs automatically shows the most dramatic effects of operating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



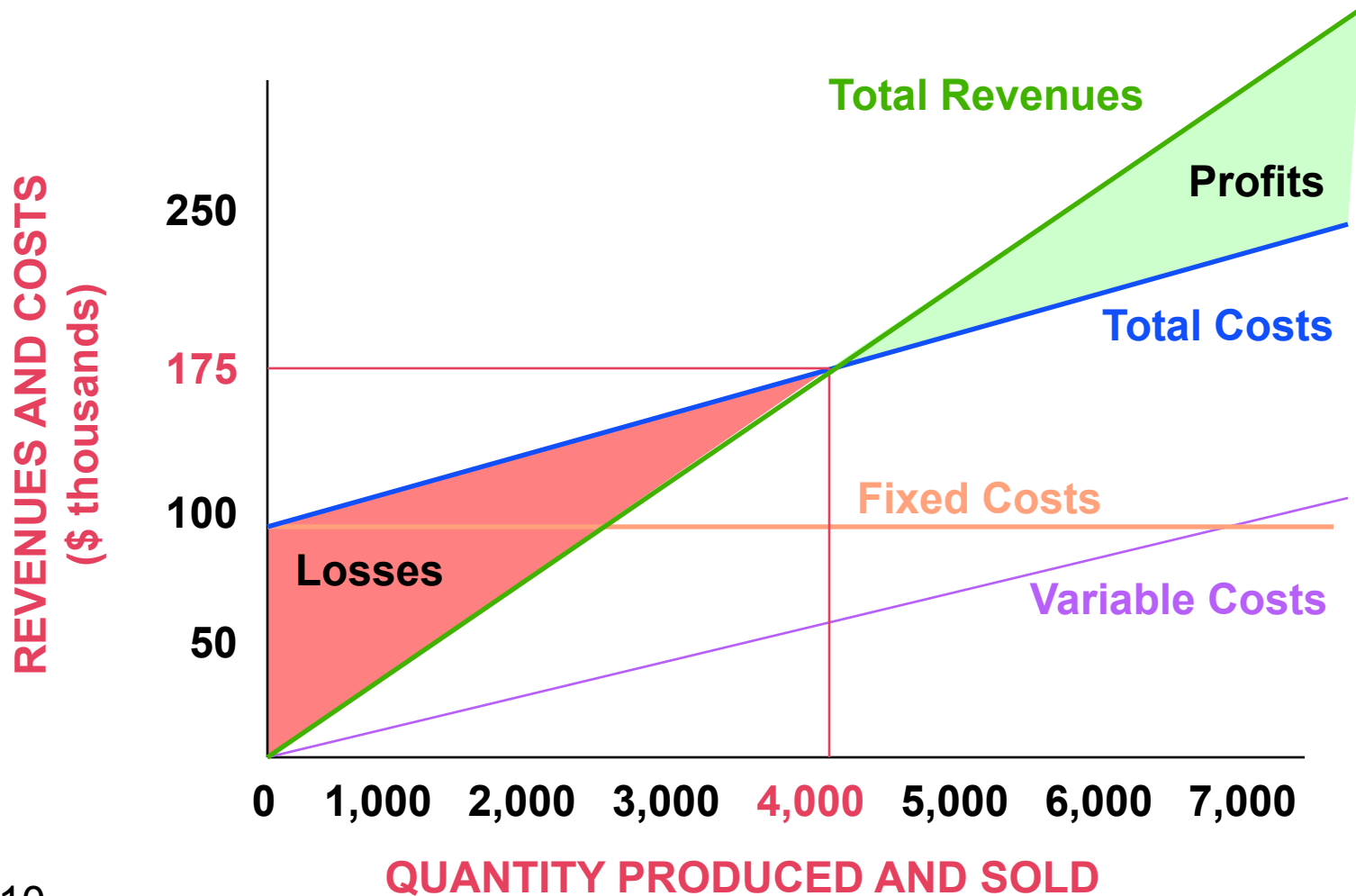
Break-Even Analysis

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:

$$\text{EBIT} = P(Q) - V(Q) - FC$$

$$\text{EBIT} = Q(P - V) - FC$$

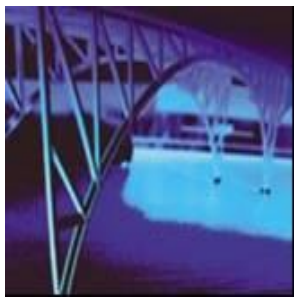
P = Price per unit

V = Variable costs per unit

FC = Fixed costs

Q = Quantity (units)

produced and sold



Break-Even (Quantity) Point

Breakeven occurs when EBIT = 0

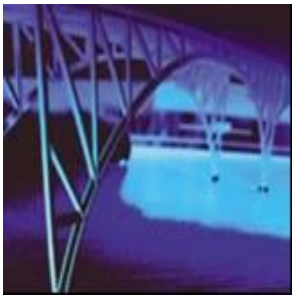
$$Q (P - V) - FC = \text{EBIT}$$

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

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

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

a.k.a. Unit Contribution Margin



Break-Even (Sales) Point

How to find the sales break-even point:

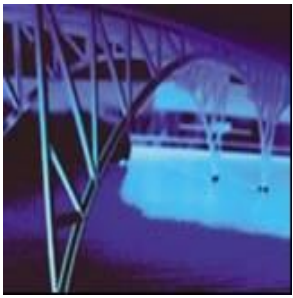
$$S_{BE} = FC + (VC_{BE})$$

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

or

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

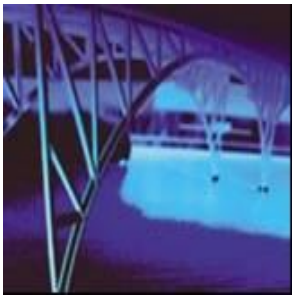
* Refer to text for derivation of the formula



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:

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

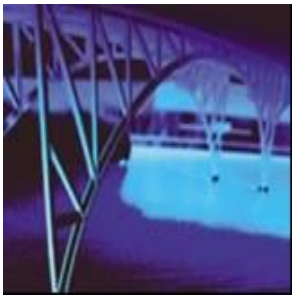
$$Q_{BE} = \$100,000 / (\$43.75 - \$18.75)$$

$$Q_{BE} = 4,000 \text{ Units}$$

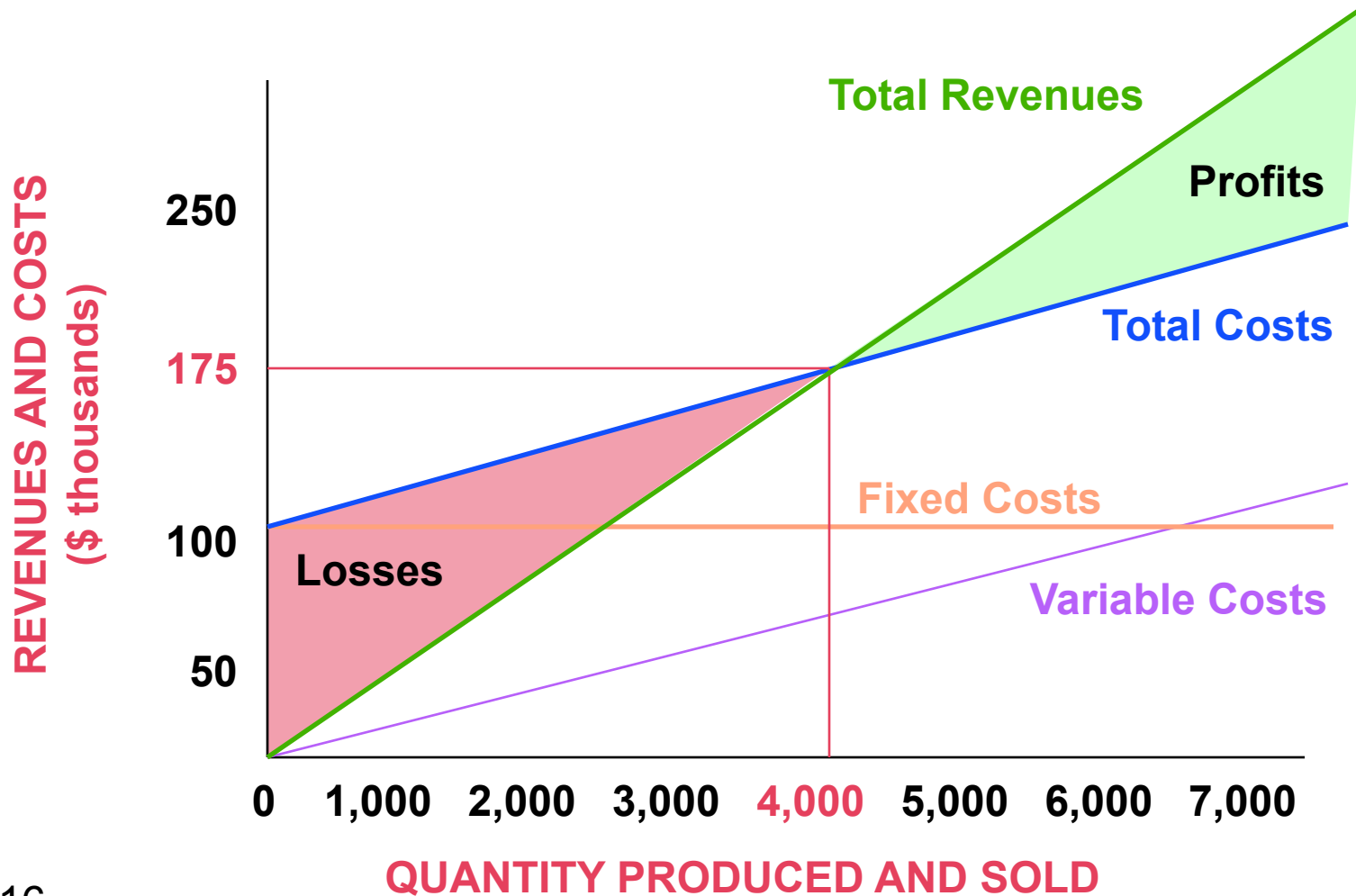
$$S_{BE} = (Q_{BE})(V) + FC$$

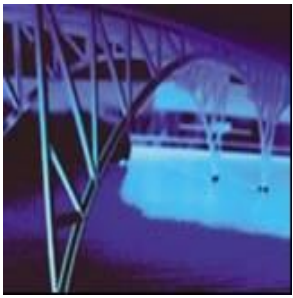
$$S_{BE} = (4,000)(\$18.75) + \$100,000$$

$$S_{BE} = \$175,000$$



Break-Even Chart





Degree of Operating Leverage (DOL)

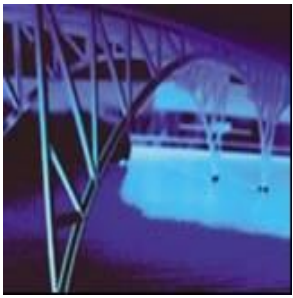
Degree of Operating Leverage -- The percentage change in a firm's operating profit (EBIT) resulting from a 1 percent change in output (sales).

DOL at Q
units of
output
(or sales)

=

**Percentage change in
operating profit (EBIT)**

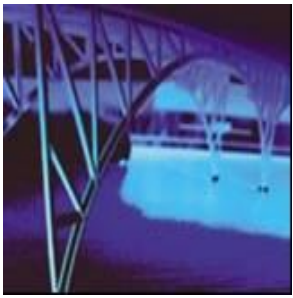
**Percentage change in
output (or sales)**



Computing the DOL

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

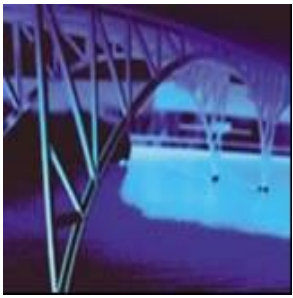
$$\begin{aligned} \text{DOL}_{Q \text{ units}} &= \frac{Q (P - V)}{Q (P - V) - FC} \\ &= \frac{Q}{Q - Q_{BE}} \end{aligned}$$



Computing the DOL

Calculating the DOL for a multiproduct firm.

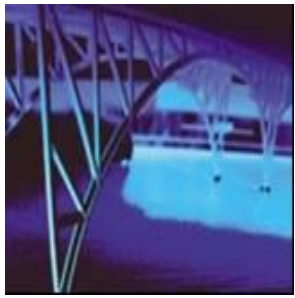
$$\begin{aligned} \text{DOL}_{\$ \text{ dollars of sales}} &= \frac{S - VC}{S - VC - FC} \\ &= \frac{EBIT + FC}{EBIT} \end{aligned}$$



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

$$\text{DOL}_{6,000 \text{ units}} = \frac{6,000}{6,000 - 4,000} = 3$$

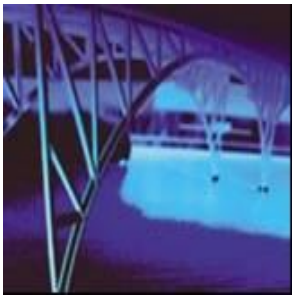
$$\text{DOL}_{8,000 \text{ units}} = \frac{8,000}{8,000 - 4,000} = 2$$



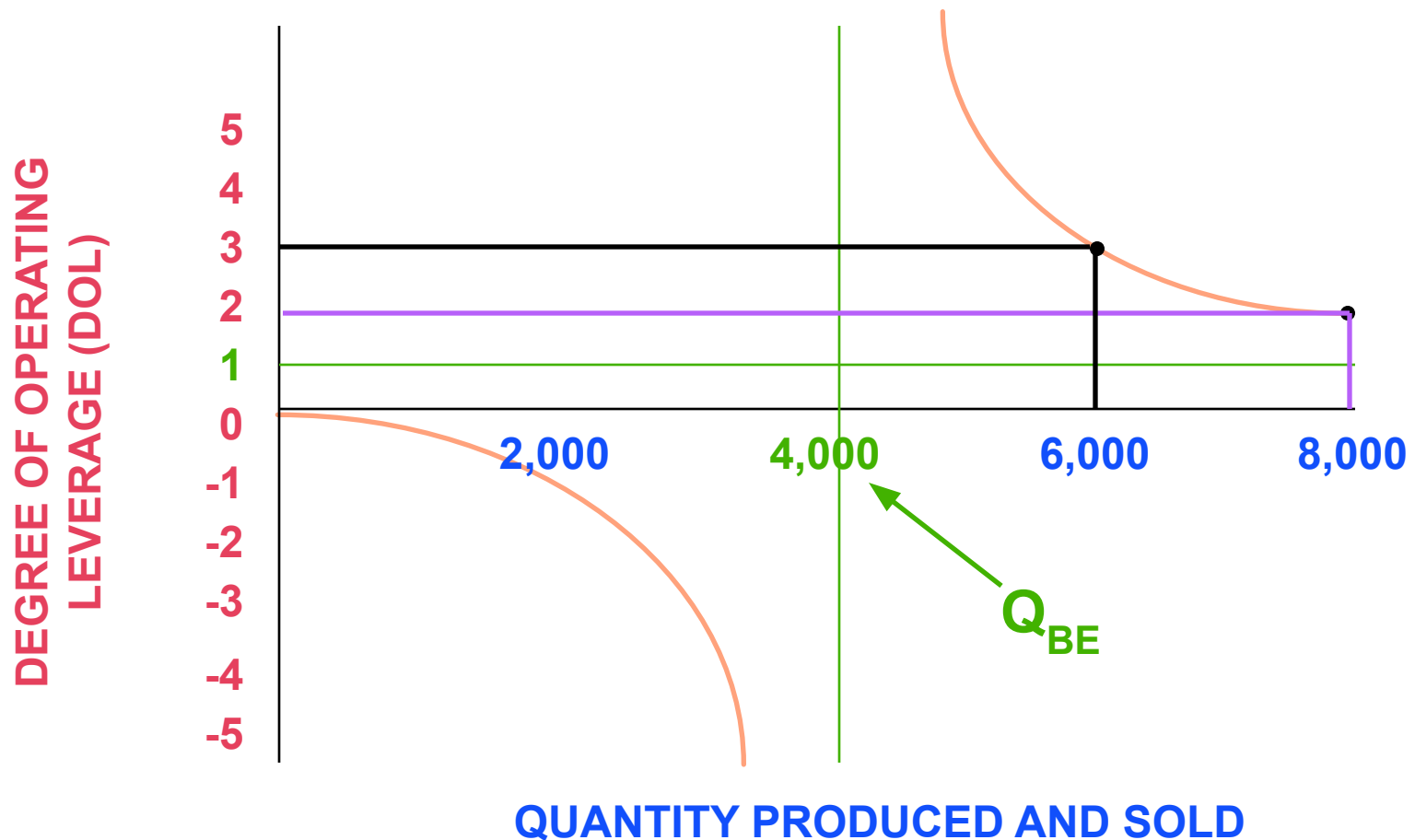
Interpretation of the DOL

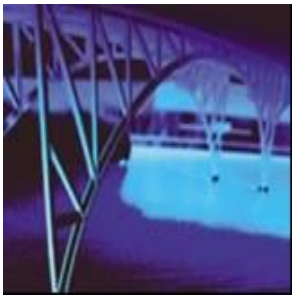
A 1% increase in sales above the 8,000 unit level increases EBIT by 2% because of the existing operating leverage of the firm.

$$\text{DOL}_{8,000 \text{ units}} = \frac{8,000}{8,000 - 4,000} = 2$$



Interpretation of the DOL

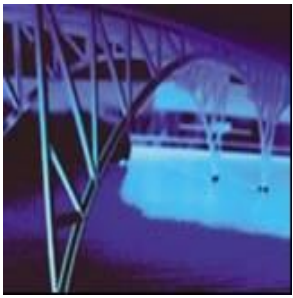




Interpretation of the DOL

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

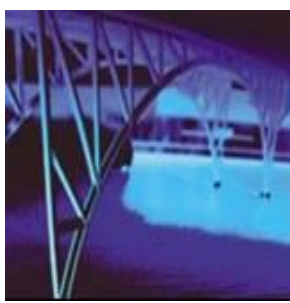
- **DOL is a quantitative measure of the “sensitivity” of a firm’s operating profit to a change in the firm’s sales.**
- **The closer that a firm operates to its break-even point, the higher is the absolute value of its DOL.**
- **When comparing firms, the firm with the highest DOL is the firm that will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

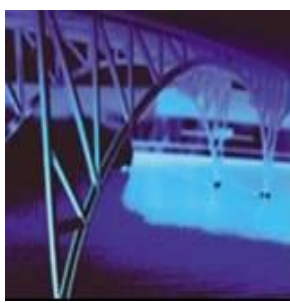


Application of DOL for Our Three Firm Example

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

$$\text{DOL} = [(\text{EBIT} + \text{FC})/\text{EBIT}]$$

$$\text{DOL}_{\$10,000 \text{ sales}} = \frac{1,000 + 7,000}{1,000} = 8.0$$

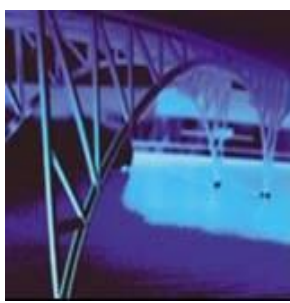


Application of DOL for Our Three Firm Example

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

$$\text{DOL} = [(\text{EBIT} + \text{FC})/\text{EBIT}]$$

$$\text{DOL}_{\$11,000 \text{ sales}} = \frac{2,000 + 2,000}{2,000} = 2.0$$

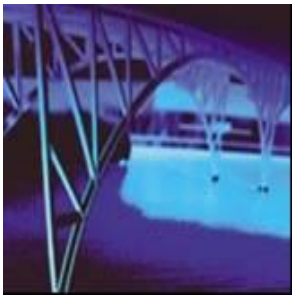


Application of DOL for Our Three-Firm Example

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

$$\text{DOL} = [(\text{EBIT} + \text{FC})/\text{EBIT}]$$

$$\text{DOL}_{\$19,500 \text{ sales}} = \frac{2,500 + 14,000}{2,500} = 6.6$$



Application of DOL for Our Three-Firm Example

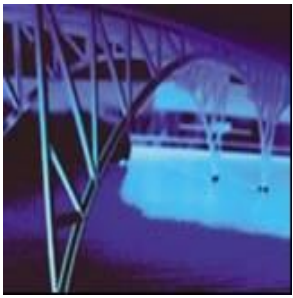
The ranked results indicate that the firm most sensitive to the presence of operating leverage is **Firm F**.

Firm F **DOL = 8.0**

Firm V **DOL = 6.6**

Firm 2F **DOL = 2.0**

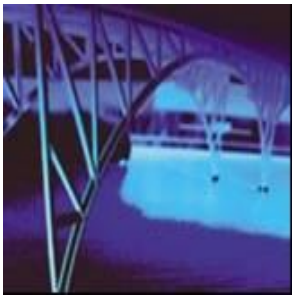
Firm F will expect a **400% increase in profit** from a **50% increase in sales** (see Slide 16-7 results).



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.

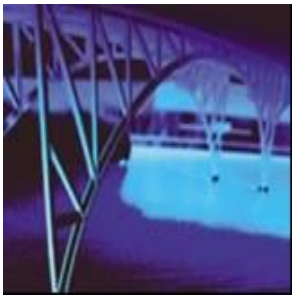


EBIT-EPS Break-Even, or Indifference, Analysis

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.

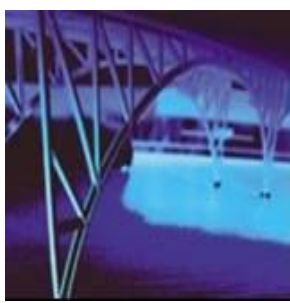
$$\text{EPS} = \frac{(\text{EBIT} - I)(1 - t) - \text{Pref. Div.}}{\text{\# of Common Shares}}$$



EBIT-EPS Chart

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

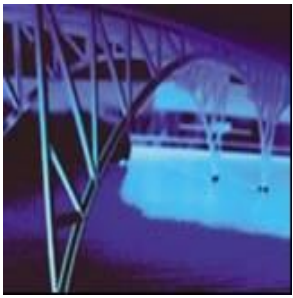
- **Current common equity shares = 50,000**
- **\$1 million in new financing of either:**
 - All C.S. sold at \$20/share (50,000 shares)
 - All debt with a coupon rate of 10%
 - All P.S. with a dividend rate of 9%
- **Expected EBIT = \$500,000**
- **Income tax rate is 30%**



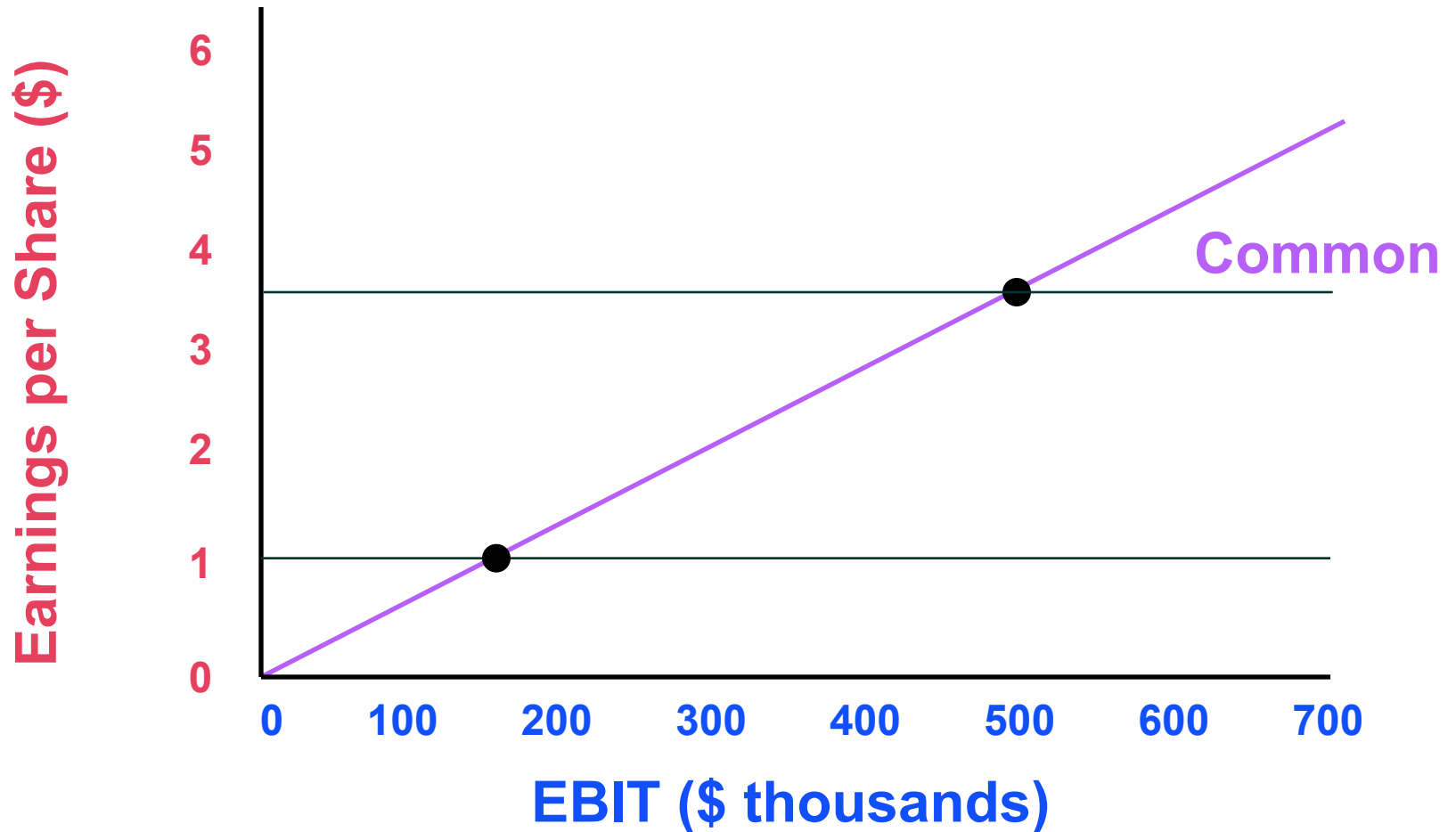
EBIT-EPS Calculation with New Equity Financing

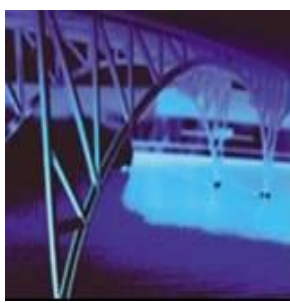
Common Stock Equity Alternative

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



EBIT-EPS Chart

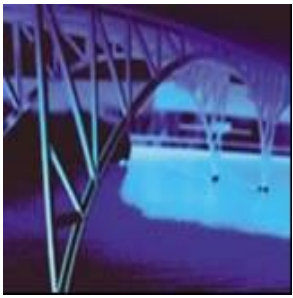




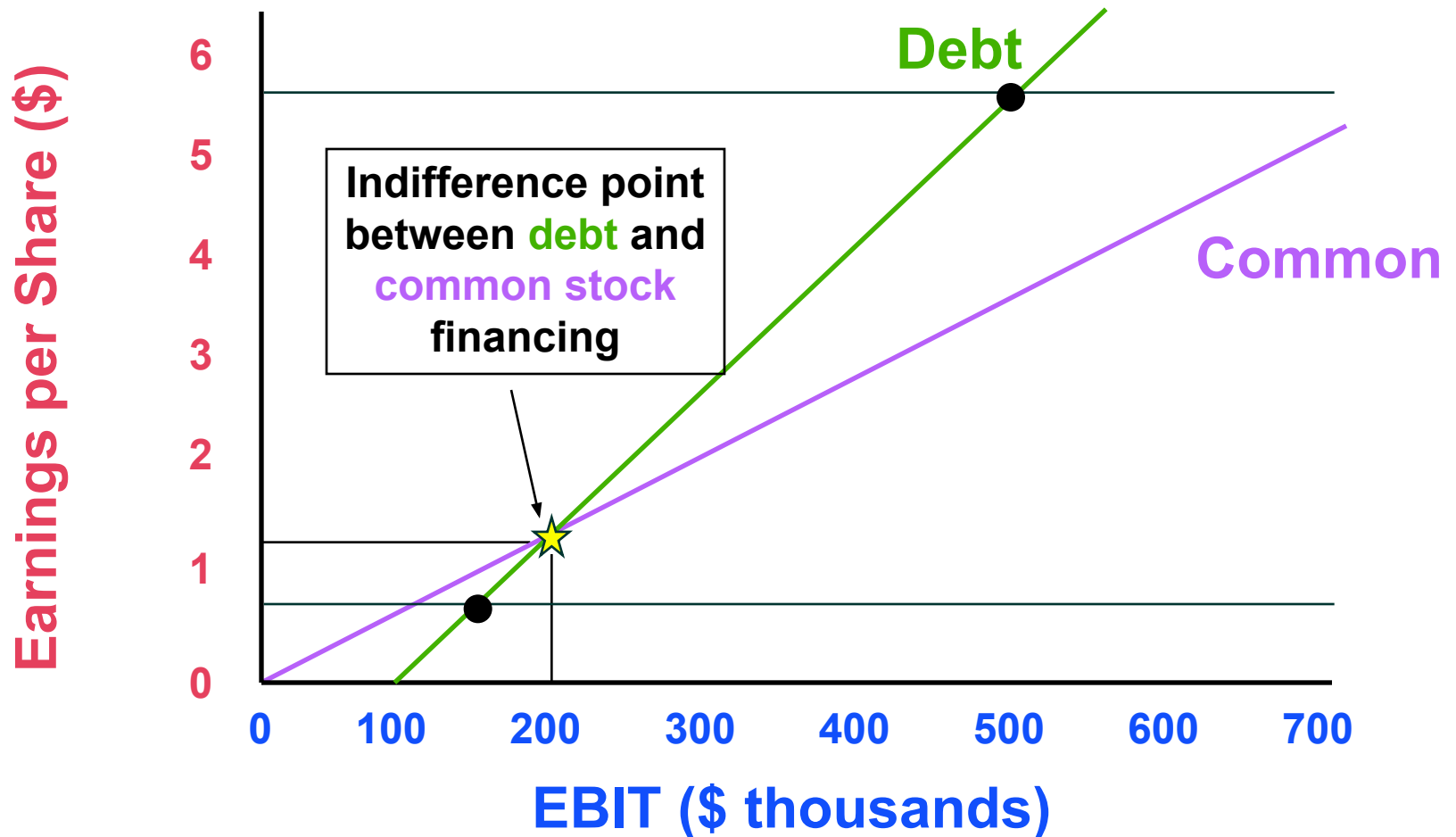
EBIT-EPS Calculation with New Debt Financing

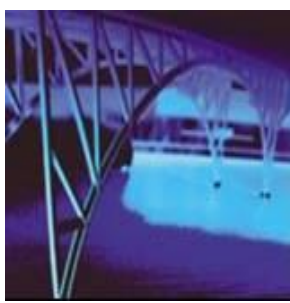
Long-term Debt Alternative

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



EBIT-EPS Chart

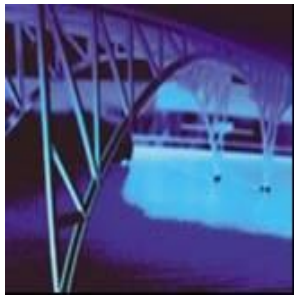




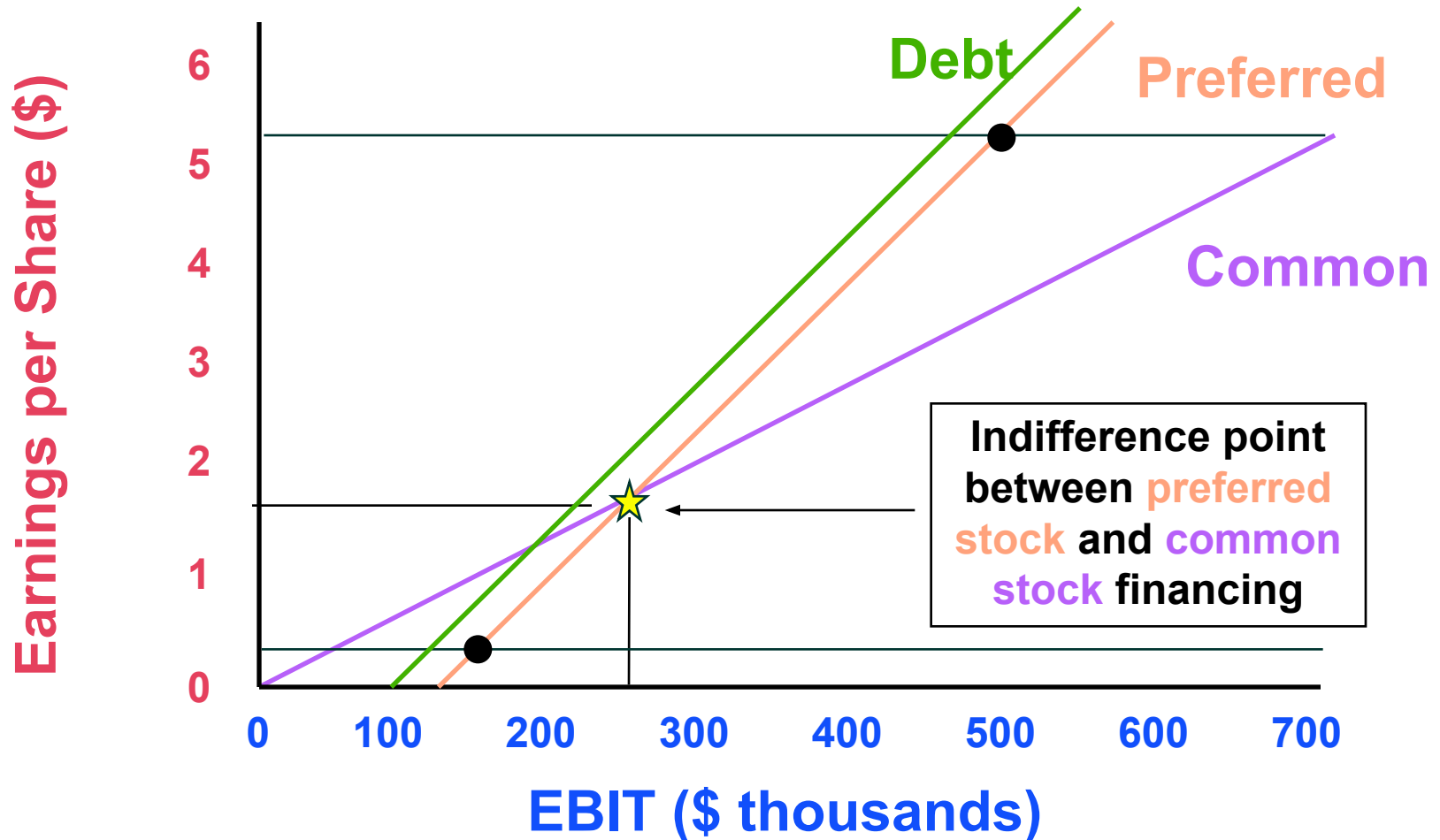
EBIT-EPS Calculation with New Preferred Financing

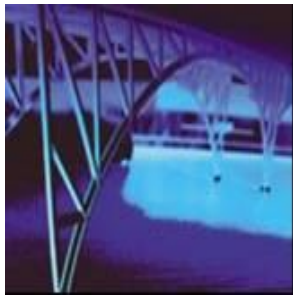
Preferred Stock Alternative

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

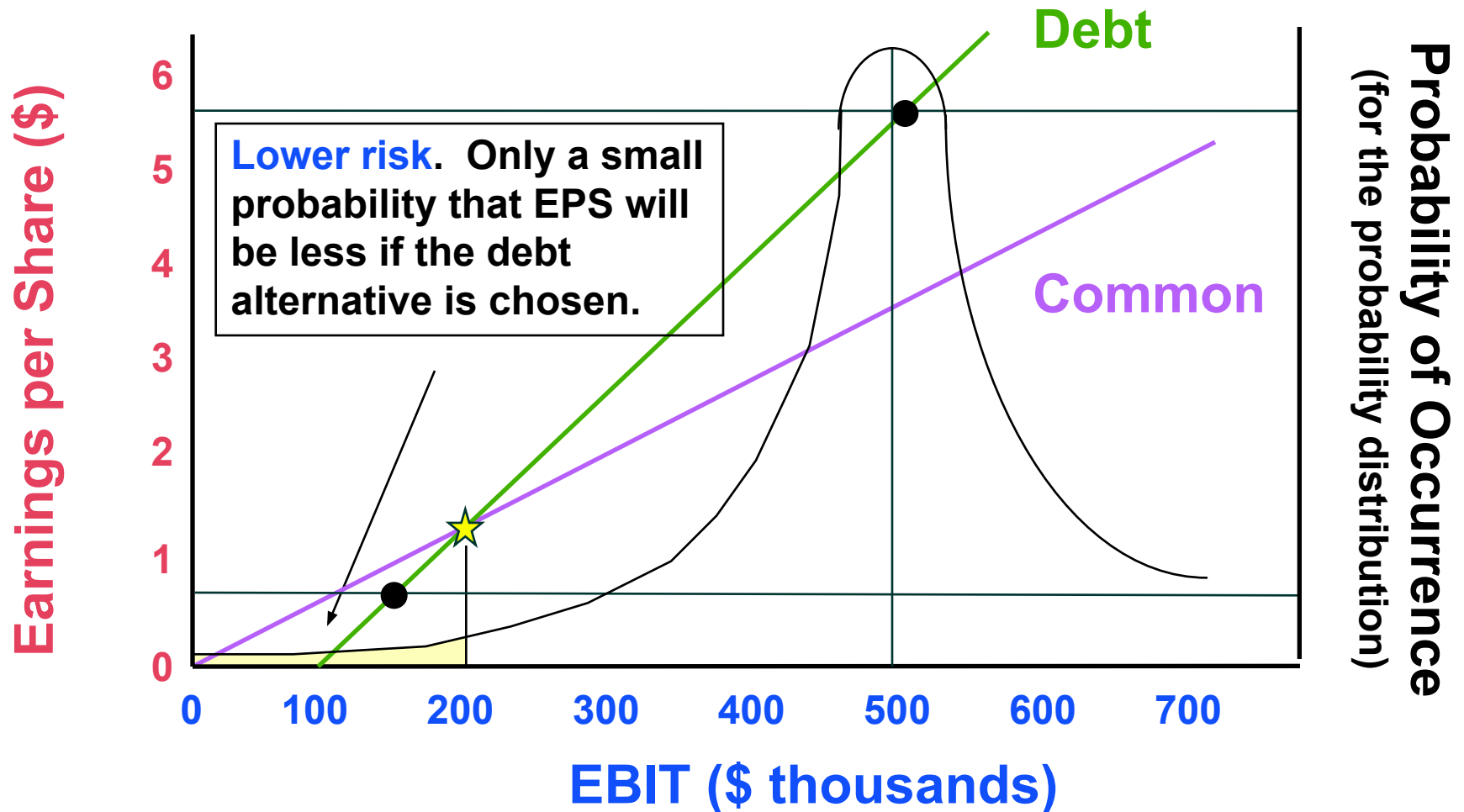


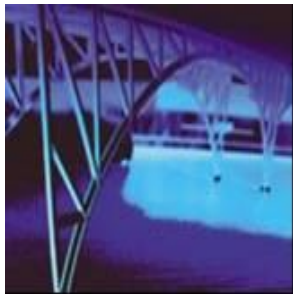
EBIT-EPS Chart



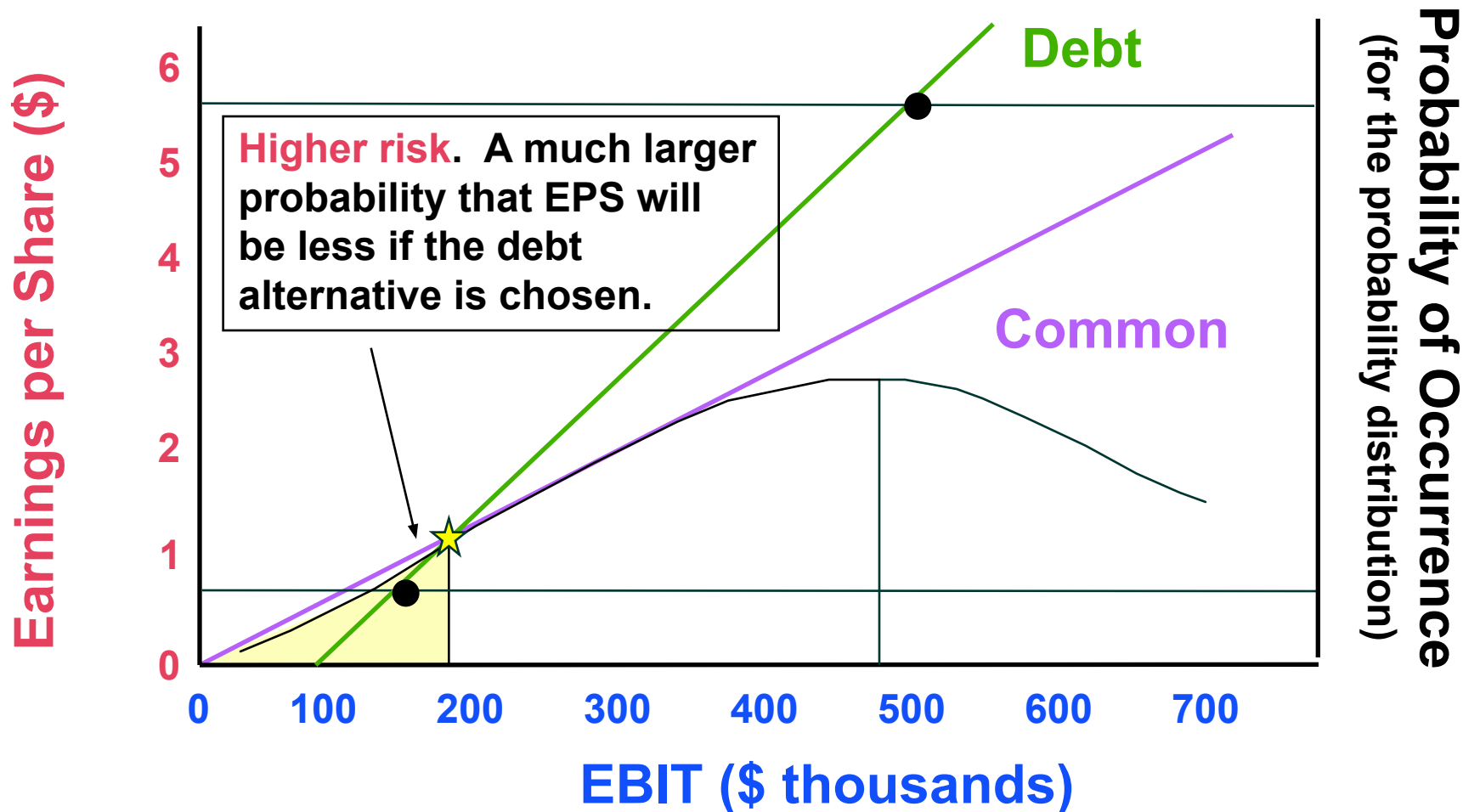


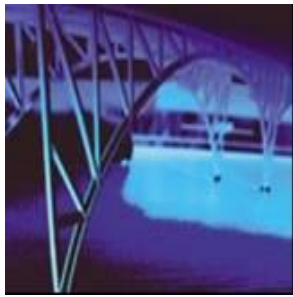
What About Risk?





What About Risk?

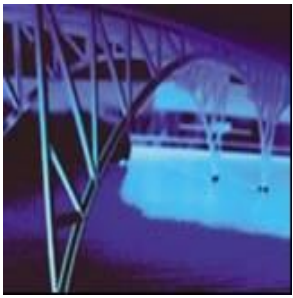




Degree of Financial Leverage (DFL)

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

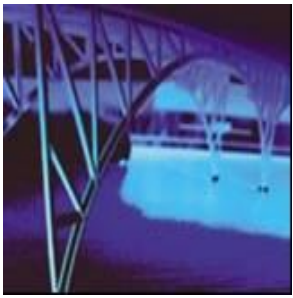
$$\text{DFL}_{\text{EBIT of \$X}} = \frac{\text{EBIT}}{\text{EBIT} - I - \left[\text{PD} / (1 - t) \right]}$$

EBIT = Earnings before interest and taxes

I = Interest

PD = Preferred dividends

t = Corporate tax rate

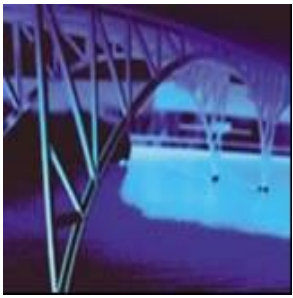


What is the DFL for Each of the Financing Choices?

Calculating the DFL for NEW equity* alternative

$$\begin{aligned} \text{DFL}_{\$500,000} &= \frac{\$500,000}{\$500,000 - 0 - [0 / (1 - 0)]} \\ &= 1.00 \end{aligned}$$

* The calculation is based on the expected EBIT

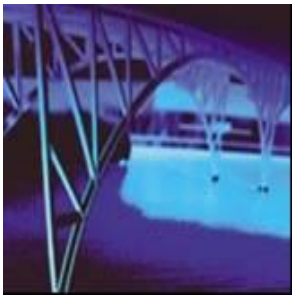


What is the DFL for Each of the Financing Choices?

Calculating the DFL for NEW debt * alternative

$$\begin{aligned} \text{DFL}_{\$500,000} &= \frac{\$500,000}{\{ \$500,000 - 100,000 - [0 / (1 - 0)] \}} \\ &= \$500,000 / \$400,000 \\ &= 1.25 \end{aligned}$$

* The calculation is based on the expected EBIT

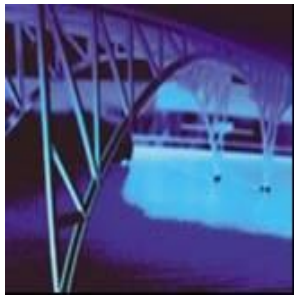


What is the DFL for Each of the Financing Choices?

Calculating the DFL for NEW preferred * alternative

$$\begin{aligned} \text{DFL}_{\$500,000} &= \frac{\$500,000}{\{ \$500,000 - 0 - [90,000 / (1 - .30)] \}} \\ &= \$500,000 / \$400,000 \\ &= 1.35 \end{aligned}$$

* The calculation is based on the expected EBIT



Variability of EPS

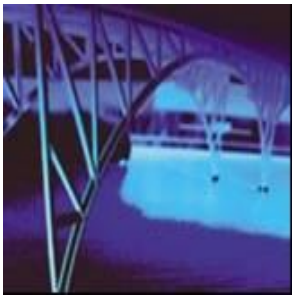
$$\text{DFL}_{\text{Equity}} = 1.00$$

$$\text{DFL}_{\text{Debt}} = 1.25$$

$$\text{DFL}_{\text{Preferred}} = 1.35$$

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

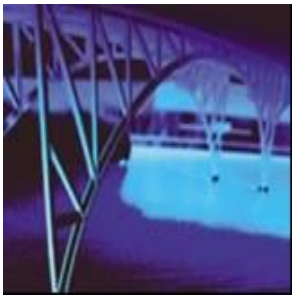
- **Preferred stock** financing will lead to the greatest variability in earnings per share based on the DFL.
- This is due to the tax deductibility of interest on debt financing.



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.

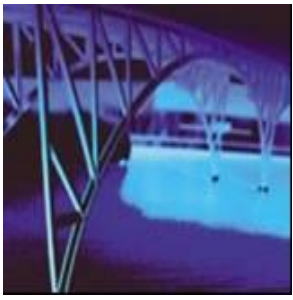


Total Firm Risk

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

$$\text{Total firm risk} = \text{business risk} + \text{financial risk}$$

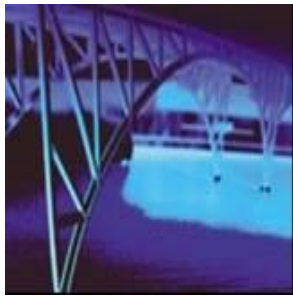
- CV_{EPS} is a measure of relative **total firm risk**
- CV_{EBIT} is a measure of relative **business risk**
- The difference, $CV_{EPS} - CV_{EBIT}$, is a measure of relative **financial risk**



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).

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

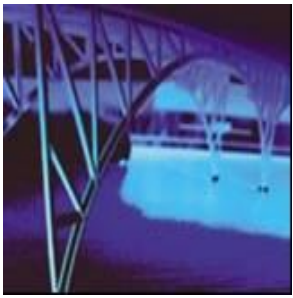


Computing the DTL

$$\text{DTL}_{Q \text{ units (or S dollars)}} = \left(\text{DOL}_{Q \text{ units (or S dollars)}} \right) \times \left(\text{DFL}_{\text{EBIT of X dollars}} \right)$$

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

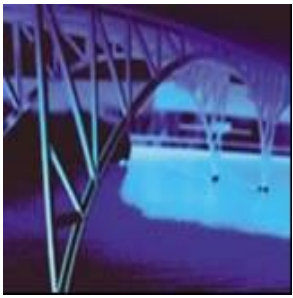
$$\text{DTL}_{Q \text{ units}} = \frac{Q(P - V)}{Q(P - V) - \text{FC} - \text{I} - [\text{PD} / (1 - t)]}$$



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**



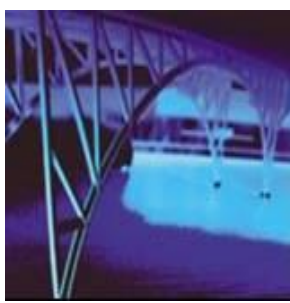
Computing the DTL for All-Equity Financing

$$\text{DTL}_{\$ \text{ dollars}} = (\text{DOL}_{\$ \text{ dollars}}) \times (\text{DFL}_{\text{EBIT of } \$S})$$

$$\text{DTL}_{\$ \text{ dollars}} = (1.2) \times (1.0^*) = 1.20$$

$$\begin{aligned} \text{DTL}_{\$ \text{ dollars}} &= \frac{\$500,000 + \$100,000}{\$500,000 - 0 - [0 / (1 - .3)]} \\ \text{of sales} &= 1.20 \end{aligned}$$

*Note: No financial leverage.



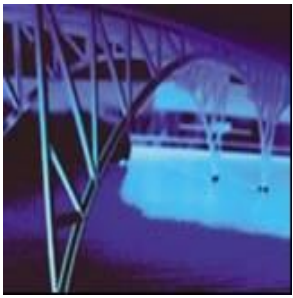
Computing the DTL for Debt Financing

$$\text{DTL}_{\$ \text{ dollars}} = (\text{DOL}_{\$ \text{ dollars}}) \times (\text{DFL}_{\text{EBIT of } \$})$$

$$\text{DTL}_{\$ \text{ dollars}} = (1.2) \times (1.25^*) = 1.50$$

$$\begin{aligned} \text{DTL}_{\$ \text{ dollars}} &= \frac{\$500,000 + \$100,000}{\{ \$500,000 - \$100,000 - [0 / (1 - .3)] \}} \\ &= 1.50 \end{aligned}$$

*Note: Calculated on Slide 16-44.

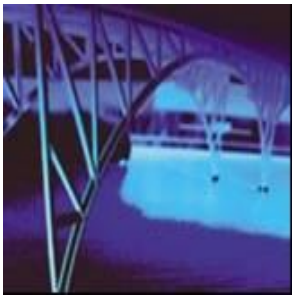


Risk versus Return

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

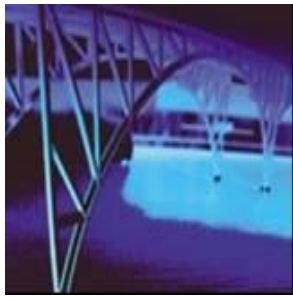
Greater expected return (higher EPS) comes at the expense of greater potential risk (higher DTL)!



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**

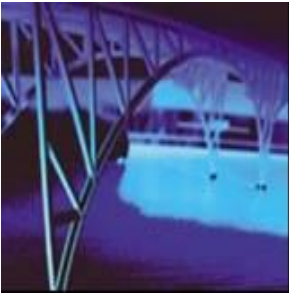
Coverage Ratios

**Indicates a firm's
ability to cover
interest charges.**

Interest Coverage

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

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



Coverage Ratios

**Income Statement
Ratios**

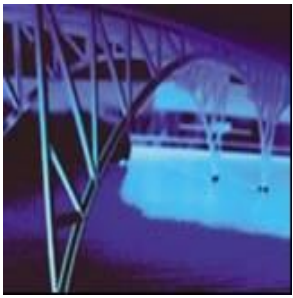
Coverage Ratios

**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.**

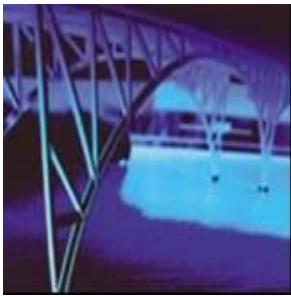


Coverage Example

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

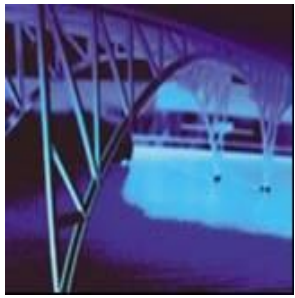


Coverage Example

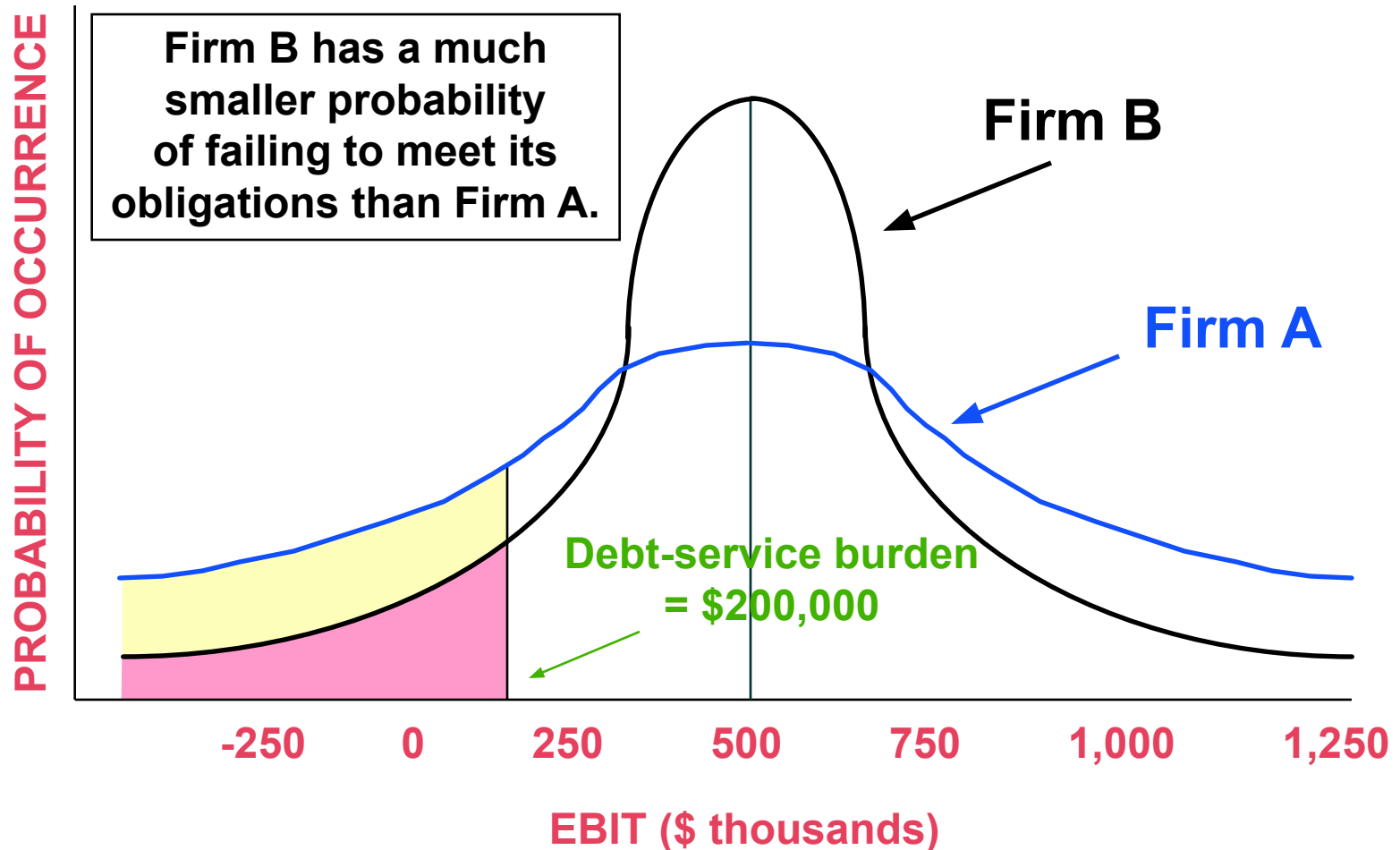
Compare the interest coverage and debt burden ratios for equity and debt financing.

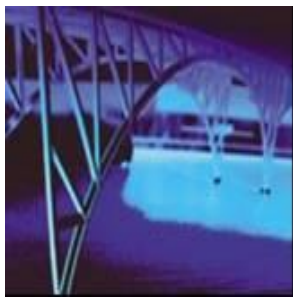
Financing	Interest Coverage	Debt-service Coverage
Equity	Infinite	Infinite
Debt	5.00	2.50

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



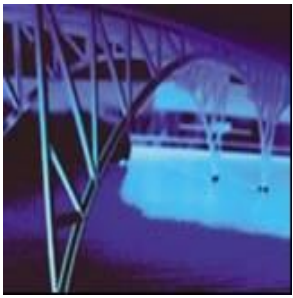
Coverage Example





Summary of the Coverage Ratio Discussion

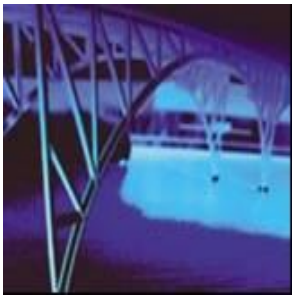
- **The debt-service coverage ratio accounts for required annual principal payments.**
- **A single ratio value cannot be interpreted identically for all firms as some firms have greater debt capacity.**
- **Annual financial lease payments should be added to both the numerator and denominator of the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

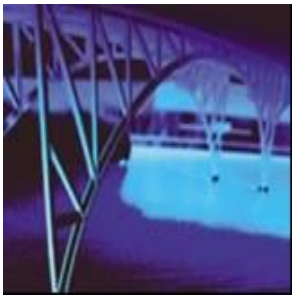
- Often, firms are compared to peer institutions in the same industry.
- Large deviations from norms must be justified.
- For example, an industry's median debt-to-net-worth ratio might be used as a benchmark for financial leverage comparisons.



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).**