Weighted Average Cost of Capital (WACC)

Given the following information, what is the WACC for the following firm?

Debt: 9,000 bonds with a par value of $1,000 and a quoted price of 112.65. The bonds have coupon rate of 7 percent and 28 years to maturity.

Preferred Stock: 20,000 shares of 3.5 percent preferred selling at a price of $65.

Common Stock: 400,000 shares of stock selling at a market price of $48. The beta of the stock is 0.9. The stock just paid a dividend of $2.10 per share and the dividends are expected to grow at 6 percent per year indefinitely.

Market: The expected return on the market is 14 percent and the risk-free rate is 3.5 percent. The company is in the 38 percent tax bracket.

Debt
Bond 1:

Enter	56		–$1,126.50	$35	$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		3.028%			

$3.028 \times 2 = 6.06\%$
$k_{d1} = 6.06\ (1 - .38) = 3.75\%$

Preferred Stock

$$k_p = \frac{D_1}{P_0} = \frac{3.50}{65} = .0538 \text{ or } 5.38\ \%$$

Equity

$k_e = R_f + \beta[E(R_M) - R_f] = 3.5 + 0.9[14 - 3.5] = 12.95\%$

$$k_e = \frac{D_1}{P_0} + g = \frac{2.10(1.06)}{48} + .06 = .1064 \text{ or } 10.64\%$$

$$k_e = \frac{12.95\% + 10.64\%}{2} = 11.80\%$$

Debt1:	9,000 × $1,126.50 =	$10,138,500	$w_d = .331$
PS:	20,000 × $65 =	$1,300,000	$w_p = .042$
E:	400,000 × $48 =	$19,200,000	$w_e = .627$
		$30,638,500	

WACC = (.331 × 3.75) + (.042 × 5.38) + (.627 × 11.80) = 8.86%

Estimating Beta

$$\beta_i = \frac{Cov\ (R_i, R_M)}{Var\ (R_M)} = \frac{\sigma_{i,M}}{\sigma_M^2}$$

Problems

1. Betas may vary over time.
2. The sample size may be inadequate.
3. Betas are influenced by changing financial leverage and business risk.

Solutions

– Problems 1 and 2 can be moderated by more sophisticated statistical techniques.
– Problem 3 can be lessened by adjusting for changes in business and financial risk.
– Look at average beta estimates of comparable firms in the industry.

Most analysts argue that betas are generally stable for firms remaining in the same industry. That's not to say that a firm's beta can't change.

– Changes in product line
– Changes in technology
– Deregulation
– Changes in financial leverage

It is frequently argued that one can better estimate a firm's beta by involving the whole industry.

If you believe that the operations of the firm are similar to the operations of the rest of the industry, you should use the industry beta.

If you believe that the operations of the firm are fundamentally different from the operations of the rest of the industry, you should use the firm's beta.

Don't forget about adjustments for financial leverage.

Determinants of Beta

Business Risk
– Cyclicality of Revenues
– Operating Leverage

Financial Risk
– Financial Leverage

Highly cyclical stocks have higher betas.

– Empirical evidence suggests that retailers and automotive firms fluctuate with the business cycle.
– Transportation firms and utilities are less dependent upon the business cycle.

Note that cyclicality is not the same as variability—stocks with high standard deviations need not have high betas.

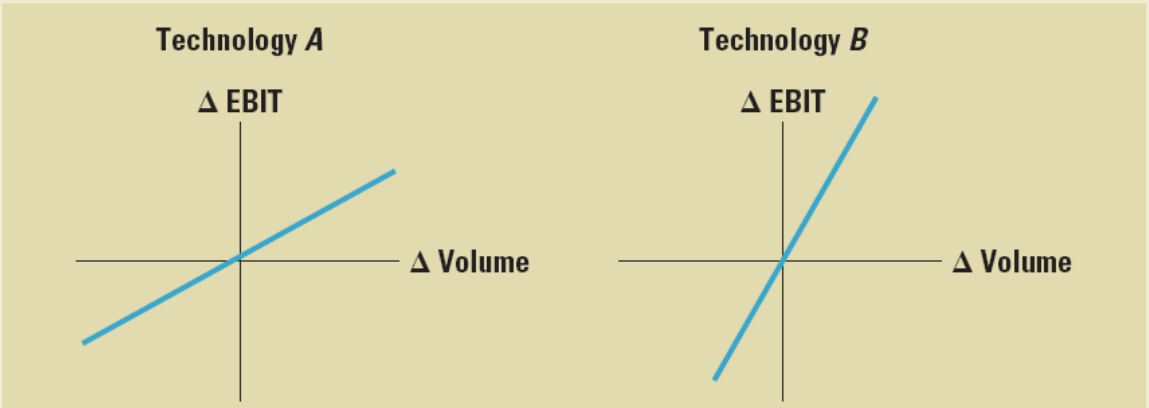
– Movie studios have revenues that are variable, depending upon whether they produce "hits" or "flops," but their revenues may not especially dependent upon the business cycle.

Operating leverage

– The degree of operating leverage measures how sensitive a firm (or project) is to its fixed costs.
– Operating leverage increases as fixed costs rise and variable costs fall.
– Operating leverage magnifies the effect of cyclicality on beta.
– The degree of operating leverage is given by:

$$DOL = \frac{\Delta \text{EBIT}}{EBIT} \times \frac{\text{Sales}}{\Delta \text{ Sales}}$$

Illustration of the Effect of a Change in Volume on the Change in Earnings before Interest and Taxes (EBIT)



Technology *B* has lower variable costs than *A*, implying a higher contribution margin. The profits of the firm are more responsive to changes in volume under technology *B* than under *A*.

Financial Leverage and Beta

– Operating leverage refers to the sensitivity to the firm's fixed costs of *production*.
– Financial leverage is the sensitivity to a firm's fixed costs of *financing*.
– The relationship between the betas of the firm's debt, equity, and assets is given by:

$$\beta_{Asset} = \frac{\text{Debt}}{\text{Debt} + \text{Equity}} \times \beta_{Debt} + \frac{\text{Equity}}{\text{Debt} + \text{Equity}} \times \beta_{Equity}$$

Financial leverage always increases the equity beta relative to the asset beta.

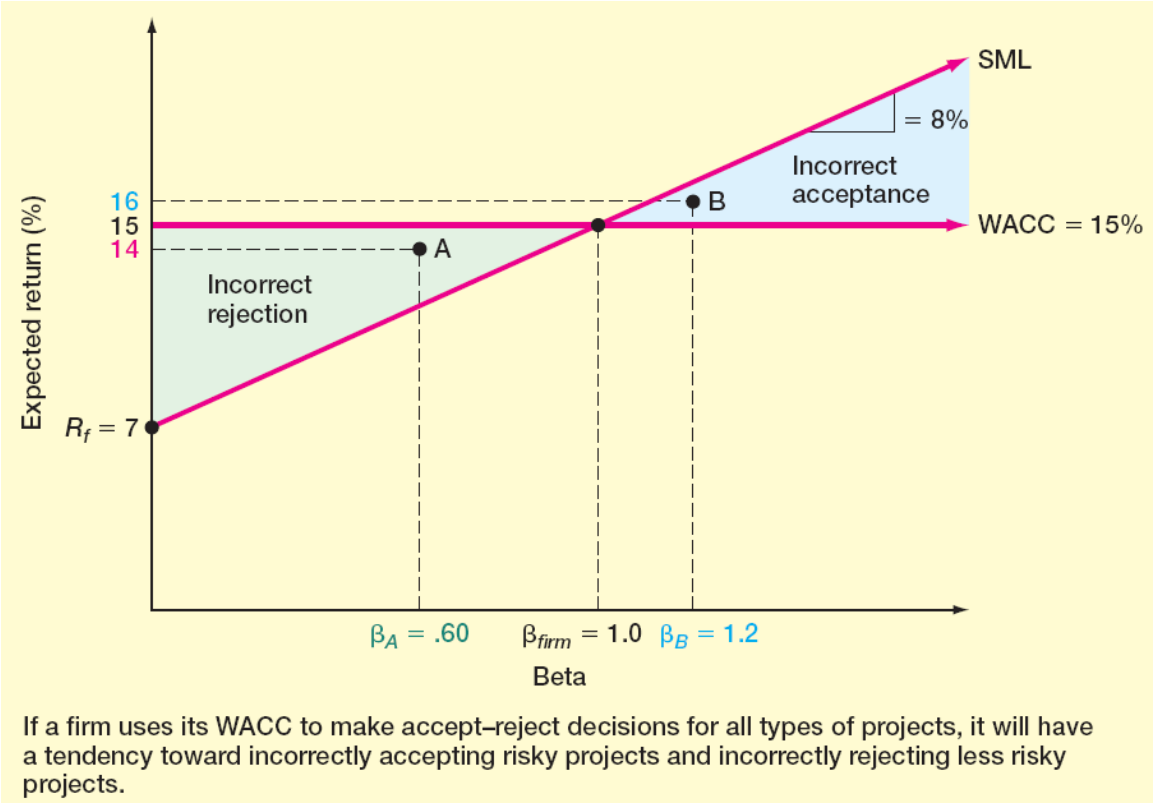
Consider Grand Sport, Inc., which is currently all-equity financed and has a beta of 0.90. The firm has decided to lever up to a capital structure of 1 part debt to 1 part equity. Since the firm will remain in the same industry, its asset beta should remain 0.90. However, assuming a zero beta for its debt, its equity beta would become twice as large:

$$\beta_{Asset} = 0.90 = \frac{1}{1+1} \times \beta_{Equity}$$

$\beta_{Equity} = 2 \times 0.90 = 1.80$

Adjusting the cost of capital

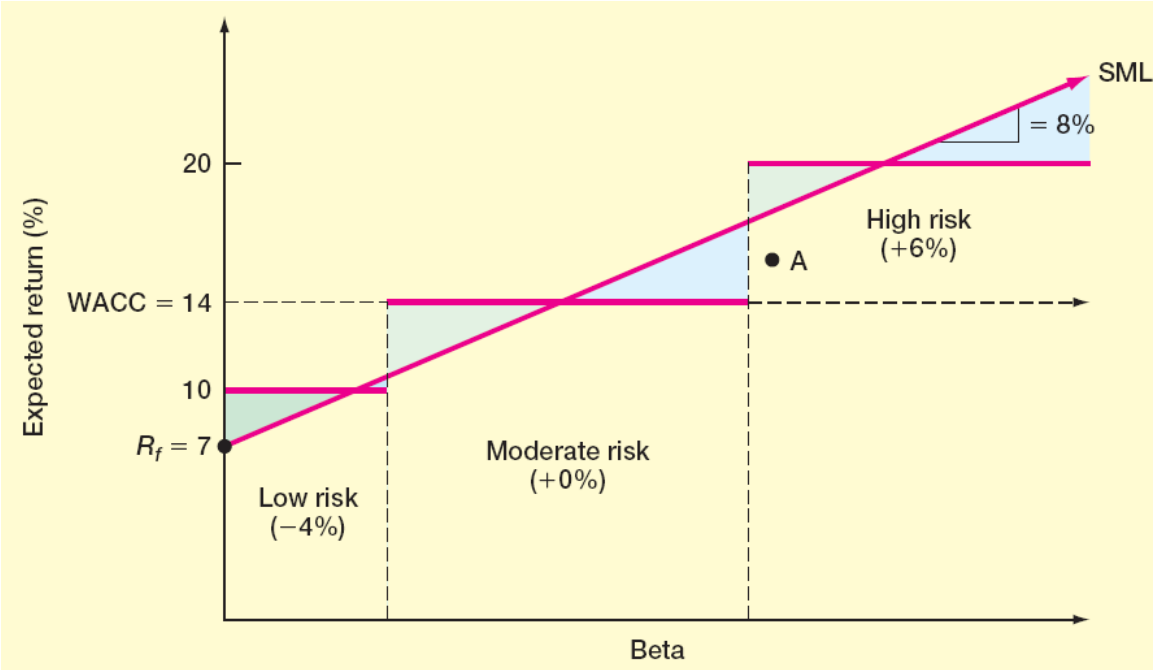
Why?



If a firm uses its WACC to make accept–reject decisions for all types of projects, it will have a tendency toward incorrectly accepting risky projects and incorrectly rejecting less risky projects.

Beta: Should you use an industry beta?

Subjective Approach



With the subjective approach, the firm places projects into one of several risk classes. The discount rate used to value the project is then determined by adding (for high risk) or subtracting (for low risk) an adjustment factor to or from the firm's WACC. This results in fewer incorrect decisions than if the firm simply used the WACC to make the decisions.

Pure Play Approach

Questions?

What companies? More than one company?

How to weight?

1) Sales
2) Profits
3) Assets
4) Market value

More on CAPM

$$E(R) = R_f + \beta[E(R_M) - R_f]$$

What is R_f?

Market return → Arithmetic or Geometric return?

Arithmetic return = $\Sigma X / n$

Geometric return = $[(1 + R_1)\ [(1 + R_2)\ldots..\ [(1 + R_n)]^{1/n} - 1$

	A	B	C
	10%	7%	–10%
	10%	14%	28%
	10%	9%	19%
	10%	8%	2%
	10%	12%	11%
Arithmetic	10.00%	10.00%	10.00%
σ	0.00%	2.92%	14.75%
Geometric	10.00%	9.98%	9.19%
σ^2	0%	0.00085	0.02175

If there is a lognormal distribution:

$R_G = R_A - 1/2\sigma^2$

For Stock C:

$= .10 - ½(.02175) = .0891$