# Module 10

## ESTIMATING THE COST OF CAPITAL

# Background

- Cash is not free—it comes at a price
  - The price is the cost to the firm of using investors' money
    - Cost of capital
      - Return expected by the investors for the capital they supply

# Background

- Objective of Module
  - Shows how to estimate the cost of capital to be used in discounted cash flows models
- Investors do not normally invest directly in projects
  - They invest in the firms that undertake projects
    - Challenge is to identify firms, called **proxies** or **pure plays**
      - Exhibit the same risk characteristics as the project under consideration.
    - After a proxy has been identified need to estimate the return expected by the investors who hold the securities the proxy has issued
      - Assume that there are only two types of securities
        - Straight bonds
        - Common shares

# Background

- Return expected from the assets managed by a firm must be the total of the returns expected by bondholders and shareholders, weighted by their respective contribution to the financing of these assets
  - **Weighted average cost of capital** or **WACC**
- Sunlight Manufacturing Company's (SMC) desk lamp project
  - Used to illustrate the case when a project's cost of capital is the same as the firm's cost of capital
- Buddy's Restaurant Project
  - Illustrates how to estimate the project's cost of capital when the project has a risk that differs from the risk of the firm

# Background

- After reading this Module, students should understand:
  - How to estimate the cost of debt
  - How to estimate the cost of equity capital
  - How to combine the cost of different sources of financing to obtain a project's weighted average cost of capital
  - The difference between the cost of capital for a firm and the cost of capital for a project

# Identifying Proxy Or Pure-Play Firms

- When the project's risk profile is similar to the firm's risk profile, the proxy is the firm itself
- Classification systems used to select pure-plays are far from perfect
  - Often trade-offs need to be made between possible large measurement errors of a small sample of closely comparable companies and a larger sample of firms that are only loosely comparable to the project

# Estimating The Cost Of Debt

- If a firm takes out a loan, the firm's cost of debt is the rate charged by the bank
- If we know a sufficient amount of information the valuation formula can be solved for the investors' required rate of return

$$\text{Bond Price} = \frac{\text{Coupon PMT}_t}{(1+k_D)^t} + \frac{\text{Coupon PMT}_{t+1}}{(1+k_D)^{t+1}} + \frac{\text{Coupon PMT}_{t+2}}{(1+k_D)^{t+2}} + \cdots + \frac{\text{Coupon PMT}_T}{(1+k_D)^T}$$

**This rate is the estimated cost of debt for the issuer.**

# Estimating The Cost Of Debt

- If the firm has no bonds outstanding, its cost of debt can be estimated by adding a **credit risk spread** to the yield on *government* securities of the same maturity
- Since interest expenses are tax deductible, the **aftertax cost of debt** is the relevant cost of debt
  - After-tax cost of debt = Pre-tax cost of debt × (1 – marginal corporate tax rate)
    - However, the after tax cost of debt is a valid estimator only if
      - The firm is profitable enough, or
      - A **carryback** or **carry forward** rule applies to interest expenses

# Estimating The Cost Of Equity: The Dividend Discount Model

- According to the dividend discount model, the price of a share should be equal to
  - Present value of the stream of future cash dividends discounted at the firm's cost of equity
- The dividend discount model cannot be use to solve for the cost of equity
  - Unless simplifying assumptions regarding the dividend growth rate are made

# Estimating The Cost Of Equity: Dividends Grow At A Constant Rate

- Firm's cost of equity is the sum of its expected dividend yield and the expected dividend growth rate
  - If we assume the dividend that a firm is expected to pay next year will grow at a constant rate forever

$$k_E = \frac{DIV_1}{P_0} + g$$

# Estimating The Cost Of Equity: How Reliable Is The Dividend Discount Model?

- For the vast majority of companies, the simplistic assumptions underlying the reduced version of the dividend discount model are unacceptable
  - Thus, an alternative valuation approach is needed
    - The **capital asset pricing model** or **CAPM**

# Estimating The Cost Of Equity: The Capital Asset Pricing Model

- The greater the risk, the higher the expected return
  - What is the nature of the risk?
  - How is it measured?
  - How does it determine the return expected by shareholders from their investment?

# EXHIBIT 10.1: Risk and Return for the Sun Cream and Umbrella Investments.

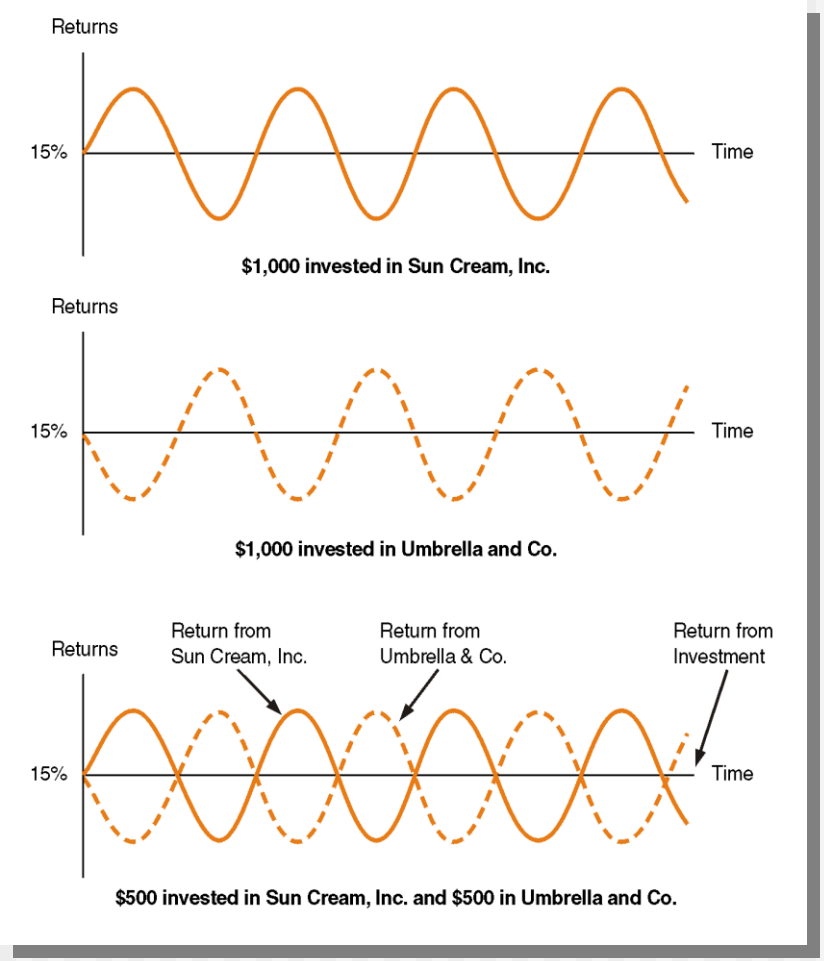



**Exhibit 10.1** shows returns of two hypothetical and perfectly negatively correlated stocks having the same average return.

Investing equal amounts in both stocks results in the same average return, which is now *riskless*. In other words, **diversification helps reduce risk.**

# Diversification Reduces Risk

- A major implication of holding a diversified portfolio of securities is that the risk of a single stock can be divided into two components
  - **Unsystematic** or **diversifiable risk**
    - Can be eliminated through portfolio diversification
      - **Includes** company-specific events such as the discovery of a new product (positive effect) or a labor strike (negative effect)
  - **Systematic** or **nondiversifiable risk**
    - Cannot be eliminated through portfolio diversification
      - Events that affect the entire economy instead of only one firm, such as
        - Changes in the economy's growth rate, inflation rate and interest rates

# Diversification Reduces Risk

- Financial markets will not reward unsystematic risk
  - Because it can be eliminated through diversification at practically no cost
    - Thus, the only risk that matters in determining the required return on a financial asset is the asset's systematic risk
      - In other words**, the required rate of return on a financial asset depends only on its systematic risk**

# Measuring Systematic Risk With the Beta Coefficient

- A firm's systematic risk is usually measured *relative* to the **market portfolio**
  - Portfolio that contains all the assets in the world
- Systematic risk of a stock is estimated by
  - Measuring the sensitivity of its returns to changes in a broad stock market index
    - Such as the S&P 500 index
  - This sensitivity is called the stock's **beta coefficient**

# EXHIBIT 10.2: SMC Stock Monthly Returns versus the S&P 500 Monthly Returns.

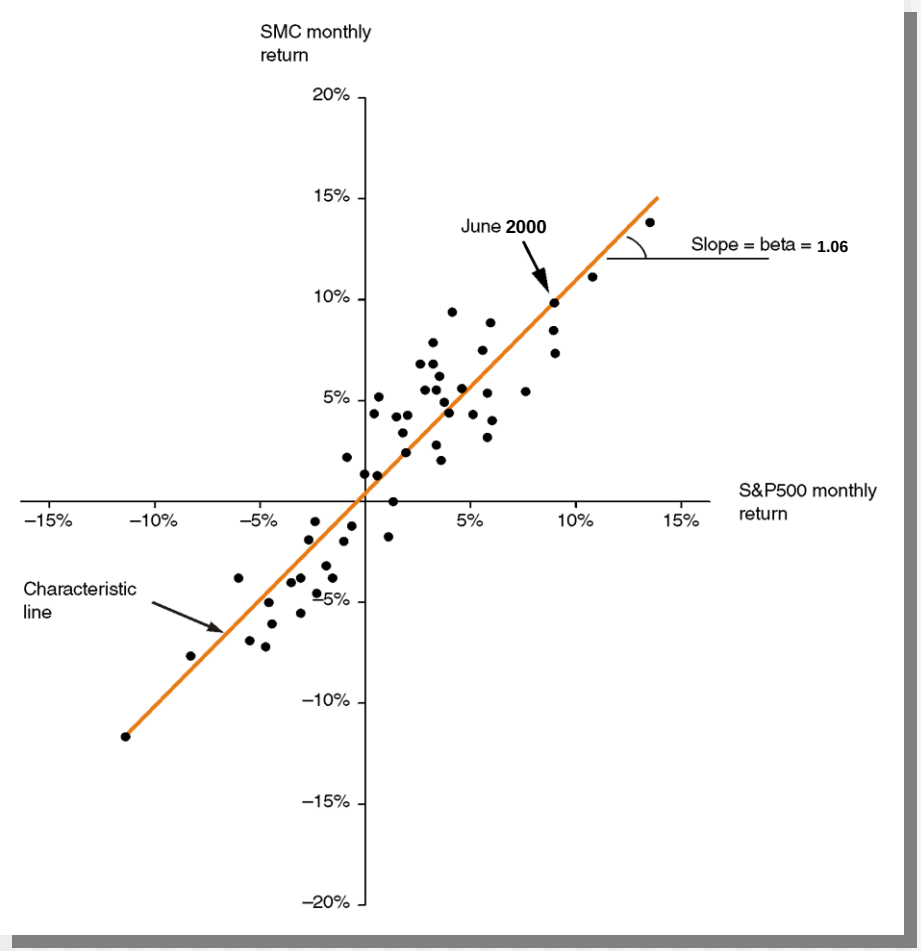



**Exhibit 10.2** shows how the beta of SMC's stock (1.05) was estimated by plotting SMC's stock returns against the returns of the S&P 500 during the last five years. The slope of the **characteristic line** measures beta.

# EXHIBIT 10.3:
# Beta Coefficients of a Sample of U.S. Stocks.

| | | | |
|---|---|---|---|
| Texas Instrument | 1.60 | AT&T | 1.00 |
| Black & Decker Corp. | 1.50 | Bayer AG | 1.00 |
| Maytag Corporation | 1.50 | McDonald's | 0.90 |
| Navistar International | 1.45 | Dow Chemical | 0.90 |
| Intel Corporation | 1.35 | Shell Transport & Trading | 0.90 |
| World Com, Inc. | 1.35 | Smithkline Beecham | 0.80 |
| US Airways | 1.35 | Boston Beer | 0.80 |
| United Air Lines | 1.20 | Walgreen | 0.80 |
| IBM | 1.20 | TotalFinaElf | 0.80 |
| Hewlett Packard Company | 1.20 | Coca-Cola Co. | 0.80 |
| LVMH Moet Hennessy LV | 1.20 | New York Times, Co. | 0.80 |
| U.S. Home & Gardens, Inc. | 1.20 | Merck & Co., Inc. | 0.70 |
| Bank of America Corp. | 1.15 | Chevron Corporation | 0.70 |
| American Express Corp. | 1.15 | Diageo PLC | 0.70 |
| General Motors | 1.10 | American Water Works Co. | 0.40 |
| Air Gas | 1.05 | Consolidated Edison Co. | 0.40 |

# The Impact Of Financial Leverage On A Stock's Beta

- A firm's risk depends on
  - Risk of the cash flows generated by the firm's assets (business risk)
    - Firm's asset (or unlevered) beta captures its business risk

$$\beta_{\text{asset}} = \frac{\beta_{\text{equity}}}{\left[1+(1 - \text{tax rate})\frac{\text{Debt}}{\text{Equity}}\right]}$$

  - The risk resulting from the use of debt (financial risk)
    - Thus, firm's beta coefficient is affected by both
      - Firm's equity beta (or levered beta) captures both business and financial risk

$$\beta_{\text{equity}} = \beta_{\text{asset}}\left[1+(1 - \text{tax rate})\frac{\text{Debt}}{\text{Equity}}\right]$$

# EXHIBIT 10.4:
# Average Annual Rate of Return on Common Stocks, Corporate Bonds, U.S. Government Bonds, and U.S. Treasury Bills, 1926 to 1995.

| TYPE OF INVESTMENT | AVERAGE ANNUAL RETURN | AVERAGE RISK PREMIUM DIFFERENCE BETWEEN RETURN OF INVESTMENT AND RETURN OF | |
|---|---|---|---|
| | | TREASURY BILLS | GOVERNMENT BONDS |
| Common stocks (S&P 500) | 11.3% | 7.5% | 6.2% |
| Corporate bonds | 5.6% | 1.8% | 0.5% |
| Government bonds | 5.1% | 1.3% | — |
| Treasury bills | 3.8% | — | — |

Source: Ibbotson Associates, Inc., 2000 Yearbook.

**Exhibit 10.4** reports average annual returns for four classes of U.S. securities: common stocks, corporate bonds, government bonds, and Treasury bills. They have different returns because they have different risks.

# The Capital Asset Pricing Model (CAPM)

- Treasury bills are the safest investment available
  - Usually used as a proxy for the **risk-free rate**
- **Risk premium** of a security
  - Difference between the *expected* return on a security and the risk-free rate
- **Market risk premium**
  - Risk premium of the market portfolio

# The Capital Asset Pricing Model (CAPM)

- Since beta measures a security's risk relative to the market portfolio
  - A security's risk premium equals the market risk premium × the security's beta.
- The CAPM states that the expected return on any security is the risk-free rate, plus the market risk premium multiplied by the security's beta

$$R_i = R_F + \left(R_M - R_F\right) \times \beta_i$$

# EXHIBIT 10.5:
# The Capital Asset Pricing Model.

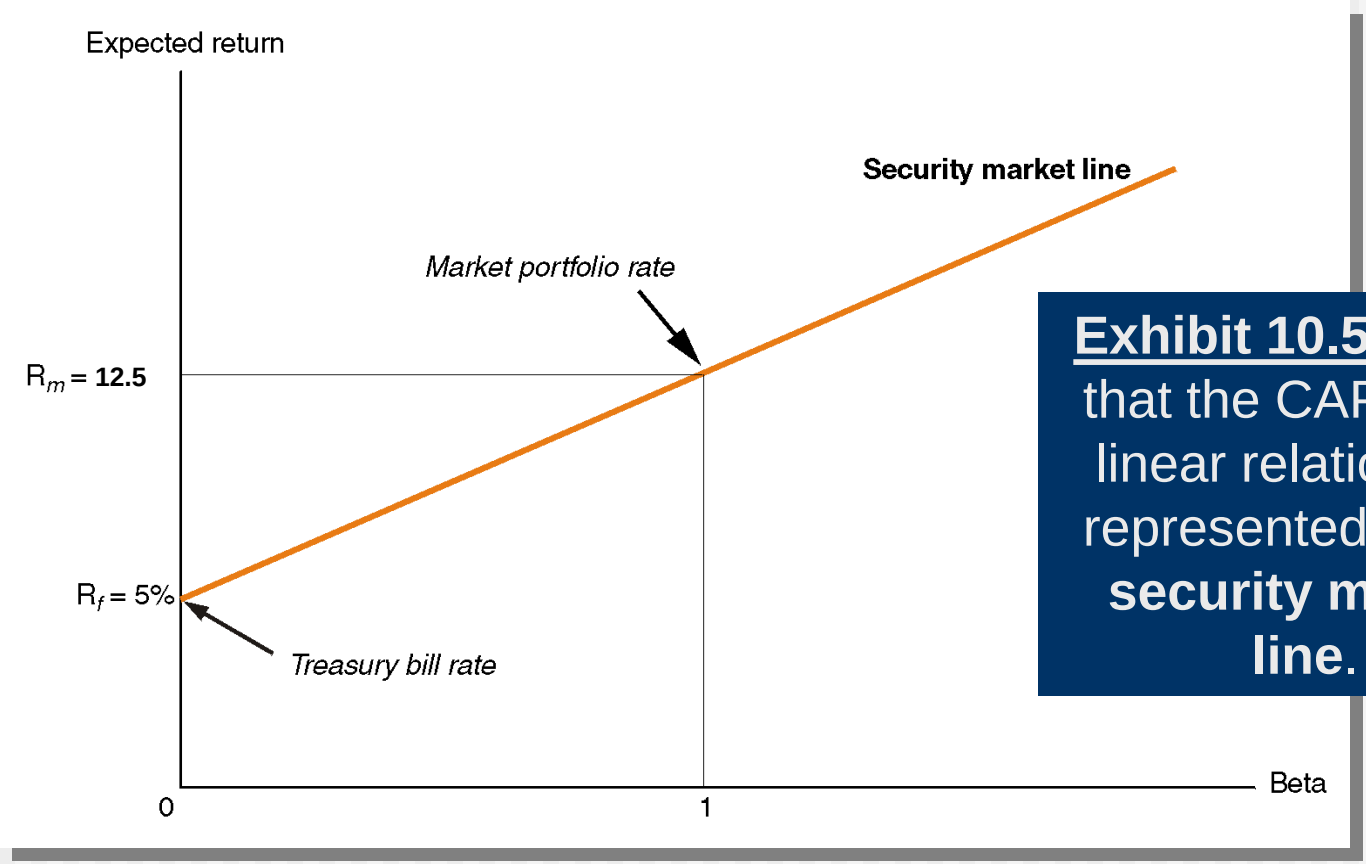



**Exhibit 10.5** shows that the CAPM is a linear relationship represented by the **security market line**.

# Using The CAPM To Estimate SMC's Cost Of Equity

- Treasury bill rate is replaced by the rate on government bonds
  - Since it is difficult to estimate future Treasury bill rates
- SMC's cost of equity of 12.37% is estimated from the market risk premium of 6.2 percent and SMC's beta of 1.06
  - $K_{E,\ SMC} = 5.8\% + (6.2\%) \times 1.06 = 12.37\%$

# EXHIBIT 10.6:
# Estimation of the Cost of Equity for a Sample of Companies Listed on the London Stock Exchange, Using the CAPM.

**Government Bond Rate = 5.1% and Market Risk Premium = 6.2% (November 2000).**

| Company | Industry | Beta Coefficient | Estimate Cost of Equity with the CAPM |
|---|---|---|---|
| British Airways | Airline | 1.30 | 5.1% x (6.2% x 1.3) = 13.2% |
| Smithkline Beecham | Pharmaceuticals | 1.15 | 5.1% x (6.2% x 1.15) = 12.2% |
| British Telecom | Telecommunications | 0.94 | 5.1% x (6.2% x 0.94) = 11.0% |
| Inchcape | Distribution | 0.60 | 5.1% x (6.2% x 0.60) = 8.8% |
| Marks & Spencer | Retailing | 0.44 | 5.1% x (6.2% x 0.44) = 7.8% |

Source: *Datastream*

# Estimating The Cost Of Capital Of A Firm

- **What is the firm's cost of capital?**
  - *Minimum* rate of return the project must generate
    - In order to meet the return expectations of its suppliers of capital
      - Assuming that a project has the *same risk* as the firm that would undertake it
  - A firm's cost of capital is its **weighted average cost of capital**, or WACC
    - Assuming that the firm is financed by debt and equity, its WACC is equal to
      - Weighted average of the cost of these two means of financing
        - Weights equal to the relative proportions of debt and equity used in financing the firm's assets

$$\text{WACC} = k_D(1 - T_C)\frac{D}{E + D} + k_E\frac{E}{E + D}$$

# The Firm's Target Capital Structure

- **Target capital structure**
  - The debt-equity mix to use in the estimation of a firm's WACC
    - Note: the firm's current capital structure may not be its target capital structure
- Proportions of debt and equity financing in the WACC should be estimated using the *market values* of debt and equity
  - Not their *accounting* or *book* values
- The market value of equity (debt) of a publicly traded company is simply its share (bond) price multiplied by the number of shares (bonds) outstanding

# The Firm's Target Capital Structure

- When market values are not available most analysts use book values
  - Debt and equity ratio based on book values can be quite different
    - Thus, when market data are not available
      - Market value ratios of proxy firms should be used rather than the firm's own book value based ratios

# EXHIBIT 10.7:
# SMC's Managerial Balance Sheet.

| INVESTED CAPITAL OR NET ASSETS | | CAPITAL EMPLOYED | |
|---|---|---|---|
| Cash | $10,000,000 | Long-term debt [1] | $90,000,000 |
| | | 90,000 bonds | |
| | | at par value $1,000 | |
| Working capital | $50,000,000 | | |
| requirement | | | |
| | | Owners' equity | $90,000,000 |
| | | 2,500,000 shares | $25,000,000 |
| | | at par value $10 | |
| Net fixed assets | $120,000,000 | Retained earnings | $65,000,000 |
| Total | $180,000,000 | Total | $180,000,000 |

[1] SMC has no short-term debt.

# The Firm's Cost Of Debt And Equity

- Cost of debt can be estimated using
  - Bond valuation formula
  - Credit spread approach
  - By asking the bank
    - Relevant cost of debt is the after-tax cost of debt
- Cost of equity can be estimated using the CAPM
  - When there are no available share prices, the average beta of proxy firms is used

# Summary Of The Firm's WACC Calculations

- **Exhibit 10.8** summarizes the four steps necessary to estimate a firm's WACC (SMC values in parentheses):
  - Estimate the relative proportion of debt and equity (40.5 percent debt)
  - Estimate the firm's after tax cost of debt (4.02 percent)
  - Estimate the firm's cost of equity (12.37 percent)
  - Calculate the firm's WACC (9 percent)
- This WACC is the discount rate the firm should use when making investment decisions
  - But only if projects involved have the same risk profile as that of the firm

# EXHIBIT 10.8a:
# The Estimation of a Firm's Weighted Average Cost of Capital (WACC), Including an Application to Sunlight Manufacturing Company (SMC).

| STEPS TO FOLLOW | HOW TO |
|---|---|
| ***Step 1:*** **Estimate the firm's relative proportions of debt (D) and equity (E) financing:** $\frac{D}{E+D}$ **and** $\frac{E}{E+D}$ | • **Use the firm's market values of debt and equity.**<br>• **The market value of debt is computed from data on outstanding bonds using the bond valuation formula (equation 10.1).**<br>• **The market value of equity is the share price times the number of shares outstanding.**<br>• **If the firm's securities are not publicly traded use the market value rations of proxy firms.** |

# EXHIBIT 10.8b:
# The Estimation of a Firm's Weighted Average Cost of Capital (WACC), Including an Application to Sunlight Manufacturing Company (SMC).

| STEPS TO FOLLOW | | HOW TO |
|---|---|---|
| *Step 2:* | Estimate the firm's aftertax cost of debt: $k_D(1 - T_c)$. | • If the firm has outstanding bonds that are publicly traded, use equation 10.1 to estimate $k_D$.<br>• Otherwise, use the credit spread equation (equation 10.2) or ask the bank.<br>• Use the marginal corporate tax rate for $T_c$ . |

# EXHIBIT 10.8c:
# The Estimation of a Firm's Weighted Average Cost of Capital (WACC), Including an Application to Sunlight Manufacturing Company (SMC).

| STEPS TO FOLLOW | | HOW TO |
|---|---|---|
| *Step 3:* | Estimate the firm's cost of equity: $K_E$. | • Use the capital asset pricing model (equation 10.11).<br>• The risk-free rate is the rate on government bonds.<br>• The market risk premium is 6.2% (historical average) . |
| *Step 4:* | Calculate the firm's weighted average cost of capital (WACC). | • Use the beta of the firm's stock. If the firm's shares are not publicly traded, estimate beta from proxies.<br>• $WACC = k_D(1 - T_C)\frac{D}{E + D} + k_E\frac{E}{E + D}$ |

# Estimating The Cost Of Capital Of A Project

- A project's cost of capital is determined by its risk
  - Some projects have risk characteristics *similar* to those of the firms that would undertake them
  - While others have a risk profile *different* from that of the firm
  - The following sections show how to estimate the cost of capital for the two types of projects

# The Project's Risk Is Similar To The Risk Of The Firm

- In this case, the firm itself is the appropriate proxy for the project
  - Project's WACC is simply the firm's WACC

# The Project's Risk Is Different From The Risk Of The Firm

- When a project has risk characteristics different from that of the firm
  - Investors expect a return from the project to at least equal the return they would get from the proxy firms
- First, the cost of capital of the proxy firms should be estimated *assuming that they have no debt financing and pay no tax*
  - These estimates are adjusted to reflect the project's target capital structure and tax rate
    - Procedure is illustrated using the Buddy's restaurants project

# The Project's Risk Is Different From The Risk Of The Firm

- **The project's target capital structure**
  - Assumption:  the proxy firms' capital structure is a good approximation of the financial leverage that investors require for the project
  - Thus, the project's financing ratios are set equal to the average of the proxies' financing ratios

# EXHIBIT 10.9a:
# Proxies for Buddy's Restaurants.

| | EQUITY BETA[1] | DEBT-TO-EQUITY RATIO[1,2] $\frac{D}{E}$ At market value | ASSET BETA[3] |
|---|---|---|---|
| **McDonalds** | **0.83** | **0.16** | **0.74** |
| **Wendy's International** | **0.63** | **0.08** | **0.60** |
| ***Average values*** | ***0.73*** | ***0.12*** | ***0.67*** |

[1] From Yahoo!Finance, November 2000.
[2] D = debt; E = equity.
[3] Calculated according to equation 10.7 with a corporate tax rate of 40 percent.

**Exhibit 10.9** reports the financing ratios for the Buddy's Restaurants proxy firms and their average values.

# EXHIBIT 10.9b:
# Proxies for Buddy's Restaurants.

| | DEBT RATIO[1,2] $\frac{D}{E+D}$ | | EQUITY RATIO[1,2] $\frac{E}{E+D}$ | |
|---|---|---|---|---|
| | At market value | At book value | At market value | At book value |
| **McDonalds** | **0.14** | **0.43** | **0.86** | **0.57** |
| **Wendy's International** | **0.16** | **0.41** | **0.84** | **0.59** |
| ***Average values*** | ***0.15*** | ***0.42*** | ***0.85*** | ***0.58*** |

[1] From Yahoo!Finance, November 2000.
[2] D = debt; E = equity.

# The Project's Risk Is Different From The Risk Of The Firm

- **The project's costs of debt and equity**
  - Both the cost of equity and the cost of debt depend on the firm's debt ratio
    - However, in practice, it is only the cost of equity that is assumed to be significantly affected by changes in financial leverage
      - Adjust for differences in capital structure when using proxies

# Buddy's Restaurants Project

- **Two proxy firms**
  - McDonalds with a rating of Aa2 and a debt rate of 7.74%
  - Wendy's International with a rating of Baa1 and a debt rate of 8.32%
    - Average = 8.03%
      - Aftertax cost of debt
        - 8.03% x (1 – 0.4) = 4.82%

# Buddy's Restaurants Project

- **Estimating the cost of equity for the Buddy's Restaurants Project**
  - If proxies have different capital structures than the project
    - Each of the proxies' equity beta is first "un-levered"
      - Then the *mean* of all the "un-levered" betas is "re-levered" at the *project*'s target capital structure, to obtain the *project*'s equity beta

$$\beta_{\text{equity, Buddy's}} = 0.67 \times \left[1+(1-0.40)\times 0.12\right] = 0.72$$

$$k_{\text{E, Buddy's}} = 5.8\% + 6.2\% \times 0.72 = 10.26\%$$

# Buddy's Restaurants Project

- **Estimating the WACC for the Buddy's Restaurants Project**
  - **Exhibit 10.10** summarize the steps required to estimate the cost of capital when the project's risk is different from the risk of the firm
    - When applied to the Buddy's Restaurants project a WACC of 9.4% is estimated

## EXHIBIT 10.10a:
## The Estimation of a Project's Cost of Capital when the Project Risk Is Different from the Risk of the Firm, Including an Application to the Buddy's Restaurants Project.

| STEPS TO FOLLOW | HOW TO |
|---|---|
| *Step 1:* Estimate the project's relative proportions of debt (D) and equity (E) financing: $\frac{D}{E+D}$ and $\frac{E}{E+D}$ using proxy firms. | • Use the proxies' market values of debt and equity.<br>• The market value of debt is computed from data on outstanding bonds using the bond valuation formula (equation 10.1).<br>• The market value of equity is the share price times the number of shares outstanding.<br>• Take the mean of the proxies' ratios. |

## EXHIBIT 10.10b:
## The Estimation of a Project's Cost of Capital when the Project Risk Is Different from the Risk of the Firm, Including an Application to the Buddy's Restaurants Project.

| STEPS TO FOLLOW | | HOW TO |
|---|---|---|
| *Step 2:* | Estimate the project's aftertax cost of debt: $k_D(1 - T_c)$. | • If the proxies have outstanding bonds that are publicly traded, use equation 10.1 to estimate their cost of debt $k_D$.<br>• Otherwise, use the credit spread equation (equation 10.2) or ask the bank.<br>• Take the mean of the proxies' cost of debt.<br>• Use the marginal corporate tax rate for $T_c$ . |

## EXHIBIT 10.10c:
## The Estimation of a Project's Cost of Capital when the Project Risk Is Different from the Risk of the Firm, Including an Application to the Buddy's Restaurants Project.

| STEPS TO FOLLOW | HOW TO |
|---|---|
| *Step 3:* Estimate the project's cost of equity: $k_E$. | • Use the capital asset pricing model (equation 10.11).<br>• The risk-free rate is the rate on government bonds.<br>• The market risk premium is 6.2% (historical average).<br>• Un-lever the proxies' equity betas using equation 10.7 to get their unlevered asset betas.<br>• Re-lever the mean of the proxies' asset betas at the project's target debt-to-equity ratio using equation 10.6 to get the project's equity beta.<br>• Apply the CAPM to the project's equity beta to get the project's cost of equity $k_E$. |

## EXHIBIT 10.10d:
## The Estimation of a Project's Cost of Capital when the Project Risk Is Different from the Risk of the Firm, Including an Application to the Buddy's Restaurants Project.

| STEPS TO FOLLOW | HOW TO |
|---|---|
| *Step 4:* Calculate the project's weighted average cost of capital (WACC). | • $WACC = k_D(1 - T_C)\frac{D}{E + D} + k_E\frac{E}{E + D}$ |

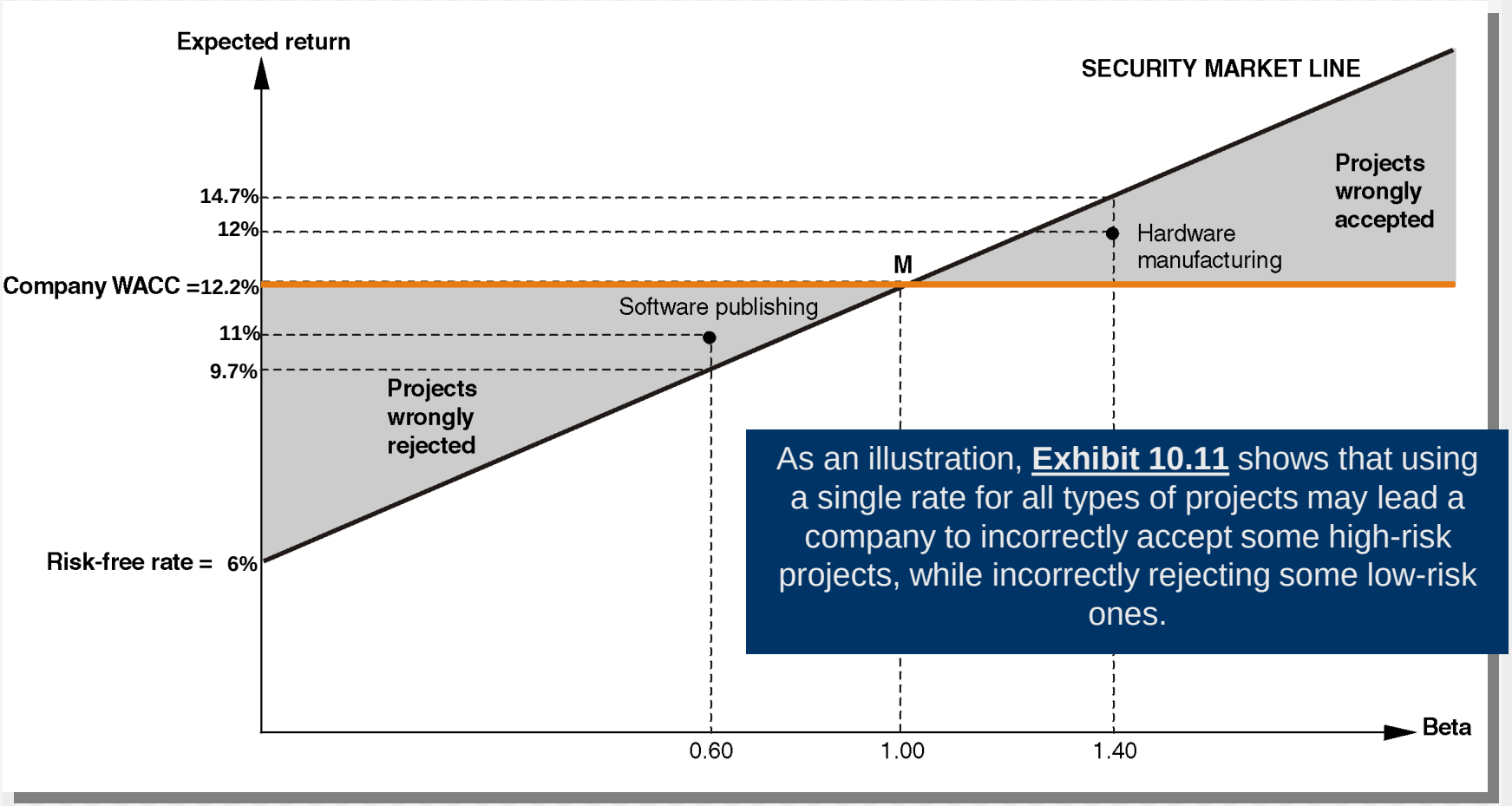
# Three Mistakes To Avoid When Estimating A Project's Cost Of Capital

- **Mistake #1**
  - "The project is going to be financed entirely with debt, so its relevant cost of capital is the interest rate on the debt."
  - Or, "The project is going to be financed entirely with equity, so its relevant cost of capital is the cost of equity."
    - Wrong because
      - If the project and the firm have the same risk
        - Return expected by investors from the project should be estimated using financing ratios that reflect the firm's target capital structure
      - If the risk of the project is different from that of the firm
        - Then use the financing ratios of the proxy firms

# Three Mistakes To Avoid When Estimating A Project's Cost Of Capital

- **Mistake #2**
  - "Although the project does not have the same risk as the firm, its relevant cost of capital should be equal to the firm's WACC."
    - Wrong because it is not the firm's cost of capital that determines a project's cost of capital
      - It is the other way around

# EXHIBIT 10.11:
# Company-Wide Cost of Capital and Projects' Expected Rates of Return.




As an illustration, **Exhibit 10.11** shows that using a single rate for all types of projects may lead a company to incorrectly accept some high-risk projects, while incorrectly rejecting some low-risk ones.

# Three Mistakes To Avoid When Estimating A Project's Cost Of Capital

- **Mistake #3**
  - "When a project's risk is different from the risk of the firm, the project's cost of capital should be lowered to account for the risk reduction that diversification brings to the firm."
    - Wrong because investors can themselves achieve the same risk diversification at practically no cost–without the help of the project's managers
- **Avoiding mistakes**
  - Mistakes made when estimating a project's cost of capital can lead to a distorted allocation of capital among projects
    - Can eventually lead to value destruction
- Our advice: When in doubt, remember that a project's cost of capital is determined by financial markets, not by managers