WACC and Financial Leverage

Company and Project Costs of Capital

The **company cost of capital** is defined as the expected return on a portfolio of all the company's outstanding debt and equity securities.

→ the oppportunity cost of capital for investment in all of the firm's assets

→ the appropriate discount rate for the firm's average-risk projects

The company cost of capital is not the correct discount rate if the new projects are more or less risky than the firm's existing business. Each project should in principle be evaluated at its **own** opportunity cost of capital.

The opportunity cost of capital depeds on **the use to which that capital is put**.

Debt and the Company Cost of Capital

Company cost of capital: The expected return on a portfolio of all the company's outstanding debt and equity securities.

→ blend of the **cost of debt** (the interest rate) and the **cost of equity** (the expected rate of return demanded by investors in the firm's common stock)

Asset value	100	Debt	$D = 30$ at 7.5%
		Equity	$E = 70$ at 15%
Asset value	100	Firm value	$V = 100$

The value of debt and equity add up to overall firm value (D + E = V) and firm value V equals asset value.

*All **market values** in figures, not book (accounting) values which is often much smaller than the former, so market debt ratio D/V is often much lower than the one computed from book value.*

$$opportunity\ cost\ of\ debt/equity \neq\ company\ cost\ of\ capital = opportunity\ cost\ of\ investing\ in\ the\ firm's\ assets$$

- the cost of debt < the company cost of capital
- the cost of equity > the company cost of capital
- the cost of debt < the cost of equity in one firm

Weighted-average cost of capital or **WACC**: the blended measure of the company cost of capital

- **Not including tax:**

$$company\ cost\ of\ capital = r_D \times \frac{D}{V} + r_E \times \frac{E}{V}$$

r_D: the cost of debt

r_E: the cost of equity

- **Tax deducted:**

$$after\_tax\ WACC = (1 - T_c) \times r_D \times \frac{D}{V} + r_E \times \frac{E}{V}$$

What is needed before calculating after-tax WACC?

- D/V and E/V in market value
- Cost of debt (YTM)
- Cost of Equity (CAPM)
  - Risk-free rate
  - Beta of company assets
  - Market risk premium

Measuring the Cost of Equity

CAPM:

$$expected\ stock\ return = r_f + \beta(r_m - r_f)$$

Estimating Beta

The estimation errors of betas tend to cancel out when estimating betas of **portfolios**, so **industry betas** are often adopted.

The Expected Return on Union Pacific Corporation's Common Stock

Risk-free interest rate:

- Using a long-term risk-free rate in the CAPM formula

  → The market risk premium must be restated as the average difference between market returns and returns on long-term Treasuries
- Retaining the usual definition of the market risk premuim as the difference between market returns and returns on short-term Treasury bill rates

Union Pacific’s After-Tax Weighted-Average Cost of Capital

Warning:

It **doesn't work** to substitute cheap debt for expensive equity to reduce the average cost of capital. As the debt ratio $\frac{D}{V}$ increases, the cost of remaining equity also increases, offsetting the appearant advantage of more cheap debt.

Unoin Pacific's Asset Beta

Asset beta is the direct measure of the average risk of the company's assets.

$$asset\ beta = \beta_A = \beta_D \times \frac{D}{V} + \beta_E \times \frac{E}{V}$$

The Effect of Financial Leverage in a Competitive Tax-Free Economy

The firm’s mix of debt and equity financing is called its **capital structure**.

→ Capital structure is not just “debt versus equity.” There are many different flavors of debt, at least two flavors of equity (common and preferred), plus hybrids such as convertible bonds.

A firm that finances an investment partly or wholly with debt is said to deploy **financial leverage**.

Financial managers' ambition: to find the combination that maximizes the market value of the firm

Levered equity: Stockholders face the benefits and costs of **financial leverage,** or **gearing**.

→ The firm issues both debt and equity securities.

In general, any increase or decrease in V (firm value) caused by a shift in capital structure accrues to the firm’s stockholders. We conclude that a policy that maximizes the market value of the firm is also best for the firm’s stockholders.

Shifts in capital structure sometimes force important decisions about payout policy.

Enter Modigliani and Miller

In a perfect market, **any combination of securities is as good as another**. The value of the firm is **unaffected** by its choice of capital structure.

A perfect capital market:

- There are sufficient stocks and investors
- Individuals have the same borrowing rate as that of firms
- There is no transaction cost
- There is no income taxes
- There is no agency problem between shareholders and managers
- There is no cost of financial distress

Corporate value is independent of debt ratio.

Two firms that generate the same stream of operating income (making the same amount of profits) and differ only in their capital structure (levered or unlevered) have **the same value**.

As long as investors can borrow or lend on their own account **on the same terms** as the firm, they can **"undo" the effect of any changes** in the firm's capital structure.

No transaction cost so investors can just leverage or de-leverage to construct the investment portfolio that best fits their preference.

Proposition 1: The market value of any firm is independent of its capital structure.

The Law of Conservation of Value

Principle of value additivity: Suppose there two streams of cash flow, A and B, then the present value of A+B is equal to the present value of A plus the present value of B.

$$PV(A+B) = PV(A) + PV(B)$$

→ Reversely, the value of parts sliced from a cash flow will always sum back to the value of the unsliced stream.

→ **the law of conservation of value**

Proposition1: Firm value is determined on the left-hand side of the balance sheet by real assets -- not by the proportions of debt and equity securities issued to buy the assets.

Application of the law of conservation of value:

- Equity: The choices among common stocks, preferred stocks and their combinations have no effect on the firm's overall value.
- Debt: The choices among long-term/short-term, secured/unsecured, senior/subordinated, and convertible/nonconvertible debt have no effect on the firm's overall value.
- Asset: Combining and splitting assets will not affect values or investors choices.

Capital structure is irrelevant **even when debt is risky**.

If company borrows money, it doesn't guarantee repayment: It repays the debt in full only of its asset are worth more than the debt obligation.

→ The shareholders in the company therefore have limited liability.

An Example of Proposition 1

Some conclusions:

- Leverage can encourage the variability of ROE (expected earnings/return per share) -- it changes more sharply within a larger range when the operating income changes.
- Shareholders can exactly replicate the leverage as the firm does by borrowing from the bank at the same interest rate.

Financial Risk and Expected Returns

Leverage increases the expected stream of earnings per share but not the share price, because the change in the expected earnings stream is exactly offset by a change in the rate at which the earnings are discounted.

$$Expected\ return\ on\ assets = r_A = \frac{expected\ operating\ income}{market\ value\ of\ all\ securities}$$

In perfect capital markets, the company's borrowing decision **does not affect**:

- the firm's operating income
- the total market value of its securities
- the expected return of the firm's assets r_A

$$Expected\ return\ on\ assets =$$
$$(proportion\ in\ debt \times expected\ return\ on\ debt) + (proportion\ in\ equity \times expected\ return\ on\ equity)$$
$$r_A = (\frac{D}{D+E} \times r_D) + (\frac{E}{D+E} \times r_E)$$

r_A: the company cost of capital / the weighted-average cost of capital (WACC)

$$Expected\ return\ on\ equity =$$
$$expected\ return\ on\ assets + (expected\ return\ on\ assets - expected\ return\ on\ debt) \times debt\_equity\ ratio$$
$$r_E = r_A + (r_A - r_D) \times \frac{D}{E}$$

Proposition 2

The security market is fully competitive, so investors expect a return from the company determined by asset beta, which is cost of capital.

Proposition 2: The expected rate of return on the common stock of a levered firm increases in proportion to the debt-equity ratio (D/E), expressed in market values; the rate of increase depends on the spread between r_A, the expected rate of return on a portfolio of all the firm's securities, and r_D, the expected return on the debt.

r_E = r_A if the firm has no debt.

When the firm in unlevered, equity investors demand a return of r_A. When the firm is levered, they require **a premium of** $(r_A - r_D) \times \frac{D}{E}$ to compensate for the extra risk.

Summary for the two propositions:

- **Proposition 1:** Financial leverage has no effect on shareholders' wealth.
- **Proposition 2:** The rate fo return that shareholders can expect to receive on their shares increases as the firm's debt-equity ratio increases.

→ Any increase in expected return is **offset by an increase in financial risk** and therefore in **shareholders' required rate of return**.

How Changing Capital Structure Affects Beta

Debtholders usually bear much less risk than stockholders. Debt betas of large firms are typically in the range of 0 to 0.2.

For a portfolio of all the firm's securities:

$$\beta_A = \beta_{portfolio} = \beta_D \times \frac{D}{V} + \beta_E \times \frac{E}{V}$$

Identifying the new beta of equity after refinancing:

- β_A: unchanged
- Check whether β_D has changed
- Check how $\frac{D}{V}$ and $\frac{E}{V}$ have changed

→ Recalulate β_E

The Weighted-Average Cost of Capital

FIGURE 17.2

MM's proposition 2. The expected return on equity r_E increases linearly with the debt–equity ratio so long as debt is risk-free. But if leverage increases the risk of the debt, debtholders demand a higher return on the debt. This causes the rate of increase in r_E to slow down.

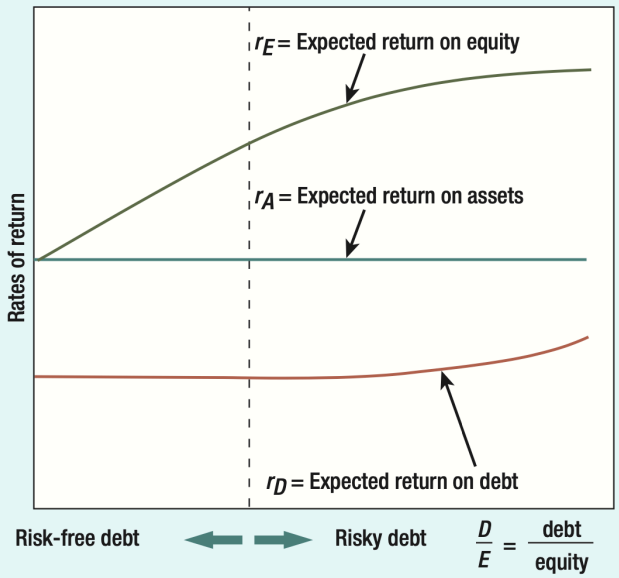


Figure 17.2 sums up the implications of MM's propositions for the costs of debt and equity and the weighted-average cost of capital. The figure assumes that the firm's bonds are essentially risk-free at low debt levels. Thus r_D is independent of D/E, and r_E increases linearly as D/E increases. As the firm borrows more, the risk of default increases and the firm is required to pay higher rates of interest. Proposition 2 predicts that when this occurs the rate of increase in r_E slows down. This is also shown in Figure 17.2. The more debt the firm has, the less sensitive r_E is to further borrowing.

A Final Word on the After-Tax Weighted-Average Cost of Capital

When companies discount an average-risk project, they use **the after-tax cost of debt** to compute the after-tax weighted-average cost of capital or WACC.

$$after\_tax\ WACC = (1 - T_c) \times r_D \times \frac{D}{V} + r_E \times \frac{E}{V}$$

MM's proposition 2 states that **in the absence of taxes** the company cost of capital **stays the same** regardless of the amount of leverage. But if companies **receive a tax shield** on their interest payments, then **the after-tax WACC declines as debt increases**.

In a world with taxes, after-tax WACC is **lower** than the before-tax one.

Appendix: COC, WACC, discount rate, and NPV

Firm's **cost of capital** is the rate of return **required** by its investors (creditors and shareholders as a whole) based on asset beta.

Company's required return is based on the **average beta** of the assets.

The average beta of the assets is based on the percentage of funds in each asset.

WACC: Weighted Average Cost of Capital

The required returns by creditors and shareholders are their opportunity cost of capital (the firm's cost of debt capital and cost of equity capital), respectively.

The WACC (weighted average cost of capital) of creditors and shareholders is the firm's COC.

WACC and NPV

- WACC is the required return (discount rate) by investors.
- If a firm generates an expected ROA larger than WACC (the discount rate), it creates value.

How to select a project?

Step 1:

- Separate financing from investment, assuming the company or project is 100% financed with equity
- Expected return of project **>** discount rate r (cost of equity) ?

→ *YES: project has positive NPV: a feasible business model*

→ *NO: give up the project*

Step 2:

- Consider financing from raising capital other than equity
- Not enough equity capital from shareholders, or looking for leverage?

→ *YES: resort to debt*

- Unable to get enough capital or cost of debt too high?

→ *YES: give up the project*

- Shareholder has positive NPV after paying creditors?

→ *YES: go with the project*

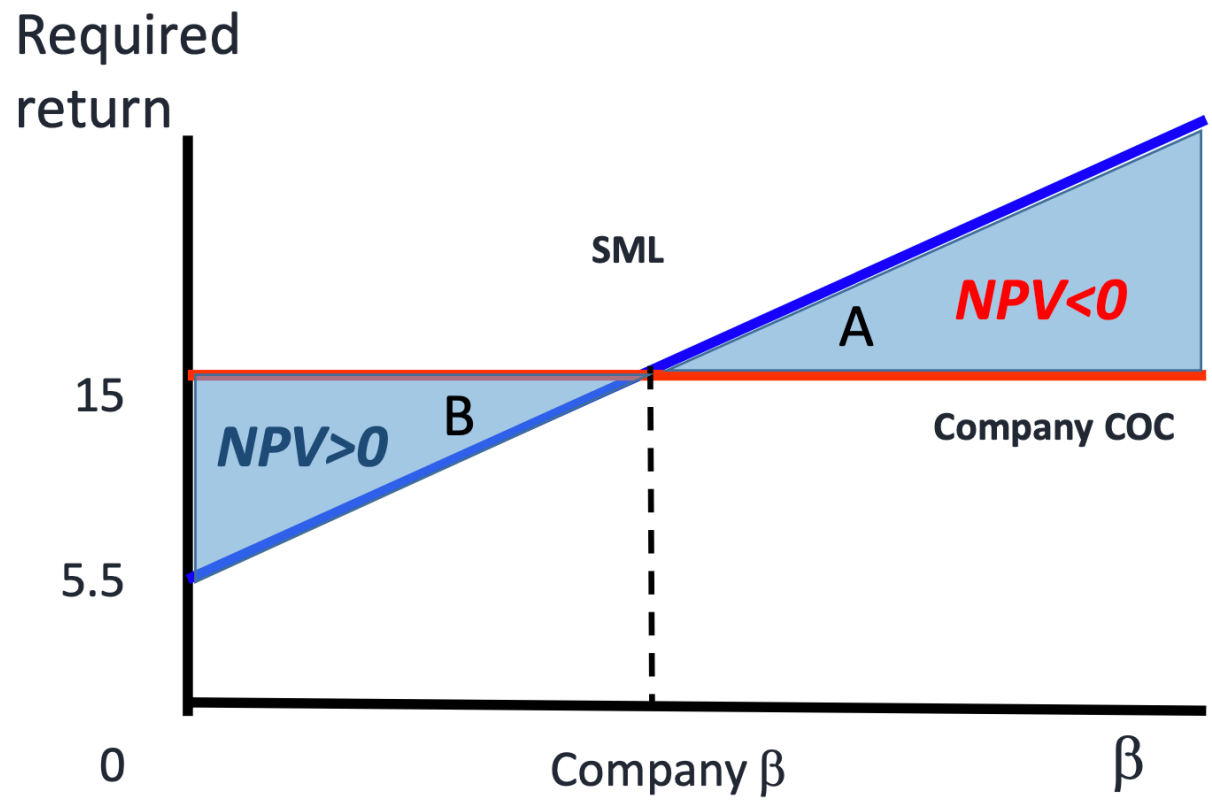
Apply COC correctly

Systematic risks of the projects in the firm differ, so the cost of capital for projects is **different** form the firm COC.

→ *Firm COC is the weighted-average of project COC.*

DO NOT apply firm's COC on a specific project!

A company's COC can be compared to the CAPM required return.



If company COC is applied to all projects, projects in area A will be accepted (since their required return is higher than COC), projects in area B will be rejected (since their required return is lower than COC). But projects in area B provide a higher rate of return than what they should do, and should be accepted. Projects in area A provide a lower rate of return than what they should do, and should be rejected.

Most projects, especially those in the main business of the firm, are **of the same risk of the firm**, so we **use COC of firm as project COC**.

How to get COC for projects?

1. Use rules of thumb

For projects that are riskier or less risky than the firm, we can add or subtract some points on or from the firm COC.

2. Find a comparative in the stock market

Find one listed company that is in the same business as that of the project, take the company asset beta as the project asset beta, and find project COC with CAPM.

Summary

Chapter 9

Chapter shows you how to apply basic principles valuing risky assets when valuing capital investment projects.

Suppose the project has the same market risk as the company's existing assets. In this case, the project cash flows can be discounted at the *company cost of capital.* The company cost of capital is the rate of return that investors require on a portfolio of all of the company's outstanding debt and equity. It is usually calculated as an **after-tax weighted-average cost of capital (after-tax WACC)**, that is, as the weighted average of the after-tax cost of debt and the cost of equity. The weights are the relative market values of debt and equity. The cost of debt is calculated after tax because **interest is a tax-deductible expense**.

The hardest part of calculating the after-tax WACC is estimation of the cost of equity. Most large, public corporations use the capital asset pricing model (CAPM) to do this. They generally estimate the firm's equity beta from past rates of return for the firm's common stock and for the market, and they check their estimate against the average beta of similar firms.

The after-tax WACC is the correct discount rate for projects that have the same market risk as the company's existing business. Many firms, however, use the after-tax WACC as the discount rate for all projects. This is a dangerous procedure. If the procedure is followed strictly, **the firm will accept too many high-risk projects and reject too many low-risk projects**. It is *project* risk that counts: the true cost of capital depends on the use to which the capital is put.

Managers, therefore, need to understand why a particular project may have above- or below-average risk. You can often identify the characteristics of a high- or low-beta project even when the beta cannot be estimated directly. For example, you can figure out how much the project's cash flows are affected by the performance of the entire economy. Cyclical projects are generally high-beta projects. You can also look at operating leverage. Fixed production costs increase beta.

Don't be fooled by diversifiable risk. **Diversifiable risks do not affect asset betas or the cost of capital**, but the possibility of bad outcomes should be incorporated in the cash-flow forecasts. Also be careful not to offset worries about a project's future performance by adding a fudge factor to the discount rate. Fudge factors don't work, and they may seriously undervalue long-lived projects.

Chapter 17

Think of the financial manager as taking all of the firm's real assets and selling them to investors as a package of securities. Some financial managers choose the simplest package possible: all-equity financing. Some end up issuing dozens of debt and equity securities. The problem is to **find the particular combination that maximizes the market value of the firm**.

Modigliani and Miller's (MM's) famous proposition 1 states that no combination is better than any other—that the firm's overall market value (the value of all its securities) is independent of capital structure. Firms that borrow do offer investors a more complex menu of securities, but investors yawn in response. The menu is redundant. Any shift in capital structure can be duplicated or "undone" by investors. Why should they pay extra for borrowing indirectly (by holding shares in a levered firm) when they can borrow just as easily and cheaply on their own accounts?

MM agree that borrowing raises the expected rate of return on shareholders' investments. But it also increases the risk of the firm's shares. MM show that **the higher risk exactly offsets the increase in expected return**, leaving stockholders no better or worse off.

Proposition 1 is an extremely general result. It applies not just to the debt–equity trade-off but to **any** choice of financing instruments. For example, MM would say that the choice between long-term and short-term debt has no effect on firm value.

The formal proofs of proposition 1 all depend on **the assumption of perfect capital markets**.

If MM are right, the overall cost of capital—the expected rate of return on a portfolio of all the firm's outstanding securities—is the same regardless of the mix of securities issued to finance the firm. **The overall cost of capital is usually called the company cost of capital or the weighted-average cost of capital (WACC).** MM say that **WACC doesn't depend on capital structure**. But MM assume away lots of complications. The first complication is taxes. When we recognize that debt interest is tax-deductible, and compute WACC with the after-tax interest rate, **WACC declines as the debt ratio increases**. There is more—lots more—on taxes and other complications in the next two chapters.

MM's theory boils down to saying, "There is no magic in financial leverage." Danger lurks where naïve financial managers try to add value simply by "levering up." MM did not say that borrowing is a bad thing, but they insisted that financial risk offsets the higher average returns from financial leverage. Do not ignore financial risk.