



CHAPTER 14

Capital Structure in a Perfect Market

Chapter Synopsis

14.1 Equity Versus Debt Financing

A firm's **capital structure** refers to the debt, equity, and other securities used to finance its fixed assets. Equity and debt are the securities most commonly used. When equity is used without debt, the firm is said to be **unlevered**. Otherwise, the firm is **levered** and the amount of debt determines the firm's degree of **leverage**. Equity in a firm that also has debt outstanding is called **levered equity**.

The optimal capital structure is the one that maximizes the value of the firm. In an influential 1958 paper, Franco Modigliani and Merton Miller argued that, with perfect capital markets, the total value of a firm does not depend on its capital structure.

14.2 Modigliani-Miller I: Leverage, Arbitrage, and Firm Value

Modigliani and Miller (MM) showed that their capital structure propositions below hold in a **perfect capital market**, which is a market with the following set of conditions:

1. Investors and firms can trade the same set of securities at competitive market prices equal to the present value of their future cash flows.
2. There are no taxes, transaction costs, or issuance costs associated with security trading.
3. A firm's financing decisions do not change the cash flows generated by its investments nor do they reveal new information about them.

Under these conditions, MM demonstrated the following result regarding capital structure in determining firm value referred to as:

MM Proposition I

In a perfect capital market, the total value of a firm is equal to the market value of the total cash flows generated by its assets and is not affected by its choice of capital structure.

MM proved their result by arguing that, in perfect capital markets, the total cash flow paid out to all of a firm's security holders is equal to the total cash flow generated by the firm's assets. Therefore, by the Law of One Price, the firm's securities and its assets must have the same total market value. Thus, as long as the firm's choice of securities does not change the cash flows generated by its assets, this decision will not change the total value of the firm or the amount of capital it can raise.

Even if investors prefer an alternative capital structure to the one chosen by the firm, MM demonstrated that the firm's capital structure is still irrelevant because investors can borrow or lend on their own and achieve the same result. For example, an investor who would like more leverage can add leverage to his or her own portfolio. When investors use leverage in their own portfolios to adjust the leverage choice made by the firm, we say that they are using **homemade leverage**. As long as investors can borrow or lend at the same interest rate as the firm, homemade leverage is a perfect substitute for the use of leverage by the firm.

A hypothetical **market value balance sheet** lists all assets and liabilities of the firm at their market values instead of their historical costs. The market value balance sheet captures the idea that value is created by a firm's choice of assets and investments. By choosing positive-NPV projects that are worth more than their initial investment, the firm can enhance its value. Holding the cash flows generated by the firm's assets fixed, the choice of capital structure does not change the value of the firm. Instead, it merely divides the value of the firm into different securities.

14.3 Modigliani-Miller II: Leverage, Risk, and the Cost of Capital

By holding a portfolio of the firm's equity and debt, you can replicate the cash flows from holding unlevered equity. Because the return of a portfolio is equal to the weighted average of the returns of the securities in it, this equality implies the following relation between the returns of levered equity (R_E), debt (R_D), and unlevered equity (R_U):

$$R_U = \frac{E}{E + D}R_E + \frac{D}{E + D}R_D \Rightarrow R_E = R_U + \frac{D}{E}(R_U - R_D).$$

This equation shows that the levered equity return equals the unlevered return, plus an additional effect due to leverage. This leads to higher returns on levered equity when the firm performs well, but causes a lower return when the firm does poorly. The amount of additional risk depends on the amount of leverage, measured by the firm's market value debt-equity ratio, D/E . Because this relation holds for realized returns, it holds for the expected returns as well (denoted by r in place of R). This observation leads to:

MM Proposition II

The cost of levered equity is equal to the cost of unlevered equity plus a premium that is proportional to the market value debt-equity ratio as provided in the equation above.

The cost of capital of the firm's assets should equal the return that is available on other investments with similar risk. The weighted average of the firm's equity and debt cost of capital is the firm's **weighted average cost of capital (WACC)**, which equals:

$$r_{\text{wacc}} \equiv \frac{E}{E + D} r_E + \frac{D}{E + D} r_D .$$

With perfect capital markets, a firm's WACC is independent of its capital structure and is equal to its unlevered equity cost of capital.

The effect of leverage on the risk of a firm's securities can also be expressed in terms of beta. Because unlevered equity is equivalent to a portfolio of debt and levered equity, and because the beta of a portfolio is the weighted average of the betas of the securities within it, the following relation exists:

$$\beta_U = \frac{E}{E + D} \beta_E + \frac{D}{E + D} \beta_D .$$

The **unlevered beta** (β_U) measures the market risk of the firm without leverage, which is equivalent to the beta of the firm's assets. The unlevered beta therefore measures the market risk of the firm's business activities, ignoring any additional risk due to leverage.

When a firm changes its capital structure without changing its investments, its unlevered beta will remain unaltered. However, its equity beta will change to reflect the effect of the capital structure change on its risk, and the **levered beta** (β_E) can be calculated as:

$$\beta_U = \frac{E}{E + D} \beta_E + \frac{D}{E + D} \beta_D \Rightarrow \beta_E = \beta_U + \frac{D}{E} (\beta_U - \beta_D)$$

It is often assumed that the debt beta is zero, so:

$$\beta_E = \beta_U + \frac{D}{E} \beta_U = \beta_U \left(1 + \frac{D}{E} \right)$$

Holding cash has the opposite effect of leverage. Thus, leverage of the firm should be measured in terms of its **net debt** = debt - cash and risk free securities.

14.4 Capital Structure Fallacies

There are at least two incorrect arguments that are sometimes cited in favor of leverage.

- One fallacy is that when leverage increases a firm's expected earnings per share (EPS), it will cause the firm's stock price to increase. However, with perfect capital markets, an increase in EPS is accompanied by an increase in risk the shareholders are exposed to and MM proposition I holds.
- Another fallacy is that issuing equity will dilute existing shareholders' ownership, so debt financing should be used instead. In this context, earnings **dilution** refers to the idea that if the firm issues new shares, the cash flows generated by the firm must be divided among a larger number of shares, thereby reducing the value of each individual share. The problem with this line of reasoning is that it ignores the fact that the cash raised by issuing new shares will increase the firm's assets. As long as the capital raised is invested in zero-NPV investments, the value per share will not change.

14.5 MM: Beyond the Propositions

The MM propositions have greatly influenced finance research and practice. Perhaps more important than the specific propositions themselves is the approach that MM took to derive them. Proposition I was one of the first arguments to show that the Law of One Price could have strong implications for security prices and firm values in a competitive market; it marks the beginning of the modern theory of corporate finance.

Their results can be interpreted as the **conservation of value principle** for financial markets: With perfect capital markets, financial transactions neither add nor destroy value, but instead represent a repackaging of risk (and therefore return). It implies that any financial transaction that appears to be a good deal in terms of adding value either is likely too good to be true or is exploiting some type of market imperfection.

Selected Concepts and Key Terms

Capital Structure

The relative proportions of debt, equity, and other securities used to finance a firm's fixed assets.

Conservation of Value Principle

With perfect capital markets, financial transactions neither add nor destroy value, but instead represent a repackaging of risk (and therefore return). It implies that any financial transaction that appears to be a good deal in terms of adding value either is likely too good to be true or is exploiting some type of market imperfection.

Dilution

The idea that if the firm issues new shares, the cash flows generated by the firm must be divided among a larger number of shares, thereby reducing the value of each individual share.

Homemade Leverage

When investors use leverage in their own portfolios to adjust the leverage choice made by the firm.

Market Value Balance Sheet

A form of balance sheet that lists all assets and liabilities of the firm at their market values instead of their historical costs as on a standard balance sheet. Unlike a traditional balance sheet, all assets and liabilities of the firm are included—even intangible assets such as reputation, brand name, or human capital.

Leveraged Recapitalization

When a firm issues debt and uses the proceeds to repurchase a significant percentage of its outstanding shares.

Levered Equity

Equity in a firm that also has debt outstanding.

Net Debt

Since holding cash is essentially the opposite of having debt, the amount of debt a firm effectively has is equal to its debt minus its cash and risk-free securities, which can be referred to as its net debt.

Unlevered Beta

The market risk of a firm's business activities, ignoring any additional risk due to leverage, which is equivalent to the beta of the firm's assets.

Unlevered Equity

Equity in a firm that has no debt outstanding.

Weighted Average Cost of Capital

The weighted average of the firm's equity and debt cost of capital, which should equal the return that is available on other investments with similar risk.

Concept Check Questions and Answers

14.1.1. Why are the value and cash flows of levered equity less than if the firm had issued unlevered equity?

The cash flows and value of levered equity are smaller than those of unlevered equity because debt payments must be made before any payments are made to equity holders.

14.1.2. How does the risk and cost of capital of levered equity compare to that of unlevered equity? Which is the superior capital structure choice in a perfect capital market?

The risk and the cost of capital of levered equity are higher than those of unlevered equity even when there is no risk that the firm will default. In a perfect market, equity financing and debt financing are equal because the total value of the firm is not affected by its choice of capital structure.

14.2.1. Why are investors indifferent to the firm's capital structure choice?

As long as the firm's choice of securities does not change the cash flows generated by its assets, this decision will not change the total value of the firm or the amount of capital it can raise. Further, investors can create whatever capital structure they want by using homemade leverage to adjust the firm's capital structure.

14.2.2. What is a market value balance sheet?

A market value balance sheet is similar to an accounting balance sheet, with two important distinctions. First, all assets and liabilities of the firm are included—even intangible assets such as reputation, brand name, or human capital that are missing from a standard accounting balance sheet. Second, all values are current market values rather than historical costs.

14.2.3. In a perfect capital market, how will a firm's market capitalization change if it borrows in order to repurchase shares? How will its share price change?

The total value of the equity will decrease by the amount of stock that is repurchased, but the value per share will remain the same.

14.3.1. How do we compute the weighted average cost of capital of a firm?

The weighted average cost of capital is computed by summing the weighted average of the firm's equity and debt cost of capital.

14.3.2. With perfect capital markets, as a firm increases its leverage, how does its debt cost of capital change? Its equity cost of capital? Its weighted average cost of capital?

With perfect capital markets, as a firm increases its leverage, its debt and equity costs of capital both increase, but its weighted average cost of capital remains constant because more weight is put on the lower cost debt.

14.4.1. If a change in leverage raises a firm's earnings per share, should this cause its share price to rise in a perfect market?

No. Even though the firm's earnings per share increase with leverage, due to the additional risk, shareholders will demand a higher return. These effects cancel out, so the price per share is unchanged.

14.4.2. True or false: When a firm issues equity, it increases the supply of its shares in the market, which should cause its share price to fall.

False. As long as the firm sells the new shares of equity at a fair price, there will be no gain or loss to shareholders associated with the equity issue itself. The money taken in by the firm as a result of the share issue exactly offsets the dilution of the shares.

14.5.1. Consider the questions facing Dan Harris, CFO of EBS, at the beginning of this chapter. What answers would you give based on the Modigliani-Miller Propositions? What considerations should the capital structure decision be based on?

Based on the Modigliani-Miller propositions in a perfect market, Dan Harris, CFO of EBS, should answer that the total value of EBS is not affected by its choice of capital structure. In other words, the value of EBS is the same whether \$50 million is raised by selling shares of EBS stock or by borrowing. Capital structure only affects a firm's value because of its impact on some type of market imperfection.

14.5.2. State the conservation of value principle for financial markets.

The conservation of value principle for financial markets states that with perfect capital markets, financial transactions neither add nor destroy value, but instead represent a repackaging of risk and return.

Examples with Step-by-Step Solutions

Solving Problems

Problems using this chapter's ideas may involve using Modigliani and Miller's proposition I (in a perfect capital market, the total value of a firm is equal to the market value of the total cash flows generated by its assets and is not affected by its choice of capital structure) to show the effects of changing a firm's capital structure on the value of the firm and its securities. See example 1 below. Problems may also involve using Modigliani and Miller's proposition II (the cost of capital of levered equity is equal to the cost of capital of unlevered equity plus a premium that is proportional to the market value debt-equity ratio) to show how the equity cost of capital increases with leverage. See example 2 below. Finally, problems may require accounting for the effect of leverage on the risk of a firm's securities in terms of beta. See example 3 below.

Examples

1. You are trying to decide whether your firm should use debt financing under different assumptions regarding the amount of debt in its capital structure. The firm's assets will generate an expected EBIT of \$800,000 per year (beginning one year from today) in perpetuity. The firm will make no new capital or working capital investments and all assets are fully depreciated. The assets have a beta of 1.5, the risk-free rate is 5%, and the market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 10%. You can issue bonds at par paying an annual coupon at a 5% annual rate. The firm has 100,000 shares outstanding. There are no corporate taxes or other market imperfections.

[A] What is the value of the firm with no debt? What is the stock value per share?

[B] What is the value of the firm if it issues \$3 million of debt and uses the proceeds to repurchase 75,000 shares for \$40 ($75,000 \times \$40 = \3 million)? What is the stock value per share? Should the firm issue the debt?

Step 1. Determine the unlevered equity cost of capital.

The equity cost of capital is $E[R_i] = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 5\% + 1.5(10\%) = 20\%$.

Step 2. Determine the free cash flows of the unlevered firm.

Since the firm will make no new investments and has no depreciation, $\text{FCF} = \text{NI}$ each year.

EBIT	\$800,000
- Tax @ 0%	0
<u>Net income</u>	<u>800,000</u>

Step 3. Determine the value of the unlevered firm.

Since the cash flows are a perpetuity, $\text{PV} = \frac{\text{FCF}}{r} = \frac{\$800,000}{0.20} = \$4$ million

Step 4. Determine the value per share.

Value per share = $\frac{V^u}{\text{Shares Outstanding}} = \frac{\$4,000,000}{100,000} = \$40$

Step 5. Determine the value of the levered firm.

By MM proposition I:

$V^L = V^u = \$4$ million

Step 6. Determine the equity value per share.

The total equity value is $V^L - D = \$4,000,000 - \$3,000,000$, so:

Value per share = $\frac{4,000,000 - 3,000,000}{100,000 - 75,000} = \40

Thus, the firm should be indifferent between issuing the debt based on these assumptions.

2. Your firm has no debt financing and a market value of equity of \$60 billion. The stock's beta is 1.2, the risk-free rate is 5%, and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 6%. There are no corporate taxes or other market imperfections.

[A] What is the equity cost of capital based on the CAPM?

[B] What is the firm's weighted average cost of capital (WACC)?

[C] The firm is considering three different recapitalizations by issuing \$10 billion, \$30 billion, or \$50 billion in 6% bonds, and using the proceeds to repurchase equity. Calculate the WACC and equity cost of capital in each of these three new capital structures.

Step 1. The unlevered cost of equity can be found using the CAPM.

$$E[R_i] = R_E = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 0.05 + 1.2(0.06) = 12.2\%$$

Step 2. Since $D = 0$, $r_{\text{WACC}} = r_E$.

$$r_{\text{wacc}} = \frac{E}{E + D}r_E + \frac{D}{E + D}r_D = \left(\frac{60}{60 + 0}\right)0.122 + \left(\frac{0}{60 + 0}\right)r_D = 12.2\%$$

Step 3. Calculate r_{WACC} and r_E for each of the proposed capital structures.

By Miller and Modigliani’s proposition II, the WACC will remain at 12.2%, but the r_E will vary according to the equation:

$$r_{\text{WACC}} = \frac{E}{E + D}r_E + \frac{D}{E + D}r_D \Rightarrow r_E = r_U + \frac{D}{E}(r_U - r_D)$$

By Miller and Modigliani’s proposition I, the value of the firm will remain the same, so the new capital structures will have D/E ratios of 10/50, 30/30, and 50/10. The costs of equity capital under the three capital structures are:

$$r_E^{\$10 \text{ billion}} = 0.122 + \frac{10}{50}(0.122 - 0.06) = 13.4\%$$

$$r_E^{\$30 \text{ billion}} = 0.122 + \frac{30}{30}(0.122 - 0.06) = 18.4\%$$

$$r_E^{\$50 \text{ billion}} = 0.122 + \frac{50}{10}(0.122 - 0.06) = 43.2\%$$

3. Your firm is considering building a casino, and you are trying to determine the cost of capital in the industry. You have collected the following information on firms in the casino industry.

Company	Beta	Stock Price	Number of Shares	Debt
MGM Mirage	1.10	\$72.67	143 million	\$5.6 billion
Mandalay Resort Group	0.95	\$70.43	65 million	\$3.0 billion
Caesars Entertainment	1.20	\$19.88	304 million	\$4.6 billion

The risk-free rate is 5%, and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 6%. There are no corporate taxes or other market imperfections.

- [A] What is the equity cost of capital for an unlevered firm in the industry?
- [B] What is the equity cost of capital for a firm in the industry with a debt-to-equity ratio of 1?

Step 1. Measure the unlevered betas.

The unlevered beta, β_U , measures the market risk of the firm without leverage, which is equivalent to the beta of the firm’s assets. The unlevered beta therefore measures the

market risk of the firm's business activities, ignoring any additional risk due to leverage, and can be estimated using:

$$\beta_U = \frac{E}{E+D}\beta_E + \frac{D}{E+D}\beta_D$$

Assuming that the debt betas are close to zero, leads to:

$$\beta_U \approx \frac{E}{E+D}\beta_E$$

E, the market value of equity, can be calculated as stock price \times number of shares:

Company	Stock Price	Number of Shares	E
MGM Mirage	\$72.67	143 million	\$10.4 billion
Mandalay Resort Group	\$70.43	65 million	\$4.6 billion
Caesars Entertainment	\$19.88	304 million	\$6.0 billion

Now, unlevered betas can be calculated:

$$\beta_U^{\text{MGM}} = \frac{10.4}{10.4 + 5.6}1.10 = 0.72$$

$$\beta_U^{\text{Mandalay}} = \frac{4.6}{4.6 + 3.0}0.95 = 0.58$$

$$\beta_U^{\text{Caesars}} = \frac{6.0}{6.0 + 4.6}1.2 = 0.68$$

Step 3. Calculate the unlevered equity cost of capital based on the average unlevered betas of the comparable firms.

$$\text{The average unlevered beta is } \frac{0.72 + 0.58 + 0.68}{3} = 0.66.$$

The equity cost of capital can be determined from the CAPM:

$$E[R] = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 0.05 + 0.66(0.06) = 9.0\%$$

Step 4. Calculate the levered beta when $D/E = 1.0$.

When a firm changes its capital structure without changing its investments, its unlevered beta will remain unaltered. However, its equity beta will change to reflect the effect of the capital structure change on its risk, and the levered beta can be calculated as:

$$\beta_U = \frac{E}{E+D}\beta_E + \frac{D}{E+D}\beta_D \Rightarrow \beta_E = \beta_U + \frac{D}{E}(\beta_U - \beta_D)$$

Assuming that the debt beta is zero:

$$\beta_E = \left(1 + \frac{D}{E}\right)\beta_U = \left(1 + \frac{1}{1}\right)0.66 = 1.32.$$

Step 5. Calculate the levered equity cost of capital based on the average unlevered beta of the comparable firms levered to reflect a D/E ratio of 1.0.

The equity cost of capital can now be determined from the CAPM:

$$E[R] = r_f + \beta_i^{\text{Mkt}}(E[R_{\text{Mkt}}] - r_f) = 0.05 + 1.32(0.06) = 12.9\%$$

Questions and Problems

- A firm expects unlevered free cash flow of \$10 million each year. Its unlevered cost of capital is 10%. The firm also has outstanding debt of \$35 million, and it expects to maintain this level of debt permanently. There are no corporate taxes or other market imperfections.
 - What is the firm's value without leverage?
 - What is the firm's value with the \$35 million of debt? How much is the equity worth in this case?
- An unlevered firm has 50 million shares outstanding and a stock price of \$20. The firm plans to unexpectedly announce that it will issue \$500 million in 10% coupon rate debt financing and use the proceeds to repurchase shares. The debt level is expected to remain at this level. There are no corporate taxes or other market imperfections.
 - What is the firm's market value before the announcement?
 - What is the market value of the firm after the debt is issued, but before the shares are repurchased?
 - What is the share price just before the share repurchase? How many shares will be repurchased at this price? What is the share price after the share repurchase?
- An unlevered firm has a beta of 0.75. The risk-free rate is 5% and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 6%. There are no corporate taxes or other market imperfections.
 - What is the equity cost of capital for an unlevered firm?
 - What is the equity cost of capital for a firm with a debt-to-equity ratio of 2.0?
- A levered firm has a beta of 1.5. The firm has a stock price of \$50, 10 million shares outstanding, and \$500 million of 6% coupon rate debt that sells at par. The risk-free rate is 5% and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 6%. There are no corporate taxes or other market imperfections.
 - What is the weighted average cost of capital of the levered firm?
 - If the firm issued enough stock to buy back all of the debt, how much would the weighted average cost of capital and equity cost of capital change?
- You are considering entering a new industry. The only publicly traded company has a beta of 2.5 and a debt-to-equity ratio of 2.2. Your firm uses 100% equity financing. What is the equity cost of capital your firm should use to evaluate the project? The risk-free rate is 6% and the historical market risk premium, $(E[R_{\text{Mkt}}] - r_f)$, is 5%. There are no corporate taxes or other market imperfections.

Solutions to Questions and Problems

- $V^U = \frac{10}{0.10} = \100 million
 - $V^L = V^U = \$100 \text{ million}$, $D = \$35 \text{ million}$ and $E = \$65 \text{ million}$.
- $V^U = \$20 \times 50 \text{ million} = \1 billion
 - $V^L = V^U = \$1 \text{ billion}$
 - Share price = $\frac{\$1 \text{ billion}}{50 \text{ million}} = \20 .
They will repurchase $\frac{\$500 \text{ million}}{\$20} = 25 \text{ million shares}$.

After the share repurchase, $E = V^L - D = \$1 \text{ billion} - \$500 \text{ million} = \$500 \text{ million}$, and the value per share equals:

$$\frac{\$500 \text{ million}}{25 \text{ million}} = \$20$$

3. [A] $r_E = r_f + \beta_i (E[R_{\text{Mkt}}] - r_f) = 0.05 + 0.75(0.06) = 9.5\%$

[B] Assuming the debt beta is zero:

$$\beta_E = \left(1 + \frac{D}{E}\right) \beta_U = \left(1 + \frac{2}{1}\right) 0.75 = 2.25.$$

$$r_E = r_f + \beta_i^{\text{Mkt}} (E[R_{\text{Mkt}}] - r_f) = 0.05 + 2.25(0.06) = 18.5\%$$

4. [A] $r_E = r_f + \beta_i^{\text{Mkt}} (E[R_{\text{Mkt}}] - r_f) = 0.05 + 1.5(0.06) = 14\%$

$$r_{\text{wacc}} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = \left(\frac{500}{500+500}\right) 0.14 + \left(\frac{500}{500+500}\right) 0.06 = 10\%$$

[B] The WACC would not change.

The new equity cost of capital would be 10%, so it would fall by 4%.

5. Assuming that the debt betas are close to zero, leads to:

$$\beta_U \approx \frac{E}{E+D} \beta_E = \frac{1}{1+3.2} 2.5 = 0.78$$

$$E[R_i] = R_E = r_f + \beta_i^{\text{Mkt}} (E[R_{\text{Mkt}}] - r_f) = 0.06 + 0.78(0.05) = 9.9\%$$