Topic 8 – Capital Structure in a Perfect Market, Debt & Taxes

BMAE Ch. 16 & 17

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Topics Covered

BMAE Ch 16:

Equity vs. Debt Financing: Overview

Modigliani−Miller Proposition I: Leverage, Arbitrage, and Firm Value

Modigliani−Miller Proposition II: Leverage, Risk, and the Cost of Capital

There is No Magic to Financial Leverage

Final Word on the Cost of Capital: After-Tax WACC

BMAE Ch 17:

Interest Tax Shields, Personal Taxes, Optimal Capital Structure with Taxes

Equity vs Debt Financing: Overview

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Equity vs. Debt Financing

Financial Leverage (a.k.a. Capital Structure)

- The relative proportions of debt, equity, and any other securities that a firm has outstanding (i.e. OWES to its various investors)
- Financial managers try to find the combination of securities that has the greatest overall appeal to investors—the combination that maximizes the market value of the firm.
- Total market value of the firm, V = D + E (plus any other funding sources)

The Effect of Leverage on Risk and Return

Leverage increases the risk of the equity of a firm.

- Hence, it is *inappropriate* to discount the cash flows of levered equity at the same discount rate (e.g. 15%) that you used for unlevered equity.
- Investors in levered equity will require a higher expected return to compensate for their increased risk.

	Date 0	Date 1: Cash Flows		Date 1: Returns		
	Initial Value	Strong Economy	Weak Economy	Strong Economy	Weak Economy	Expected Return
Debt	$500	$525	$525	5%	5%	5%
Levered equity	$500	$875	$375	75%	−25%	25%
Unlevered equity	$1000	$1400	$900	40%	−10%	15%

The Effect of Leverage on Risk and Return

Reflecting on the previous example…

- If we have perfect capital markets (a big if!):
  - When the firm was 100% equity financed, the equity holders would have required a 15% expected return.
  - When the firm was financed with 50% debt / 50% equity, the debtholders will receive a return of 5%, while the levered equity holders would require an expected return of 25% (because of their increased risk).
- **Leverage increases the risk of equity even when there is no risk that the firm will default.**
  - Debt AMPLIFIES the volatility of the cash flows to equity-holders.
  - Thus, while debt may be cheaper, it also raises the cost of capital for equity.
  - Considering both sources of capital together, the firm's WACC with leverage is the same as WACC for an unlevered firm.

Modigliani–Miller Proposition I: Leverage, Arbitrage, and Firm Value

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Modigliani−Miller I

The Law of One Price implies that leverage should not affect the total value of the firm.

- Instead, it merely changes the allocation of cash flows between debt and equity, without altering the total cash flows of the firm.

Modigliani and Miller (MM) showed that this result holds more generally under a set of conditions referred to as perfect capital markets:

- Investors and firms can trade the same set of securities at competitive market prices equal to the PV of their future cash flows.
- There are no taxes, transaction costs, or issuance costs associated with security trading.
- A firm's financing decisions do not change the cash flows generated by its investments, nor do they reveal new information about them - generally under a set of conditions referred to as perfect capital markets.

Assuming these conditions are true, it makes no difference whether the firm borrows or individual shareholders borrow. Firm value is independent of capital structure.

Modigliani−Miller I

MM Proposition I – Capital Structure Irrelevance

- 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 established their result with the following argument:

- In the absence of taxes or other transaction costs, 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.

Modigliani−Miller I

Capital structure irrelevance illustrated, $100 (unlevered) firm:

Dollar Investment	Dollar Return
$0.01V_U$	$0.01 \times$ Profits

Replicating investment strategy – buy D & E of a levered firm:

	Dollar Investment	Dollar Return
Debt	$0.01D_L$	$0.01 \times$ Interest
Equity	$0.01E_L$	$0.01 \times (\text{Profits} - \text{interest})$
Total	$0.01(D_L + E_L)$	$0.01 \times$ Profits
	$= 0.01V_L$	

Modigliani−Miller I

Capital structure irrelevance illustrated, $100 (levered) firm:

Dollar Investment	Dollar Return
$0.01E_L$	$0.01\times(\text{Profit}-\text{Interest})$
$=0.01(V_L-D_L)$	

Replicating investment strategy – borrow to invest in an unlevered firm:

	Dollar Investment	Dollar Return
Debt	$-0.01D_L$	$-0.01\times\text{Interest}$
Equity	$0.01V_U$	$0.01\times\text{Profits}$
Total	$0.01(V_U-D_L)$	$0.01\times(\text{Profits}-\text{Interest})$

Modigliani−Miller I

Capital structure irrelevance illustrated – summary:

- Both scenarios involved a replicating strategy that gave the same payoff (same profit)
- By the Law of One Price, for each scenario, both investments must have the same cost
- Hence, $V_U = V_L$
- In other words…capital structure is irrelevant to firm value! (*Assuming perfect capital markets…*)
- Practical insight: debt can increase earnings per share (EPS), but also increases riskiness of that EPS, *thus share value remains unchanged*.

Modigliani−Miller Proposition II: Leverage, Risk, and the Cost of Capital

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Modigliani−Miller II

Leverage and the Equity Cost of Capital

- MM's first proposition can be used to derive an explicit relationship between leverage and the equity cost of capital.

Leverage and the Equity Cost of Capital

- E = Market value of equity in a *levered* firm
- D = Market value of debt in a levered firm
- V_U = Market value of equity in an *unlevered* firm
- A = Market value of the firm's assets

Modigliani−Miller II

Leverage and the Equity Cost of Capital

- MM Proposition I states that

$$E + D = V_L = V_U = A$$

- The total market value of the firm's securities (E + D) is equal to the market value of its assets (A), whether the firm is unlevered or levered.
- The expected return on assets, "R_A" = R_U, the expected return on unlevered equity
- The cash flows from holding unlevered equity can be replicated using homemade leverage by holding a portfolio of the firm's equity and debt.

Modigliani−Miller II

The expected return on unlevered equity (R_U) is the weighted-average of the expected returns of levered equity (R_E) and debt (R_D):

$$R_U = \left(\frac{D}{V}\right) \times R_D + \left(\frac{E}{V}\right) \times R_E$$

Solving for levered R_E yields the formula:

$$R_E = \underbrace{R_U}_{\substack{\textit{Risk without} \\ \textit{leverage}}} + \underbrace{\frac{D}{E}(R_U - R_D)}_{\substack{\textit{Additional risk} \\ \textit{due to leverage}}}$$

- Levered equity return = unlevered equity return PLUS a premium for leverage.
- Size of leverage premium depends on the extent of leverage as measured by the firm's market value debt−equity ratio, **D/E**

Modigliani−Miller II

MM 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−to−equity ratio

- Cost of Capital for Levered Equity:

$$r_E = r_U + \frac{D}{E}(r_U - r_D)$$

Modigliani−Miller II

Recall from our earlier example (slide 5):

- If the firm is all−equity financed, the expected return on unlevered equity is 15%.
- If the firm is financed with $500 of debt, the expected return of the debt is 5%.
- Therefore, according to MM Proposition II, the expected return on equity for the levered firm is:

$$r_E = 15\% + \frac{500}{500}(15\% - 5\%) = \mathbf{25\%}$$

Capital Budgeting and WACC

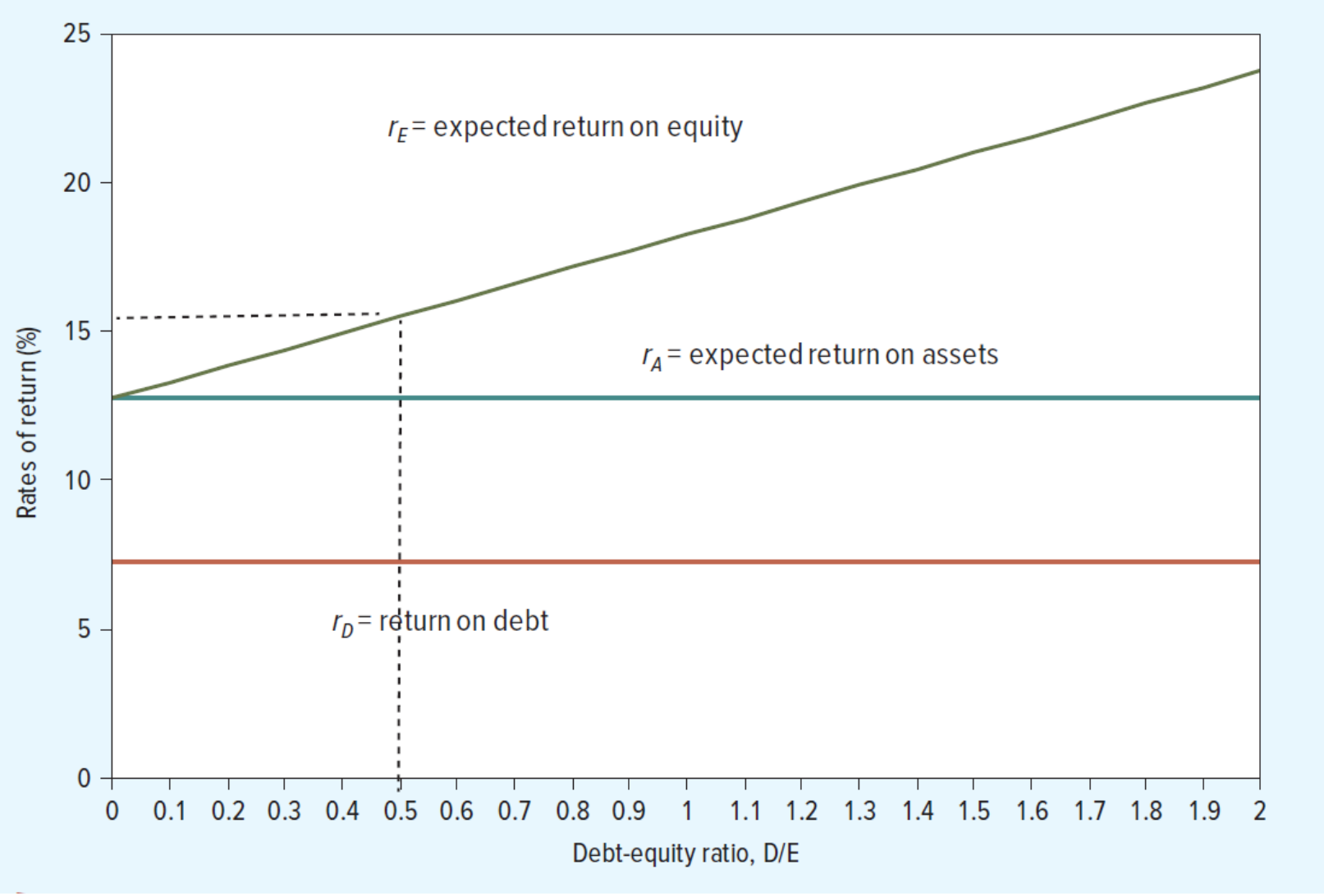
- If a firm is unlevered, all of the free cash flows generated by its assets are paid out to its equity holders
  - The market value, risk, and cost of capital for the firm's assets and its equity coincide and therefore
- If a firm is levered, project r_A is equal to the firm's weighted average cost of capital.

$$r_{WACC} = \begin{Bmatrix} Fraction\ of\ firm \\ financed\ by\ equity \end{Bmatrix} \begin{Bmatrix} Equity\ cost \\ of\ capital \end{Bmatrix} + \begin{Bmatrix} Fraction\ of\ firm \\ financed\ by\ debt \end{Bmatrix} \begin{Bmatrix} Debt\ cost \\ of\ capital \end{Bmatrix}$$

- Unlevered cost of capital (pretax WACC)

$$r_{wacc} = r_U = r_A$$

Capital Budgeting and WACC



No Magic to Financial Leverage?

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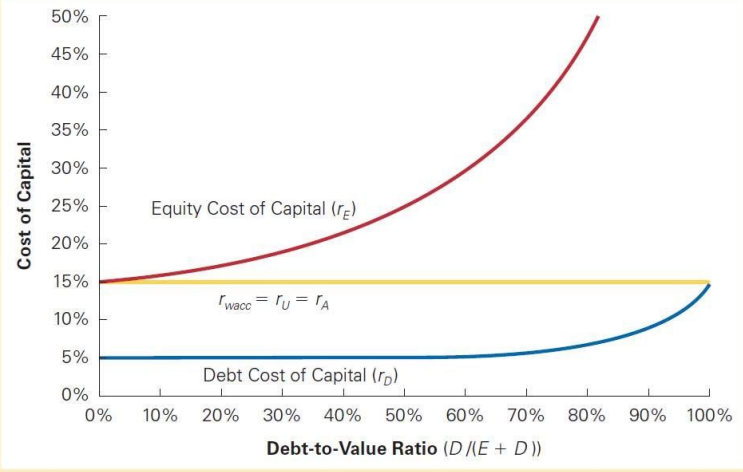
Capital Budgeting and WACC

- With perfect capital markets, a firm's WACC is independent of its capital structure and is equal to its equity cost of capital if it is unlevered, which matches the cost of capital of its assets.
- Debt−to−Value Ratio
  - The fraction of a firm's enterprise value that corresponds to debt
- With no debt, the WACC is equal to the unlevered equity cost of capital.
- As the firm borrows at the low cost of capital for debt, its equity cost of capital rises. The net effect is that the firm's WACC is unchanged.

Capital Budgeting and WACC

(a) The graph shows costs of equity, costs of debt, and WACC for different amounts of leverage. The rate of increase of r_D and r_E, and thus the shape of the curves, depends on the characteristics of the firm's cash flows.

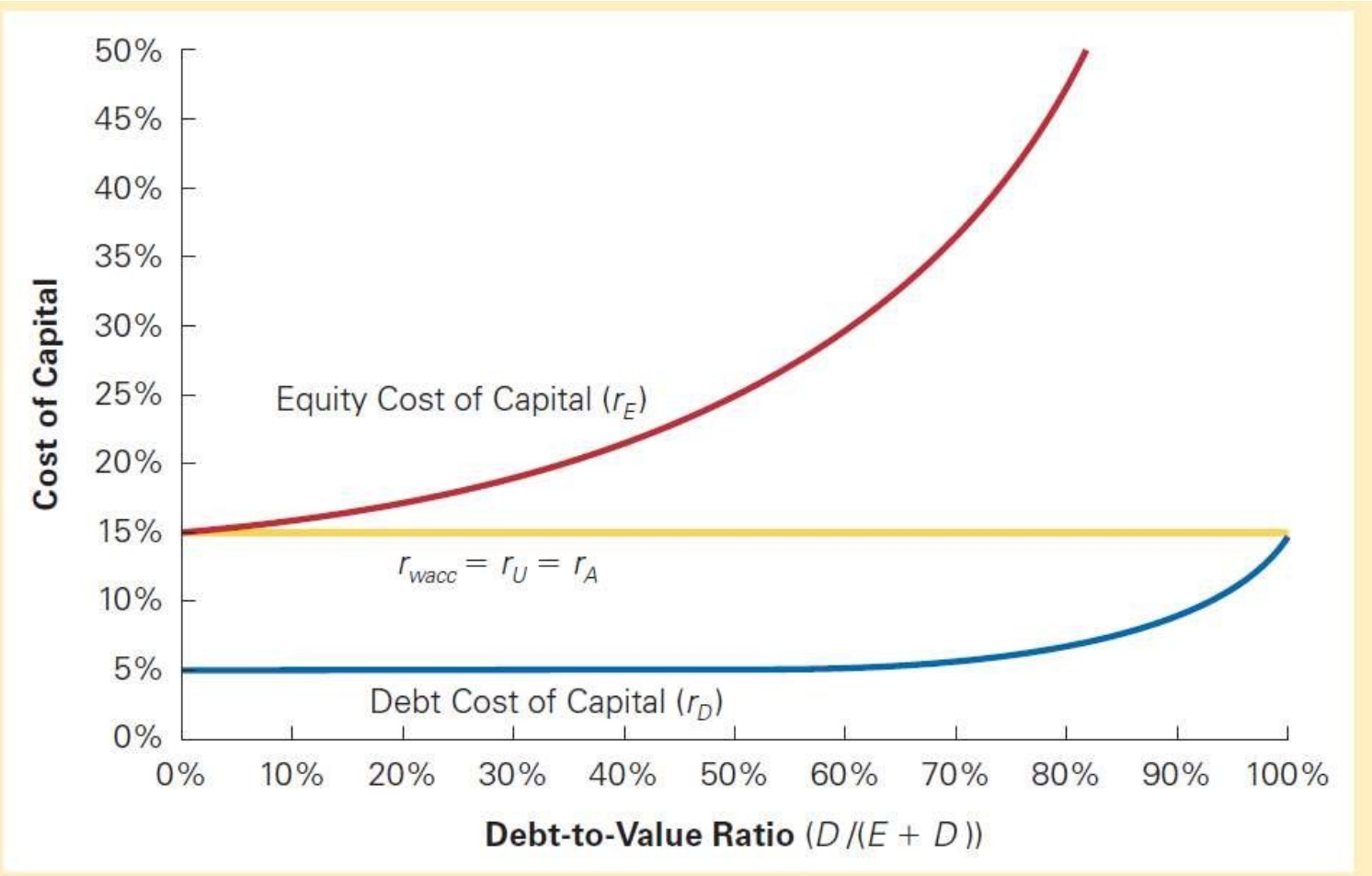
(b) The table calculates WACC for different capital structures. Data in this table correspond to the early example from Slide 5.



(a)

E	D	r_E	r_D	$\frac{E}{E+D}r_E + \frac{D}{E+D}r_D$	$= r_{wacc}$
1000	0	15.0%	5.0%	1.0 × 15.0% + 0.0 × 5.0%	= 15%
800	200	17.5%	5.0%	0.8 × 17.5% + 0.2 × 5.0%	= 15%
500	500	25.0%	5.0%	0.5 × 25.0% + 0.5 × 5.0%	= 15%
100	900	75.0%	8.3%*	0.1 × 75.0% + 0.9 × 8.3%	= 15%

(b)



(a)

E	D	r_E	r_D	$\frac{E}{E+D}r_E + \frac{D}{E+D}r_D$	$= r_{wacc}$
1000	0	15.0%	5.0%	$1.0 \times 15.0\% + 0.0 \times 5.0\%$	$= 15\%$
800	200	17.5%	5.0%	$0.8 \times 17.5\% + 0.2 \times 5.0\%$	$= 15\%$
500	500	25.0%	5.0%	$0.5 \times 25.0\% + 0.5 \times 5.0\%$	$= 15\%$
100	900	75.0%	8.3%*	$0.1 \times 75.0\% + 0.9 \times 8.3\%$	$= 15\%$

(b)

Levered and Unlevered Betas

The effect of leverage on the risk of a firm's securities can also be expressed in terms of beta:

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

Unlevered Beta, β_U (or β_A):

- A measure of the risk of a firm as if it did not have leverage, which is equivalent to the beta of the firm's assets.

If you are trying to estimate the unlevered beta for an investment project, you should base your estimate on the unlevered betas of firms with comparable investments.

Levered and Unlevered Betas

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

Leverage amplifies the market risk of a firm's assets, β_U, raising the market risk of its equity

Final Word on the Cost of Capital: After-Tax WACC

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A Final Word on the Cost of Capital

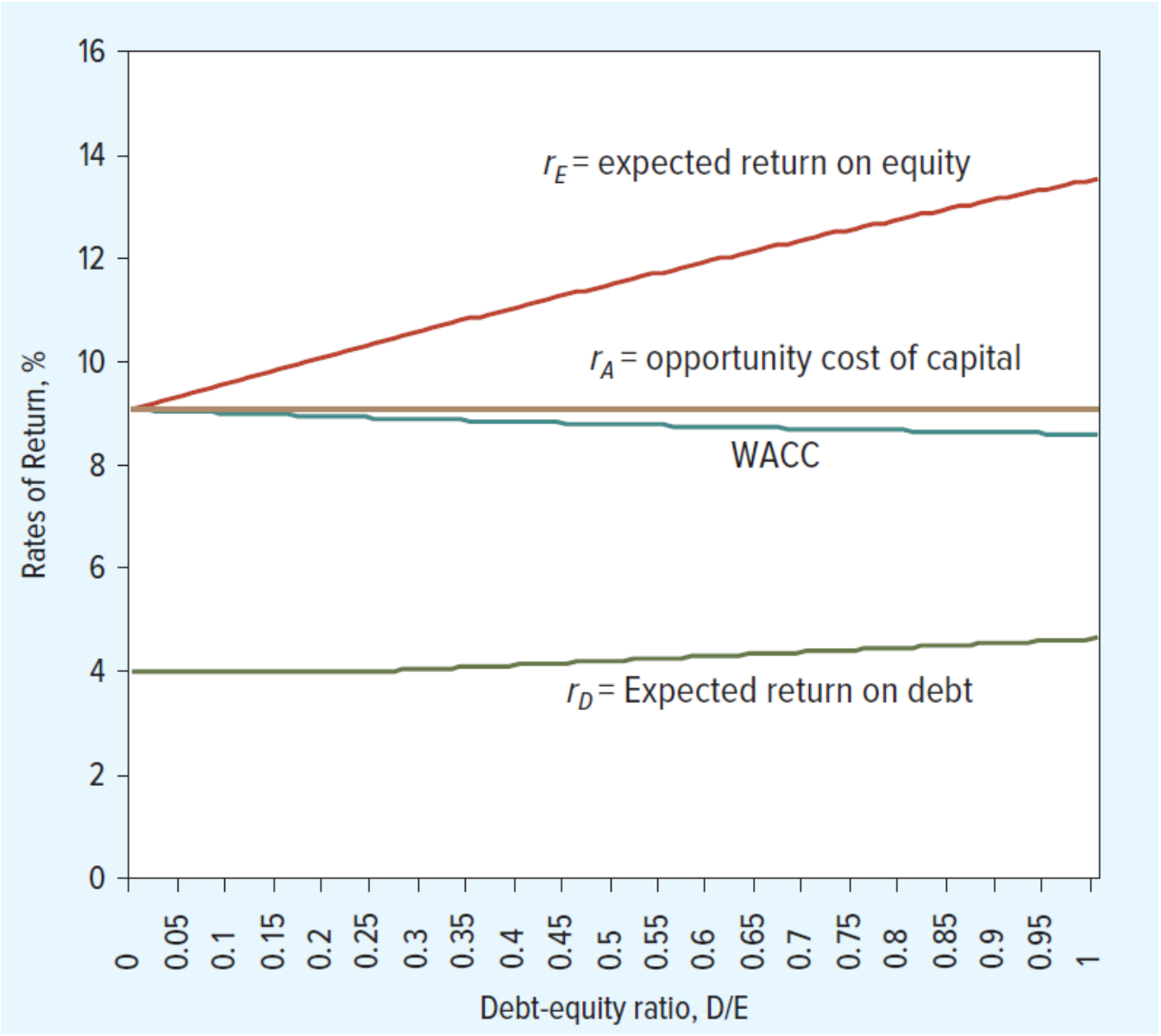
- WACC is the traditional view of capital structure, risk, and return.
- The tax benefit from interest expense deductibility must be included in the cost of funds.
- This tax benefit reduces the effective cost of debt by a factor of the marginal tax rate.

After-Tax WACC

Tax-Adjusted WACC Formula

$$\text{WACC} = r_D \times (1 - Tc) \times \left(\frac{D}{V} \right) + \left(r_E \times \frac{E}{V} \right)$$

After-Tax WACC, illustrated



Debt & Taxes: Interest Tax Shields

(BMAE Ch. 17)

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The Interest Tax Deduction

Corporations pay taxes on their profits after interest payments are deducted.

- Thus, interest expense reduces the amount of corporate taxes.
- This creates an incentive to use debt.

Consider Macy's, which had earnings before interest and taxes of approximately $2.8b in 2014 and interest expenses of about $400m.

- Macy's marginal corporate tax rate was 35%

As shown on the next slide, Macy's net income in 2014 was lower with leverage than it would have been without leverage.

The Interest Tax Deduction

	With Leverage	Without Leverage
EBIT	$2800	$2800
Interest expense	−400	0
Income before tax	2400	2800
Taxes (35%)	−840	−980
Net income	$1560	$1820

Macy's debt obligations reduced the value of its equity.

But the total amount available to all investors was higher with leverage.

	With Leverage	Without Leverage
Interest paid to debt holders	400	0
Income available to equity holders	1560	1820
Total available to all investors	$1960	$1820

The Interest Tax Deduction

Without leverage, Macy's was able to pay out $1.82b in total to its investors.

With leverage, Macy's was able to pay out $1.96b in total to its investors.

Where did the extra $140m come from?

The Interest Tax Deduction

Interest Tax Shield

- The reduction in taxes paid due to the tax deductibility of interest

Interest Tax Shield = Corporate Tax Rate × Interest Expense

- In Macy's case, the gain is equal to the reduction in taxes with leverage:

$980m − $840m = $140 million

- The interest payments provided a tax saving of:

35% × $400m = $140 million

Valuing the Interest Tax Shield

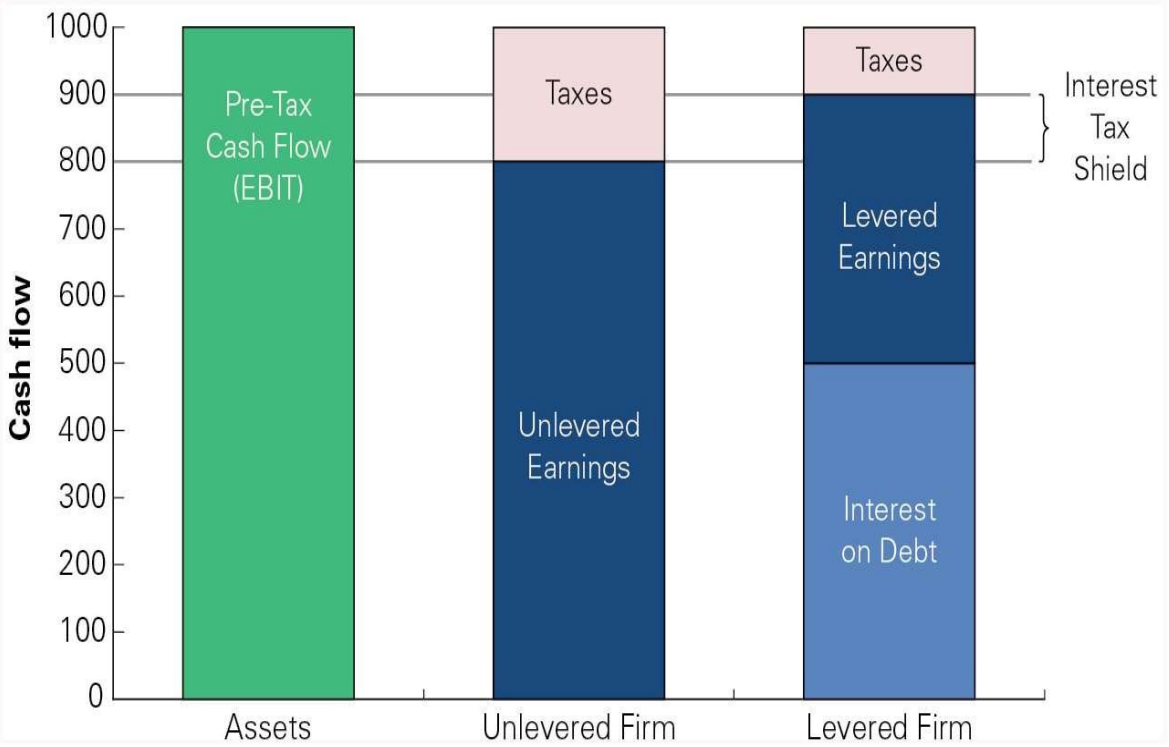
The Interest Tax Shield and Firm Value

When a firm uses debt, the interest tax shield provides a corporate tax benefit each year.

This benefit is the computed as the present value of the stream of future interest tax shields the firm will receive.

The Interest Tax Shield and Firm Value

The cash flows a levered firm pays to investors will be higher than they would be without leverage by the amount of the interest tax shield.



$$\begin{Bmatrix} CF\ to\ Investors \\ with\ Leverage \end{Bmatrix} = \begin{Bmatrix} CF\ to\ Investors \\ Without\ Leverage \end{Bmatrix} + \{Interest\ Tax\ Shield\}$$

The Interest Tax Shield and Firm Value

MM Proposition I with Taxes:

- The total value of the levered firm exceeds the value of the firm without leverage due to the present value of the tax savings from debt.

$$V_L = V_U + PV(\text{Interest Tax Shield})$$

Firm Value with Permanent Debt

- Typically, the level of future interest payments is uncertain due to changes in the marginal tax rate, the amount of debt outstanding, the interest rate on that debt, and the risk of the firm.
  - For simplicity, we will consider the special case in which the above variables are kept constant.
- Suppose a firm borrows debt D and keeps the debt permanently. If the firm's marginal tax rate is τ_c if the debt is riskless with a risk-free interest rate r_f, then the interest tax shield each year is $\tau_c \times r_f \times D$, and the tax shield can be valued as a perpetuity:

$$PV(\text{Interest Tax Shield}) = \frac{\tau_c \times \text{Interest}}{r_f} = \frac{\tau_c \times (r_f \times D)}{r_f}$$

$$= \tau_c \times D$$

WACC with Tax

With tax-deductible interest, the effective after-tax borrowing rate is $r(1-\tau_c)$ and the WACC becomes:

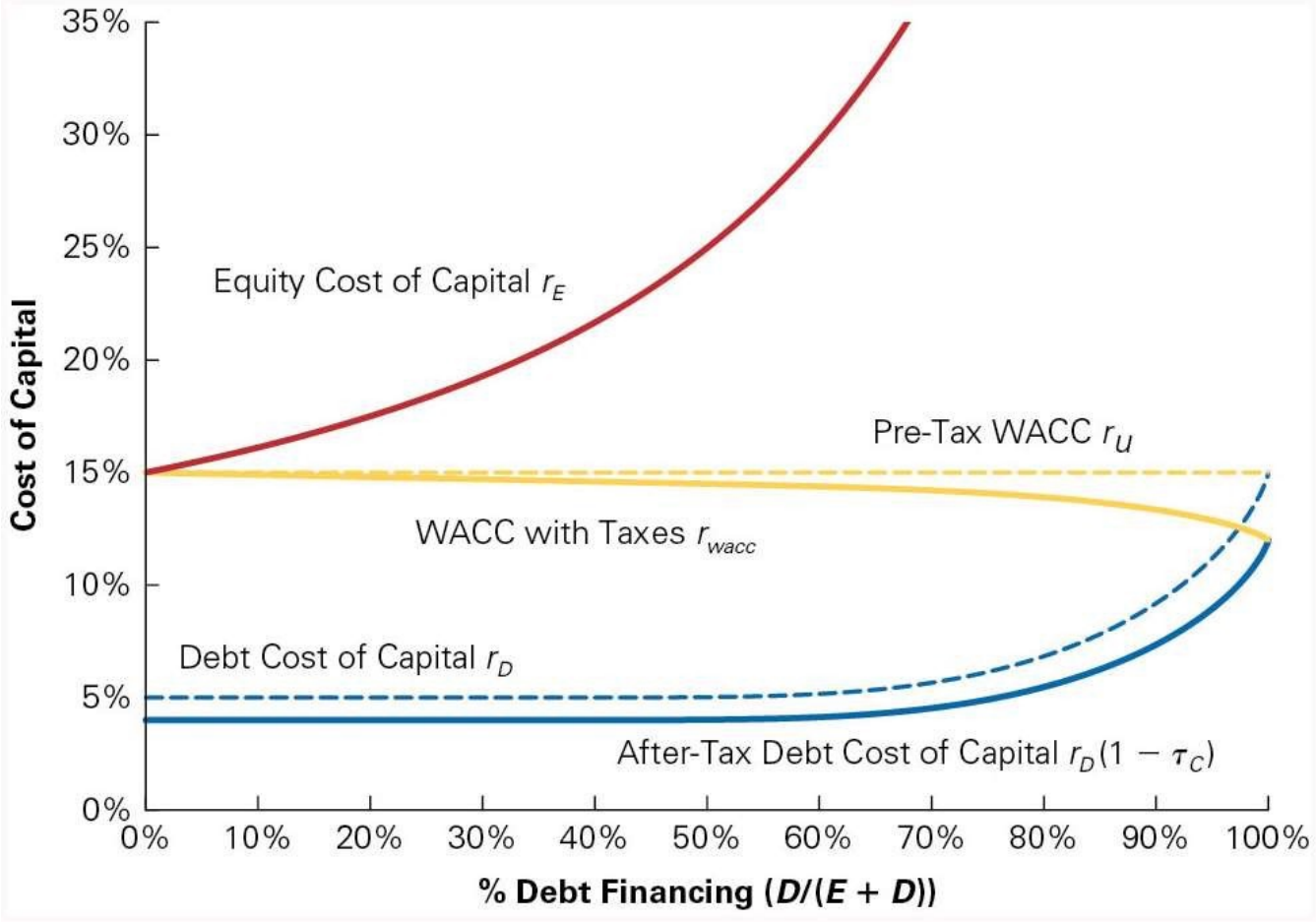
$$r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c)$$

$$r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D - \frac{D}{E+D} r_D \tau_c$$

Pretax WACC

Reduction due to interest tax shield

WACC with and Without Corporate Taxes



Personal Taxes

Personal Taxes

Cash flows to investors are typically taxed twice: firstly at the *corporate level* (in the case of equity), and secondly investors are taxed again at the *personal level* when they receive their interest or divided payment.

- *Note on taxes at the personal level in Australia*: in Australia, equity investors receive franking credits with their dividends which effectively refund the taxes that have already been paid at the corporate level. This minimises double-taxation of company profits.

For individuals,

- Interest payments received from debt are taxed as income.
- Equity investors also must pay taxes on dividends and capital gains.

Personal Taxes

The amount of money an investor will pay for a security depends on the cash flows the investor will receive **after all taxes have been paid.**

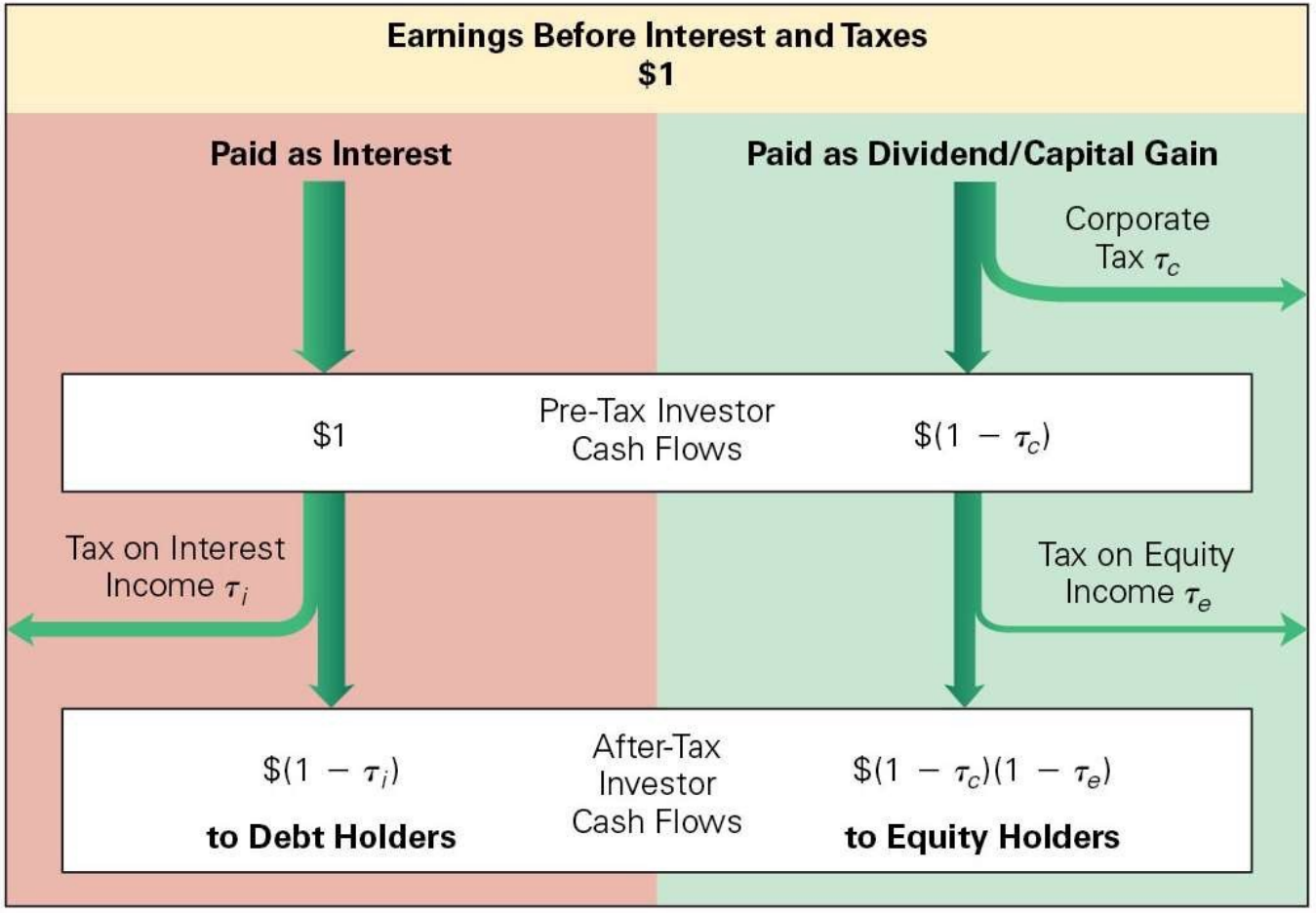
Personal taxes reduce the cash flows to investors and can offset some of the corporate-level tax benefits of leverage.

- **In Australia:** interest and dividend income are taxed the same at the personal level, HOWEVER dividend income comes with franking credits attached. Thus in net terms dividends have a tax advantage at the personal level, while interest is taxed favourably at the corporate level.

The actual interest tax shield depends on both corporate and personal taxes that are paid.

To determine the true tax benefit of leverage, the combined effect of both corporate and personal taxes needs to be evaluated.

Personal Taxes



Personal Taxes

In general, every $1 received after taxes by debt holders from interest payments costs equity holders on an after-tax basis, where

- Effective Tax Advantage of Debt: $$\tau^* = \frac{(1-\tau_i) - (1-\tau_c)(1-\tau_e)}{(1-\tau_i)} = 1 - \frac{(1-\tau_c)(1-\tau_e)}{(1-\tau_i)}$$

When there are no corporate taxes on debt income **and** when the personal tax rates on debt and equity income are the **same** the formula reduces to: $\tau^* = \tau_c$

When equity income is taxed less heavily at the personal level than debt income (τ_e is less than τ_i), then τ^* is reduced.

Personal Taxes

With personal taxes and permanent debt, the value of the firm with leverage becomes

$$V^L = V^U + \tau^* D$$

If τ^* is less than τ_c, the benefit of leverage is reduced in the presence of personal taxes.

Personal taxes have a similar effect on the firm's weighted average cost of capital. However, we still compute the WACC as

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c)$$

Actual Tax Advantage of Debt

It was assumed that investors pay the top marginal federal income tax rates. In reality, rates vary for individual investors, and many investors face lower rates.

- At lower rates, the effects of personal taxes are less substantial.

Many investors face no personal taxes

- For example, investments held in retirement savings accounts or pension funds that are not subject to taxes.
- For these investors, the effective tax advantage of debt is the full corporate tax rate.

The bottom line

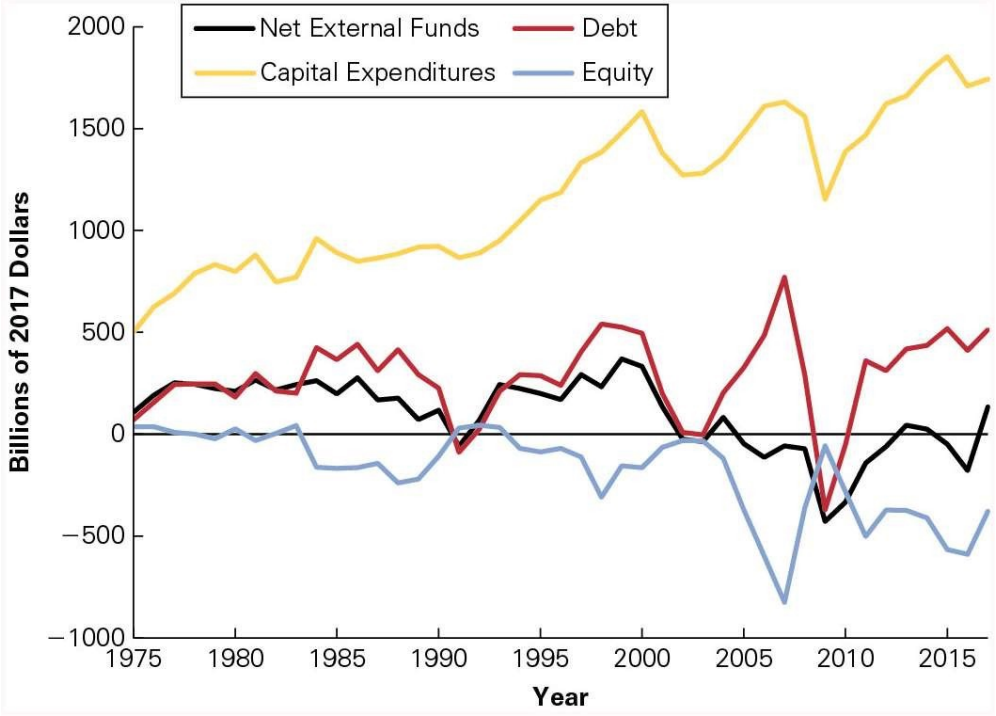
- Calculating the effective tax advantage of debt accurately is extremely difficult.
  - A firm must consider the tax bracket of its typical debt holders, and the tax bracket and holding period of its typical equity holders.
- The tax advantage of debt will vary across firms and from investor to investor.

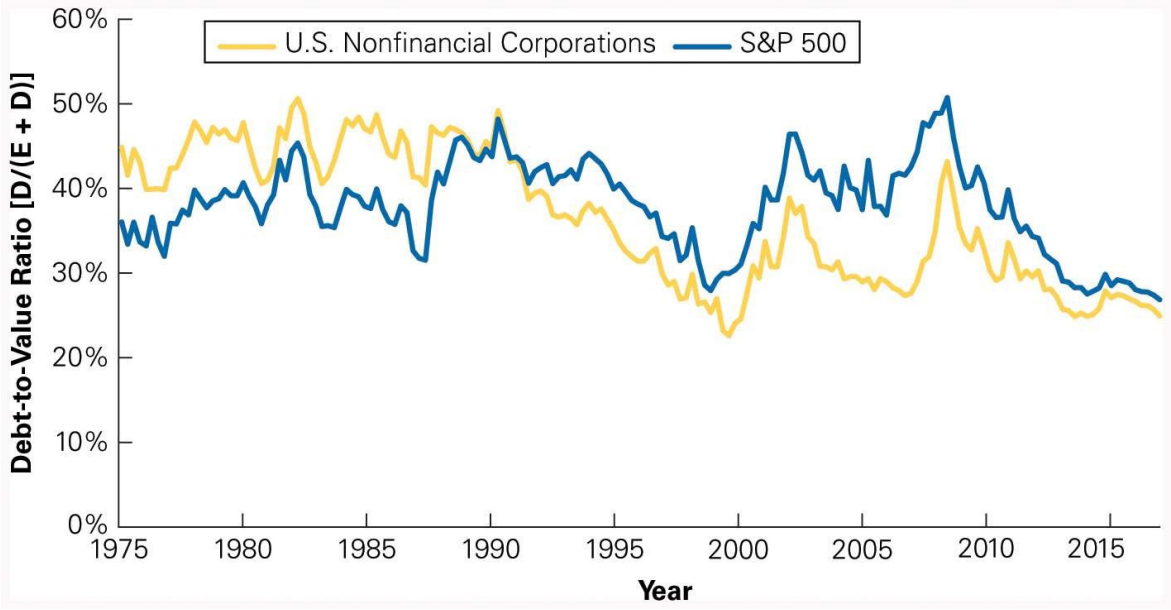
Optimal Capital Structure with Taxes

Do Firms Prefer Debt?

- When firms raise new external funds they do so **primarily by issuing debt.**
- In most years, **aggregate equity issues are actually negative**.
  - On average, firms are *reducing* the amount of equity outstanding by share buybacks.
- While firms seem to prefer debt when raising external funds, not all investment is externally funded.
- Most investment and growth is supported by **internally generated funds**.
  - Even though firms have not issued new equity, the market value of equity has risen over time as firms have grown.
  - For the average firm, the result is that debt as a fraction of firm value has varied in a range from 30% to 45%.

Do Firms Prefer Debt?





Do Firms Prefer Debt?

- The use of debt varies greatly by industry.
- Firms in growth industries like digital tech or biotechnology carry very little debt, while those in traditional industries with mature cash flows (e.g. airlines, automakers, utilities, and financial firms) have higher leverage ratios.

Limits to the Benefit of Debt

To receive the full tax benefits of leverage, a firm need not use 100% debt financing, but the firm does need to have taxable earnings.

- This constraint may limit the amount of debt needed as a tax shield.

Limits to the Benefit of Debt

The optimal level of leverage from a tax saving (narrow) perspective is the level such that interest equals EBIT.

- At the optimal level of leverage, the firm shields all of its taxable income, and it does not have any tax-disadvantaged excess interest.

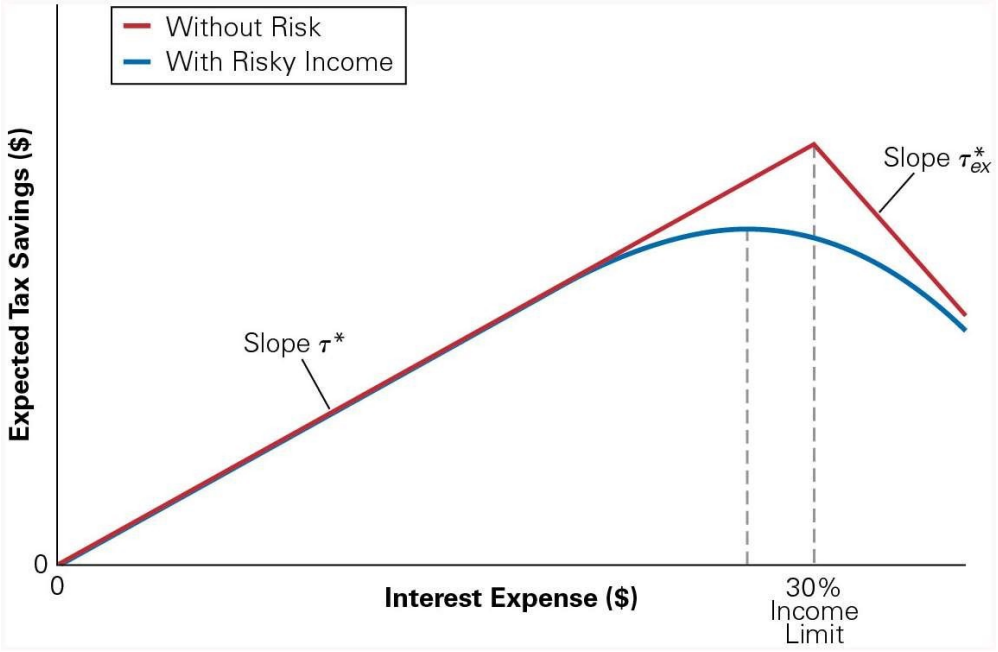
However, it is unlikely that a firm can predict its future EBIT (and the optimal level of debt) precisely.

- If there is uncertainty regarding EBIT, then there is a risk that interest will exceed EBIT. As a result, the tax savings for high levels of interest falls, possibly reducing the optimal level of the interest payment.

Limits to the Benefit of Debt

In general, as a firm's interest expense approaches its expected taxable earnings, *the marginal tax advantage of debt declines.*

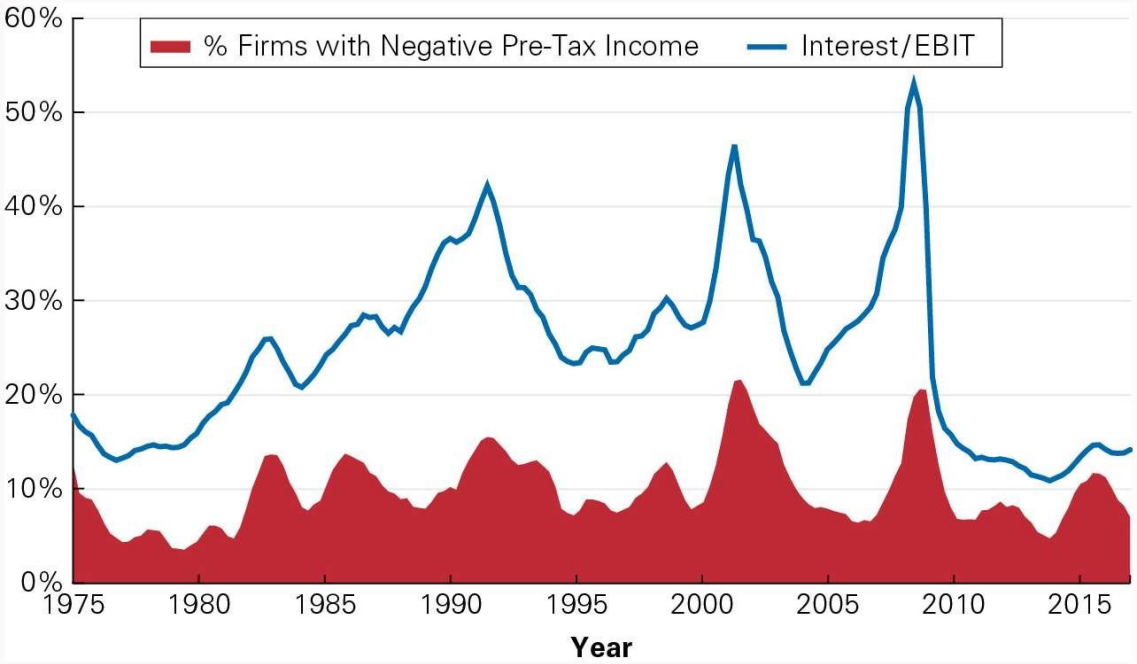
This limits the amount of debt the firm should use.



Low Leverage?

Firms have used debt to shield a greater percentage of their earnings from taxes in more recent years (mirroring the increase in the effective tax advantage of debt).

Firms have far less leverage than our analysis of the interest tax shield would predict.



Low Leverage?

It would appear that firms, on average, are under-leveraged. However, it is hard to accept that most firms are acting sub-optimally.

- In reality, there is more to the capital structure story than discussed so far.

A key item missing from the analysis thus far is that increasing the level of debt increases the probability of bankruptcy.

If bankruptcy is costly, these costs might offset the tax advantages of debt financing.