Debt and Tax

Outline

- MM第一定理(With Taxes)
- MM第二定理(With Taxes)
- Optimal Capital Structure with Taxes

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.

The Interest Tax Deduction

TABLE 15.1 **Safeway's Income with and without Leverage, 2005 ($ million)**

	With Leverage	Without Leverage
EBIT	$1,250	$1,250
Interest expense	−400	0
Income before tax	850	1,250
Taxes (35%)	−298	−438
Net income	$552	$812

	With Leverage	Without Leverage
Interest paid to debt holders	400	0
Income available to equity holders	552	812
Total available to all investors	$952	$812

Interest Tax Shield(税盾)

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

$$\text{Interest Tax Shield} = \text{Corporate Tax Rate} \times \text{Interest Payments}$$

  - In Safeway's case, the interest payments provided a tax savings of 35% × $400 million = $140 million.

Interest Tax Shield(税盾)

Computing the Interest Tax Shield

Problem

Shown below is the income statement for D.F. Builders (DFB). Given its marginal corporate tax rate of 35%, what is the amount of the interest tax shield for DFB in years 2003 through 2006?

DFB Income Statement ($ million)	2003	2004	2005	2006
Total sales	$3,369	$3,706	$4,077	$4,432
Cost of sales	−2,359	−2,584	−2,867	−3,116
Selling, general, and administrative expense	−226	−248	−276	−299
Depreciation	−22	−25	−27	−29
Operating income	762	849	907	988
Other income	7	8	10	12
EBIT	769	857	917	1,000
Interest expense	−50	−80	−100	−100
Income before tax	719	777	817	900
Taxes (35%)	−252	−272	−286	−315
Net income	$467	$505	$531	$585

Interest Tax Shield(税盾)

Solution

From Eq. 15.1, the interest tax shield is the tax rate of 35% multiplied by the interest payments in each year:

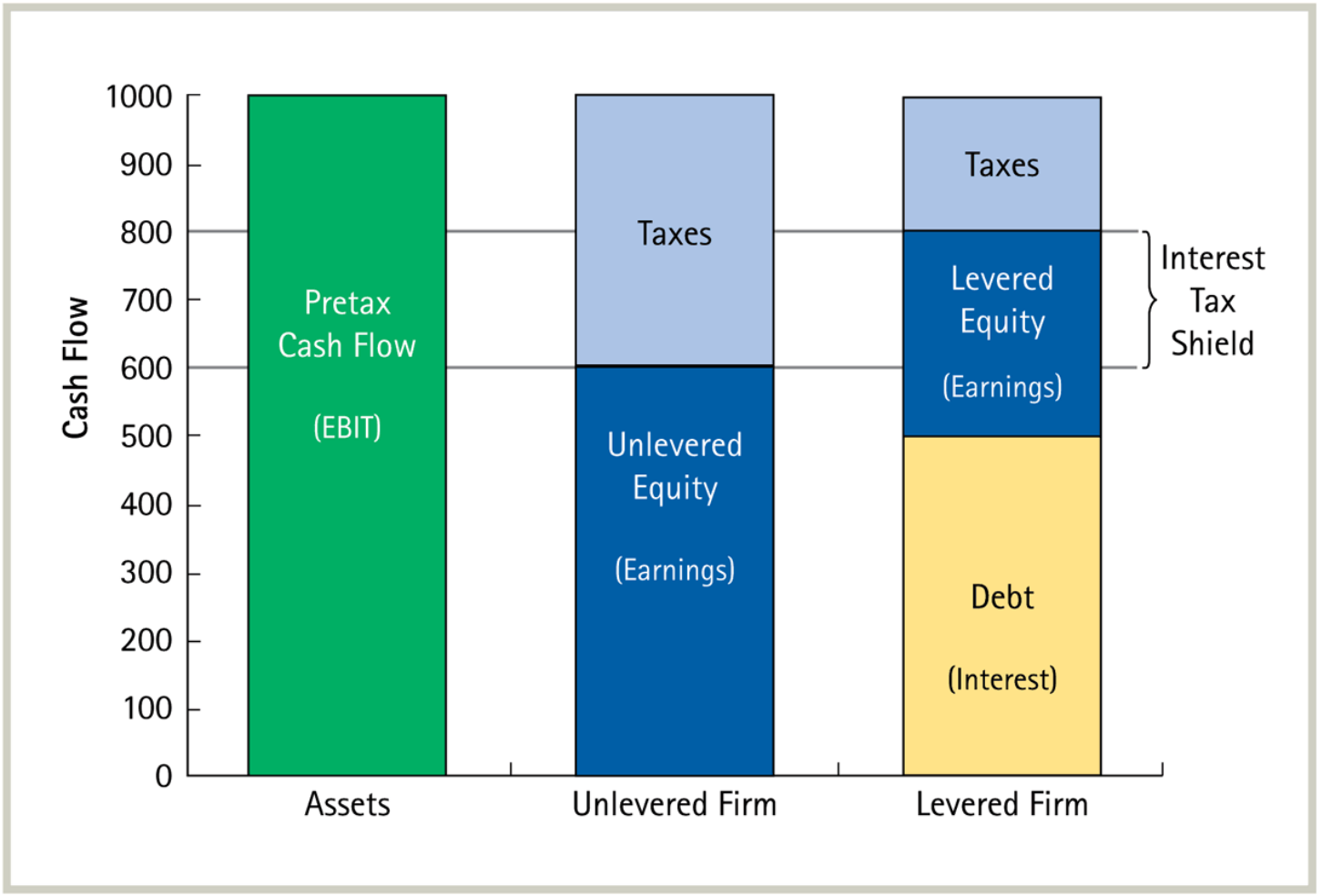
($ million)	2003	2004	2005	2006
Interest expense	−50	−80	−100	−100
Interest tax shield (35% × interest expense)	**17.5**	**28**	**35**	**35**

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.

$$\begin{pmatrix}\text{Cash Flows to Investors}\\ \text{with Leverage}\end{pmatrix} = \begin{pmatrix}\text{Cash Flows to Investors}\\ \text{without Leverage}\end{pmatrix} + (\text{Interest Tax Shield})$$

The Interest Tax Shield and Firm Value



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.*

$$V^L = V^U + PV(\text{Interest Tax Shield})$$

The Interest Tax Shield with Permanent Debt

- Suppose a firm borrows debt *D* and keeps the debt permanently. If the firm's marginal tax rate is τ_c, and 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.

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

The Interest Tax Shield with Permanent Debt

- If the debt is fairly priced, no arbitrage implies that its market value must equal the present value of the future interest payments.

$$\text{Market Value of Debt} = D = PV(\text{Future Interest Payments})$$

$$\begin{aligned} PV(\text{Interest Tax Shield}) &= PV(\tau_c \times \text{Future Interest Payment} \\ &= \tau_c \times PV(\text{Future Interest Payment} \\ &= \tau_c \times D \end{aligned}$$

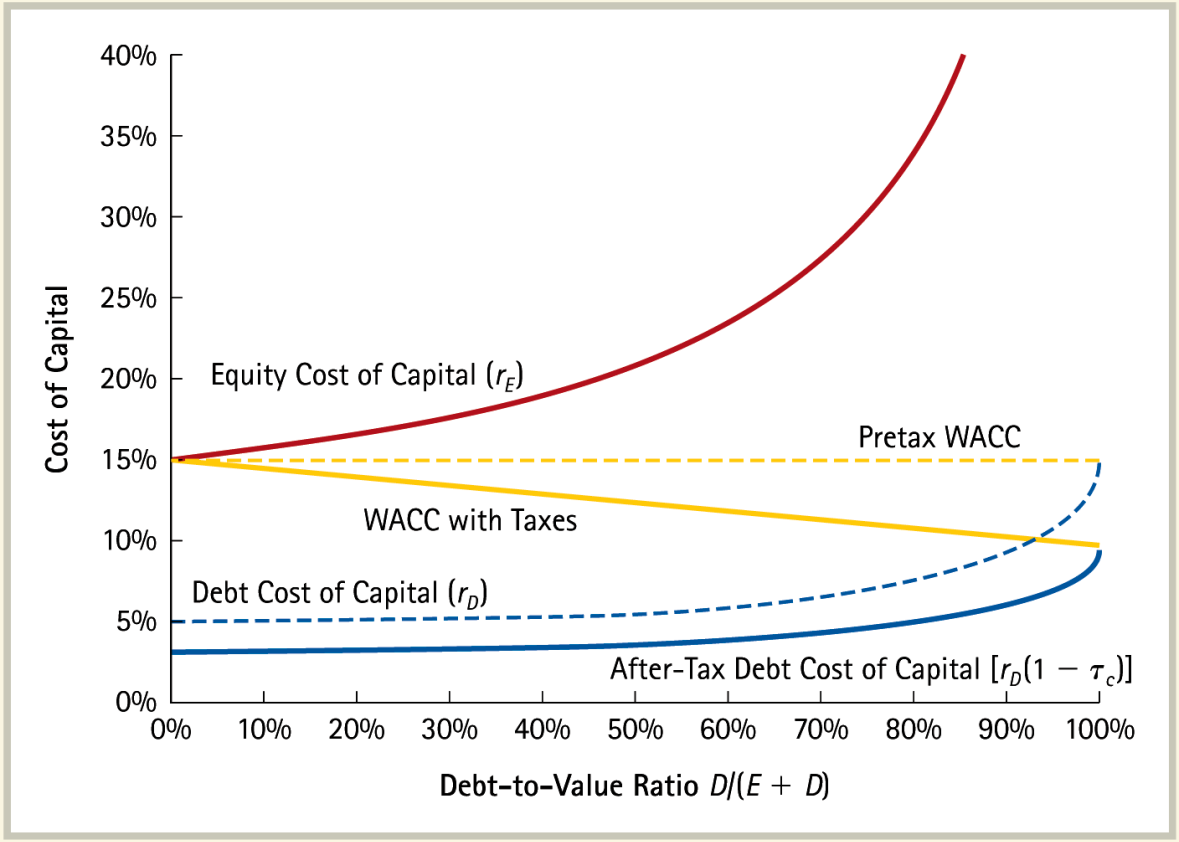
$$V^L = V^U + \tau_c D$$

The Weighted Average Cost of Capital with Taxes

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

$$r_{wacc} = \underbrace{\frac{E}{E+D} r_E + \frac{D}{E+D} r_D}_{\text{Pretax WACC}} - \underbrace{\frac{D}{E+D} r_D \tau_c}_{\text{ReductionDue to Interest Tax Shield}}$$

The WACC with and without Corporate Taxes



Interest Tax Shield with a Target Debt-Equity Ratio

- The value of the interest tax shield can be found by comparing the value of the levered firm, V^L, to the unlevered value, V^U, of the free cash flow discounted at the firm's unlevered cost of capital, the pretax WACC.

$$PV(InterestTaxShield) = V_L - V_U$$

Example

Valuing the Interest Tax Shield with a Target Debt-Equity Ratio

Problem

Western Lumber Company expects to have free cash flow in the coming year of $4.25 million, and its free cash flow is expected to grow at a rate of 4% per year thereafter. Western Lumber has an equity cost of capital of 10% and a debt cost of capital of 6%, and it pays a corporate tax rate of 35%. If Western Lumber maintains a debt-equity ratio of 0.50, what is the value of its interest tax shield?

Solution

We can estimate the value of Western Lumber's interest tax shield by comparing its value with and without leverage. We compute its unlevered value by discounting its free cash flow at its pretax WACC:

$$\text{Pretax WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = \frac{1}{1+0.5} 10\% + \frac{0.5}{1+0.5} 6\% = 8.67\%$$

Because Western Lumber's free cash flow is expected to grow at a constant rate, we can value it as a constant growth perpetuity:

$$V^U = \frac{4.25}{8.67\% - 4\%} = \$91 \text{ million}$$

To compute Western Lumber's levered value, we calculate its WACC:

$$\begin{aligned} \text{WACC} &= \frac{E}{E+D} r_E + \frac{D}{E+D} r_D(1 - \tau_c) \\ &= \frac{1}{1+0.5} 10\% + \frac{0.5}{1+0.5} 6\%(1 - 0.35) = 7.97\% \end{aligned}$$

Thus Western Lumber's value including the interest tax shield is

$$V^L = \frac{4.25}{7.97\% - 4\%} = \$107 \text{ million}$$

The value of the interest tax shield is therefore

$$PV(\text{Interest Tax Shield}) = V^L - V^U = 107 - 91 = \$16 \text{ million}$$

Leverage and the Equity Cost of Capital

- The return on unlevered equity (R_U) is related to the returns of levered equity (R_E) and debt (R_D):

$$\frac{E}{E + D(1-\tau_c)} R_E + \frac{D(1-\tau_c)}{E + D(1-\tau_c)} R_D = R_U$$

$$R_E = \underbrace{R_U}_{\text{Risk without leverage}} + \underbrace{\frac{D}{E}(R_U - R_D)(1-\tau_c)}_{\text{Additional risk due to leverage}}$$

Recapitalizing to Capture the Tax Shield

- Assume that Midco Industries has 20 million shares outstanding with a market price of $15 per share and no debt. Midco pays a 35% tax rate. Management plans to borrow $100 million on a permanent basis and they will use the borrowed funds to repurchase outstanding shares.

Tax Benefit

- Without leverage
  - V^U = (20 million shares) $\times$ ($15/share) = $300million
- With Leverage

PV(interest tax shield) = $\tau_c D$ = 35% $\times$ $100 million = $35 million

$V^L = V^U + \tau_c D$ = $300 million + $35 million = $335 million

$E = V^L - D$ = $335 million − $100 million = $235 million

The Share Repurchase

- Assume Midco repurchases its shares at the current price of $15/share. The firm will repurchase

  $100 million ÷ $15/share = 6.67 million shares

- It will then have 13.33 million shares outstanding.

  20 million − 6.67 million = 13.33 million

- The total value of equity is $235 million; therefore the new share price is $17.625/share.

  $235 million ÷ 13.33 million shares = $17.625

The Share Repurchase

- The total gain to shareholders is $35 million.
  - $2.625/share × 13.33 million shares = $35 million
- If the shares are worth $17.625/share after the repurchase, why would shareholders tender their shares to Midco at $15/share?

The Share Repurchase

- Realistically, the value of the Midco's equity will rise immediately from $300 million to $335 million after the repurchase announcement. With 20 million shares outstanding, the share price will rise to $335 million ÷ 20 million shares = $16.75 per share

The Share Repurchase

- The benefit of the interest tax shield goes to all 20 million of the original shares outstanding for a total benefit of $35 million.
  - $1.75/share × 20 million shares = $35 million
- *When securities are fairly priced, the original shareholders of a firm capture the full benefit of the interest tax shield from an increase in leverage.*

Example

Alternative Repurchase Prices

Problem

Suppose Midco announces a price at which it will repurchase $100 million worth of its shares. Show that $16.75 is the lowest price it could offer and expect shareholders to tender their shares. How will the benefits be divided if Midco offers more than $16.75 per share?

Solution

For each repurchase price, we can compute the number of shares Midco will repurchase, as well as the number of shares that will remain after the share repurchase. Dividing the $235 million total value of equity by the number of remaining shares gives Midco's new share price after the transaction. No shareholders will be willing to sell their shares unless the repurchase price is at least as high as the share price after the transaction; otherwise, they would be better off waiting to sell their shares. As the table shows, the repurchase price must be at least $16.75 for shareholders to be willing to sell rather than waiting to receive a higher price.

Repurchase Price ($/share)	**Shares Repurchased (million)**	**Shares Remaining (million)**	**New Share Price ($/share)**
P_R	$R = 100/P_R$	$N = 20 - R$	$P_N = 235/N$
15.00	6.67	13.33	$17.63
16.25	6.15	13.85	16.97
16.75	5.97	14.03	16.75
17.25	5.80	14.20	16.55
17.50	5.71	14.29	16.45

If Midco offers a price above $16.75, then all existing shareholders will be eager to sell their shares, because the shares will have a lower value after the transaction is completed. In this case, Midco's offer to repurchase shares will be oversubscribed and Midco will need to use a lottery or some other rationing mechanism to choose from whom it will repurchase shares. In that case, more of the benefits of the recap will go to the shareholders who are lucky enough to be selected for the repurchase.

Personal Taxes

- The cash flows to investors are typically taxed twice. Once at the corporate level and then investors are taxed again when they receive their interest or dividend payment.
  - Interest payments received from debt are taxed as income.
  - Equity investors also must pay taxes on dividends and capital gains.

Including Personal Taxes in the Interest Tax Shield

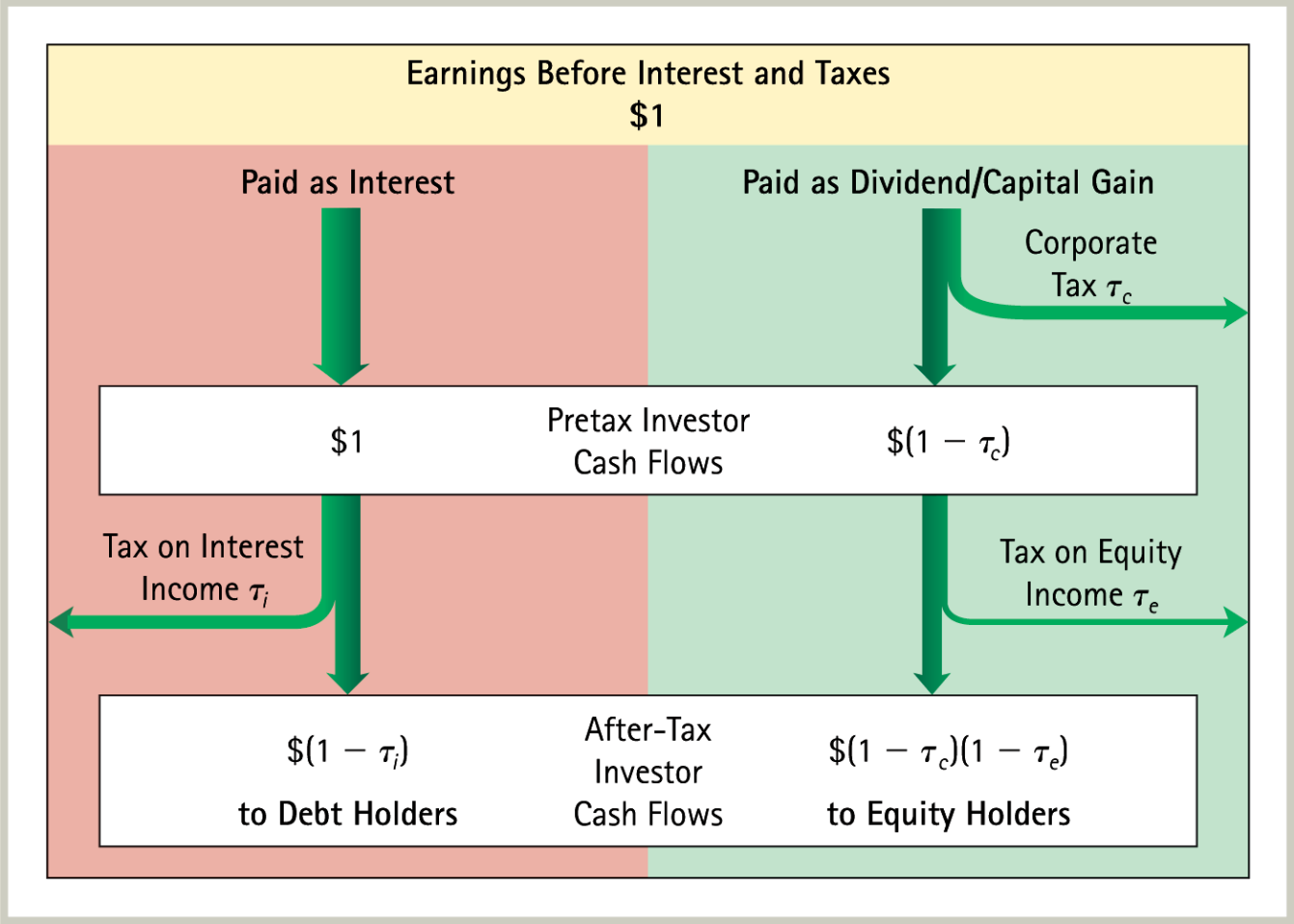
- Personal taxes reduce the cash flows to investors and can offset some of the corporate tax benefits of leverage.
- The actual interest tax shield depends on both corporate and personal taxes that are paid.

TABLE 15.3 **Top Federal Tax Rates in the United States, 1971–2005**

Year	Corporate Tax Rate†	Personal Tax Rates*			
		Interest Income	Average Rate on Equity Income	Dividends	Capital Gains
1971–1978	48%	70%	53%	70%	35%
1979–1981	46%	70%	49%	70%	28%
1982–1986	46%	50%	35%	50%	20%
1987	40%	39%	33%	39%	28%
1988–1990	34%	28%	28%	28%	28%
1991–1992	34%	31%	30%	31%	28%
1993–1996	35%	40%	34%	40%	28%
1997–2000	35%	40%	30%	40%	20%
2001–2002	35%	39%	30%	39%	20%
2003–2005	35%	35%	15%	15%	15%

*Interest income is taxed as ordinary income. Until 2003, dividends were also taxed as ordinary income. The average tax rate on equity income is an average of dividend and capital gain tax rates (consistent with a 50% dividend payout ratio and annual realization of capital gains), where the capital gain tax rate is the long-term rate applicable to assets hold more than one year.

†The corporate rate shown is for C corporations with the highest level of income. Marginal rates can be higher for lower brackets. (For example, since 2000, the 35% tax rate applies to income levels above $18.3 million, while the tax rate for income levels between $100,000 and $335,000 is 39%.)



After-Tax Investor Cash Flows Resulting from $1 in EBIT

Including Personal Taxes in the Interest Tax Shield

$$\tau^* = \frac{(1-\tau_i) - (1-\tau_c)(1-\tau_e)}{(1-\tau_i)}$$

$$= 1 - \frac{(1-\tau_c)(1-\tau_e)}{(1-\tau_i)}$$

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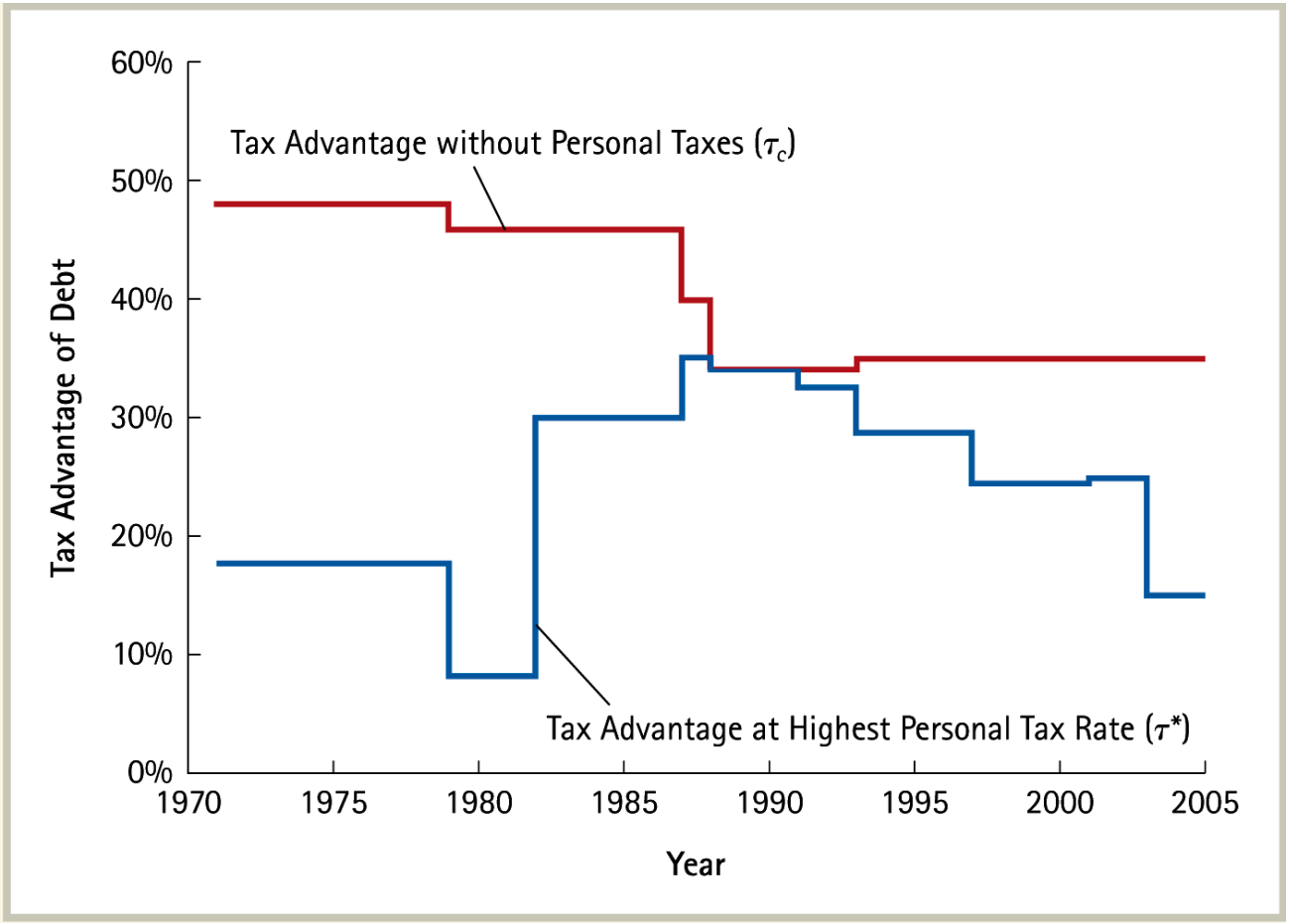
The Effective Tax Advantage of Debt with and without Personal Taxes, 1971–2005



Including Personal Taxes in the Interest Tax Shield

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

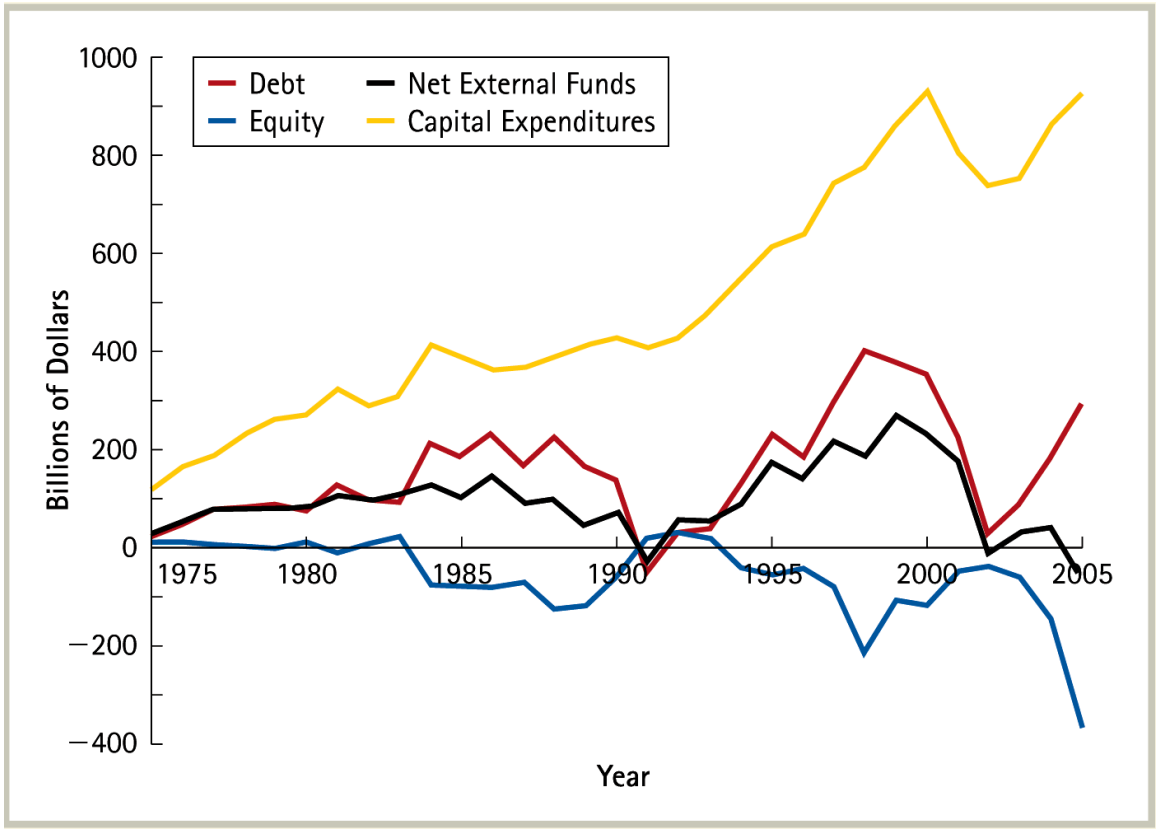
$$V^L = V^U + \tau^* D$$

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

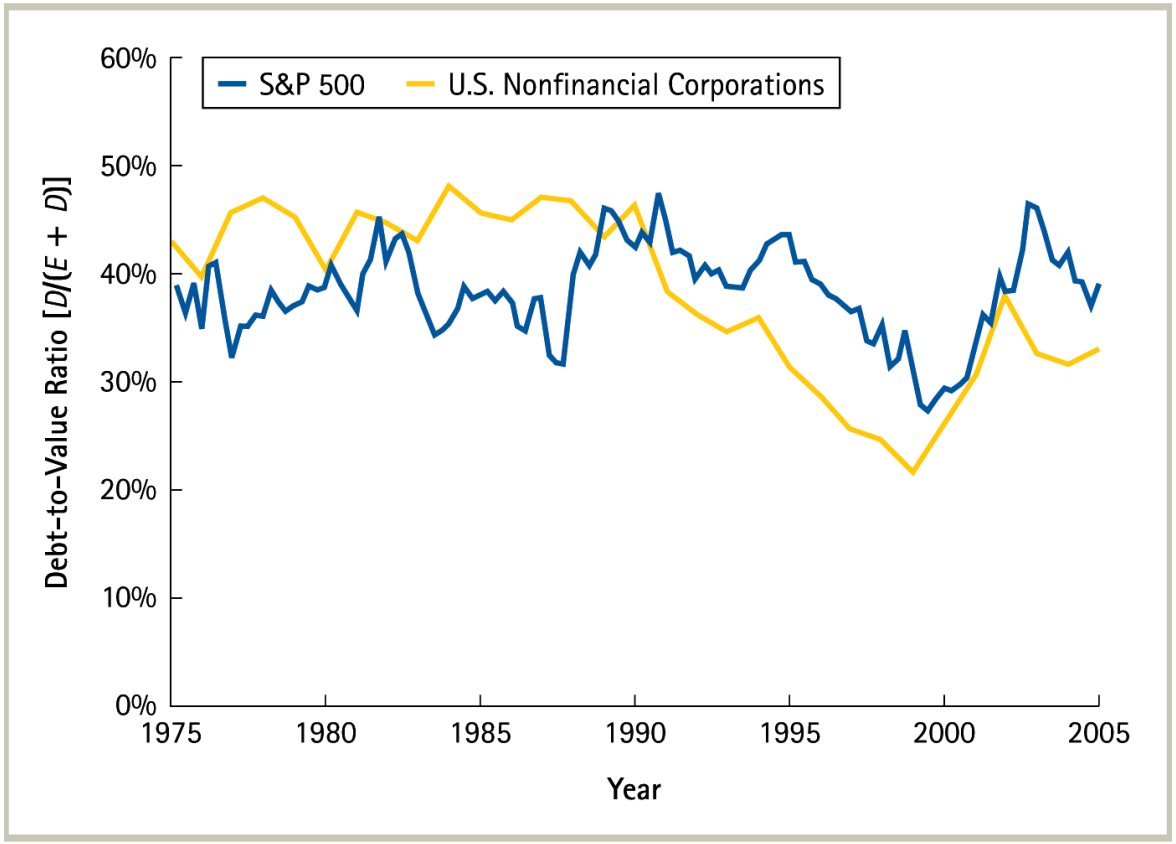
$$r_{wacc} = \frac{E}{E+D} r_E^* + \frac{D}{E+D} r_D^* (1 - \tau_c)$$

Optimal Capital Structure with Taxes

- Do Firms Prefer Debt?

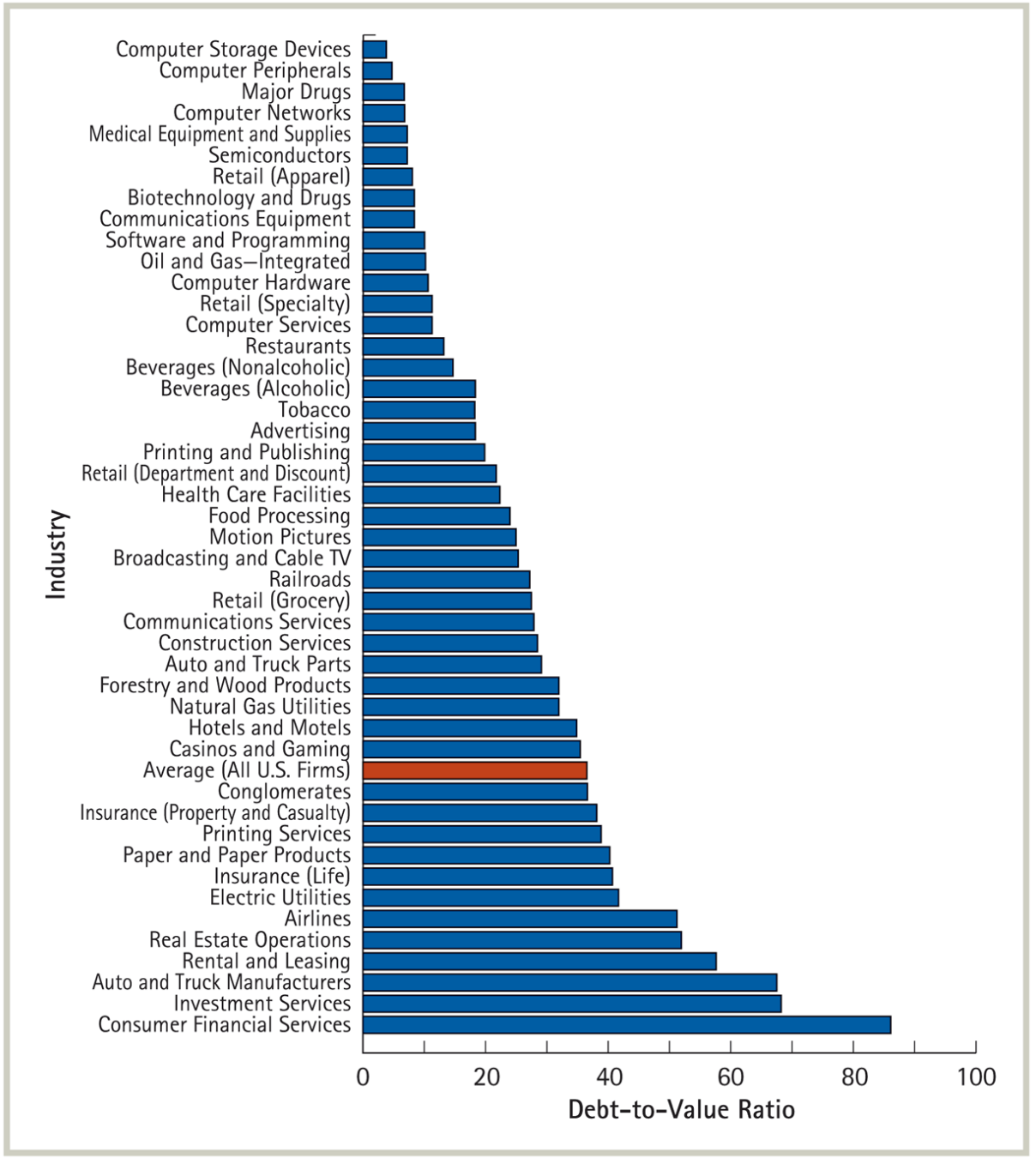


Net External Financing and Capital Expenditures by U.S. Corporations, 1975–2005



Debt-to-Value Ratio
[*D* / (*E* + *D*)] of U.S. Firms, 1975–2005

Firms in growth industries like biotechnology or high technology carry very little debt, while airlines, automakers, utilities, and financial firms have high leverage ratios.



Limits to the Tax 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 Tax Benefit of Debt

TABLE 15.4 Tax Savings with Different Amounts of Leverage

	No Leverage	High Leverage	Excess Leverage
EBIT	$1,000	$1,000	$1,000
Interest expense	0	−1,000	−1,100
Income before tax	1,000	0	0
Taxes (35%)	−350	0	0
Net income	650	0	−100
Tax savings from leverage	$0	$350	$350

Limits to the Tax Benefit of Debt

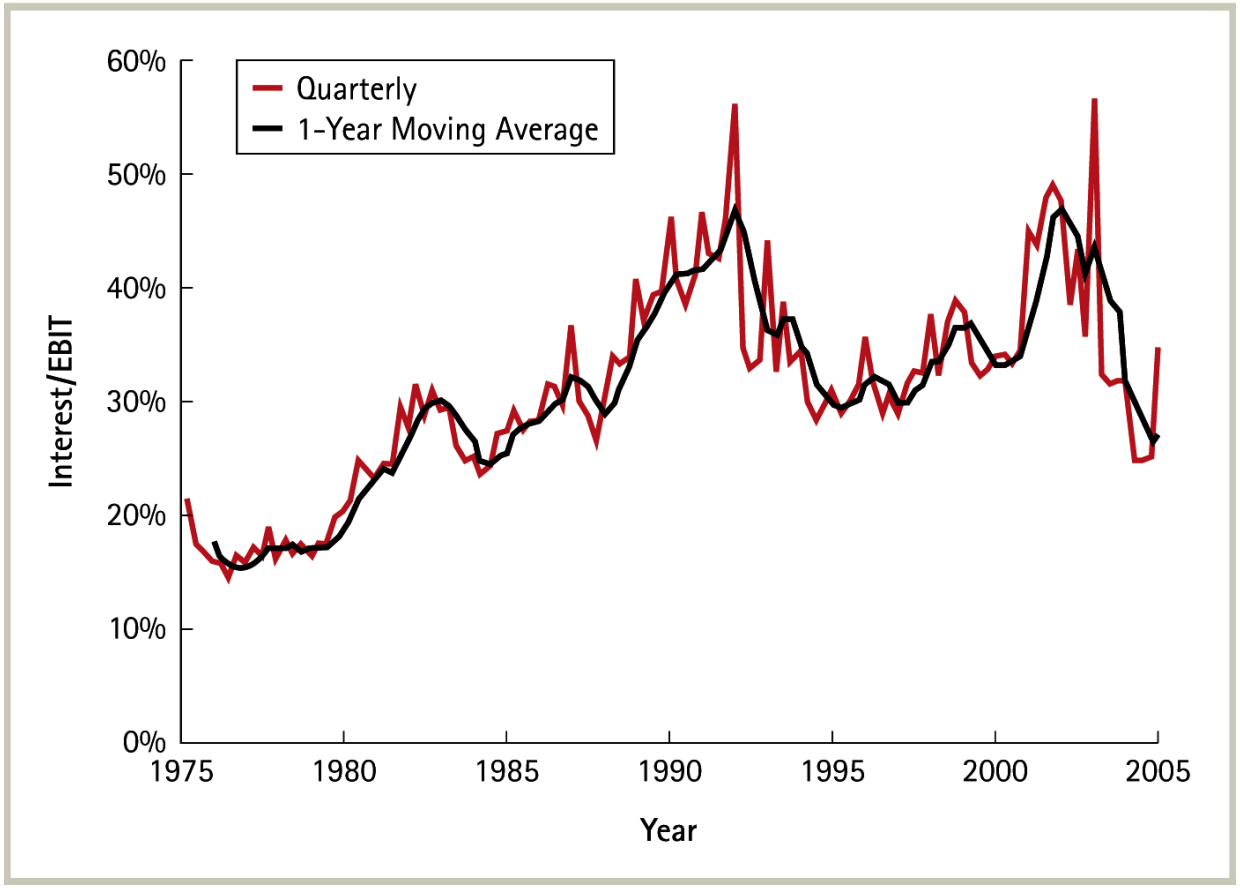
- No corporate tax benefit arises from incurring interest payments that exceed EBIT.
- If the firm is not paying taxes, where $\tau_c = 0$, then the tax disadvantage of excess leverage is:

$$\tau_{ex}^{*} = 1 - \frac{(1 - \tau_e)}{(1 - \tau_i)} = \frac{\tau_e - \tau_i}{(1 - \tau_i)} < 0$$

Limits to the Tax Benefit of Debt

- *The optimal level of leverage from a tax saving 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.

Interest Payments as a Percentage of EBIT for S&P 500 Firms, 1975–2005



The Low Leverage Puzzle

- It would appear that firms, on average, are under-leveraged. However, it is hard to accept that most firms are acting suboptimally.
- Increasing the level of debt increases the probability of bankruptcy. The bankruptcy costs might offset the tax advantages of debt financing.

Summary: No Taxes

- In a world of no taxes, the value of the firm is unaffected by capital structure.
- This is M&M Proposition I:

$$V_L = V_U$$

- In a world of no taxes, M&M Proposition II states that leverage increases the risk and return to stockholders

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

Summary: Taxes

- In a world of taxes, but no bankruptcy costs, the value of the firm increases with leverage.
- This is M&M Proposition I:

$$V_L = V_U + T_C D$$

- In a world of taxes, M&M Proposition II states that leverage increases the risk and return to stockholders.

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