Capital Structure (Chapter 14) — Lecture Notes

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Figures from slides

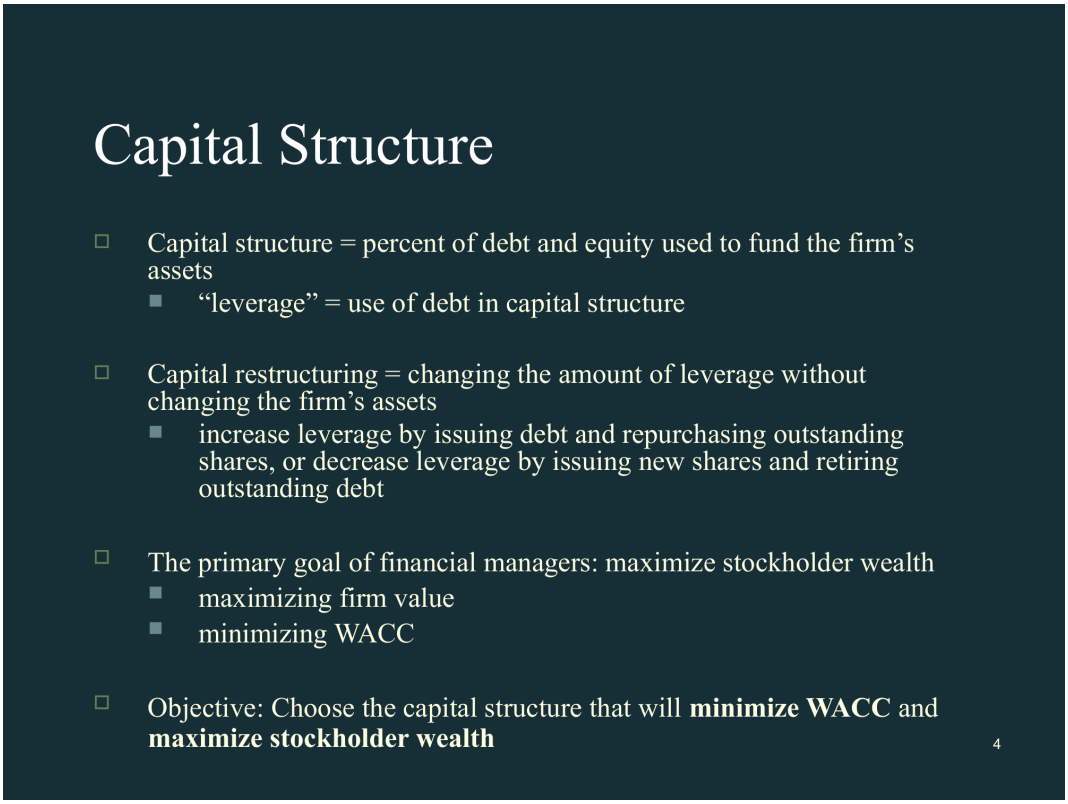


Figure 1: Capital structure definitions and objective: minimize WACC, maximize firm value.

Executive summary (exam-useful)

- **Capital structure** is the mix of debt and equity financing; **leverage** means using debt; **restructuring** changes leverage without changing assets (e.g., issue debt and repurchase shares).
- Managerial objective in this chapter: choose financing to **minimize WACC** and thereby **maximize firm value** (stockholder wealth), subject to real-world frictions.
- **Leverage increases equity risk**: EPS and ROE become more sensitive to EBIT; downside worsens in recessions, upside improves in expansions.
- **EPS break-even EBIT** (no taxes) separates regions where debt raises vs. lowers EPS; *but EPS maximization is not value maximization.*
- **Beta/levering relation**: asset beta is a value-weighted average of debt and equity betas; if $\beta_D \approx 0$, then $\beta_E = \beta_A(1 + D/E)$ (leverage increases equity beta).

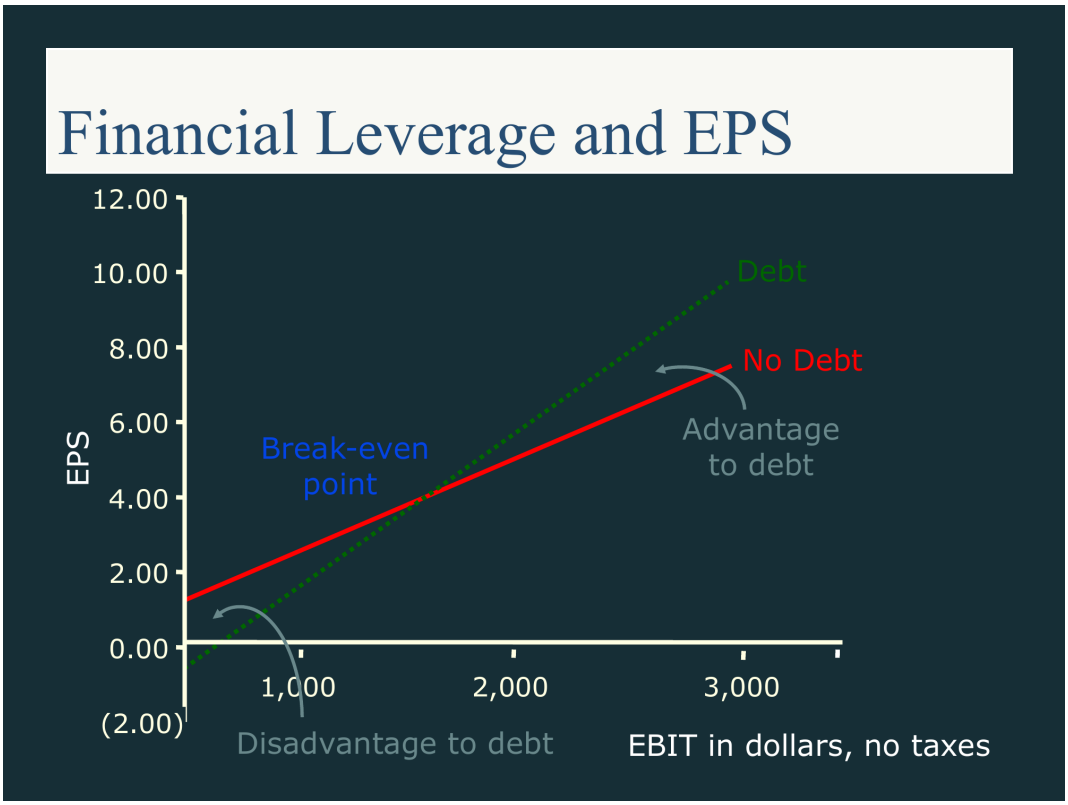


Figure 2: EPS vs. EBIT (no taxes): break-even EBIT where leverage switches from EPS-disadvantage to EPS-advantage.

- **MM Case I (no taxes, no distress)**: Prop I $\Rightarrow$ firm value invariant to capital structure; Prop II $\Rightarrow$ R_E rises linearly with D/E so **WACC stays constant** at R_0.
- **Homemade leverage**: investors can replicate firm leverage on their own in perfect markets; hence financing choice cannot create value in Case I.
- **MM Case II (corporate taxes, no distress)**: interest tax deductibility creates value: $V_L = V_U + T_C D$; WACC declines with leverage; extreme implication: **100% debt** is optimal (in this stylized case).
- **Case III (taxes + bankruptcy/distress costs)**: increasing D/E raises expected distress costs; optimal debt is where marginal tax-shield benefit equals marginal expected distress cost (static tradeoff theory).
- **Pecking order theory** (information asymmetry): internal funds first, then debt, equity last; predicts no target D/E and profitable firms borrow less (because they do not need external finance).

Definitions & notation (glossary)

- D (or B): market value of debt (slides use B); E (or S): market value of equity (slides use S); $V = D + E$.

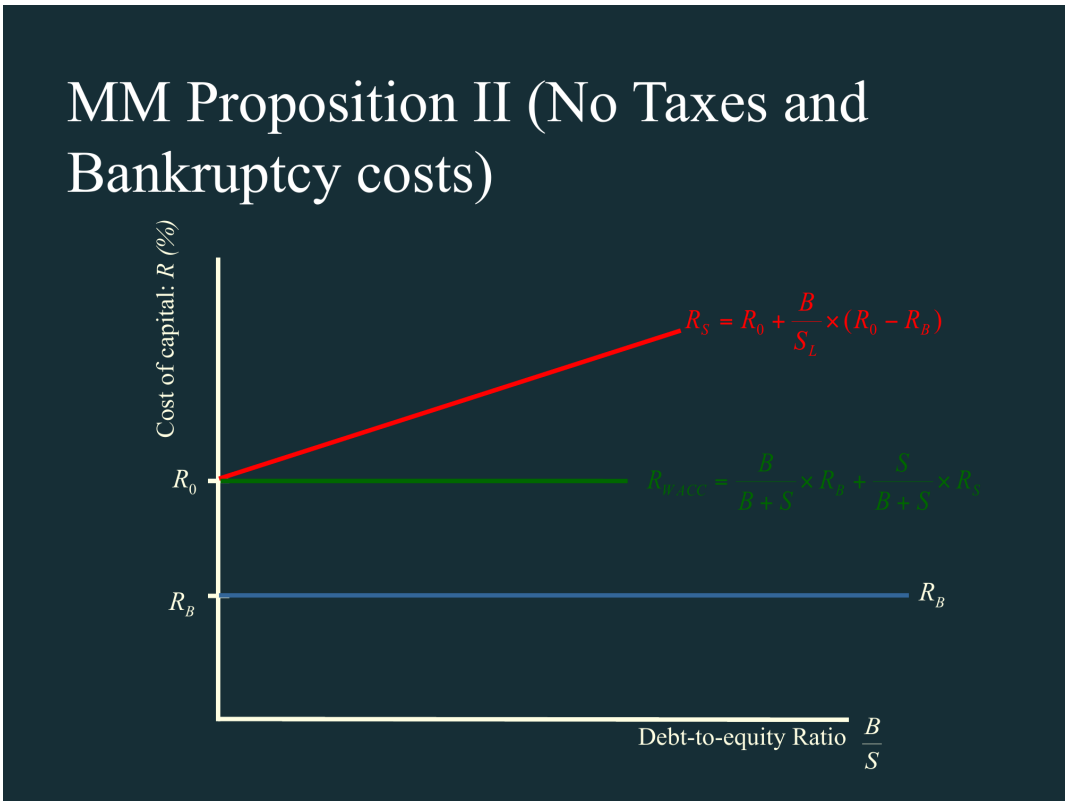


Figure 3: MM Prop II (no taxes): R_E increases with D/E, R_D flat, and $WACC$ constant at R_0.

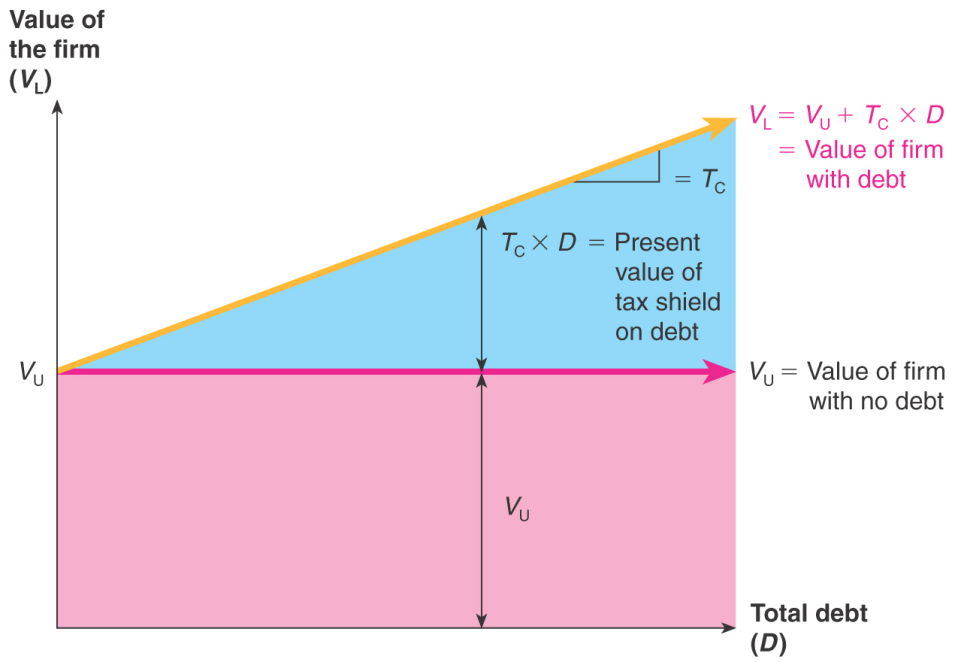
- D/E: debt-to-equity ratio (leverage ratio). **Trap:** do not confuse with D/V or E/V.
- R_D (or R_B): cost of debt (required return on debt); R_E (or R_S): cost of equity (required return on levered equity).
- R_0: unlevered cost of capital (required return on assets; "business risk").
- R_{WACC}: weighted average cost of capital.
- T_C: corporate tax rate.
- $EBIT$: earnings before interest and taxes; $EBT = EBIT - \text{Interest}$.
- $\beta_A, \beta_E, \beta_D$: asset, equity, and debt betas (CAPM systematic risk measures).
- **Financial distress costs**: direct (legal/admin, fire sales) and indirect (lost sales, impaired operations, agency conflicts).

Core theory + formulas

1) Leverage, EPS/ROE sensitivity, and break-even EBIT (no taxes)

With fixed interest expense $I = R_D D$, net income (no taxes) is

$$NI = EBIT - I.$$



The value of the firm increases as total debt increases because of the interest tax shield. This is the basis of M&M Proposition I with taxes.

Figure 4: MM Prop I (with corporate taxes): $V_L = V_U + T_C D$ (linear increase in firm value with debt).

Earnings per share:

$$EPS = \frac{NI}{N} = \frac{EBIT - I}{N},$$

where N is shares outstanding.

EPS break-even EBIT (comparing two capital structures 1 and 2, no taxes). Let (I_1, N_1) and (I_2, N_2) denote interest and shares. Solve

$$\frac{EBIT - I_1}{N_1} = \frac{EBIT - I_2}{N_2} \quad \Rightarrow \quad EBIT^* = \frac{N_1 I_2 - N_2 I_1}{N_1 - N_2}.$$

Interpretation: for $EBIT > EBIT^*$, the structure with higher leverage (typically higher I but lower N) can have higher EPS; for $EBIT < EBIT^*$, leverage hurts EPS.

ROA and ROE (as used in slides). If assets are A and equity is E:

$$ROA = \frac{NI}{A}, \qquad ROE = \frac{NI}{E}.$$

Trap: in practice ROA is often computed using operating income and average assets; here slides use net income and (implicitly) book/market levels given in the setup.

2) Leverage and beta (CAPM risk decomposition)

Value-weighted beta identity:

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

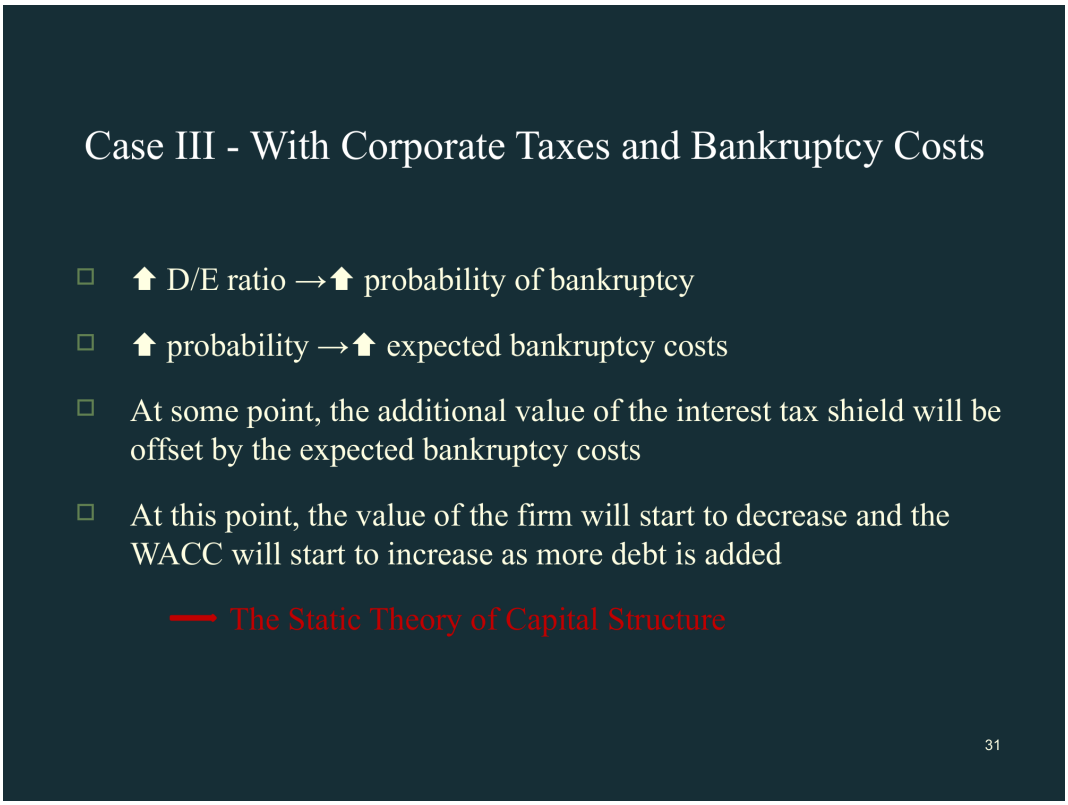


Figure 5: Tradeoff theory (tax shield vs. distress costs): firm value maximized at an interior optimal debt level.

If $\beta_D \approx 0$ (riskless or very low systematic risk debt), then

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

Exam note: if $\beta_D \neq 0$, solve the general equation:

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

3) Modigliani–Miller (MM) Case I: no taxes, no bankruptcy costs

Proposition I (Pie model).

$$V_L = V_U \quad \text{(capital structure irrelevance)}.$$

Logic: cash flows to the firm and asset risk are unchanged; in perfect markets, slicing the pie differently does not change pie size.

Proposition II (cost of equity increases with leverage).

$$R_E = R_0 + \frac{D}{E}(R_0 - R_D).$$

WACC invariance (Case I).

$$R_{\text{WACC}} = \frac{E}{V}R_E + \frac{D}{V}R_D = R_0.$$

Decomposition:

$$R_E = \underbrace{R_0}_{\text{business risk}} + \underbrace{\frac{D}{E}(R_0 - R_D)}_{\text{financial risk premium}}.$$

4) Homemade leverage (replication argument)

In perfect markets, an investor can replicate levered equity payoffs by:

- buying shares of the unlevered firm and borrowing personally (margin) to match the firm's D/E, or
- buying shares of the levered firm and lending (buying some of its debt) to "unlever" exposure.

Hence, no arbitrage implies identical values for levered vs. unlevered firms in Case I.

5) MM Case II: corporate taxes, no bankruptcy costs

Interest is tax deductible, creating an **interest tax shield**:

$$\text{Tax shield each period} = T_C \cdot (R_D D).$$

Under the standard MM assumption of perpetual debt with constant D and discounting the tax shield at R_D (or equivalently treating it as as risky as debt), PV of tax shield is:

$$PV(\text{tax shield}) = T_C D.$$

Proposition I with taxes.

$$V_L = V_U + T_C D.$$

WACC with taxes.

$$R_{\text{WACC}} = \frac{E}{V}R_E + \frac{D}{V}R_D(1 - T_C).$$

Implication in Case II: as D increases, the after-tax cost of debt is lower, so R_{WACC} decreases and firm value increases monotonically $\Rightarrow$ corner solution "100% debt" (stylized).

6) Case III: taxes + bankruptcy/distress costs (static tradeoff theory)

Let $PV(\text{Distress Costs}(D))$ be increasing and convex in D (via higher bankruptcy probability and severity). Then:

$$V(D) = V_U + PV(\text{Tax Shield}(D)) - PV(\text{Distress Costs}(D)).$$

Optimal debt D^* satisfies the marginal condition:

$$\frac{d}{dD}PV(\text{Tax Shield}(D)) = \frac{d}{dD}PV(\text{Distress Costs}(D)).$$

Qualitative: beyond D^*, expected distress costs dominate; firm value falls and WACC rises.

7) Pecking order theory (information asymmetry)

Financing preference ordering:

$$\text{Internal funds} \succ \text{Debt} \succ \text{Equity}.$$

Equity issuance can be interpreted as a negative signal (managers issue equity when they believe shares are overpriced), causing price drops; thus firms avoid equity unless necessary. Predicts:

- no stable target D/E,
- profitable firms use less debt (they have internal cash),
- firms value financial slack (unused debt capacity/cash).

Tables reproduced from slides (key computations)

A) Capital restructuring example: current vs. proposed

Table 1: Current (unlevered) vs. proposed (levered) structure after borrowing \$8,000 and repurchasing 160 shares at \$50.

	Current	**Proposed**
Assets	\$20,000	\$20,000
Debt D	\$0	\$8,000
Equity E	\$20,000	\$12,000
Debt/Equity D/E	0.00	2/3
Interest rate R_D	n/a	8%
Shares outstanding N	400	240
Share price	\$50	\$50

B) EPS and ROE under current (all-equity) structure

Table 2: Current structure (no debt): EPS/ROA/ROE across states.

	Recession	**Expected**	**Expansion**
$EBIT$	1,000	2,000	3,000
Interest	0	0	0
Net income NI	1,000	2,000	3,000
$EPS = NI/N$ $(N = 400)$	2.50	5.00	7.50
ROA	5%	10%	15%
ROE	5%	10%	15%

Table 3: Proposed structure: $D = 8{,}000$ at $8\% \Rightarrow I = 640$; $N = 240$.

	Recession	**Expected**	**Expansion**
$EBIT$	1,000	2,000	3,000
Interest I	640	640	640
Net income NI	360	1,360	2,360
$EPS = NI/N$ $(N = 240)$	1.50	5.67	9.83
ROA	1.8%	6.8%	11.8%
ROE	3.0%	11.3%	19.7%

Table 4: After-tax cash flows: unlevered vs. levered; levered total to investors includes interest to bondholders.

All-equity firm			
	Recession	**Expected**	**Expansion**
$EBIT$	1,000	2,000	3,000
Interest	0	0	0
EBT	1,000	2,000	3,000
Taxes $(0.35 \times EBT)$	350	700	1,050
Total CF to S/H (NI)	650	1,300	1,950
Levered firm: $D = 8{,}000$, $R_D = 8\%$, $I = 640$			
$EBIT$	1,000	2,000	3,000
Interest	640	640	640
EBT	360	1,360	2,360
Taxes $(0.35 \times EBT)$	126	476	826
CF to S/H (NI)	234	884	1,534
CF to B/H (interest)	640	640	640
Total CF to (S/H + B/H)	874	1,524	2,174

C) EPS and ROE under proposed (levered) structure

D) Total cash flow to investors with corporate taxes ($T_C = 35\%$)

Procedures (step-by-step)

1) Compute EPS/ROE impact of a leverage change (given EBIT scenarios)

1. Identify D, R_D, and compute interest expense $I = R_D D$ (careful: per period).
2. For each EBIT scenario, compute $EBT = EBIT - I$.
3. If taxes apply, compute $NI = EBT(1 - T_C)$; if no taxes, $NI = EBT$.
4. Compute $EPS = NI/N$ using the correct shares outstanding *after* repurchase/issuance.
5. Compute $ROE = NI/E$ using the equity value consistent with the scenario (slides use the post-restructuring equity level).
6. Compare volatility across states: leverage increases sensitivity of EPS and ROE to $EBIT$.

2) Find EPS break-even EBIT between two structures (no taxes)

1. Write $EPS_i = (EBIT - I_i)/N_i$ for $i \in \{1, 2\}$.
2. Set $EPS_1 = EPS_2$ and solve:
$$EBIT^* = \frac{N_1 I_2 - N_2 I_1}{N_1 - N_2}.$$
3. Interpret regions: if $EBIT$ is expected to be mostly above $EBIT^*$, leverage tends to raise EPS; otherwise it lowers EPS.
4. **Exam warning:** EPS criterion ignores risk and discount rates; value depends on cash flows *and* required returns.

3) Use MM Prop II (no taxes) to compute R_E given R_0, R_D, and leverage

1. Compute D/E from the target weights: if given D/V and E/V, then $D/E = (D/V)/(E/V)$.
2. Apply:
$$R_E = R_0 + \frac{D}{E}(R_0 - R_D).$$
3. Verify WACC invariance (Case I):
$$R_{\text{WACC}} = \frac{E}{V}R_E + \frac{D}{V}R_D \stackrel{?}{=} R_0.$$

4) Value with taxes (MM Case II) for perpetual debt

1. Compute unlevered value V_U from unlevered free cash flows discounted at R_0 (not detailed on slides, but standard DCF).
2. Compute PV of tax shield: $PV(\text{TS}) = T_C D$ (under MM assumptions).
3. Obtain levered value:
$$V_L = V_U + T_C D.$$
4. If asked for WACC with taxes, use:
$$R_{\text{WACC}} = \frac{E}{V}R_E + \frac{D}{V}R_D(1 - T_C).$$

Canonical examples (symbolic)

Example 1: Ricardo (MM Case I, no taxes) — compute R_E under two target structures

Given $R_{\text{WACC}} = R_0 = 12\%$, $R_D = 8\%$.

(i) Target: $E/V = 0.8$, $D/V = 0.2$. Compute $D/E = (0.2/0.8) = 0.25$. Then

$$R_E = 0.12 + 0.25(0.12 - 0.08) = 0.12 + 0.25(0.04) = 0.13 = 13\%.$$

Check WACC:

$$R_{\text{WACC}} = 0.8(0.13) + 0.2(0.08) = 0.104 + 0.016 = 0.12.$$

(ii) Target: $E/V = 0.5$**,** $D/V = 0.5$**.** Compute $D/E = (0.5/0.5) = 1$. Then

$$R_E = 0.12 + 1(0.12 - 0.08) = 0.16 = 16\%.$$

Check WACC:

$$R_{\text{WACC}} = 0.5(0.16) + 0.5(0.08) = 0.08 + 0.04 = 0.12.$$

Conclusion (Case I): R_E increases with leverage, exactly offsetting the heavier debt weight; WACC stays at 12%.

Example 2: Levering/unlevering beta (assuming $\beta_D = 0$)

Given $\beta_A = 0.8$ and target $D/E = 0.5$:

$$\beta_E = \beta_A(1 + D/E) = 0.8(1.5) = 1.2.$$

Interpretation: leverage increases systematic risk borne by equity.

Pitfalls / exam traps

- **Market vs. book values:** MM and WACC formulas use *market* values D, E unless explicitly stated otherwise.
- **Notation trap:** slides use B for debt and S for equity; many texts use D and E. Keep consistent within a solution.
- **WACC tax adjustment:** only the *debt* component is multiplied by $(1 - T_C)$ in the standard corporate-tax WACC:

  $$R_{\text{WACC}} = \frac{E}{V}R_E + \frac{D}{V}R_D(1 - T_C).$$

  Do *not* tax-adjust R_E directly.
- **EPS vs. value:** higher expected EPS under leverage does not imply higher firm value; required return R_E rises with leverage (risk).
- **Break-even EBIT:** ensure consistent timing and that interest is per period; do not mix annual interest with quarterly EBIT.
- **Homemade leverage logic:** replication requires perfect markets (same borrowing/lending rates, no taxes/transaction costs). If assumptions fail, MM irrelevance can fail.
- **Tax shield PV:** $PV(\text{TS}) = T_C D$ relies on perpetual, fixed debt and discounting at R_D (or equivalent MM assumptions). If debt is changing or risky, PV differs.
- **Financial distress vs. bankruptcy:** distress costs can occur *before* formal bankruptcy (lost customers, supplier terms, employee departures).
- **Agency costs in distress:** underinvestment and risk shifting are indirect distress costs; they push optimal leverage lower than the pure tax-shield case.

Quick checklist (before submitting an exam solution)

- Did I define D, E, V and confirm whether values are market or book?
- Did I compute D/E correctly from given weights ($D/E = (D/V)/(E/V)$)?
- For EPS/ROE tables: did I use correct shares outstanding *after* repurchase/issuance and correct interest $I = R_D D$?
- If taxes: did I compute $NI = EBT(1 - T_C)$ and apply $(1 - T_C)$ only to the debt term in WACC?
- If using MM Case I: did I keep $R_{\text{WACC}} = R_0$ and adjust R_E via Prop II?
- If using MM with taxes: did I add $T_C D$ to V_U (under the stated assumptions)?
- Did I explicitly state which case (I/II/III) assumptions apply?
- Did I mention (if relevant) that EPS improvements come with higher risk (R_E, β_E increase)?