Financial Management

Global Glossary (Symbols and Notation)

- Time and cash flows:
  - t: time index; $t = 0$ is "today".
  - n: number of periods (often years); N: number of periods (often used when compounding frequency differs from years).
  - CF_t: cash flow at time t (positive = inflow to the decision-maker; negative = outflow).
  - PV: present value at the valuation date (typically $t = 0$).
  - FV: future value at a specified future date.
  - P_0: price/value at $t = 0$ (used for securities such as stocks/bonds).
  - TV_N: terminal value at time N (value at $t = N$ of cash flows from $N+1$ onward).
  - HV_N: horizon value at time N (synonym of terminal value in dividend models).
- Capital budgeting criteria:
  - $\text{NPV}(k) = \sum_{t=0}^{n} \dfrac{CF_t}{(1+k)^t}$: net present value at discount rate k.
  - IRR: internal rate(s) of return; any r such that $\text{NPV}(r) = 0$.
  - MIRR: modified internal rate of return (unique rate based on PV of outflows and FV of inflows).
  - PI: profitability index, typically $\text{PI} = \dfrac{\text{PV(future inflows)}}{\text{PV(outflows in abs. value)}}$; for conventional projects $\text{PI} = \dfrac{\sum_{t=1}^{n} \frac{CF_t}{(1+k)^t}}{|CF_0|}$.
  - EAA: equivalent annual annuity; converts an NPV over life n into an annuity: $\text{EAA} = \text{NPV} \cdot \dfrac{k}{1-(1+k)^{-n}}$.
- Rates and growth:
  - i: effective interest rate per period (TVM).
  - k: required return / opportunity cost of capital / discount rate (capital budgeting).
  - r: generic discount rate/required return (used in valuation and risk-return chapters).
  - r_f: risk-free rate.
  - RP: risk premium; typically $RP = \mathbb{E}[R] - r_f$; market risk premium $= \mathbb{E}[R_M] - r_f$.
  - g: constant growth rate (dividends or cash flows); requires $g < r$ (or $g < \text{WACC}$) for Gordon/terminal value formulas.
- Financial statements and cash flow components:
  - CA: current assets; CL: current liabilities; NWC = CA − CL.
  - ΔNWC: change in net working capital; typically $\Delta\text{NWC} > 0$ is a use of cash.
  - NFA: net fixed assets (fixed assets net of accumulated depreciation; book).
  - EBIT: earnings before interest and taxes; EBT: earnings before taxes; NI: net income.
  - Dep: depreciation expense (non-cash; creates tax shield).
  - OCF: operating cash flow (unlevered in these notes): $\text{OCF} = \text{EBIT} + \text{Dep} - \text{Taxes} = \text{EBIT}(1 - T_c) + \text{Dep}T_c$.
  - NCS: net capital spending: $\text{NCS} = (\text{NFA}_t - \text{NFA}_{t-1}) + \text{Dep}$ (book-based computation).
  - CFFA: cash flow from assets: $\text{CFFA} = \text{OCF} - \text{NCS} - \Delta\text{NWC}$.
  - FCF: free cash flow to the firm (project/firm DCF); in project form: $\text{FCF}_t = \text{OCF}_t - \text{CapEx}_t - \Delta\text{NWC}_t$ plus terminal after-tax salvage and NWC recovery.

  - Tax shield: reduction in taxes due to deductible expenses (e.g., interest or depreciation); depreciation tax shield in year t is $T_c \text{Dep}_t$.
- Valuation and capital structure:
  - D: market value of debt; E: market value of equity; $V = D + E$ (or $V = D + E + P$ if preferred exists).
  - D/E: debt-to-equity ratio; D/V and E/V are capital structure weights.
  - WACC: weighted average cost of capital: $\text{WACC} = w_E r_E + w_D r_D (1 - T_c) + w_P r_P$ (market-value weights).
  - r_D: cost of debt (pre-tax, typically YTM); after-tax cost is $r_D(1 - T_c)$.
  - r_E: cost of equity (required return on equity).
  - D_0, D_1: dividend just paid (D_0) and next dividend ($D_1 = D_0(1 + g)$).
  - β: beta (systematic risk); $\beta_i = \dfrac{\text{Cov}(R_i, R_M)}{\text{Var}(R_M)}$.
- Accounting values and market values:
  - BV: book value (accounting carrying value).
  - MV: market value (current market price $\times$ quantity).
- Financial ratios (Chapter 3):
  - $\text{ROE} = \dfrac{\text{NI}}{E}$ (book equity in ratio analysis context); $\text{ROA} = \dfrac{\text{NI}}{A}$ (book assets).
  - $\text{PM} = \dfrac{\text{NI}}{Sales}$ profit margin.
  - $\text{TIE} = \dfrac{\text{EBIT}}{Int}$ times interest earned.
  - DSO/DSI: days' sales in receivables/inventory; Inventory turnover, Receivables turnover, Total asset turnover (TAT).
  - EM (equity multiplier): $EM = \dfrac{A}{E} = 1 + \dfrac{D}{E}$ (ratio analysis).
- Risk and statistics:
  - σ: standard deviation; $\text{Var}(\cdot)$ variance; $\text{Cov}(\cdot, \cdot)$ covariance; ρ correlation.
  - For historical sample variance: $s^2 = \dfrac{1}{T-1} \sum_{t=1}^{T} (R_t - \bar{R})^2$.
- Equity payout and growth:
  - EPS: earnings per share, $\text{EPS} = \text{NI}/N$ (shares outstanding N).
  - payout: dividend payout ratio $= \dfrac{\text{Dividends}}{\text{NI}}$ (or DPS/EPS).
  - b: retention ratio (plowback), $b = 1 - \text{payout}$; sustainable growth approximation $g = b \cdot \text{ROE}$.

1 Chapter 1: Course Introduction; What is Finance?; Capital Allocation and Capital Flows

Executive summary (exam-useful)

- Finance is fundamentally about **investment decisions under uncertainty** and therefore about **valuation**: determining the value of stocks, bonds, firms, and real assets.
- Corporate finance focuses on **how firms invest** (capital budgeting/asset allocation) and **how firms raise capital** (financing/capital structure), with the objective of creating value for investors.
- In a well-functioning economy, **capital flows** from **suppliers** (savers with excess funds) to **demanders** (borrowers/firms with investment opportunities) at an equilibrium required return.
- Capital transfer channels: **direct transfers**, **investment banks (pass-through intermediation)**, and **financial intermediaries** (banks, funds) that improve market efficiency via pooling, screening, and maturity transformation.
- Financial markets classify by issuance/trading: **primary market** (new securities; cash to issuer) vs. **secondary market** (existing securities; no cash to issuer).
- Financial markets classify by maturity: **money markets** (short-term debt) vs. **capital markets** (long-lived securities: bonds, stocks).
- Persistent exam theme: **cash flow timing and sign conventions** (e.g., $t = 0$ vs. $t = 1$) and **market classification** (primary vs. secondary; money vs. capital).

Key figures (keep for recall)

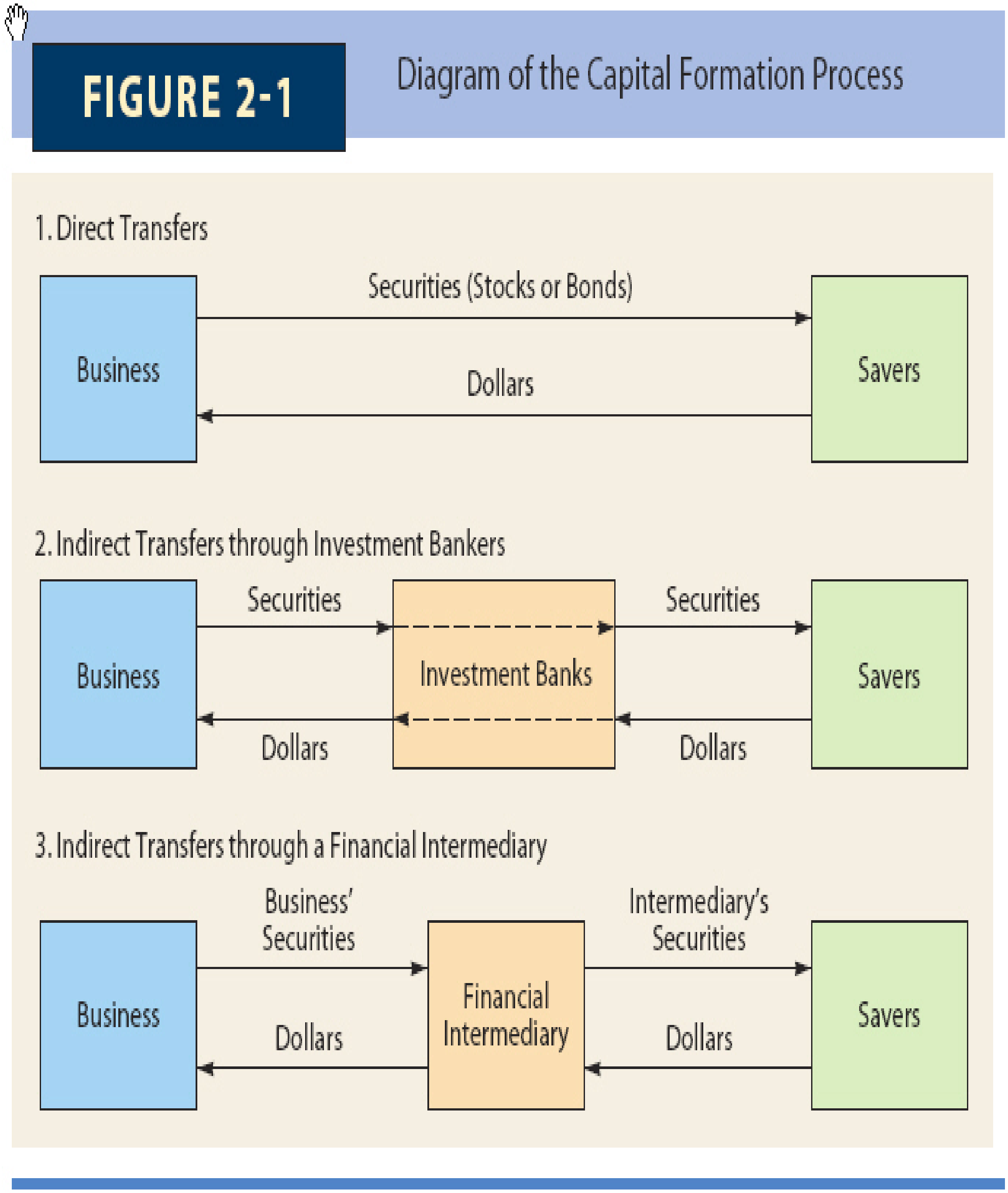


Figure 1: Capital formation channels: direct transfers vs. indirect transfers via investment banks or financial intermediaries.

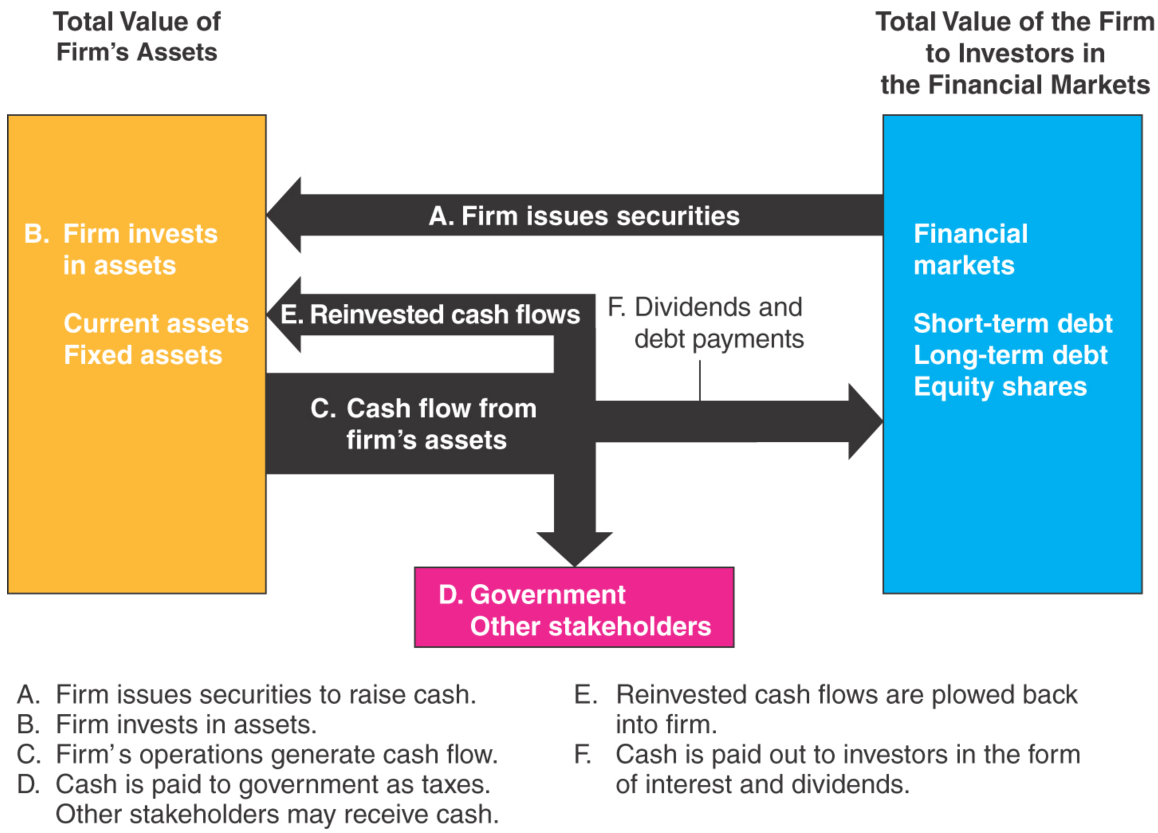


Figure 2: Cash flows between the firm and financial markets (arrows A–F). Key idea: ultimately, cash flow from assets must support payments to investors and reinvestment.

Core concepts

Finance as valuation under time and risk.

$$\text{Value} = \text{PV}(\text{expected future cash flows discounted at an appropriate required return}).$$

Primary vs. secondary markets.

- Primary: new issue $\Rightarrow$ investors' cash $\rightarrow$ issuer.
- Secondary: trade outstanding claims $\Rightarrow$ investor-to-investor; issuer receives no cash.

Money vs. capital markets.

- Money market: short-term debt.
- Capital market: longer-lived securities (bonds, stocks).

Procedures (exam-style)

1. **Classify a transaction** as primary vs. secondary by asking: *Does cash go to the issuer?*
2. **Identify the capital transfer channel**: direct vs. investment bank vs. financial intermediary.
3. **Map firm cash flows** conceptually (A–F): financing inflow $\rightarrow$ investment $\rightarrow$ operations $\rightarrow$ taxes/stakeholders $\rightarrow$ reinvestment $\rightarrow$ payout.

2 Chapter 2: Financial Statements, Taxes, and Cash Flow; Corporate Governance and Agency Problems

2.1 Part 2A: Corporate Objective, Agency Problem, and Governance

Executive summary (exam-useful)

- **Corporate objective (finance):** maximize *shareholder wealth* $\Leftrightarrow$ maximize *market value of equity* (stock price), not accounting profit.
- **Agency problem:** separation of ownership (shareholders) and control (managers) creates incentives for managers to deviate from value maximization; **agency costs** include value loss + monitoring/constraint costs.
- **Corporate governance** is the system of controls/regulation/incentives that mitigates agency conflicts and fraud.

Figure 3: Goal of the firm: maximize owners' wealth (market value of equity / stock price).

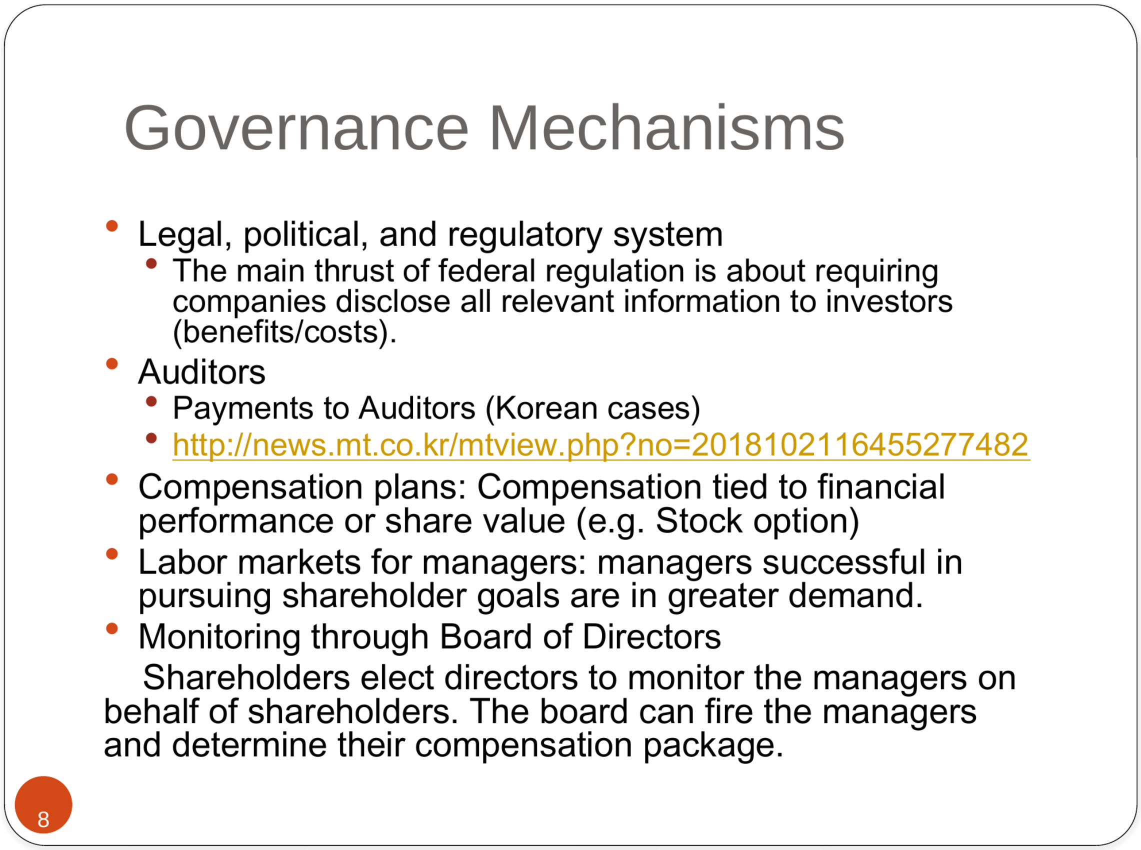


Figure 4: Governance mechanisms: regulation, auditors, compensation, labor markets, board monitoring.

Core theory

$$\max\ \mathrm{MV(equity)} \quad \text{(often proxied by stock price).}$$

Agency costs (conceptual):

$$\text{Agency costs} \approx (V^{\star} - V) + C_M.$$

2.2 Part 2B: Financial Statements and Book vs. Market Values

Executive summary (exam-useful)

- Annual report core statements: Balance Sheet (point-in-time), Income Statement (over a period), Statement of Cash Flows (over a period), Statement of Stockholders' Equity.
- Balance sheet identity: Assets = Liabilities + Equity holds for both BV and MV.
- Net working capital: NWC = CA − CL; typically ΔNWC > 0 is a *use of cash*.
- Market vs book: managers care about MV; book values are historical-cost accounting numbers and can diverge substantially from MV.

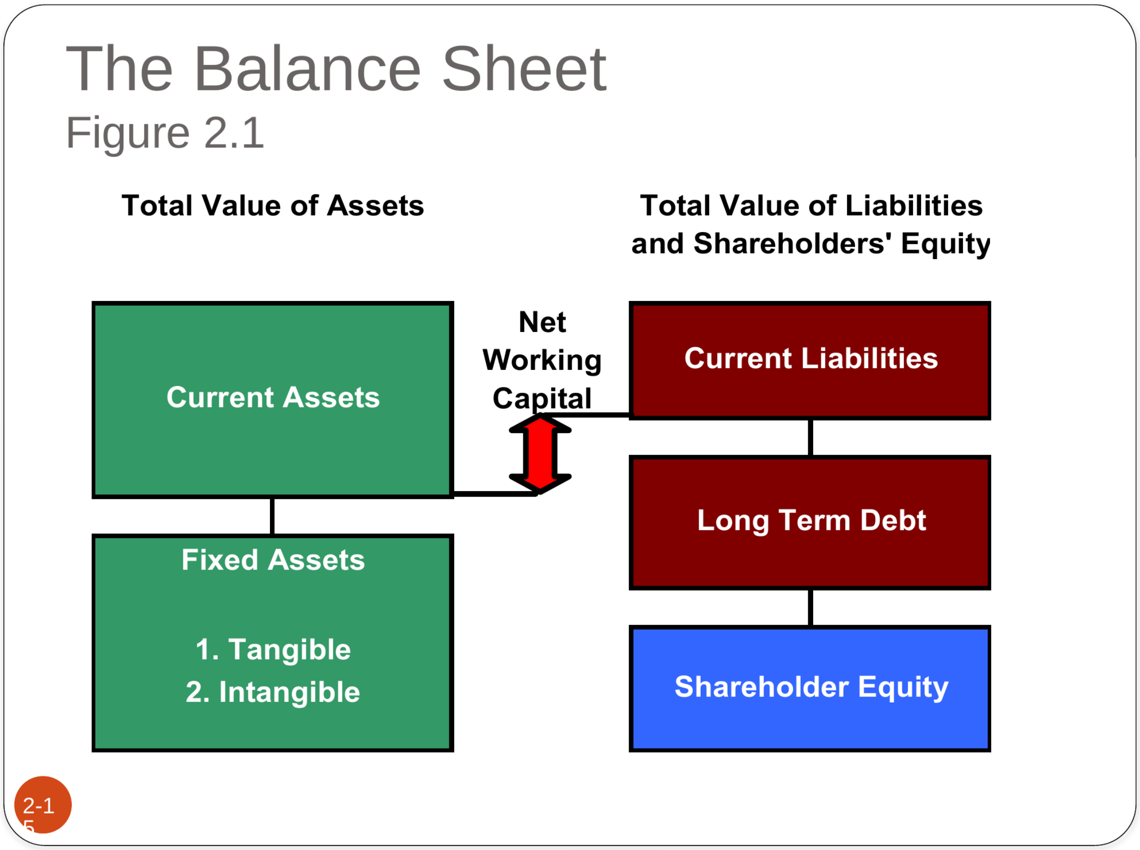


Figure 5: Balance sheet layout (Figure 2.1): assets vs liabilities/equity; net working capital highlighted.

Core identities

$$\text{Assets} = \text{Liabilities} + \text{Equity}, \qquad \text{NWC} = \text{CA} - \text{CL}.$$

Net income allocation (conceptual):

$$\text{NI} = \text{Dividends} + \Delta\text{Retained Earnings}.$$

Key table (from slides)

Table 1: Klingon Corporation balance sheets: book vs market values (all \$).

	Assets			Liabilities & Equity	
Item	**Book**	**Market**	**Item**	**Book**	**Market**
CA	400	600	Debt	500	500
NFA	700	1,000	Equity	600	1,100
Total	1,100	1,600	**Total**	1,100	1,600

2.3 Part 2C: Taxes and Financial Cash Flow (CFFA)

Executive summary (exam-useful)

- Taxes affect cash flows and valuation; distinguish *marginal* vs. *average* tax rates.
- Accounting net income is not cash due to accruals and noncash charges (depreciation).
- Core identity (financial cash flow): cash generated by assets equals cash paid to capital providers:

$$\text{CFFA} = \text{CF to creditors} + \text{CF to stockholders}.$$

- Compute cash flow from assets via:

$$\text{CFFA} = \text{OCF} - \text{NCS} - \Delta\text{NWC},$$

where $\text{OCF} = \text{EBIT} + \text{Dep} - \text{Taxes}$, $\text{NCS} = (\text{NFA}_t - \text{NFA}_{t-1}) + \text{Dep}$.

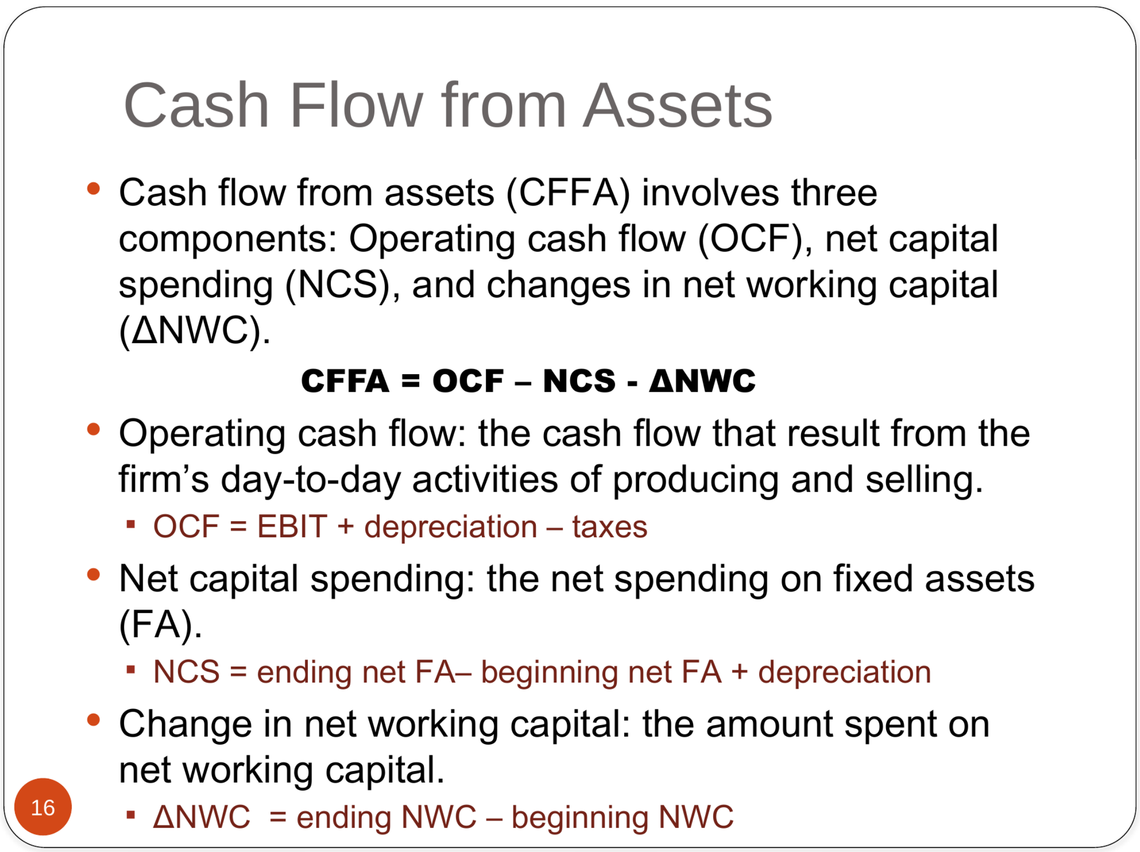


Figure 6: Cash flow from assets decomposition: $\text{CFFA} = \text{OCF} - \text{NCS} - \Delta\text{NWC}$.

Taxes: marginal vs. average

$$\text{Taxes} = T(\text{TI}), \qquad \bar{T} = \frac{\text{Taxes}}{\text{TI}}, \qquad T' = \frac{\Delta\text{Taxes}}{\Delta\text{TI}}.$$

Decision rule: for incremental decisions, use the marginal tax rate on incremental taxable income (subject to bracket changes/NOLs).

Financial cash flow formulas

$$
\begin{aligned}
\text{CFFA} &= \text{OCF} - \text{NCS} - \Delta\text{NWC}, \\
\text{OCF} &= \text{EBIT} + \text{Dep} - \text{Taxes} = \text{EBIT}(1 - T_c) + \text{Dep}T_c, \\
\text{NCS} &= (\text{NFA}_t - \text{NFA}_{t-1}) + \text{Dep}, \\
\Delta\text{NWC} &= \text{NWC}_t - \text{NWC}_{t-1}.
\end{aligned}
$$

Cash flow to creditors and stockholders (net payouts):

$$\text{CF to creditors} = \text{Interest} - \Delta\text{Debt}, \qquad \text{CF to stockholders} = \text{Dividends} - \text{Net new equity}.$$

Key tables (from slides)

Table 2: Corporate tax rate schedule (illustrative progressive brackets as shown).

Lower	**Upper**	**Rate**
\$0	\$50,000	15%
\$50,001	\$75,000	25%
\$75,001	\$100,000	34%
\$100,001	\$335,000	39%
\$335,001	\$10,000,000	34%
\$10,000,001	\$15,000,000	35%
\$15,000,001	\$18,333,333	38%
\$18,333,334	∞	35%

Table 3: Dole Cola (2020) income statement highlights (amounts in \$).

Item	Amount
Net sales	600
COGS	300
Depreciation	150
EBIT	150
Interest paid	30
Taxable income	120
Taxes	41
NI	79
Dividends	30
Addition to retained earnings	49

3 Chapter 3: Financial Statement Analysis — Common-Size Statements and Financial Ratios

Executive summary (exam-useful)

- **Standardized (common-size) statements** remove scale effects: balance sheet items as % of total assets; income statement items as % of sales.
- **Ratio analysis** compresses information into interpretable metrics; document conventions (end vs average balances; debt definition; 365 vs 360).
- Liquidity ratios measure short-term solvency; leverage and coverage measure long-term solvency; turnover measures asset utilization; profitability measures performance; market value ratios require market data.
- DuPont identity decomposes ROE into margin, turnover, and leverage.

3.1 Part 3A: Common-Size Statements

$$\text{Common-size BS share of } X = \frac{X}{A}, \qquad \text{Common-size IS share of } Y = \frac{Y}{Sales}.$$

PRUFROCK CORPORATION
Common-Size Balance Sheets
December 31, 2019 and 2020

Assets	**2019**	**2020**	**Change**
Current assets			
Cash	2.5%	2.7%	+ .2%
Accounts receivable	4.9	5.2	+ .3
Inventory	11.7	11.8	+ .1
Total	19.0	19.7	+ .7
Fixed assets			
Net plant and equipment	81.0	80.3	− .7
Total assets	100.0%	100.0%	.0%
Liabilities and Owners' Equity			
Current liabilities			
Accounts payable	9.2%	9.6%	+ .3%
Notes payable	6.8	5.5	−1.4
Total	16.1	15.1	−1.0
Long-term debt	15.7	12.8	−2.9
Owners' equity			
Common stock and paid-in surplus	14.8	14.5	− .3
Retained earnings	53.3	57.6	+4.3
Total	68.2	72.1	+4.0
Total liabilities and owners' equity	100.0%	100.0%	.0%

Figure 7: Prufrock common-size balance sheets (2019–2020, % of total assets) with percentage-point changes.

3.2 Part 3B: Ratio Analysis

Liquidity

$$\text{Current Ratio} = \frac{\text{CA}}{\text{CL}}, \qquad \text{Quick Ratio} = \frac{\text{CA} - \text{Inv}}{\text{CL}}, \qquad \text{Cash Ratio} = \frac{C}{\text{CL}}.$$

Leverage and coverage

$$\text{Total Debt Ratio} = \frac{A-E}{A} = 1 - \frac{E}{A},$$
$$D/E = \frac{D}{E}, \qquad EM = \frac{A}{E} = 1 + \frac{D}{E},$$
$$\text{TIE} = \frac{\text{EBIT}}{Int}, \qquad \text{Cash Coverage} = \frac{\text{EBIT} + \text{Dep}}{Int}.$$

Asset management (turnover and days)

$$\text{Inventory Turnover} = \frac{COGS}{Inv}, \qquad \text{DSI} = \frac{365}{\text{Inventory Turnover}},$$
$$\text{Receivables Turnover} = \frac{Sales}{AR}, \qquad \text{DSO} = \frac{365}{\text{Receivables Turnover}},$$
$$\text{TAT} = \frac{Sales}{A}.$$

Profitability

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

Market value measures (public firms)

Let P be price per share and N shares outstanding:

$$\text{EPS} = \frac{\text{NI}}{N}, \qquad \frac{P}{Sales/N} = \frac{PN}{Sales}, \qquad \frac{P}{E/N} = \frac{PN}{E} \quad \text{(market-to-book)}.$$

DuPont identity

$$\text{ROE} = \frac{\text{NI}}{Sales} \cdot \frac{Sales}{A} \cdot \frac{A}{E} = \text{PM} \cdot \text{TAT} \cdot EM = \text{ROA} \cdot EM.$$

Payout and retention

$$\text{payout} = \frac{\text{Dividends}}{\text{NI}}, \qquad b = 1 - \text{payout} = \frac{\Delta RE}{\text{NI}}.$$

Benchmarking and limitations

- Time-trend analysis (3–5 years) and peer/industry comparisons (SIC/NAICS).
- Potential problems: accounting differences, fiscal year mismatch, one-time events, diversified firms, cross-industry comparability.

Table 4: Trimark vs Industry Average (selected ratios).

Ratio	**Trimark**	**Industry Avg.**
Current Ratio	1.766	2.200
Quick Ratio	1.048	1.500
Cash Ratio	0.108	0.135
Debt Ratio	0.371	0.430
Cash Coverage	37.189	10.600
DSO	16.512	12.000
TAT	2.390	2.800
Inventory Turnover	28.808	30.100
DSI	12.670	11.500
Receivables Turnover	22.105	30.000
Profit Margin	0.053	0.045
ROA	0.128	0.126
ROE	0.203	0.221

4 Chapter 4: Time Value of Money (TVM)

4.1 Part 4A: Single Cash Flows, Rates, and Compounding

Core formulas

Single-sum compounding/discounting (per-period effective rate i):

$$\mathrm{FV}_n = \mathrm{PV}(1+i)^n, \qquad \mathrm{PV} = \frac{\mathrm{FV}_n}{(1+i)^n}.$$

Solve for rate and time:

$$i = \left(\frac{\mathrm{FV}}{\mathrm{PV}}\right)^{1/n} - 1, \qquad n = \frac{\ln(\mathrm{FV}/\mathrm{PV})}{\ln(1+i)}.$$

Non-annual compounding (APR i_{nom}, m periods/year):

$$i_{\text{per}} = \frac{i_{\text{nom}}}{m}, \qquad N = nm, \qquad \mathrm{FV} = \mathrm{PV}\left(1 + \frac{i_{\text{nom}}}{m}\right)^{nm}.$$

Effective annual rate:

$$\mathrm{EAR} = \left(1 + \frac{i_{\text{nom}}}{m}\right)^{m} - 1.$$

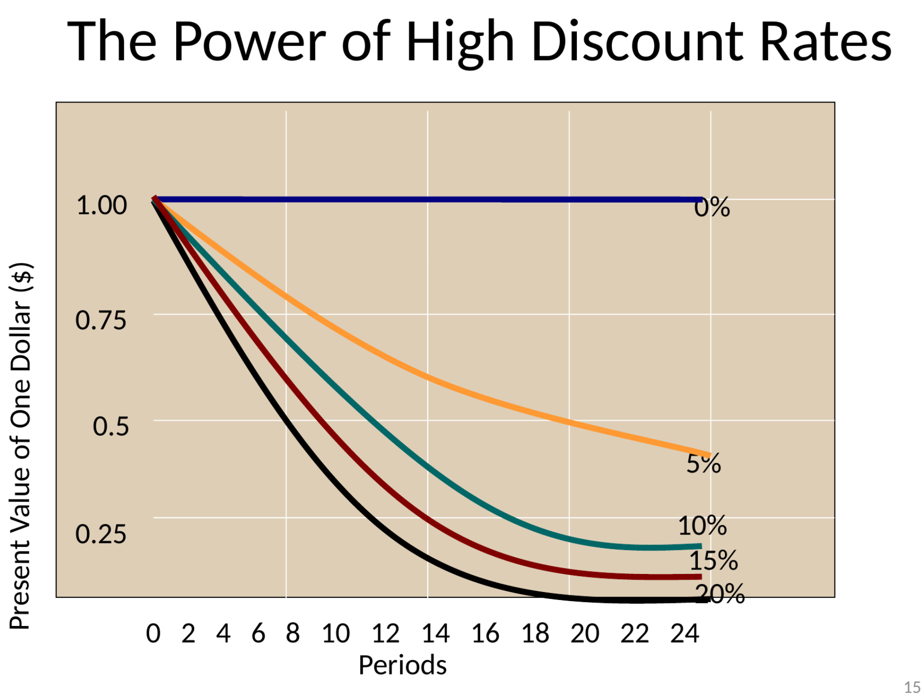


Figure 8: Present value of $1 vs. time for discount rates 0%, 5%, 10%, 15%, 20%.

4.2 Part 4B: Annuities, Perpetuities, and Uneven Cash Flows

Ordinary annuity (payments at $t = 1, \ldots, n$)

$$\mathrm{PV}_{\mathrm{OA}} = C\frac{1-(1+i)^{-n}}{i}, \qquad \mathrm{FV}_{\mathrm{OA}} = C\frac{(1+i)^{n}-1}{i}.$$

Annuity due (payments at $t = 0, \ldots, n-1$)

$$\mathrm{PV}_{\mathrm{AD}} = \mathrm{PV}_{\mathrm{OA}}(1+i), \qquad \mathrm{FV}_{\mathrm{AD}} = \mathrm{FV}_{\mathrm{OA}}(1+i).$$

Perpetuity and growing perpetuity

First payment at $t = 1$:

$$\mathrm{PV}_0 = \frac{C}{r}.$$

Growing perpetuity (C_1 at $t = 1$, growth g, $r > g$):

$$\mathrm{PV}_0 = \frac{C_1}{r-g}.$$

Uneven cash flows

$$\mathrm{PV} = \sum_{t=0}^{T} \frac{CF_t}{(1+i)^t}, \qquad \mathrm{FV}_T = \sum_{t=0}^{T} CF_t(1+i)^{T-t}.$$

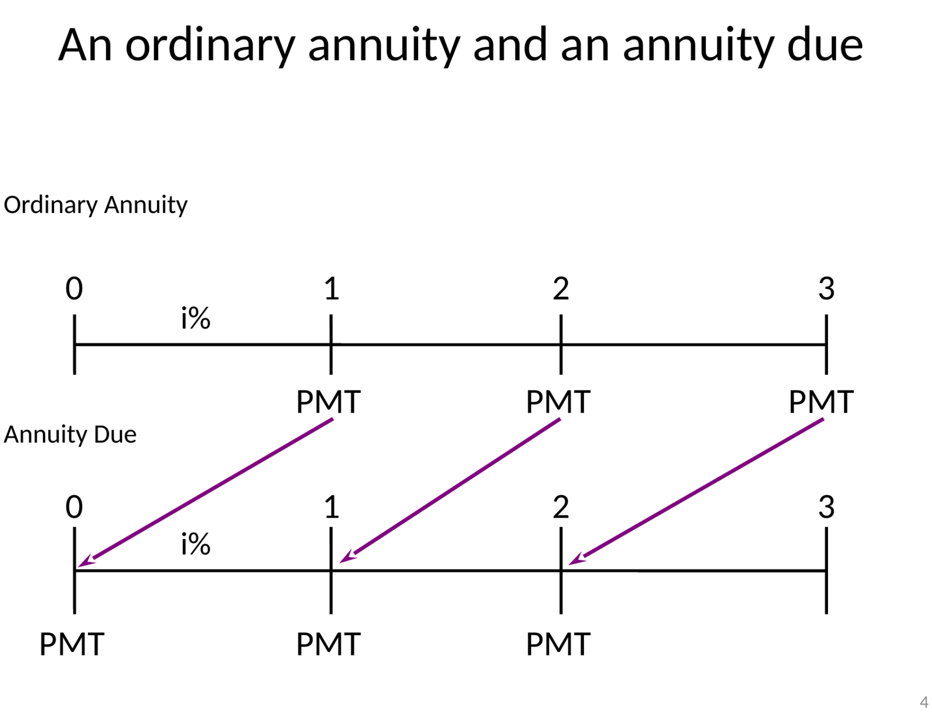


Figure 9: Ordinary annuity vs annuity due: end-of-period payments vs beginning-of-period payments.

5 Chapter 6: Valuation of Bonds and Stocks

5.1 Part 6A: Stock Valuation (DDM, Corporate Value Model, Multiples)

Executive summary (exam-useful)

- Intrinsic value equals PV of expected future cash flows.
- Stock cash flows: dividends D_t and resale price P_T.
- DDM: $P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r_E)^t}$; special cases: zero growth, constant growth (Gordon), variable growth with horizon value.
- Corporate value model: value firm as PV of FCF_t discounted at WACC, plus terminal value.

General finite-horizon stock pricing identity

$$P_0 = \sum_{t=1}^{T} \frac{D_t}{(1+r_E)^t} + \frac{P_T}{(1+r_E)^T}.$$

DDM (infinite horizon)

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r_E)^t}.$$

Zero growth

If $D_t = D$ for all $t \geq 1$:

$$P_0 = \frac{D}{r_E}.$$

Constant growth (Gordon)

If $D_1 = D_0(1+g)$ and $g < r_E$:

$$P_0 = \frac{D_1}{r_E - g} = \frac{D_0(1+g)}{r_E - g}, \qquad r_E = \frac{D_1}{P_0} + g.$$

Sustainable growth approximation:

$$g = b \cdot \text{ROE}.$$

Variable growth then constant growth

Non-constant growth for $t = 1, \ldots, N$, then constant g_c from $N+1$ onward:

$$HV_N = \frac{D_{N+1}}{r_E - g_c}, \qquad P_0 = \sum_{t=1}^{N} \frac{D_t}{(1+r_E)^t} + \frac{HV_N}{(1+r_E)^N}.$$

Corporate value model (FCF/WACC)

$$V_0 = \sum_{t=1}^{N} \frac{\mathrm{FCF}_t}{(1+\mathrm{WACC})^t} + \frac{TV_N}{(1+\mathrm{WACC})^N}, \qquad TV_N = \frac{\mathrm{FCF}_{N+1}}{\mathrm{WACC} - g_c}\ (g_c < \mathrm{WACC}).$$

Equity value:

$$\mathrm{MV}(E) = V_0 - \mathrm{MV}(D) - \mathrm{MV}(\text{Preferred}), \qquad P_0 = \frac{\mathrm{MV}(E)}{\#\text{shares}}.$$

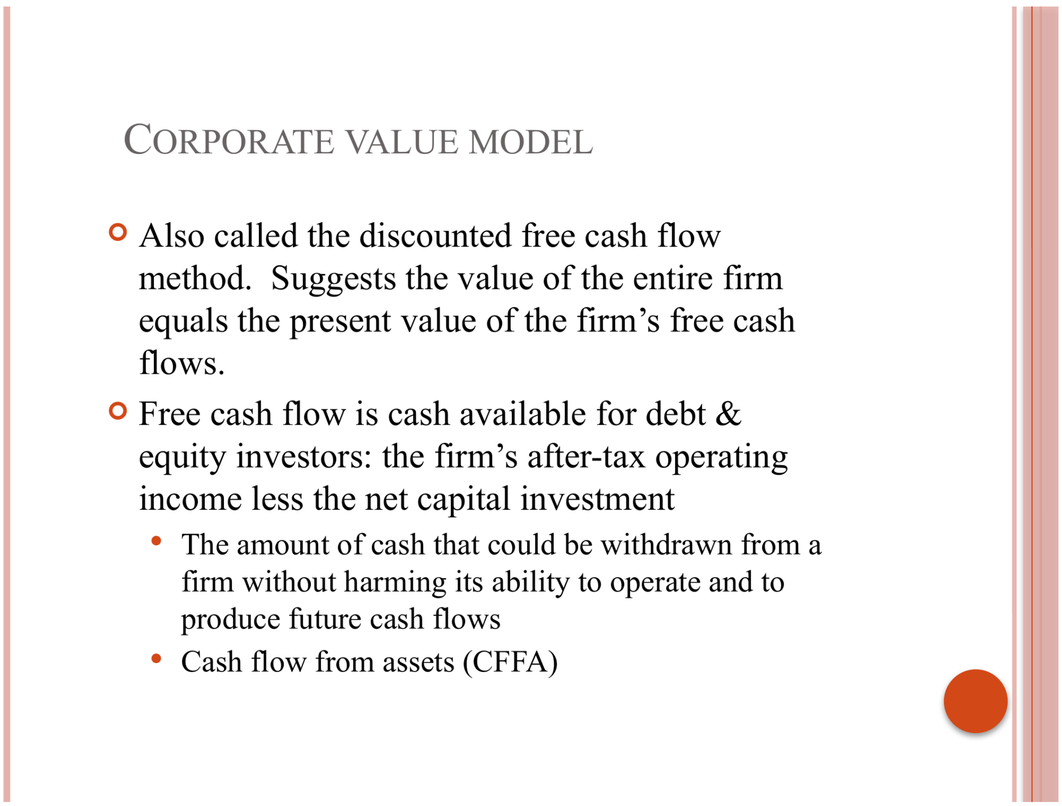


Figure 10: Corporate value model: value firm as PV of free cash flows discounted at WACC.

5.2 Part 6B: Bond Valuation and Yields

Bond pricing (level coupon)

For T periods, coupon C per period, face value F, yield per period r:

$$P_0 = \sum_{t=1}^{T} \frac{C}{(1+r)^t} + \frac{F}{(1+r)^T} = C\left(\frac{1-(1+r)^{-T}}{r}\right) + F(1+r)^{-T}.$$

Premium/discount/par (coupon rate c with $C = cF$ for annual coupons):

$$r > c \Rightarrow P_0 < F, \quad r = c \Rightarrow P_0 = F, \quad r < c \Rightarrow P_0 > F.$$

Semiannual convention (APR quoted)

If $m = 2$:

$$r_{\text{per}} = \frac{\mathrm{APR}}{2}, \quad T = 2(\text{years}), \quad C_{\text{per}} = \frac{cF}{2}.$$

Zero-coupon bond

$$P_0 = \frac{F}{(1+r)^T}.$$

Yield to maturity (YTM)

YTM is the IRR on promised cash flows:

$$P_0 = \sum_{t=1}^{T} \frac{C}{(1+r)^t} + \frac{F}{(1+r)^T}.$$

Callable bonds and yield to call (YTC)

If callable at t_c with call price P_{call}:

$$P_0 = \sum_{t=1}^{t_c} \frac{C}{(1+r_c)^t} + \frac{P_{\text{call}}}{(1+r_c)^{t_c}}.$$

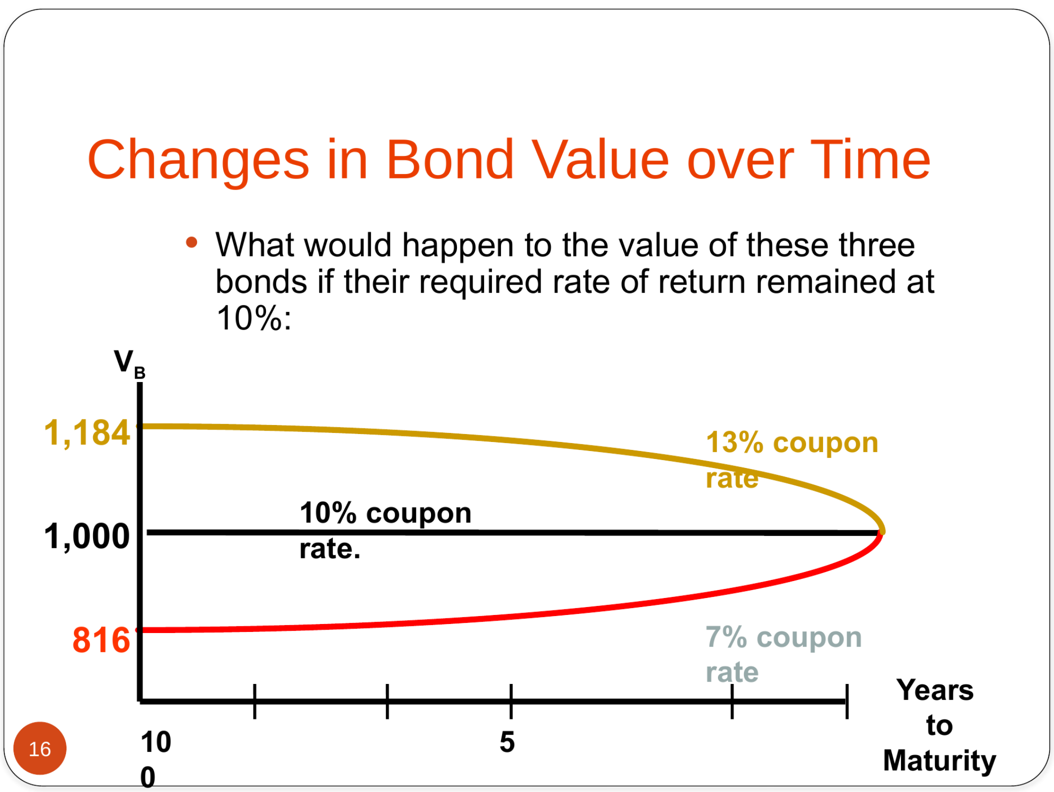


Figure 11: Bond values over time with constant required return: premium bonds fall toward par, discount bonds rise toward par, par bonds stay at par.

6 Chapter 7: Capital Budgeting Decision Criteria

Executive summary (exam-useful)

- Capital budgeting selects projects by valuing incremental cash flows at the opportunity cost of capital k.
- Criteria: NPV, IRR, MIRR, Payback, Discounted Payback, PI; **NPV is value-maximizing** absent capital rationing.
- For independent normal projects: $NPV(k) > 0 \iff IRR > k$.
- For mutually exclusive projects: NPV and IRR can rank differently (scale/timing); choose highest NPV.
- Non-normal cash flows can produce multiple IRRs or no IRR; use NPV (or MIRR).

6.1 Part 7A: NPV and IRR

$$\mathrm{NPV}(k) = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}.$$

IRR solves:

$$0 = \sum_{t=0}^{n} \frac{CF_t}{(1+\mathrm{IRR})^t}.$$

Crossover rate (mutually exclusive projects)

For projects A, B:

$$\Delta CF_t = CF_t^A - CF_t^B, \qquad 0 = \sum_{t=0}^{n} \frac{\Delta CF_t}{(1+r^*)^t}.$$

6.2 Part 7B: MIRR, Payback, Discounted Payback, PI

Split cash flows:

$$\mathrm{CIF}_t = \max(CF_t, 0), \qquad \mathrm{COF}_t = \min(CF_t, 0).$$

Terminal value of inflows (reinvest at k):

$$TV_{\text{in}} = \sum_{t=0}^{n} \mathrm{CIF}_t (1+k)^{n-t}.$$

PV of outflows (discount at k):

$$PV_{\text{out}} = \sum_{t=0}^{n} \frac{\mathrm{COF}_t}{(1+k)^t} \ (< 0).$$

MIRR:

$$\mathrm{MIRR} = \left(\frac{TV_{\text{in}}}{-PV_{\text{out}}} \right)^{1/n} - 1.$$

Payback (PB): smallest t where cumulative undiscounted CF becomes nonnegative (interpolate within year).
Discounted payback (DPB): same using discounted CFs at k.

Profitability index:

$$\mathrm{PI} = \frac{\sum_{t=1}^{n} \frac{CF_t}{(1+k)^t}}{|CF_0|} \quad \text{(conventional case)}.$$

Link (conventional case):

$$\mathrm{NPV} = |CF_0|(\mathrm{PI} - 1).$$

7 Chapter 8: Making Capital Investment Decisions — Cash Flow Estimation; Forecasting Risk; Unequal Lives

Executive summary (exam-useful)

- Relevant cash flows are incremental: with project minus without project; exclude sunk costs; include opportunity costs and side effects (erosion/synergy).
- Separate project cash flows into: initial outlay ($t = 0$), annual operating cash flows ($t = 1, \ldots, N$), terminal cash flow ($t = N$).
- Unlevered project cash flow identity:

$$\text{FCF}_t = \text{OCF}_t - \text{CapEx}_t - \Delta\text{NWC}_t \quad \text{(plus terminal after-tax salvage and NWC recovery).}$$

- Depreciation affects cash flow only through taxes (depreciation tax shield).
- Terminal cash flow includes after-tax salvage and recovery of NWC.
- Forecasting risk: scenario analysis (joint changes) and sensitivity analysis (one-at-a-time).
- Unequal lives: use replacement chain or EAA.

7.1 Part 8A: Incremental Cash Flows and Pro Forma to Cash Flow

Incremental test

$$CF_t^{\text{relevant}} = CF_t^{\text{with}} - CF_t^{\text{without}}.$$

Operating cash flow (tax-shield form)

$$\text{OCF}_t = \text{EBIT}_t(1 - T_c) + \text{Dep}_t T_c = \text{EBIT}_t - \text{Taxes}_t + \text{Dep}_t.$$

Project free cash flow

$$\text{FCF}_t = \text{OCF}_t - \text{CapEx}_t - \Delta\text{NWC}_t.$$

Net working capital

$$\text{NWC}_t = \text{CA}_t - \text{CL}_t, \qquad \Delta\text{NWC}_t = \text{NWC}_t - \text{NWC}_{t-1}.$$

In project CFs: subtract ΔNWC_t (increase is a cash outflow); typically recover NWC at the end.

After-tax salvage and terminal cash flow

If sold for salvage value SV at $t = N$ with book value BV_N:

$$SV_{AT} = SV - T_c(SV - BV_N).$$

Terminal cash flow often:

$$TCF_N = SV_{AT} + \text{NWC}_N \quad \text{(if NWC fully recovered to 0 after project).}$$

Key figures (Ping Kings structure)

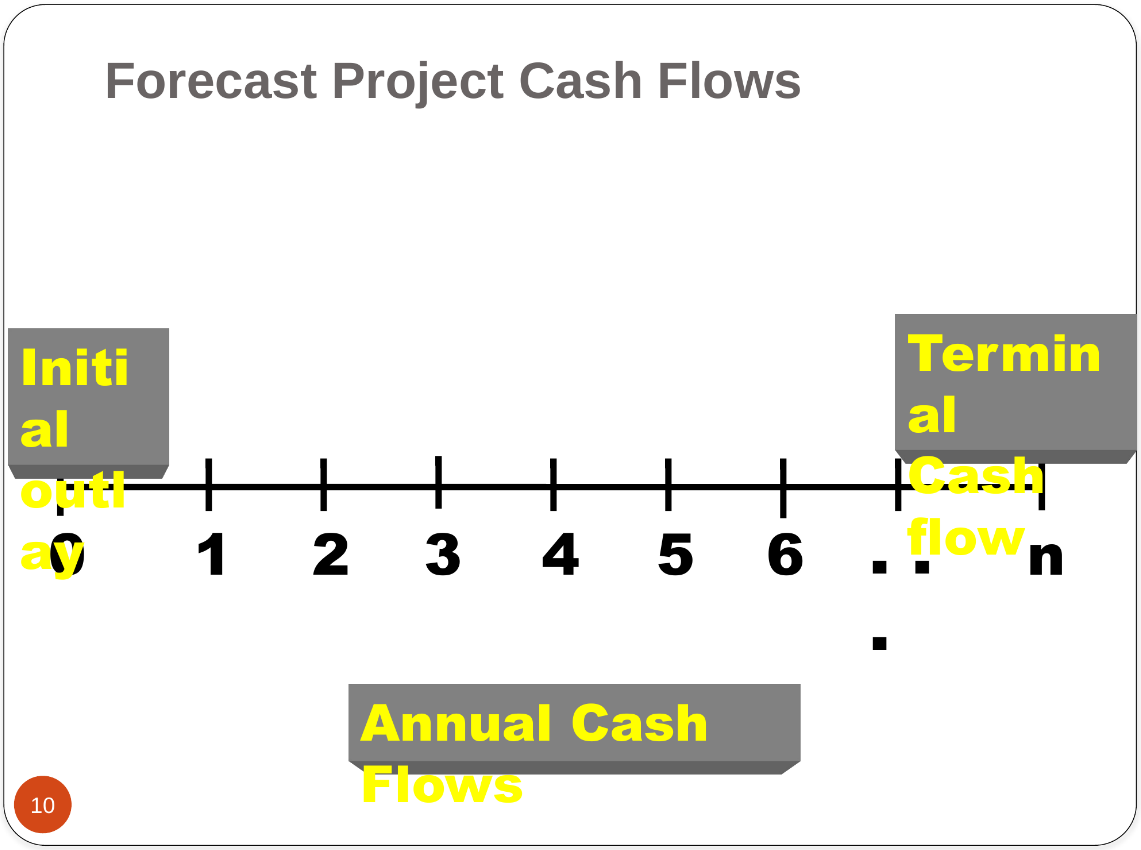


Figure 12: Pro forma approach: $\text{OCF} = \text{EBIT} - \text{Taxes} + \text{Dep}$ and $\text{FCF} = \text{OCF} - \text{CapEx} - \Delta\text{NWC}$.

7.2 Part 8B: Depreciation (Straight-Line and MACRS)

Straight-line (depreciable basis B, salvage for depreciation S_{dep}, life N):

$$\text{Dep}_t = \frac{B - S_{\text{dep}}}{N}, \quad t = 1, \dots, N.$$

MACRS: $\text{Dep}_t = \alpha_t \cdot B$ with statutory rates α_t; book value:

$$BV_k = B - \sum_{t=1}^{k} \text{Dep}_t.$$

7.3 Part 8C: Other Incremental Cash Flow Issues (Sunk, Opportunity, Erosion)

- Sunk costs: exclude.
- Opportunity costs: include (foregone after-tax proceeds at $t = 0$).
- Erosion/synergy: include on an after-tax basis.
- Financing flows (interest/dividends): exclude from project CFs when discounting at WACC.

7.4 Part 8D: Scenario and Sensitivity Analysis

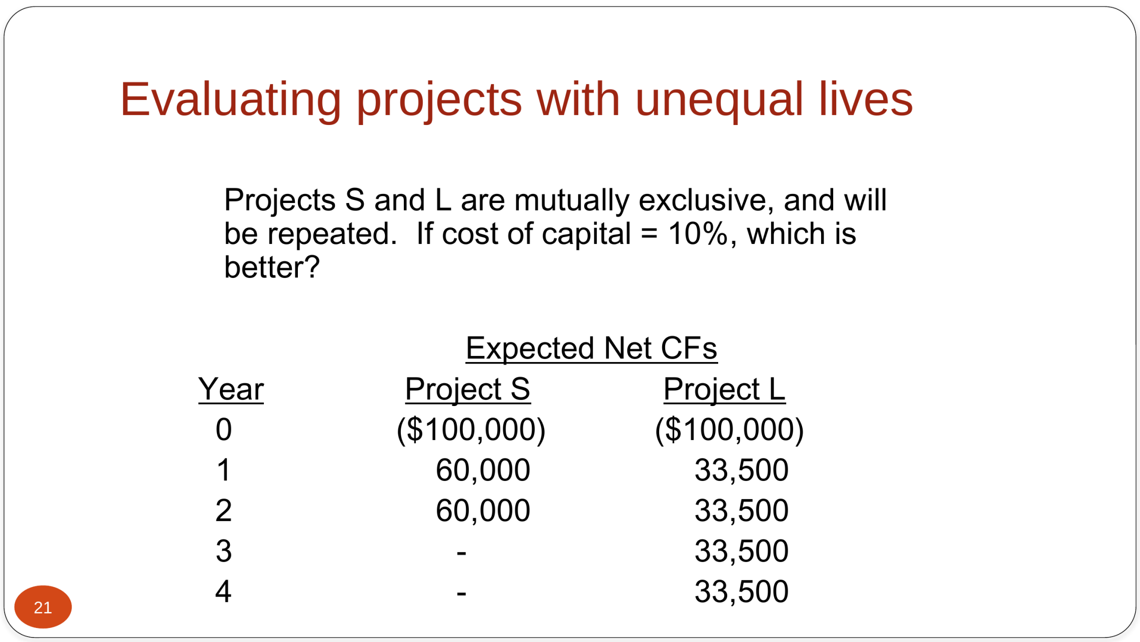
- Scenario analysis: compute NPV under worst/base/best joint assumptions.
- Sensitivity analysis: vary one input at a time to map NPV(x).

7.5 Part 8E: Mutually Exclusive Projects with Unequal Lives (Replacement Chain and EAA)

Replacement chain: extend to common horizon $H = \mathrm{lcm}(n_S, n_L)$ by repeating projects and compare extended NPVs.

Equivalent annual annuity:

$$\mathrm{EAA} = \mathrm{NPV} \cdot \frac{k}{1-(1+k)^{-n}}.$$



Year	Project S	Project L
0	($100,000)	($100,000)
1	60,000	33,500
2	60,000	33,500
3	-	33,500
4	-	33,500

Figure 13: Unequal lives: projects S (2-year) and L (4-year); introduction of Equivalent Annual Annuity (EAA).

8 Chapter 10: Risk and Return — Measuring Returns, Volatility, and Risk Premiums

Executive summary (exam-useful)

- Holding-period return (HPR): $R_{t+1} = \dfrac{D_{t+1} + P_{t+1} - P_t}{P_t}$.
- Risk premium: $RP = \mathbb{E}[R] - r_f$.
- Volatility: variance and standard deviation; historical sample variance uses $T - 1$.
- Arithmetic vs geometric mean: arithmetic estimates one-period expected return; geometric is compound growth rate; $G \le A$.
- EMH: prices reflect information; only unexpected news moves prices; weak/semistrong/strong forms.

Return measurement

$$R_{t+1} = \frac{D_{t+1} + P_{t+1} - P_t}{P_t} = \underbrace{\frac{D_{t+1}}{P_t}}_{\text{income yield}} + \underbrace{\frac{P_{t+1} - P_t}{P_t}}_{\text{capital gains yield}}.$$

Historical mean and variance

$$\bar{R} = \frac{1}{T}\sum_{t=1}^{T} R_t, \qquad s^2 = \frac{1}{T-1}\sum_{t=1}^{T}(R_t - \bar{R})^2, \qquad s = \sqrt{s^2}.$$

Geometric average return

$$G = \left(\prod_{t=1}^{T}(1 + R_t)\right)^{1/T} - 1.$$

Risk premium

$$RP = \mathbb{E}[R] - r_f, \qquad \widehat{RP} \approx \bar{R} - \bar{R}_f.$$

Key figure (market history)

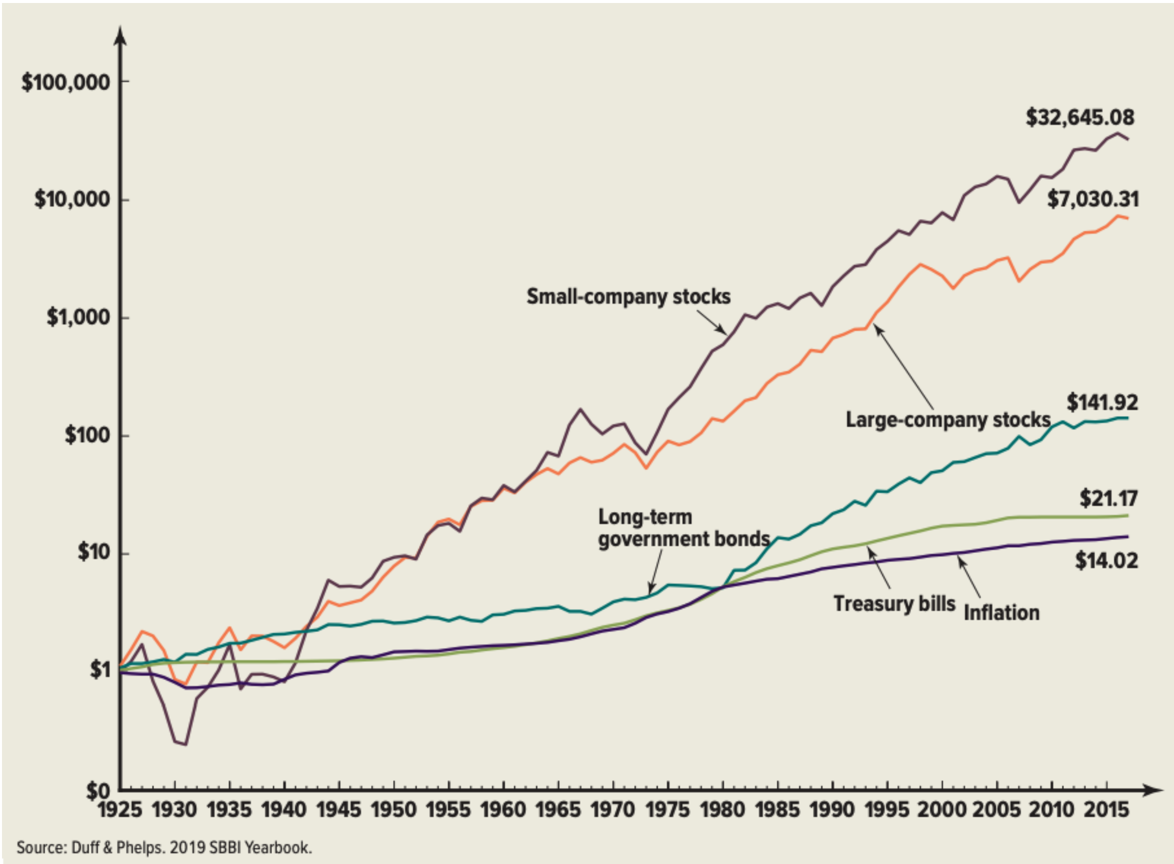


Figure 14: U.S. market history: growth of $1 (log scale), 1925–2015, across asset classes.

9 Chapter 11: Diversification, Portfolio Risk, Efficient Frontier, and CAPM

Executive summary (exam-useful)

- Portfolio expected return is linear in weights; portfolio variance depends on covariances/correlations.
- Diversification reduces unsystematic risk; systematic risk remains.
- CAPM: $E[R_i] = r_f + \beta_i(E[R_M] - r_f)$; only systematic risk is priced.

Expected return and variance (two assets)

$$E[R_p] = w_1 E[R_1] + w_2 E[R_2], \qquad w_1 + w_2 = 1,$$
$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\mathrm{Cov}(R_1, R_2) = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{12}\sigma_1\sigma_2.$$

Covariance and correlation

$$\mathrm{Cov}(R_i, R_j) = E[(R_i - E[R_i])(R_j - E[R_j])], \qquad \rho_{ij} = \frac{\mathrm{Cov}(R_i, R_j)}{\sigma_i\sigma_j}.$$

Diversification figure

(1) NUMBER OF STOCKS IN PORTFOLIO	(2) AVERAGE STANDARD DEVIATION OF ANNUAL PORTFOLIO RETURNS	(3) RATIO OF PORTFOLIO STANDARD DEVIATION TO STANDARD DEVIATION OF A SINGLE STOCK
1	49.24%	1.00
2	37.36	.76
4	29.69	.60
6	26.64	.54
8	24.98	.51
10	23.93	.49
20	21.68	.44
30	20.87	.42
40	20.46	.42
50	20.20	.41
100	19.69	.40
200	19.42	.39
300	19.34	.39
400	19.29	.39
500	19.27	.39
1,000	19.21	.39

Figure 15: Diversification and portfolio risk: portfolio standard deviation declines with number of stocks toward a floor.

Beta and CAPM

$$\beta_i = \frac{\mathrm{Cov}(R_i, R_M)}{\mathrm{Var}(R_M)} = \rho_{iM}\frac{\sigma_i}{\sigma_M}, \qquad E[R_i] = r_f + \beta_i(E[R_M] - r_f).$$

Portfolio beta:

$$\beta_p = \sum_i w_i \beta_i.$$

10 Chapter 12: Weighted Average Cost of Capital (WACC) — Components, Cost of Equity, Beta and Leverage

Executive summary (exam-useful)

- WACC is a market-based opportunity cost of capital for average-risk projects financed at target capital structure.
- Use market-value weights when available.
- Cost of equity via CAPM and/or Gordon: $r_E = r_f + \beta(E[R_M] - r_f)$ and $r_E = \dfrac{D_1}{P_0} + g$.
- Cost of debt is YTM (not coupon); use after-tax $r_D(1 - T_c)$ in WACC.
- Leverage increases equity beta; adjust betas when capital structure changes.

WACC

Let $V = D + E + P$ (if preferred exists):

$$\text{WACC} = w_E r_E + w_P r_P + w_D r_D(1 - T_c), \qquad w_E = \frac{E}{V},\ w_P = \frac{P}{V},\ w_D = \frac{D}{V}.$$

Cost of equity

CAPM:

$$r_E = r_f + \beta_E(E[R_M] - r_f).$$

Dividend growth (constant growth):

$$r_E = \frac{D_1}{P_0} + g = \frac{D_0(1+g)}{P_0} + g, \qquad (g < r_E).$$

Beta estimation and leverage

$$\beta_i = \frac{\text{Cov}(R_i, R_M)}{\text{Var}(R_M)}.$$

Asset beta identity:

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

If $\beta_D \approx 0$:

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

Cost of debt

Use YTM on outstanding/new comparable debt; after-tax:

$$r_{D,\text{after}} = r_D(1 - T_c).$$

Table 5: Example (from slides): WACC inputs using market weights and after-tax component costs.

Capital component	Weight	Component cost	Notes
Debt	0.38	5.06%	$r_D(1-T_c)$
Preferred stock	0.14	10.00%	r_P
Common stock	0.48	11.22%	r_E

11 Chapter 14: Capital Structure — Leverage, EPS/ROE, Beta, and Modigliani–Miller

Executive summary (exam-useful)

- Capital structure is the mix of debt and equity; objective: minimize WACC and maximize firm value (subject to frictions).
- Leverage increases equity risk: EPS and ROE become more sensitive to EBIT.
- MM Case I (no taxes, no distress): $V_L = V_U$; r_E rises with D/E so WACC stays constant.
- MM with corporate taxes: $V_L = V_U + T_c D$ (under standard assumptions); tax shield increases value.
- With taxes and distress costs: tradeoff theory implies an interior optimal debt level.
- Leverage increases equity beta: if $\beta_D \approx 0$, then $\beta_E = \beta_A(1 + D/E)$.

Leverage and EPS (no taxes)

Interest expense $I = r_D D$; net income (no taxes): $\text{NI} = \text{EBIT} - I$; EPS:

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

Break-even EBIT between structures (I_1, N_1) and (I_2, N_2):

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

MM Case I (no taxes, no distress)

$$V_L = V_U.$$

Proposition II:

$$r_E = r_0 + \frac{D}{E}(r_0 - r_D).$$

WACC invariance:

$$\text{WACC} = \frac{E}{V} r_E + \frac{D}{V} r_D = r_0.$$

MM with corporate taxes (no distress)

Tax shield each period: $T_c(r_D D)$; under standard MM assumptions:

$$PV(\text{tax shield}) = T_c D, \qquad V_L = V_U + T_c D.$$

WACC with taxes:

$$\text{WACC} = \frac{E}{V} r_E + \frac{D}{V} r_D (1 - T_c).$$

Tradeoff theory (tax shield vs distress costs)

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

Key tables (from slides)

Table 6: 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
D/E	0.00	2/3
Interest rate r_D	n/a	8%
Shares outstanding N	400	240
Share price	\$50	\$50

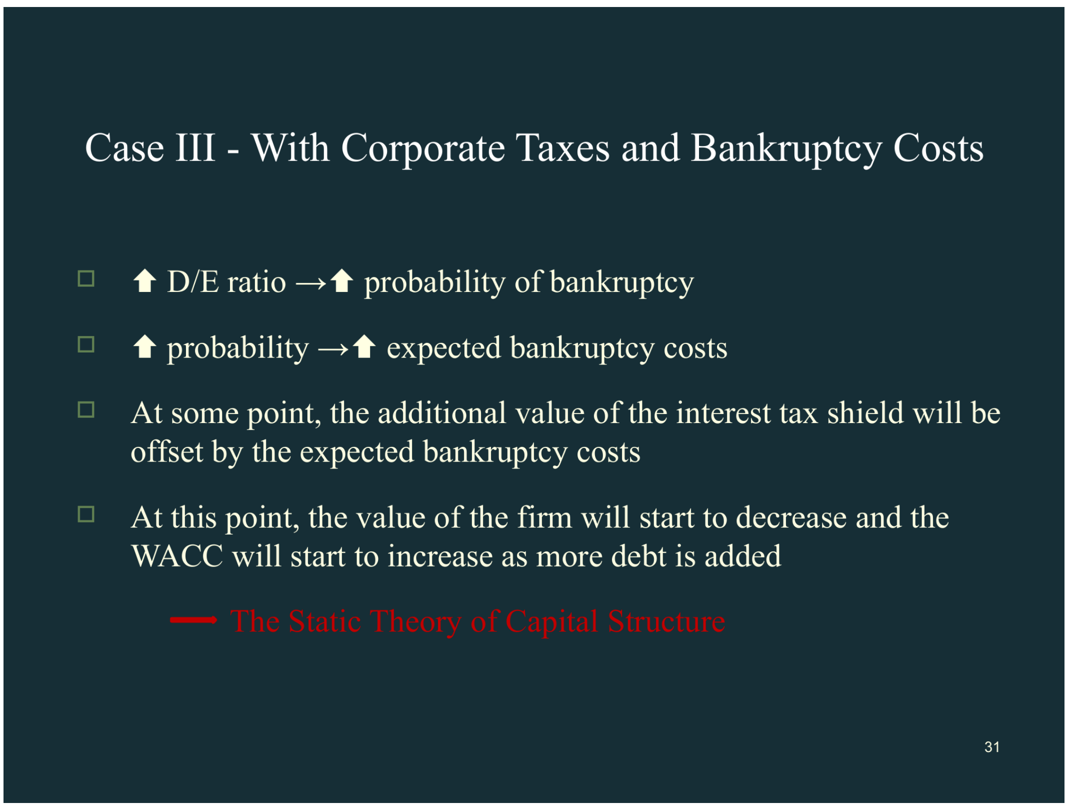


Figure 16: Tradeoff theory (tax shield vs. distress costs): firm value maximized at an interior optimal debt level.