Financial Management — Synthesized Course Notes

KAIST BTM (Instructor: Ryoonhee Kim)

Global Glossary (Notation Normalization)

- Time: $t = 0$ is today; $t = 1$ is end of period 1 unless stated.
- Cash flows: CF_t is cash flow at time t (inflow > 0, outflow < 0) from the perspective stated.
- Rates: i is effective rate per period; i_{nom} is nominal/APR; m compounding periods/year; $\text{EAR} = (1 + i_{\text{nom}}/m)^m - 1$.
- Valuation: $\text{PV} = \sum_t \frac{CF_t}{(1+r)^t}$; $\text{FV}_T = \sum_t CF_t(1 + r)^{T-t}$.
- Financial statements: $\text{CA}, \text{CL}, \text{NWC} = \text{CA} - \text{CL}$; NFA net fixed assets; $\text{EBIT}, \text{EBT}, \text{NI}$; Dep depreciation.
- Corporate finance cash flows: $\text{OCF} = \text{EBIT} + \text{Dep} - \text{Taxes} = \text{EBIT}(1 - T_c) + \text{Dep}T_c$; FCF (project/firm) is unlevered free cash flow.
- Capital budgeting: $\text{NPV}(r) = \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$; IRR solves $\text{NPV(IRR)} = 0$; MIRR uses PV(outflows) and FV(inflows); $\text{PI} = \text{PV(inflows)}/\,\text{PV(outflows)}$.
- Risk/return: $R_{t+1} = \frac{D_{t+1}+P_{t+1}-P_t}{P_t}$; $\sigma^2 = \text{Var}(R)$; $\rho_{ij} = \text{Cov}(R_i, R_j)/(\sigma_i\sigma_j)$; $\beta_i = \text{Cov}(R_i, R_M)/\,\text{Var}(R_M)$.
- Cost of capital: $\text{WACC} = w_E R_E + w_P R_P + w_D R_D(1 - T_c)$ with market-value weights.

Contents

Part I
Foundations and Financial Statements

1 Chapter 1: Introduction to Finance, Capital Allocation, and Governance

1.1 What is Finance? (Valuation under time and risk)

Core principle used throughout the course:

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

Corporate finance focuses on:

- **Investment decisions** (capital budgeting): which real assets/projects to undertake.
- **Financing decisions** (capital structure): how to raise funds (debt/equity).
- **Payout policy**: dividends/repurchases vs reinvestment.

1.2 Capital allocation process and market classifications

Capital flows from **suppliers** (savers) to **demanders** (borrowers/issuers) through:

- **Direct transfers** (rare).
- **Investment banks** (issuance facilitation; pass-through).
- **Financial intermediaries** (banks/funds; issue their own claims and invest in others).

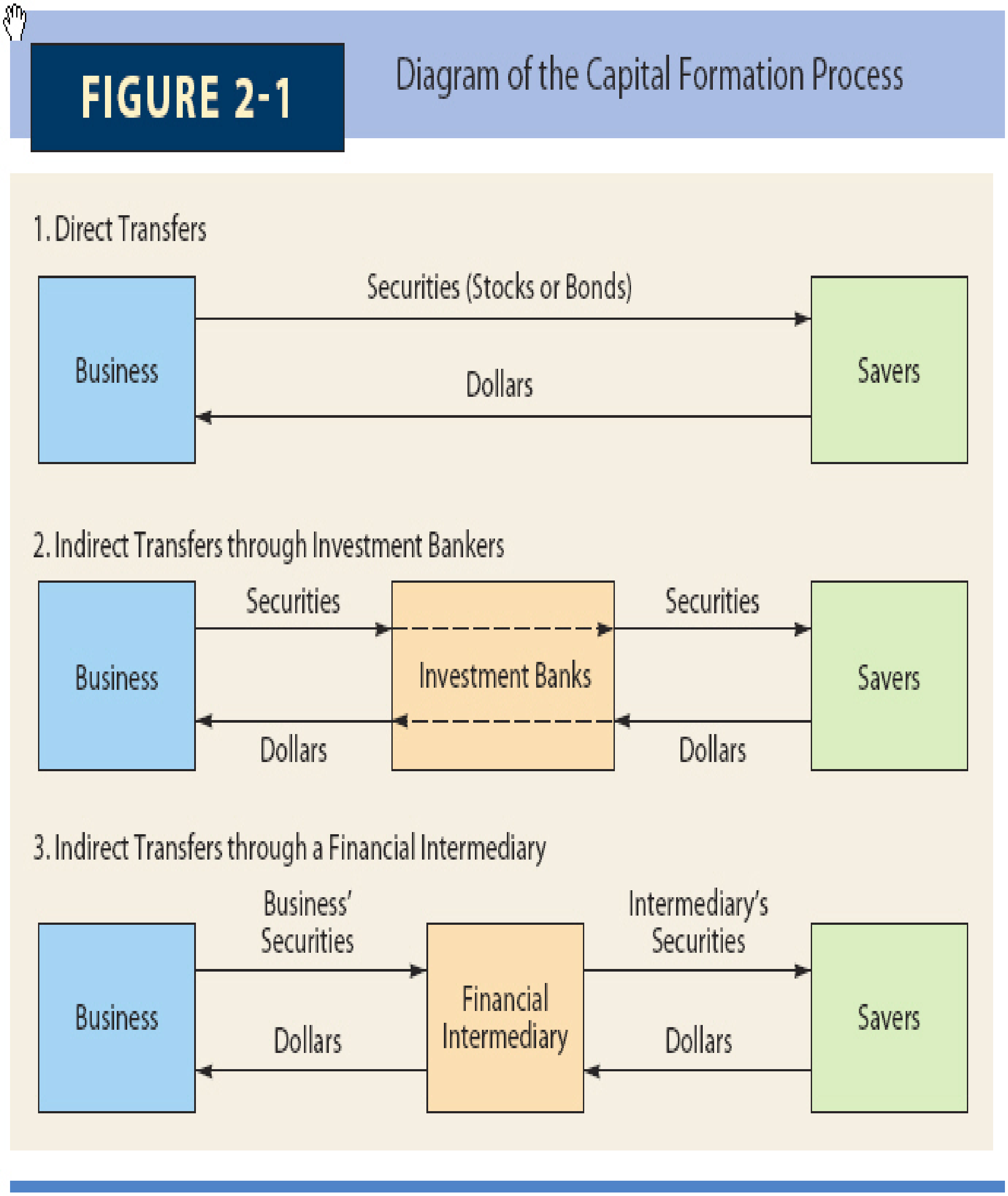


Figure 1: Capital formation channels: direct transfers vs indirect transfers via investment banks or financial intermediaries.

Primary vs. secondary markets.

- **Primary**: new securities issued; cash flows to issuer.
- **Secondary**: existing securities traded; no cash flows to issuer (but affects prices/cost of capital).

Money vs. capital markets.

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

1.3 Firm–financial market cash flow map

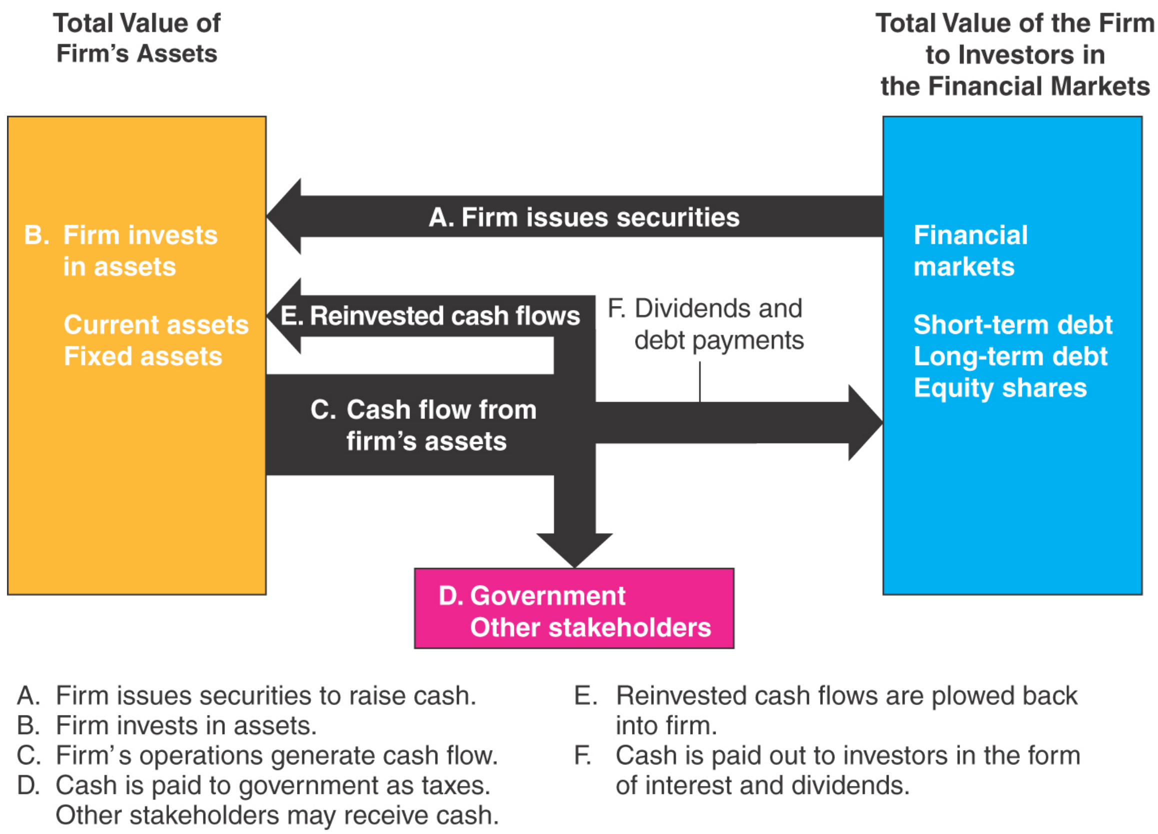


Figure 2: Cash flows between the firm and financial markets (A–F). Key idea: assets must ultimately generate cash to fund reinvestment and payouts.

1.4 Business organization forms (finance implications)

- **Sole proprietorship**: simple; unlimited liability; limited capital; limited life.
- **Partnership**: more capital; general partners unlimited liability; limited life; transfer difficulties.
- **Corporation**: separate legal entity; limited liability; unlimited life; easier capital raising; agency problems; (stylized) double taxation.

1.5 Agency problem and corporate governance (preview)

Separation of ownership and control creates agency conflicts; governance mechanisms (board, audits, regulation, compensation, takeover/labor markets) mitigate agency costs.

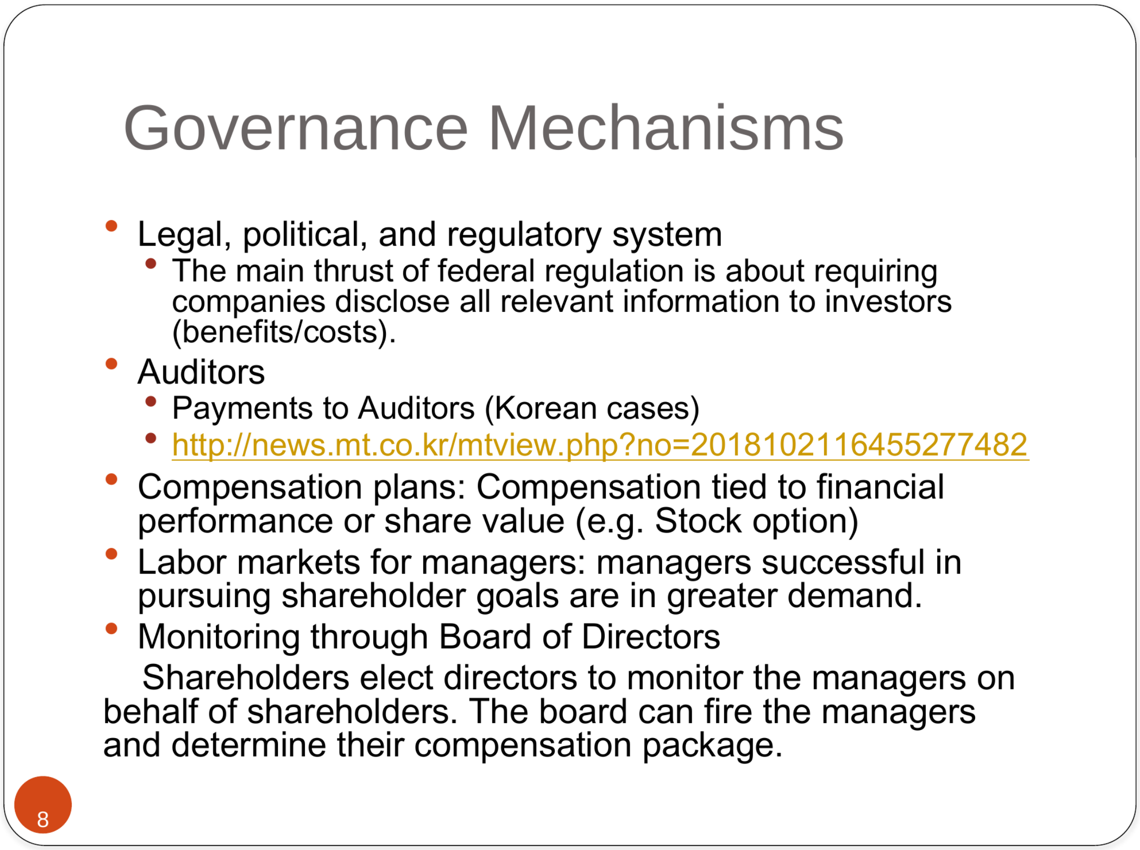


Figure 3: Governance mechanisms: regulation, auditors, compensation, labor markets, board monitoring.

2 Chapter 2: Financial Statements, Taxes, and Cash Flow

2.1 Objective of the firm and governance

Finance objective:

$$\max \mathrm{MV}(\text{equity}) \quad \text{(shareholder wealth maximization).}$$

Agency costs (conceptual):

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

where $V^{\star}$ is value under value-maximizing actions and C_M monitoring/contracting costs.

2.2 Core financial statements and timing

- **Balance sheet (BS)**: point-in-time snapshot.
- **Income statement (IS)**: flows over a period.
- **Statement of cash flows (SCF)**: cash flows over a period (operating/investing/financing).
- **Statement of stockholders' equity**: changes in equity accounts.

2.3 Balance sheet identity; net working capital

$$\text{Assets} = \text{Liabilities} + \text{Equity}$$

(holds for both book and market values, but components differ).

$$\text{NWC} = \text{CA} - \text{CL}.$$

Interpretation: short-run liquidity buffer; in cash-flow analysis, typically $\Delta\text{NWC} > 0$ is a *use* of cash.

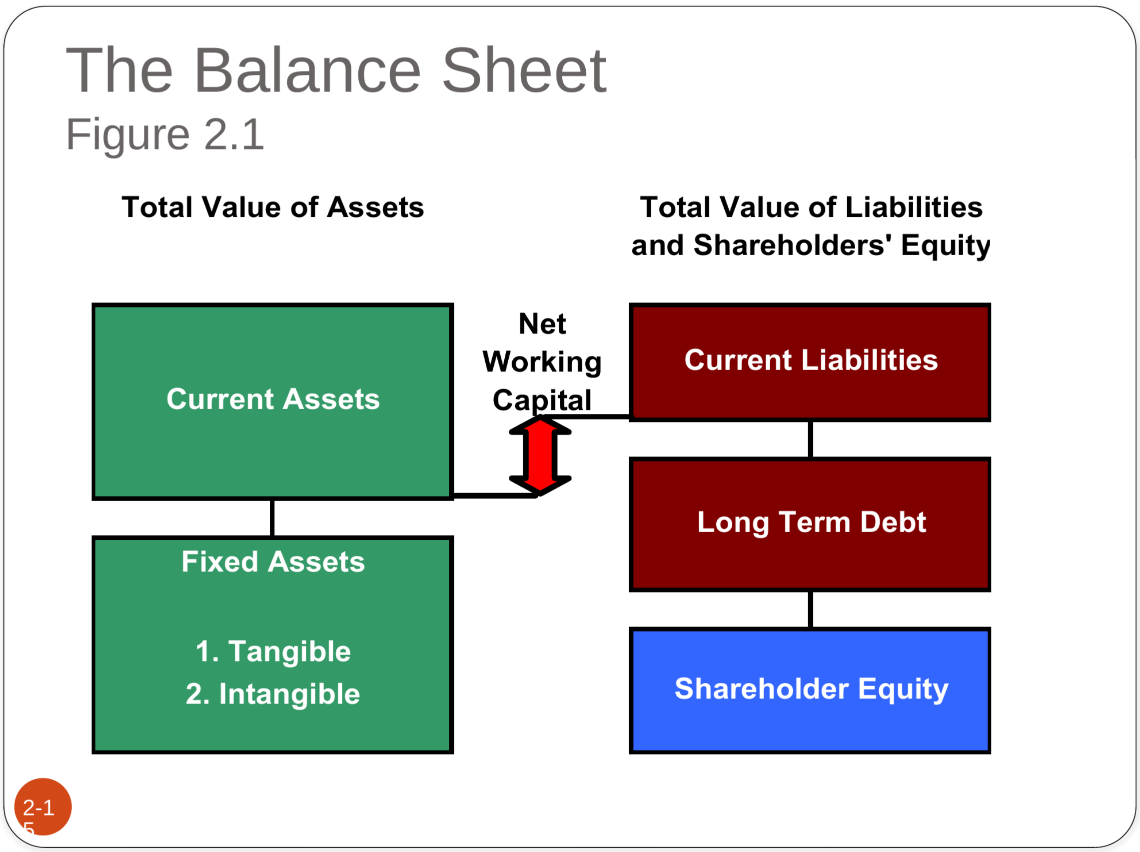


Figure 4: Balance sheet layout (Figure 2.1): assets vs liabilities/equity; net working capital highlighted.

2.4 Book value vs market value

- BV: accounting (historical cost, depreciation rules).
- MV: current market valuation (price-based).

For publicly traded equity:

$$\text{MV}(E) = P_0 \times N_{\text{shares}}.$$

Table 1: Klingon Corporation: 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

2.5 Taxes: marginal vs average

Given taxable income TI:

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

For incremental decisions, use the **marginal** tax rate on incremental taxable income (subject to bracket changes/NOLs).

2.6 Accounting cash flow vs financial cash flow

Accounting SCF identity:

$$\Delta\text{Cash} = \text{CFO} + \text{CFI} + \text{CFF}.$$

Corporate finance uses **financial cash flow** identities.

2.7 Financial cash flow identity (cash flow from assets)

Cash flow identity.

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

Compute cash flow from assets.

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

with

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

$$\text{NCS} = (\text{NFA}_t - \text{NFA}_{t-1}) + \text{Dep}, \qquad \Delta\text{NWC} = \text{NWC}_t - \text{NWC}_{t-1}.$$

Cash flow to capital providers.

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

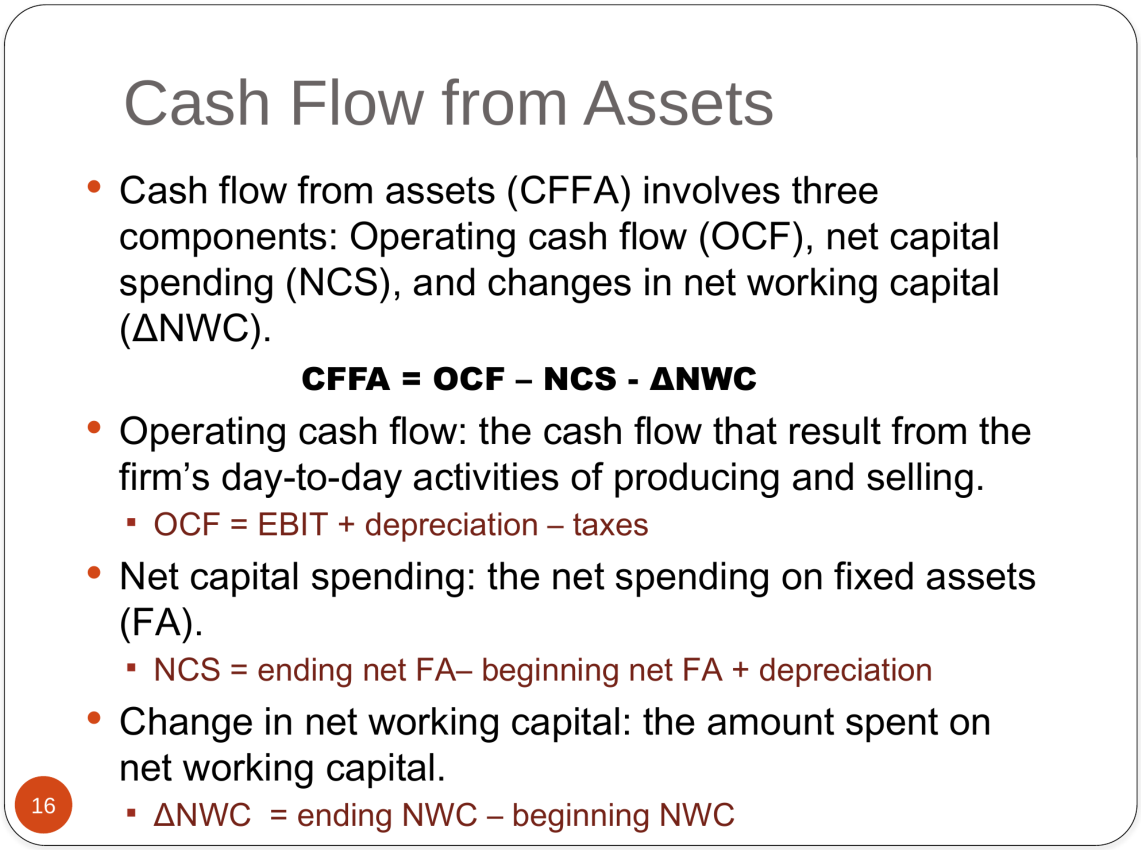


Figure 5: Cash flow from assets decomposition: CFFA = OCF − NCS − ΔNWC.

2.8 Worked structure: Dole Cola (sign discipline)

From slides (2020): Sales 600, COGS 300, Dep 150, EBIT = 150, Interest 30, Taxes 41.

$$\text{OCF} = 150 + 150 - 41 = 259.$$

Balance sheet changes imply $\Delta\text{NWC} = 40$ and $\text{NCS} = 400$, so:

$$\text{CFFA} = 259 - 400 - 40 = -181.$$

Interpretation: operations generated cash but reinvestment exceeded it; firm must raise financing.

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

3.1 Standardized (common-size) statements

Common-size balance sheet. For line item X:

$$\text{Share of } X = \frac{X}{A}.$$

Common-size income statement. For line item Y:

$$\text{Share of } Y = \frac{Y}{Sales}.$$

Use for time-trend and peer comparisons; interpret **percentage-point** changes.

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 6: Prufrock common-size balance sheets (2019–2020) with percentage-point changes.

3.2 Ratio analysis: categories and formulas

3.2.1 Liquidity (short-term solvency)

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

3.2.2 Long-term solvency: leverage and coverage

Leverage:

$$\text{Total debt ratio} = \frac{A - E}{A}, \quad \frac{D}{E}, \quad \text{Equity multiplier} = \frac{A}{E} = 1 + \frac{D}{E}.$$

Coverage:

$$\text{TIE} = \frac{\text{EBIT}}{\text{Int}}, \qquad \text{Cash coverage} = \frac{\text{EBIT} + \text{Dep}}{\text{Int}}.$$

3.2.3 Asset management (turnover)

$$\text{Inventory turnover} = \frac{\text{COGS}}{\text{Inv}}, \quad \text{DSI} = \frac{365}{\text{Inv turnover}}.$$

$$\text{Receivables turnover} = \frac{Sales}{AR}, \quad \text{DSO} = \frac{365}{\text{AR turnover}}.$$

$$\text{Total asset turnover (TAT)} = \frac{Sales}{A}.$$

3.2.4 Profitability

$$\text{Profit margin (PM)} = \frac{\text{NI}}{Sales}, \quad \text{ROA} = \frac{\text{NI}}{A}, \quad \text{ROE} = \frac{\text{NI}}{E}.$$

3.3 Market value measures (public firms)

Let P be price per share and N shares outstanding:

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

3.4 DuPont identity (ROE decomposition)

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

Use to diagnose whether ROE differences come from margins, asset utilization, or leverage.

TABLE 3.7

Du Pont analysis for Yahoo! and Google

Yahoo!							
Year	**ROE**	=	**Profit margin**	×	**Total asset turnover**	×	**Equity multiplier**
2008	3.8%	=	5.9%	×	0.527	×	1.22
2007	6.9%	=	9.5%	×	0.570	×	1.28
2006	8.2%	=	11.7%	×	0.558	×	1.26

Google							
Year	**ROE**	=	**Profit margin**	×	**Total asset turnover**	×	**Equity multiplier**
2008	18.9%	=	19.4%	×	0.686	×	1.42
2007	21.1%	=	25.3%	×	0.655	×	1.27
2006	18.1%	=	29.0%	×	0.574	×	1.08

Figure 7: DuPont decomposition example (Yahoo! vs Google): ROE as PM × TAT × EM.

3.5 Payout and retention

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

3.6 Benchmarking and limitations

Ratios require benchmarks:

- **Time-trend** (3–5 years).
- **Peer/industry** (SIC/NAICS).

Common pitfalls: accounting differences, fiscal year mismatch, one-time items, different business mixes.

Table 2: 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 (days)	16.512	12.000
TAT	2.390	2.800
Inventory Turnover	28.808	30.100
Profit Margin	0.053	0.045
ROA	0.128	0.126
ROE	0.203	0.221

Part II
Time Value of Money and Valuation

4 Chapter 4: Time Value of Money (TVM)

4.1 Single cash flow: compounding and discounting

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

Solve for rate and time:

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

4.2 Compounding conventions: APR, periodic rate, EAR

With m compounding periods/year:

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

Use EAR to compare investments with different m.

4.3 Annuities

Let payment be C each period, rate i, n payments.

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

$$PV_{\text{OA}} = C\frac{1-(1+i)^{-n}}{i}, \qquad FV_{\text{OA}} = C\frac{(1+i)^n - 1}{i}.$$

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

$$PV_{\mathrm{AD}} = PV_{\mathrm{OA}}(1+i), \qquad FV_{\mathrm{AD}} = FV_{\mathrm{OA}}(1+i).$$

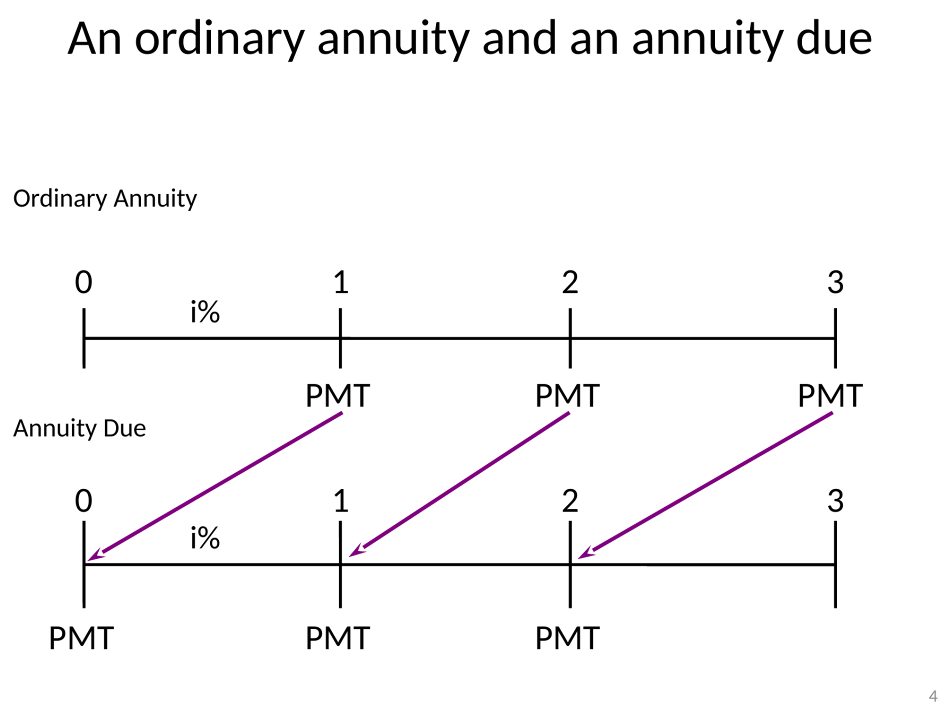


Figure 8: Ordinary annuity vs annuity due timing.

4.4 Perpetuities and growing perpetuities

$$PV_0 = \frac{C}{r} \quad \text{(first payment at } t=1\text{)}, \qquad PV_0 = \frac{C_1}{r-g} \quad (r > g).$$

4.5 Uneven cash flows

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

5 Chapter 6: Bonds and Stocks (Valuation)

5.1 Part A: Stock valuation (DDM, FCF model, multiples)

5.1.1 General stock pricing identity

Holding to time T:

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

Infinite-horizon DDM:

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

5.1.2 Zero growth and constant growth (Gordon)

Zero growth ($D_t = D$):

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

Constant growth ($g < r_S$):

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

Sustainable growth approximation:

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

5.1.3 Multi-stage (variable growth) DDM

If non-constant growth for $t = 1, \ldots, N$ then constant g_c thereafter:

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

5.1.4 Corporate value model (FCF/WACC)

Enterprise value:

$$V_0 = \sum_{t=1}^{N} \frac{FCF_t}{(1 + \text{WACC})^t} + \frac{TV_N}{(1 + \text{WACC})^N}, \qquad TV_N = \frac{FCF_{N+1}}{\text{WACC} - g_c} \ (g_c < \text{WACC}).$$

Equity value:

$$\text{MV}(E) = V_0 - \text{MV}(D) - \text{MV}(\text{Pref}), \qquad P_0 = \frac{\text{MV}(E)}{N_{\text{shares}}}.$$

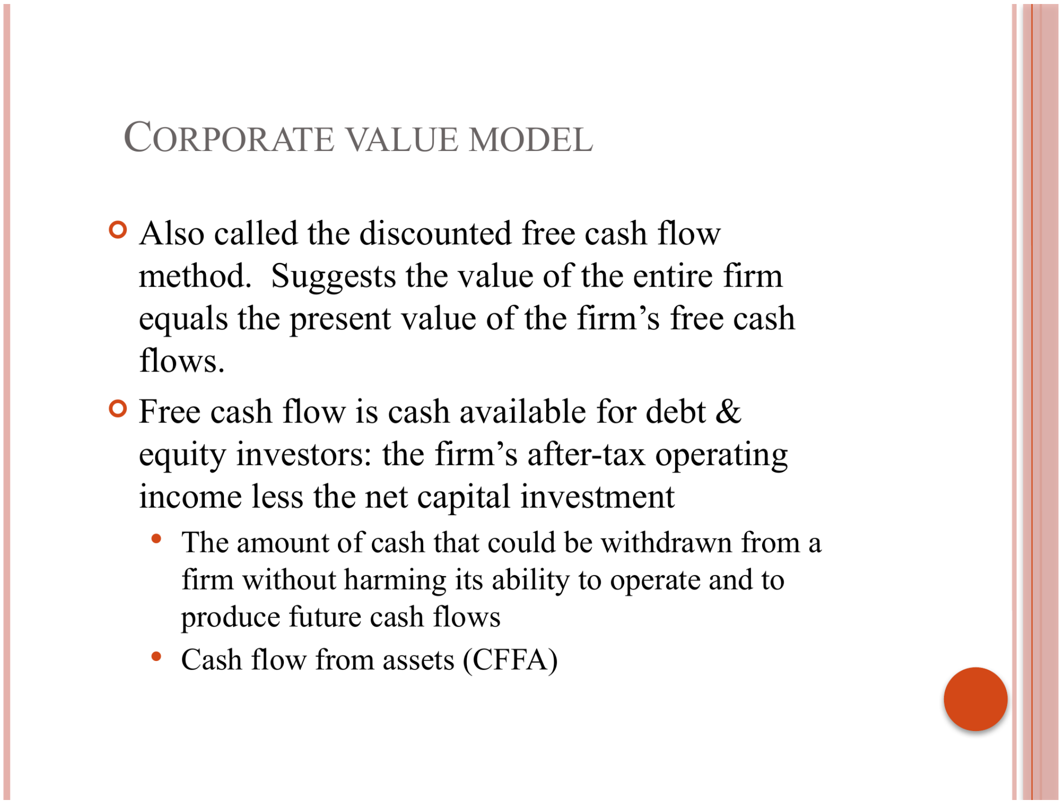


Figure 9: Corporate value model: value firm as PV of free cash flows discounted at WACC.

5.1.5 Multiples (comparables)

Example:

$$\widehat{P}_0 = (P/E)_{\text{peers}} \times \text{EPS}_{\text{target}}.$$

Caveat: comparability and accounting differences.

5.1.6 Preferred stock

Fixed dividend perpetuity:

$$V_P = \frac{D_P}{r_P}, \qquad r_P = \frac{D_P}{P_0}.$$

5.2 Part B: Bond valuation and yields

5.2.1 Bond pricing (annual coupons)

Face value F, coupon dollars C, maturity T (periods), yield per period r:

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

Premium/discount:

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

where c is coupon rate per year and $C = cF$ (annual coupon case).

5.2.2 Semiannual convention (APR quoted)

If $m = 2$:

$$r_{\text{per}} = \frac{y_{\text{APR}}}{2}, \quad N = 2T, \quad C_{\text{per}} = \frac{cF}{2},$$

$$P_0 = C_{\text{per}} \left(\frac{1 - (1 + r_{\text{per}})^{-N}}{r_{\text{per}}} \right) + \frac{F}{(1 + r_{\text{per}})^N}.$$

5.2.3 Zero-coupon bond

$$P_0 = \frac{F}{(1 + r)^T} \quad \text{(match compounding to convention).}$$

5.2.4 Yield to maturity (YTM)

YTM is the IRR on promised cash flows:

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

Current yield (annual coupon):

$$\text{CY} = \frac{cF}{P_0}.$$

5.2.5 Bond price over time (pull-to-par)

With constant required yield, premium bonds drift down toward par; discount bonds drift up toward par.

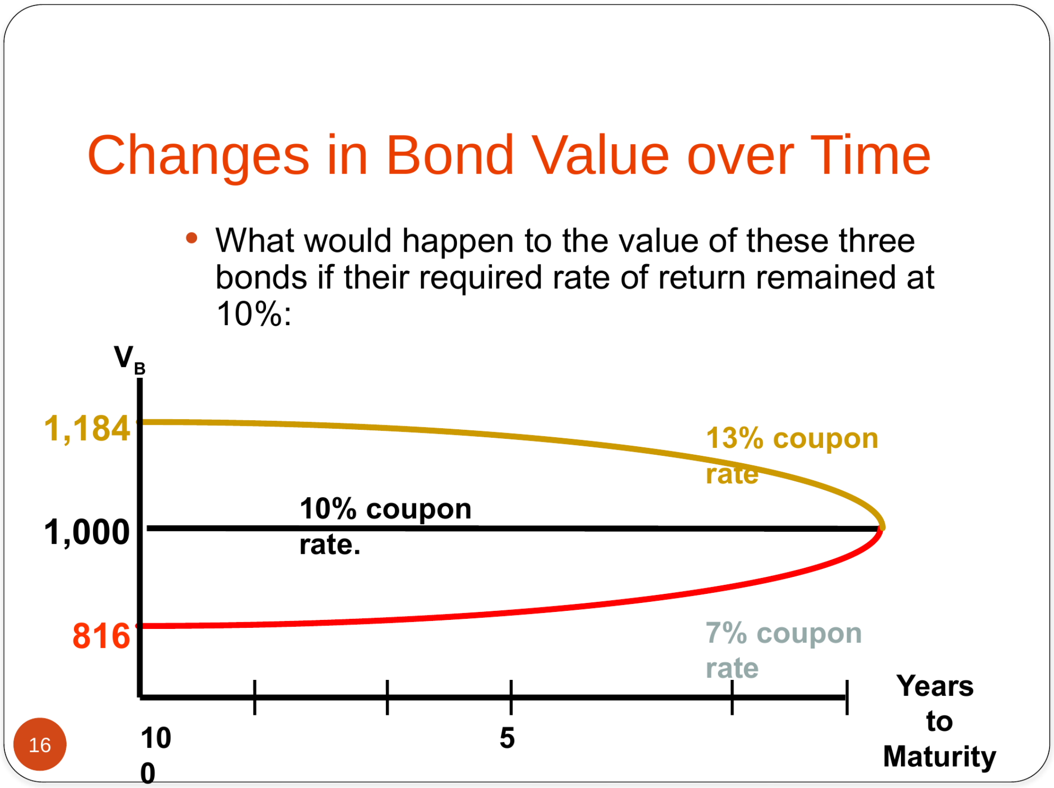


Figure 10: Bond values over time with constant required return: premium bonds fall toward par, discount bonds rise toward par.

5.2.6 Callable bonds and yield to call (YTC)

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

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

annualize r_c to YTC. Callability caps upside when rates fall.

5.2.7 Fisher effect (nominal vs real)

$$(1+R) = (1+r)(1+h) \quad \Rightarrow \quad R = r + h + rh \approx r + h.$$

Part III
Capital Budgeting

6 Chapter 7: Capital Budgeting Decision Criteria

6.1 Capital budgeting setup

Given cash flows $\{CF_t\}_{t=0}^{n}$ and discount rate k:

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

Decision (independent): accept if NPV > 0.

6.2 IRR

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

For **normal** cash flows (one sign change), accept if IRR $> k$ and NPV and IRR agree on accept/reject.

6.3 NPV vs IRR conflicts (mutually exclusive projects)

Conflicts arise due to:

- **Scale** differences (IRR is a percent; NPV is dollars).
- **Timing** differences (later cash flows penalized more at high k).

Use **highest NPV** at the relevant k.

6.4 NPV profiles and crossover rate

For projects A and B, define incremental cash flows $\Delta CF_t = CF_t^A - CF_t^B$. Crossover rate r^* solves:

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

At $k = r^*$, $NPV_A = NPV_B$.

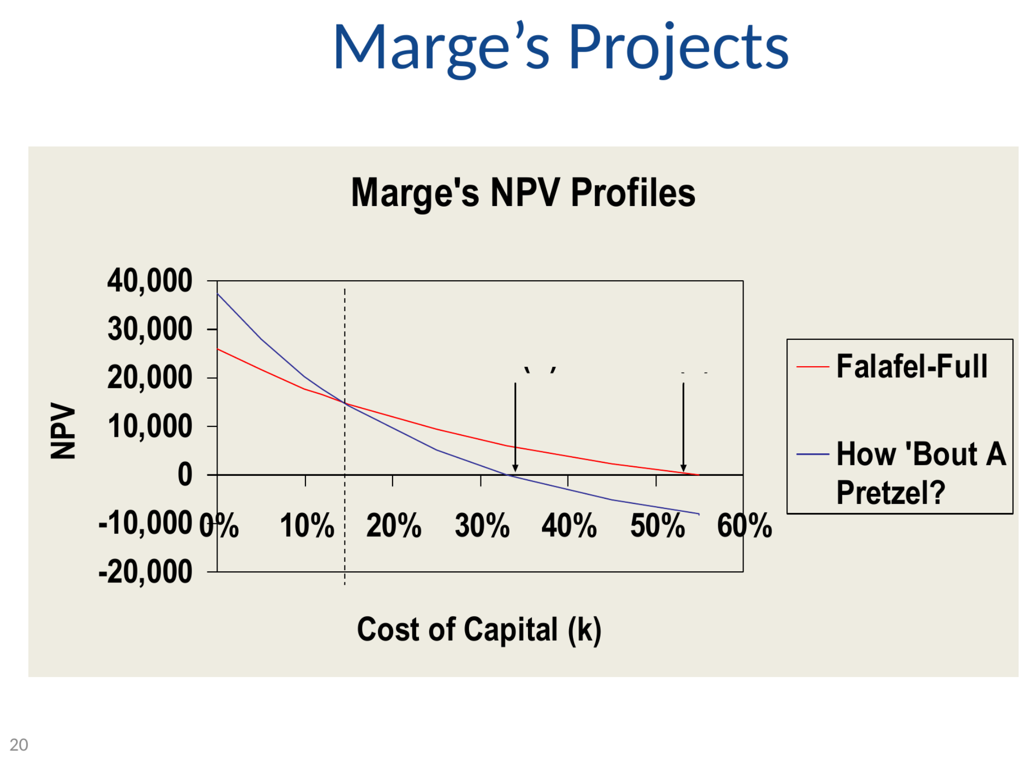


Figure 11: Example NPV profiles crossing at a crossover rate.

6.5 MIRR

Split cash flows into inflows and outflows:

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

Using reinvestment and finance rates (often both k):

$$TV_{\text{in}} = \sum_{t=0}^{n} \mathrm{CIF}_t (1+k)^{n-t}, \qquad PV_{\text{out}} = \sum_{t=0}^{n} \frac{\mathrm{COF}_t}{(1+k)^t} \ (< 0),$$

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

MIRR avoids multiple-IRR ambiguity for non-normal cash flows.

6.6 Payback, discounted payback, profitability index

Payback (PB): smallest t where cumulative undiscounted cash flows become nonnegative (interpolate within year). Discounted payback (DPB): same using discounted cash flows at k. Profitability index:

$$\mathrm{PI} = \frac{\mathrm{PV(future\ inflows)}}{\mathrm{PV(outflows\ in\ absolute\ value)}}.$$

For conventional projects with only $CF_0 < 0$:

$$\text{PI} = \frac{\sum_{t=1}^{n} \frac{CF_t}{(1+k)^t}}{|CF_0|}, \qquad \text{PI} > 1 \iff \text{NPV} > 0.$$

PI is useful under capital rationing; can mis-rank mutually exclusive projects (scale).

7 Chapter 8: Cash Flow Estimation and Project Analysis

7.1 Relevant (incremental) cash flows

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

Include opportunity costs and side effects (erosion/synergy); exclude sunk costs and financing flows (interest/dividends) when discounting at WACC.

7.2 Project free cash flow decomposition

For project life N:

$$\text{FCF}_t = \text{OCF}_t - \text{NCS}_t - \Delta\text{NWC}_t \quad (t = 1, \ldots, N-1),$$

with terminal additions at $t = N$ (after-tax salvage and NWC recovery). Operating cash flow:

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

7.3 Depreciation and tax shield

Straight-line (to salvage for book, if specified):

$$\text{Dep} = \frac{B - S_{\text{dep}}}{N}.$$

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

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

7.4 Net working capital (NWC) as a cash flow

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

In project cash flows, $-\Delta\text{NWC}_t$ enters: increases are cash outflows; recovery at end is an inflow.

7.5 After-tax salvage and terminal cash flow

If salvage value at $t = N$ is SV and book value is BV_N:

$$SV_{\text{AT}} = SV - T_c(SV - \text{BV}_N).$$

Terminal cash flow typically:

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

7.6 Ping Kings (structure and key computations)

Key figures retained for the worked case.

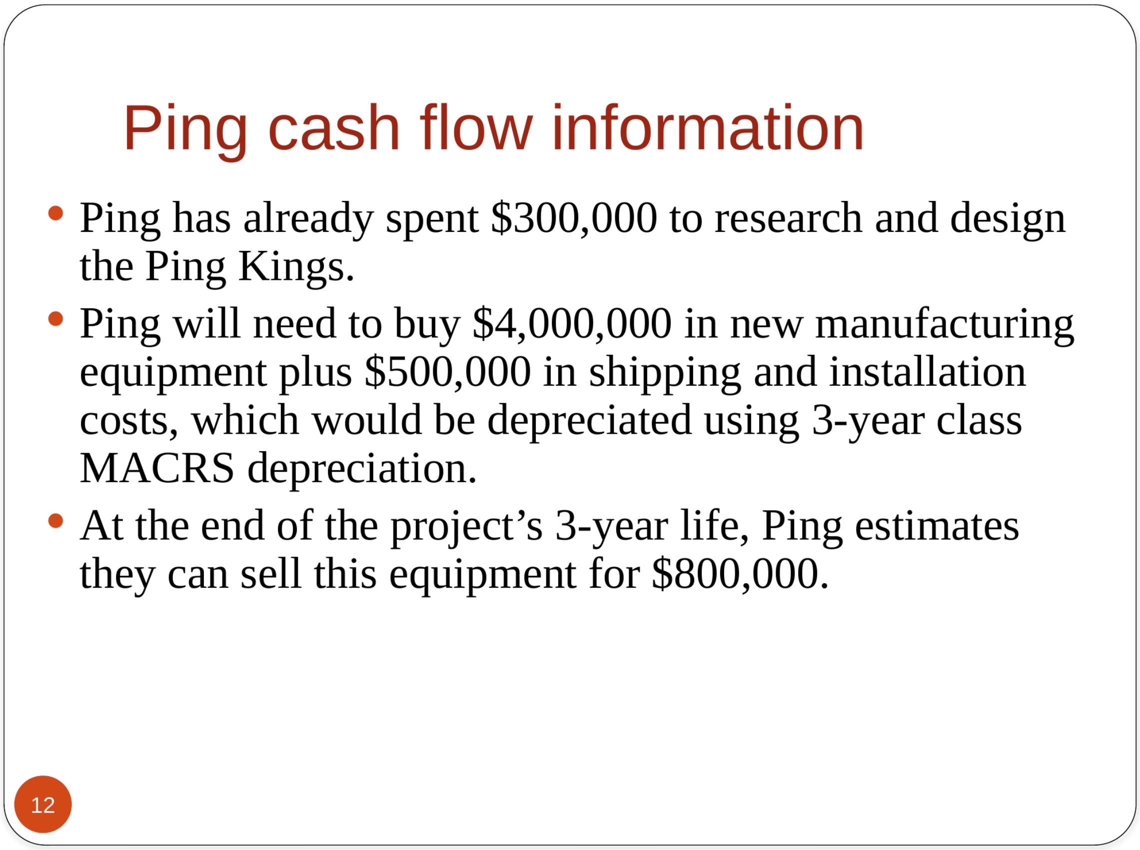


Figure 12: Ping Kings case: 3-year project; estimate cash flows and decision metrics.

Depreciable basis and MACRS (as in slides). Basis $B = 4.5\text{M}$; MACRS rates: 33%, 45%, 15% (Year 4: 7% implies remaining BV).

$$\text{Dep}_1 = 1{,}485{,}000, \quad \text{Dep}_2 = 2{,}025{,}000, \quad \text{Dep}_3 = 675{,}000,$$

$$\text{BV}_3 = 4{,}500{,}000 - (1{,}485{,}000 + 2{,}025{,}000 + 675{,}000) = 315{,}000.$$

After-tax salvage (end of year 3). With $SV = 800{,}000$ and $T_c = 40\%$:

$$SV_{\text{AT}} = 800{,}000 - 0.40(800{,}000 - 315{,}000) = 606{,}000.$$

7.7 Side effects (erosion) and forecasting risk

Erosion example: if incremental ΔEBIT_t from cannibalization is negative, after-tax impact on OCF is:

$$\Delta\text{OCF}_t = \Delta\text{EBIT}_t(1 - T_c) \quad \text{(if no depreciation change)}.$$

7.8 Scenario and sensitivity analysis

- **Scenario analysis**: vary multiple inputs jointly (worst/base/best) to obtain NPV range.
- **Sensitivity analysis**: vary one input at a time to identify high-impact variables.

7.9 Unequal lives: replacement chain and EAA

For repeatable mutually exclusive projects with lives n_i:

$$\mathrm{EAA}_i = \mathrm{NPV}_i \cdot \frac{r}{1-(1+r)^{-n_i}}.$$

Alternatively, replacement chain: extend each project to common horizon $H = \mathrm{lcm}(n_1, n_2, \dots)$ and compare extended NPVs.

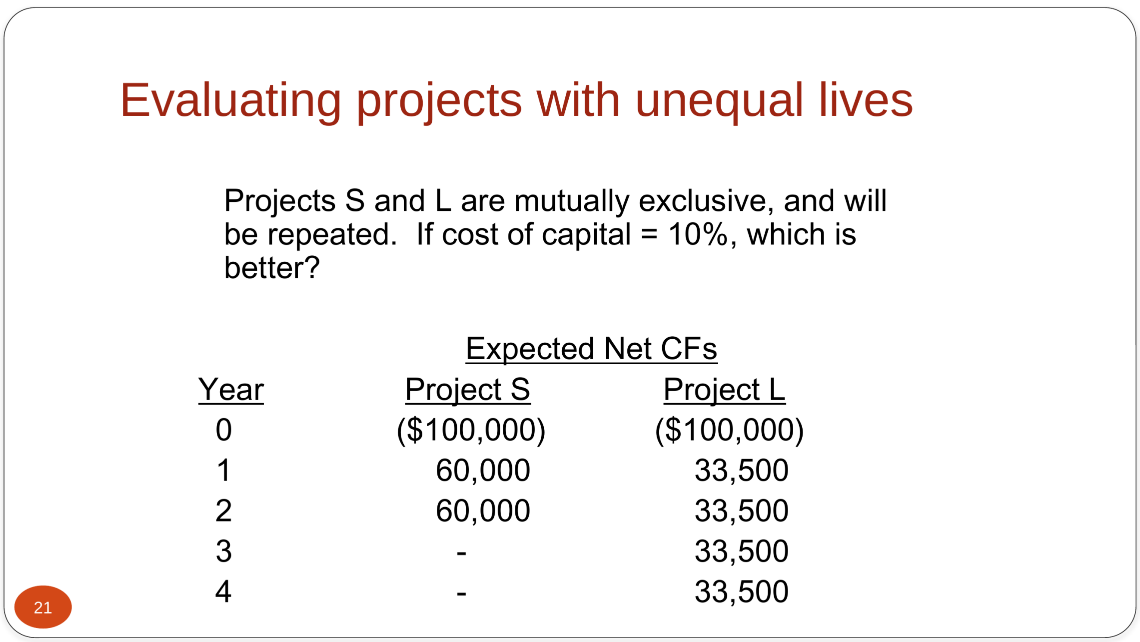


Figure 13: Unequal lives: introduction of EAA for comparing repeatable projects.

Part IV
Risk, Return, CAPM, and Cost of Capital

8 Chapter 10: Risk and Return (Measurement and Historical Evidence)

8.1 Holding-period return (HPR)

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

8.2 Historical mean and volatility

Arithmetic mean:

$$\bar{R} = \frac{1}{T}\sum_{t=1}^{T} R_t.$$

Sample variance and standard deviation:

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

Risk premium:

$$RP = \mathbb{E}[R] - R_f \quad \text{(historical estimate } \approx \bar{R} - \bar{R}_f\text{)}.$$

8.3 Arithmetic vs geometric average

Geometric average (compound growth rate):

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

8.4 Efficient Market Hypothesis (EMH) (conceptual)

Prices reflect information; only unexpected news moves prices. Forms: weak, semistrong, strong (nested information sets).

9 Chapter 11: Diversification, Efficient Frontier, and CAPM

9.1 Expected return and variance (discrete distribution)

$$\mathbb{E}[R] = \sum_i P_i r_i, \qquad \sigma^2 = \sum_i P_i (r_i - \mathbb{E}[R])^2.$$

9.2 Covariance and correlation

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

9.3 Portfolio return and risk

For weights w_i:

$$\mathbb{E}[R_p] = \sum_i w_i \mathbb{E}[R_i], \qquad \mathrm{Var}(R_p) = \sum_i \sum_j w_i w_j \,\mathrm{Cov}(R_i, R_j).$$

Two-asset case:

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1 w_2 \rho_{12}\sigma_1\sigma_2.$$

Diversification benefit requires $\rho_{12} < 1$.

(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 14: Portfolio risk declines with number of stocks and approaches a systematic-risk floor.

9.4 Systematic vs unsystematic risk; beta

Systematic risk is priced; unsystematic risk diversifies away in large portfolios.

$$\beta_i = \frac{\mathrm{Cov}(R_i, R_M)}{\mathrm{Var}(R_M)} = \rho_{iM}\frac{\sigma_i}{\sigma_M}.$$

9.5 CAPM (Security Market Line)

$$\mathbb{E}[R_i] = R_f + \beta_i\big(\mathbb{E}[R_M] - R_f\big).$$

Portfolio beta:

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

9.6 Efficient frontier and risk-free asset (intuition)

With a risk-free asset, optimal portfolios lie on the Capital Market Line (CML) in $(\sigma, \mathbb{E}[R])$ space; CAPM gives the SML in $(\beta, \mathbb{E}[R])$ space.

10 Chapter 12: WACC and Cost of Capital

10.1 WACC definition and use

Let $V = D + P + E$ be total market value of financing:

$$\mathrm{WACC} = w_E R_E + w_P R_P + w_D R_D (1 - T_c), \quad w_E = \frac{E}{V},\ w_P = \frac{P}{V},\ w_D = \frac{D}{V}.$$

Use WACC as discount rate for **average-risk** projects consistent with target capital structure.

10.2 Cost of equity

CAPM.

$$R_E = r_f + \beta_E(\mathbb{E}[R_M] - r_f).$$

Dividend growth (Gordon). If constant growth g:

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

10.3 Cost of debt

Use **YTM** on comparable-risk debt (not coupon). Apply after-tax adjustment:

$$R_{D,\text{after}} = R_D(1 - T_c).$$

10.4 Beta estimation and leverage

Beta estimated via regression of asset returns on market returns:

$$R_i = \alpha + \beta_i R_M + \varepsilon.$$

Asset beta as value-weighted average:

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

If $\beta_D \approx 0$:

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

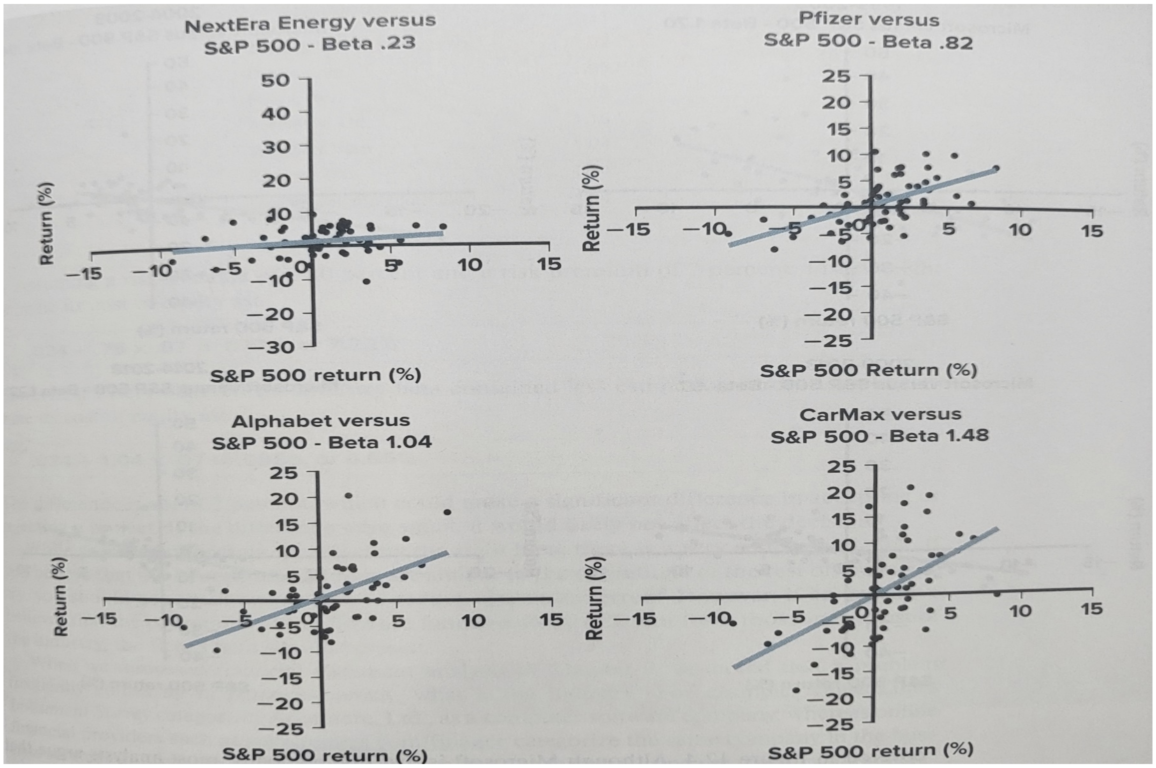


Figure 15: Beta estimation via return scatterplots and fitted regression lines (Figure 12.3).

10.5 Project/division discount rates

Do not apply firm WACC to projects with different risk. Use project beta (pure-play comparables) and CAPM to obtain project required return.

Part V
Capital Structure

11 Chapter 14: Capital Structure and Modigliani–Miller

11.1 Capital structure objective

Choose financing mix to minimize WACC and maximize firm value, recognizing real-world frictions (taxes, distress costs, agency, information).

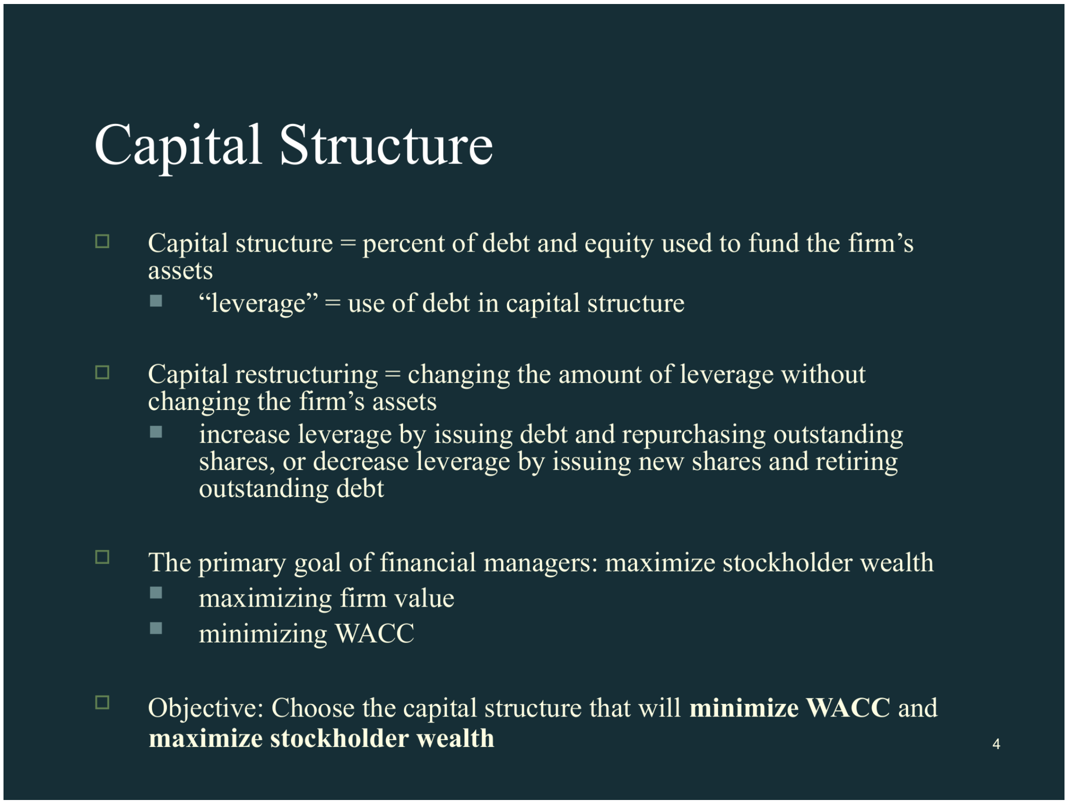


Figure 16: Capital structure definitions and objective: minimize WACC, maximize firm value.

11.2 Leverage and EPS/ROE sensitivity

No taxes:

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

EPS break-even EBIT between structures 1 and 2 (no taxes):

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

Caution: EPS maximization is not value maximization (risk and discount rates change with leverage).

11.3 Leverage and beta

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

so if $\beta_D \approx 0$:

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

11.4 MM Case I: no taxes, no distress

Proposition I (irrelevance).

$$V_L = V_U.$$

Proposition II (cost of equity increases with leverage).

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

WACC invariance.

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

11.5 Homemade leverage (replication)

In perfect markets, investors can lever/unlever on their own; hence capital structure cannot change firm value in Case I.

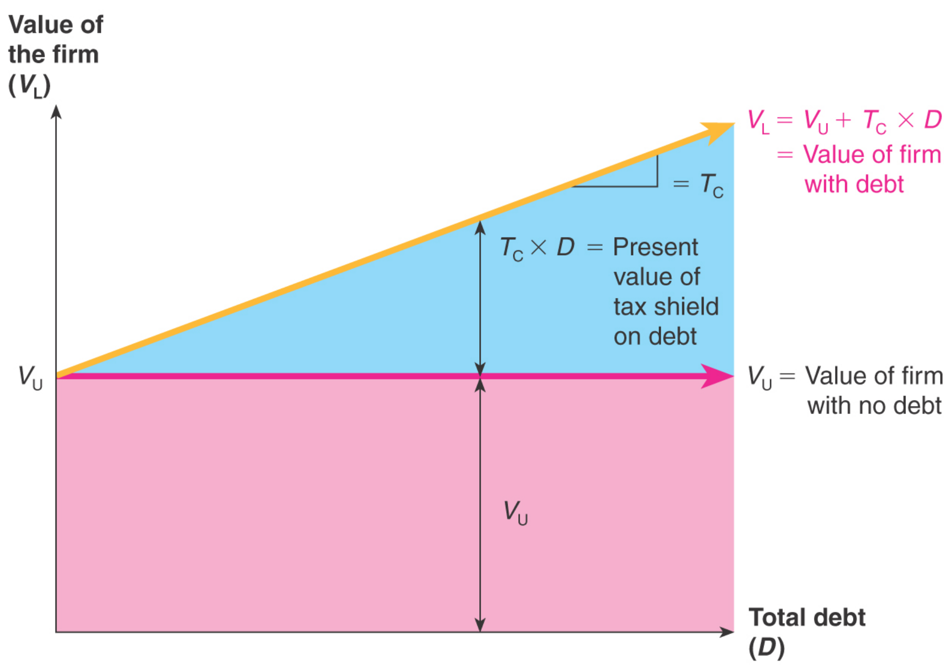
11.6 MM Case II: corporate taxes, no distress

Interest tax shield implies:

$$PV(\text{tax shield}) = T_c D \quad (\text{perpetual, fixed } D \text{ under MM assumptions}),$$

$$V_L = V_U + T_c D.$$

Implication in this stylized case: value increases monotonically with debt (corner solution).



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 17: MM Prop I (with corporate taxes): $V_L = V_U + T_C D$.

11.7 Case III: taxes + distress costs (tradeoff theory)

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

Optimal debt D^* where marginal tax benefit equals marginal expected distress cost.

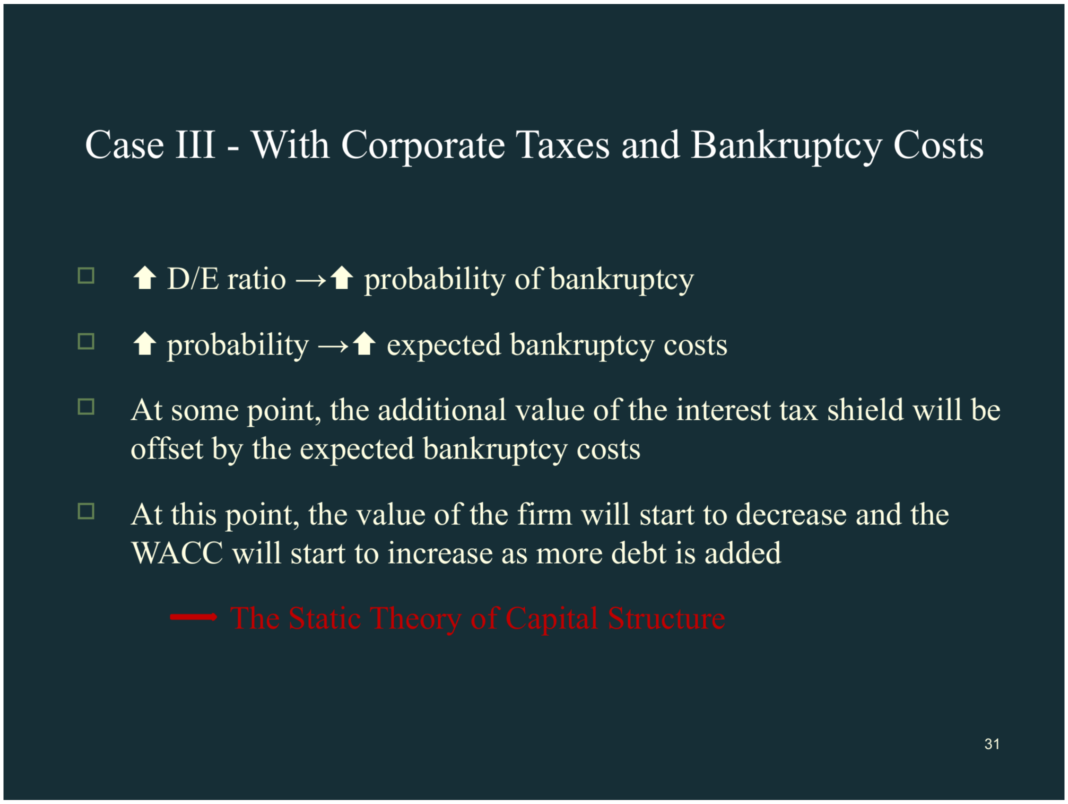


Figure 18: Tradeoff theory: firm value maximized at an interior optimal debt level.

11.8 Pecking order theory (information asymmetry)

Financing preference:

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

Predicts no stable target leverage; profitable firms borrow less (less need for external finance).