Stock Value, Growth, and Market Expectations

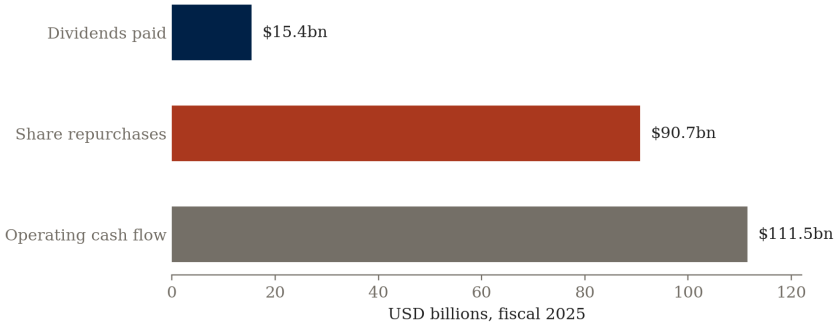
From shareholder distributions to enterprise cash flow

Summer 2026

Computational Finance / FinTech Summer School

Day 3 | final-year undergraduate / introductory master's level

Apple paid shareholders mainly through repurchases, not dividends



Apple Form 10-K, fiscal year ended 27 September 2025. Cash payments; USD billions.

Repurchase = company cash used to acquire its own shares. A dividend-only model establishes the logic of equity valuation, but may omit the dominant observed payout channel.

Appendix A8 · Source audit

Decision brief: what assumptions support £44 per Aster share?

Valuation date	14 August 2026
Business	Payment acceptance, merchant software, and settlement services
Observed price	£44.00 per share; 100 million diluted shares
Capital structure	£350m cash and securities; £500m debt
Committee question	Is the price supported by a defensible operating and payout story?

Aster Payments plc is a fully disclosed fictional company. Diluted shares include ordinary shares plus potential shares from instruments such as employee options.

Day 3 roadmap: six questions turn a share quote into a decision

1. **Claim:** what does one share own, and how can its return arrive?
2. **Payout:** how do distributions become today's value?
3. **Growth:** when does retaining cash create value?
4. **Enterprise:** how do operations become equity value?
5. **Market:** which expectations are embedded in £44?
6. **Decision:** which assumptions carry the recommendation?

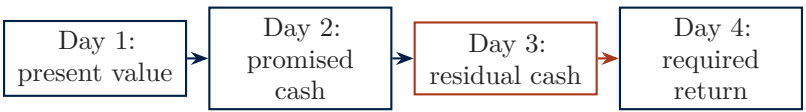
The route is causal: identify the claim, select its cash flow, test growth economics, value operations, interrogate price, then decide.

By the end, you should be able to defend a valuation range

- **Derive** one-period and continuing equity valuation equations.
- **Distinguish** dividends, total payout, free cash flow to equity, and free cash flow to the firm.
- **Test** whether growth creates value through reinvestment and return on capital.
- **Build** a five-year enterprise discounted-cash-flow valuation.
- **Reverse** the market price into implied assumptions.
- **Cross-check** with multiples without confusing price with value.
- **Recommend** only after scenarios, sensitivity, and failure checks.

Discounted cash flow (DCF) values expected future cash flows at the valuation date. A valuation range reports model uncertainty rather than hiding it.

Days 1–4 form one valuation chain



- Today, the cost of equity and WACC are declared inputs.
- Day 4 will estimate required return from market risk.

Residual cash flow is what remains for common shareholders after contractual and operating claims.
WACC = weighted average cost of capital.

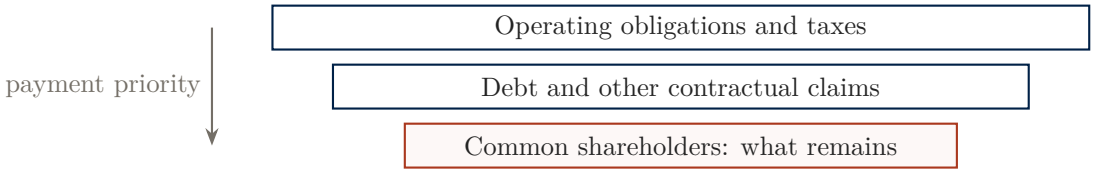
PART 1 OF 6

Read the claim

What does one share own, and how can its return arrive?

Begin with legal and economic ownership before writing a valuation formula.

A common share is a residual claim, not a promised payment



- The amount and timing of shareholder cash are not contractually fixed.
- Limited liability caps the shareholder's loss at the invested amount.

Residual claim = right to value remaining after senior claims. Common stock = ordinary equity ownership with voting and residual cash-flow rights.

Appendix A1 · Priority audit

One company has two valuation units

$$\text{value per share} = \frac{\text{equity value}}{\text{diluted shares}}.$$

Enterprise value belongs to debt and equity capital providers. Equity value belongs to common shareholders after net debt and other claims are recognised.

A shareholder receives cash and a changed market price

- D_1 is the distribution paid during the period.
- P_1 is the ex-distribution resale price at the period end.

Ex-distribution means the buyer at $t = 1$ is not entitled to D_1. Realised quantities are observed afterward; valuation uses expectations beforehand.

Appendix A2 · Return identity Python P2 · Return

Total return has income and capital-gain components

$$R_1 = \frac{D_1 + P_1 - P_0}{P_0} = \underbrace{\frac{D_1}{P_0}}_{\text{distribution yield}} + \underbrace{\frac{P_1 - P_0}{P_0}}_{\text{capital gain}}.$$

- A zero-dividend stock can still deliver a positive return through price appreciation.
- A high dividend does not guarantee a high total return if price falls.

R_1: one-period holding return. Distribution yield uses shareholder cash paid during the period; capital gain measures the price change.

Required return turns the one-period payoff into value

$$P_0 = \frac{\mathbb{E}_0[D_1 + P_1]}{1 + r_e}.$$

- $\mathbb{E}_0[\cdot]$ records information and expectations available today.
- r_e compensates for time and equity risk; it is an input on Day 3.
- The equation is conditional: change expected payout, resale value, or required return and value changes.

Cost of equity r_e = expected return investors require for bearing the stock's risk. Day 4 studies how to estimate it.

The resale price moves the same valuation problem one period forward

$$P_1 = \frac{\mathbb{E}_1[D_2 + P_2]}{1 + r_e} \quad \Longrightarrow \quad P_0 = \frac{\mathbb{E}_0[D_1]}{1 + r_e} + \frac{\mathbb{E}_0[D_2 + P_2]}{(1 + r_e)^2}.$$

- Selling does not create value from nowhere: the next buyer also values later cash flows.
- Repeating the substitution exposes the distributions supporting every future resale price.

Recursion means substituting the same pricing relation repeatedly. Constant r_e is used here for clarity; time-varying discount rates are possible.

Appendix A3 · Two-period recursion

Repeated substitution yields the dividend-discount identity

$$P_0 = \sum_{t=1}^{\infty} \frac{\mathbb{E}_0[D_t]}{(1+r_e)^t}, \qquad \lim_{N\to\infty} \frac{\mathbb{E}_0[P_N]}{(1+r_e)^N} = 0.$$

- The terminal condition prevents price from being supported only by ever-higher resale prices.
- This is a present-value identity; it does not tell us how to forecast distributions.

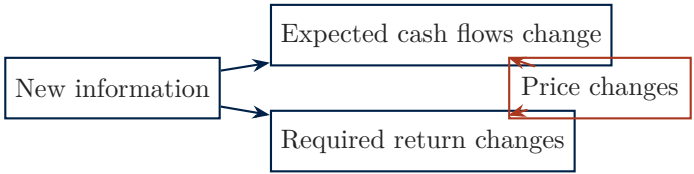
Dividend-discount model (DDM) = equity valuation from expected shareholder distributions. The terminal condition is often called a no-bubble or transversality condition.

Price is observed; value is conditional on a model

	Market price	Estimated value
Source	Trades and quoted orders	Forecasts, rates, and valuation model
Nature	One clearing number now	Conditional range of outcomes
Main question	What did the market pay?	What assumptions support this amount?
Discipline	Check date and liquidity	Check cash flow, rate, timing, and sensitivity

Market price and model value can disagree without either being relabelled. The analytical task is to locate the disagreement in assumptions.

News changes price through cash-flow or discount-rate expectations



- Good reported results can accompany a price fall when prior expectations were better.
- The economic surprise is the result relative to the market's prior distribution, not relative to zero.

Appendix A27 · Information

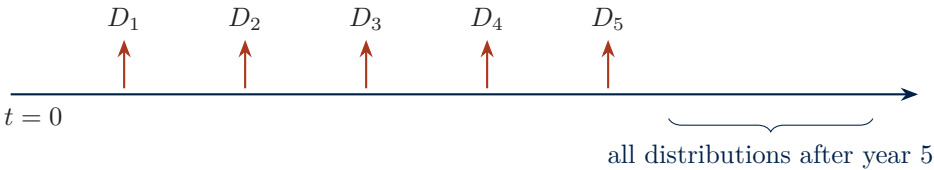
PART 2 OF 6

Value the payout

How do future shareholder distributions become today's value?

Start with dividends, then repair the model when payout policy changes the observed cash-flow channel.

The DDM prices a stream, not the next dividend alone



- Near-term forecasts are valued explicitly.
- A continuation or horizon value summarises cash flows beyond the forecast window.

Horizon value = value, at the end of the explicit forecast, of all subsequent expected cash flows. It is not an extra cash payment.

No-growth equity is an earnings perpetuity only under strict conditions

$$P_0 = \frac{EPS_1}{r_e}.$$

- Earnings per share are constant forever.
- All earnings are distributable and paid; no reinvestment is required to maintain them.
- Accounting earnings therefore coincide with shareholder cash flow.

EPS = earnings per share. A perpetuity is an equal cash flow continuing without a stated final date. This benchmark is not a general stock-pricing formula.

Constant growth compresses the stream into the Gordon model

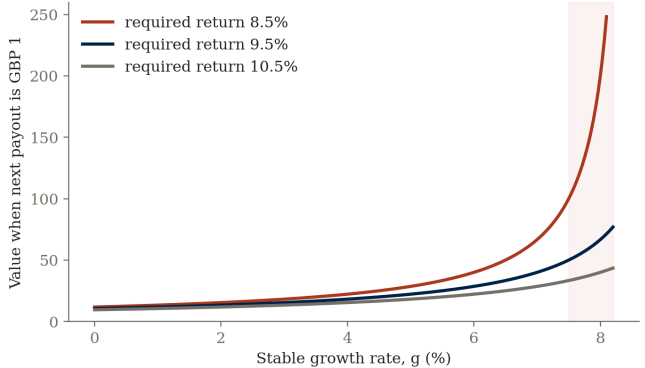
$$D_t = D_1(1+g)^{t-1} \quad \Longrightarrow \quad P_0 = \frac{D_1}{r_e - g}, \qquad r_e > g.$$

- D_1 is next period's expected dividend, not the dividend just paid.
- g is the perpetual nominal growth rate under a stable policy and risk profile.
- The denominator compares required return with long-run growth.

Gordon growth model = constant-growth DDM. The condition $r_e > g$ is mathematical and economic: value must remain finite.

Appendix A5 · Derivation Python P3 · DDM

The spread $r_e - g$ controls constant-growth value



Author calculation. $D_1 = £1$; rates are annual decimals shown as percentages.

As stable growth approaches required return, the denominator becomes small and value becomes extremely sensitive. The shaded edge is a warning region, not a plausible forecast.

Appendix A6 · Sensitivity

A 50 bp change can matter greatly when the spread is narrow

Assumption	r_e	g	P_0 for $D_1 = £1$
Base	9.0%	4.0%	£20.00
Required return +50 bp	9.5%	4.0%	£18.18
Growth +50 bp	9.0%	4.5%	£22.22
Both +50 bp	9.5%	4.5%	£20.00

- The same 50 bp movement has opposite effects depending on the parameter.
- Reporting one point estimate without its rate-growth pairing conceals model risk.

bp = basis point; 100 bp = one percentage point. Sensitivity is the change in model output caused by a declared change in an input.

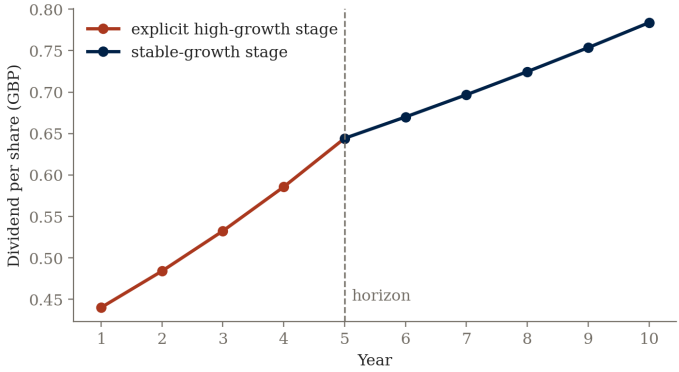
Stable growth is an economic regime, not high growth forever

- Growth must be supportable by reinvestment and long-run returns on capital.
- Risk, leverage, and payout policy should also be stable.
- A mature firm's nominal growth cannot permanently outrun the economy financing it.
- Stable growth begins only after temporary competitive advantages have faded.

> Extending a temporary 15% growth rate into perpetuity is not optimism; it is an internally inconsistent model.

Nominal growth includes inflation. A stable regime is a coherent long-run set of growth, reinvestment, return, risk, and payout assumptions.

Most firms require explicit growth, transition, and stability



Author simulation. Dividends per share in GBP; the explicit high-growth stage ends after year 5.

A multi-stage model forecasts temporary conditions explicitly and uses a stable-growth rule only after the horizon. The transition need not be abrupt.

A two-stage DDM separates forecast dividends from horizon value

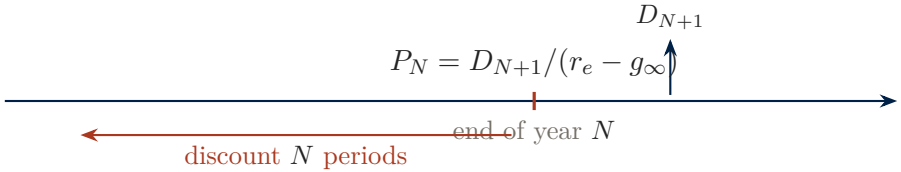
$$P_0 = \sum_{t=1}^{N} \frac{D_t}{(1+r_e)^t} + \frac{1}{(1+r_e)^N}\left(\frac{D_{N+1}}{r_e - g_\infty}\right).$$

- Years $1, \ldots, N$ carry explicit dividend forecasts.
- The bracketed Gordon value is measured at $t = N$.
- The whole horizon value is then discounted from N to today.

g_∞: stable perpetual growth after the explicit horizon. The same cost of equity is shown for clarity; staged rates can be used if risk changes.

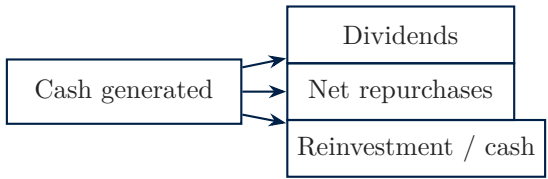
Appendix A7 · Full arithmetic

Terminal value uses the first cash flow after the horizon



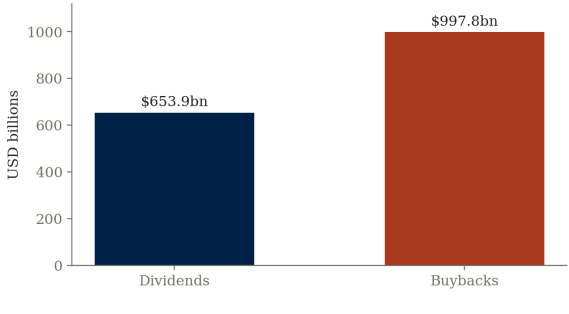
- Using D_N instead of D_{N+1} loses one year of growth.
- Treating P_N as a time-zero amount loses N years of discounting.

Dividends reflect payout policy; cash generation reflects economics



- A low dividend can accompany strong cash generation and large buybacks.
- It can also reflect financing constraints or weak cash generation; context decides.

Buybacks are a market-wide payout channel, not an Apple exception



S&P Dow Jones Indices, 12 months to 30 June 2025. Reported S&P 500 dividends and gross buybacks; USD billions.

Companies paid $653.9bn in dividends and spent $997.8bn on buybacks. Inference: dividend-only payout can be incomplete at market level as well as for one company.

Appendix A8 · Source audit

Total payout restores net repurchases to equity cash flow

$$\text{total payout} = \text{dividends} + \text{repurchases} - \text{share issuance},$$

$$P_0 = \sum_{t \geq 1} \frac{\mathbb{E}_0[\text{total payout}_t]}{(1 + r_e)^t}.$$

- Net repurchases reduce the number of claims when shares acquired exceed shares issued.
- Value per share requires consistent total equity value and diluted share count.
- Total payout is useful when buybacks are material and forecastable.

Net repurchases = cash spent buying shares minus cash received from issuing shares. Total-payout valuation first produces total equity value.

Appendix A9 · Share-count audit Python P4 · Total payout

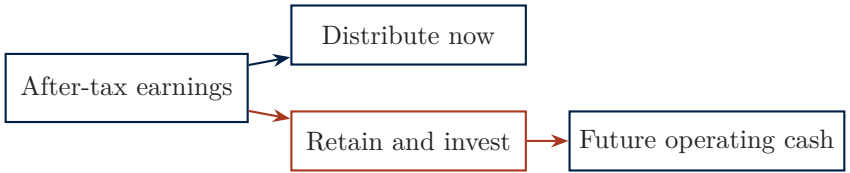
PART 3 OF 6

Test the growth story

When does retaining cash create shareholder value?

Growth needs financing; value depends on the return earned on what the firm retains.

Growth must be financed



- One pound retained is one pound not distributed today.
- The trade creates value only if the present value of future incremental cash exceeds that pound.

Retention is an investment decision by management on behalf of shareholders, not a free source of value.

Sustainable equity growth links retention to return on equity

$$g = b \times \text{ROE}, \qquad b = 1 - \text{payout ratio}.$$

- b is the fraction of earnings retained in the business.
- ROE measures accounting earnings relative to opening common equity.
- The identity is sustainable only when leverage, profitability, and payout policy are stable.

ROE = return on equity. Payout ratio = distributions divided by earnings under the chosen payout definition.

Appendix A10 · Derivation

Operating growth depends on reinvestment and return on invested capital

$$g_{\text{operating}} = \underbrace{\frac{\text{reinvestment}}{\text{NOPAT}}}_{\text{reinvestment rate}} \times \text{ROIC}\,.$$

- ROIC measures operating profit earned on debt-and-equity capital used in operations.
- This firm-level relation avoids attributing leverage-driven ROE changes to operating quality.

NOPAT = net operating profit after tax. ROIC = NOPAT divided by invested operating capital.

Appendix A11 · ROE versus ROIC

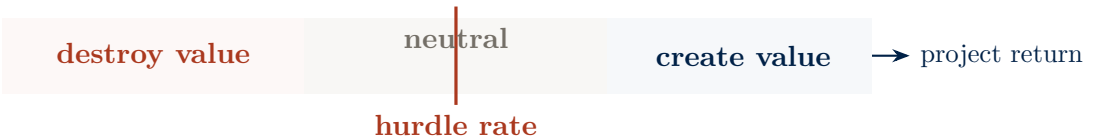
Retention raises potential growth but lowers current payout

$$D_1 = (1 - b)EPS_1, \qquad g = b\,\mathrm{ROE}\,.$$

Higher retention b	Current payout	Potential growth	Value effect
Mechanical effect	falls	rises	ambiguous
Economic test	—	—	compare project return with hurdle

The growth rate cannot be increased independently of payout. The value effect is determined by investment returns, not by growth alone.

Growth creates value only above the relevant hurdle rate



- For operating investment, compare ROIC with WACC.
- For shareholder-level reinvestment, compare the relevant equity return with r_e.

Hurdle rate = minimum return required for an investment's risk. A project with return equal to its hurdle has zero net present value.

Aster's one-pound reinvestment test makes the comparison explicit

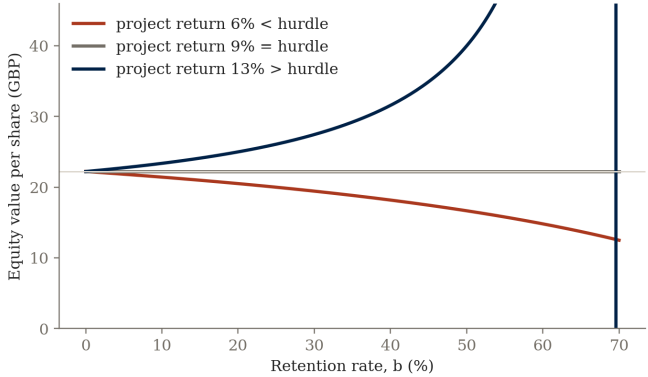
Project return	Value next year	PV at 9% hurdle	NPV per £1 retained
6%	£1.06	£0.972	−£0.028
9%	£1.09	£1.000	£0.000
13%	£1.13	£1.037	+£0.037

- Retaining cash for a 6% project destroys value even though earnings grow.
- A 13% project creates value because its discounted payoff exceeds the sacrificed pound.

NPV = net present value: present value of incremental payoff minus the amount invested.

Appendix A12 · Reinvestment audit

Higher growth can lower value when reinvestment earns too little



Author calculation. One-period project followed by stable payout; $EPS_1 = £2$, required return 9%.

When project return is below the 9% hurdle, more retention lowers equity value. At the hurdle, payout timing changes but value does not.

Appendix A12 · Reinvestment audit

PVGO separates assets in place from future positive-NPV investment

$$P_0 = \underbrace{\frac{EPS_1}{r_e}}_{\text{value with no growth}} + \underbrace{\text{PVGO}}_{\text{value of future growth opportunities}}.$$

- The first term assumes current sustainable earnings are fully distributed forever.
- PVGO is positive only when future investments have positive NPV.
- Negative PVGO is possible when expected expansion destroys value.

PVGO = present value of growth opportunities. It is a value decomposition, not a separately traded asset.

Appendix A13 · Decomposition

A growth company is not merely a company with growing earnings

Insufficient label	Value-relevant question
"Revenue grew 20%"	What reinvestment financed it?
"EPS rose"	Did operating return rise, or did leverage/share count change?
"Large addressable market"	Can the firm earn above its hurdle after competition?
"High P/E means growth"	How much growth, return, duration, and risk does it imply?

A growth stock derives material value from expected positive-NPV opportunities; historical growth alone does not establish that condition.

P/E partly reflects growth opportunities – and much else

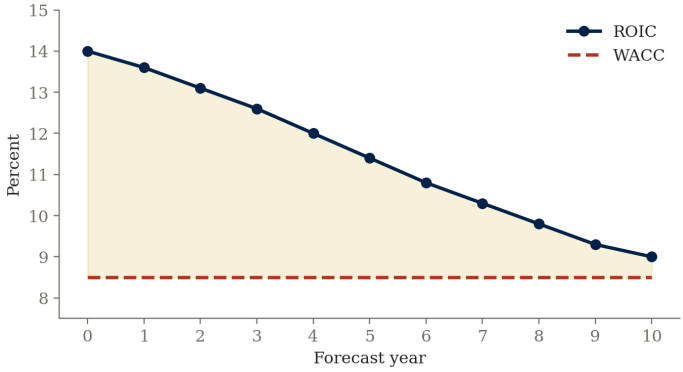
$$\frac{P_0}{EPS_1} = \frac{1}{r_e} + \frac{\text{PVGO}}{EPS_1}.$$

- Positive PVGO raises P/E relative to the no-growth benchmark $1/r_e$.
- Lower risk also raises P/E by lowering the required return.
- Accounting choices, cyclicality, and temporary earnings can move the denominator.

P/E = price-to-earnings ratio. It must state whether earnings are trailing, current, or forward and whether both price and EPS share the same date basis.

Appendix A14 · P/E algebra

Competitive advantage should fade in a defensible forecast



Author scenario. ROIC fades from 14% toward a WACC of 8.5% over ten forecast years.

Economic profit persists while ROIC exceeds WACC. A fade path makes the duration of competitive advantage explicit instead of hiding it in terminal value.

Audit the growth story before valuing it

1. How much cash must be reinvested to produce the forecast growth?
2. What return will that new capital earn relative to its hurdle?
3. How long can excess returns persist, and what protects them?
4. Does the terminal growth rate use a mature reinvestment rate and return?
5. Are dilution, acquisitions, and capitalised intangible investment treated consistently?

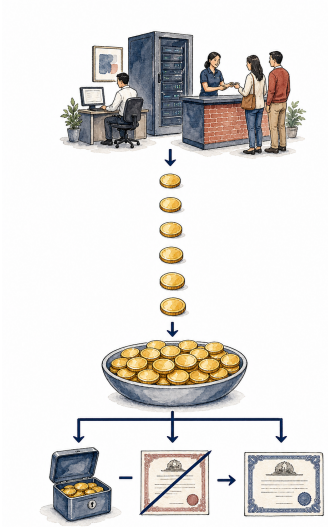
The test is economic: a forecast must connect growth to investment, return, competitive duration, and eventual stability.

PART 4 OF 6

Value the enterprise

How do operations become enterprise value and then equity value?

Choose the cash flow first, match its discount rate, and preserve the bridge from business to share.



Choose the cash flow before choosing the formula

Cash flow	Claim valued	Useful when
Dividends	Equity	Payout policy is stable and representative
Total payout	Equity	Repurchases are material and forecastable
FCFE	Equity	Financing and net borrowing can be modelled
FCFF	Enterprise	Operating drivers are clearer than payout/financing

FCFE = free cash flow to equity. FCFF = free cash flow to the firm. These cash-flow definitions are alternatives, not amounts to add together.

Appendix A16 · FCFE bridge

Match the claim, cash flow, and discount rate

Valuation object	Cash flow	Discount rate
Common equity	Dividends / total payout / FCFE	Cost of equity r_e
Operating enterprise	FCFF	WACC

> Discounting FCFF at the cost of equity and then subtracting debt mixes two claim definitions and generally misvalues equity.

WACC = weighted average required return of debt and equity capital, after the tax treatment of debt. Its construction is taken as an input today.

Appendix A17 · Consistency audit

FCFF is operating cash after tax and reinvestment

$$\text{FCFF} = \underbrace{EBIT(1-T)}_{\text{NOPAT}} + D\&A - Capex - \Delta NWC.$$

- Start with operating profit after tax but before financing costs.
- Add non-cash depreciation; subtract investment in fixed and working capital.
- The result is cash available to debt and equity capital providers.

EBIT = earnings before interest and tax; T = operating tax rate; D&A = depreciation and amortisation; Capex = capital expenditure; ΔNWC = change in net working capital.

Appendix A15 · Accounting bridge Python P5 · FCFF

Depreciation and capital expenditure answer different questions

Item	Income statement	Cash-flow treatment
Depreciation	Allocates past asset cost as expense	Added back because it is non-cash today
Capital expenditure	Usually capitalised, not fully expensed today	Subtracted because cash is invested today
Net effect	Affects accounting profit timing	Measures maintenance plus growth investment

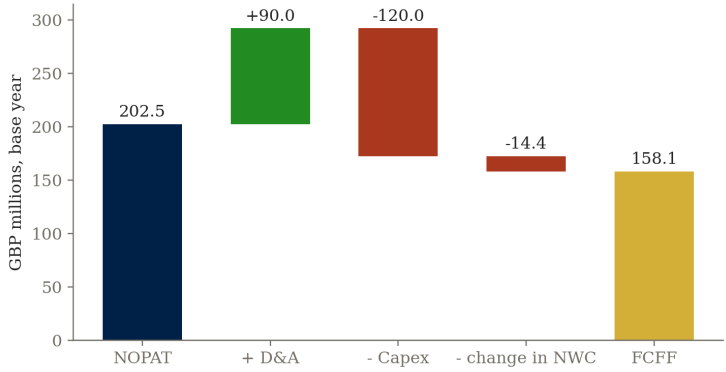
Adding back depreciation does not make assets free. Capex captures current cash investment; their difference helps reveal whether the asset base is expanding.

Growth can consume cash through working capital

$$NWC = \text{operating receivables} + \text{inventory} - \text{operating payables}.$$

NWC = net working capital used in operations. A positive ΔNWC is a use of cash because more operating funds are tied up.

Aster base year: operating profit becomes £158.1m FCFF



Fictional Aster case. GBP millions; base year before the explicit forecast.

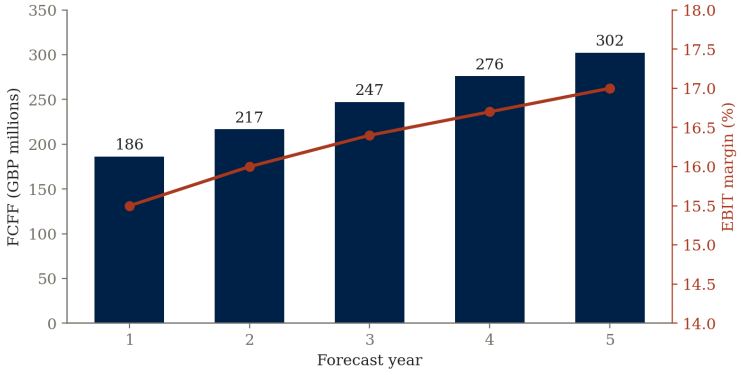
NOPAT £202.5m + D&A £90.0m - Capex £120.0m - ΔNWC £14.4m = FCFF £158.1m.

Appendix A19 · Arithmetic

Forecast the business drivers, not an isolated cash-flow row

- Revenue requires customer, price, volume, and retention assumptions.
- Margin requires operating leverage and competitive assumptions.
- Reinvestment must be consistent with forecast growth and ROIC.

Aster base case: growth fades while the margin stabilises



Fictional Aster base scenario. GBP millions; EBIT margin on right axis.

Revenue growth fades from 10% to 4.5%; EBIT margin rises from 15.5% to 17.0%; FCFF grows from £186m to £302m.

Appendix A18 · Inputs

Discount each forecast FCFF to the valuation date

Year	FCFF	$1/(1.085)^t$	PV of FCFF	Cumulative PV
1	186.1	0.9217	171.5	171.5
2	216.7	0.8495	184.1	355.6
3	247.2	0.7829	193.6	549.2
4	276.0	0.7216	199.2	748.4
5	302.2	0.6651	201.0	949.3

Amounts in GBP millions; WACC = 8.5%. Explicit-period enterprise value is £949.3m before adding the present value of cash flows after year 5.

Appendix A19 · Year-by-year audit

Terminal value represents all FCFF after the explicit horizon

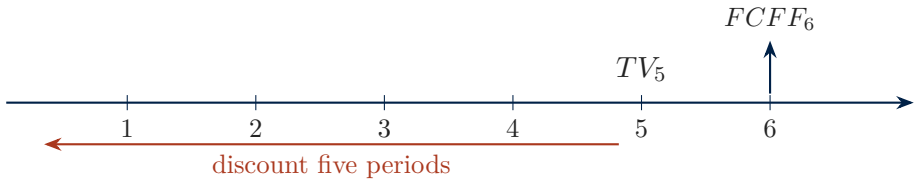
$$TV_5 = \frac{\text{FCFF}_6}{\text{WACC} - g_\infty} = \frac{\text{FCFF}_5(1 + g_\infty)}{\text{WACC} - g_\infty}.$$

- Base case: $\text{FCFF}_5 = £302.2m$, $\text{WACC} = 8.5\%$, and $g_\infty = 3.0\%$.
- $TV_5 = £5{,}659.8m$ at year 5, not at the valuation date.
- Discounting five years gives $\text{PV}(TV_5) = £3{,}764.0m$.

Terminal value is a compact representation of continuing operations, not a forecast that the business is sold in year 5.

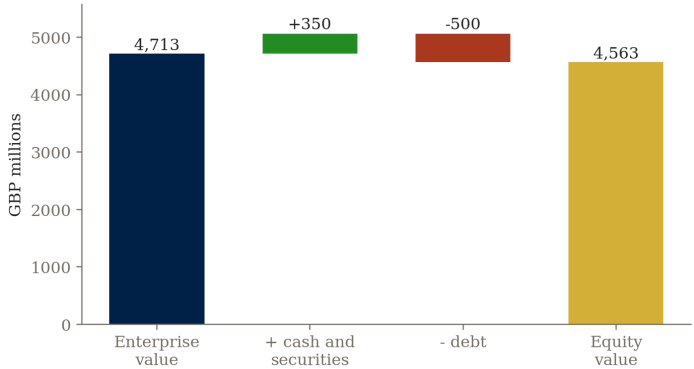
Appendix A20 · Timing derivation

Terminal timing creates two distinct one-year errors



- Numerator error: use year 5 instead of year 6 cash flow.
- Discount error: treat the year 5 terminal value as today's value.

Enterprise value must be bridged to common equity value

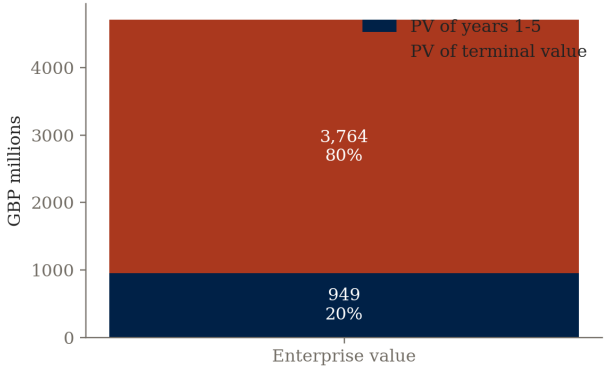


Fictional Aster base case. GBP millions; no non-controlling interest or other claims assumed.

Enterprise value £4,713m + cash/securities £350m - debt £500m = common equity value £4,563m = £45.63 per diluted share.

Appendix A21 · Bridge audit

If terminal value dominates, disclose it and stress it



Fictional Aster base case. Present values in GBP millions.

The present value of terminal cash flows is 80% of enterprise value. This is not automatically wrong, but it makes WACC, stable growth, and mature economics decision-critical assumptions.

Appendix A22 · Sensitivity table

Interrogate the market price

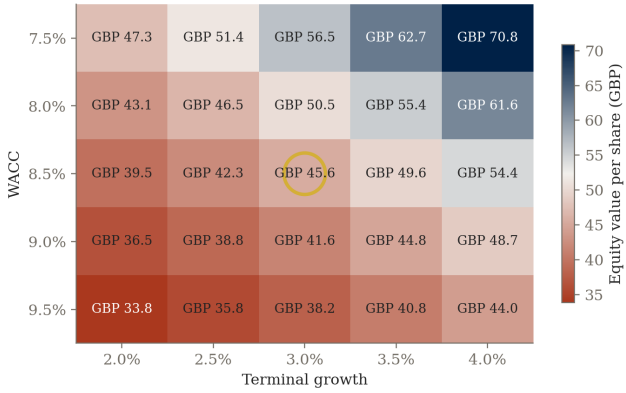
What expectations are embedded in the observed price?

Use sensitivity, reverse valuation, and comparable firms to organise disagreement with the market.

A DCF is a conditional mapping, not an oracle

- A DCF makes assumptions visible and internally connected.
- It does not remove uncertainty about growth, margins, reinvestment, or required return.
- The output should preserve uncertainty through sensitivities and scenarios.

Sensitivity is part of valuation, not an afterthought



Fictional Aster base forecast. GBP per diluted share; only WACC and stable growth vary.

The base cell is £45.63 at 8.5% WACC and 3.0% stable growth. Nearby plausible cells range from roughly £39 to £55.

Appendix A22 · Full table Python P6 · Sensitivity

Reverse DCF asks what the market price requires

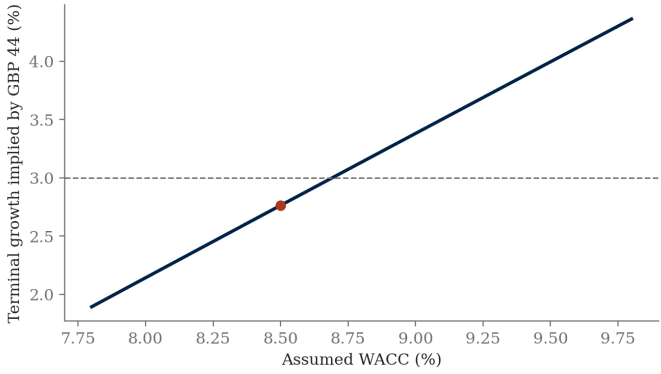
$$\text{find assumption } \theta \text{ such that} \qquad V(\theta) = P_{\text{market}}.$$

- Forward valuation maps assumptions to value.
- Reverse valuation holds price fixed and solves for one assumption or a family of assumptions.
- The output is a break-even expectation, not a forecast guaranteed by the price.

Reverse DCF = valuation inversion. θ can be stable growth, margin, revenue growth, or another declared driver.

Appendix A23 · Root and non-uniqueness

At £44, the base forecast implies 2.76% stable growth



Fictional Aster base operating forecast. Price fixed at £44; implied g_∞ solved for each WACC.

At WACC 8.5%, the price-implied stable growth rate is 2.76%. The upward curve shows non-uniqueness: a higher discount rate requires higher growth to support the same price.

Appendix A23 · Root audit

Market price can be informative without being infallible

Why price is informative	Why price can differ from later value
Many investors process dispersed information	Information is incomplete and expectations differ
Competition rewards profitable analysis	Limits to capital and trading can slow correction
Trades reveal willingness to bear risk	Risk premia and sentiment can change
Price updates quickly after public news	The realised state can differ from every forecast

Informational efficiency concerns how prices incorporate information; it does not say every observed price equals future realised fundamental value.

Appendix A27 · Efficiency and disagreement

A multiple is a compressed forecast

$$\text{multiple} = \frac{\text{market value of a claim}}{\text{current accounting or operating measure}}.$$

- Growth, margins, reinvestment, risk, and competitive duration are compressed into the numerator.
- Accounting policy and business cyclicality affect the denominator.
- Comparability requires consistency in claim, date, currency, and denominator definition.

A valuation multiple is not model-free; it replaces explicit forecasts with a relative comparison whose assumptions must still be audited.

P/E is an equity-to-equity multiple

$$P/E = \frac{\text{equity price per share}}{\text{earnings per share}}.$$

- Price and EPS refer to common equity, so the claims match.
- State whether EPS is trailing twelve-month, current-year, or forward.
- Losses, temporary earnings, buybacks, and stock-based compensation can make P/E misleading.

Forward P/E uses forecast EPS. Trailing P/E uses reported earnings over the prior twelve months. Neither convention is interchangeable without relabelling.

Appendix A24 · Denominator audit

EV/EBITDA is an enterprise-to-enterprise multiple

$$EV/EBITDA = \frac{\text{enterprise value}}{\text{earnings before interest, tax, depreciation and amortisation}}.$$

- Both numerator and denominator are measured before debt financing costs.
- EBITDA is not cash flow: it omits Capex, working capital, and cash taxes.
- Capital intensity can make apparently similar EBITDA multiples economically different.

EBITDA = earnings before interest, tax, depreciation, and amortisation. Enterprise value must use consistent debt, cash, leases, and other claims.

Appendix A25 · Claim audit

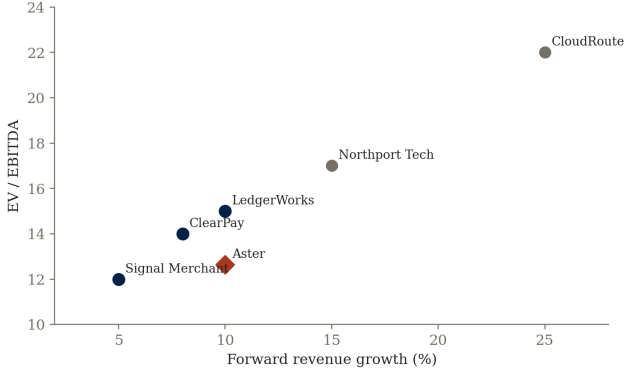
Comparable means similar economics, not merely the same label

1. Match business model, customer economics, and geographic exposure.
2. Compare growth, margins, reinvestment needs, and return on capital.
3. Compare operating and financial risk.
4. Align accounting definitions and forecast dates.
5. Explain exclusions before calculating the peer median.

Peer selection is part of the valuation judgement. An industry database filter is a starting universe, not a final comparable set.

Appendix A26 · Screen construction

Aster's peer screen changes when economics become visible



Fictional peer set. Forward growth and EV/EBITDA; matched peers satisfy the declared operating screen.

CloudRoute and Northport Tech share a technology label but differ materially in growth and margin. The matched-peer median is 22.0x forward P/E and 14.0x EV/EBITDA.

Appendix A26 · Screen Python P7 · Peers

Multiples reveal relative pricing, not absolute correctness

- A premium multiple can be justified by superior growth, return, duration, or lower risk.
- A discount can indicate undervaluation or weaker economics omitted from the screen.
- Every peer can be expensive under the same optimistic industry assumptions.
- A median removes extreme observations; it does not create a fundamental anchor.

> "Cheaper than peers" is a relative statement. It is not yet an investment conclusion.

Triangulation reconciles methods instead of averaging blindly

Method	Best question	Main limitation
Dividend DDM	What do declared dividends support?	Payout policy may be unrepresentative
Total payout	What cash reaches equity?	Buybacks and issuance are volatile
FCFF DCF	What do operations support?	Forecast and terminal assumptions dominate
Reverse DCF	What does price require?	Solutions are not unique
Multiples	How does pricing compare?	Peer assumptions can be shared and wrong

Triangulation means explaining differences across methods using their cash-flow definitions and assumptions; it does not mean taking an unweighted average.

Make the decision

Is £44 supported, and which assumptions carry the conclusion?

Translate coherent business narratives into scenarios, reconcile methods, and state what would change the view.

Return to the committee brief

Observed	Aster at £44 on 14 August 2026 (fictional quote)
Mandate	Seek 15% discount to base-case value before a positive recommendation
Evidence	Five-year operating forecast, payout record, capital structure, matched peers
Decision rule	Use scenarios and leading indicators; do not rely on one terminal assumption

A margin of safety is the required discount between estimated value and price. The 15% threshold is the case rule, not universal investment advice.

Build three business narratives before three spreadsheets

Scenario	Operating narrative
Bear	Merchant wins slow; pricing pressure prevents margin expansion; competitive return fades quickly.
Base	Growth normalises from 10%; software mix lifts EBIT margin gradually to 17%; reinvestment remains productive.
Bull	Customer retention and platform adoption sustain stronger growth; margin reaches 18.5%; excess returns persist longer.

A scenario is a coherent joint state of the business. Changing one spreadsheet cell at a time is sensitivity analysis, not a scenario narrative.

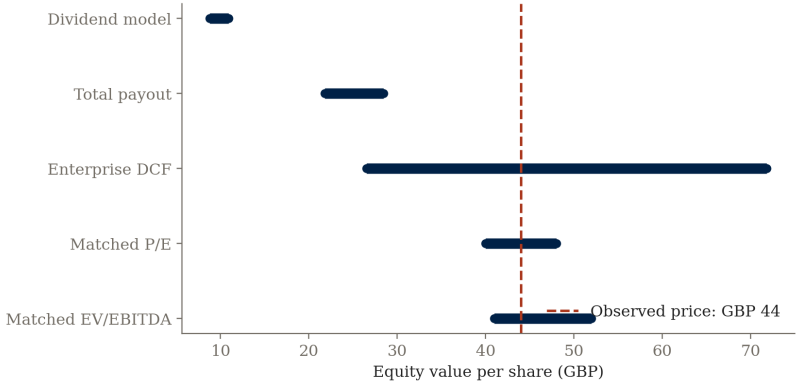
Translate each narrative into an internally consistent model

Scenario	Year-1 growth	Year-5 growth	Year-5 EBIT margin	WACC	Stable g
Bear	6.0%	3.0%	15.5%	9.5%	2.0%
Base	10.0%	4.5%	17.0%	8.5%	3.0%
Bull	13.0%	6.0%	18.5%	7.8%	4.0%

- Reinvestment follows growth; ROIC fades toward each scenario's mature economics.
- Discount rate and stable growth move with scenario risk and durability, not independently.

All values are stated assumptions for the fictional case. Forecasts are nominal and amounts are in GBP millions unless stated per share.

The valuation range is a result, not an embarrassment



Fictional Aster case. GBP per diluted share; observed price £44 shown by dashed line.

The enterprise DCF spans £26.50–£71.84 across coherent scenarios. Relative methods cluster nearer the observed price but answer narrower questions.

Dividend and total-payout values differ because policy differs from capacity

Method	Value per share	Interpretation
Dividend DDM	£9.77	Values the declared dividend path only
Total payout	£24.74	Adds modelled net repurchases
Enterprise DCF	£45.63	Values operating cash before financing policy

- The gap is evidence that current payout forecasts do not exhaust distributable capacity.
- It is not a licence to add the three values together.

DCF and multiples differ because they import assumptions differently

	Enterprise DCF	Matched multiples
Growth and margin	Aster-specific explicit forecast	Embedded in peer prices
Risk	Explicit WACC	Implicit in peer valuations
Reinvestment	Explicit Capex and working capital	Often hidden behind denominator
Terminal economics	Explicit stable assumptions	Inherited from peer market prices

Reconciliation asks which assumption explains the difference. It does not force methods to converge mechanically.

At £44, the market requires a defensible but demanding package

- Base operating path: growth fades from 10% to 4.5% while EBIT margin rises to 17%.
- At WACC 8.5%, stable growth of about 2.76% reproduces the observed price.
- The matched-peer median supports roughly the same price region.
- Terminal cash flows carry most of DCF value, so small long-run revisions matter materially.

> The price is not obviously inconsistent with the base narrative; it leaves little margin of safety under the committee's 15% rule.

Recommendation follows the mandate, not the most attractive scenario

Position	Value	Upside to £44	Mandate implication
Bear	£26.50	−39.8%	Material downside
Base	£45.63	+3.7%	Below 15% margin
Bull	£71.84	+63.3%	Requires strong execution

Decision: **watchlist**, not buy. The base case does not clear the stated margin-of-safety threshold.

This conclusion is an exercise in conditional valuation, not investment advice or a view on any real company.

Five observable indicators would change the decision

1. **Revenue quality:** merchant retention, transaction volume, and take rate.
2. **Operating leverage:** progress toward the 17% EBIT margin without underinvestment.
3. **Reinvestment productivity:** incremental growth relative to capital deployed.
4. **Equity leakage:** employee share issuance versus gross repurchases.
5. **Required return:** market rates and risk evidence developed on Day 4.

A leading indicator is an observable measure expected to update a valuation driver before the full long-run outcome is known.

Seven failure modes can invalidate an apparently precise valuation

1. Cash flow and discount rate refer to different claimholders.
2. Terminal value uses the wrong cash-flow year or discount date.
3. Stable growth is incompatible with reinvestment or mature returns.
4. Diluted shares, net debt, leases, or other claims are omitted.
5. Growth is forecast without the investment needed to finance it.
6. Peers match an industry label but not business economics.
7. Market data, forecasts, and accounting denominators use different dates.

Day 3 synthesis: the quote is the beginning of the question

- Value the cash flow belonging to the claim and discount it at the matching rate.
- Growth creates value only when reinvestment earns above its hurdle.
- Price is a package of expectations; interrogate it with sensitivity, reverse DCF, and peers.
- A recommendation states the assumptions, uncertainty, mandate, and evidence that would change it.

Technical appendix Python practical

References and data sources

- Brealey, Myers, Allen and Edmans, *Principles of Corporate Finance*, Ch. 4.
- Berk and DeMarzo, *Corporate Finance*, Ch. 9: stock valuation, total payout, enterprise DCF, and multiples.
- MIT OpenCourseWare, 15.401 Finance Theory I, Lecture 7: equities.
- Aswath Damodaran, NYU Stern, valuation lecture notes and datasets.
- Apple Inc., Form 10-K for fiscal year ended 27 September 2025; SEC filing.
- Apple Inc., Q2 2026 results, 30 April 2026, for current payout-policy context.
- S&P Dow Jones Indices, "S&P 500 Q2 2025 Buybacks," 23 September 2025.
- Aster Payments and peer observations are constructed case data; calculations frozen 14 August 2026.

Full URLs, data construction, reported/calculated fields, and transformations are documented in Appendix A28 and the project source manifest.

Using these slides

- Course materials for the Computational Finance / FinTech Summer School.
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Technical appendix map

1. Claim priority
2. Return identity
3. Two-period recursion
4. Infinite recursion
5. Gordon derivation
6. Gordon sensitivity
7. Two-stage DDM
8. Observed payout audit
9. Total payout
10. Sustainable growth
11. ROE versus ROIC
12. Retention NPV
13. PVGO
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15. FCFF bridge
16. FCFE bridge
17. Rate consistency
18. Forecast inputs
19. FCFF arithmetic
20. Terminal timing
21. EV-to-equity bridge
22. Sensitivity
23. Reverse DCF
24. P/E date audit
25. EV/EBITDA audit
26. Comparable screen
27. Information and price
28. Data provenance

← **Return to Day 3 synthesis**

Practical map

APPENDIX

Technical appendix

A1. Claim priority and limited-liability audit

Claim	Contractual position	Equity consequence
Operating claims	Employees, suppliers, tax authorities	Paid before residual distribution
Debt	Interest/principal with seniority terms	Fixed claim until default/restructuring
Common equity	No promised amount or maturity	Receives the residual; votes under charter

$$\text{equity payoff at liquidation} = \max\{\text{asset value} - \text{senior claims}, 0\}.$$

Limited liability creates the zero lower bound for the shareholder's liquidation payoff; it does not make the share riskless.

← **Return to the residual claim**

Appendix map

A2. One-period return identity

$$\begin{aligned}\text{ending wealth} &= D_1 + P_1,\\ \text{net gain} &= D_1 + P_1 - P_0,\\ R_1 &= \frac{D_1 + P_1 - P_0}{P_0} = \frac{D_1}{P_0} + \frac{P_1 - P_0}{P_0}.\end{aligned}$$

> Buy at £40, receive £0.80, sell ex-dividend at £43.20: $R_1 = 0.80/40 + 3.20/40 = 2\% + 8\% = 10\%$.

The identity is realised ex post. Before investment, replace uncertain outcomes with conditional expectations and use a required expected return.

← **Return to the one-period timeline**

Appendix map

A3. Two-period price recursion

$$
\begin{aligned}
P_0 &= \frac{\mathbb{E}_0[D_1 + P_1]}{1 + r_e}, \\
P_1 &= \frac{\mathbb{E}_1[D_2 + P_2]}{1 + r_e}, \\
P_0 &= \frac{\mathbb{E}_0[D_1]}{1 + r_e} + \frac{\mathbb{E}_0[\mathbb{E}_1(D_2 + P_2)]}{(1 + r_e)^2} \\
&= \frac{\mathbb{E}_0[D_1]}{1 + r_e} + \frac{\mathbb{E}_0[D_2 + P_2]}{(1 + r_e)^2}.
\end{aligned}
$$

The final equality uses iterated expectations. For simplicity, the required return is constant and distributions are dated at period ends.

← **Return to price recursion**

Appendix map

A4. Infinite recursion requires a terminal condition

$$P_0 = \sum_{t=1}^{N} \frac{\mathbb{E}_0[D_t]}{(1+r_e)^t} + \frac{\mathbb{E}_0[P_N]}{(1+r_e)^N},$$

$$\lim_{N\to\infty} \frac{\mathbb{E}_0[P_N]}{(1+r_e)^N} = 0,$$

$$\therefore \quad P_0 = \sum_{t=1}^{\infty} \frac{\mathbb{E}_0[D_t]}{(1+r_e)^t}.$$

- The terminal condition rules out value supported only by the discounted resale term.
- It does not require the undiscounted future price to approach zero.

← **Return to the DDM identity**

Appendix map

A5. Gordon-growth derivation

$$
\begin{aligned}
P_0 &= \sum_{t=1}^{\infty} \frac{D_1(1+g)^{t-1}}{(1+r_e)^t} \\
&= \frac{D_1}{1+r_e} \sum_{j=0}^{\infty} \left(\frac{1+g}{1+r_e} \right)^j \\
&= \frac{D_1}{1+r_e} \frac{1}{1-(1+g)/(1+r_e)} = \frac{D_1}{r_e - g}.
\end{aligned}
$$

The geometric series converges only when $|(1+g)/(1+r_e)| < 1$; with economically relevant positive gross rates this requires $r_e > g$.

← **Return to the Gordon model**

Appendix map

A6. Gordon sensitivity and the boundary

$$
\begin{aligned}
P_0 &= \frac{D_1}{r_e - g}, \\
\frac{\partial P_0}{\partial r_e} &= -\frac{D_1}{(r_e - g)^2} < 0, \\
\frac{\partial P_0}{\partial g} &= +\frac{D_1}{(r_e - g)^2} > 0, \\
\frac{\partial \ln P_0}{\partial r_e} &= -\frac{1}{r_e - g}, \qquad \frac{\partial \ln P_0}{\partial g} = +\frac{1}{r_e - g}.
\end{aligned}
$$

The same spread governs level and sensitivity. As $r_e - g$ narrows, a small parameter error produces a large proportional value error.

← **Return to Gordon sensitivity**

Appendix map

A7. Two-stage DDM: complete timing arithmetic

Assume $D_0 = £0.40$, 10% growth for five years, $r_e = 9.5\%$, then 4% stable growth.

t	D_t	discount factor	PV
1	0.4400	0.9132	0.4018
2	0.4840	0.8340	0.4037
3	0.5324	0.7616	0.4055
4	0.5856	0.6955	0.4073
5	0.6442	0.6352	0.4092

$$P_5 = \frac{0.6442(1.04)}{0.095 - 0.04} = £12.1813,$$
$$P_0 = £2.0276 + 0.6352(£12.1813) = £9.7655.$$

← **Return to the two-stage DDM**

Appendix map

A8. Apple and S&P 500 payout source audit

Item	Reported USD bn	Source interpretation
Dividends paid	15.421	Financing cash-flow statement
Cash paid for share repurchases	90.711	Financing cash-flow statement
Shares acquired under programme	89.3	Equity note; differs by settlement/accounting scope
Operating cash flow	111.482	Cash-flow statement; not payout
Capital expenditure	12.715	Purchase of property, plant and equipment

- The lecture chart uses cash payments for comparability with dividends paid.
- Fiscal year ended 27 September 2025; amounts are rounded only in the visual.
- S&P 500, 12 months to 30 June 2025: dividends $653.9bn; gross buybacks $997.8bn; combined $1.6517tn.

Reported facts are kept separate from the inference that dividend-only payout is empirically incomplete in these cases.

← **Return to market-wide payout** Appendix map

A9. Total payout and share-count arithmetic

$$\begin{aligned}
\text{net repurchases}_t &= \text{gross repurchases}_t - \text{share issuance}_t, \\
\text{total payout}_t &= \text{dividends}_t + \text{net repurchases}_t, \\
\text{payout per share}_t &= \frac{\text{total payout}_t}{\text{relevant diluted shares}_t}.
\end{aligned}$$

- Repurchasing £80m at £40 retires 2m shares before offsetting issuance.
- Issuing 0.5m employee shares leaves a 1.5m net reduction.
- Use forecast share counts consistently when moving between aggregate and per-share values.

← **Return to total payout**

Appendix map

A10. Sustainable equity-growth derivation

Let opening equity be B_0, earnings $E_1 = \text{ROE}\ B_0$, and retention b.

$$\Delta B = bE_1 = b\,\text{ROE}\ B_0,$$

$$\frac{\Delta B}{B_0} = b\,\text{ROE}\,.$$

If ROE and payout policy remain stable, earnings and book equity can grow at

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

The result is an internally sustainable accounting growth rate. New equity issuance, changing leverage, changing ROE, or acquisition accounting breaks the simple relation.

← **Return to sustainable growth**

Appendix map

A11. ROE versus ROIC and the leverage caveat

	ROE	ROIC
Numerator	Net income to common equity	NOPAT from operations
Denominator	Common book equity	Operating invested capital
Financing effect	Directly affected by leverage	Before financing mix
Hurdle	Cost of equity	WACC

- Debt can raise ROE when operating returns exceed borrowing cost.
- Higher ROE caused only by leverage does not prove stronger operating economics.

← **Return to operating growth**

Appendix map

A12. Aster one-pound retention NPV

For one pound invested for one year at project return q, with 9% hurdle:

$$NPV(q) = -1 + \frac{1+q}{1.09} = \frac{q - 0.09}{1.09}.$$

$$\begin{aligned} NPV(6\%) &= -£0.0275, \\ NPV(9\%) &= £0, \\ NPV(13\%) &= +£0.0367. \end{aligned}$$

The sign depends on return minus hurdle. Growth in accounting earnings can coexist with negative NPV when the return on incremental investment is too low.

← **Return to retention and value**

Appendix map

A13. PVGO decomposition

Define the no-growth policy as distributing all sustainable EPS_1 forever:

$$V_{\text{assets in place}} = \frac{EPS_1}{r_e},$$

$$\text{PVGO} = P_0 - \frac{EPS_1}{r_e},$$

$$P_0 = \frac{EPS_1}{r_e} + \text{PVGO}\,.$$

> If $P_0 = £30$, $EPS_1 = £2$, and $r_e = 10\%$, then the no-growth value is £20 and PVGO is £10.

The decomposition uses sustainable earnings. Applying it to temporarily depressed or inflated EPS gives a misleading assets-in-place benchmark.

← **Return to PVGO**

Appendix map

A14. P/E decomposition from PVGO

Divide the PVGO identity by forward earnings:

$$P_0 = \frac{EPS_1}{r_e} + \text{PVGO},$$
$$\frac{P_0}{EPS_1} = \frac{1}{r_e} + \frac{\text{PVGO}}{EPS_1}.$$

- At $r_e = 10\%$, the no-growth forward P/E benchmark is 10x.
- Positive growth opportunities raise the ratio; higher risk lowers it.
- The identity is only as meaningful as the sustainable EPS denominator.

← **Return to P/E and growth**

Appendix map

A15. FCFF accounting bridge

$$
\begin{aligned}
EBIT &= \text{revenue} - \text{operating cash costs} - D\&A, \\
NOPAT &= EBIT(1 - T), \\
\text{FCFF} &= NOPAT + D\&A - Capex - \Delta NWC.
\end{aligned}
$$

- Interest is excluded because FCFF is before distributions to debt and equity.
- Use an operating tax rate consistent with unlevered EBIT.
- Separate operating working capital from cash and interest-bearing debt.

← **Return to FCFF**

Appendix map

A16. FCFE bridge and when it is usable

$$\text{FCFE} = \text{net income} + D\&A - Capex - \Delta NWC + \text{net borrowing}.$$

- FCFE belongs to common equity after interest, debt repayment, and new borrowing.
- Discount FCFE at the cost of equity to obtain equity value directly.
- It is useful when leverage policy and net borrowing are stable enough to forecast.
- FCFF is often clearer when leverage is changing materially.

Net borrowing = new debt issued minus debt principal repaid. FCFE can differ from payout because the firm may retain equity cash.

← **Return to the cash-flow choice**

Appendix map

A17. Cash-flow and discount-rate consistency audit

Cash flow	Interest included?	Net borrowing included?	Correct output
Dividends / pay-out	Yes, implicitly	Yes, implicitly	Equity value at r_e
FCFE	Yes	Explicitly	Equity value at r_e
FCFF	No	No	Enterprise value at WACC

> An internally inconsistent valuation can look numerically plausible. Audit the claim before interpreting the answer.

← **Return to claim-rate matching**

Appendix map

A18. Aster forecast assumptions and units

Base scenario	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue growth	10.0%	9.0%	8.0%	6.0%	4.5%
Revenue, GBP m	1,980.0	2,158.2	2,330.9	2,470.7	2,581.9
EBIT margin	15.5%	16.0%	16.4%	16.7%	17.0%
D&A / revenue	5.0%	5.0%	5.0%	5.0%	5.0%
Capex / revenue	6.5%	6.3%	6.1%	5.9%	5.7%
Tax rate	25.0%	25.0%	25.0%	25.0%	25.0%

- Base-year revenue is £1,800m; ΔNWC is 8% of the annual revenue increase.
- WACC is 8.5%; stable growth is 3.0%; all cash flows occur at year-end.

← **Return to Aster's forecast**

Appendix map

A19. Aster FCFF arithmetic, year by year

GBP millions	Year 1	Year 2	Year 3	Year 4	Year 5
NOPAT	230.2	259.0	286.7	309.5	329.2
+ D&A	99.0	107.9	116.5	123.5	129.1
- Capex	128.7	136.0	142.2	145.8	147.2
- ΔNWC	14.4	14.3	13.8	11.2	8.9
FCFF	186.1	216.7	247.2	276.0	302.2
PV at 8.5%	171.5	184.1	193.6	199.2	201.0

$$\sum_{t=1}^{5} \mathrm{PV}(FCFF_t) = £949.3\text{m}.$$

← **Return to discounted FCFF**

Appendix map

APPENDIX

Technical appendix

A20. Terminal-value timing derivation

At the end of year 5, the first stable cash flow is one period ahead:

$$FCFF_6 = 302.2231(1.03) = 311.2898,$$
$$TV_5 = \frac{311.2898}{0.085 - 0.03} = 5{,}659.8144,$$
$$\mathrm{PV}(TV_5) = \frac{5{,}659.8144}{1.085^5} = 3{,}764.0337.$$

$$EV_0 = 949.2886 + 3{,}764.0337 = £4{,}713.3223\text{m}.$$

Every amount is GBP millions. Rounding is postponed until the end so the displayed bridge reproduces the verified result.

← **Return to terminal timing**

Appendix map

A21. Enterprise-to-equity bridge and diluted shares

$$\begin{aligned}\text{common equity value} &= EV + \text{cash and securities} - \text{debt} - \text{other claims}\\ &= 4{,}713.322 + 350 - 500 - 0\\ &= £4{,}563.322\text{m},\\ \text{value per diluted share} &= \frac{4{,}563.322}{100} = £45.633.\end{aligned}$$

- Excess cash is non-operating in this case.
- Real cases may also require leases, pensions, non-controlling interests, or investments in associates.

← **Return to the EV bridge**

Appendix map

A22. Sensitivity table and terminal-value share

WACC \ g	2.0%	2.5%	3.0%	3.5%	4.0%
7.5%	47.31	51.42	56.45	62.74	70.82
8.0%	43.10	46.46	50.50	55.44	61.61
8.5%	39.53	42.33	**45.63**	49.60	54.44
9.0%	36.48	38.83	41.58	44.82	48.72
9.5%	33.84	35.84	38.15	40.85	44.03

$$\text{terminal share of EV} = \frac{3{,}764.0}{4{,}713.3} = 79.86\%,$$

$$\text{base price premium to market} = \frac{45.633}{44} - 1 = 3.71\%.$$

← **Return to sensitivity**

Appendix map

A23. Reverse-DCF root and non-uniqueness

Hold the explicit base forecast and WACC at 8.5%; solve

$$f(g) = \frac{EV_{\text{explicit}} + FCFF_5(1+g)/(0.085-g)/(1.085)^5 + 350 - 500}{100} - 44 = 0,$$

$$g^* = 2.763718\%,$$

$$|f(g^*)| < 10^{-10} \text{ GBP per share.}$$

- This root is unique only after every other assumption is held fixed.
- Growth-margin, growth-WACC, and reinvestment-ROIC combinations can support the same price.

Root = input value making a function equal zero. The numerical solver is reproduced in Python P6.

← **Return to implied growth**

Appendix map

A24. P/E algebra and denominator-date audit

Convention	Numerator date	Denominator
Trailing P/E	Current price	EPS over previous 12 months
Current-year P/E	Current price	Forecast EPS for current fiscal year
Forward P/E	Current price	Forecast EPS for next fiscal year / 12 months

$$\text{matched forward P/E value} = 22.0 \times £2.00 = £44.00.$$

Aster's £2.00 forward EPS and 22.0x matched-peer median are fictional case inputs. Report the forecast date with the multiple.

← **Return to P/E**

Appendix map

A25. EV/EBITDA claim-matching audit

$$EV = \text{equity value} + \text{debt} + \text{other claims} - \text{cash},$$
$$EBITDA = EBIT + D\&A.$$

Audit question	Why it matters
Are leases treated in EV and EBITDA consistently?	Otherwise the numerator and denominator use different operating boundaries.
Are Capex needs comparable?	EBITDA omits investment required to sustain assets.
Are pension/associate claims material?	Headline EV may omit non-common claims or investments.

← **Return to EV/EBITDA**

Appendix map

A26. Comparable-screen construction

Company	Growth	EBIT margin	Fwd P/E	EV/EBITDA	Matched
Aster	10%	15.5%	22x	12.6x	case
ClearPay	8%	18%	22x	14x	yes
LedgerWorks	10%	16%	24x	15x	yes
Signal Merchant	5%	20%	20x	12x	yes
Northport Tech	15%	12%	28x	17x	no
CloudRoute	25%	8%	35x	22x	no

- Screen: payment/merchant economics, 5–12% forward growth, 14–22% EBIT margin.
- Matched medians: 22.0x forward P/E and 14.0x EV/EBITDA.

All companies and values are fictional. The screen is declared before computing medians to expose selection judgement.

← **Return to the peer screen**

Appendix map

A27. Information, efficiency, and model disagreement

- **Semi-strong efficiency:** public information is rapidly reflected in market prices under the maintained hypothesis.
- A joint test remains: rejecting a price model may reject market efficiency, the valuation model, or both.
- Disagreement can concern expected cash flows, discount rates, or interpretation of the same signal.
- Trading frictions, funding constraints, short-sale limits, and uncertainty can delay convergence.

> Practical stance: treat price as an information-rich benchmark and ask which explicit assumptions justify taking the other side.

← **Return to news and price**

Appendix map

A28. Data provenance, licences, and source URLs

- Apple 2025 Form 10-K, SEC filing and data tables.
- Apple Q2 2026 results, company release.
- S&P DJI, Q2 2025 buybacks release and aggregate payout data.
- MIT OpenCourseWare 15.401, Lecture 7: Equities.
- NYU Stern valuation materials, Aswath Damodaran.
- Aster and peer CSV files: constructed and frozen 14 August 2026; no live market dependency.

The source manifest records file paths, dates, units, transformations, and whether each field is reported, calculated, assumed, or simulated.

← **Return to Day 3 synthesis**

Appendix map

APPENDIX

Technical appendix

Python practical map

1. Read case inputs and validate units
2. Compute and decompose a one-period return
3. Value constant- and multi-stage dividends
4. Model total payout and share count
5. Build and discount FCFF
6. Create sensitivity and solve a reverse DCF
7. Screen peers and assemble a decision table

The local CSV inputs are fixed case data. Rates enter Python as decimals; Aster accounting amounts are GBP millions unless a variable says `per_share`.

← **Return to Day 3 synthesis**

Appendix map

P1. Read the case inputs and validate them

```python
import pandas as pd

# A DataFrame is a labelled table read from a local CSV file.
inputs = pd.read_csv("../data/cases/aster_base_inputs.csv")
values = dict(zip(inputs["item"], inputs["value"]))

# assert stops the calculation if a declared condition is false.
assert values["wacc"] > values["terminal_growth"]
assert values["diluted_shares_m"] > 0
print(values["market_price_per_share_gbp"])
```

`pd.read_csv` reads comma-separated data. `dict(zip(...))` pairs item names with values. Expected printed price: `44.0`.

← **Return to the Aster brief**

Practical map

PYTHON

Python practical

P2. Compute and decompose one-period return

```python
# Inputs are GBP per share.
p0 = 40.00
distribution = 0.80
p1 = 43.20

income_yield = distribution / p0
capital_gain = (p1 - p0) / p0
total_return = income_yield + capital_gain

print(income_yield, capital_gain, total_return)
```

`=` assigns a value; `/` divides. Expected output: `0.02 0.08 0.10`, or 2%, 8%, and 10%.

← **Return to the return timeline**

Practical map

PYTHON

Python practical

P3. Value a multi-stage dividend path with explicit timing

```python
d0, high_g, re, stable_g, horizon = 0.40, 0.10, 0.095, 0.04, 5

# A list stores the year-by-year dividends.
dividends = [d0 * (1 + high_g) ** t for t in range(1, horizon + 1)]
pv_explicit = sum(d / (1 + re) ** t
                  for t, d in enumerate(dividends, start=1))
d6 = dividends[-1] * (1 + stable_g)
terminal5 = d6 / (re - stable_g)
value = pv_explicit + terminal5 / (1 + re) ** horizon
print(round(value, 4))
```

`**` raises to a power; `range` supplies years; `sum` adds discounted terms. Expected value: `9.7655`.

← **Return to dividend valuation**

Practical map

PYTHON

Python practical

P4. Model total payout and changing share count

```python
shares_m = 100.0
dividends_m = 40.0
gross_repurchases_m = 100.0
issuance_m = 20.0
repurchase_price = 40.0

net_repurchases_m = gross_repurchases_m - issuance_m
shares_retired_m = net_repurchases_m / repurchase_price
ending_shares_m = shares_m - shares_retired_m
total_payout_m = dividends_m + net_repurchases_m

print(total_payout_m, ending_shares_m)
```

Amounts are GBP millions except price. Expected output: total payout `120.0` and ending shares `98.0` million.

← **Return to total payout**

Practical map

PYTHON

Python practical

P5. Build FCFF from operating assumptions

```python
revenue, ebit_margin, tax = 1980.0, 0.155, 0.25
depreciation, capex, change_nwc = 99.0, 128.7, 14.4

ebit = revenue * ebit_margin
nopat = ebit * (1 - tax)
fcff = nopat + depreciation - capex - change_nwc
discounted_fcff = fcff / (1 + 0.085)

print(round(fcff, 3), round(discounted_fcff, 3))
```

All amounts are GBP millions. Expected year-1 FCFF: `186.075`; present value at 8.5%: `171.498`.

← **Return to the FCFF bridge**

Practical map

PYTHON

Python practical

P6. Solve the price-implied stable growth rate

```python
from scipy.optimize import brentq

def price_from_growth(g):
    terminal5 = 302.223101 * (1 + g) / (0.085 - g)
    ev = 949.288626 + terminal5 / (1.085 ** 5)
    equity = ev + 350.0 - 500.0
    return equity / 100.0

# brentq finds a root inside a bracket with opposite endpoint signs.
implied_g = brentq(lambda g: price_from_growth(g) - 44.0,
                   0.00, 0.06)
print(round(100 * implied_g, 4))
```

A function packages a repeated calculation; `lambda` defines the residual. Expected implied growth: `2.7637` percent.

← Return to reverse DCF

Practical map

PYTHON

Python practical

P7. Screen peers and assemble the decision table

```python
import pandas as pd

peers = pd.read_csv("../data/cases/aster_peer_screen.csv")
matched = peers[peers["matched_peer"] == True]
peer_median = matched["forward_pe"].median()
matched_value = peer_median * 2.00  # GBP2 forward EPS

scenarios = pd.Series({"Bear": 26.50, "Base": 45.63, "Bull": 71.84})
decision = "watchlist" if scenarios["Base"] < 44.0 * 1.15 else "buy"
print(peer_median, matched_value, decision)
```

Boolean `True` selects declared matches; `median()` finds the middle peer value. Expected output: `22.0 44.0 watchlist`.

← Return to the peer screen

Practical map

PYTHON

Python practical