

Stock Valuation

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Stock Cash Flows

- In principle, dividend represents cash flow to shareholders
- In practice, amount of dividend is at discretion of firm
- Firms try to maintain stable dividend policy
- Firms are very reluctant to cut dividend
- Hence firms will usually pay smaller dividend than is potentially available, to allow for unanticipated downturns
- Stock repurchase (or share buyback) represents alternate channel to return cash to (some) shareholders
- **Free cash flow to equity (FCFE)** is indirect measure of potential cash flow to shareholders

Dividend Discount Model

- Expected (holding period) return for stock over single time period, with dividend payment at end of time period:

$$E_t(r_{t,t+1}) = \frac{E_t(P_{t+1} + D_{t+1})}{P_t} - 1$$

- Here P_t is (ex-dividend) stock price at time t while D_t is amount of dividend (or FCFE) at time t
- Also $E_t(\cdot)$ is **conditional expectation** that takes all available information at time t into consideration
- For simplicity, assume that expected return is constant:

$$E_t(r_{t,t+1}) = E_{t+1}(r_{t+1,t+2}) = \cdots = r$$

Dividend Discount Model

- Market price to buy stock at time t , if held for one time period and sold immediately after receiving dividend at time $t + 1$:

$$P_t = \frac{E_t(D_{t+1})}{1+r} + \frac{E_t(P_{t+1})}{1+r}$$

- From economic perspective, market price is expected future cash flows discounted at expected rate of return
- By extension, market price to buy stock at time $t + 1$, if sold immediately after receiving dividend at time $t + 2$:

$$P_{t+1} = \frac{E_{t+1}(D_{t+2})}{1+r} + \frac{E_{t+1}(P_{t+2})}{1+r}$$

Dividend Discount Model

- Apply law of iterated expectations: $E_t[E_{t+k}(\cdot)] = E_t(\cdot)$
- Market price to buy stock at time t , if held for two time periods and sold after receiving dividend at time $t + 2$:

$$P_t = \frac{E_t(D_{t+1})}{1+r} + \frac{E_t(D_{t+2})}{(1+r)^2} + \frac{E_t(P_{t+2})}{(1+r)^2}$$

- By extension, market price to buy stock at time t , if held for T time periods and sold after receiving dividend at time $t + T$:

$$P_t = \frac{E_t(D_{t+1})}{1+r} + \dots + \frac{E_t(D_{t+T})}{(1+r)^T} + \frac{E_t(P_{t+T})}{(1+r)^T}$$

Dividend Discount Model

- In principle, stock has no fixed maturity date, so can hold stock indefinitely and receive dividends forever
- Assume no price bubbles \implies present value of P_{t+T} gets smaller as T gets bigger, and converges to zero as $T \rightarrow \infty$
- Hence market price to buy stock at time t if held indefinitely:

$$P_t = \frac{E_t(D_{t+1})}{1+r} + \frac{E_t(D_{t+2})}{(1+r)^2} + \frac{E_t(D_{t+3})}{(1+r)^3} + \dots$$

- In practice, impossible to calculate present value for infinite number of dividends unless dividends are constant (for preferred stock), or growing at constant rate

Stable Growth Model

- Suppose that dividends are projected to grow indefinitely at constant rate of $g < r$, so $E_t(D_{t+k}) = D_t(1+g)^k$
- Dividends represent growing perpetuity, so market price of stock for **stable growth model** (or **Gordon growth model**):

$$P_t = D_t \left(\frac{1+g}{r-g} \right) = \frac{E_t(D_{t+1})}{r-g}$$

- Here D_t represents trailing dividend while $E_t(D_{t+1})$ represents projected forward dividend
- Dividend cannot grow faster than mature economy, or else dividend will eventually become bigger than entire economy!

Extraordinary Growth Model

- In short term, dividend can grow faster than economy
- Known as **extraordinary growth** or **supernormal growth**
- In long term, dividend cannot grow faster than economy
- Assume that stock will transition to stable growth immediately after receiving dividend at time $t + T$
- Market price to buy stock at time t , if sold for projected **terminal value** of $E_t(P_{t+T})$ at start of stable growth:

$$P_t = \underbrace{\frac{E_t(D_{t+1})}{1+r} + \dots + \frac{E_t(D_{t+T})}{(1+r)^T}}_{\text{Extraordinary Growth}} + \frac{E_t(P_{t+T})}{(1+r)^T}$$

Two-Stage Growth Model

- Assume that dividends will grow at constant rate of g during extraordinary growth: $D_{t+i} = D_t (1 + g)^i$ for $i = 1, \dots, T$
- Immediate transition to stable growth after time $t + T$
- Treat dividends during extraordinary growth as **growing annuity**, and use formula to find combined present value:

$$P_t = D_t \left(\frac{1 + g}{r - g} \right) \left[1 - \left(\frac{1 + g}{1 + r} \right)^T \right] + \frac{E_t(P_{t+T})}{(1 + r)^T}$$

- Pricing formula applies for $g < r$ and $g > r$, since dividends can grow faster than economy during extraordinary growth
- Less flexible than extraordinary growth model, but more convenient to handle without spreadsheet

Payout Ratio & Retention Ratio

- **Payout ratio** is proportion of earnings paid to shareholders:

$$\text{Payout Ratio} = \frac{\text{Dividend}}{\text{Earnings}} = 1 - b$$

- **Retention ratio** (or **plowback ratio**) is proportion of earnings retained by firm, to be used for reinvestment:

$$\text{Retention Ratio} = 1 - \text{Payout Ratio} = b$$

- Payout ratio can be extended to cover share buyback
- Payout ratio can be negative when calculated using FCFE instead of dividend \implies receiving additional capital from investors

Sustainable Growth Rate

- Sustainable growth rate (SGR), or fundamental growth rate, is maximum sustainable rate of earnings growth:

$$\text{SGR} = b \times (\text{Forward}) \text{ ROE}$$

- Return on equity (ROE) measures firm's ability to generate earnings from existing stock of shareholders' equity:

$$(\text{Forward}) \text{ ROE} = \frac{\text{Projected Forward Earnings}}{\text{Current Shareholders' Equity}}$$

- SGR assumes constant ROE, since not sustainable otherwise
- Hence earnings growth comes from reinvestment, which adds to existing stock of shareholders' equity

Example: AAPL Valuation

- Projected earnings of \$7.47 per share for FY 2025, which runs from September 2024 to September 2025
- Projected earnings (and dividend or FCFE) growth rate of 20% per year for next five years (of extraordinary growth)
- Projected ROE of 100% per year during extraordinary growth \implies projected retention ratio of 20% and payout ratio of 80%
- Projected growth rate of 5% per year during stable growth
- Projected ROE of 25% per year during stable growth \implies projected retention ratio of 20% and payout ratio of 80%
- Required return of 13% per year during extraordinary growth, and 10% per year during stable growth, based on CAPM

Example: AAPL Valuation

- Projected earnings per share (EPS), dividend per share (DPS), and present value (PV) of dividend for next five years:

FY	2025	2026	2027	2028	2029	2030
EPS	\$7.47	\$8.96	\$10.76	\$12.91	\$15.49	\$18.59
DPS		\$7.17	\$8.61	\$10.33	\$12.39	\$14.87
PV		\$6.35	\$6.74	\$7.16	\$7.60	\$8.07

- Combined present value of projected dividends:

$$\$7.47 \times 0.8 \times \frac{1.2}{0.13 - 0.2} \times \left[1 - \left(\frac{1.2}{1.13} \right)^5 \right] = \$35.91$$

Example: AAPL Valuation

- Projected terminal value at end of FY 2030:

$$\text{EPS}_{2031} = \$7.47 \times 1.2^5 \times 1.05 = \$19.52$$

$$\text{DPS}_{2031} = \$19.52 \times 0.8 = \$15.61$$

$$P_{2030} = \frac{\$15.61}{0.1 - 0.05} = \$312.27$$

- Projected fundamental share price at end of FY 2025:

$$\$35.91 + \frac{\$312.27}{1.13^5} = \$205.40$$

Price Multiples

$$\text{Price-to-Earnings (P/E)} = \frac{\text{Market Cap}}{\text{Net Income}} = \frac{\text{Price}}{\text{EPS}}$$

$$\text{Price-to-Sales (P/S)} = \frac{\text{Market Cap}}{\text{Revenue}} = \frac{\text{Price}}{\text{RPS}}$$

$$\text{Price-to-Book (P/B)} = \frac{\text{Market Capitalisation}}{\text{Shareholders' Equity}}$$

- Market capitalisation is market price of all outstanding shares
- Often used for **relative valuation**: identify overpriced or underpriced stocks by comparison of price multiples

Example: Fundamental P/E for AAPL

- Projected fundamental P/E at end of FY 2025:

$$\frac{\$205.40}{\$7.47} = 27.5$$

- Fundamental P/E (for two-stage growth model) is based on projected short-term and long-term economic fundamentals:
 - Systematic risk, as reflected by required return
 - Growth potential, as reflected by SGR
 - Reinvestment policy, as reflected by retention ratio
 - Financial performance, implicitly, as reflected by ROE

Price-to-Sales Ratio

- P/S is related to P/E:

$$\begin{aligned}\frac{\text{Price}}{\text{Sales}} &= \frac{\text{Price}}{\text{Earnings}} \times \frac{\text{Earnings}}{\text{Revenue}} \\ &= \text{P/E} \times \text{Net Margin}\end{aligned}$$

- Based on same underlying economic fundamentals as P/E
- But more strongly affected by net margin than P/E
- Hence bigger (relative) difference in P/S when comparing stocks with different net margin
- Unlike P/E, can (always) be applied to loss-making firms

Price-to-Book Ratio

- P/B is related to P/E:

$$\begin{aligned}\frac{\text{Price}}{\text{Book}} &= \frac{\text{Price}}{\text{Earnings}} \times \frac{\text{Earnings}}{\text{Book}} \\ &= \text{P/E} \times (\text{Trailing}) \text{ ROE}\end{aligned}$$

- Based on same underlying economic fundamentals as P/E
- But more strongly affected by ROE than P/E
- Hence bigger (relative) difference in P/B when comparing stocks with different ROE
- Unlike P/E, can (usually) be applied to loss-making firms

Relative Valuation

- Relative valuation aims to identify overpriced or underpriced stocks by comparing price multiples for different stocks
- Price multiples are affected by underlying economic fundamentals, so restrict comparison to stocks that are identical (or at least very similar) in terms of fundamentals
- Alternatively, use regression model to control for differences in underlying economic fundamentals
- Can also compare price multiples for different industries or sectors, or even different stock markets
- Can also compare price multiples for same stock (or industry, or stock market) at different points of time