15.401 Finance Theory

MIT Sloan MBA Program

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Lecture 7: Equities

Critical Concepts

- Industry Overview
- The Dividend Discount Model
- DDM with Multiple-Stage Growth
- EPS and P/E
- Growth Opportunities and Growth Stocks

Reading

- Brealey, Myers and Allen, Chapter 4

Industry Overview

What Is Common Stock?

- **Equity**, an ownership position, in a corporation
- Payouts to common stock are dividends, in two forms:
  - Cash dividends
  - Stock dividends
- Unlike bonds, payouts are uncertain in both magnitude and timing
- Equity can be sold (private vs. public equity)

Key Characteristics of Common Stock:

- Residual claimant to corporate assets (after bondholders)
- Limited liability
- Voting rights
- Access to public markets and ease of shortsales

Industry Overview

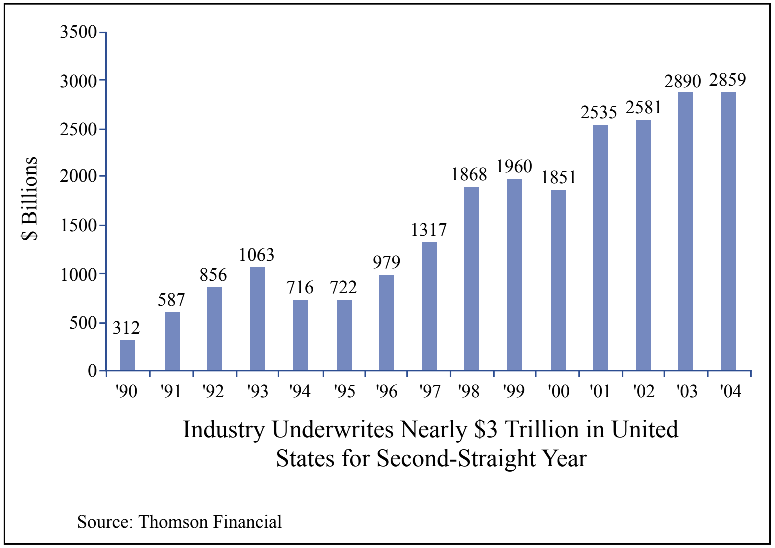
The Primary Market (Underwriting)

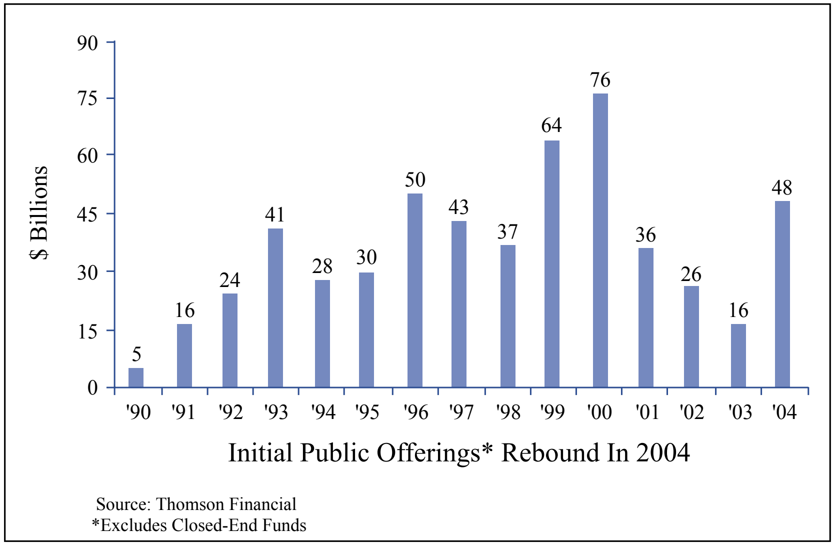
- **Venture capital**: A company issues shares to special investment partnerships, investment institutions, and wealthy individuals
- **Initial public offering** (IPO): A company issues shares to the general public for the first time (i.e., **going public**)
- Secondary or **seasoned** equity offerings (SEO): A public company issues additional shares
- Stock issuance to the general public is usually organized by an **investment bank** who acts as an **underwriter**: it buys part or all of the issue and resells it to the public

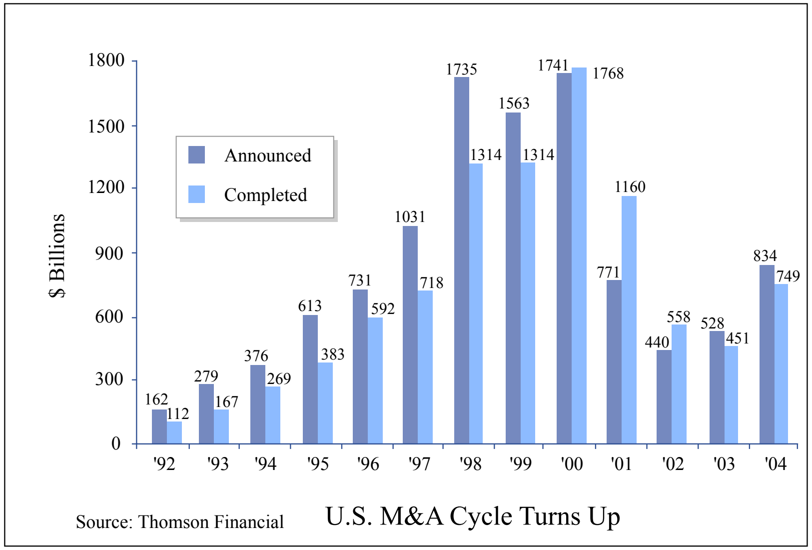
Secondary Market (Resale Market)

- Organized exchanges: NYSE, AMEX, NASDAQ, etc.
- Specialists, broker/dealers, and electronic market-making (ECNs)
- OTC: NASDAQ

Industry Overview







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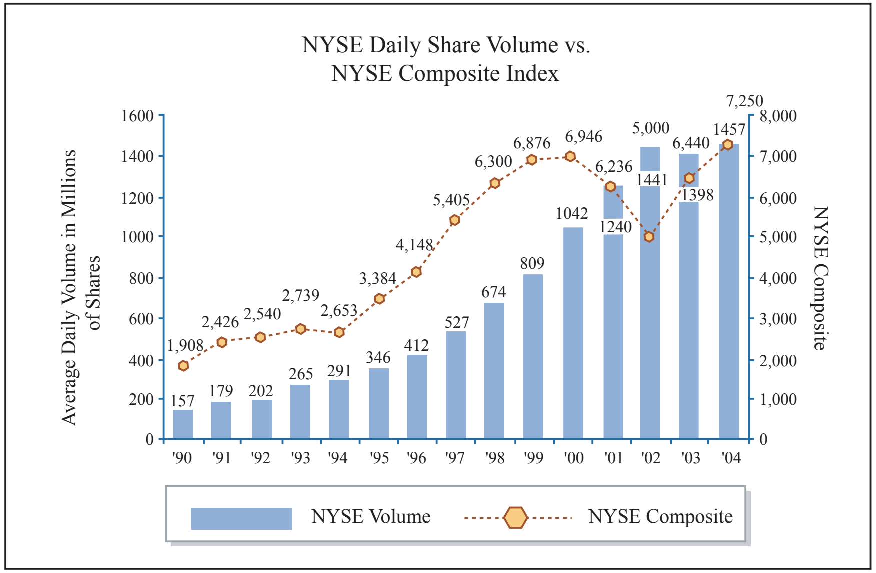

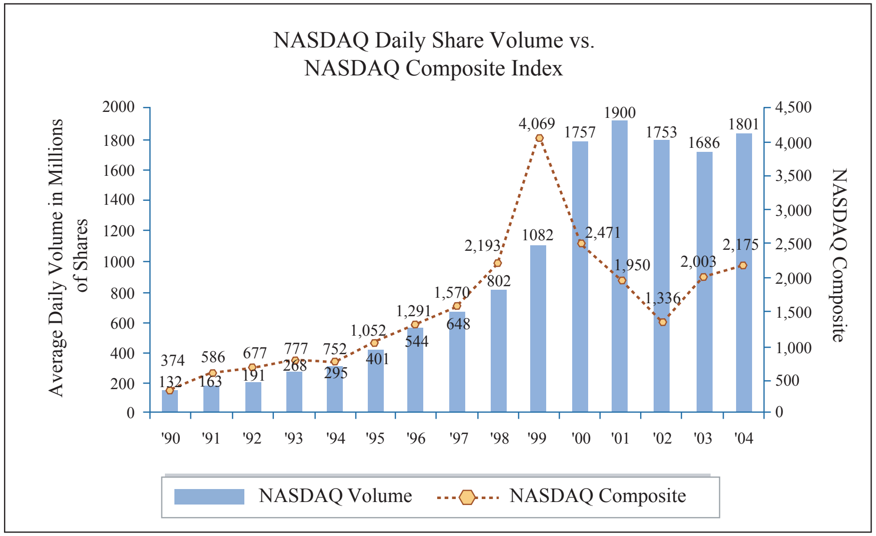

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The Dividend Discount Model

Most Basic Valuation Model for Common Stock

- Applies PV formulas to common-stock payouts
- Two inputs: expected future dividends, discount rate
- Notation:
  - P_t: Price of stock at *t* (ex-dividend)
  - D_t: Cash dividend at *t*
  - $\mathrm{E}_t[\ ]$: Expectation operator (forecast) at *t*
  - r_t: Risk-adjusted discount rate for cashflow at *t*

$$P_t = V_t(D_{t+1}, D_{t+2}, \ldots) = \frac{\mathrm{E}_t[D_{t+1}]}{(1+r_{t+1})} + \frac{\mathrm{E}_t[D_{t+2}]}{(1+r_{t+2})^2} + \cdots$$

$$P_t \equiv \sum_{k=1}^{\infty} \frac{\mathrm{E}_t[D_{t+k}]}{(1+r_{t+k})^k}$$

The Dividend Discount Model

Most Basic Valuation Model for Common Stock

- Two additional simplifying assumptions:

$$\mathrm{E}_t[D_{t+k}] \;=\; D \quad , \quad r_{t+k} \;=\; r$$

- In this case, we have the first version of the **dividend discount model** or the **discounted cashflow (DCF) model**

$$P_t \;\equiv\; \sum_{k=1}^{\infty} \frac{\mathrm{E}_t[D_{t+k}]}{(1+r_{t+k})^k} \;=\; \sum_{k=1}^{\infty} \frac{D}{(1+r)^k} \;=\; \frac{D}{r}$$

- Suppose dividends grow at rate *g* over time (**Gordon growth model**):

$$P_t \;\equiv\; \sum_{k=1}^{\infty} \frac{\mathrm{E}_t[D_{t+k}]}{(1+r_{t+k})^k} \;=\; \sum_{k=1}^{\infty} \frac{D(1+g)^{k-1}}{(1+r)^k} \;=\; \frac{D}{r-g} \quad , \; r > g$$

The Dividend Discount Model

Most Basic Valuation Model for Common Stock

- This provides a convenient expression for the discount rate:

$$P_t = \frac{D}{r-g} \quad , \; r > g$$

$$r - g = \frac{D}{P_t}$$

$$\boxed{r = \frac{D}{P_t} + g = \frac{D_0(1+g)}{P_t} + g}$$

The Dividend Discount Model

Example:

Dividends are expected to grow at 6% per year and the current dividend is $1 per share. The expected rate of return is 20%. What should the current stock price be?

$$P_0 = \frac{1.06}{0.20-0.06} \times 1 = \$7.57$$

- Note: DDM with constant growth gives a relation between current stock price, current dividend, dividend growth rate and the expected return. Knowing three of the variables determines the fourth.

Example:

Determine the cost of capital of Duke Power. In 09/92, the dividend yield for Duke Power was $D_0/P_0 = 0.052$. Estimates of long-run growth:

Info Source	Value Line (VL)	I/B/E/S
Growth g	0.049	0.041

- The cost of capital is given by

$$r = \frac{(1+g)D_0}{P_0} + g$$

Thus,

	Cost of Capital
VL	$r = (0.052)(1.049) + 0.049 = 10.35\%$
IBES	$r = (0.052)(1.041) + 0.041 = 9.51\%$

DDM with Multiple-Stage Growth

Firms May Have Multiple Stages of Growth

- **Growth Stage**: rapidly expanding sales, high profit margins, and abnormally high growth in earnings per share, many new investment opportunities, low dividend payout ratio
- **Transition Stage**: growth rate and profit margin reduced by competition, fewer new investment opportunities, high payout ratio
- **Mature Stage**: earnings growth, payout ratio and average return on equity stabilizes for the remaining life of the firm

Example:

A company with D_0 = \$1 and r = 20% grows at 6% for the first 7 years and then drops to zero thereafter. What should its current price be?

$$P_0 = \sum_{t=1}^{7} \frac{(1.06)^t(1)}{1.2^t} + \frac{1}{1.2^7}\frac{(1.06)^7(1)}{0.2} = \$6.49.$$

EPS and P/E

Dividend Forecasts Involve Many Practical Challenges

- Terminology:
  - **Earnings**: total profit net of depreciation and taxes
  - **Payout Ratio p**: dividend/earnings = DPS/EPS
  - **Retained Earnings**: (earnings - dividends)
  - **Plowback Ratio b**: retained earnings/total earnings
  - **Book Value BV**: cumulative retained earnings
  - **Return on Book Equity ROE**: earnings/BV
- Using these concepts, different valuation formulas may be derived
- Note: these are mostly based on accounting data, not market values

EPS and P/E

Example:

(Myers) Texas Western (TW) is expected to earn $1.00 next year. Book value per share is $10.00 now. TW plans an investment program which will increase net book assets by 8% per year. Earnings are expected to grow proportionally. The investment is financed by retained earnings. The discount rate is 10%, which is assumed to be the same as the rate of return on new investments. Price TW's share price if

- TW expands at 8% forever
- TW's expansion slows down to 4% after year 5

- Observe that
  - Plowback Ratio b = (10)(0.08)/(1) = 0.8
  - Payout Ratio p = (1-0.8)/(1) = 0.2
  - ROE = 10%

EPS and P/E

Example (cont):

- Continuing Expansion Case:

$$
\begin{aligned}
g &= \text{ROE} \times b = (0.10)(0.8) = 0.08 \\
D_1 &= \text{EPS}_1 \times p = (1)(0.2) = 0.2 \\
P_0 &= \frac{D_1}{r-g} = \frac{0.2}{0.10 - 0.08} = \$10.00
\end{aligned}
$$

EPS and P/E

Example (cont):

- 2-Stage Expansion Case. Forecast EPS, D, BVPS by year:

Year	0	1	2	3	4	5	6
EPS		1.00	1.08	1.17	1.26	1.36	1.47
Investment		0.80	0.86	0.94	1.00	1.08	0.59
Dividend		0.20	0.22	0.23	0.26	0.28	0.88
BVPS	10.00	10.80	11.66	12.60	13.60	14.69	15.28

$$P_0 = \sum_{t=1}^{5} \frac{D_t}{(1.1)^t} + \frac{1}{(1.1)^5} \frac{0.88}{(0.10 - 0.04)} = \$10.00$$

<u>Question</u>: Why are the values the same under both scenarios?

Growth Opportunities and Growth Stocks

What Are Growth Stocks?

- Stocks of companies that have access to growth opportunities are considered **growth stocks**
- **Growth opportunities** are investment opportunities that earn expected returns *higher* than the required rate of return on capital
- Example: IBM in the 60's and 70's.
- Note: The following may not be growth stocks
  - A stock with growing EPS
  - A stock with growing dividends
  - A stock with growing assets
- Note: The following may be growth stocks
  - A stock with EPS growing slower than required rate of return
  - A stock with DPS growing slower than required rate of return

Example:

ABC Software has: Expected EPS next year of \$8.33; Payout ratio of 0.6; ROE of 25%; and, cost of capital of r=15%

$$
\begin{aligned}
D_1 &= p \times \text{EPS} = (0.6)(8.33) = \$5.00 \\
g &= b \times \text{ROE} = (0.4)(0.25) = 0.10
\end{aligned}
$$

- Following a no-growth strategy (g=0,p=1), its value is

$$P_0 = \frac{D_1}{r-g} = \frac{\text{EPS}_1}{r} = \frac{8.33}{0.15} = \$55.56$$

- Following a growth strategy, its price is

$$P_0 = \frac{D_1}{r-g} = \frac{5.00}{0.15 - 0.10} = \$100$$

- Difference of \$100 - \$55.56 = \$44.44 comes from growth opportunities, which offers a return of 25%, higher than the required rate of return 15%

Growth Opportunities and Growth Stocks

Example (cont):

- At t = 1: ABC can invest (0.4)(8.33)=$3.33 at a permanent 25% rate of return. This investment generates a cash flow of (0.25)(3.33) = $0.83 per year starting at the t=2. Its NPV at t=1 is

$$\mathrm{NPV}_1 = -3.33 + \frac{0.83}{0.15} = \$2.22$$

- At t = 2: Everything is the same except that ABC will invest $3.67, 10% more than at t = 1 (the growth is 10%). The investment is made with NPV being

$$\mathrm{NPV}_2 = (2.22)(1.1) = \$2.44$$

- The total **present value of growth opportunities (PVGO)** is

$$\mathrm{PVGO} = \frac{NPV_1}{r-g} = \frac{2.22}{0.15-0.10} = \$44.44$$

- This makes up the difference in value between growth and no-growth

Growth Opportunities and Growth Stocks

Stock Price Can Be Decomposed Into Two Components

1. Present value of earnings under a no-growth policy
2. Present value of growth opportunities

$$\boxed{P_0 = \frac{\mathrm{EPS}_1}{r} + \mathrm{PVGO}}$$

- Terminology*:
  - Earnings yield: E/P = EPS_1/P_0
  - P/E ratio: P/E = P_0/EPS_1

***Note: In newspapers, P/E ratios are often computed with the most recent earnings, but investors are more concerned with price relative to future earnings.**

Growth Opportunities and Growth Stocks

- If PVGO = 0, P/E ratio equals inverse of cost of capital

$$\text{P/E} = \frac{1}{r}$$

- If PVGO > 0, P/E ratio becomes higher:

$$\text{P/E} = \frac{1}{r} + \frac{\text{PVGO}}{\text{EPS}_1} > \frac{1}{r}$$

- PVGO is positive only if the firm earns more than its cost of capital

Key Points

- The Dividend Discount Model
- The Gordon Growth Model
- Discount rate, cost of capital, required rate of return
- Estimating discount rates with D/P and g
- EPS, P/E, and PVGO
- Definitions of growth stocks and growth opportunities

Additional References

- Harris, L., 2002, *Trading and Exchanges: Market Microstructure for Practitioners*. New York: Oxford University Press.
- Lefevre, E., 2006, *Reminiscences of a Stock Operator*. New York: John Wiley & Sons.
- Malkiel, B., 1996, *A Random Walk Down Wall Street: Including a Life-Cycle Guide to Personal Investing*. New York: W.W. Norton.

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