15.401 Finance Theory

MIT Sloan MBA Program

Andrew W. Lo
Harris & Harris Group Professor, MIT Sloan School

Lecture 7: Equities

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**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

Industry Underwrites Nearly $3 Trillion in United States for Second-Straight Year

Source: Thomson Financial

Initial Public Offerings* Rebound In 2004

Source: Thomson Financial
*Excludes Closed-End Funds

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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 \( t \)
  - \( E_t[\ ] \): Expectation operator (forecast) at \( t \)
  - \( r_t \): Risk-adjusted discount rate for cashflow at \( t \)

\[
P_t = V_t(D_{t+1}, D_{t+2}, \ldots) = \frac{E_t[D_{t+1}]}{(1 + r_{t+1})} + \frac{E_t[D_{t+2}]}{(1 + r_{t+2})^2} + \ldots
\]

\[
P_t = \sum_{k=1}^{\infty} \frac{E_t[D_{t+k}]}{(1 + r_{t+k})^k}
\]
The Dividend Discount Model

Most Basic Valuation Model for Common Stock

- Two additional simplifying assumptions:

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

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

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

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

\[ P_t = \sum_{k=1}^{\infty} \frac{\mathbb{E}_t[D_{t+k}]}{(1 + r_{t+k})^k} = \sum_{k=1}^{\infty} \frac{D(1 + g)^{k-1}}{r - g}, \quad r > g \]
The Dividend Discount Model

Most Basic Valuation Model for Common Stock

- This provides a convenient expression for the discount rate:

\[ P_t = \frac{D}{r - g}, \quad r > g \]

\[ r - g = \frac{D}{P_t} \]

\[ r = \frac{D}{P_t} + g = \frac{D_0(1 + g)}{P_t} + g \]
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.
The Dividend Discount Model

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:

<table>
<thead>
<tr>
<th>Info Source</th>
<th>Value Line (VL)</th>
<th>I/B/E/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth $g$</td>
<td>0.049</td>
<td>0.041</td>
</tr>
</tbody>
</table>

- The cost of capital is given by

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

Thus,

<table>
<thead>
<tr>
<th></th>
<th>Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL</td>
<td>$r = (0.052)(1.049) + 0.049 = 10.35%$</td>
</tr>
<tr>
<td>IBES</td>
<td>$r = (0.052)(1.041) + 0.041 = 9.51%$</td>
</tr>
</tbody>
</table>
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?

\[
P_0 = \sum_{t=1}^{7} \frac{(1.06)^t(1)}{1.2^t} + \frac{1}{1.2^7} \frac{(1.06)^7(1)}{0.2} = \$6.49. \]
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
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 $p = (1-0.8)/(1) = 0.2$
  - $\text{ROE} = 10\%$
Example (cont):
- Continuing Expansion Case:

\[ g = \text{ROE} \times b = (0.10)(0.8) = 0.08 \]

\[ D_1 = \text{EPS}_1 \times p = (1)(0.2) = 0.2 \]

\[ P_0 = \frac{D_1}{r - g} = \frac{0.2}{0.10 - 0.08} = $10.00 \]
Example (cont):

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

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td>EPS</td>
<td>1.00</td>
<td>1.08</td>
<td>1.17</td>
<td>1.26</td>
<td>1.36</td>
<td>1.47</td>
<td></td>
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<tr>
<td>Investment</td>
<td>0.80</td>
<td>0.86</td>
<td>0.94</td>
<td>1.00</td>
<td>1.08</td>
<td>0.59</td>
<td></td>
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<tr>
<td>Dividend</td>
<td>0.20</td>
<td>0.22</td>
<td>0.23</td>
<td>0.26</td>
<td>0.28</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>BVPS</td>
<td>10.00</td>
<td>10.80</td>
<td>11.66</td>
<td>12.60</td>
<td>13.60</td>
<td>14.69</td>
<td>15.28</td>
</tr>
</tbody>
</table>

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

**Question**: 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
Growth Opportunities and Growth Stocks

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%

\[ D_1 = p \times EPS = (0.6)(8.33) = 5.00 \]

\[ g = b \times ROE = (0.4)(0.25) = 0.10 \]

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

\[ P_0 = \frac{D_1}{r-g} = \frac{EPS_1}{r} = \frac{8.33}{0.15} = 55.56 \]

- 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

  $$NPV_1 = -3.33 + \frac{0.83}{0.15} = $2.22$$

- 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

  $$NPV_2 = (2.22)(1.1) = $2.44$$

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

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

- 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

\[ P_0 = \frac{\text{EPS}_1}{r} + \text{PVGO} \]

Terminology*:
- Earnings yield: \( E/P = \text{EPS}_1/P_0 \)
- P/E ratio: \( P/E = P_0/\text{EPS}_1 \)

*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

\[
P/E = \frac{1}{r}
\]

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

\[
P/E = \frac{1}{r} + \frac{PVGO}{EPS_1} > \frac{1}{r}
\]

- 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

15.401 Finance Theory I
Fall 2008

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