Financial Markets I

Lecture 7: Valuation of Stocks

Master Finance & Strategy

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SciencesPo

Overview of Lecture 7

Big question: How to value a stock?

1. Valuation Formulas.
2. Obtaining the Formula Inputs.
3. Stock Valuation in Practice.
4. Interpreting and Using Valuation Results.
5. Tools for Valuation Analysis (Valuation Ratios and PVGO).

1. Valuation Formulas

- Consider a stock which pays annual dividends.
- Dividend in year $t = 0, 1, ..$ is D_t.
- The "ex-dividend" price in year t is P_t.
  - This is the stock price immediately after dividend D_t has been paid.
- Valuing the stock at $t = 0$ consists in determining P_0.

Price and Expected Return

- The rate of return on the stock between years 0 and 1 satisfies

$$1 + R = \frac{D_1 + P_1}{P_0}.$$

- Expected return is such that

$$1 + E(R) = \frac{E(D_1) + E(P_1)}{P_0}.$$

- Taking $E(R)$ as given, we can solve for P_0

$$P_0 = \frac{E(D_1) + E(P_1)}{1 + E(R)}.$$

Back to the Present Value Rule

- Setting $r = E(R)$, we have

$$P_0 = \frac{E(D_1) + E(P_1)}{1 + r}.$$

  Interpretation: Price P_0 is the Present Value (PV) of expected cashflows, discounted at a risk-adjusted rate.

- **Expected cashflows** are
  - the expected dividend $E(D_1)$,
  - the expected "ex-dividend" price $E(P_1)$.

- The **risk-adjusted rate** is given by the expected return r.
  - This is the level of expected return required by market participants.

- To simplify notations, we will denote $E(D_t)$ by D_t, and $E(P_t)$ by P_t.

Iterating Once

- Equation for the initial stock price P_0:

$$P_0 = \frac{D_1 + P_1}{1 + r}.$$

- P_0 depends on P_1.
  $\Rightarrow$ Our valuation analysis is incomplete.

- Repeating our analysis at $t = 1$, and assuming that the expected return between years 1 and 2 is also r, we get

$$P_1 = \frac{D_2 + P_2}{1 + r}.$$

- Plugging back into the formula for P_0:

$$P_0 = \frac{D_1}{1 + r} + \frac{1}{1 + r}\frac{D_2 + P_2}{1 + r} = \frac{D_1}{1 + r} + \frac{D_2}{(1 + r)^2} + \frac{P_2}{(1 + r)^2}.$$

Multiple Iterations

- If we keep iterating, we get

$$P_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \cdots + \frac{D_T}{(1+r)^T} + \frac{P_T}{(1+r)^T}.$$

- P_0 now depends on P_T.
- Assumption ("No-bubble"): We assume that the stock price does not grow too fast in the far distant future, so that

$$\frac{P_T}{(1+r)^T} \underset{T\to\infty}{\longrightarrow} 0.$$

- Taking the limit as $T \to \infty$, we find that the initial stock price P_0 is driven only by the infinite sequence of cashflows (dividends).

A General Valuation Formula

- Under the no-bubble assumption, we get

$$\begin{aligned} P_0 &= \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \cdots \\ &= \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t}. \end{aligned}$$

- In words:

> Price of a stock is PV of expected dividends discounted at the stock's expected return.

Special Case: Constant Growth Model

- Assume that expected dividends grow at a constant rate $g < r$,

$$D_t = D_{t-1}(1+g).$$

- General valuation formula becomes

$$P_0 = \frac{D_1}{1+r} + \frac{D_1(1+g)}{(1+r)^2} + \cdots + \frac{D_1(1+g)^{T-1}}{(1+r)^T} + \cdots .$$

- Using the growing perpetuity formula from Lecture 1, we get

$$\boxed{P_0 = \frac{D_1}{r-g}}$$

- This is the **constant growth valuation formula**.

2. Obtaining the Formula Inputs

- We will use the constant growth formula for stock valuation.
- The inputs we need are:
  - Expected dividend in year 1, D_1.
  - Dividend growth rate g.
  - Expected return r.

Dividends

- Estimates of D_1 can be obtained from financial sources.
- Two alternative estimates of g:
  - Historical growth.
  - Forecasted growth.

Historical and Forecasted Growth

- Historical growth:
  - Dividend growth rate in year t is

$$g_t = \frac{D_t - D_{t-1}}{D_{t-1}}.$$

  - Historical growth rate is obtained as the sample average of dividend growth rates over past sample period.

- Forecasted growth:
  - Provided by financial analysts.

Expected Return

- An estimate of expected return can be obtained from the CAPM:

$$r = R_f + \text{MRP} \times \beta,$$

  where
  - R_f is the riskless rate,
  - β is the stock's beta,
  - MRP is the market risk premium (expected excess return of market portfolio).

- Remark: the CAPM estimate typically differs from the sample average of the stock's past realized returns.

Riskless Rate and Beta

- Riskless rate: typically the one-month T-bill rate.
- Estimates of beta can be obtained from:
  - Financial sources.
  - Regression.

Market Risk Premium Estimates

- Using sample averages of realized returns.
  - e.g., the 1926-2013 sample averages for large stocks and T-bills in the U.S. are 12.1% and 3.5%, respectively.
  - Estimate of MRP is 8.6%.
- Using constant growth model for the *aggregate* stock market.
  - See Section 5.
  - The aggregate U.S. stock market valuation implies an estimate of the MRP around 4% (this estimate varies over time).
- We will use the second estimate in the following valuation exercise.

3. Valuation in Practice

We are back in 2001. We have to value the stocks of two companies:

- **Duke Energy (DUK)**

  Holding company for Duke Power Company, which supplies electricity to 2 million customers in North and South Carolina. Market capitalization is $30 billion.

- **Anheuser Busch (BUD)**

  The world's largest brewer (owns Budweiser). Also theme park operator, and manufacturer and recycler of aluminum beverage containers. Market capitalization is $39.1 billion.

For each of stock, we use analyst reports issued at the beginning of 2001.

- Source: Valueline, February & March 2001.

Dividends

Estimate of D_1: Forecasted dividend for 2001.

Company	D_1
Duke Energy	1.10
Anheuser Busch	0.66

Dividend Growth Rate

- Historical growth: 5-yr average 1996-2000.

Company	Historical Growth
Duke Energy	1.94%
Anheuser Busch	8.79%

- Forecasted growth:

$$1.10 \times (1 + g_{\text{DUK}})^5 = 1.30.$$

$$0.64 \times (1 + g_{\text{BUD}})^4 = 0.78.$$

Company	Forecasted Growth
Duke Energy	3.40%
Anheuser Busch	5.07%

- The two estimates can differ substantially. We will focus on forecasted growth.

Expected Return

Assume

- One month T-bill rate: 4%.
- Market risk premium: 4%.

Company	Beta	Expected Return
Duke Energy	0.55	6.20%
Anheuser Busch	0.70	6.80%

Valuation

Restating the relevant input data:

Company	D_1	Historical Growth	Forecast Growth	Expected Return
Duke	1.10	1.92%	3.40%	6.20%
Anheuser	0.66	8.79%	5.07%	6.80%

Prices implied by Constant Growth Model vs. Actual Prices:

	Prices Based on		
Company	Historical Growth	Forecasted Growth	Actual Price
Duke Energy	**25.70**	**39.25**	40.75
Anheuser Busch	**N/A**	**38.15**	43.36

Summary

- Historical growth: Model-implied prices are quite different from actual prices or not even well-defined (because $g > r$).
- Forecasted growth: Model-implied prices are quite close to the actual ones.

4. Interpreting and Using Valuation Results

- Under the forecasted growth estimate, the model-implied prices of the two stocks are lower than the actual prices.
- Does this mean that we should short the stocks?
- More generally, how should we interpret and use valuation results?

Reminder: Bond Valuation & Arbitrage

- If actual (market) price of a bond is different than our theoretical price, we can construct an arbitrage.
- We are very confident about our bond valuation results because
  - cashflows are certain,
  - discount rates are given by the term structure of riskfree interest rates.

Stock Valuation & Arbitrage

- For stock valuation, we have to use estimates for
  - cashflows, since future dividends are unknown
  - discount rates, since the fair adjustment for risk is not known.
- We also made one extra assumption:
  - constant dividend growth rate.
- Therefore, our stock valuation results may be quite imprecise.
- If actual price of a stock is different than our theoretical price:
  - It may be because we, and not the market, are wrong.
  - Not a good basis for constructing an arbitrage.

Using Stock Valuation Results

- Although our results may be quite imprecise, they are still useful.
- Uses:
  - Value assets which are not traded in the market. (IPOs, spinoffs, etc.)
  - Understand what assumptions (on growth rates, market risk premium, etc) the market makes to value stocks.
  - Trade, but only if we disagree with these assumptions very strongly.

5. Tools for Valuation Analysis

- Dividend yield (D/P).
- Price-earnings ratio (P/E).
- Present value of growth opportunities (PVGO).

Dividend Yield

- The dividend yield of a stock is
$$\frac{D_0}{P_0}.$$
- The constant growth formula implies that
$$P_0 = \frac{D_0(1+g)}{r-g} \quad \Rightarrow \quad \frac{D_0}{P_0} = \frac{r-g}{1+g}.$$
- We can approximate this by
$$\frac{D_0}{P_0} \approx r - g.$$
- To evaluate the discrepancy between actual price of a stock and our theoretical price, we can compare
  - Left-hand side (actual dividend yield),
  - Right-hand side (using our estimates for r and g).

Example

- For our companies:

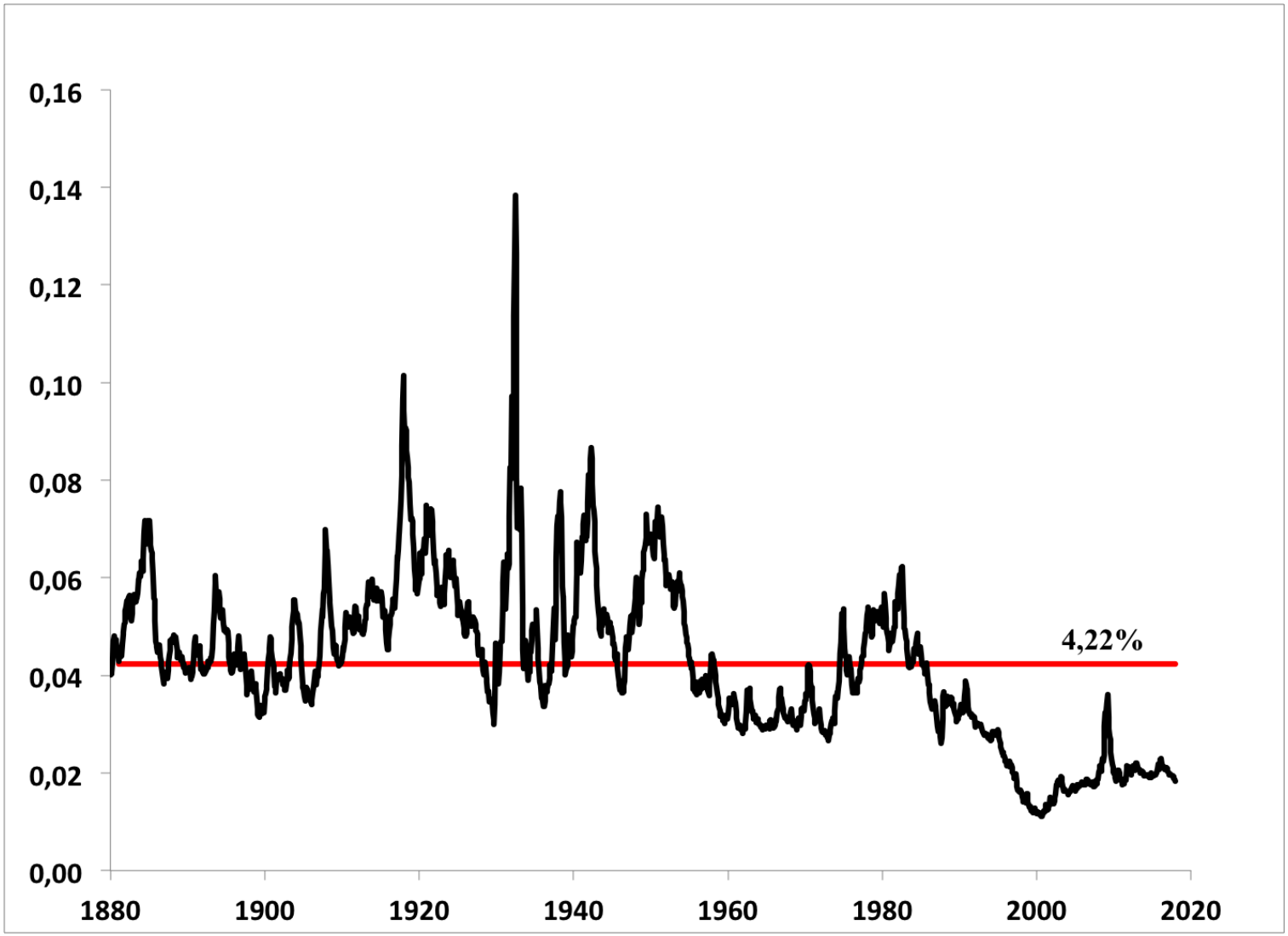
Company	D_0	P_0	Dividend Yield	Expected Return	Forecasted Growth	Difference $r - g$
Duke	1.10	40.75	2.70%	6.20%	3.40%	**2.80%**
Anheuser	0.64	43.36	1.48%	6.80%	5.07%	**1.73%**

- Actual dividend yields are quite close to the model-predicted ones.

Application: US Stock Market Valuation

- S&P500, April 2001:
  - Dividend yield (April 6, 2001): D/P = 1.38%.
  - Riskless rate: $R_f = 4\%$.
  - Expected return: r = 4%+4% = 8%.
  - Dividend growth rate: g = 5%.
- Large discrepancy between D/P and $r - g$.
- Three possibilities:
  - true g is higher: Maybe (g was computed based on historical growth).
  - r is lower: Maybe MRP has declined?
  - Market was overvalued (P simply too high): Possible...

Aggregate Dividend Yield in the US, 1880-2017



Source: Robert Shiller (Yale University).

Price-Earnings Ratio

- The price-earnings ratio of a stock is

$$P/E = \frac{P_0}{EPS_1},$$

  where EPS denotes **earnings per share**.

- P/E ratio is a "normalized" measure of a stock's valuation.
  - Price is expressed as a multiple of "fundamental".
  - Typically between 5 and 25.

- Although similar companies may have very different price per share, they should have similar P/E ratios (same applies to dividend yield).

- W. Buffett's viewpoint: "With P/E ratios, small is beautiful!"

Example

- For our companies:

Company	P_0	EPS_1	P/E
Duke Energy	40.75	2.35	17.34
Anheuser Busch	43.36	1.90	22.82

- Firms whose stocks have high P/E typically have high growth opportunities (holding all else equal).

Present Value of Growth Opportunities

- The present value of growth opportunities captures the "part" of a stock's price which is due to the firm's growth opportunities.
- Consider a firm entirely financed by equity (i.e., no debt).
- In the absence of growth opportunities, the firm does not invest.
  - (Expected) earnings are constant over time.
  - Earnings are entirely paid out as dividends (no 'retained' earnings).
- Therefore, we can define a "no-growth" price by

$$\text{No-Growth Price} = \frac{EPS_1}{r}.$$

- The present value of growth opportunities (PVGO) is defined by

$$PVGO = \text{Price} - \text{No-Growth Price}.$$

Example

- For our companies:

Company	EPS_1	r	No-Growth Price	Actual Price	PVGO
Duke Energy	2.35	6.20	37.90	40.75	2.85
Anheuser Busch	1.90	6.80	27.94	43.36	15.42