Equity Analysis FN 451

- Economic and firm analysis and market environment
- **Dividend discount models and real option valuation**
- Discounted cash flow models
- Market multiples

Discounted Dividend Valuation

Challenges

Basis for all approaches of assets valuation: We buy most assets because we expect them to generate cash flows for us in the future.

- Defining and forecasting CF’s
- Estimating appropriate discount rate

Basic DCF model

- An asset's value is the present value of its (expected) future cash flows

$$V_0 = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t}$$

Three alternative definitions of cash flow

- **Dividend discount model:**
  - The DDM defines cash flows as dividends.
  - An investor who buys and holds a share of stock receives cash flows only in the form of dividends.
- **Free cash flow model:**
  - Free cash flows are the cash flows that are available (or free) for distribution to all investors
- **Residual income model:**
  - RI focuses on profitability in relation to opportunity costs.
  - A stock’s value is the book value per share plus the present value of expected future residual earnings

Dividend discount model

- The DDM defines cash flows as dividends.
- Why? An investor who buys and holds a share of stock receives cash flows only in the form of dividends
- Problems:
  - Companies that do not pay dividends.
  - **No clear relationship between dividends and profitability**

Dividend discount model

- The DDM is most suitable when:
  - the company is dividend-paying
  - the board of directors has a dividend policy that has an understandable relationship to profitability
  - the investor has a non-control perspective.

Discount rate determination

- **Discount rate:** any rate used in finding the present value of a future cash flow
- **Required rate of return:** minimum return required by investor to invest in an asset
- **Cost of equity:** required rate of return on common stock
- **Weighted average cost of capital (WACC):** the weighted average of the cost of equity, after-tax cost of debt, and cost of preferred stock

Two major approaches for cost of equity

- Equilibrium models:
  - Capital asset pricing model (CAPM)
  - Arbitrage pricing theory (APT)
- Bond yield plus risk premium method (BYPRP)

Equilibrium models assumptions

- Investors are rational mean-variance optimizers with homogeneous expectations.
- The market is in a competitive equilibrium (i.e. the market price is the fair price) and no investors can manipulate the market;
- All assets are tradable (all investors have the same assets to invest in);
- No transaction costs, no taxation, investors are not limited in their borrowing and lending, Same interest rate for lending and borrowing (risk free rate of interest);
- Single-period investment horizon (all investors are facing the same investments problems).

Capital asset pricing model (CAPM)

- Expected return is the risk-free rate plus a risk premium related to the asset's beta:
- $E(R_i) = R_{\boldsymbol{F}} + \mathrm{B}_i[E(R_M) - R_F]$

- The beta is $\mathrm{B}_i = Cov(R_i, R_M)/Var(R_M)$
- $[E(R_M) - R_F]$ is the market risk premium or the equity risk premium

Risk-free rate of return

- What do we use for the risk-free rate of return?
  - Choice is often a **short-term rate** such as the 30-day T-bill rate or a long-term government bond rate.
  - We usually match the **duration of the bond rate with the investment period**, so we use the long-term government bond rate.

Equity risk premium

- Historical estimates: Average difference between equity market returns and government debt returns.
- Expectational method is forward looking instead of historical
- One common estimate of this type:
  - GGM equity risk premium estimate
    = dividend yield on index based on year-ahead dividends + consensus long-term earnings growth rate - current long-term government bond yield

Arbitrage Pricing Theory (APT)

- CAPM adds a single risk premium to the risk-free rate. APT models add a set of risk premiums to the risk-free rate:
- $E(R_i) = R_F + (\text{Risk premium})_1 + (\text{Risk premium})_2 + \ldots + (\text{Risk premium})_K$
- $(\text{Risk premium})_i = (\text{Factor sensitivity})_i \times (\text{Factor risk premium})_i$

APT models

- One popular model is the **Fama-French three factor model** using company-specific attributes:
  - RMRF – return on **equity index minus 30 day T-bills**
  - **SMB (small minus big)** – return on small cap portfolio minus return on large cap portfolio
  - **HML (high minus low)** – return on high book-to-market portfolio minus return on low book-to-market portfolio

- SMB = small (market capitalization) minus big (the spread in returns between small market capitalization and big market capitalization stocks)
- HML = high (book-to-market ratio) minus low (the spread in returns between value and growth stocks)

Fama and French Three Factors Model

Fama and French Three Factors Model:

$K_i = R_f + \beta_i * (k_m - R_f) + \beta_s SMB + \beta_v HML$

Market risk premium

Small cap premium

High book-to-market ratio premium

SMB = small (market capitalization) minus big (the spread in returns between small market capitalization and big market capitalization stocks)

HML = high (book-to-market ratio) minus low (the spread in returns between value and growth stocks)

APT models: BIRR

- The Burmeister, Roll, and Ross (**BIRR**) model uses five macroeconomic factors
  - Confidence risk
  - Time-horizon risk
  - Inflation risk
  - Business-cycle risk
  - Market timing risk

Bond yield plus risk premium (BYPRP) method

- The **bond yield plus risk premium** method finds the cost of equity as:

  BYPRP cost of equity
  = YTM on the company's long-term debt
  + Risk premium

- The typical risk premium added is 3-4 percent.

Dividend discount models (DDMs)

- Single-period DDM:

$$V_0 = \frac{D_1}{(1+r)^1} + \frac{P_1}{(1+r)^1} = \frac{D_1 + P_1}{(1+r)^1}$$

Multiple period DDM

- Two-period DDM:

$$V_0 = \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{P_2}{(1+r)^2} = \frac{D_1}{(1+r)^1} + \frac{D_2 + P_2}{(1+r)^2}$$

- Multiple-period DDM:

$$V_0 = \frac{D_1}{(1+r)^1} + \cdots + \frac{D_n}{(1+r)^n} + \frac{P_n}{(1+r)^n}$$

$$V_0 = \sum_{t=1}^{n} \frac{D_t}{(1+r)^t} + \frac{P_n}{(1+r)^n}$$

Indefinite HP DDM

- For an indefinite holding period, the PV of future dividends is:

$$V_0 = \frac{D_1}{(1+r)^1} + \cdots + \frac{D_n}{(1+r)^n} + \cdots$$

$$V_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t}.$$

Forecasting future dividends

- Using stylized growth patterns
  - Constant growth forever (the Gordon growth model)
  - Two-distinct stages of growth (the two-stage growth model and the H model)
  - Three distinct stages of growth (the three-stage growth model)

Forecasting future dividends

- Forecast dividends for a visible time horizon, and then handle the value of the remaining future dividends either by
  - Assigning a stylized growth pattern to dividends after the terminal point
  - Estimate a stock price at the terminal point using some method such as a multiple of forecasted book value or earnings per share

Gordon Growth Model

- Assumes a specifically constant growth (g)
- PV of dividend stream is:

$$V_0 = \frac{D_0(1+g)}{(1+r)} + \frac{D_0(1+g)^2}{(1+r)^2} + \cdots + \frac{D_0(1+g)^n}{(1+r)^n} + \cdots$$

- Which can be simplified to:

$$V_0 = \frac{D_0(1+g)}{r-g} = \frac{D_1}{r-g}$$

Gordon growth model: model sensitive to inputs

- Valuations are very sensitive to inputs. Assuming D_1 = 0.83, the value of a stock is:

	g = 3.45%	**g = 3.70%**	g = 3.95%
r = 5.95%	$33.20	$36.89	$41.50
r = 6.20%	$30.18	**$33.20**	$36.89
r = 6.45%	$27.67	$30.18	$33.20

Other Gordon Growth issues

- Generally, it is illogical to have a perpetual dividend growth rate that exceeds the growth rate of GDP
- Perpetuity value (g = 0): $$V_0 = \frac{D_1}{r}$$
- Negative growth rates are also acceptable in the model.

Expected rate of return

- The expected rate of return in the Gordon growth model is:

$$r = \frac{D_0(1+g)}{P_0} + g = \frac{D_1}{P_0} + g$$

Forecasting growth rates

- There are three basic methods for forecasting growth rates:
  - Using analyst forecasts
  - Using historical rates (use historical dividend growth rate or use a statistical forecasting model based on historical data)
  - Using company and industry fundamentals

Finding g

- The simplest model of the dividend growth rate is:
  - g = b x ROE
  - where g = Dividend growth rate
  - b = Earnings retention rate (1 – payout ratio)
  - ROE = Return on equity.

Finding g

- The ROE, found with the duPont model is:

$$ROE = \frac{Net\ Income}{Sales} \times \frac{Sales}{Average\ Total\ Assets} \times \frac{Average\ Total\ Assets}{Average\ Stockholders'\ Equity}$$

- The growth rate can also be expressed as:

$$g = \frac{\text{Net income} - \text{Dividends}}{\text{Net income}} \times \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Shareholders' equity}}$$

Gordon Model & P/E ratios

- If E is next year's earnings (leading P/E):

$$\frac{P_0}{E_1} = \frac{D_1 / E_1}{r-g} = \frac{\text{Payout ratio}}{r-g}$$

- If E is this year's earnings (trailing P/E):

$$\frac{P_0}{E_0} = \frac{D_0(1+g)/E_0}{r-g} = \frac{\text{Payout ratio}\,(1+g)}{r-g}$$

Strengths of Gordon growth model

- Good for valuing stable-growth, dividend-paying companies
- Good for valuing indexes
- Simplicity and clarity, also helps understanding of relationships between V, r, g, and D
- Can be used as a component in more complex models

Weaknesses of Gordon growth model

- Calculated values are very sensitive to assumed values of g and r
- Is not applicable to non-dividend-paying stocks
- Is not applicable to unstable-growth, dividend paying stocks

Two-stage DDM

- The two-stage DDM is based on the multiple-period model:

$$V_0 = \sum_{t=1}^{n} \frac{D_t}{(1+r)^t} + \frac{P_n}{(1+r)^n}$$

- Assume the first n dividends grow at g_S and dividends then grow at g_L. The first n dividends are:

$$D_t = D_0 (1 + g_S)^t$$

Two-stage DDM

- Using D_{n+1}, the value of the stock at t=n is

$$P_n = \frac{D_0(1+g_S)^n(1+g_L)}{r-g_L}$$

- The value at t = 0 is

$$P_0 = \sum_{t=1}^{n} \frac{D_0(1+g_S)^t}{(1+r)^t} + \frac{D_0(1+g_S)^n(1+g_L)}{(1+r)^n(r-g_L)}$$

Two-stage DDM example

- Assume the following values
  - D_0 is \$1.00
  - g_S is 30%
  - Supernormal growth continues for 6 years
  - g_L is 6%
  - The required rate of return is 12%

Two-stage DDM example

Time	Value	Calculation	D_t or V_t	Present Values $D_t/(1.12)^t$ or $V_t/(1.12)^t$
1	D_1	$1.00(1.30)$	1.30	1.161
2	D_2	$1.00(1.30)^2$	1.69	1.347
3	D_3	$1.00(1.30)^3$	2.197	1.564
4	D_4	$1.00(1.30)^4$	2.856	1.815
5	D_5	$1.00(1.30)^5$	3.713	2.107
6	D_6	$1.00(1.30)^6$	4.827	2.445
6	V_6	$1.00(1.30)^6(1.06) / (0.12 – 0.06)$	85.273	43.202
Total				53.641

"Shortcut" two-stage DDM

- If g_S is constant during stage 1, this works:

$$P_0 = \frac{D_0(1+g_S)}{r-g_S}\left(1-\frac{(1+g_S)^n}{(1+r)^n}\right)+\frac{D_0(1+g_S)^n(1+g_L)}{(1+r)^n(r-g_L)}$$

- For g_S=30%, g_L=6%, D_0=1.00 and r=12%

$$V_0 = \frac{1.00(1.30)}{0.12-0.30}\left(1-\frac{(1.30)^6}{(1.12)^6}\right)+\frac{1.00(1.30)^6(1.06)}{(1.12)^6(0.12-0.06)}$$

$$V_0 = -7.222\left(-1.4454\right)+\frac{85.274}{(1.12)^6}=10.439+42.202=53.64$$

Valuing a non-dividend paying stock

- This can be viewed as a special case of the two-stage DDM where the dividend in stage one is zero.
- Forecasting the length of stage one and the dividend pattern in stage two are the challenges.

The H model

- The basic two-stage model assumes a constant, extraordinary rate for the super-normal growth period that is followed by a constant, normal growth rate thereafter.
- Fuller and Hsia (1984) developed a variant of the two-stage model where the growth rate begins at a high rate and declines linearly throughout the super-normal growth period until it reaches the normal growth rate at the end. The normal growth rate continues thereafter.

The H model

- The value of the dividend stream in the H model is:

$$P_0 = \frac{D_0(1+g_L)}{r-g_L} + \frac{D_0 H(g_S - g_L)}{r-g_L}$$

- V_0 = value per share at time zero
- D_0 = current dividend
- r = required rate of return on equity
- H = half-life of the high growth period (i.e., high growth period = 2H years)
- g_S = initial short-term dividend growth rate
- g_L = normal long-term dividend growth rate after year 2H

H model example

- For Siemans AG, the inputs are:
  - Current dividend is €1.00.
  - The dividend growth rate is 29.28%, declining linearly over a sixteen year period to a final and perpetual growth rate of 7.26%.
  - The risk-free rate is 5.34%, the market risk premium is 5.32%, and the Siemens beta, estimated against the DAX index, is 1.37.
  - The required rate of return for Siemens is:

    $r = r_f + b_i(r_m - r_f) = 5.34\% + 1.37(5.32\%) = 12.63\%$.

H model example

- Using the H model, the value of the company is:

$$V_0 = \frac{D_0(1+g_L)}{r-g_L} + \frac{D_0 H(g_S - g_L)}{r-g_L} = \frac{1.00(1.0726)}{0.1263-0.0726} + \frac{1.00(8)(0.2928-0.0726)}{0.1263-0.0726}$$

- V_0 = 19.97 + 32.80 = €52.77.
- If Siemens experienced normal growth starting now, its value would be €19.97. The extraordinary growth adds €32.80 to its value, which results in Siemens being worth a total of €52.77.

Three-stage DDM

- There are two popular version of the three-stage DDM
  - The first version is like the two-stage model, only the firm is assumed to have a constant dividend growth rate in each of the three stages.
  - A second version of the three-stage DDM combines the two-stage DDM and the H model. In the first stage, dividends grow at a high, constant (supernormal) rate for the whole period. In the second stage, dividends decline linearly as they do in the H model. Finally, in stage three, dividends grow at a sustainable, constant rate.

Three-stage DDM with three distinct stages

- Assume the following for IBM:
  - Required rate of return is 12%
  - Current dividend is $0.55
  - Growth rate and duration for phase one are 7.5% for two years
  - Growth rate and duration for phase two are 13.5% for the next four years
  - Growth rate in phase four is 11.25% forever

Three-stage DDM with three distinct stages

Time	Value	Calculation	D_t or V_t	Present values $D_t/(1.12)^t$ or $V_t/(1.12)^t$
1	D_1	$0.55(1.075)$	0.5913	0.5279
2	D_2	$0.55(1.075)^2$	0.6356	0.5067
3	D_3	$0.55(1.075)^2(1.135)$	0.7214	0.5135
4	D_4	$0.55(1.075)^2(1.135)^2$	0.8188	0.5204
5	D_5	$0.55(1.075)^2(1.135)^3$	0.9293	0.5273
6	D_6	$0.55(1.075)^2(1.135)^4$	1.0548	0.5344
6	V_6	$0.55(1.075)^2(1.135)^4(1.1125)/(.12 - .1125)$	156.4620	79.2685
Total				82.3897

Spreadsheet modeling

- Spreadsheets allow the analyst to build very complicated models that would be very cumbersome to describe using algebra.
- Built-in functions such as those to find rates of return use algorithms to get a numerical answer when a mathematical solution would be impossible or extremely complicated.

Strengths of multistage DDMs

- Can accommodate a variety of patterns of future dividend streams.
- **The expected rates of return can be imputed by finding the discount rate that equates the present value of the dividend stream to the current stock price.**

Weaknesses of multistage DDMs

- Garbage in, garbage out. If the inputs are not economically meaningful, the outputs from the model will be of questionable value.
- Valuations are very sensitive to the inputs to the models.
- Analysts sometimes employ models that they do not understand fully.
- The choice of model should be made very carefully. There is a tendency to grab a model, put in the data, get the results, and use them without carefully justifying the logic of the underlying model and the appropriateness and realism of the values inserted into the model.