1 Bond Markets

Formula 1.1 (Price of zero-coupon bonds)

$$P = \frac{FV}{(1+Y)^n} \quad Y = \left(\frac{FV}{P}\right)^{\frac{1}{n}} - 1$$

Formula 1.2 (Price of coupon bonds)

$$P = \frac{C}{(1+Y)^1} + \frac{C}{(1+Y)^2} + ... + \frac{C}{(1+Y)^n} + \frac{FV}{(1+Y)^n}$$

Formula 1.3 (Spot and forward rate)

$$f_{a,b} = \frac{(1+r_b)^b}{(1+r_a)^a} - 1$$

2 Equity Markets

Formula 2.1 (Dividend Discount Model) *Assume first dividend is received 1 year from now*

1. ***Steady Dividend Stream:*** $P_0 = \frac{D_1}{r}$

2. ***Constant Growth:*** $P_0 = \frac{D_1}{r-g}$

3. ***Supernormal Growth:*** $P_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \frac{\frac{D_2*(1+g)}{r-g}}{(1+r)^2}$

Formula 2.2 (Discounted Cashflow Model)

$$Working\ Capital = Current\ Assets - Current\ Liabilities$$

$$FCF = EBIT(1-t) + Depreciation - CAPEX - Changes\ in\ Working\ Capital$$

$$FCF_{N+1} = FCF_N * (1+g)$$

$$TV = \frac{FCF_{N+1}}{r_{WACC} - g}$$

$$E = V - D$$

Formula 2.3 (Comparables)

$$PE = \frac{Current\ Share\ Price}{Earnings\ Expected\ Over\ 12\ Months}$$

$$Fair\ Value = Industry\ PE * EPS$$

Formula 2.4 (Returns)

$$R_{t+1} = \frac{Div_{t+1} + P_{t+1} - P_t}{P_t}$$

$$R_{t+1}^R = \frac{(Div_{t+1} + P_{t+1})/I_{t+1}}{P_t/I_t} - 1 = (1 + R_{t+1})(1 - h_{t+1}) - 1 \approx R_{t+1} - h_{t+1}$$

Theorem 2.5 (Efficient Market Hypothesis)

1. ***Weak Form:*** *Share prices fully reflect all information contained in past price movements*

2. ***Semi Strong Form:*** *Share prices fully reflect all the relevant, publicly available information*

3. ***Strong Form:*** *All relevant information, including that which is privately held, is reflected in the share price*

3 Portfolio Allocation

Formula 3.1 (Portfolio Risk-Return)

$$R_p = x_A R_A + x_B R_B$$

$$\sigma_p = \sqrt{x_A^2 \sigma_A^2 + x_B^2 \sigma_B^2 + 2x_A x_B \sigma_A \sigma_B \rho_{AB}}$$

Formula 3.2 (Capital Asset Pricing Model)

$$E(R_i) - r_f = \beta_i (E(R_m) - r_f)$$

4 Cost of Capital

Formula 4.1 (Weighted Average Cost of Capital)

$$WACC = \frac{E}{D+E} r_E + \frac{D}{D+E} r_D (1 - \tau_C) = R_U - \tau_C R_D \frac{D}{V}$$

Formula 4.2 (Cost of Equity)

$$Cost\ of\ Equity = Dividend\ Yield + Growth\ Rate\ of\ Dividends$$

5 Capital Structure

Theorem 5.1 (Modigliani and Miller Theorem)

$$R_E = R_A + \frac{D}{E} * (R_A - R_D)$$

1. The firm's value is unaffected by the capital structure as cash flows are independent on financing sources

2. The cost of capital is not influenced by the capital structure

Formula 5.2 (Levered Beta)

$$\beta_L = \beta_U + (1 + \frac{D}{E})$$

6 Options

$$C = \frac{pC^{up} + (1-p)C_{down}}{r}$$

$$p = \frac{r - d}{u - d}$$