

# Introduction to Finance

## Asset Valuation

- Arbitrage Pricing
  - Assets having same payoffs must have same prices
  - Fixed-Income securities, Common Stocks, Forwards, Futures etc.
- Equilibrium Pricing
  - Determinants of fundamentals
  - Expectation of cash flows, investor preferences, discount rate etc.

## Market

- Function of Financial Market
  - Allocate resources
  - Communicate information
- Role of Manager
  - Maximize current market value of the firm
- Household
  - Optimize investments based on preferences.

# Present Value

- Components

- Expected Cash Flow
- Discount Rates
  - \* Compounding

$$(1 + r_{\text{EAR}}) = \left(1 + \frac{\text{APR}}{k}\right)^k$$

- \* Nominal versus Real

$$(1 + r_{\text{real}})(1 + \text{inflation}) = (1 + r_{\text{nominal}})$$

- Investment Rule

- Take project:  $\text{NPV} > 0$

- Present Value Formula

$$\text{PV} = \sum_t \frac{\text{CF}_t}{(1 + r_t)^t}$$

- Future Value

$$\text{FV}_t = \text{PV}_0(1 + r_t)^t$$

- Special equations

- perpetuity
- perpetuity with growth
- annuity
- annuity with growth

- Consistency

- Match characteristics of cash flows and discount rates
- Risk, Real, Nominal, Currency, tax etc.

Remember to discount everything to the same point of time, and also note if inflation affect your results!

# Fixed-Income Securities

- Spot rates,  $r_t$

- Term Structure

- Forward rates

$$(1 + r_t)^t = (1 + r_s)^s (1 + f_{s,t})^{t-s}$$

- Bond Price

$$B = \sum_{t=1}^T \frac{C_t}{(1 + r_t)^t} + \frac{P}{(1 + r_T)^T}$$

- Yield-to-maturity,  $y$

$$B = \sum_{t=1}^T \frac{C_t}{(1 + y)^t} + \frac{P}{(1 + y)^T}$$

- Duration

$$D = \frac{1}{B} \sum \frac{CF_t \times t}{(1 + y)^t}$$

- Modified Duration

$$MD = \frac{D}{1 + y} \quad \text{or} \quad MD = -\frac{1}{B} \frac{dB}{dy}$$

- Convexity

$$CX = \frac{1}{2} \frac{1}{B} \frac{d^2 B}{dy^2}$$

- Price Approximation

$$\frac{\Delta B}{B} \approx -MD \times (\Delta y) + CX \times (\Delta y)^2 + \dots$$

- Hedging

$$\begin{aligned} V_P &= V_A + V_B \\ MD_P &= \frac{V_A}{V_P} MD_A + \frac{V_B}{V_P} MD_B \end{aligned}$$

- Inflation Risk

- Default Risk

- Default Premium
- Risk Premium

# Common Stocks

- General Pricing Formula

$$P_0 = \sum_{t=1}^{\infty} \frac{E_0(D_t)}{(1+r_t)^t} + \lim_{T \rightarrow \infty} \frac{E_0(P_T)}{(1+r)^T}$$

- constant growth
- multiple stage growth

- Terminology

- Earnings per share (EPS)
- Payout ratio ( $p$ )
- Plowback ratio ( $b$ )

$$b = 1 - p$$

- Dividends per share (DPS)

$$\text{DPS} = (1 - b) \cdot \text{EPS}$$

- Return on Equity (ROE)
- Growth rate ( $g$ )

$$g = \text{ROE} \cdot b$$

- Book Value
- Dividend Yield

- Growth Opportunities

- Growth stocks

$$\text{ROE} > r$$

- Present Value of Growth Opportunities (PVGO)

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

# Forwards and Futures

- Prices

$$F = S_0(1 + r_F - \hat{y})^T \approx H$$

- Differences between Futures and Forwards

- Standardized contracts
- Margin account
- Exchange traded
- ...

- Risk Management

- Hedging with Futures/Forwards
- Basis

$$F - S$$

- Minimum Variance Hedge

$$\Delta S_t = a + b \Delta H_t + e_t$$

# Options

- Price bounds
- Put-Call Parity
  - $C - P = S - K * B$
  - Given any two of the three among stock, call and put (same strike), you can always replicate the third one. For example, buying a call and short a stock, and investing cash in risk-free rate is the same as buying a put.
- Early exercise for American options
  - If there is no dividend, don't exercise a call early
  - With or without dividend, it could be optimal to exercise a put option early
- "Risk-Neutral" Pricing
  - Comes from no arbitrage, have nothing to do with risk-neutrality
  - Could be much faster than finding a replicating portfolio
- Binomial Tree - Applying risk-neutral pricing
- Black Scholes Pricing Formula

## Review Questions

These questions should help you focus on some of the important concepts covered in class. They are not a complete catalog of what you should know.

1. What is the opportunity cost of capital? Why is it generally not equal to the firm's cost of borrowing?
2. Finance theory says that financial managers should invest in all positive-NPV projects, and reject all negative-NPV projects. The theory also says that all stockholders should endorse this investment strategy, regardless of differences in the stockholders' wealth, patience, risk tolerance, etc. Why?
3. Suppose a company undertakes a positive-NPV project that is
  - (a) unusually risky and
  - (b) will not pay off for several years

Why should a shareholder who is an 80-year old, risk-averse retiree endorse this investment?

4. The DCF formula calls for a series of cash flows and a discount rate. Assume the cash flows have at least some risk. Are the cash flows supposed to be
  - (a) the most likely outcomes,
  - (b) the median outcomes,
  - (c) the maximum attainable outcomes, or
  - (d) the average or expected outcomes?

Is (c) an acceptable answer in any circumstances? (Hint: corporate bonds)

5. Suppose you are valuing the stock of a private company. The shares are not traded, so you do a DCF analysis. An investment banker also values the stock by multiplying its projected EPS by price-earnings ratios of similar traded companies. Which valuation is more likely to be correct? Answer: it depends ... but on what?
6. Suppose a cash flow stream is expected to grow forever at a constant rate  $g$ , say at 5% per year. The inflation rate is 3% and the nominal discount rate is 8%. The first cash flow is \$5 million. Value the stream expressed in nominal terms, then in real terms. You should get the same answer.
7. What is the difference between a spot and a forward interest rate? How are forward rates calculated?

8. Equilibrium in the market for U.S. Treasury notes and bonds rules out any arbitrage opportunities among them.
  - (a) Define “arbitrage”.
  - (b) Define “equilibrium”.
9. What is yield-to-maturity and how is it calculated?
10. Construct a numerical example where
  - (a) Bond Q’s yield-to-maturity is higher than bond R’s,
  - (b) Bond Q is a negative-NPV investment, and
  - (c) Bond R is a positive-NPV investment.

The last two conditions of course imply mispricing.
11. What is (modified) duration? What does it measure? How would an investor use it to assess or hedge the risk of a fixed-income portfolio?
12. Suppose you invest \$1 million in each of four bonds with different durations. How would you calculate the duration of your portfolio?
13. The interest and principal payments on a long-duration U.S. Treasury bond are safe. Does that mean that the bond is a safe investment? Which strategy has yielded the higher average return, investing in long-duration bonds or short-term Treasury bills?
14. What are risk premium and default premium? What are the factors that determine these premia? Can a bond have only default premium but not risk premium? Why?
15. Does the price of a stock equal the present value of future earnings per share?
16. What happens to a stock price on the ex-dividend date? Do the standard DCF valuation formulae calculate present value cum-dividend or ex-dividend?
17. What is a growth stock? Is it a stock with growing earnings per share?
18. When the P/E ratios of most stocks increase, does it mean that average cost of capital decreases (say, because the market becomes less risk averse)?
19. Encablulator Corporation is about to undertake a massive three-year CAPEX program. It has cut its cash dividend to zero and plans to issue shares to finance growth. In year 4, after the CAPEX program is complete, Encablulator will resume paying cash dividends. How would you value and existing Encablulator share?
20. In what circumstances would you use two-stage DCF valuation formula to value a firm? Give at least two examples.

21. Some companies tell managers to rank capital investment projects on the basis of IRR. What mistakes can follow from this practice? (Make sure you have a complete list.)
22. Suppose a company faces strict limits on the total dollar amount of capital investment. How should it rank projects and decide which ones to undertake?
23. Consider a company that has ROE same as the cost of capital at 10%. Today's price is \$10. Describe the price path of the company if:
  - (a) The company never pays dividend
  - (b) The company always pays all its income as dividend
  - (c) The company pays a dividend of \$5 now, and then never pays dividend in the future.
24. What is the difference between a forward (over-the-counter) and a futures market? Explain how positions in futures markets are "marked-to-market", thus eliminating counterparty risk.
25. What is the general formula relating spot and futures prices? Explain how the formula applies to:
  - (a) Commodity futures, e.g. heating oil or jet fuel
  - (b) Financial futures, e.g. a futures contract on the S&P 500 index
26. A baker needs a large quantity of wheat in 3 months. It can
  - (a) buy the wheat now and store it, or
  - (b) buy a 3-month wheat futures contract.

How would the baker choose between the two options?
27. What are the risks involved in hedging using futures? Derive a hedging strategy that minimizes such risks.
28. Suppose the put-call parity does not hold. Devise arbitrage strategies that gives you riskless profit.
29. For american call options of Kodak and the S&P index, when would it be possible that you will want to exercise each of them? (Extra: How about american put options?)
30. In the binomial tree, given  $u$ ,  $d$  and  $R$ , derive the equation for  $p$ , the risk-neutral probability.