

Valuation and Risk

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OBJECTIVES

- Consider characteristics and valuation of stocks
- Consider characteristics and valuation of stocks
- Look at Risk as well as a key method to calculate Risk

Computing the Price of Common Stock

- Valuing common stock
 - Similar to valuing debt securities
 - **determine future cash flows & discount**
 - at an appropriate discount rate
- Price Earnings, PE, Method
- Dividend Discount Model, DDM
- Free Cash Flow Model, FCF
- In this class we will focus on DDM techniques

Price-earnings (PE) method

- Assigns the **mean PE ratio** based on **expected earnings of the industry** to the **firm's expected earnings** for the next year
- Widely watched measure of how much the market is willing to pay for £1.00 of earnings from the firm
 - Assumes **future earnings** are an important determinant of a firm's value
 - Assumes that the **growth in earnings** in future years will be **similar to that of the industry**

Price-earnings method

Reasons for different valuations

- Investors may use **different forecasts for the firm's earnings** or the mean industry earnings
- Investors disagree on the proper measure of earnings

Limitations of the PE method

- May result in inaccurate valuation for a firm if **errors are made in forecasting future earnings or in choosing the industry composite**
- Questions whether an investor should **trust a PE ratio**

Valuing A Stock Using the PE Method

A firm is expected to generate earnings of £2 per share next year

Mean ratio of share price to expected earnings of competitors in the same industry is 14

What is the valuation of the firm's shares according to the PE method?

Valuation per share = (Expected Earnings of firm per share) * (Mean Industry PE ratio)

Dividend Discount Model

- John Williams (1931) stated that the price of a stock should reflect the present value of the stock's future dividends:

$$\text{Price} = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t}$$

- D can be revised in response to changes in firm's cash flows
- k can be changed as required rate of return by investors changes

Dividend discount model

- For a constant dividend, the cash flow is a perpetuity:

$$\text{Price} = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t} = \frac{D}{k}$$

- For a constantly growing dividend, the cash flow is a growing perpetuity:

$$\text{Price} = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t} = \frac{D_1}{k-g}$$

Dividend discount model

- **Limitations** of the dividend discount model
 - Errors can be made in determining the:
 - Dividend to be paid
 - Growth rate
 - Required rate of return
 - Errors are more pronounced for firms that retain most of their earnings

Factors That Affect Stock Prices

- Economic factors
 - Impact of economic growth
 - Impact of interest rates
 - Impact of the exchange rate

Factors That Affect Stock Prices

- Market-related factors

- **Investor sentiment**

- In some periods, stock market performance is not highly correlated with existing economic conditions
 - Stocks can exhibit excessive volatility because their prices are partially driven by fads and fashions

- **January effect**

- Many portfolio managers invest in riskier small stocks at the beginning of the year and shift to larger companies near the end of the year
 - Places upward pressure on small stocks in January

Factors That Affect Stock Prices

– Firm-specific factors

- Some firms are more exposed to **conditions within their own industry** than to general economic conditions, so participants monitor:
 - **Industry sales forecasts**
 - **Entry into the industry by new competitors**
 - **Price movements of the industry's products**
- Market participants focus on announcements that signal information about a firm's sales growth, earnings, or characteristics that cause a revision in the expected cash flows

Factors That Affect Stock Prices

– Firm-specific factors

– Dividend policy changes

- An increase in dividends may reflect the firm's expectation that it can more easily afford to pay dividends

– Earnings surprises

- When a firm's announced earnings are higher than expected, investors may raise their estimates of the firm's future cash flows

– Acquisitions

- Expected acquisitions typically result in an increased demand for the target's stock and raise the stock price
- The effect on the acquiring firm is less clear

– Expectations

- Investors attempt to anticipate new policies so they can make their move before other investors

- Measures of risk
 - The volatility of a stock
 - The beta of a stock
 - Value at risk, VaR
- **The volatility of a stock**
 - May indicate the degree of uncertainty surrounding the stock's future returns
 - Reflects total risk because it reflects movements in stock prices for any reason

– Measures of risk

– The beta of a stock:

- Measures the sensitivity of its returns to market returns
- Is used by many investors who have a diversified portfolio of stocks
- Can be estimated by obtaining returns of the firm and the stock market and applying regression analysis to derive the slope coefficient:

$$R_{jt} = B_0 + B_1 R_{mt} + u_t$$

■ Measures of risk

□ Value at risk

- **Is a risk measurement which estimates the largest expected loss to a particular investment position for a specified confidence level.**
- Became very popular in the late 1990s after some mutual funds and pension funds experienced abrupt large losses
- **Is intended to warn investors about the potential maximum loss that could occur**
- Focuses on the pessimistic portion of the probability distribution of returns
- Is commonly used to measure the risk of a portfolio
- Considered in detail later

Stock Performance Measurement

- The Sharpe index is appropriate when **total variability** is thought to be the appropriate measure of risk:

$$\text{Sharpe index} = \frac{\bar{R} - \bar{R}_f}{\sigma}$$

- The higher the stocks' mean return relative to the mean risk-free rate and the lower the standard deviation, the higher the Sharpe index
- Measures the excess return above the risk-free rate per period

Stock Performance Measurement

- The Treynor index is appropriate when beta is thought to be the most appropriate type of risk:

$$\text{Treynor index} = \frac{\bar{R} - \bar{R}_f}{B}$$

- The higher the Treynor index, the higher the return relative to the risk-free rate, per unit of risk

20M break

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OVERVIEW

What are Bonds ?

*Fixed Income Investments
with known returns over a specific period of
time*

- A way for entities to raise money
 - At *relatively low* rates of interest
- Promise to pay i.e, “*bond*”
- To value its best
- to view as a package of cash flows

- Maturity
 - The fixed income instrument stops paying *interest*
 - *Principal* is returned to bond buyer
- Par Value
 - face value, nominal, par, principal of bond
- Coupon
 - The interest rate issuer promises to pay
 - based on par value of bond

- Discount and Premium
 - Bonds may be priced above or below par
- Time-to-Maturity
 - Time until bond matures
- Current Yield
 - Divide interest paid by current bond price

- One of the largest issuers of debt securities are governments
- Government finance spending by taxes
 - But borrow for *revenue smoothing*
- Government debt is generally viewed as *risk free*
 - and we have r_f as a special notation
- The *risk free* rate is used as a baseline for *security valuation*
- All other assets will trade at a spread, generally positive

TREASURY NOTES & BONDS - PARAMETERS

- Treasuries have a par value of \$1,000
- Maturity
 - Discount securities
 - T-Bills, 1M to 1Y (trade in what's called *money markets*)
 - Zero coupon bonds
 - Coupon bearing
 - Notes, 1Y to 10Y
 - Bonds, 1Y to 30Y
- Quoting convention
 - percentage of par and in fractions

CHARACTERISTICS OF TREASURIES

- Prices changes as market interest rates changes
- Interest payments are commonly semiannual
- Bond investors receive face value when bonds mature
- Bonds are issued at par (face) but during lifetime may trade
 - At a premium (i.e., market price $>$ \$100)
 - Or at a discount (i.e., market price $<$ \$100)

USTREASURY BOND LISTINGS

Rate	Maturity	Bid	Ask	Chg.	Ask Yield
3.785	Jan.19	105:30	105:31	+1	3.66

- Coupon is 3.785%, the bond matures January 2019, has a par value of \$1,000 and the market quotes prices in $1/32^{\text{nds}}$, expressed as a percentage of par
- BID side
 - The price is \$1,059.375 where $0.9375 = 30/32$
- ASK side
 - The price \$1,059.6875, where where $0.9688 = 31/32$
- THE SPREAD is a difference of 31.25 cents (bid and ask spread)

CORPORATE BONDS

- The second group of issuers of debt are *corporations*
- Corporations borrow for many reasons
 - A source of funding
 - Modify *capital structure* i.e., WACC
 - *Tax shields*
- Unlike government debt corporate debt is *risky*
- Almost always corporate debt must yield MORE than r_f
 - BUT NOT ALWAYS

- Maturities vary significantly
 - commercial paper, trades in *Money Markets*, less than 1Y
 - But some maturities run to 100 years
- Convertible bonds allow holders to convert to equity
 - Under agreed circumstances
- Large number of variants – very rich asset class
- Two fundamental types of corporate bonds differing in risk
 - unsecured - backed by faith of issuer
 - secured - tied to collateral
- Measuring risk is difficult, so we turn to *ratings agencies*

WHAT ARE RATINGS AGENCIES?

- Intermediaries who assesses credit worthiness
 - Originally of railroads, industrial corporations, and financial institutions
- In run up to financial crisis turned focus to ABS (week 1)
- Widely blamed for their role in financial crisis
 - But is this fair?
- **IMPORTANT!**
 - Ratings agencies offer NO opinion on whether debt instrument should be bought or sold
 - ONLY a rating, and ratings are relative

WHY DO WE NEED RATINGS AGENCIES

- Information asymmetry
 - borrowers and lenders have different information
 - in some ways borrowers have superior information
- Efficiency
 - Proprietary research is costly and duplicative
 - Core competence
 - Rapid dissemination of information

WHAT DO THEY DO?

- Agencies sell Ratings & Advice
- Ratings are “opinions”
 - They are NOT statements of facts
 - They are NOT investment advice
- They also will sell related services
 - Credit Rating Advisory Services

WHAT DO THEY DO?

- Rate both issuers & instruments
- Investment grade
 - BBB (or Baa3) and above
 - Important to institutional investors
- And below Investment grade?
- Important point
 - Banks and other entities
 - have their own internal ratings systems for borrowers

Moody's	S&P	Entity
Aaa	AAA	US Treasury
Aa1	AA+	State of Nebraska
Aa2	AA	Citigroup
Aa3	AA-	Goldman Sachs
A1	A+	Italy
A2	A	AT&T
A3	A-	Malaysia
Baa1	BBB+	Bulgaria
Baa2	BBB	Sprint-Nextel
Baa3	BBB-	Whole Foods
Ba1	BB+	Colombia
Ba2	BB	Harrah's
Ba3	BB-	Indonesia
B1	B+	Pakistan
B2	B	Ford Motor
B3	B-	Six Flags
Caa1	CCC+	Movie Gallery
Caa2	CCC	Ecudaor
Caa3	CCC-	
Ca	CC	
C	C	
D	D	DEFAULT

WHAT DO THEY DO?

- Sell ratings
- Ratings can apply to
 - sovereigns, corporates and or specific issues
- Who pays for these opinions?
 - Until mid 1970s by investors
 - However now by rated issuers or underwriters
- This gives rise to what is called *moral hazard*

INVESTING IN FIXED INCOME

- Why invest in bonds?
 - Look at needs of participants: less risk and steady returns
- Diversification
 - Risk / return is different for different asset classes
 - By diversifying away from equities to fixed income
 - We can modify portfolio risk / return characteristics
- Overall the biggest benefit is risk reduction
 - Small amounts of bonds can sharply lower overall risk

Bond Pricing

$$P_B = \sum_{t=1}^N \frac{C_t}{(1+R)^t} + \frac{NV}{(1+R)^N}$$

- Where
 - P_B the price of the bond
 - C_t is the coupon payment
 - t counts the number of periods to maturity
 - N is the number of periods to maturity
 - R is the discount rate or yield to maturity

PRICE of 8%, 3 year MARKET YIELD 6%

$$1053.46 = \sum_{i=1}^3 \frac{80}{(1+0.06)^i} + \frac{1,000}{(1+0.06)^3}$$

—Where

- *Coupon* = 8%
- *Coupon payments* = \$1,000 * 0.08 = \$80
- *Discount rate* = *MARKET YIELD* = 0.06
- *Maturity* = 3 years
- *Par Value* = \$1,000

PRICE of 8%, 3 year MARKET YIELD 8%

$$1000 = \sum_{i=1}^3 \frac{80}{(1+0.08)^i} + \frac{1,000}{(1+0.08)^3}$$

–Where

- *Coupon* = 8%
- *Coupon payments* = \$1,000 * 0.08 = \$80
- *Discount rate* = *MARKET YIELD* = 0.08
- *Maturity* = 3 years
- *Par Value* = \$1,000

PRICE of 8%, 3 year MARKET YIELD 10%

$$950.26 = \sum_{i=1}^3 \frac{80}{(1+0.10)^i} + \frac{1,000}{(1+0.10)^3}$$

—Where

- *Coupon* = 8%
- *Coupon payments* = \$1,000 * 0.08 = \$80
- *Discount rate* = *MARKET YIELD* = 0.10
- *Maturity* = 3 years
- *Par Value* = \$1,000

20M break

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Value at Risk -- VAR

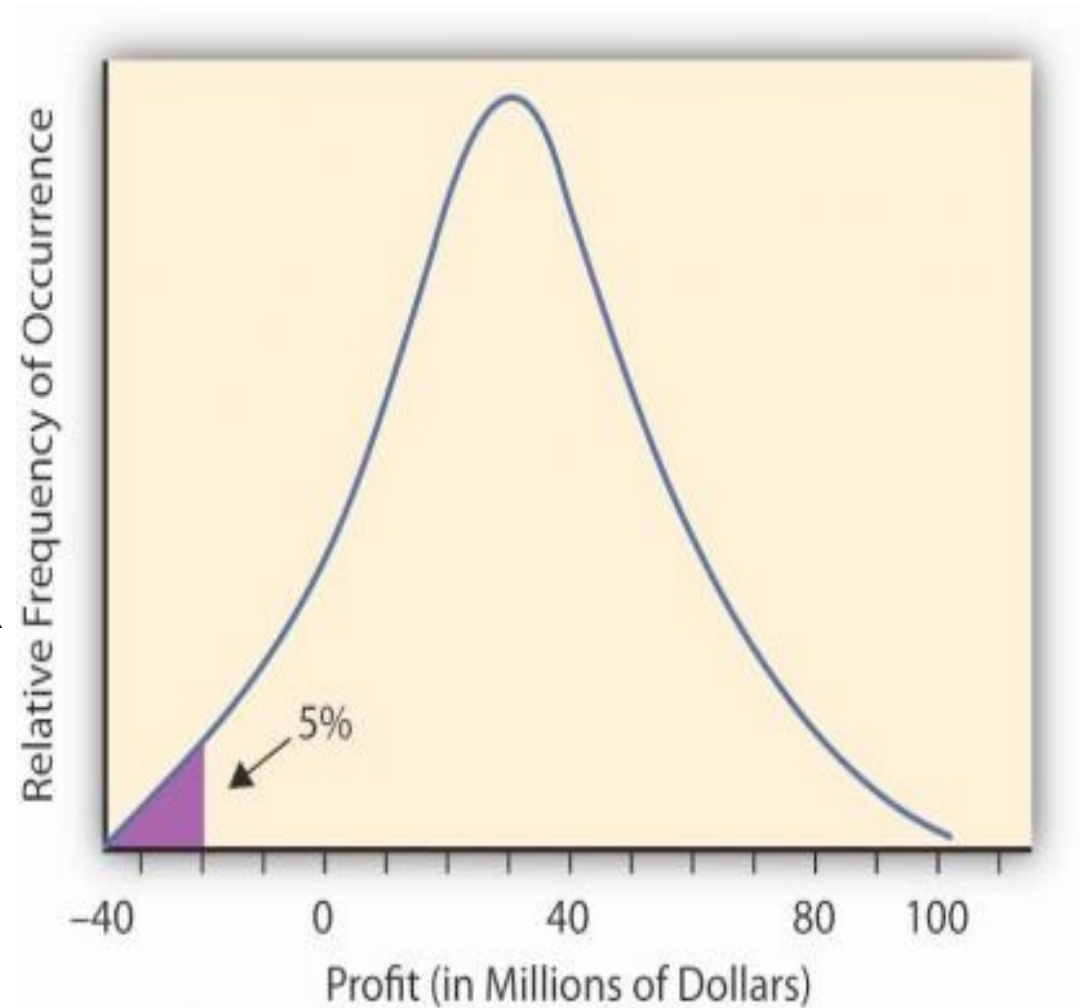
- Widely used by Regulators to set regulatory capital
- Tracked and calculated by trading desks
- VaR asks a very simple question

“What loss level is such that we are $X\%$ confident it will not be exceeded in N business days?”

EXAMPLE OF VALUE AT RISK

Assumptions

- 95% *confidence interval*
- One day *liquidation period*
- VAR is the maximum one day loss, 95% of the time
- Another view - the projected loss - VAR - will only be exceeded 5% of the time
- VAR is the left tail of the *return distribution*
- In this case, VAR is dark blue.



VALUE AT RISK ASSUMPTIONS

- A VaR result is based on specific assumptions
- *Liquidation period t*
- *Confidence interval x*

Without knowing t and x , VaR is meaningless

- Changing either t or x changes the VaR result
- Think about HOW?

VALUE AT RISK ASSUMPTIONS

- The portfolio is assumed to be static over t
- t should reflect *portfolio turnover*
- x must reflect the *risk tolerance* of the portfolio owner
- Many hedge funds have a high degree of risk tolerance
- Institutional investors have low degree of risk tolerance
- Banking - US / European banks differ on risk tolerance
- Most individuals have a low degree of risk tolerance
- *Risk tolerance* is cultural - no “right” or “wrong” answer.

VALUE AT RISK AND REGULATORY CAPITAL

- Regulators base capital requirements of banks on VaR
- Market Risk
 - Required capital is k times the 10-day 99% VaR where k is at least 3.0
- Credit risk & Operational Risk
 - Required capital is based on a one-year 99.9% VaR
- Although these are often changed
 - To suit overall market and local conditions

ADVANTAGES OF VAR

- Easy to understand
- Captures an important aspect of risk
 - in a single number
- Asks a very simple question: *“How bad can things get?”*

ASSUMPTION OF NORMALITY

- We assume daily gains/losses are
 - normally distributed independent
 - with mean 0
 - standard deviation σ
- This makes it easy to calculate VaR
 - from the standard deviation (1-day VaR= 2.33σ)
- The T -day VaR equals $\sqrt{T}$ times
 - one-day VaR

ASSUMPTION OF NORMALITY

- Regulators allow banks to calculate the 10 day VaR as $\sqrt{10}$ times the one-day VaR
- Clearly this is important use of VaR
 - BUT BE CRITICAL
- Do *real* returns follow a *normal* distribution?
 - NO
- Hull (2010) examined USD / JPY returns
 - Returns < 3 SD behaved as expected
 - But ≥ 3 SD the assumption was invalidated

CHOICE OF VAR PARAMETERS

- Time horizon
 - how quickly can portfolio be unwound
 - Factors to consider
 - Liquidity of instruments
 - Capability of market to absorb
- Bank regulators use
 - 1-day for market risk
 - 1-year for credit/operational risk
- Fund managers often use one month
- HFT will operate across several minutes
 - But also may consider daily VaR

CHOICE OF VAR PARAMETERS

- Confidence level -- what are objectives?
- Bank regulators use
 - 99% for market risk
 - 99.9% for credit
 - 99.9% operational risk
- Higher confidence intervals imply a “surprise” is less likely
- A bank may want to maintain specific credit rating
 - will often use a confidence levels to this end
- HFT will link this back to preferred drawdown

CALCULATING VAR – THREE APPROACHES

- Historical simulation
 - Apply *previous* observations to current portfolio
 - Inapplicable to HFT
- Monte Carlo Simulation
 - Generate *forward looking* scenarios determine portfolio values
 - Used in HFT but at daily thresholds
- Variance-covariance method
 - Assuming a distribution (usually *normal*), use statistical properties of the portfolio to find VAR
 - Can be used in HFT but calculation intensive

VAR FOR A SINGLE ASSET

$$\text{VaR}_{asset} = \mu - \alpha \sigma_{asset}$$

- With
 - μ the *expected return* of the asset
 - σ *standard deviation* of the asset
 - α is a *deviate* (from statistics)
- As a rough calculation apply this to a portfolio

VaR FOR A SINGLE ASSET

- Descriptive stats for a portfolio
 - Over six month horizon
 - μ \$2 million
 - σ \$10 million
- α is 2.33 for 99% confidence
- The 1% point of the VaR distribution
 - is $2 - 2.33 \times 10$ or \$21.3 million
- In other words, VaR for the portfolio
 - with a six month time horizon and 99% confidence level
 - is \$21.3 million

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