Calculating a Discounted Cashflow (5)

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The Economics of Energy Corporations (2)

Outline of the course

Overall objective – understand how senior management use economic models to make investment decisions

1. Introduction to key themes in the global energy market
2. Introduction to financial modelling as a management tool
   1. Understanding some key concepts
3. Starting a model for a shale oil and gas field – revenues and prices
4. Inputting the costs – capital expenditure, operating costs and taxes
5. **Calculating a discounted cashflow**
   1. **Why is it important**
   2. **How is it used to make decisions**
6. Power plants – a gas-fired CCGT and a wind farm
7. Testing the investment decisions: running some numbers under different assumptions
8. Answering your questions

The Discount Rate

- A firm is like a pool of cash that has been financed from two sources – debt from banks and equity capital from shareholders

- Both sources of financing demand a return for providing cash

- Companies therefore need to at least recuperate their Weighted Average Cost of Capital from each investment they make
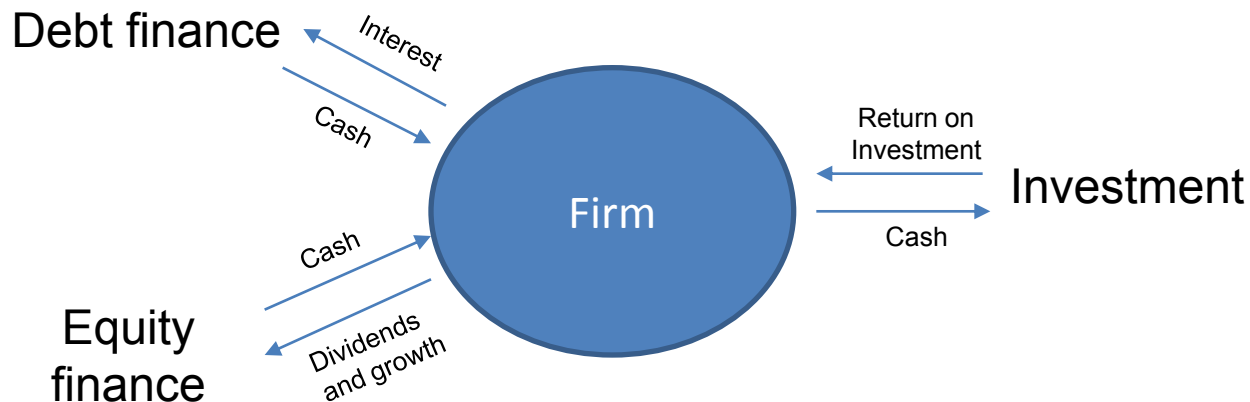
Weighted Average Cost of Capital

- **WACC = [E/V * Re] + [D/V * Rd * (1-Tc)]**

- E = firm's equity, D = firm's debt, V = total value of firm's financing (V = E+D)

- Re = cost of equity, Rd = cost of debt

- Tc = corporate tax rate (firms can claim cost of interest against tax)

Cost of Debt

- How much does it cost to borrow money?

- Government borrowing rate (LIBOR)
  - US$ 4.6% (up from 1.75% 18 months ago)
  - UK£ 5.4% (up from 0.70%)

- Corporate borrowing rate (LIBOR + X%)
  - Depends on loan amount and credit worthiness of borrower
  - Ratings agencies provide assessments used by lenders

- Corporate bond rate (historic Eurobond offerings)
  - Gazprom 2017 Eurobond – 4.25%
  - BP 2017 US$ bond – 2.24%

- Interest payments are allowable for tax
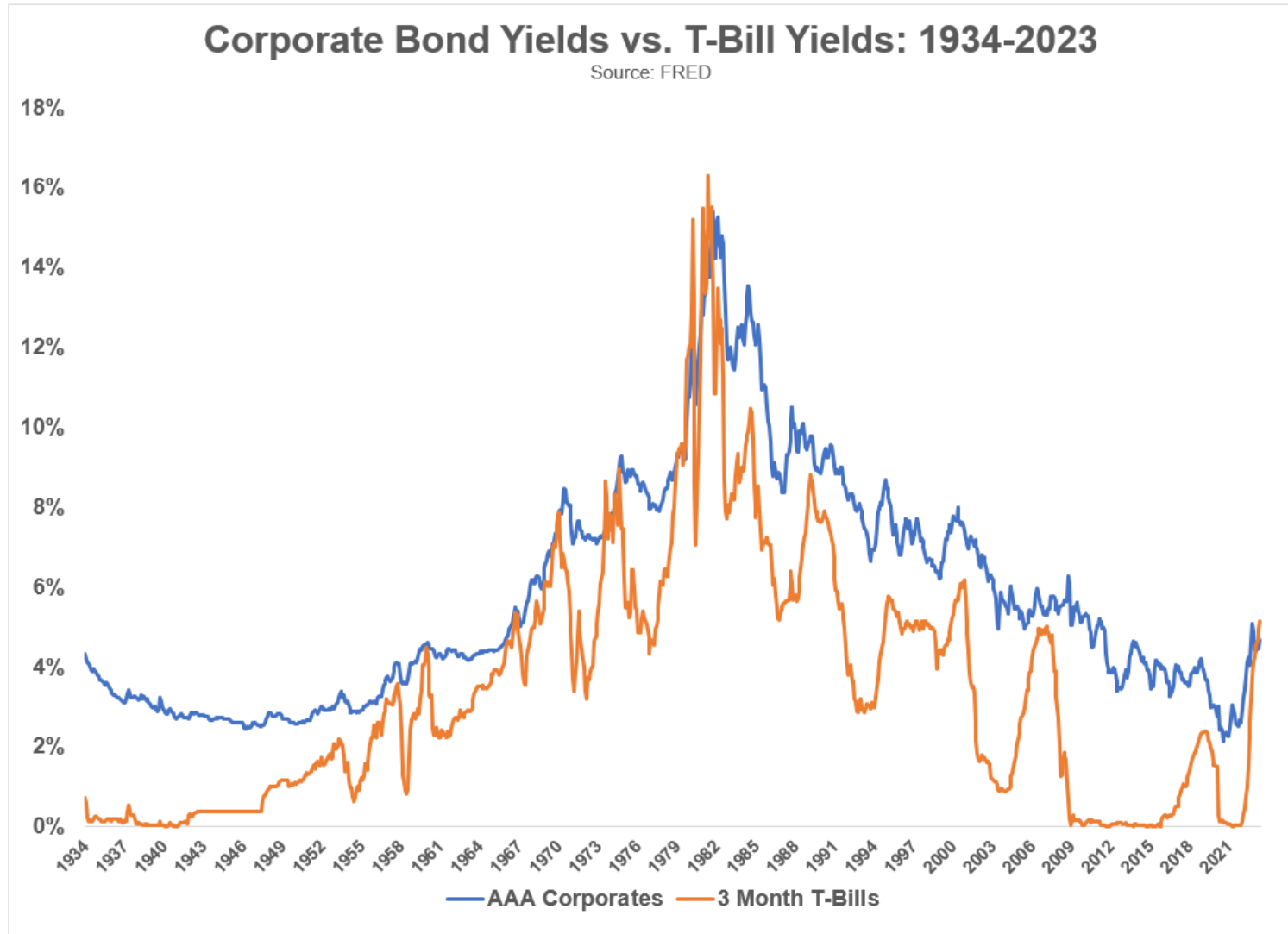 - Cost of debt = Interest rate x (1-tax rate)

Yield on 10-Year US Treasury Bonds
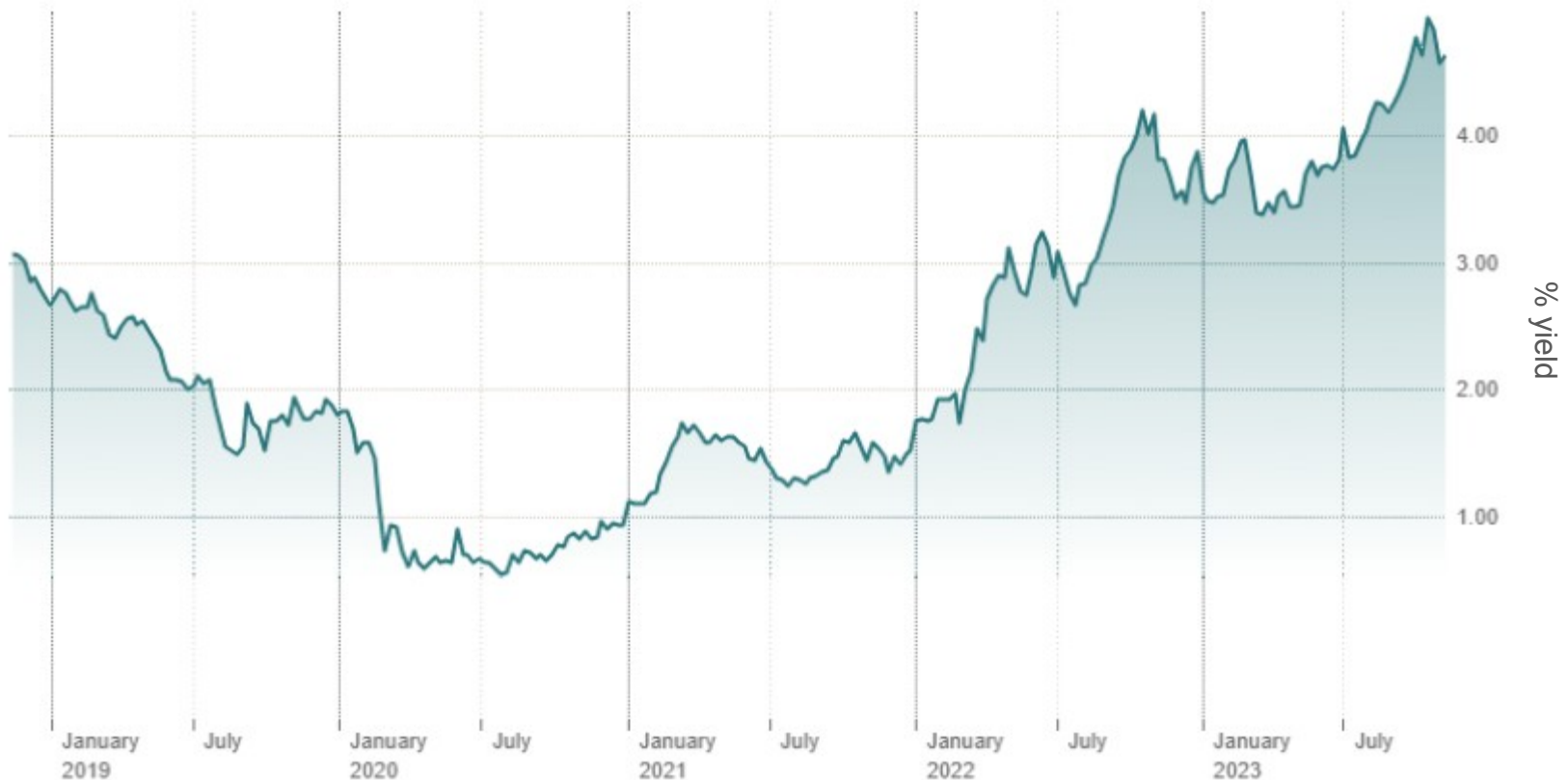
- Cost of borrowing reached a historic low during the COVID pandemic as Central Banks attempted to stimulate the economy
- Rising inflation has led to a significant rebound in borrowing costs, which has a large impact on WACC calculations

History of corporate borrowing costs

Corporate Bond Yields vs. T-Bill Yields: 1934-2023
Source: FRED

AAA Corporates   3 Month T-Bills

- text

Credit ratings impact the cost of debt, as well as investor preceptions



Source: The Association of Corporate Treasurers

Cost of Equity

- **What constitutes a return for a shareholder?**
  - Dividends
  - Capital Growth
  - Total Shareholder Return

- **Average cost of equity**
  - The minimum acceptable return – the risk free rate
  - The premium for investing in the equity market (the extra return on the equity market compared to the risk free rate)
  - The specific premium for each company (the Beta) – how different is it to the market
    - Beta value is a measure of specific risk for a company – 1 is the market average
    - BP – 0.99; ExxonMobil - 0.84
    - Sound Energy – 2.83; Chesapeake – 2.68

- **Risk free rate (LIBOR) + (Beta for a specific company * the equity market premium)**

Total return to shareholders
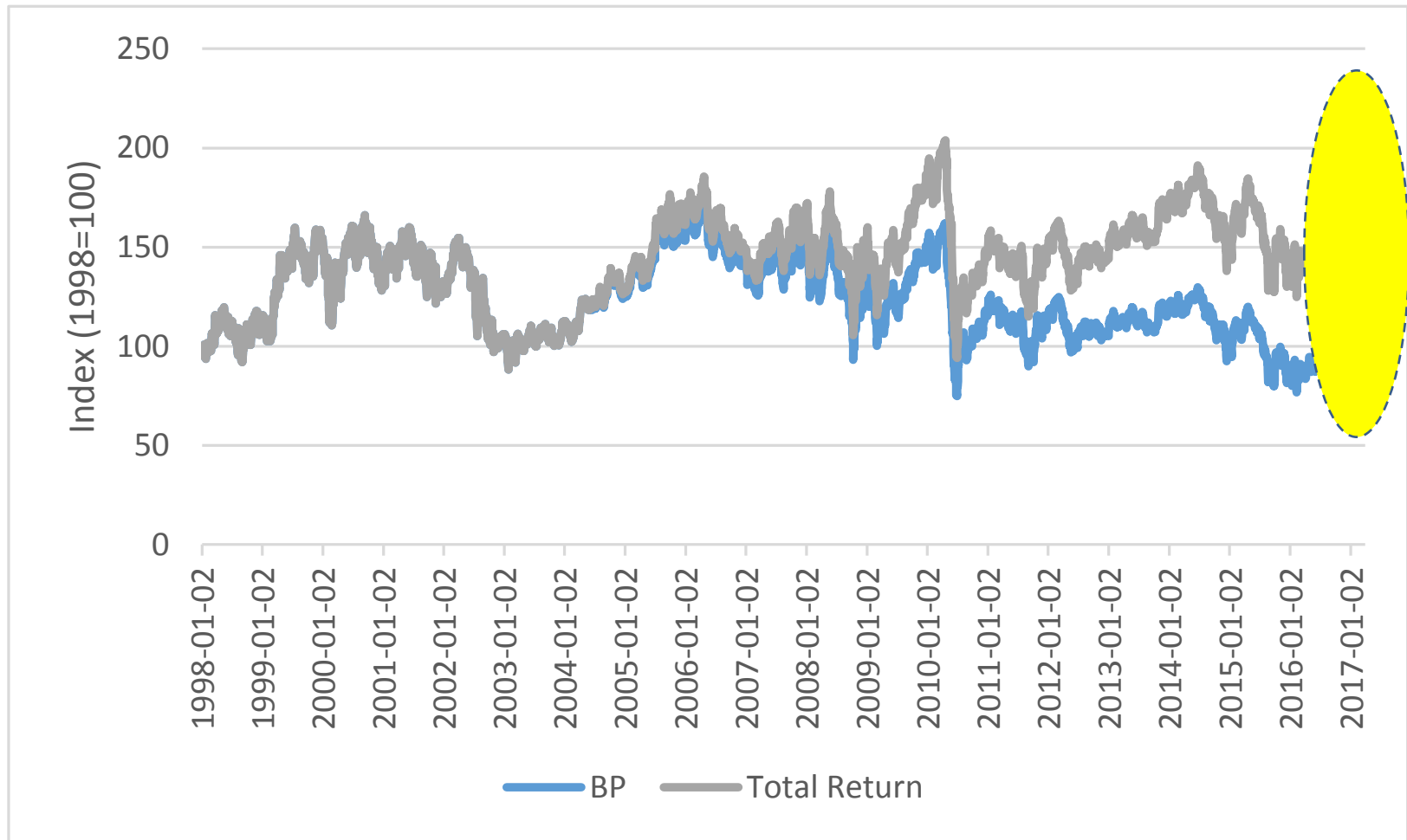
- Almost no gain in share price terms over almost 20 years
- Shareholders doubled their money when dividends and other incentives are included

Annual performance of S&P 500 Index since 1872
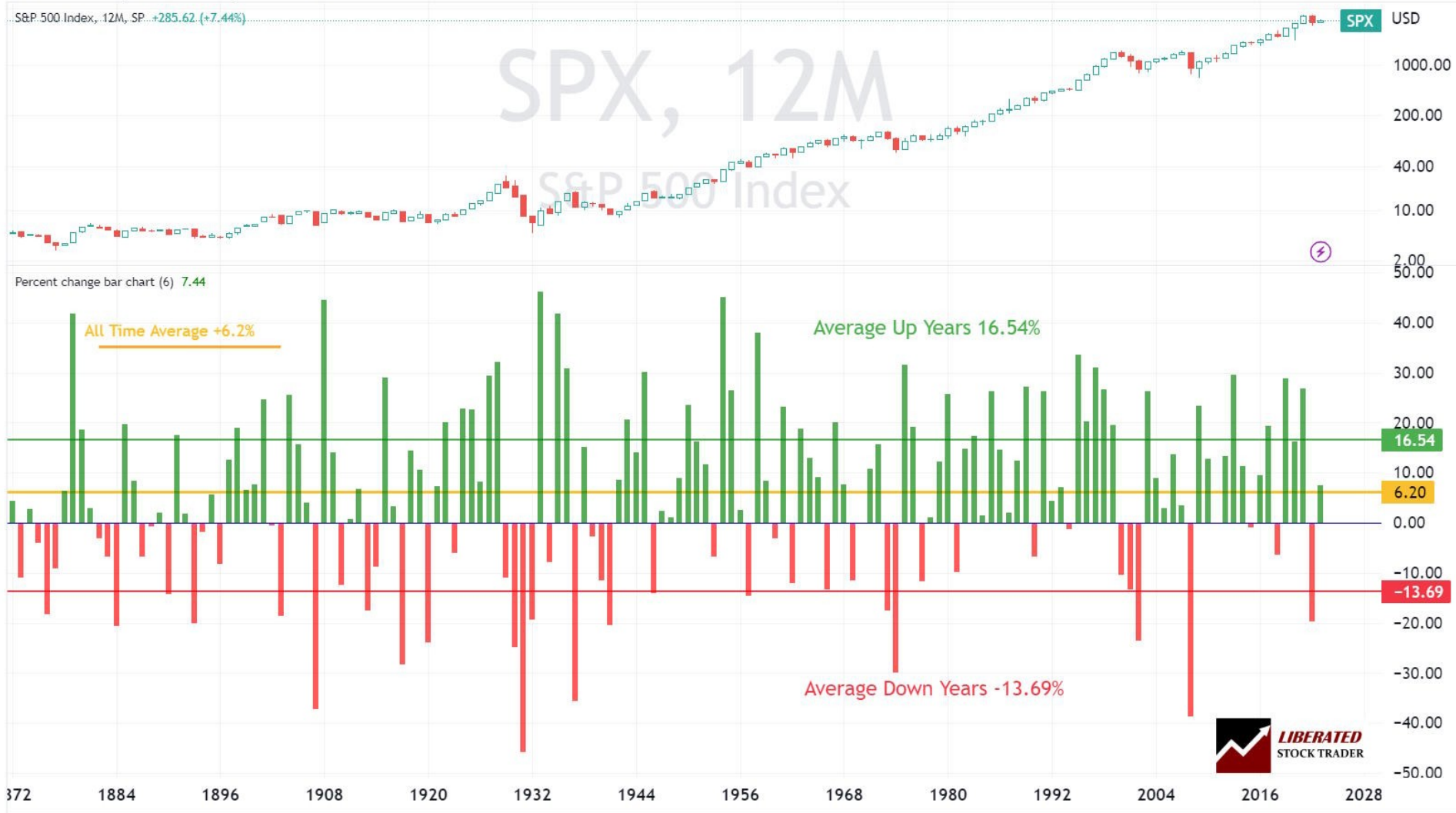
More recent stock market returns

GLOBAL STOCK MARKET
ANNUAL RETURNS 1995-2019

MSCI All Country World IMI Index (Net Div, GBP)

Average Return

Source: MSCI
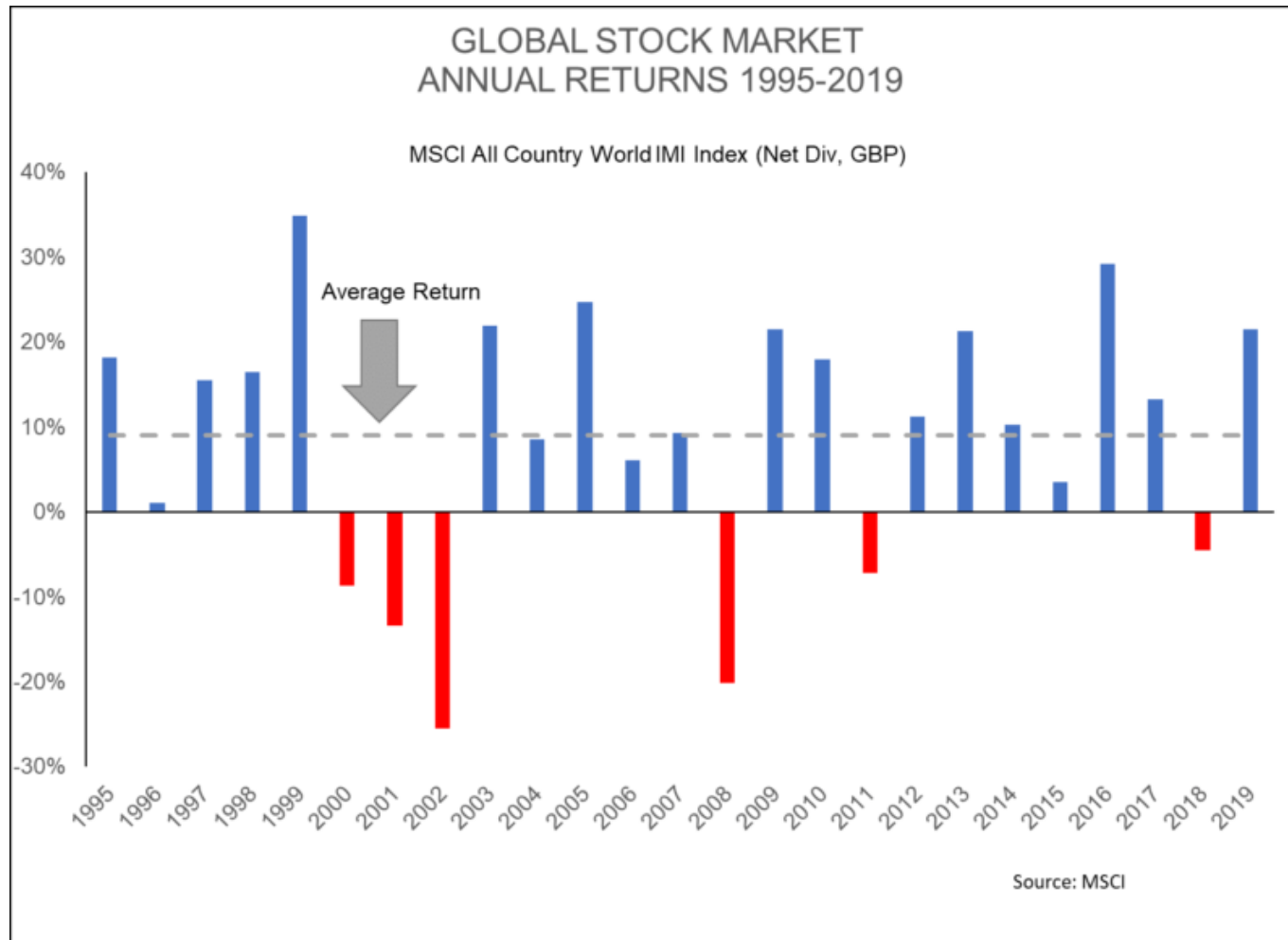
- Average return in the period before COVID was just below 10% per annum (including dividends)
- This is what shareholders expect from their investments in company shares

MSCI World Index since 2008

CUMULATIVE INDEX PERFORMANCE — GROSS RETURNS (USD)
(OCT 2008 – OCT 2023)

- MSCI World
- MSCI Emerging Markets
- MSCI ACWI

419.62
393.09
242.69

X-axis: Oct 08, Jan 10, May 11, Jul 12, Oct 13, Jan 15, Apr 16, Jul 17, Oct 18, Jan 20, Apr 21, Jul 22, Oct 23

Y-axis: 50, 200, 400

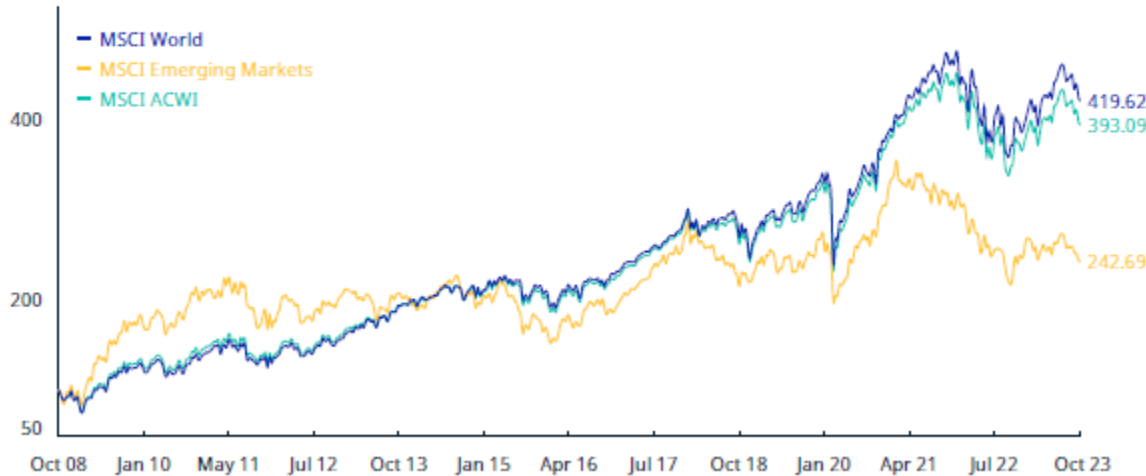**ANNUAL PERFORMANCE (%)**

Year	MSCI World	MSCI Emerging Markets	MSCI ACWI
2022	-17.73	-19.74	-17.96
2021	22.35	-2.22	19.04
2020	16.50	18.69	16.82
2019	28.40	18.88	27.30
2018	-8.20	-14.24	-8.93
2017	23.07	37.75	24.62
2016	8.15	11.60	8.48
2015	-0.32	-14.60	-1.84
2014	5.50	-1.82	4.71
2013	27.37	-2.27	23.44
2012	16.54	18.63	16.80
2011	-5.02	-18.17	-6.86
2010	12.34	19.20	13.21
2009	30.79	79.02	35.41

- MSCI World Index captures performance of the main global equity markets
- Includes total return – capital gain plus dividends
- Average returns have been fairly consistent
  - Since 2009: 11.8% pa
  - Last 10 years: 10.6% pa
  - Last 5 years: 8.3% pa

The DCF Calculation as a foundation – WACC concept

Weighted average cost of capital is corporate "interest rate"

$$WACC = \frac{E}{D + E}(r_e) + \frac{D}{D + E}(r_d)(1 - t)$$

Where:
E = market value of equity
D = market value of debt
r_e = cost of equity
r_d = cost of debt
t = corporate tax rate

WACC is the cost to a company of financing the capital for a project, including debt and equity

Cost of debt = average interest rate for company

Cost of equity is theoretical return to investors in the company

Cost of Equity = Risk free rate + (Beta*(Market return – Risk free rate))

Essentially, how much return would an investor expect relative to putting his money with US Treasury stock, or in the stock market
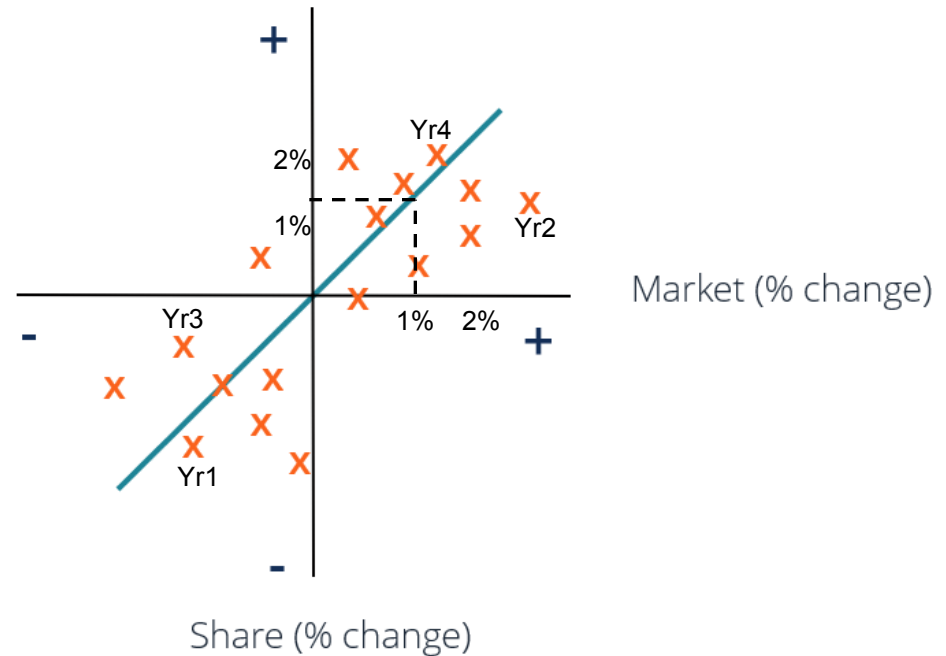
What is the Beta of a share?

The Beta tells shareholders how much a share moves relative to the overall market

Is it more or less volatile than the market as a whole?

More volatile = more risky

For more risk shareholders want more return

Beta = slope of the line

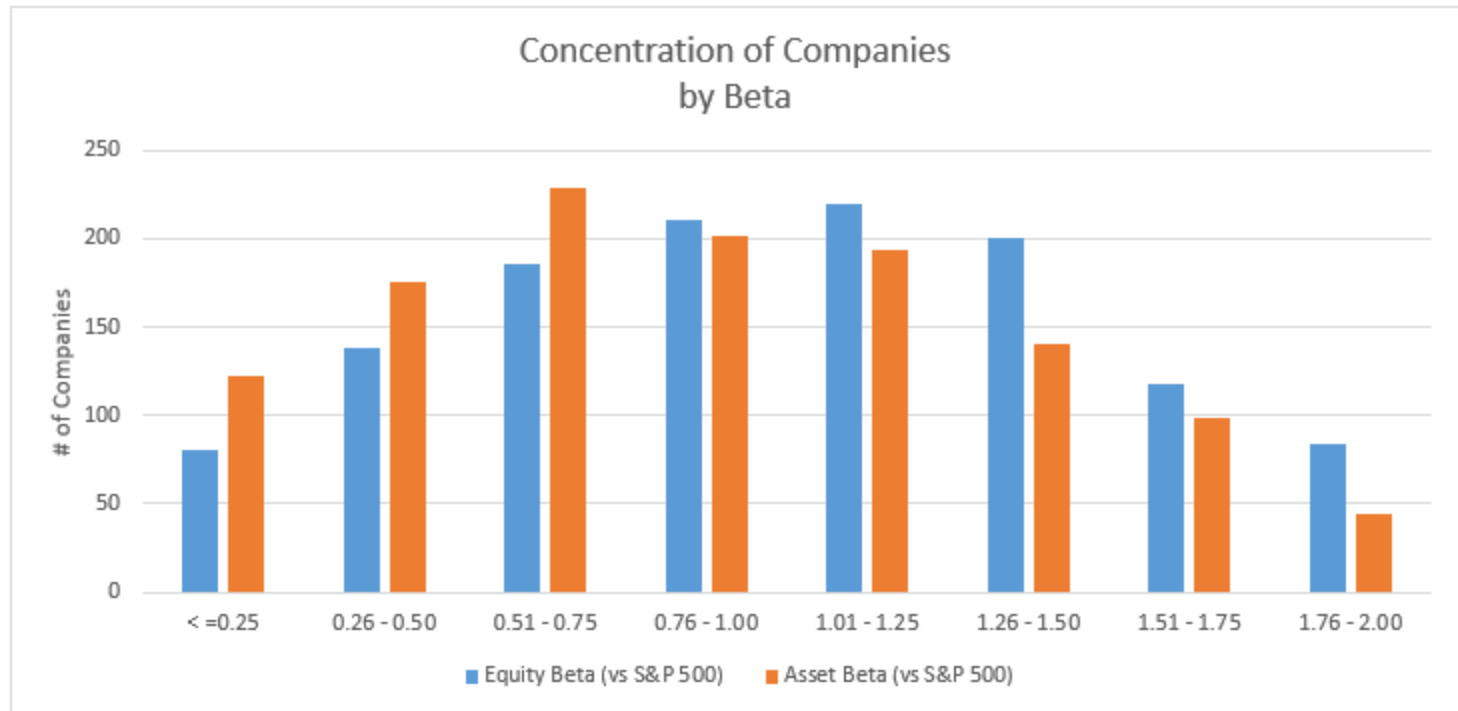Market (% change)

Share (% change)

A share with a Beta of 2 moves up and down twice as much as the market on average
- market down by 2%, share down by 4%

A share with a Beta of 0.5 moves half as much
- market up by 10%, share up by 5%

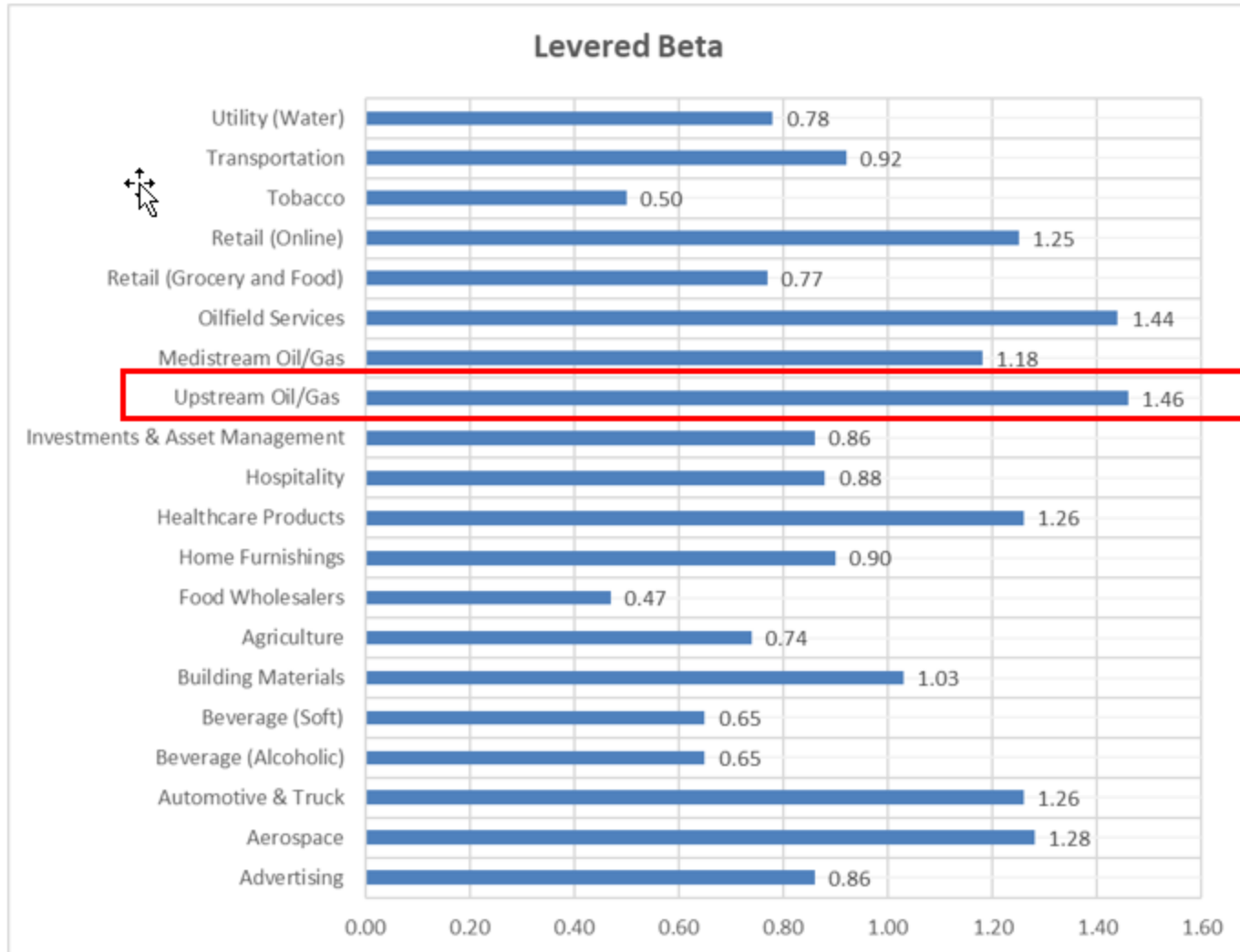# Range of company Betas

Concentration of Companies by Beta

- Analysis of 1768 companies on NYSE, NASDAQ and Amex exchanges in the US

- Highest concentration in the 0.51-1.50 range, with 1.01-1.25 having the largest number of companies for equity beta

Betas across a number of industry sectors

- Average upstream oil company Beta is 1.46

Analysis of Beta and Leverage (Debt to Equity)

Industry Name	Number of firms	Beta	D/E Ratio
Oil/Gas (Integrated)	4	0.98	11.50%
Oil/Gas (Production and Exploration)	174	1.26	20.08%
Oil/Gas Distribution	23	0.99	71.41%
Oilfield Svcs/Equip.	101	1.38	32.60%
Power	48	0.73	77.16%
Software (Internet)	33	1.55	17.66%
Utility (General)	15	0.64	74.18%

Source: NYU Stern, https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html

- Compare Betas across sector – see the higher risk industries

- D/E ratio explains how the companies are funded on average – the companies with higher Betas are able to raise less debt as a share of their capital

- Banks want to see shareholders taking most of the risk in higher Beta companies

WACC Calculation

Exxon

- Debt/Equity – 70:30

- Equity Market return – 10.6%

- Risk free rate – 4.61%

- Beta – 0.91

- Cost of Equity

- 4.61 + (0.91 x (10.6 – 4.61)) = 4.61 + 5.45 = 10.06

- Cost of Debt – 5.43% x (1-0.2) = 4.34%

- WACC calculation

    (10.06*0.3)+(4.34*0.7)

    =3.01% + 3.0%

    =6.01%

WACC Calculation

Devon Energy

- Debt/Equity – 30:70

- Equity Market return – 10.60%

- Risk free rate – 4.61%

- Beta – 2.32

- Cost of Equity

- 4.61 + (2.32 x (10.60 – 4.61)) = 4.61 + 13.89 = 18.51

- Cost of Debt – 7.86% (LIBOR+3.25%) x (1-0.2) = 6.29%

- WACC calculation

    (18.51*0.7)+(6.29*0.3)

    =12.96% + 1.89%

    =14.85%

WACC Questions

- Calculate the WACC based on the following assumptions:

- General
  - Risk-free rate – 4.5%
  - Equity market return – 10%
  - Corporate tax rate – 25%

- Specific
  - Company 1: Beta – 0.85, Interest rate on Debt – 3.5%, Share of Equity – 40%
  - Company 2: Beta – 1.75, Interest rate on Debt – 5%, Share of Equity – 30%
  - Company 3: Beta – 3.0, Interest rate on Debt – 7.5%, Share of Equity – 70%

- Double the Beta of Company 1. What happens to the WACC?
  - Do the same for company 3. What happens?

- In general, what is the optimal financing strategy for reducing WACC?
 - Can you think why it may or may not be possible to achieve this?

Internal Rate of Return

- To calculate a NPV, we have to use a discount rate

- This rate is set by calculating the cost of capital, based on the expected rate of return expected by debt and equity investors

- But how high could this expected rate go before the NPV equals zero?

- This figure tells us the Internal Rate of Return (IRR) of the project
  - When the NPV is zero, it means that all the capital is repaid plus a certain level of return
  - As long as the IRR is higher than our discount rate, then the project will have a positive NPV and as reasonable rate of return

Establishing the IRR of a project cashflow

|	Today	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cashflow	0	-10	-10	-10	20	20	20	20	20	20	20
Discount factor	1	1.08	1.16	1.25	1.35	1.46	1.57	1.70	1.83	1.97	2.13
Discounted Cashflow	0	-9.27	-8.60	-7.97	14.78	13.71	12.71	11.78	10.93	10.13	9.39
Total Value	57.59										
Discount Rate	7.85%										
IRR	41%										
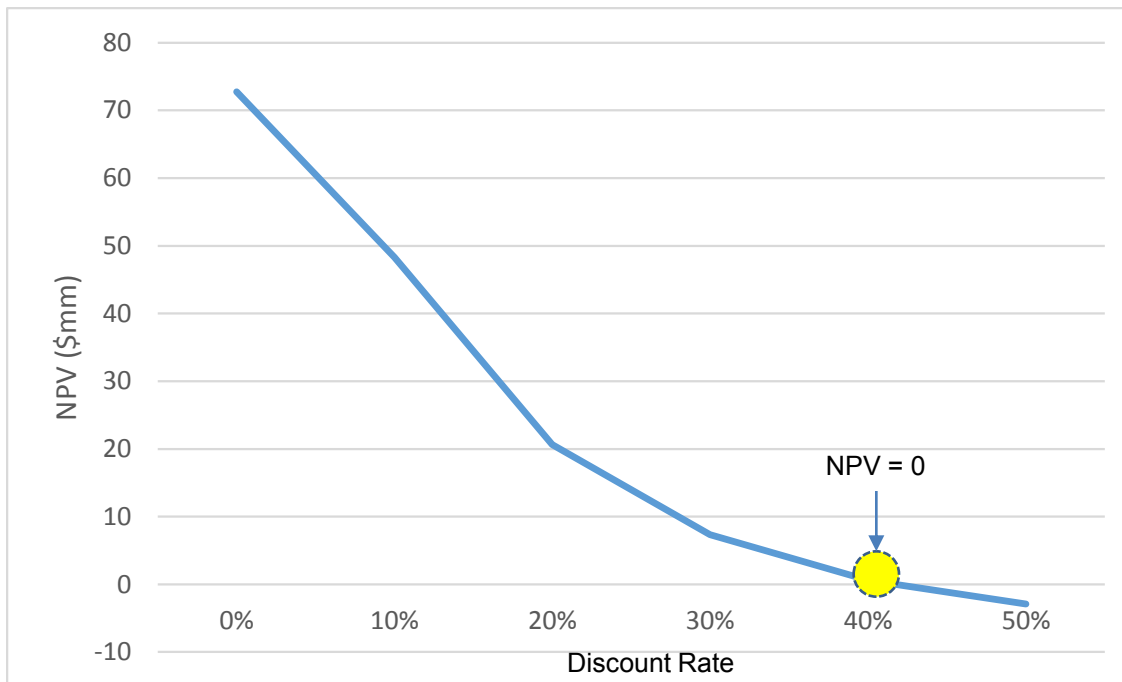
Payback

- How long does it take to recover the initial investment

- Measured in years (usually) but can be months for very rapid projects

- Can be calculated in simple or discounted terms
  - In other words either taking into account the time value of money or not

Calculating Payback
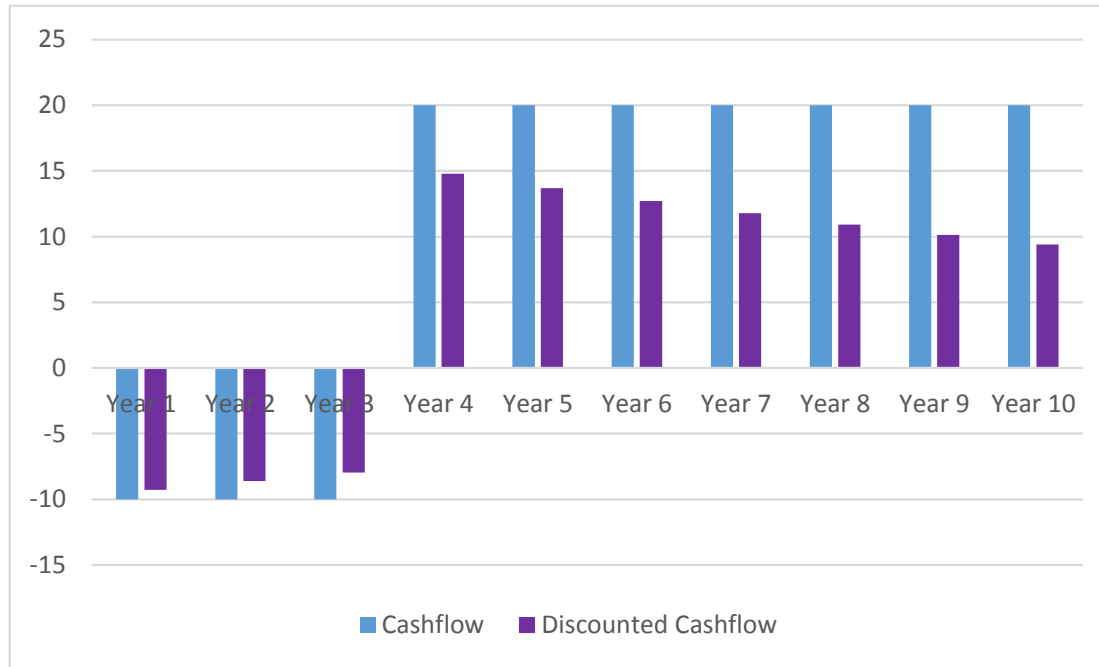
- US$30mm invested over three years

- Simple payback – US$30mm recovered after 1.5 years

- Discounted payback - $26mm recovered after 2 years