THE OXFORD INSTITUTE FOR ENERGY STUDIES

A RECOGNIZED INDEPENDENT CENTRE OF THE UNIVERSITY OF OXFORD

UNIVERSITY OF OXFORD

Cashflow Modelling for the Energy Industry (2)

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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 two models for an oil and a gas field – revenues and prices
4. Inputting the costs – capital expenditure
5. Operating costs and paying the government
6. A power plant – a buyer and seller of energy
7. Calculating a discounted cashflow
   1. Why is it important
   2. How is it used to make decisions
8. Testing the investment decisions: running some numbers under different assumptions
9. Answering your questions

The Question

- Value an energy asset given specific assumptions
  - Examples of a shale gas field and a power station
- Test the sensitivity of the model
- Provide an investment conclusion for senior management

- Detailed breakdown of company operating and financial performance
- Investment analysts are responsible for asking fundamental questions of senior management
- There is pressure to perform across a broad range of metrics
- A “Sell” recommendation can have big implications

Petroleo Brasileiro S.A. (PBR)

Bad news!

Income statement (BRLmn)	2016A	2017E	2018E	2019E	CAGR
EBITDA (adj)	69,076	96,614	119,885	120,155	20.3%
EBIDA (adj)	62,095	79,251	95,530	96,630	15.9%
Net income (op basis)	-3	21,257	35,640	35,257	N/A
EPS (adj) ($)	0.00	1.10	2.00	1.95	N/A
Diluted shares (mn)	6,522.2	6,522.2	6,522.2	6,522.2	0.0%
DPS (BRL)	0.00	0.00	0.00	1.09	N/A
Return data					**Average**
ROACE (%)	2.3	5.8	8.2	8.0	6.1
ROAE (%)	-0.0	8.7	13.8	12.1	8.6
ROMC (%)	3.3	8.4	12.3	13.2	9.3
Balance sheet and cash flow (BRLmn)					**CAGR**
Shareholders' equity	250,230	241,248	276,649	304,539	6.8%
Net debt/(funds)	316,676	266,058	195,632	142,220	-23.4%
Total debt	385,784.0	357,003.1	333,978.2	279,878.1	-10.1%
Market capital employed	585,629	521,402	481,548	432,681	-9.6%
Cash flow from operations	89,709	123,001	128,252	127,617	12.5%
Capital expenditure	-49,744	-59,698	-44,656	-47,641	N/A
Dividends paid	0	0	0	-7,128	N/A
Free cash flow	39,965	63,303	83,596	79,976	26.0%
Net cash surplus/(deficit)	-28,737	21,837	47,401	-688	N/A
Valuation and leverage metrics					**Average**
P/E (adj) (x)	N/A	8.3	4.6	4.7	5.9
EV/EBITDA (adj) (x)	7.2	4.7	3.2	2.7	4.4
EV/EBIDA (adj) (x)	8.1	5.7	4.0	3.4	5.3
Equity FCF yield (%)	67.3	106.5	140.7	134.6	112.3
Dividend yield (%)	0.0	0.0	0.0	3.9	1.0
Total debt/capital (%)	60.7	59.7	54.7	47.9	55.7
Total debt/equity (%)	154.2	148.0	120.7	91.9	128.7
NAV per share	N/A	N/A	N/A	N/A	N/A
EV/boe	N/A	N/A	N/A	N/A	N/A
Selected operating metrics					
Upstream					
Oil production (000 b/d)	2,224.3	2,185.0	2,362.2	2,531.8	
Gas production (000 cf/d)	3,396.0	3,025.1	3,015.4	3,026.4	
Total production (000 boe/d)	2,790.3	2,689.2	2,864.7	3,036.2	
Realisations ($/boe)	37.5	61.3	74.9	71.4	
Downstream					
Refining capacity (000 b/d)	N/A	N/A	N/A	N/A	
Refining throughput (000 b/d)	1,945.0	1,977.0	N/A	N/A	

Price (22-Mar-2017)	USD 9.11
Price Target	USD 11.00

Why Underweight? Despite an attractive NAV valuation, we believe shares will be held captive with limited upside, as the market continues to focus on the unsustainable debt levels and cash flow outlook as well as headlines surrounding the ongoing corruption investigation. Between the two share classes, we believe the preferred offer much better value and upside potential.

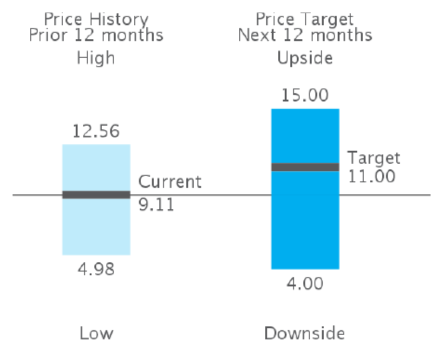
Upside case	USD 15.00

Our upside case assumes a long-term Brent price deck of $90/bl in our NAV analysis plus a potential premium/discount.

Downside case	USD 4.00

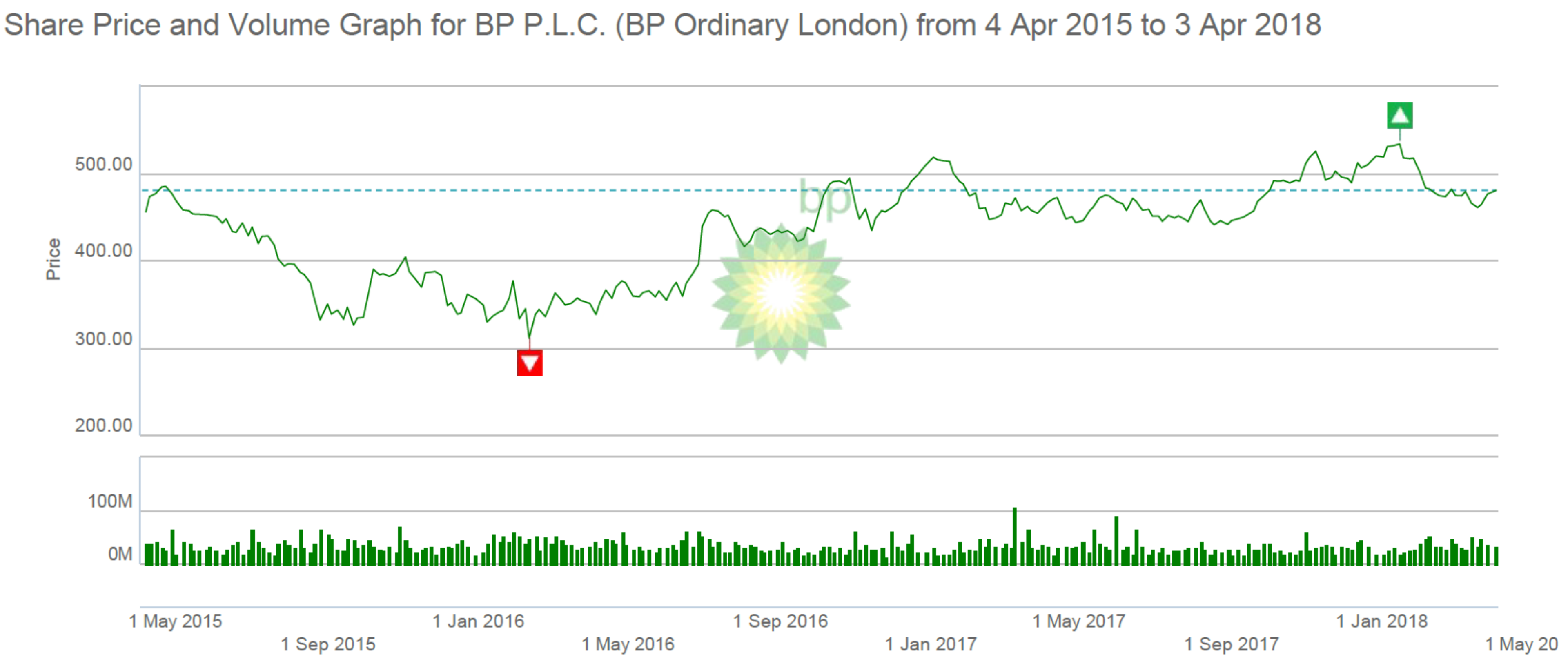
Our downside case assumes a long-term Brent price deck of $50/bl in our NAV analysis plus a potential premium/discount.

Upside/Downside scenarios



Source: Company data, Barclays Research
Note: FY End Dec

Share price determines market valuation



- Share price multiplied by number of shares in issue = market value
- Market value divided by profits gives "price to earnings ratio"
- Potential value can be derived by using multiples and future profit forecasts

Comparison with Peer Groups

Global peer valuation multiples

	MCap	EV	EV/EBITDA			P/E		
	$ bln	$ bln	'20E	'21E	'22E	'20E	'21E	'22E
Global majors								
ExxonMobil	239	315	15.9	7.9	6.9	neg	19.5	14.7
Chevron	199	243	14.0	7.2	6.6	neg	20.6	17.2
Royal Dutch Shell	158	238	8.0	5.0	4.6	32.7	11.9	9.5
BP	87	151	12.5	5.3	4.8	neg	13.6	9.7
Average			**12.6**	**6.4**	**5.7**	**neg**	**16.4**	**12.8**
EU majors								
Total	126	170	10.2	5.8	5.2	31.0	13.1	10.6
ENI	44	64	6.1	3.9	3.4	neg	17.8	12.0
Equinor	64	80	5.9	3.4	3.2	>50	12.9	12.4
Average			**7.4**	**4.4**	**3.9**	**31.0**	**14.6**	**11.7**
EM majors								
Petrochina	115	209	4.6	4.2	4.2	42.9	29.0	17.4
Petrobras	57	120	4.3	4.0	3.8	8.8	7.9	7.3
Sinopec	76	124	5.3	4.1	3.8	16.1	9.5	9.2
Ecopetrol	27	41	8.9	5.5	5.1	45.5	11.5	9.6
ONGC	19	35	6.9	4.2	3.6	17.6	7.1	5.9
PTT E&P	15	15	4.1	3.8	3.4	20.4	14.9	12.3
CNOOC	3	3	10.1	9.0	8.4	35.0	22.2	15.0
Saudi Aramco	1,885	1,990	16.6	10.5	9.4	40.3	22.7	19.5
Average			**7.6**	**5.7**	**5.2**	**28.3**	**15.6**	**12.0**
US majors								
Pioneer NR	35	38	16.3	7.6	6.2	>50	18.8	13.4
ConocoPhillips	71	81	14.7	6.1	5.6	neg	23.6	18.7
Apache	7	18	8.3	5.4	5.7	18.1	14.4	14.1
EOG	41	44	8.9	5.6	5.3	48.1	14.9	13.6
Average			**16.2**	**6.5**	**6.1**	**neg**	**neg**	**14.9**
Russia majors								
Lukoil	56	61	6.4	4.3	3.6	23.1	8.0	6.2
Rosneft	71	143	9.0	4.4	4.1	9.3	4.2	3.8
Gazprom Neft	24	32	6.3	3.8	3.2	12.1	4.4	3.7
Tatneft	18	18	7.0	4.5	4.1	11.5	6.7	6.1
Gazprom	72	113	5.7	3.7	3.2	9.7	4.1	3.6
Novatek	58	49	8.7	6.3	6.4	27.0	12.6	13.0
Average			**7.2**	**4.5**	**4.1**	**15.4**	**6.7**	**6.1**
Peer average			**10.4**	**5.6**	**5.1**	**28.7**	**15.7**	**12.4**
Peer median			**8.9**	**5.4**	**5.1**	**31.0**	**14.6**	**12.4**

A typical spreadsheet summary of a cashflow model

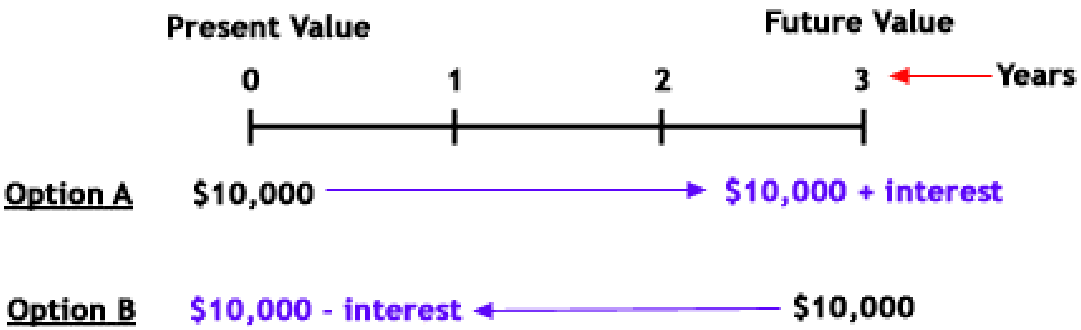
DCF Valuation *Calendar Years ending December 31,* *($ in thousands)*	Projected Free Cash Flow Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
EBITDA	$8,954	$9,898	$10,941	$12,093	$13,367	$13,367
Less D&A	1,112	1,222	1,343	1,476	1,623	1,623
EBIT	7,842	8,676	9,598	10,617	11,745	11,745
Less: Cash Taxes (35%)	(2,745)	(3,037)	(3,359)	(3,716)	(4,111)	(4,111)
Tax-adjusted EBIT	**5,097**	**5,639**	**6,239**	**6,901**	**7,634**	**7,634**
Pluss: D&A	1,112	1,222	1,343	1,476	1,623	1,623
Less: Capital Expenditures	(1,750)	(1,750)	(1,750)	(1,750)	(1,750)	(1,750)
Less: Change in Net Working Investment	(318)	(350)	(384)	(423)	(465)	(465)
Unlevered Free Cash Flow	**$4,141**	**$4,762**	**$5,447**	**$6,205**	**$7,042**	**$7,042**

$$\$19{,}845 = \frac{\$4{,}141}{(1+.11)^1} \quad \frac{\$4{,}762}{(1+.11)^2} \quad \frac{\$5{,}447}{(1+.11)^3} \quad \frac{\$6{,}205}{(1+.11)^4} \quad \frac{\$7{,}042}{(1+.11)^5}$$

Time Value of Money

- Money available at the present time is **worth** more than the **same** amount in the **future** due to its potential earning capacity.
- This **core** principle of finance holds that, provided money can earn interest, any amount of money is **worth** more the sooner it is received
- Equally, money available now can buy more than a similar amount of money available in the future because **inflation** erodes the value of money over time

Time Value of Money Example



- If you had $10,000 today, you could earn interest on it
- Its future value is $10,000 x $(1 + \text{interest rate})^{\text{No. of years}}$
- If interest rate is 5%, then $10,000 in 3 years is worth
  - $\$10{,}000 \times (1+.05)^3 = \$11{,}576$
- As a result, $10,000 in 3 years is not worth $10,000 now
  - $\$10{,}000 / (1+.05)^3 = \$8{,}638$
- Let's look at an example

Impact of inflation

- I have $100
- A bar of chocolate costs $1
- Inflation is 5%
- In Year 1 I can buy 100 bars of chocolate
- In Year 2 the cost of a bar of chocolate has risen to $1.05

	Money in wallet	Cost of chocolate	Chocolate bars
Year 1	100	1.05	95
Year 2	100	1.10	91
Year3	100	1.16	86
Year 4	100	1.22	82
Year 5	100	1.28	78
Year 6	100	1.34	75

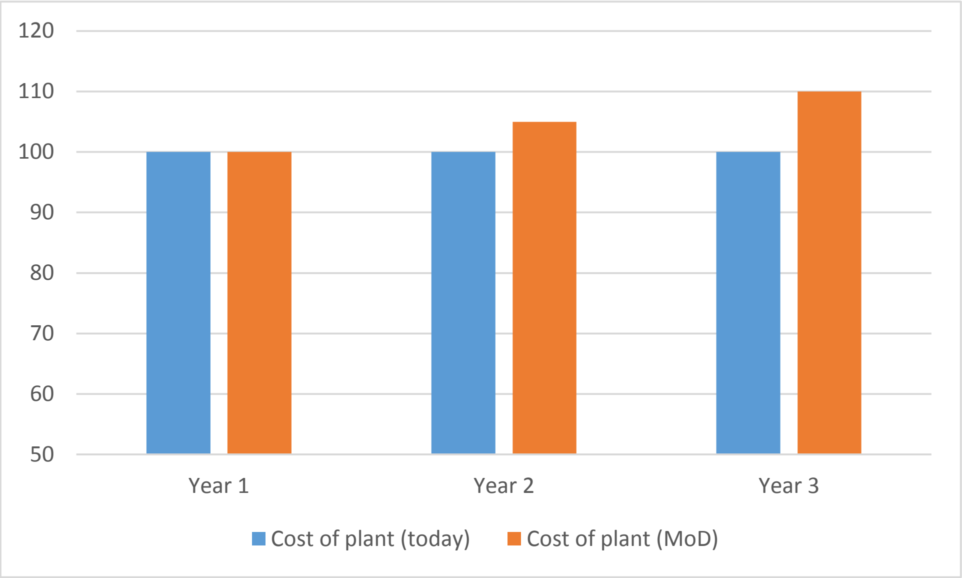
Inflation and interest rates

- I have \$500
- Inflation is running at 4% per annum, and the interest rate is 5%
- I want to purchase printer ink, which costs \$5 per cartridge
- How many fewer cartridges can I buy in 7 years time than now if I just keep my \$500 in my wallet?
- If I put my \$500 in an interest bearing account, how many cartridges could I buy in 4 years time?

Real and Nominal Figures

- Nominal cashflows include the impact of inflation
- They are called Money of the Day (MoD) because they reflect the actual worth in a certain year
- If we were forecasting the cost of a project, for example, we would need to add inflation to each year as we moved across the time horizon
- This is relevant for multi-year developments when parts are being purchased over time

Nominal Costs Example



	Year 1	Year 2	Year 3	Total
Cost of plant (today)	100	100	100	300
Cost of plant (MoD)	100	105	110	315

- Costs will rise over time because of inflation (in this example 5% per annum)

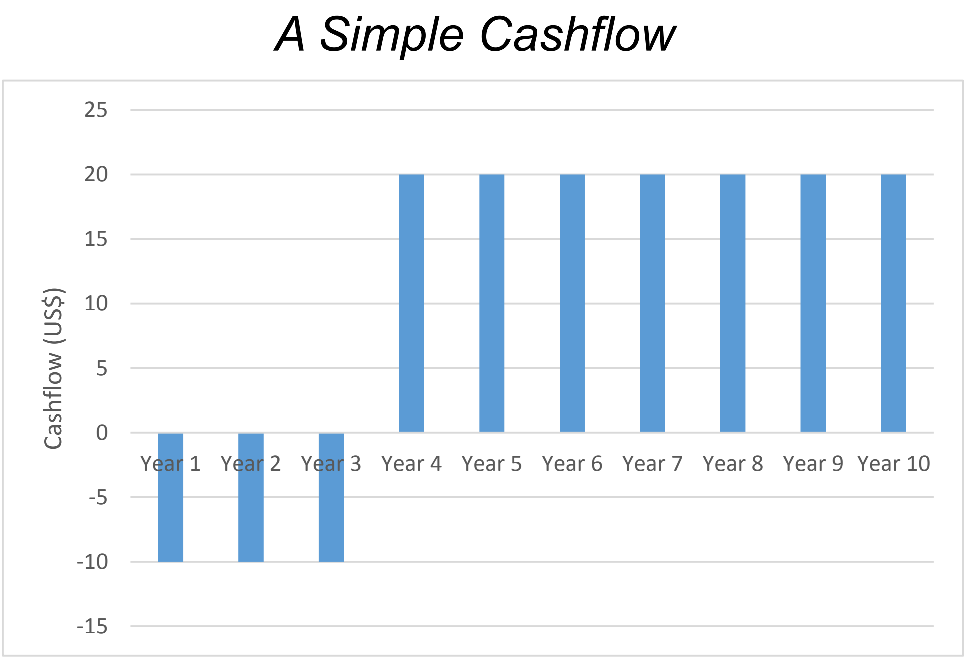
Using “Real” figures makes life easier

- When making assumptions in nominal, every figure needs to take an inflation assumption into account
- This can make things very complex
- To make life easier, we can just assume that our model is in “today’s money” – otherwise known as “in real terms”
- Generally, we would define all the figures as being in (e.g.) US$2020
- All figures in the cashflow will be lower as a result, and so it is important to define how the model is considering inflation

Real and Nominal Figures

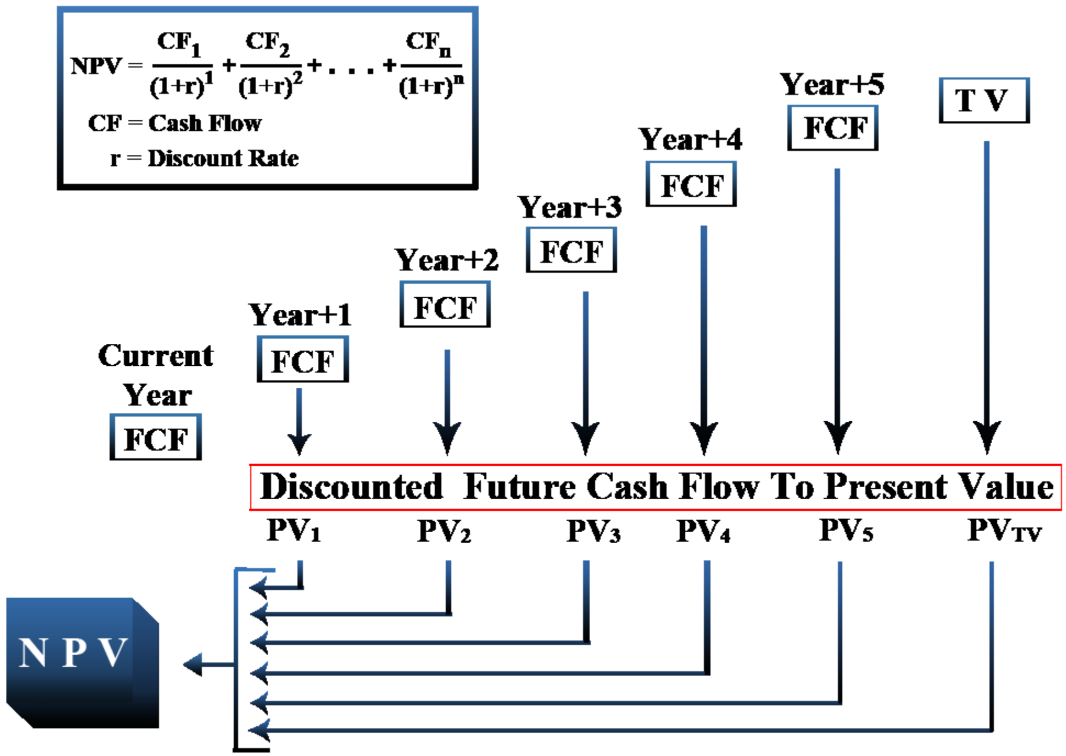
- Question 1
  - The cost of a plant is $500mm spent equally over 5 years in real (2020) terms
  - Inflation throughout the period is forecast to be 2.5% per annum
  - What is the expenditure on the plant in nominal terms in Year 5 and what is the total nominal cost?
- Question 2
  - We are assuming that the oil price is $30 in real (2020) terms
  - Inflation is assumed to be 2% per annum
  - What is the real oil price in Year 5?
  - What is the nominal price in Year 5?
  - What is the real price in Year 5 if we assume that the oil price will rise at 1% above inflation?

Discounted Cashflow



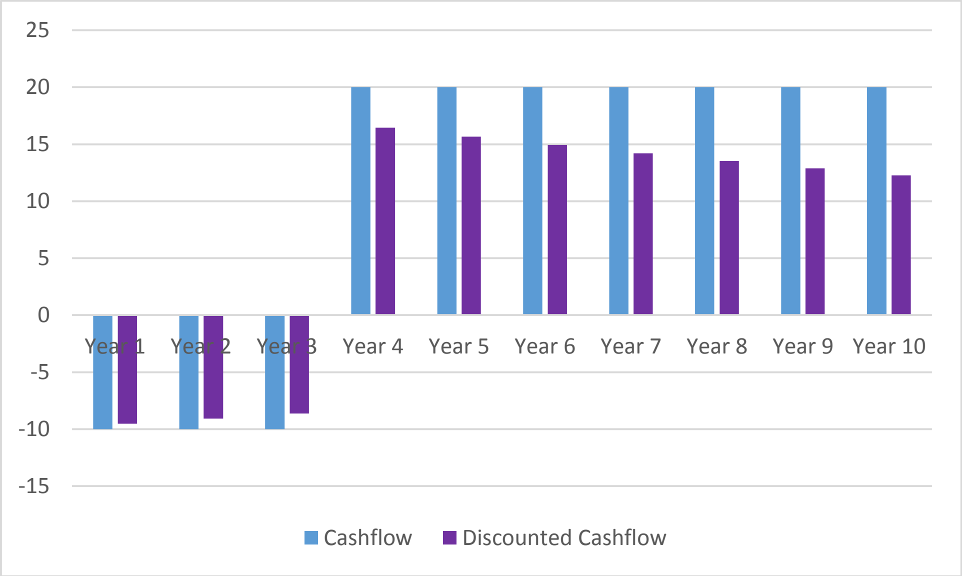
- In Year 0 (today), I decide to invest \$30mm over 3 years in a plant that will run for 7 years, generating \$20mm per year
- The plant will then be dumped
- What is the value (worth) of this investment in today's terms?

The DCF Calculation as a foundation



- Management thought process is encapsulated in the DCF model
  - Key assumptions include price, cost, tax, long-term outlook, short-term cashflow and the value of money
- Management must ensure at all times that the combined value of their assets remains NPV positive, and should aim to maximise the return on their assets

Discounted Cashflow Example



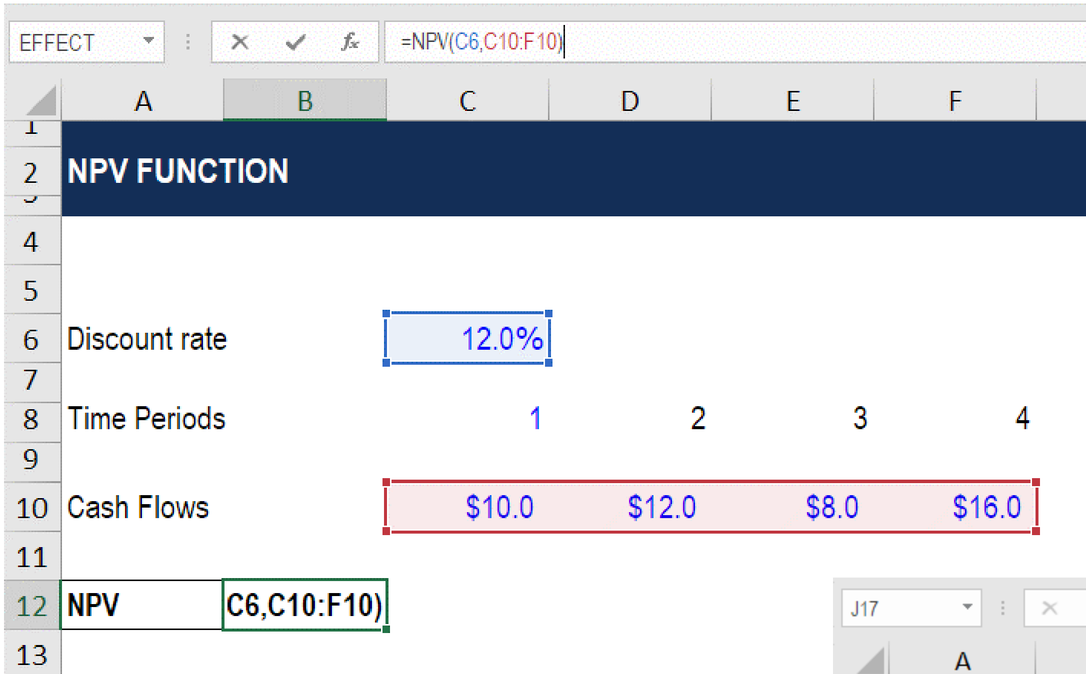
	Today	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cashflow	0	-10	-10	-10	20	20	20	20	20	20	20
Discount factor	1	1.05	1.10	1.16	1.22	1.28	1.34	1.41	1.48	1.55	1.63
Discounted Cashflow	0	-9.52	-9.07	-8.64	16.45	15.67	14.92	14.21	13.54	12.89	12.28
Total Value	72.74										

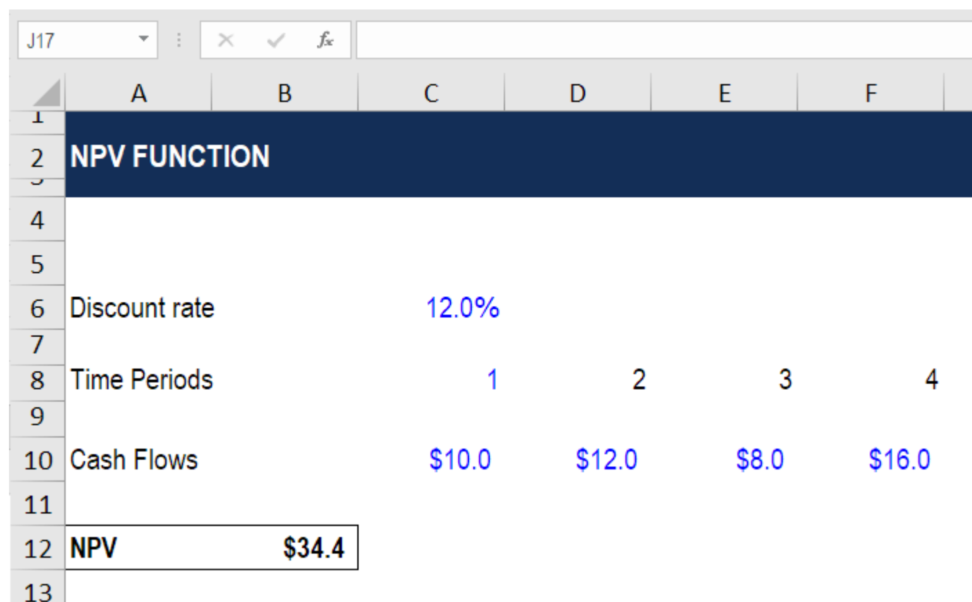
- The further away that money is earned (or spent) the less worth (value) it has today
- We discount future cashflow by a factor reflecting the other options we had for using the initial funds
- If the total sum of negative and positive cashflow is positive then the investment is worth making

A Good Explanation from Harvard

- https://hbr.org/2014/11/a-refresher-on-net-present-value

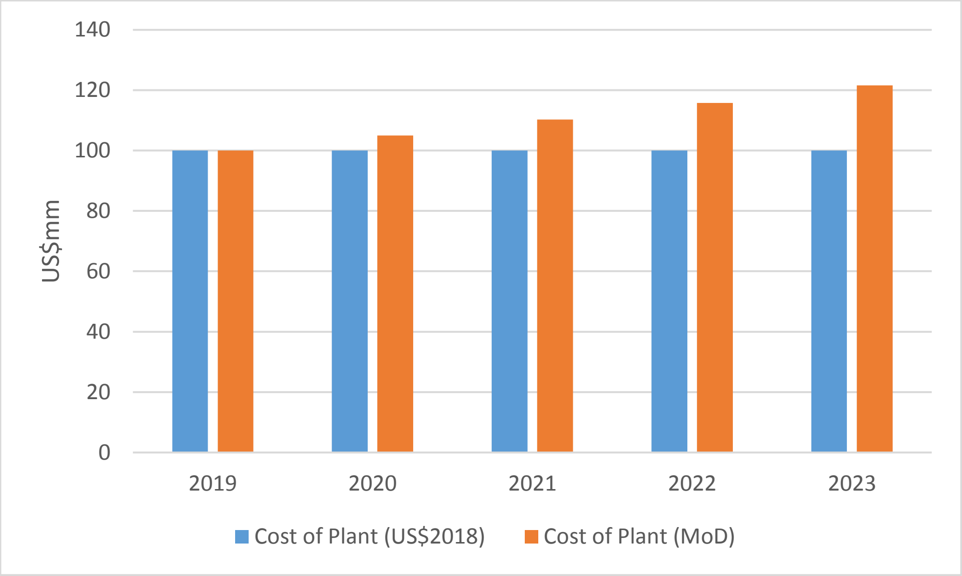
Functionality in Excel





- The NPV function in Excel makes life very easy
- =NPV(discount rate, range of net cashflow)

Real vs Nominal Cashflow and NPV



	2019	2020	2021	2022	2023
Cost of Plant (US$2018)	100	100	100	100	100
Cost of Plant (MoD)	100	105	110	116	122
NPV (Real)	433				
NPV (MoD)	476				

- To make our lives easier, all our modelling will be carried out in real terms
- Our expectations of return should therefore be lower

Construct a simple cashflow model

- All figures in US$2019 (Real)
- Capital costs - $600 over 3 years
- Revenues – start in year 4, $100 per year from year 4 to year 20
- Operating costs - $20 per year starting in year 4 until end of operations
- Discount rate 10%