The Building Blocks Approach – Part I

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RPI-X, price cap in practice

- Calculated by estimating price control period's:
  - required efficient costs of operating the network
  - including necessary extensions and improvements
  - and the costs of financing this expenditure
- The price control is set so that entire period's…
  - (NPV of) allowed revenue = expected costs
  - Adjustments for previous under or over-performance
- Range of profiling options:
  - e.g. Large upfront price cut followed by price increases
  - or constant negative price control

Plan

- Financial modelling: the basics
- Building blocks:
  - The weighted average cost of capital
  - Regulatory asset value and allowable costs
- Financial modelling: an example
  - Computing allowable revenues
  - The appropriate revenue sliding scale?

How to value the future?

- A euro today is worth more than one tomorrow!
- Why? Possible to earn interest! If it is 10% a year…
  - Investing 10 million today gives 11 million in a year
  - The future value (in a year) of 10 million is 11 million
  - The present value of 11 million in a year is 10 million

Future and Present Values

- Future Value: Amount to which an investment will grow after earning interest

$$FV = £C_0 \times (1+r)^t$$

  - For example, 10 million after two years will be

$$FV = £10m \times (1+0.1)^2 = 12.1m$$

- Present Value: Value today of a future (expected) cash flow

$$PV = \frac{1}{(1+r)^t} \times C_t$$

  - For example, 12.1 million in two years is

$$PV = \frac{1}{(1+0.1)^2} \times 12.1m = 10m$$

Net Present Value

- Example: Cash flows: immediate £81.6 million "outflow" and an "inflow" of £28 million per year for 4 years

Month:	0	1	2	3	4
Cash flow:	−\$81.60	+\$28	+\$28	+\$28	+\$28

- Therefore, if discount rate is *r = 0.10*, the NPV is:

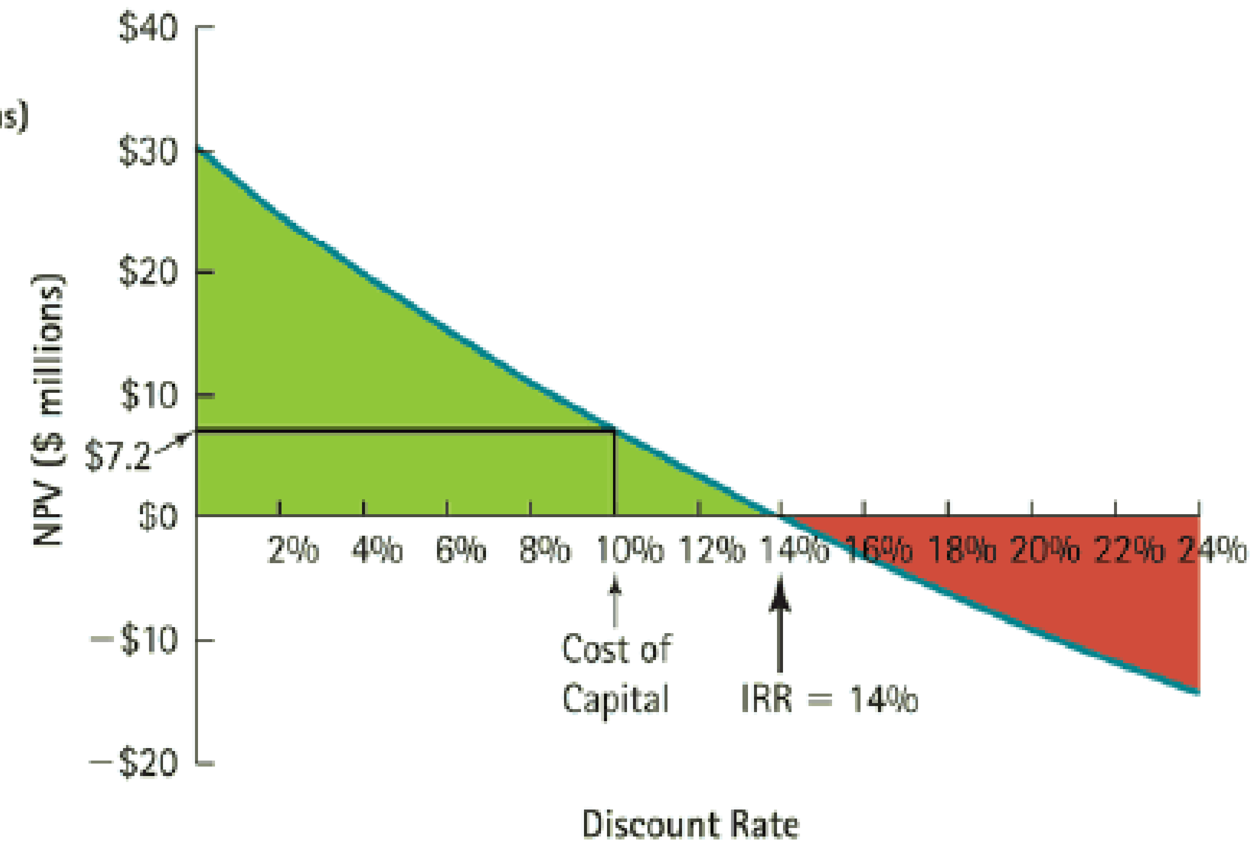
$$NPV = -81.6 + \frac{28}{(1+0.1)^1} + \frac{28}{(1+0.1)^2} + \frac{28}{(1+0.1)^3} + \frac{28}{(1+0.1)^4} = 7.2$$

- Discount rate depends on the riskiness of the cash flows
  - Higher risk implies greater discount and lower present value

Panel (a)

Discount Rate	NPV ($ millions)
0%	$30.4
2%	$25.0
4%	$20.0
6%	$15.4
8%	$11.1
10%	$7.2
12%	$3.4
14%	$0.0
16%	−$3.3
18%	−$6.3
20%	−$9.1
22%	−$11.8
24%	−$14.3

Panel (b)



More generally

- Present Value: Value today of a future (expected) cash flow

$$PV = \frac{1}{(1+r)} \times C_1 + \frac{1}{(1+r)^2} \times C_2 + \ldots + \frac{1}{(1+r)^t} \times C_t = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

- And the net present value

$$NPV = -I + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

(Internal) rate of return

- Consider an asset (value "V"):

1. Value in two subsequent periods:
   - V_0: 80m and V_1: 96.8m
   - Return: r = (96.8 – 80)/80 = 0.21 or 21%

2. Value in two non-subsequent periods:
   - V_0: 80m and V_2: 96.8m, average return: ?
   - Numerical method: find *r* such that Net Present Value (NPV) = 0

$$NPV = -80 + \frac{96.8}{(1+r)^2} = 0 \quad \text{or} \quad r = 0.10 = 10\%$$

   - Just checking:

$$80(1+0.1)(1+0.1) = 96.8$$

   - What is the rate of return in the example two slides before?

(Internal) Rate of Return

- More generally, the internal rate of return of a cash flow stream is the interest rate y that makes the NPV of a project equal to 0:

$$0 = \mathrm{C}_0 + \frac{C_1}{1+y} + \frac{C_2}{(1+y)^2} + \frac{C_3}{(1+y)^3} + \ldots + + \frac{C_T}{(1+y)^T}$$

IRR in Regulation

- Regulatory asset value (RAV/RAB) (value of capital employed in regulated business)
  - RAV_0: 80m and RAV_2: 96.8m

$$NPV = -80 + \frac{96.8}{(1+r)^2} = 0 \quad \text{or} \quad r = 10\%$$

- Asset values and revenues:
  - RAV_0: 80m, RAV_2: 96.8m, R_1: 2m, R_2: 2.5m

$$NPV = -80 + \frac{2}{(1+r)^1} + \frac{2.5}{(1+r)^2} + \frac{96.8}{(1+r)^2} = 0 \quad \text{or} \quad r = 12.7\%$$

- Revenues, costs and asset values:
  RAV_0: 80m, RAV_2: 96.8m, R_1: 2m, R_2: 2.5m, C_1: 1m, C_2: 1.2m

$$NPV = -80 + \frac{2}{(1+r)^1} - \frac{1}{(1+r)^1} + \frac{2.5}{(1+r)^2} - \frac{1.2}{(1+r)^2} + \frac{96.8}{(1+r)^2} = 0 \quad \text{or} \quad r = 11.36\%$$

Computing allowable revenues

- To obtain a given rate of return (e.g. r=11.36%), find revenues (R_1 and R_2) such that.:

$$NPV = -80 + \frac{R_1}{(1.1136)^1} - \frac{1}{(1.1136)^1} + \frac{R_2}{(1.1136)^2} - \frac{1.2}{(1.1136)^2} + \frac{96.8}{(1.1136)^2} = 0$$

- Several options are available
  - E.g. R_1=2 and R_2=2.5 (as in the previous slide)
  - But also R_1=1.5 and R_2=3.05
- Even more flexibility in periods of 5 years
- In practice, set revenues
  - with initial value (so-called P0) plus fixed yearly change (X)
  - But still, several combinations available of P0 and X

The building blocks approach

- What is the appropriate rate of return (r)?
  - See: the weighted average cost of capital
- What are the "appropriate" costs and the RAV?
  - See: allowable costs
- How we compute the allowable revenues?
  - See: computing allowable revenues
- What is the appropriate revenue sliding scale?
  - Unclear (see discussion at the end)

Weighted average cost of capital: The “fair” rate of return

Weighted Average Cost of Capital

- Return that "an average" investor would have earned if she invested in any other firm with a comparable level of risk (opportunity cost of capital)
- Cost of capital is the cost of debt (e.g. bonds) and equity (e.g. common stocks) weighted by their market values

$$r = d\frac{D}{D+E} + k\frac{E}{D+E}$$

where d is the cost of debt, k the cost of equity and D the value of debt outstanding and E the value of equity outstanding

The proportion of debt over total value (E+D) is called gearing

Finding the cost of capital

- Cost of equity k:
  - Capital Asset Pricing Model (CAPM)
    - Econometric method, based on a financial market micro-model
    - Elements: risk free rate, market premium, beta (listed and non-listed companies, multi-sector companies)
  - Alternatives:
    - (1) Alternative econometric method: Arbitrage Pricing Theory (APT)
    - (2) Accounting method: dividend growth model
- Cost of debt d:
  - If traded and if not traded
- Value of debt (D) and value of equity (E)
- Treatment of taxes

Capital Asset Pricing Model (CAPM)

- Risk-averse investors…
  - can reduce the all portfolio variance by diversifying,..
  - except for market or systematic risk…
  - resulting in a risk premium
- The cost of equity is determined by such risk premium

$$k = E(r_e) = r_f + \beta(r_m - r_f)$$

Risk free interest rate

Market Index Risk Premium

Beta (β) (relative risk of company's equity with respect to “market” risk)

- How do we obtain (estimate) the elements of the model?

Risk-free rate and market risk premium

- Risk-free rate
  - Use some government bond interest rate as a proxy
  - Example: Competition Commission UK in 2001
    - Real yield for long (20 year) bond: 2.2%
    - For medium (10 years) and short (5 year): approx 2.3%
    - *Expected* risk-free rate: range of 2.5%-2.75%
- Equity risk-premium:
  - Use country "index" portfolio e.g. FTSEE 100, IBEX 35,…
  - But more integrated capital markets: maybe global indices
  - Example: Competition Commission in 2001:
    - Range 2.5%-4.5%

Beta for a listed company

If company is listed: use past returns to estimate beta!

$$\left(r_i - r_f\right) = \beta_i \left(r_m - r_f\right) + e_i$$

Stock i Risk Premium   Market Index Risk Premium

Table 1: Average assets betas by country and sector, 1996-2001

	Electricity	Gas	Water	Telecoms
UK	0.40	0.70	0.25	0.89
US	0.28	0.28	0.20	0.60
Canada				0.46
Japan	0.09			1.01
Argentina	0.25			0.57
Chile	0.43			
Germany	0.40			
Spain	0.43	0.71	0.37	
Sweden				0.95
Australia		0.25		
New Zealand				0.81

Source: PwC/Franks (2002) page 65.

Finding beta for a non-listed company

- If company is not listed, use CAPM of comparable firms
- Example: Ideko (sells sportswear glasses)

Equity Betas with Confidence Intervals for Comparable Firms

	Monthly Returns		Ten-Day Returns	
Firm	**Beta**	**95% C.I.**	**Beta**	**95% C.I.**
Oakley	1.99	1.2 to 2.8	1.37	0.9 to 1.9
Luxottica	0.56	0.0 to 1.1	0.86	0.5 to 1.2
Nike	0.48	−0.1 to 1.0	0.69	0.4 to 1.0

“Unlevering” the betas

- Debt levels might differ across firms
- Unlever other firms’ beta with their capital structure and lever it with values of firm of interest

$$\beta_U = \left(\frac{\text{Equity Value}}{\text{Enterprise Value}}\right)\beta_E + \left(\frac{\text{Net Debt Value}}{\text{Enterprise Value}}\right)\beta_D$$

Capital Structure and Unlevered Beta Estimates for Comparable Firms

Firm	$\frac{E}{E+D}$	$\frac{D}{E+D}$	β_E	β_D	β_U
Oakley	1.00	0.00	1.50	—	1.50
Luxottica	0.83	0.17	0.75	0	0.62
Nike	1.05	−0.05	0.60	0	0.63

Relevering the beta

- Since Ideko products ...
  - Are not as luxurious as those of Oakley, its sales should vary less with the economic cycle
  - They are not prescription products as Luxottica's
  - ... the unlevered beta should be around 1.20
- Using the same formula, assuming βd=0,

$$\beta_E = \beta_U \left(1 + \frac{D}{E} \right)$$

where D and E are the debt and equity values of Ideko

What to do for multi-sector firms (e.g. Disney)?

Business	Value	Sector of firms	Unlevered bata sector	Division weight within Disney
Creative Content	22167	Motion pictures and TV program producers	1,25	35,71%
Retailing	2217	High end speciality retailers	1,5	3,57%
Broadcasting	18842	TV broadcasting companies	0,9	30,36%
Theme Parks	16625	Entertaiment complexes	1,1	26,79%
Real Estate	2217	Hotel and vacational properties	0,7	3,57%
	62068			100%

βu=1,25*35,7%+1,5*3,57%+0,9*30,36%+26,79%*1,1+0,7*3,57%=1,09

Find levered beta as before

Alternative 1: Arbitrage Pricing Theory

- Under a set of assumptions:

$$\bar{r}_i - r_f = \beta_{i,1}(\bar{r}_{\text{Factor 1}} - r_f) + \ldots + \beta_{i,K}(\bar{r}_{\text{Factor K}} - r_f)$$

- Returns assumed to be generated by small number of "factors"
  - Betas are the sensitivities to each factor
  - ε_i are uncorrelated firm-specific components

- Risk from…
  - Common factors cannot be eliminated by diversification
  - Unique factors can be eliminated and should be ignored

- A diversified portfolio with 0 sensitivity to each macro factor…
  - Is essentially risk-free and should offer no market premium

- A diversified portfolio with sensitivity to the factors…
  - Should offer a risk premium proportional to its sensitivity to the factor

Alternative 2: Dividend growth models

- Share price determined by the PV of dividend stream:

$$P = \frac{D_1}{(1+k)^1} + \frac{D_2}{(1+k)^2} + \ldots + \frac{D_i}{(1+k)^i} + \ldots$$

where P is current share price, D_i expected dividends in year i and k is the opportunity cost of equity (discount rate used by investors)

- If dividends are expected to grow at a constant rate g, then

$$k = \frac{D_1}{P} + g$$

  - For example, if dividend yield (D_1/P) is 8% and dividends are expected to grow at 7% then cost of equity capital is 15%

Cost of debt, d

- Repayments due to interest on debt issued
- Cost of debt…
  - Lower than cost of equity: debt payments senior to (paid before) equity payments
  - Sum of the risk-free rate (government debt) and the risk premium of the debt

- Possible to estimate from current debt outstanding
- Alternatives: (a) if traded, treat it like an asset and use CAPM

$$d = E(r_d) = r_f + \beta_d (r_m - r_f)$$

- (b) if not, use spread of bonds of the same rating or, if not rated, use interest coverage ratio to attribute spread

Interest coverage ratio = EBIT/interest expenses

Estimates of default spread

If Interest coverage ratio is	Estimated bond rating	Default Spread
>8,50	AAA	0,2%
6,50-8,50	AA	0,5%
5,5-6,5	A+	0,8%
4,25-5,5	A	1,00%
3-4,25	A-	1,25%
2,5-3	BBB	1,5%
2-2,50	BB	2%
1,75-2	B+	2,5%
1,5-1,75	B	3,25%
1,25-1,5	B-	4,25%
0,80-1,25	CCC	5%
0,65-0,80	CC	6%
0,20-0,65	C	7,5%
<0,20	D	10%

For example, for Disney, which has earnings before interest and tax of $2500 and interest expenses of $479, the ICR is 5,2. Hence Disney´s rating is A, and its spread 1%. Suppose that the risk free rate is 4,8% (average US treasury bills 1990-2002), then for Disney: rd = 4,8%+1%= 5,8%

Debt value

- In theory, need to estimate market value of debt
- If debt is traded, find value!
  - yet only very few firms have publicly traded debt
- If not, estimate market value from accounting value
  - discount during T periods (average debt maturity), expected average annual interest (Int) to be paid at a rate given by the cost of debt (rd)

$$D = \frac{Int}{r_d}\left(1 - \frac{1}{(1+r_d)^T}\right) + \text{Nominal D}\frac{1}{(1+r_d)^T}$$

  - Example: Disney
    - T=3, Int=479m and Nominal D=12342 then D=11606,5 m
- In practice, take the book value
  - Example: in distribution in the UK: 50%-60%

Equity value

- If the firm is listed….
  - Market capitalization: shares outstanding x share price
- If the firm is not listed,
  - Estimate it using discounting stream of expected dividends
  - Several dividend growth models available
- In practice, non-listed firms
  - submit a series of these valuations made by analysts
- Example:

Disney (listed firm)= 675,13 million* 75,38=50,88 billion

Treatment of taxes

- If debt is tax-deductible, post-tax WACC can be shown to be

$$r_{post-tax} = d(1-\tau)\frac{D}{D+E} + k\frac{E}{D+E}$$

where corporate tax is τ. Therefore, pre-tax WACC is

$$r_{pre-tax} = d\frac{D}{D+E} + \frac{k}{1-\tau}\frac{E}{D+E}$$

- "Vanilla" WACC (=pre-tax cost of debt and post-tax cost of equity)

$$r_{vanilla} = d\frac{D}{D+E} + k\frac{E}{D+E}$$

Two different approaches

- Pre-tax cost of capital:
  - Tax allowances included in the WACC
  - Example: Ofgem up to 2004
- Vanilla cost of capital
  - Do not include any tax adjustment in the WACC
  - Include specific tax allowances with likely tax treatment
  - Example: Ofgem after 2004

Example: Electricity Distribution

		OFGEM 1999		OFGEM 2004	
		LOW	HIGH	LOW	HIGH
A	risk-free rate	2.25	2.75	2.25	3
B	debt premium	1.85	1.7	1	1.8
C	pre-tax cost of debt = A+B	4.10	4.45	3.25	4.80
D	post-tax cost of debt = C x (1-K)	2.87	3.12	2.28	3.36
E	gearing	0.5	0.5	0.5	0.6
F	Equity Risk Premium	3.25	3.75	2.5	4.5
G	equity beta	1	1	0.6	1
H	pre-tax cost of equity = J / (1-K)	7.86	9.29	5.36	10.71
J	post-tax cost of equity = A + (F x G)	5.50	6.50	3.75	7.50
K	corporation tax	0.30	0.30	0.30	0.30
L	pre-tax CoK = (C x E) + (H x [1-E])	5.98	6.87	4.3	7.2
M	post-tax CoK = (D x E) + (J x [1-E])	4.19	4.81	3.0	5.0
N	'Vanilla' WACC = (C x E) + (J x [1-E])	4.80	5.48	3.5	5.9
	Proposed Range Vanilla WACC			**5.1**	**5.9**
	Equivalent Range pre-tax			6.0	7.2
	Equivalent Range post-tax			4.2	5.0