Cost of Capital

João Carvalho das Neves
Professor of Leadership & Finance
ISEG, Universidade de Lisboa
jcneves@iseg.ulisboa.pt
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Types of cost of capital we need to address

- Cost of equity (ke)
- Cost of debt (kd)
- Cost of prefered equity (kp)
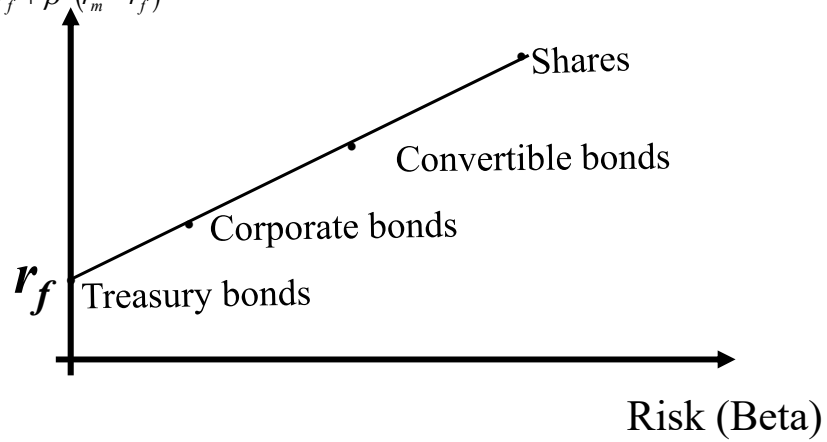- WACC (km)
- Unlevered cost of capital (ku)

i. Cost of equity (ke)

Financial markets
(CAPM – Capital Asset Pricing Model)

Return

$$k_e = r_f + \beta \cdot \left(r_m - r_f \right)$$

Shares

Convertible bonds

Corporate bonds

r_f Treasury bonds

Risk (Beta)

Models to estimate the cost of equity

- Historical based
  - **CAPM**
  - CAPM 2° moment
  - D-CAPM
  - Merton
  - APM – Arbitrage Pricing Model
  - Multifactors (Fama e French)
  - Regression

- Accounting Approach
  - **Modigliani e Miller**
  - Covariance of operational income
  - Covariance of sales

- Implicit prices using discounting models
  - Models of **Gordon**, Malkiel, H
  - EVA Model
  - DCF

- Compound betas
  - Leverage effect
  - Conservation of risk
  - Simultaneous equations
  - Regression of Business Units

- Implicit prices using options models
  - Shares (Hsia)
  - Options on shares (McNulty)

Most commonly used models to estimate the cost of equity (ke)

* CAPM

$$k_e = r_f + \beta\left(r_m - r_f\right)$$

r_f = Risk free rate of return
B = Beta
r_m = Market return
r_m-r_f = Market risk premium

* THE GORDON MODEL

$$k_e = \frac{d_1}{P_0} + g$$

d_1 = Dividend per share year 1
P_0 = Share price year 0
g = Growth rate in the long term

* THE MODIGLIANI & MILLER (M&M) MODEL

$$k_e = k_u + \left(k_u - k_d\right) \times \frac{D}{E} \times (1-t)$$

k_u – Unlevered cost of capital
D – Debt
E - Equity
t – Corporate income tax rate

* INTUITIVE BASIC MODELS

$$k_e = k_d + \rho$$
$$k_e = r_f + \eta$$

k_d = Cost of debt
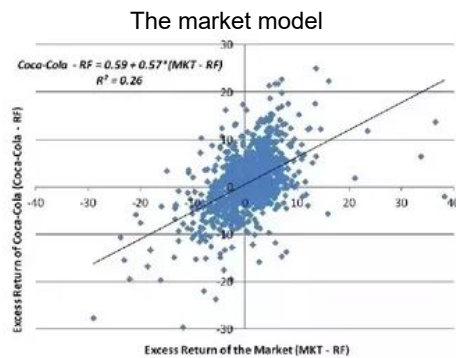ρ = Risk premium over debt
η = Risk premium over Treasury Bonds

CAPM – A standard in the market

$$r_e = r_f + \boldsymbol{\beta}\left(r_m - r_f\right)$$

CAPM

$$r_e - r_f = \alpha + \beta\left(r_m - r_f\right)$$

The market model

The market model

Coca-Cola - RF = 0.59 + 0.57*(MKT - RF)
$R^2 = 0.26$

Choosing the CAPM variables!

- Risk free rate
  - Which rate to choose?
  - Stationary or variable?
- Market risk premium
  - Stationary or variable?
- Betas
  - Raw data, adjusted for market conditions, adjusted for trends?
- Cost of equity
  - Stationary or variable?
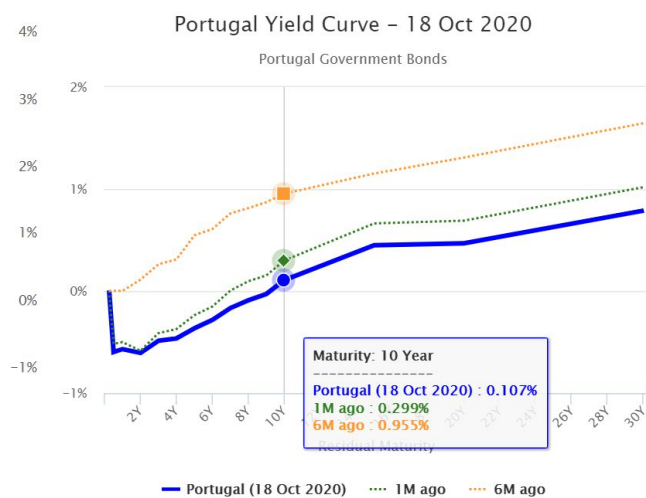 - Nominal terms or real terms (constant)?

$$r_e = r_f + \boldsymbol{\beta}\cdot\left(r_m - r_f\right)$$

4

Risk free rate

Yield Curve
(Treasury Bonds Portuguese Government)

Portugal Yield Curve – 18 Oct 2020

Portugal Government Bonds

Maturity: 10 Year

Portugal (18 Oct 2020) : 0.107%
1M ago : 0.299%
6M ago : 0.955%

Residual Maturity

— Portugal (18 Oct 2020)   ···· 1M ago   ···· 6M ago

Source: http://www.worldgovernmentbonds.com/country/portugal/

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10 Y Bond Yield around the world

10Y Bond Yield – 18 Oct 2020
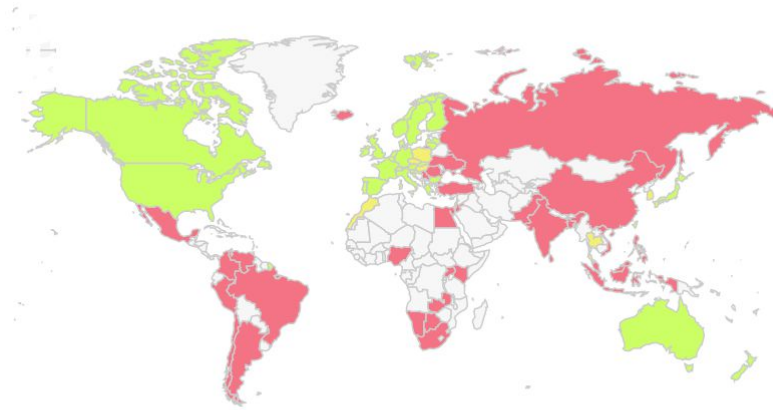
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Spread vs 🇩🇪		
up to 150	up to 300	more

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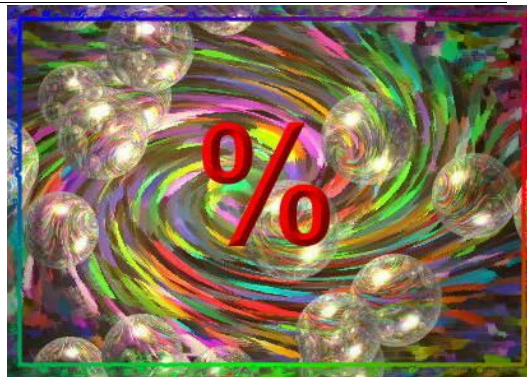
Last Update: 18 Oct 2020 20:15
GMT+0

Market risk premium (Rm-Rf)

Three ways to estimate risk premium

- Investor's Survey – inquiry investors on required risk premiums and use the average premium from these surveys.
- Historical (naïve) risk premium - Assume that the risk premium delivered over long-term periods is equal to the expected premium.
- Implied risk premium - in today's asset prices.

1. Investor's Surveys

- Impractical surveying all investors in a market place.
- Surveys are usual sent to a sample of few individuals and use these results. Examples:
  - Investors Securities Industries Association (individual investors);
  - Merrill Lynch (Institutional Investors);
  - Campbell Harvey & Graham (CFOs);
  - Pablo Fernandez (Analysts) and (Academics)
- The limitations of this approach are:
  - There are no constraints on reasonability
  - The survey results are backward looking
  - They tend to be short term; even the longest surveys do not go beyond one year

2. Historical (also known as naïve) approach: Equity risk premium is non-stationary

7.00%
6.75%
6.50%
6.25%
6.00%
5.75%
5.50%
5.25%
5.00%

6.5%   6.0%   6.3%   6.0%   6.0%   6.5%   6.0%   5.75%   5.5%   5.75%
5.75%

| Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |
| 2012 | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | |

Source: KPMG, Nederlands, Equity Market Risk Premium – Research Summary, 30 June 2019

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Standard error of equity risk premium against the number of years

Estimation Period	Standard Error of Risk Premium Estimate
5 years	$20\%/\sqrt{5} = 8.94\%$
10 years	$20\%/\sqrt{10} = 6.32\%$
25 years	$20\%/\sqrt{25} = 4.00\%$
50 years	$20\%/\sqrt{50} = 2.83\%$
80 years	$20\%/\sqrt{80} = 2.23\%$

The longer the series is, the smaller the standard error

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Can we trust the past?

- Noisy estimates:
  - Even with long time periods of history, the risk premium that you derive will have substantial standard error.
    - If you have 80 years of historical data and you assume a standard deviation of 20% in annual stock returns, the Standard Error in the Risk Premium would be = $20\%/\sqrt{80} = 2.26\%$
- Survivorship Bias:
  - Using historical data from equity markets creates a sampling bias.

3. Implied risk premium

- If shares are correctly priced in the market and we can estimate the expected cash flows from buying these shares, than we can estimate the expected rate of return by computing the internal rate of return. Subtracting out the risk free rate yields the implied equity risk premium.
- This implied equity premium is a forward looking approach
- It can be updated as often as you want (every minute of every day if you wish).

The country risk affects the equity risk premium

STERLING'S ROLLERCOASTER RIDE AGAINST THE DOLLAR
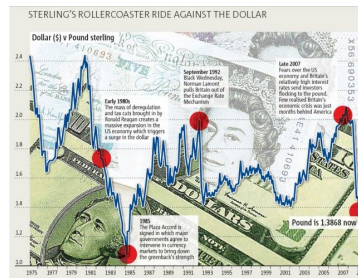
Equity risk premium varies across countries

TABLE 3
Equity Premium for Selected Countries

Country	Period	Mean real return		
		Market index (%)	Relatively riskless security (%)	Equity premium (%)
United Kingdom	1900–2005	7.4	1.3	6.1
Japan	1900–2005	9.3	−0.5	9.8
Germany	1900–2005	8.2	−0.9	9.1
France	1900–2005	6.1	−3.2	9.3
Sweden	1900–2005	10.1	2.1	8.0
Australia	1900–2005	9.2	0.7	8.5
India	1991–2004	12.6	1.3	11.3

Source: Dimson et al. (2002) and Mehra (2007) for India.

Macro determinants of equity risk premium

- Economic risk: If the underlying economy is more uncertain, equity risk will be higher.
  - Higher volatility in the GDP implies higher equity risk.
- Political risk: The higher the uncertainty about fiscal and government policy implies higher level of equity risk.
- Market transparency: If information provided by companies are more transparent, equity risk premiums would be lower.
- Liquidity: Markets with higher level of liquidity would have lower level of equity risk.
- Catastrophic risk: The perceived likelihood to occur catastrophic risk in investing in equites, would increase the equity risk.

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https://tradingeconomics.com/country-list/rating

How to measure country risk:
1 – Sovereign ratings

TRADING ECONOMICS

	S&P	Moody's	Fitch	DBRS	TE
Albania	B+	B1			35
Andorra	BBB		BBB+		62
Angola	CCC+	Caa1	CCC		21
Argentina	CCC+	Ca	CCC	CCC	15
Armenia		Ba3	B+		16
Aruba	BBB+ ↓		BB ↓		55
Australia	AAA ↓	Aaa	AAA ↓	AAA	100
...					
United Arab Emirates	AA	Aa2	AA		90
United Kingdom	AA	Aa3	AA- ↓	AAA ↓	91
United States	AA+	Aaa	AAA ↓	AAA	98

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1 – Sovereign ratings – TE & description (Prime to medium grade)

TE	S&P	Moody's	Fitch	DBRS	Description
100	AAA	Aaa	AAA	AAA	Prime
95	AA+	Aa1	AA+	AA (high)	High grade
90	AA	Aa2	AA	AA	
85	AA-	Aa3	AA-	AA (low)	
80	A+	A1	A+	A (high)	Upper medium grade
75	A	A2	A	A	
70	A-	A3	A-	A (low)	
65	BBB+	Baa1	BBB+	BBB (high)	Lower medium grade

1 – Sovereign ratings – TE & description (Speculative)

TE	S&P	Moody's	Fitch	DBRS	Description
60	BBB	Baa2	BBB	BBB	
55	BBB-	Baa3	BBB-	BBB (low)	
50	BB+	Ba1	BB+	BB (high)	Non-investment grade speculative
45	BB	Ba2	BB	BB	
40	BB-	Ba3	BB-	BB (low)	
35	B+	B1	B+	B (high)	Highly speculative
30	B	B2	B	B	
25	B-	B3	B-	B (low)	

1 – Sovereign ratings – TE & description (Substantial risks and default)

TE	S&P	Moody's	Fitch	DBRS	Description
20	CCC+	Caa1	CCC	CCC (high)	Substantial risks
15	CCC	Caa2		CCC	Extremely speculative
10	CCC-	Caa3		CCC (low)	In default with little prospect for recovery
	CC	Ca		CC	
5	C	C		C	
0	D	/	DDD		In default
		/	DD	D	
			D		

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How to measure country risk: 2 – Country Risk Scores (0 a 100)

- The PRS Group
  - Political Risk Services
- ICRG
  - International Country Risk Guide
- The Economist

Economist.com rankings

Country risk
Selected countries and territories, July 2008 (except where noted)

Least risky			Most risky		
Rank		Score*	Rank		Score
1	Switzerland †	12	120	Zimbabwe	86
2	Finland	14	119	Iraq	78
	Norway	14	118	Sudan	76
	Sweden **	14	117	Myanmar	75
5	Austria ††	16	116	Jamaica	69
6	Canada	17	115	Nicaragua	68
	Denmark †	17	114	Cuba	64
8	Germany **	18		Kenya	64
	Netherlands §	18	112	Cambodia	62
10	France **	19		Ecuador	62
11	Belgium **	20	110	Vietnam	61
	Singapore	20	109	Côte d'Ivoire	60
13	Hong Kong	23		Syria	60
	Japan	23	107	Lebanon	59
	Britain #	23		Venezuela	59

*Out of 100, with higher numbers indicating more risk. Scores are based on indicators from three categories: currency risk, sovereign debt risk and banking risk.
† May 2008; ** June 2008; †† January 2008; § February 2008; # March 2008
Source: Economist Intelligence Unit

PS: Scores are not linear

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How to measure country risk:
3 – Market data

- Bond default spread
  - Treasury bond of emergent country – Treasury bond of stable country
- Credit Default Swap Spreads
  - A credit default swap (CDS) is a financial swap agreement that the seller of the CDS will compensate the buyer in the event of a loan default or other credit event.
- Relative volatility of markets
  - volatilidade of emergent country / volatilidade of stable country

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Risk premium based on
"Bond Default Spread"

Equity risk premium = Equity risk premium in USA + Emergent country risk premium
(4,79%)   (?)

$$CRP = CDS \frac{\sigma_e}{\sigma_T}$$

CRP= Country Risk Premium
CDS = Country Default Spread
= Treasury Yield of Emergent Country – USA Treasury Yield
σ_e = Standard deviation of shares
σ_T = Standard deviation of Treasury Bonds

India Example from Damodaran, The Dark Side of Valuation, p. 68:

$$CRP = 3\% \times \frac{31,82\%}{14,90\%} = 6,43\%$$

$$ERP = ERP_{USA} + CRP_{Emergent} = 4,79\% + 6,43\% = 11,22\%$$

Equity risk premium based on "relative volatility of markets"

$$ERP_{Emergent} = ERP_{USA} \frac{\sigma_{Emergent}}{\sigma_{USA}}$$

$ERP_{Emergent}$ = Equity risk premium of emergent market
ERP_{USA} = Equity risk premium of USA
$\sigma_{Emergent}$ = Standard deviation of shares in the emergent country
σ_{USA} = Standard deviation of shares in USA or equivalent country

Brasil example:

$$ERP_{Brasil} = 4,79\% \times \frac{25,83\%}{15,27\%} = 8,1\%$$

$$CRP = 8,1\% - 4,79\% = 3,31\%$$

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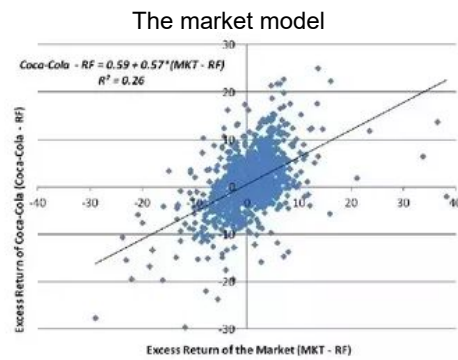# Betas

CAPM – A standard in the market

$$r_e = r_f + \beta\left(r_m - r_f\right)$$

$$r_e - r_f = \alpha + \beta\left(r_m - r_f\right)$$

CAPM

The market model
Bloomberg, Datastream, Reuters, etc.

The market model

Coca-Cola - RF = 0.59 + 0.57*(MKT - RF)
$R^2 = 0.26$

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ii. Cost of debt (kd)

Cost of debt
Ranked by best practice

- The company has bonds quoted:
  - Use the yield to maturity
- The company has a rating but no bond is quoted:
  - Use yield to maturity of identical risk bonds
- No bonds are quoted and no rating:
  - Interets rate of next loan
  - Interest rate of most recent loan
  - Estimate a syntetic rating base on Times interest earning
  - Average cost of debt

Reuters corporate default spreads

Rating	1 yr	2 yr	3 yr	5 yr	7 yr	10 yr	30 yr
Aaa/AAA	14	16	27	40	56	68	90
Aa1/AA+	22	30	31	48	64	77	99
Aa2/AA	24	37	39	54	67	80	103
Aa3/AA-	25	39	40	58	71	81	109
A1/A+	43	48	52	65	79	93	117
A2/A	46	51	54	67	81	95	121
A3/A-	50	54	57	72	84	98	124
Baa1/BBB+	62	72	80	92	121	141	170
Baa2/BBB	65	80	88	97	128	151	177
Baa3/BBB-	72	85	90	102	134	159	183
Ba1/BB+	185	195	205	215	235	255	275
Ba2/BB	195	205	215	225	245	265	285
Ba3/BB-	205	215	225	235	255	275	295
B1/B+	265	275	285	315	355	395	445
B2/B	275	285	295	325	365	405	455
B3/B-	285	295	305	335	375	415	465
Caa/CCC+	450	460	470	495	505	515	545
US Treasury Yield	4.74	4.71	4.68	4.63	4.60	4.59	4.56

Spread values represent basis points (bps) over a US Treasury security of the same maturity, or the closest matching maturity.

Rating and interest coverage ratio

For larger non-financial service companies
(market cap > $ 5 billion)

For developed market firms with market cap > $5 billion			
If interest coverage ratio is			
>	≤ to	Rating is	Spread is
8.50	100000	Aaa/AAA	0.63%
6.5	8.499999	Aa2/AA	0.78%
5.5	6.499999	A1/A+	0.98%
4.25	5.499999	A2/A	1.08%
3	4.249999	A3/A-	1.22%
2.5	2.999999	Baa2/BBB	1.56%
2.25	2.249999	Ba1/BB+	2.00%
2	2.2499999	Ba2/BB	2.40%
1.75	1.999999	B1/B+	3.51%
1.5	1.749999	B2/B	4.21%
1.25	1.499999	B3/B-	5.15%
0.8	1.249999	Caa/CCC	8.20%
0.65	0.799999	Ca2/CC	8.64%
0.2	0.649999	C2/C	11.34%
-100000	0.199999	D2/D	15.12%

Source: Damodaran, January 2020

iii. Cost of prefered equity (kp)

Cost of prefered shares

- No growth of dividends:
  - = dividends/Price
- Constant growth of dividens:
  - = (Dividends/Price) + g
- If there are special rights
  - Use the options theory

Hibrid securities

- Decompose the security into equity and debt

Flotation costs

- Flotation cost as a fixed cost per share

$$k_e = \frac{D_1}{P_0 - F} + g$$

- Flotation cost as a percentage of the share price

$$k_e = \frac{D_1}{P_0 \times (1 - f)} + g$$

iv. Weighed average cost of capital (km)

Weighted average cost of capital (km)

$$k_m = k_e \frac{E}{C} + k_p \frac{E_p}{C} + k_d \frac{D}{C}(1-t)$$

$$k_m = k_u \cdot \left(1 - t\frac{D}{C}\right)$$

E – Equity based on ordinary shares
E_p – Equity based on prefered shares
D – Debt
C = Invested Capital = Capital Employed = E+E_p+D
t = Income tax rate

Target capital structure is recommended to estimate WACC.

- If you do not know what is the target capital structure, then you may:
    - Read statements by management to infer what is the target capital structure
    - Assume the current capital structure as the target capital structure
    - Examine trends in the company capital structure to infer about the target capital structure
    - Use averages of comparable companies' capital structure as the target capital structure

v. Unlevered cost of capital (ku)

Unlevered cost of capital (ku)

Hamada Formula:

Be=Bu+(Bu-Bd)*D/E*(1-t)

- CAPM (Unlevered)

$$\beta_u = \frac{\beta_e + \beta_D \left(\frac{D}{E}\right)}{1 + \frac{D}{E}(1-t)}$$

$$k_u = r_f + \beta_u \left(r_m - r_f\right)$$

Hamada Formula Simplified Bd=0:

- MODIGLIANI & MILLER

$$\beta_U = \frac{\beta_E}{1 + \frac{D}{E}(1-t)}$$

$$k_u = \frac{k_m}{1 - t \times \frac{D}{D+E}}$$

$$k_u = \frac{k_e + \frac{D}{E} k_d (1-t)}{1 + \frac{D}{E}(1-t)}$$

Estimating a Beta of an unquoted company using the pure-play model

Step 1: Select the comparable   Determine comparable company or companies. These are companies with similar business risk.

↓

Step 2: Estimate comparable's beta   Estimate the equity beta of the comparable company or companies.

↓

Step 3: Unlever the comparable's beta   Unlever the beta of the comparable company or companies, removing the financial risk component of the equity beta, leaving the business risk component of the beta.

↓

Step 4: Lever the beta for the project's financial risk   Lever the beta of the project by adjusting the asset beta for the financial risk of the project.

Source: Reading 36, Cost of capital, Corporate Finance, CFA level I

Levered betas and unlevered betas

$$\frac{\beta_E}{1+\frac{D}{E}(1-t)} = \beta_u$$

Industry	Number of firms	Beta	Market D/E	Tax rate	Unlevered Beta
Advertising	38	1,02	69,06%	30,60%	0,69
Aerospace and Defense	27	1,02	36,89%	20,49%	0,79
Agricultural Products	33	0,82	63,38%	15,71%	0,53
...	...	...	...	...	...
Tires and Rubber	5	1,37	147,21%	32,84%	0,69
Tobacco	4	0,58	53,27%	24,63%	0,41
Trading Companies and Distributors	49	1,19	158,87%	25,88%	0,55
Trucking	16	0,93	142,43%	17,08%	0,43
Water Utilities	12	0,60	137,38%	39,13%	0,33
Wireless Telecommunication Services	11	1,00	45,26%	25,30%	0,75
Grand Total	**4167**	**1,04**	**85,33%**	**20,93%**	**0,80**

Source: http://pages.stern.nyu.edu/~adamodar/

vi. Applying the cost of capital in budgeting

Marginal cost of capital schedule

WACC

Amount of New Capital
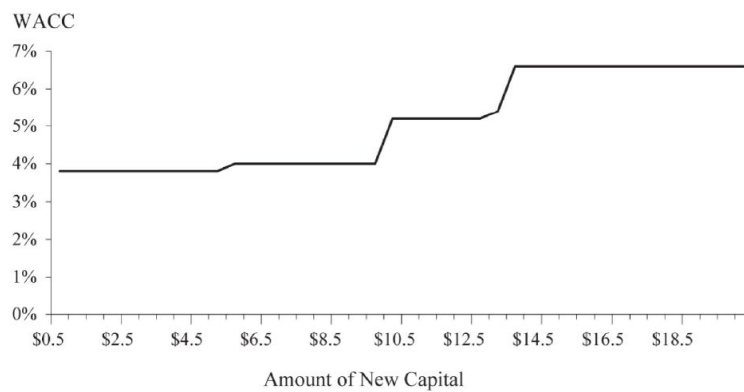
Source: Reading 36, Cost of capital, Corporate Finance, CFA level I

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Optimal investment decision
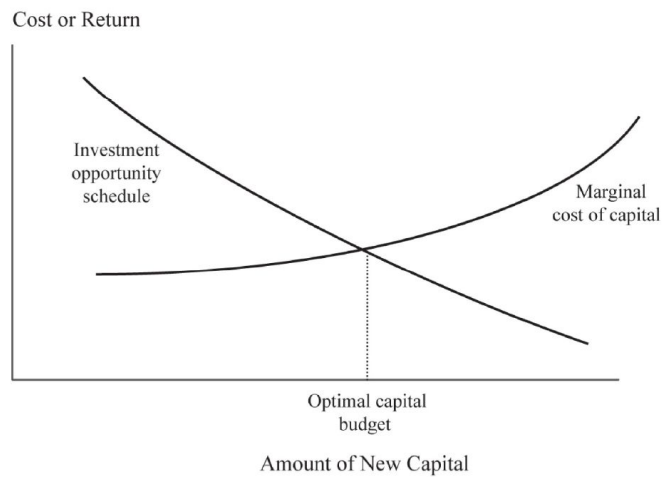
Cost or Return

Investment opportunity schedule

Marginal cost of capital

Optimal capital budget

Amount of New Capital

Source: Reading 36, Cost of capital, Corporate Finance, CFA level I

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What do CFO's do?

- The most popular method for estimating the cost of equity is the capital asset pricing model.

- Few companies use the dividend cash flow model to estimate a cost of equity.

- Publicly traded companies are more likely to use the capital asset pricing model than are private companies.

- In evaluating projects, the majority use a single company cost of capital, but a large portion apply some type of risk adjustment for individual projects.

Source: Reading 36, Cost of capital, Corporate Finance, CFA level I

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