ITU ADVANCED LEVEL TRAINING

Strategic Costing and Business Planning for Quadplay

WINDHOEK, NAMIBIA

6-10 October, 2014

Harm Aben

ITU Expert

Session 7:
Weighted Average Cost of Capital (WACC) – theory and practice

Overview

- An operator requires capital to finance its investments in the production of the regulated service(s)
- Cost-based price regulation needs to take account of these investments and allow the regulated firm a reasonable rate of return on capital employed (ROCE)
- Companies raise capital through a mixture of debt and equity
- WACC is the average of the cost of each of these sources of financing, weighted by their respective usage
- WACC represents the minimum rate of return the regulated firm must earn on its invested capital to finance its debts and provide sufficient returns to investors
- WACC is thus the minimum return that a regulator should allow in setting regulated prices

Introduction to WACC

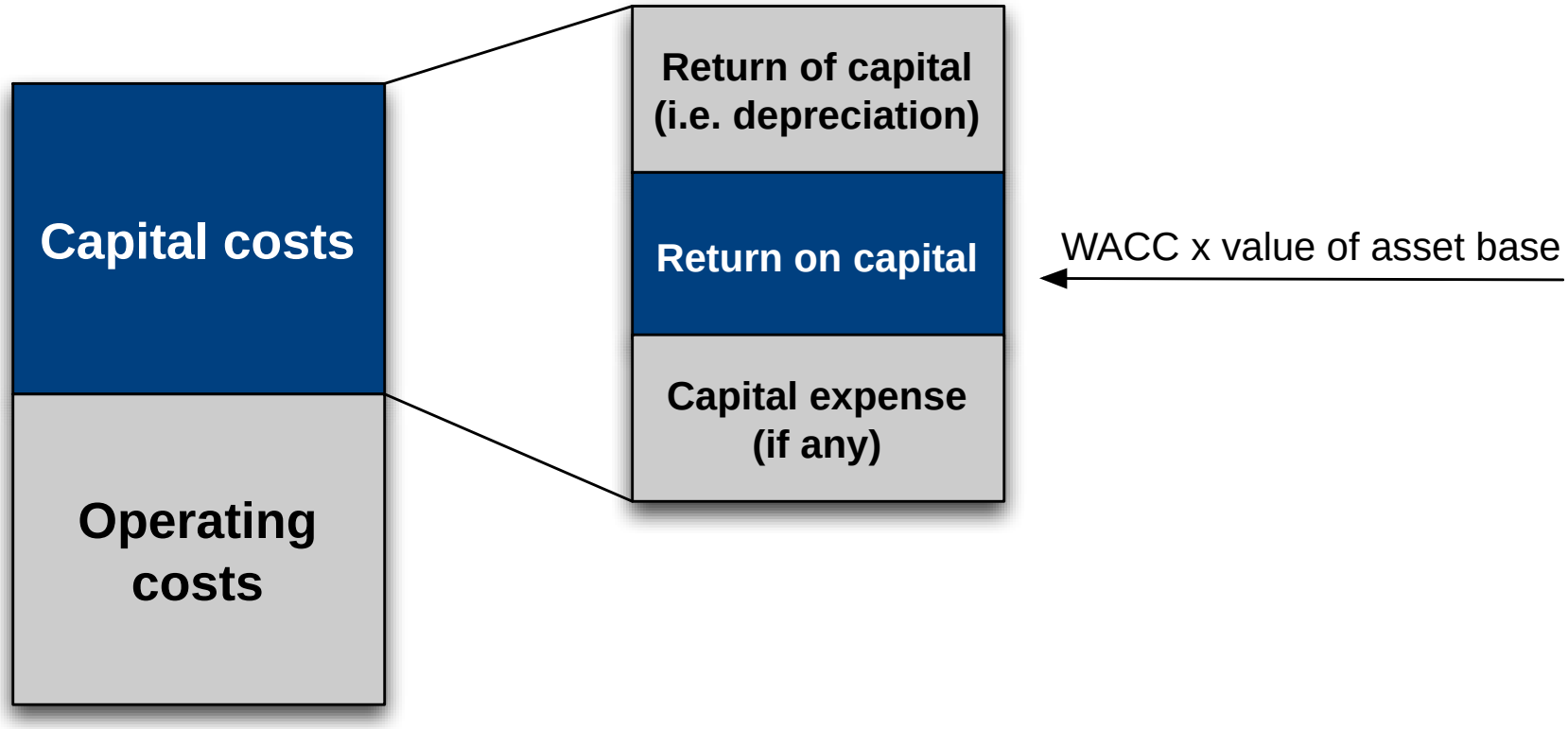
What is WACC?

- A firm's assets are financed through a mixture of debt and equity
- The returns required by the providers of these two forms of capital tend to be different
  - Debt holders face a different level of risk to equity holders as they have a prior claim on a firm's earnings
- WACC is the average of the cost of each of these sources of financing, weighted by their respective usage
- It is the minimum expected return investors of all forms of capital require in order to invest in a business
- It is thus the minimum return that a regulator should allow in setting the price(s) of regulated services

Why do we need a WACC?

- A regulated firm should be able to recover the efficient costs incurred in providing a service
  - The costs of financing the business is one such cost
- Firms finances their operations through a mixture of debt and equity
- Revenue must cover its operating expenses and the costs of its capital investments
  - A profit on top of this is also highly desirable!
- Regulated prices should cover the efficiently incurred operating expenses and the cost of capital…but not the further profit
  - As the profit is not necessary for the provision of the service
- The WACC is used to calculate the required annual return on the capital investments to cover the costs of financing

The costs to be recovered in the regulated prices



Why is the WACC important? (1)

- The WACC is a key component in any cost model because it determines the annual charges from capital investments
  - e.g. the capital charge typically accounts for approximately 25% of the cost of mobile termination
- Accurate determination of the WACC is thus crucial as it is a key determinant of the:
  - the regulated firm's revenues
  - the wholesale access prices (i.e. expenses) paid by competitors

Why is the WACC important? (2)

- If set correctly, the WACC provides an efficient price signal and an incentive for efficient investment
- If set too low, it risks making investment unattractive
  - Too low means less than the opportunity cost of capital
- If set too high, it would allow the regulated firm to earn excessive returns on its capital
  - Would affect the competitiveness of the market
  - Would distort pricing signals to customers and investors
  - Lead to a misallocation of resources

Many factors to balance

The WACC should

- be fair and reasonable between the interests of shareholders and customers
- provide a return comparable to that on alternative investments of similar risk
- be sufficient to attract new capital investment for future service obligations
- allow each separately regulated business within the organisation to be financially viable.

Calculating WACC

- WACC may be measured either in nominal or in real terms
  - i.e. the real WACC is expressed in constant terms and so excludes the effects of inflation
- The WACC should be consistent with the choice of price base
  - i.e. if prices are regulated in nominal terms, the cost of capital should also be expressed in nominal terms
- WACC may be measured either pre-tax or post-tax
  - Post-tax WACC reflects adjustments to allow for corporate tax payments (in addition to interest payments and returns on equity)
    - Used for discounting free cash flows (e.g. commercial valuations)
  - Pre-tax WACC is used for tariff regulation because the revenues generated need to be sufficient to pay any tax liabilities

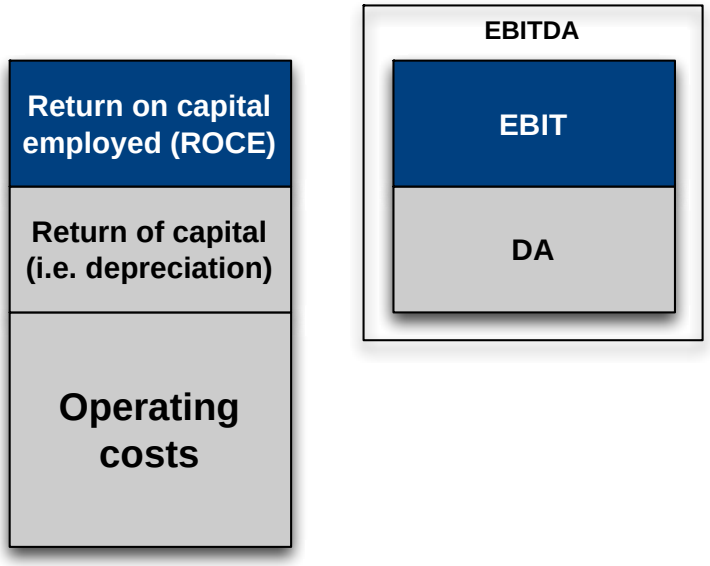
Why tariff regulation uses pre-tax WACC

Revenue - Operating costs = EBITDA

EBITDA - (Depreciation + Amortisation) = EBIT

Thus, EBIT = ROCE

Hence the pre-tax WACC aims to estimate a pre-tax return for the providers of capital



WACC formulae

$$\textbf{Pre-tax WACC} = (C_D \times g) + \frac{C_E \times (1 - g)}{(1 - t)}$$

$$\textbf{Post-tax WACC} = [C_D \times (1 - t) \times g] + [C_E \times (1 - g)]$$

where:
C_D is the pre-tax cost of debt (expressed as a percentage)
C_E is the post-tax cost of equity (expressed as a percentage)
g is the gearing ratio (i.e. debt / (debt + equity)
t is the tax rate

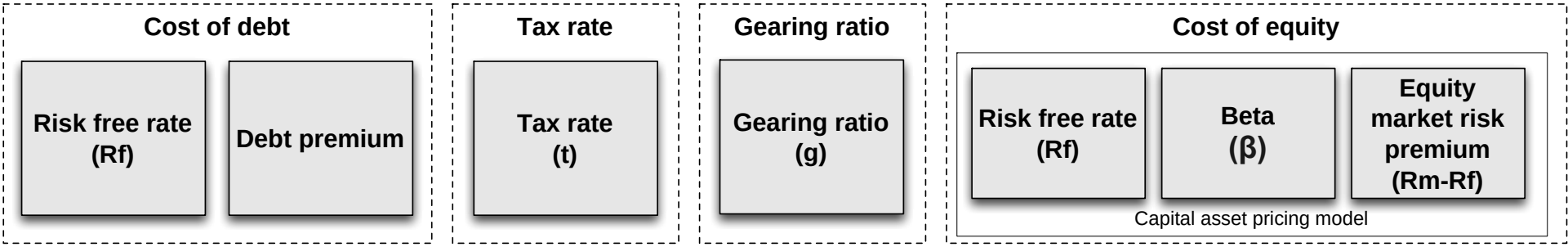
Tax considerations

- Corporation taxes affect providers of debt and equity differently
  - Interest payments on debt reduce profits and the tax liability
  - Equity providers receive dividends from post-tax profits
- The cost of equity is naturally expressed on a post-tax basis
  - i.e. CAPM (discussed shortly) does not incorporate tax considerations
  - A pre-tax cost of equity is obtained by “grossing up” post-tax returns by the applicable tax rate
- The cost of debt is naturally expressed on a pre-tax basis
  - A post-tax cost of debt is obtained by deducting the tax liability
- The difference between the pre-tax and post-tax debt yields is the “tax shield”

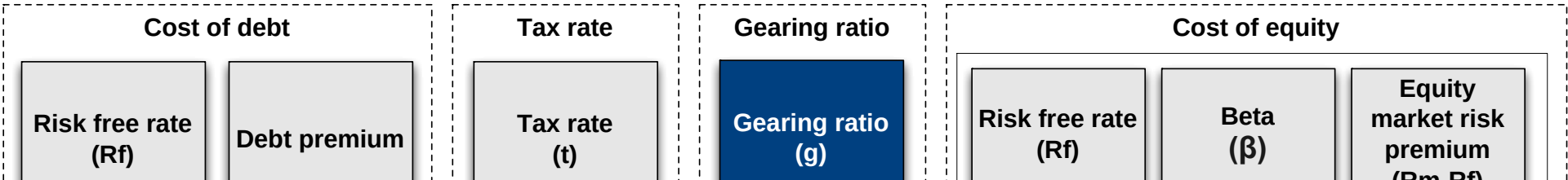
Components of WACC formulae

- Calculation of WACC thus requires calculation of 3 components:
  - cost of debt: the interest rate debt providers would charge for providing debt to such an investment
  - cost of equity: the rate of return equity investors would expect on an investment of this nature
  - the gearing ratio: the relative proportions of debt and equity used to finance the investment
- The tax rate is usually a given
- Most of the parameters used in the calculations have to be estimated or inferred from observable data
  - The calculated WACC is thus an estimation based on assumptions and judgments and the data used

Components of WACC formulae



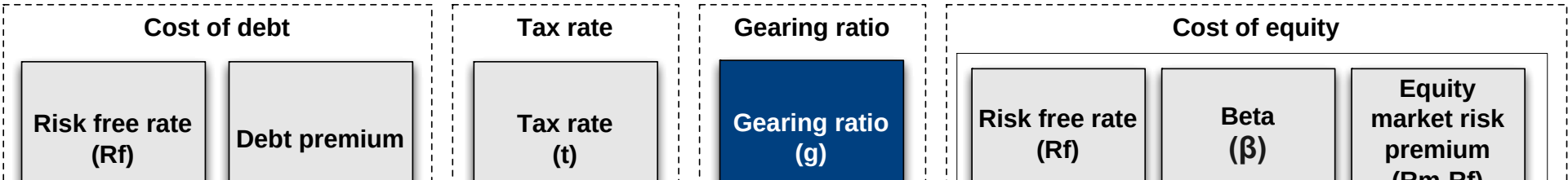
Tax rate (t)


Cost of debt
Risk free rate (Rf)
Debt premium
Tax rate
Tax rate (t)
Gearing ratio
Gearing ratio (g)
Cost of equity
Risk free rate (Rf)
Beta (β)
Equity market risk premium (Rm-Rf)
Capital asset pricing model

Tax rate (t)

- WACC may be calculated either pre-tax or post-tax
- Headline tax rate or the effective tax rate?
  - May want calculate the effective tax rate if there are factors which result in the regulated firm paying an effective tax rate that is structurally different from the headline rate
  - An effective rate should reflect only enduring differences, not short term or transitory differences or fluctuations

Gearing ratio (g)



Gearing ratio (g)

- Gearing is the proportion of debt in a firm's capital

$$\text{Gearing} = \frac{\text{Debt}}{\text{Debt} + \text{Equity}}$$

- Determines the relative weights for the different capital sources in the WACC formula
  - May also be used in un-levering and re-levering of beta coefficients (discussed later)
- Three ways of determining the gearing ratio
  - Based on book values
  - Based on market values
  - Regulator determination of an optimal / efficient ratio

Gearing based on book values

- Level of gearing is determined based on the accounting value of the regulated firm's debt and equity
- Positives:
  - Transparent
  - Easy to check and audit.
- Negatives:
  - Not forward-looking
  - Does not reflect the the firm's true economic value
  - Dependent on the accounting policies adopted by the regulated firm

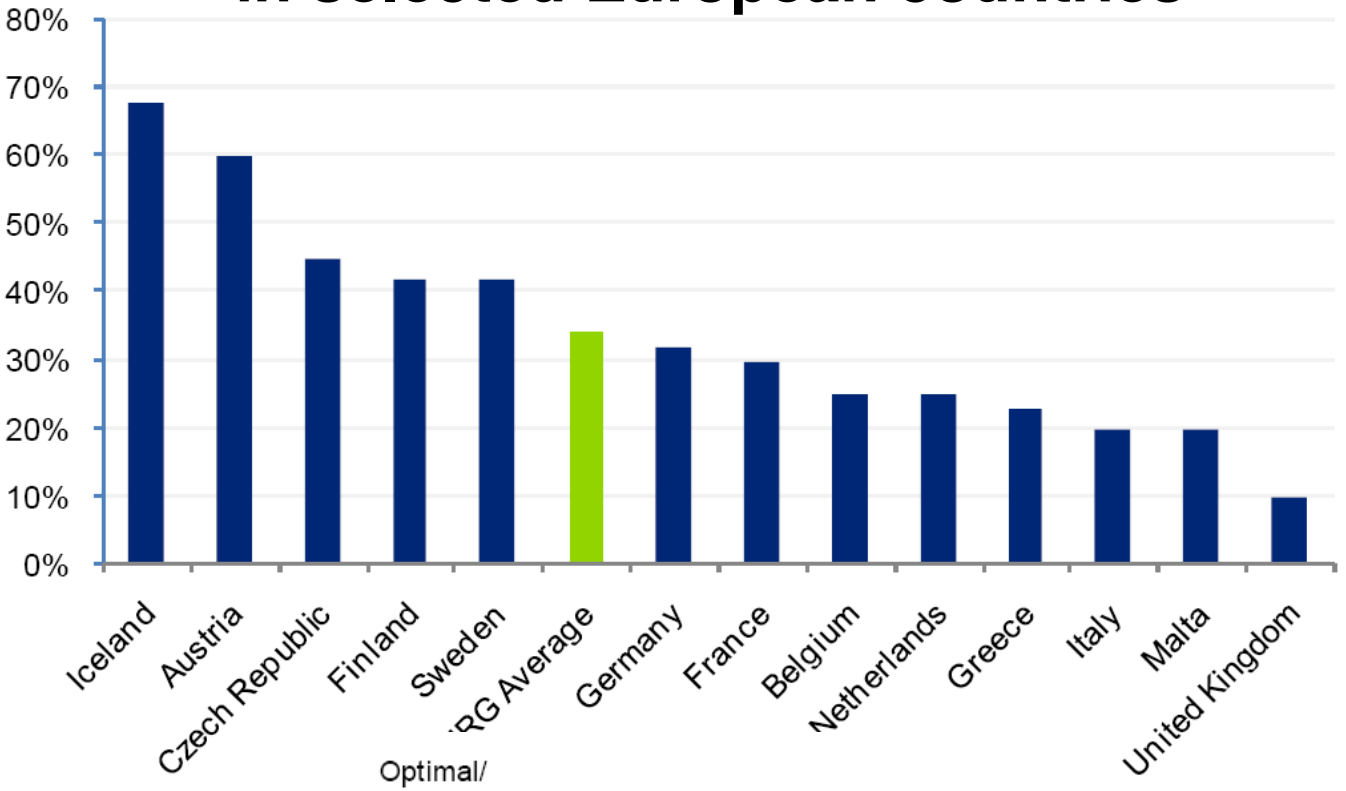
Gearing based on market values

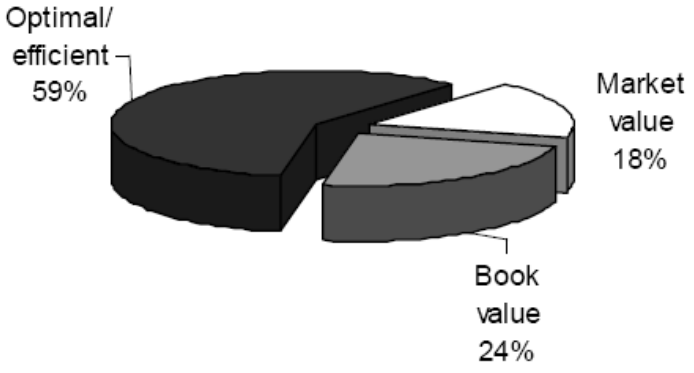
- Level of gearing is calculated based on the market value of the regulated firm's debt and equity
  - Market value of equity obtained by multiplying the number of shares with their current price
  - Market value of debt can be calculated by treating the entire book debt as one coupon bond
- Positives:
  - Theoretically is a better reflection of the true economic value of the firm's capital structure
- Negatives:
  - Reflect market volatility, investors' expectations and speculation
  - Market values can be subject to significant fluctuations

Gearing based on optimal structure

- Level of gearing is determined by the regulator based on the Regulator's judgment as to the optimal capital structure for the regulated firm
  - i.e. an appropriate capital structure for an efficient operator
  - e.g. European regulators have tended to apply a gearing ratio of 30% to 50%
- Positives:
  - Ensures the regulated firm is not rewarded (with a higher WACC) if it over borrows or borrows at an excessively high rate of interest
- Negatives:
  - Subjective

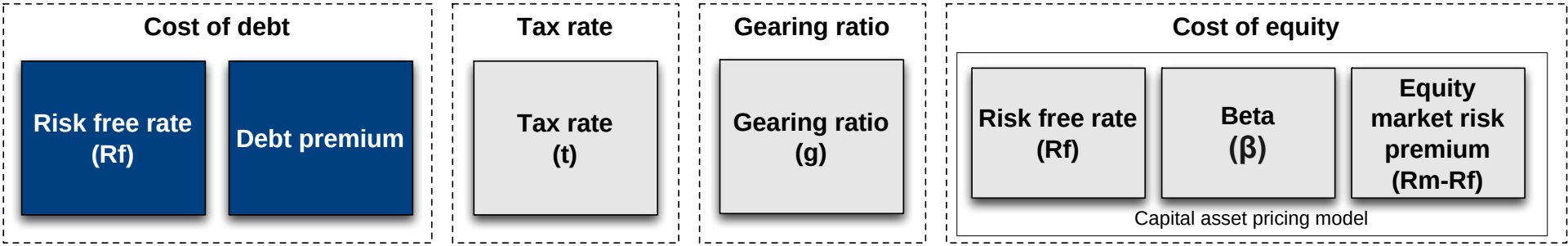
Gearing ratios for mobile operators and methodology applied by telecoms regulators in selected European countries





Source: ERG, 2009

Cost of debt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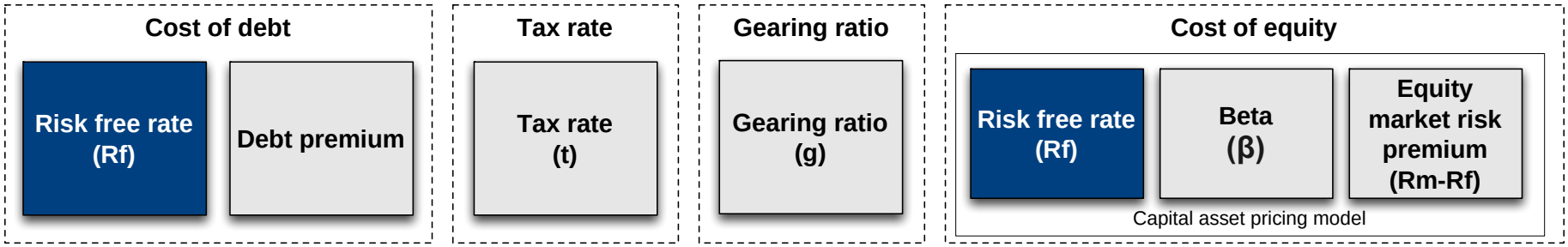
Capital asset pricing model

Cost of debt

- The cost of debt reflects the cost the regulated firm has to sustain to obtain capital from financial institutions or through loans from other companies.
- The cost of debt is the sum of the **risk-free rate (R_f)** and the margin (**premium**) that lenders require above the risk-free rate
  - This is the pre-tax cost of debt
  - May be adjusted by the tax shield to reflect that interest payments on debt reduce the taxable profit of the investment, and hence reduce the tax liability and the effective post-tax cost of serving the debt
    - This would produce a post-tax estimate of WACC
- We are interested in the costs of long-term debt only

Risk free rate of return (Rf)



- Risk-free means devoid of the following risks:
  - interest rate risk: changes in market interest rates
  - inflation risk: changes in inflation expectations;
  - default risk: i.e. default on the repayment of the principal
  - liquidity risk: i.e. inability to liquidate the investment timely
  - reinvestment risk: i.e. inability to reinvest investment returns into new securities with the same return characteristics
- But no investment is completely risk-free!
  - In reality we seek the return of an investment with minimum risk
  - Or returns that are not correlated with market returns

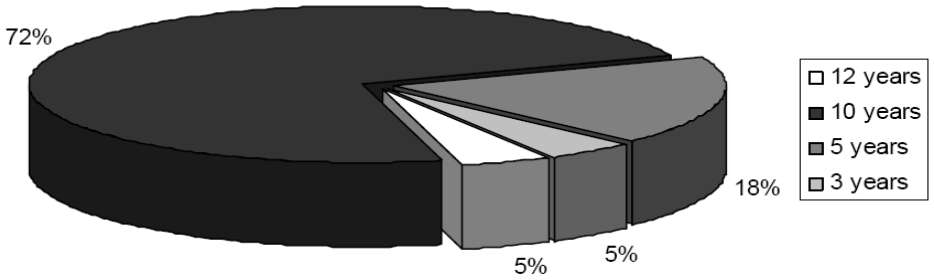
Government bonds as a proxy

- Freely trade investment-grade Government bond yields are considered to be proxies for risk free returns
- Two issues to consider in identifying bond rates:
  1. Which market?
     - i.e. government bond issued by which country
     - Choice should be consistent with the market considered in estimating the other WACC parameters
     - If another country's government bond rate is to be used, it should be marked by the the Country Risk Premium (discussed later) and also adjusted for the expected inflation differential
  2. What maturity period?
     - Current or historical values?

Maturity period of bonds

- The maturity period could be selected based on:
  - The investment horizon: taking into account that investors expect to be compensated for making long term investments. Therefore, the risk free rate should reflect investors' expectations over the relevant time period.
  - The planning horizon: i.e. the average life of the group of assets making up the investment
  - The time horizon of the regulatory review period

Bond maturity period adopted by European regulators

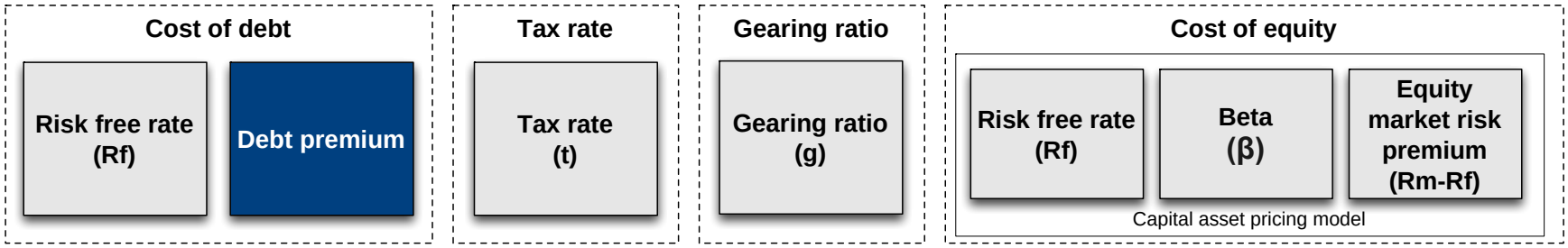


Source: ERG, 2008

Averaging of historical values

- If capital markets were perfectly efficient, the current yield would reflect all expectations of future earnings
  - But capital markets are volatile
  - Spot rates can be temporarily influenced by market anomalies and are prone to significant cyclical variations
- It is thus prudent to average recent historical rates
  - This minimises any short-term fluctuations in rates while still capturing the most up-to-date information and expectations
- As we seek a forward-looking estimation, it may also be appropriate to exclude recent periods of economic instability
  - September 2008 to March 2009 (Lehman Brothers)
  - Period beginning July 2011 (Eurozone crisis)

Debt premium



- Debt premium is the additional return expected by debt investors to invest in corporate debt instead of in government debt
  - Typically the debt premium is specific to the regulated firm
- Three common ways to compute a debt premium:
  - the use of accounting data
  - the use of credit ratings
  - determined by the regulator

Debt premium based on book value

- Debt premium can be inferred from the regulated firm's actual interest payments as recorded in its current loan book
  - i.e. the weighted average cost of its various long-term loans
- Positives:
  - Transparent
  - Easy to audit
  - Reflects the costs that the regulated firm actually paid
- Negatives:
  - Backwards-looking
  - May reflect inefficiently incurred costs (e.g. too high an interest rate)

Debt premium based on credit ratings

- The debt premium can also be derived from the regulated firm's credit rating
  - As assigned by specialised credit rating agencies
- Positives:
  - Forward-looking
  - Reflects the perceived financial risk of the regulated firm
- Negatives:
  - May reflect an incorrect perception or misunderstanding of the environment (by either the credit rating agency or the regulator)

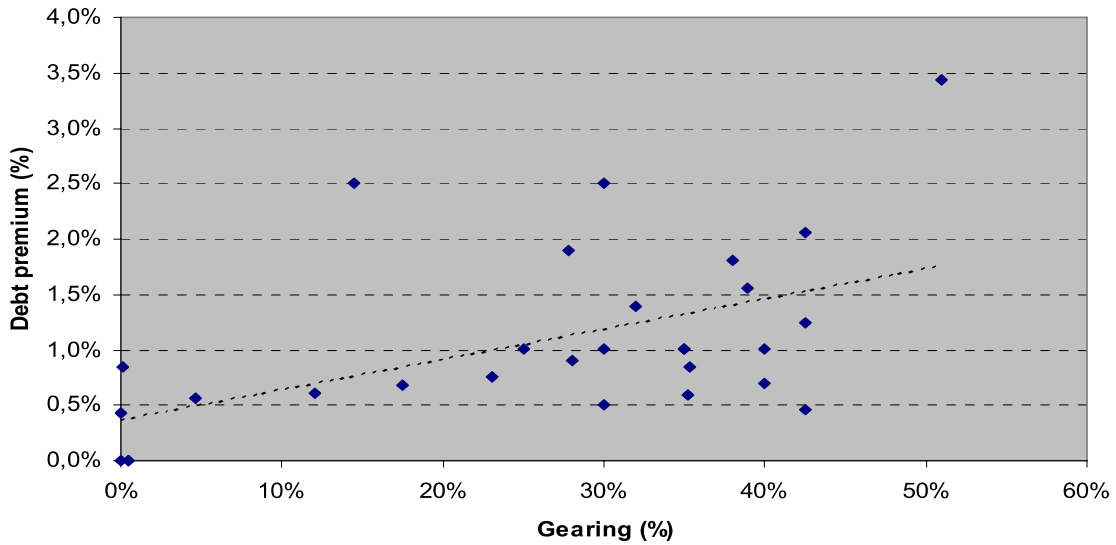
Debt premium determined by the Regulator

- The regulator may form its own view of an appropriate debt premium based on:
  - its determination of an efficient / optimal borrowing level (which itself would take into account an assumed debt premium)
  - The use of benchmarks of companies that are financially similar to the regulated firm
- Positives:
  - Ensures the regulated firm is not rewarded (with a higher WACC) if it over borrows or borrows at an excessively high rate of interest
- Negatives:
  - May not result in an optimal return or may restrict the amount available from other forms of funding

Gearing and the debt premium

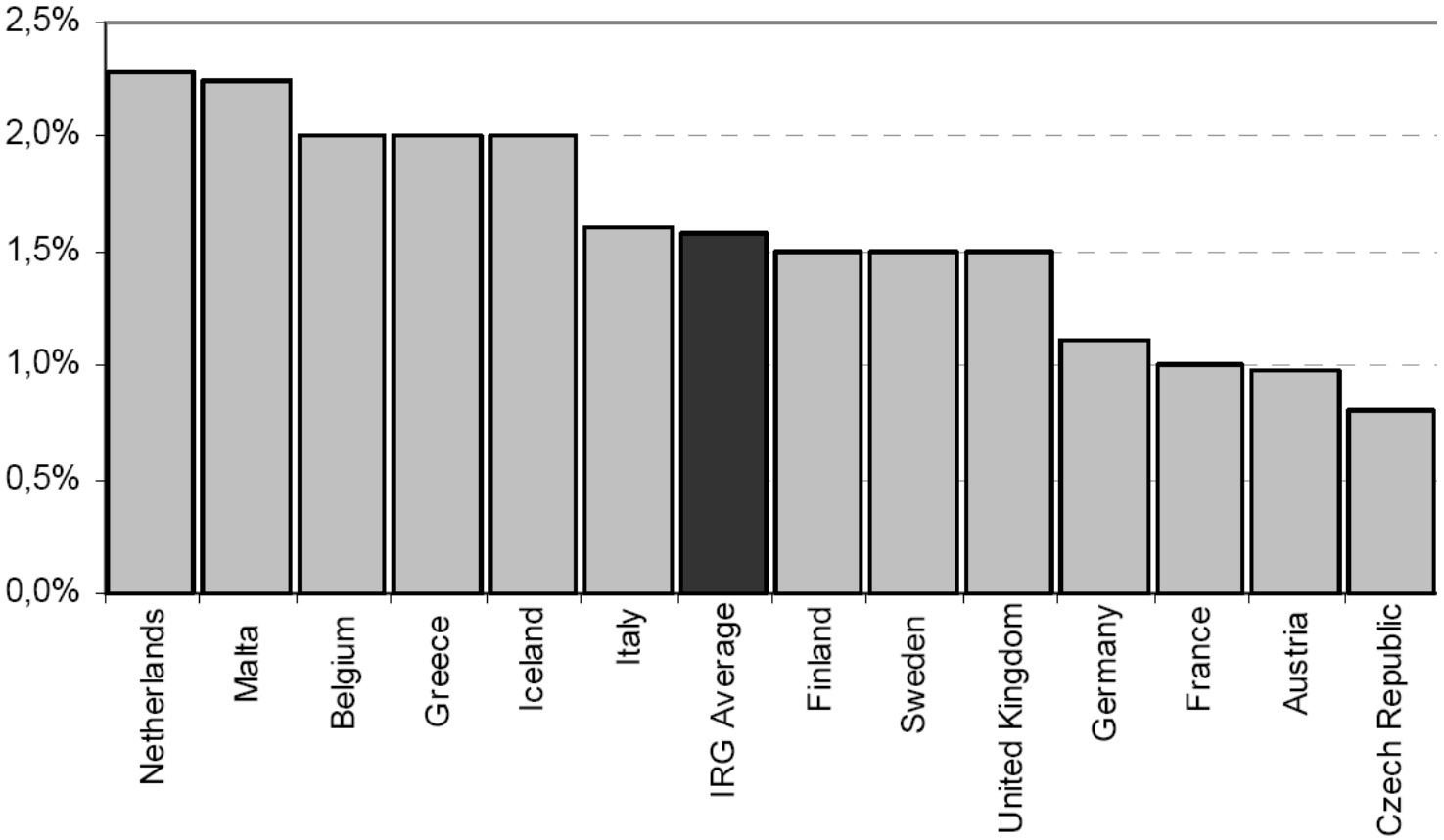
- A firm's debt premium will tend to increase with higher levels of gearing
  - More debt = more financial risk
  - This is because the firm requires more cash flows to meet the higher interest payments

Relationship between gearing ratio and debt premium for fixed and mobile operators in European countries



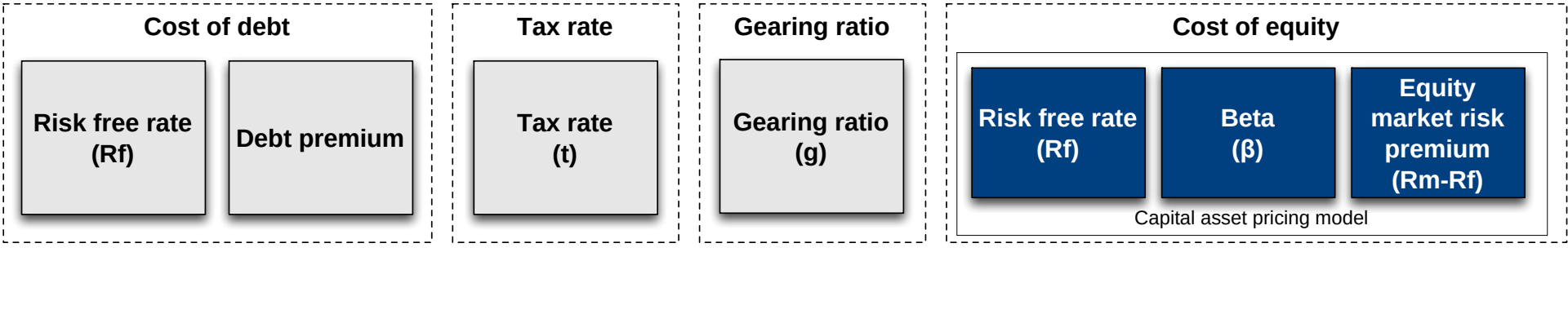
Source: ERG, 2008

Debt premium applied by telecoms regulators in selected European countries



Source: ERG, 2008

Cost of equity



Cost of equity

- The cost of equity is the return required by shareholders on their investment as a form of compensation for the risk they bear by making such an investment
- The standard framework for calculating the cost of equity is the Capital Asset Pricing Model (CAPM)
  - The preferred approach of most regulators
  - A fundamental concept in investment theory
- Other methods for calculating cost of equity are:
  - Gordon's Dividend Growth Model (DGM)
  - Arbitrage Pricing Theory (APT)
  - Fama – French three factor model
  - Real Option Theory

Capital Asset Pricing Model

- Assumes an equity investor require that investment to yield:
  - at least the return available on risk-free investments **PLUS**
  - a premium for the risk involved in making an equity investment
- Total risk comprises two components:
  - **specific** (diversifiable or idiosyncratic) risk—the risk specific to a particular firm that **can be diversified** away by investors and thus is not priced into investor's required rates of return
  - **systematic** (or undiversifiable) risk—how the value of an asset co-varies with the economy as a whole and **cannot be diversified** away by investors, as it tends to have some impact on all firms
- CAPM assumes the required return need reflect only the systematic risk
  - Derived by reference to the volatility of the returns on the particular firm relative to those of the market portfolio as a whole

CAPM formula (post-tax)

$$C_E = R_F + (\beta \times EMRP)$$

where:

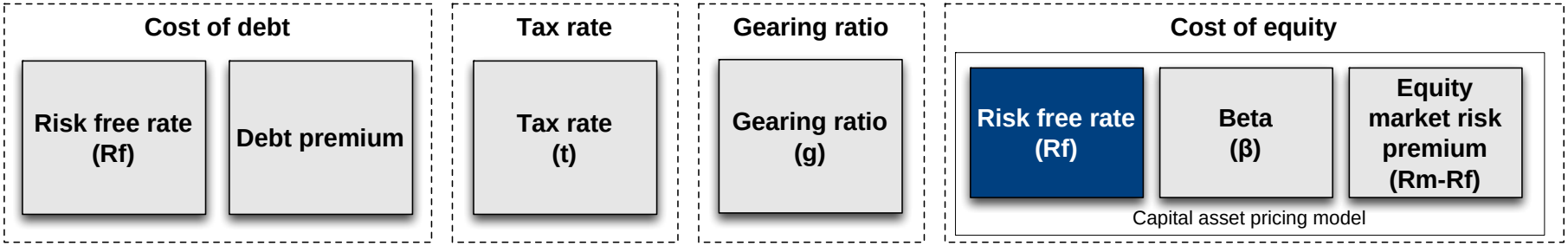
C_E is the cost of equity: a return required by equity investors (expressed as a percentage)

R_F is the risk free rate

β is the beta coefficient: a measure of the extent to which returns on the regulated firm's shares co-vary with the returns of the market as a whole

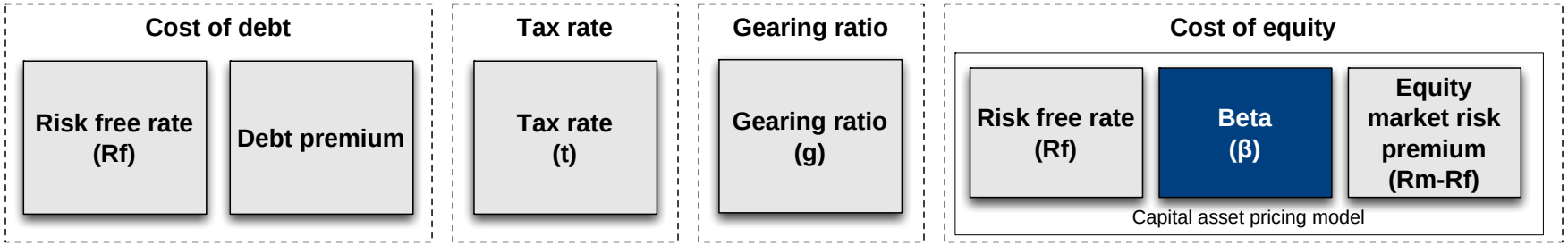
EMRP is the Equity Market Risk Premium: the additional return required for investing in the equity market compared to investing in risk-free assets

Risk free rate (Rf)



- Use the same risk free rate as was determined for the cost of debt.

Beta coefficient (β)



- A measure of the (systematic) risk of an investment relative to the market risk
  - Measures the volatility of the returns on an investment in a particular firm relative to the returns on the benchmark it is being compared to (typically the equity market as a whole)
- The market portfolio has a beta of 1
  - <1 means less volatile, less systematic risk, no correlation
  - >1 means more volatile, more systematic risk, high correlation
- Three common approaches to estimate beta:
  - Regression analysis of historical returns
  - Bottom-up estimation with reference to a comparable set
  - Specification of a target beta

Beta based on regression analysis

- Estimated by regressing the company's past returns against the market's past returns
  - Company returns include both dividends and price appreciation
- The period of analysis should be as long as possible to iron out fluctuations over the business cycle
  - 2–5 years is typical
  - Beta values may vary significantly over time
- Positives:
  - Data available for publicly listed companies
- Negatives:
  - Influenced by accounting practices and policies
  - Uses historic returns to estimate a forward-looking beta value
  - Data not readily available for unlisted companies

Bottom-up beta

- Estimated through benchmark from the betas of specific firms
- A set of comparable companies is identified
  - Bear in mind that several factors can influence the covariance of a firm's returns with the market returns
  - e.g. regulation, competition, company size, taxation
- Positives:
  - Avoids the need for historical stock prices and reducing the standard error created by regression betas
  - Forward-looking
- Negatives:
  - A homogenous sample of companies may turn out to have heterogeneous un-levered betas

Calculating a bottom-up beta

- Identify a set of comparable companies is identified
  - Bear in mind that several factors can influence the covariance of a firm's returns with the market returns
  - e.g. regulation, competition, company size, taxation, gearing
- Estimate or obtain betas for each of the selected companies
- De-lever the betas of the selected companies
  - i.e. strip out the gearing component (and maybe also tax)
  - Resultant "unlevered betas" reflect the risks of a 100% equity financed business
- Re-lever the betas of the selected companies by the gearing ratio considered appropriate for the regulated firm (and maybe the appropriate tax rate)
  - This neutralises the effects of each company's gearing (and tax regime)

Equity beta vs asset beta

- Equity beta, aka levered beta
  - Reflects financial risk
  - Takes account of the firm's financial position and capital structure
- Asset beta, aka unlevered beta
  - Reflects business risk
  - Measures the riskiness of the firm's assets; firms with similar activities can be expected to have a similar un-levered beta
  - Enables evaluation of volatility of a stock without the debt benefit
  - Provides a better indication of the market risk of a stock as changes in the amount of debt changes risk
- Potential to disaggregate different asset betas (and thus set different WACCs) for different parts of the one regulated firm (to be discussed later)
  - e.g. mobile and fixed networks

Formulae for de-leveraging / re-leveraging betas

Miller - Modigliani formula:

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

Miller formula:

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

where:

β_E is the levered (equity) beta

β_U is the unlevered (asset) beta

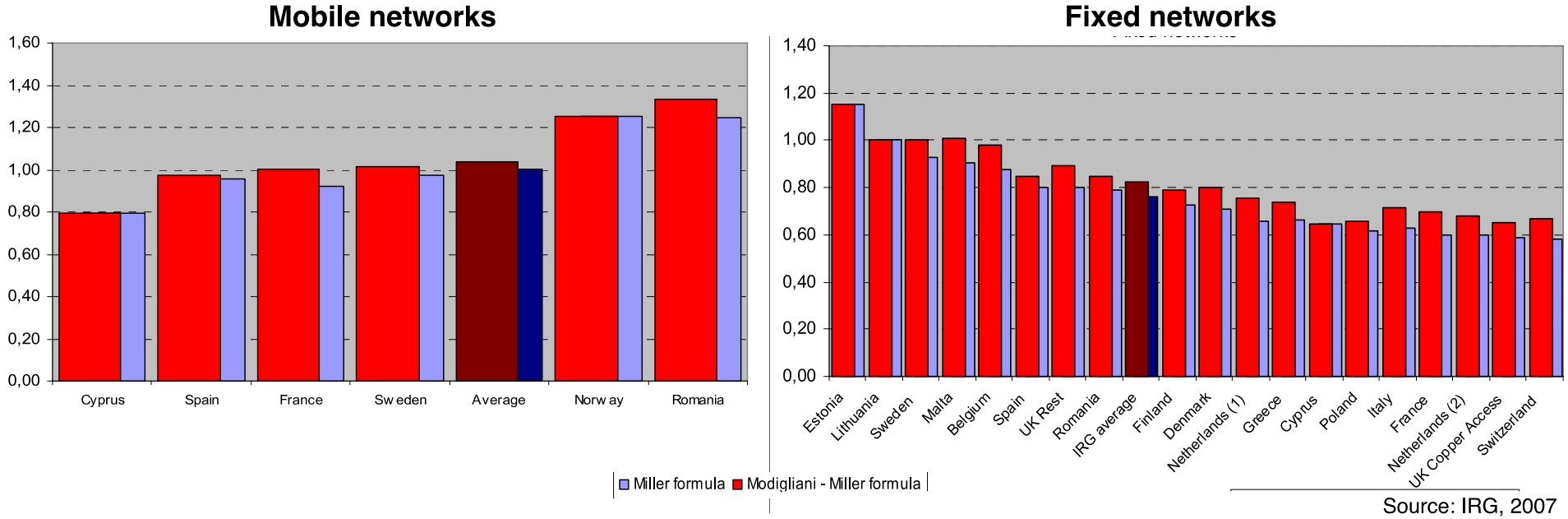
t is the appropriate corporate tax rate

D/E is the debt to equity (gearing) ratio based on market values

- Difference in the results of the 2 formulae is small
- The Miller Formula is simpler as it does not require estimation of forward-looking effective tax rates

Difference between the two formulae

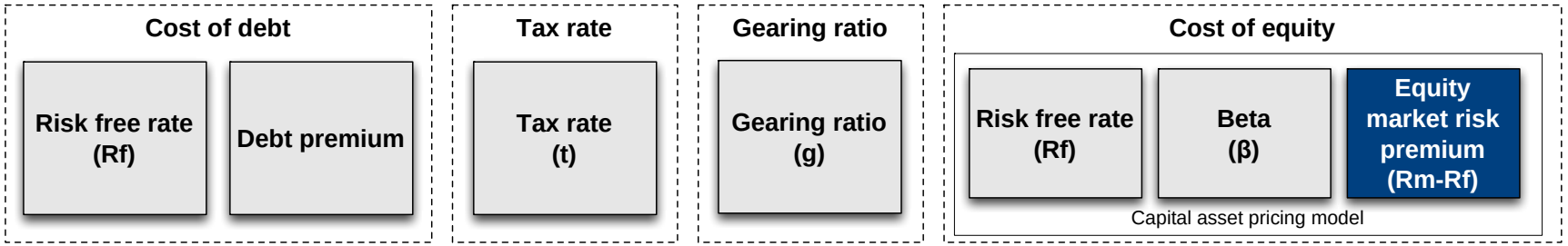
Asset betas for network operators in selected European countries



Source: IRG, 2007

- The regulator may want to determine a target un-levered beta that represents the activity risk

Equity market risk premium (Rm-Rf)



- The additional return above the risk free rate that is required to compensate an average investor for investing in equities of average risk
  - Represents the investors' expected returns
  - A market factor, not company-specific
  - Calculated as the difference between the return on the equity market (R_m) and the risk free rate (R_f)
- Can be contentious as a wide range of estimates can be derived from commonly-used estimation techniques
  - Lower EMRP means lower prices in the short term; a higher EMRP means increased investment incentives
- Derived from either ex post estimations or ex ante estimations

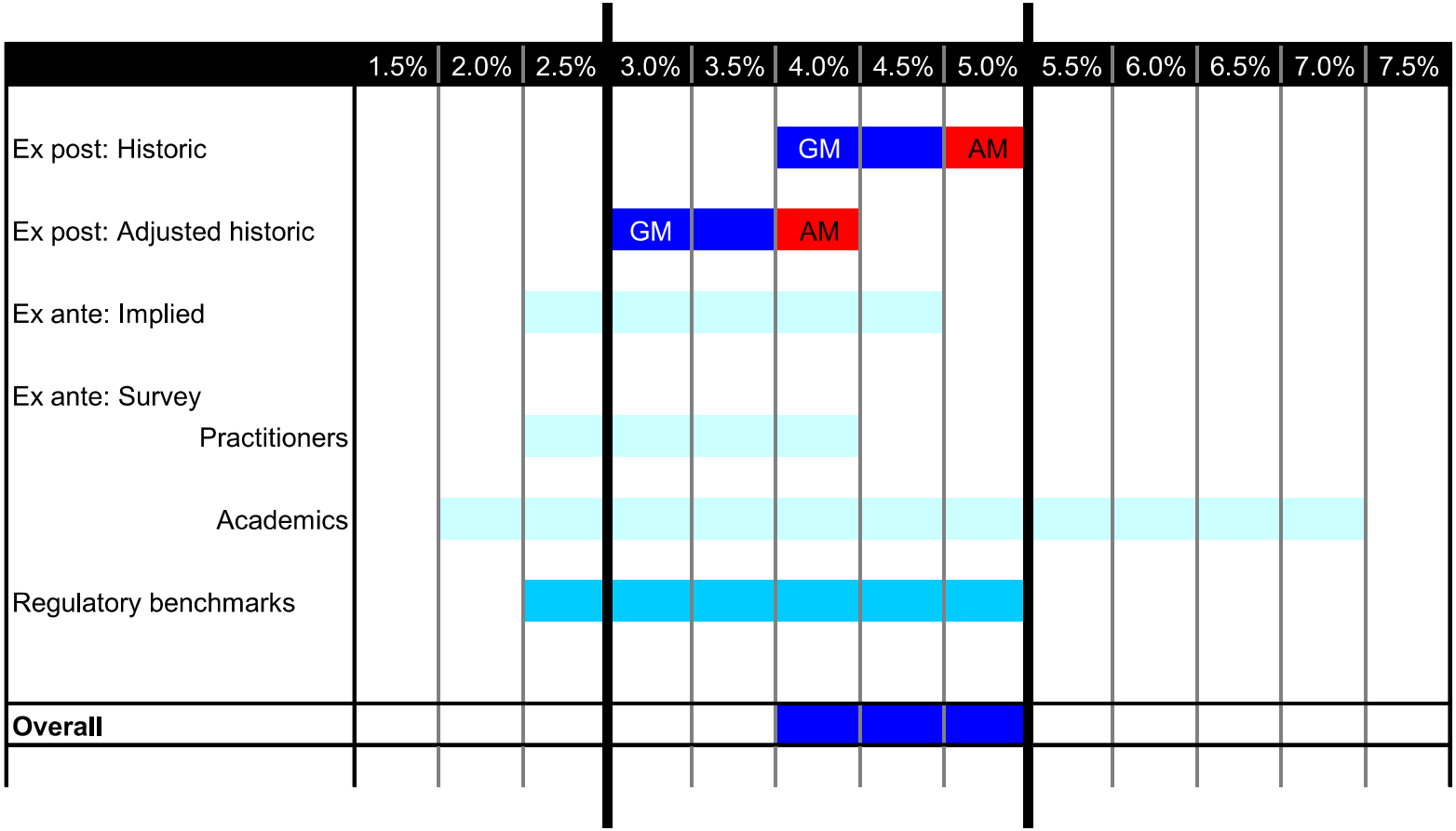
Ex post approach to EMRP

- EMRP is estimated by extrapolating historical risk premia
  - i.e. the average difference over the long term between realised returns on the market portfolio and government bond yields
- Key issues to resolve:
  - Arithmetic or geometric mean?
  - Which indices to use (national or international)?
- Positives:
  - The most common approach
- Negatives:
  - Assumes past data is a reliable indicator of how the market will behave in the future
  - May overstate the premium as the level of risk associated with the equity market will likely be lower in the future than it was the case in the past (hence sometimes addressed by a downwards adjustment to the premium)
  - Difficult with a nascent stock markets or in closed economies

Ex ante approaches to EMRP

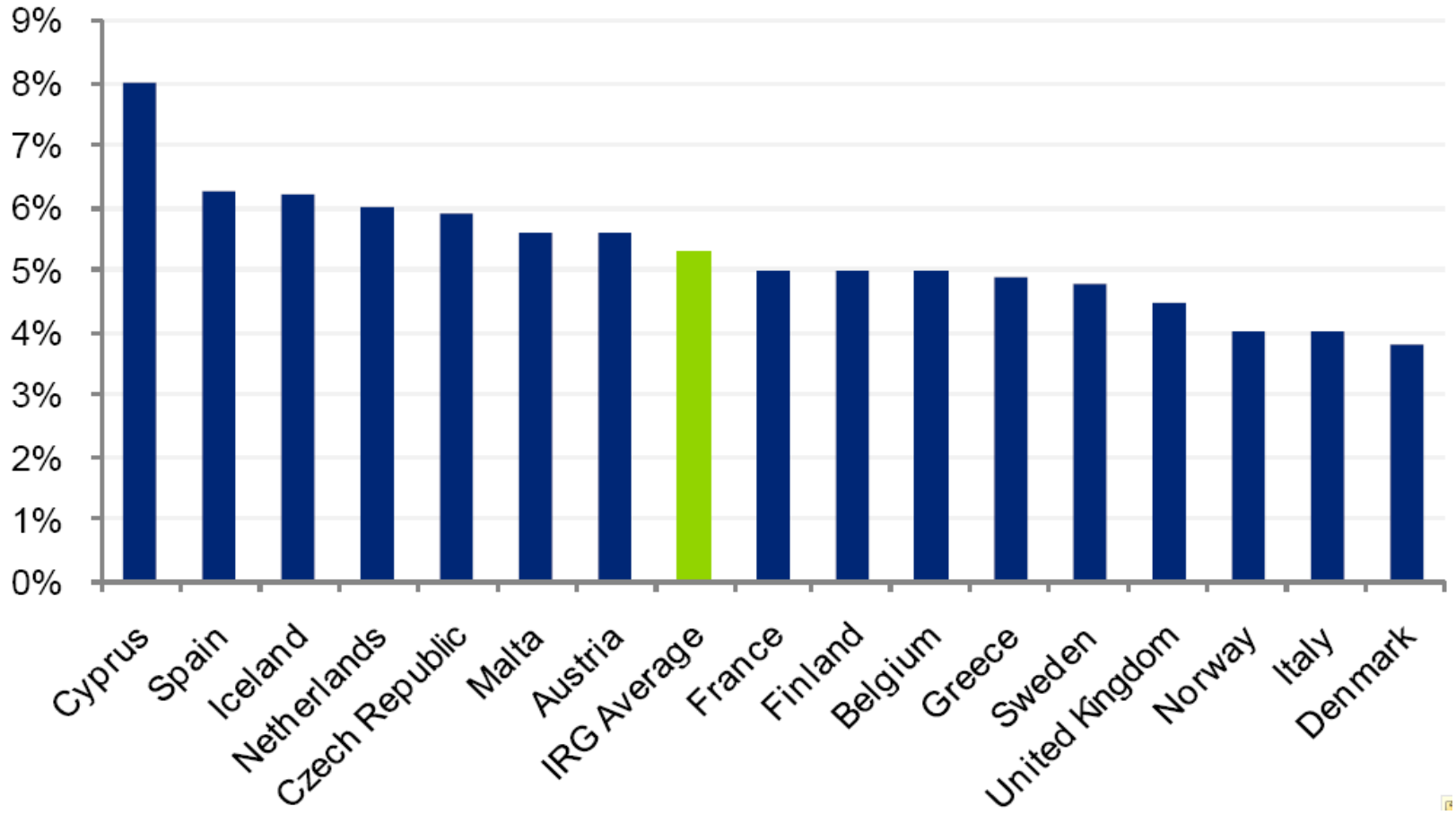
- EMRP is estimated based on:
  - the dividend growth model
  - surveys of academic and practitioner expectations;
  - international (or national) benchmarks
    - Adjusted for differences in nature and size of the companies, taxation, and country risk
- Positives:
  - Does not rely on (or require) historical data to estimate expectations of future returns
- Negatives:
  - Models are sensitive to the method of estimating long-run dividend growth (e.g. analysts' expectations, assumed constant growth rates)
  - Surveys are sensitive to nature of the questions asked, the sample, the weighting of responses, and the calculation converting responses into an estimate of the ERP

Results of the estimation of EMRP (in the UK) using different methods



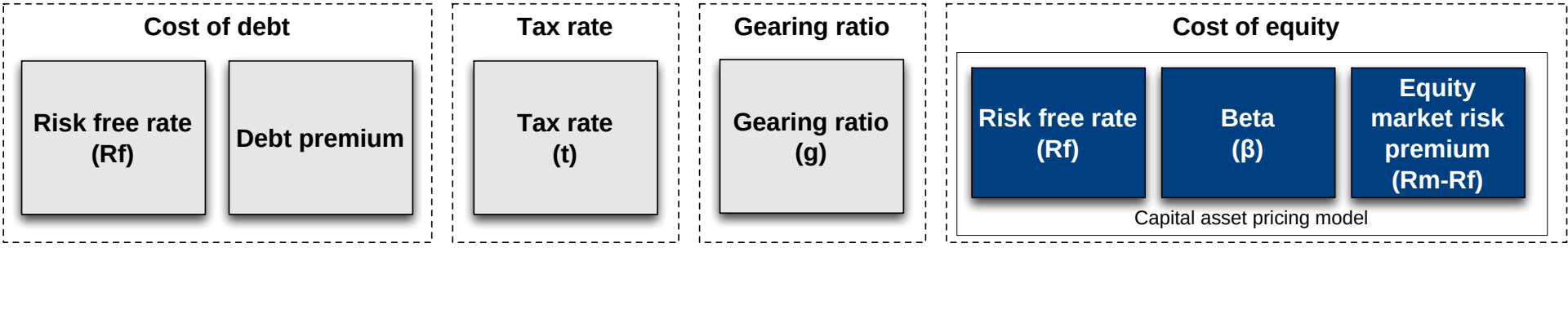
Source: Ofcom, 2005

EMRP applied by telecoms regulators in selected European countries

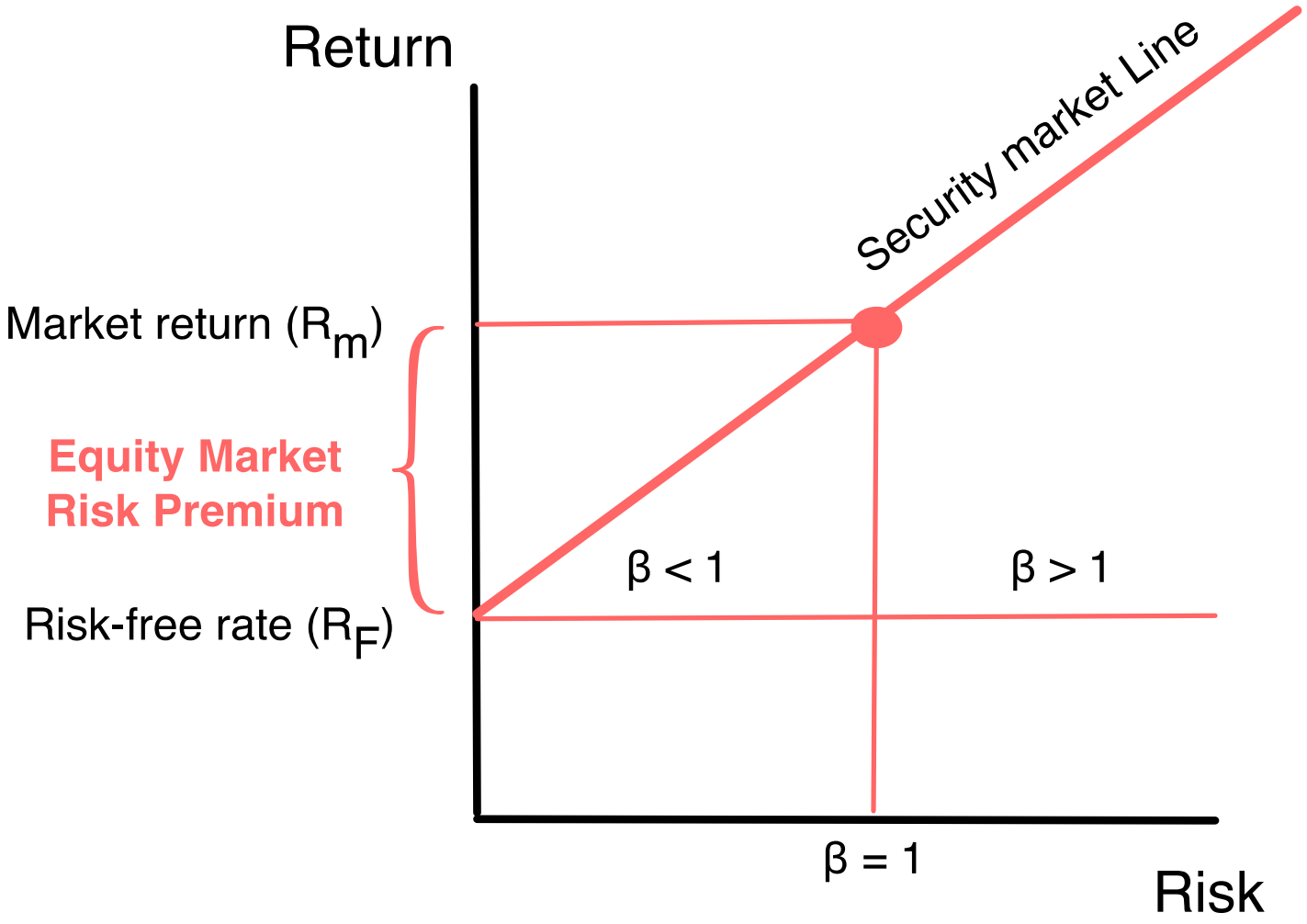


Source: ERG, 2009

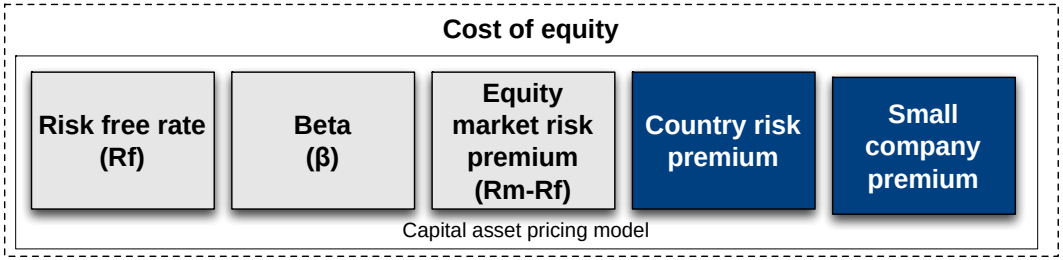
Bringing it all together – CAPM



Capital Asset Pricing Model

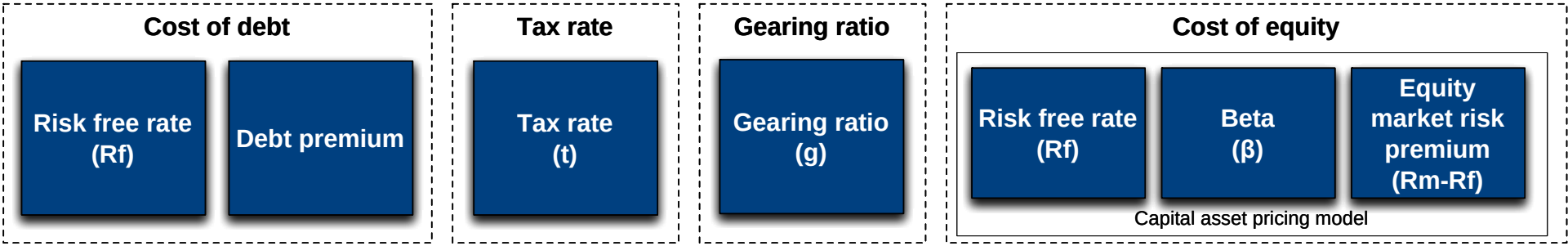


Two additional potential risks

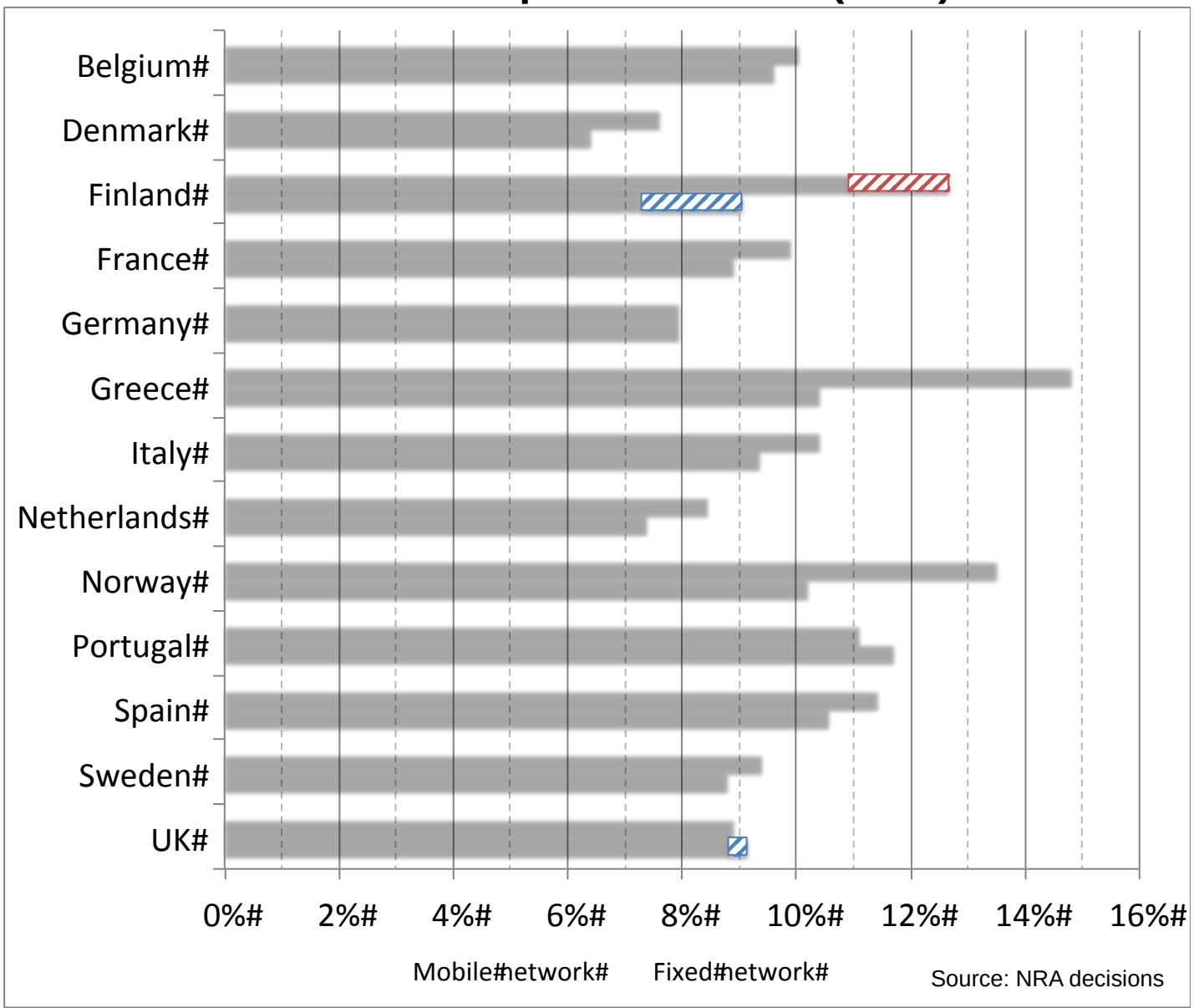


- **Country risk premium**
  - Reflects the inherent risks of investing in particular countries
  - Reflects differences in the level of financial, political, economic and institutional stability of different countries
  - Close to zero for most developed and stable countries
- **Small company risk premium**
  - Reflects finding that companies with smaller market capitalisation tend to earn higher returns over the long term as they are risker
  - Threshold usually the bottom decile of publicly traded companies
  - Estimated by comparing historical premiums earned by small companies over the market
  - E.g. Oftel (UK) in 2002, 1.35% premium on post-tax cost of equity for small mobile network operators

Bringing it all together – WACC



Nominal pre-tax WACCs for telecoms operators in selected European countries (2012)



Divisional WACCs

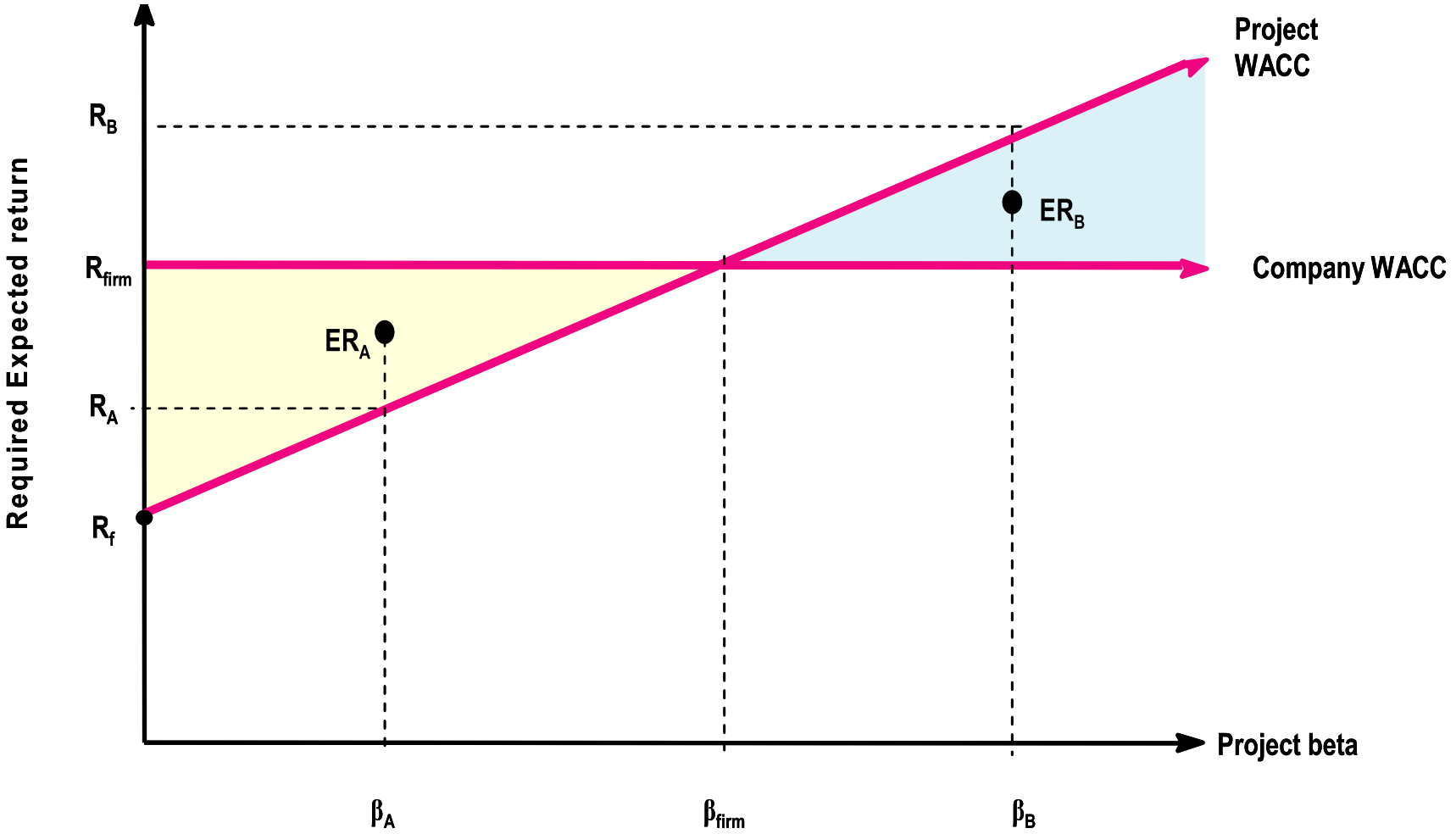
- Differentiated WACCs may be set for different units or projects within the one regulated firm
  - i.e. a firm's equity beta is the weighted average of the betas of the various businesses that the firm is engaged in
  - Made difficult by lack of capital market data at divisional level
- Example: Ofcom in UK re BT (2005)

	Copper access network	Rest of BT	Combined
Asset beta	0.9	1.23	1.1
Pre-tax WACC	10.0%	11.4%	

- E.g. SKMM in Malaysia re Telekom Malaysia (2012)

	Core	Fixed access	HSBB	Other	Group
Asset beta	0.60	0.54	0.85	0.88	0.65
Pre-tax WACC	8.65%	8.39%	9.70%		8.86%

Rationale for divisional WACCs



Source: IRG, 2007

Group Exercise

Group exercise

- Given:
  - Risk free rate (R_F) = 5.0%
  - Equity Market Risk Premium (EMRP) = 6.0%
  - Equity Beta (β) = 1.20
  - Corporate tax rate (t) = 30%
  - Debt premium (DP) = 1.0%
  - Gearing: D/(D+E) = 30%

- Please calculate:
  - Post-tax cost of equity
  - Pre-tax cost of equity
  - Pre-tax WACC

Answer 1 – Post-tax cost of equity

Post-tax $C_E = R_F + (\beta \times EMRP)$

Post-tax $C_E = 5\% + (1.2 \times 6\%)$

Post-tax $C_E = 12.2\%$

Answer 2 – Pre-tax cost of equity

Pre-tax C_E = Post-tax C_E / (1 - t)

Pre-tax C_E = 12.2% / (1 - 30%)

Pre-tax C_E = 17.4%

Answer 3 – Pre-tax WACC

First need to calculate the cost of debt:

$C_D = R_F + DP$

$C_D = 6.0\%$

You can now calculate the WACC:

WACC = [Pre-tax C_D x (D/(D+E))] + [**Post-tax C_E** x E/(D+E) / **(1 – t)**]

WACC = [6% x 30%] + [12.2% x 70% / 70%]

WACC = 1.8% + 12.2%

WACC = 14.0%

Alternatively:

Pre-tax WACC = Pre-tax C_D x (D/(D+E))] + [**Pre-tax C_E** x E/(D+E)]

Pre-tax WACC = [6% x 30%] + [17.4% x 70%]

Pre-tax WACC = 14.0%