Europe Economics Report for the Commission for Energy Regulation (CER)

Cost of Capital for Transmission Asset Owner (TAO), Transmission System Operator (TSO), Distribution System Operator (DSO)

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EXECUTIVE SUMMARY

1 This report sets out our views on the cost of capital for the Transmission Asset Owner (TAO), Transmission System Operator (TSO) and Distribution System Operator (DSO), based on data up to the end of February 2010.

2 We have used the Capital Asset Pricing Model (CAPM) and the Weighted Average Cost of Capital (WACC) framework to derive our cost of capital estimate.[1] Below, we summarise our views for each WACC parameter in turn and then set out our views on the overall range for the market cost of capital faced by the TAO, TSO and DSO over the next price control period. Finally we present our recommendation on the regulatory WACC that should be applied by the CER, allowing for the asymmetry of consequences of setting the regulatory WACC either too high or too low.

3 In arriving at our views, we have taken account of the current macroeconomic context in Ireland (see section 2). We have also carried out qualitative analysis of the systematic risk exposure of the TAO, TSO and DSO (see section 5) as a prelude to our analysis of the equity beta and debt premium.

Risk-free rate

4 Our range for the risk-free rate is based on evidence from yields on nominal government bonds in Ireland and Germany, yields on index-linked bonds in France, and regulatory precedents.

5 At the current time, Irish government bonds cannot be considered a risk-free asset. Irish government debt has been down-graded below AAA by both Standard and Poor's and Fitch, and CDS spreads for Irish government debt are significantly higher than those for German and French debts. Hence, in considering evidence from Irish government bonds we have adjusted observed yields using CDS data with the aim of removing the additional default risk.

6 Based on market data and regulatory precedents, our range estimate for the risk-free rate is **1.6 to 2.2 per cent** with a point estimate of **2 per cent**.

Equity risk premium

7 We have examined evidence on the equity risk premium (ERP), focusing particularly on the widely recognised DMS dataset of historic equity returns.

8 Drawing particularly on the DMS 2007 estimates of the Irish ERP (between 3.9 and 5.4 per cent), on recent regulatory precedents and taking into account the financial crisis in

[1] The CAPM-WACC framework is briefly explained in the introduction to the report (section 1).

Ireland, we believe that an appropriate range for the ERP is **4.5 to 5.4 per cent** with a point estimate towards the top end of this range of **5.2 per cent**.

Asset beta

9 To inform our asset beta estimates, we have carried out a comparator analysis of equity betas for other European energy companies that own transmission and/or distribution networks. As of 26 February 2010, asset betas of the European comparator utilities were in the range 0.16 to 0.35, after the exclusion of outliers. Historic analysis of the asset betas of our comparator companies suggests that they have generally been fairly stable since the last price review for the TAO, TSO and DSO, when the CER estimated an equity beta range of 0.2 to 0.4.

10 Examining recent regulatory determinations gave the range 0.2 to 0.41 for the asset betas of similar energy network companies.

11 Based on evidence from our comparator analysis and on regulatory precedents, we consider that 0.2 to 0.4 is the most appropriate range for the CER to use for the asset beta of the TAO, TSO and DSO with a point estimate of 0.3.

Debt premium

12 To inform our debt premium range, we have examined spreads on the bonds of comparator companies, recent bond issues by utility companies, and evidence from wider market indices.

13 In our view, the appropriate credit rating to assume for ESB and EirGrid is A rather than BBB. To ensure that this assumption is reflected throughout the WACC calculation, we have adopted a gearing assumption which we believe to be consistent with an A rating, and have re-levered our asset betas to this level of gearing in order to derive our equity beta range.

14 Given the assumption of a rating in the A category, our view on an appropriate range for the debt premium is **1.0 to 1.4 per cent** with a point estimate of **1.2 per cent**. Combined with our range for the risk-free rate, this gives a range for the real pre-tax cost of debt of 2.6 to 3.6 per cent.

Gearing

15 We consider that a gearing range of **50 to 60 per cent** with a point estimate of **55 per cent** is an appropriate level of notional gearing to assume.

16 While neither ESB nor EirGrid are currently rated, we consider that gearing at this level would enable them (subject to performance against other financial ratios) to achieve a rating in the A range, if they were to be rated. This ensures consistency with our cost of debt assumption.

17 A range of 50 to 60 per cent is also consistent with a number of regulatory precedents (although not all of them). For instance, 50 to 60 per cent is the range that the CER used in its 2005 determination, and recent figures used by the Northern Ireland Authority for Regulation (NIAUR) for System Operators Northern Ireland (SONI) and by Ofwat for the UK water industry lie within this range. We note, however, that Ofgem has tended to use a somewhat higher gearing assumption for energy networks in Great Britain.

18 Gearing of 50 to 60 per cent is not too far out of line with actual imputed gearing for ESB Networks. In particular, the imputed gearing for ESB Networks was within this range in 2006 and 2007 (although it shot up above it in 2008).

Market cost of capital

19 Our view is that the real, pre-tax cost of capital for the TAO, TSO and DSO lies within the range **3.2 to 5.6 per cent**, with a best point estimate of the market cost of capital of **4.6 per cent**. This is based on a pre-tax cost of equity of 3.9 to 8.7 per cent and a pre-tax cost of debt of 2.6 to 3.6 per cent. The parameter estimates on which this range is based are shown in the table below.

20 We have used the Irish corporation tax rate of 12.5 per cent to uplift the cost of equity in order to calculate a pre-tax cost of capital.

Table 1: Recommended WACC range

	Low	High	Point estimate
Cost of equity			
Risk-free rate	1.6	2.2	2.0
Equity risk premium	4.5	5.4	5.2
Asset beta	0.2	0.4	0.3
Equity beta	0.4	1.0	0.67
Post-tax cost of equity	3.4	7.6	5.5
Pre-tax cost of equity	3.9	8.7	6.2
Cost of debt			
Debt premium	1.0	1.4	1.2
Pre-tax cost of debt	2.6	3.6	3.2
Post-tax cost of debt	2.3	3.2	2.8
WACC			
Notional gearing (%)	50	60	55
Corporation tax rate (%)	12.5	12.5	12.5
Post-tax WACC	2.8	4.9	4.0
Vanilla WACC	3.0	5.2	4.2
Pre-tax WACC	3.2	5.6	4.6

Source: Europe Economics

Regulatory cost of capital

21 It is sometimes argued that when estimating the cost of capital for a regulated firm there are asymmetric consequences to getting the estimate either too low or too high. In particular, if the estimate is too high, consumers pay more than necessary over the next price review period; whereas if it is too low, the regulated firm may not be able to raise the finance necessary to carry out investment, potentially causing more serious detriment to consumers in the long run. This argument may carry particular weight in contexts in which the regulated firm is being asked to carry out a significant programme of investment.

22 It is a matter of regulatory judgment how much uplift should be applied to the regulatory WACC to reflect this consideration. However, we carried out some analysis based on regulatory precedents in order to arrive at a recommendation for the regulatory WACC that the CER should apply.

23 Based on this analysis we recommend that the CER should select a pre-tax regulatory WACC within the range **4.8 to 5.2 per cent**, thus aiming up on our best estimate of the market cost of capital to take account of asymmetry of consequences. While the precise point chosen from within this range is a matter of regulatory judgment, our recommendation is that the CER takes the mid-point of this range and uses a pre-tax regulatory WACC of **5.0 per cent.**

Other issues

24 We gave consideration to whether, within the WACC range, the TSO should be given a different cost of capital from the TAO and DSO. We recommend against using different costs of capital.

25 We also considered whether EirGrid requires an additional small company premium. We recommend against such an adjustment.

26 We carried out some sensitivity analysis to determine the possible effects of subtracting a default premium from the cost of debt, and using non-zero debt betas to calculate the asset betas and re-lever the equity beta. This resulted in a very similar range and the same indicative point estimate to that presented in Table 1 above.

1 INTRODUCTION

Note: in this published version of the report, confidential information has been replaced by the symbol [✂].

1.1 This is Europe Economics' report for the Commission for Energy Regulation (CER) setting out our views on the cost of capital for the Transmission Asset Owner (TAO), Transmission System Operator (TSO) and Distribution System Operator (DSO).

1.2 Below, we briefly summarise the methodological framework used in this report and set out the structure of the rest of this report.

Overview of Methodology

The CAPM-WACC framework

1.3 We have used the Capital Asset Pricing Model (CAPM) and the Weighted Average Cost of Capital (WACC) framework to derive our cost of capital estimate. For the purpose of introduction, we briefly rehearse what this framework is.

1.4 The cost of capital allowed by a regulator in setting price limits should reflect the opportunity cost of the funds invested in assets; it represents the rate of return that an investor would be likely to require in order to invest in a company, given its risk profile compared with other potential investments. It can also be thought of as the discount rate which an investor would use in evaluating the income stream to be expected from investing in the company.

1.5 For the purpose of the price control we need to derive a real WACC, and hence we carry out our analysis in real terms rather than nominal terms.

1.6 The weighted average cost of capital (WACC) is computed from (a) the average cost of debt for the various forms of debt held by the company, and (b) the cost of equity. This is the return that investors (shareholders and lenders of various types) require in order to invest in the company.

1.7 Mathematically, the following formula is used:

$$WACC = r_E . \frac{E}{D+E} + r_D \frac{D}{D+E} \qquad [1]$$

where r_E is the cost of equity, r_D is the cost of debt, and E and D are the total values of equity and debt respectively used to determine the level of gearing in the company, so giving the relative weights between the cost of equity and debt finance.

Cost of debt

1.8 The cost of debt measures the combination of interest rates charged by banks to the company and the return paid by the company on any corporate bonds or other loan instruments issued. It is standard practice to think of this as being made up of a risk-free component and a company-specific risk premium.

$$r_D = r_f + debtpremium \quad [2]$$

1.9 Since payments on debt are generally fixed (in contrast to the variable returns on equity), "risk" in this context principally means the risk of non-payment. One potential measure of the risk of non-payment is the rating on the company's debt, provided by ratings agencies. Thus, one way to calculate a company's debt premium is to consider the rating(s) of its debt and then take market data on spreads on bonds with this rating. For companies which do not have listed bonds and which are not rated, one can make a reasonable assumption about the rating that they might have were they to be rated, based on other similar companies.

Cost of Equity

1.10 The capital asset pricing model (CAPM) is used to determine the cost of equity, r_E, applying the following equation:

$$r_E = r_f + \beta_E * MRP \quad [3]$$

- r_f is the return on a risk-free asset, usually proxied by a measure of the rate on medium to long-term government bonds.
- β_E is the correlation between the risk in company returns and those of the market as a whole, which can be estimated from primary market data for listed companies, or by analysing the betas of comparators for companies which are not listed.
- *MRP* is the market-risk premium over the risk-free rate, an Irish economy-wide parameter. Conceptually, the market includes all assets. In practice, however, it is generally assumed that a broad equity market-base index is a good proxy. Thus, estimates of the equity risk premium are used as a proxy in estimating the MRP.

1.11 Thus in the standard CAPM there are three determinants of the expected return on any asset: the return on a riskless asset - the market premium over that riskless rate that is earned by investors as a whole, reflecting systematic risk; and the particular company's exposure to systematic risk. As discussed further below, company specific risks do not enter the cost of capital in the CAPM model, as they can, by definition, be diversified away by investors.

Approach to risks

1.12 Under CAPM, risks are divided into two major categories:

(a) systematic risks; and

(b) specific risks.

1.13 Systematic risks are risks that affect the whole market. Systematic risks relate to outcomes that cause the whole market to move, such as economic growth or recession, or wars. Even fully diversified investors are subject to systematic risk, and require a compensation for it through the cost of capital. The amount of compensation (the level of the cost of capital) they require from a particular company or a project depends on how exposed that company is to systematic risks.

1.14 The specific risks affecting an individual firm are those risks that can be offset by investors diversifying their investments. These are not taken into account in CAPM because it is assumed that in an efficient capital market investors can protect themselves against such risks by holding a diversified portfolio. Thus, in CAPM, specific risks are assumed not to affect the rate of return to investors (i.e. because they can be diversified away) that the company has to cover through its cost of capital.

1.15 If you consider an industry in which there is no systematic risk (and no industry-specific risk), but each of the companies in the industry faces company-specific risk CAPM predicts that the rate of return in this industry would be the risk-free rate. Since there is no systematic risk, an investor with equal shares in all the companies in the industry would be guaranteed to receive the risk-free rate every period — the company-specific risks taken that turned out badly in some companies would exactly balance those that turned out well in others (that is precisely what it means to say that there is no systematic risk).[2]

1.16 An example of a specific risk would be cost shocks caused by failure of the engineering solutions adopted by an electricity network company.

Structure of Report

1.17 This rest of this report is structured as follows:

(a) Section 2 discusses the macroeconomic context in Ireland;

(b) Section 3 analyses the risk-free rate;

[2] Note that industry-wide industry-specific risks can be diversified by investors, in an analogous way to that set out in the thought experiment above, through holding shares across industries.

(c) Section 4 considers the equity risk premium;

(d) Section 5 presents analysis of the risks faced by the TAO, TSO and DAO;

(e) Section 6 contains our comparator beta analysis;

(f) Section 7 assesses the cost of debt;

(g) Section 8 considers capital structure;

(h) Section 9 presents our view on the market cost of capital;

(i) Section 10 presents our views on the appropriate regulatory cost of capital;

(j) Section 11 summarises our final conclusions.

1.18 A number of appendices are contained in a separate document. In particular:

(a) Appendix 1 examines the case for a small company premium for EirGrid;

(b) Appendix 2 considers whether a default premium adjustment is necessary in the cost of debt;

(c) Appendix 3 carries out sensitivity analysis to determine the effect on the WACC of a default premium adjustment;

(d) Appendix 4 reviews the regulatory precedents on cost of capital in Ireland and the UK; and

(e) Appendix 5 reviews how regulators have dealt with financeability in Ireland and the UK.

2 MACROECONOMIC CONTEXT IN IRELAND

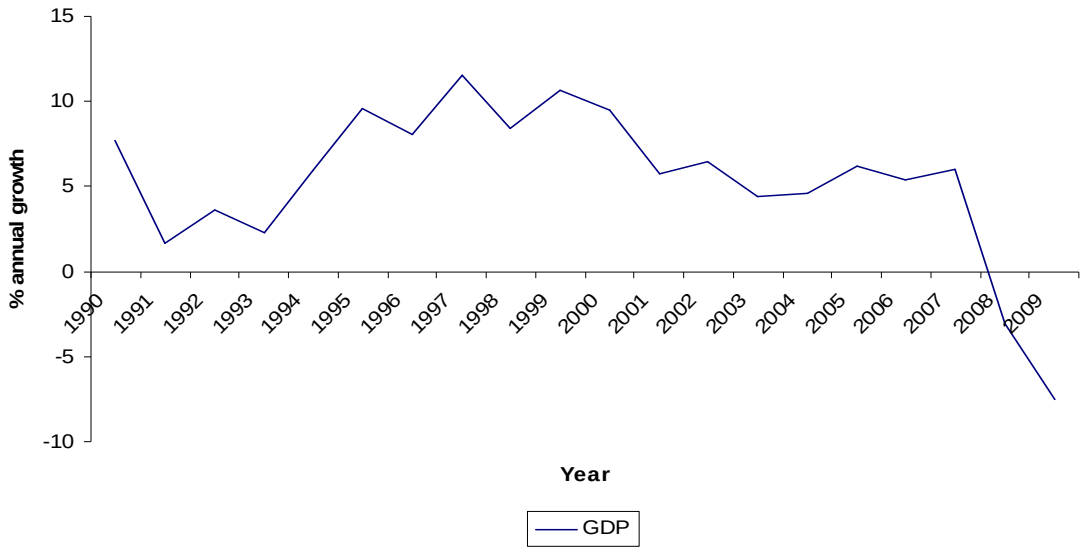
Introduction

2.1 In this price review, the CER faces additional challenges in determining the cost of capital as a result of the current financial and macroeconomic context. The credit crunch has caused significant dislocations in financial markets, with capital being constrained and bond spreads having risen significantly above historic levels before falling back again. Further, events in the real economy are having added knock-on impacts on financial variables – for example, the likelihood of significant defaults due to the recession means that bond spreads factor in a larger default premium. In this section, we set out the macroeconomic context of the Irish economy and identify what the key economic trends have been over the last two decades. We then discuss some of the key implications of the recent financial crisis on the Irish economy and identify the possible implications for the various WACC components.

Background to the Irish Economy

2.2 As illustrated in Figure 2.1 below, the Irish economy grew by an annual average of 6.5 per cent between 1990 and 2007.

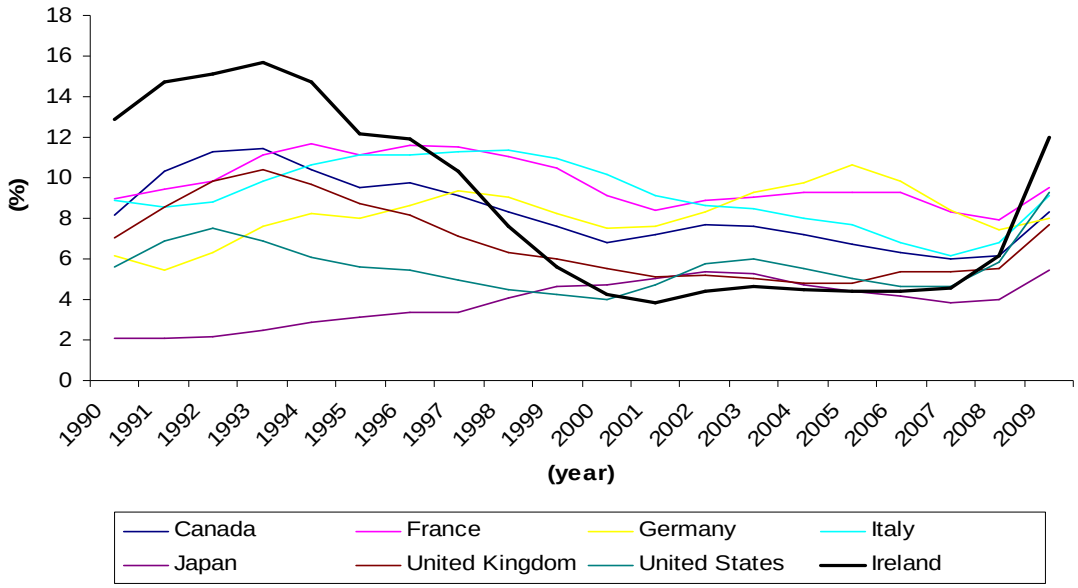
Figure 2.1: Growth in real GDP, 1990-2009



Source: Eurostat

2.3 In the 10 years prior to the financial crisis, Ireland experienced one of the highest growth rates in real GDP per capita and experienced one of the lowest unemployment rates among major advanced economies (see Figure 2.2 below). Further, this period was characterised by a significant expansion in higher value-added activities such as financial services, information technology services, and other business services.

Figure 2.2: Unemployment rate in Ireland and the G7, 1990-2009



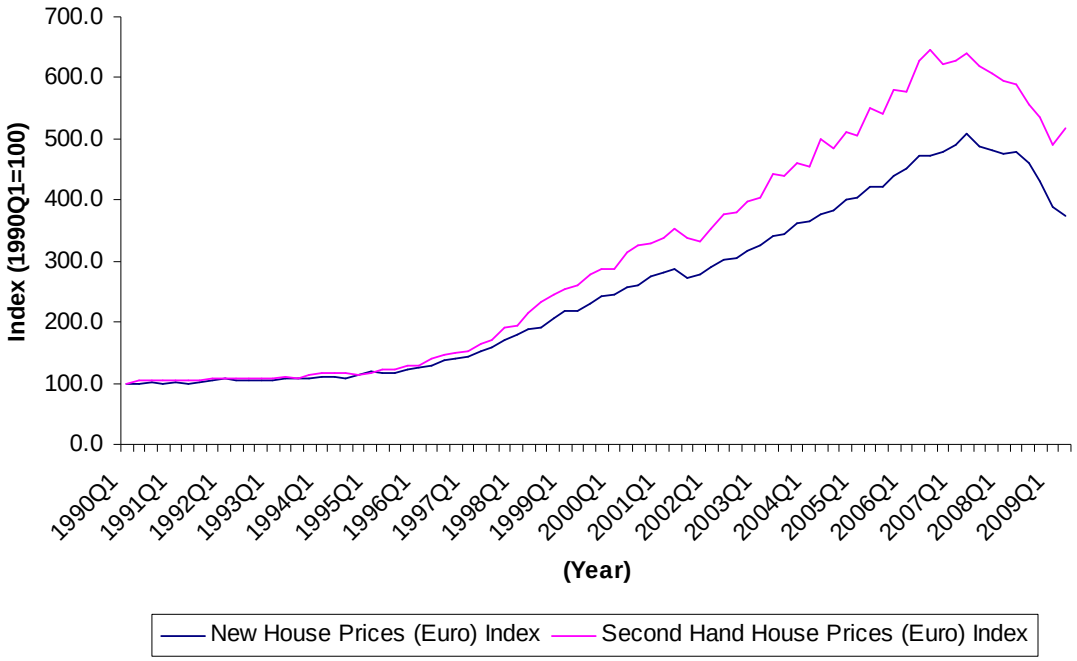
Source: Eurostat

2.4 When discussing macroeconomic developments in Ireland between 1990 and 2007, it is possible to distinguish between two phases in Ireland's growth.

2.5 The first phase was driven predominantly by exports and Foreign Direct Investment (FDI). Foreign companies invested substantial amounts in the country, providing capital and know-how, attracted by the high competitiveness of the country (low nominal wages, high productivity, very low corporate taxation and access to the EU single market). By the end of 2002, however, these ceased to be the main driving forces behind Ireland's growth.

2.6 In contrast to the first phase of Ireland's growth, the second phase was based on less stable foundations. Low interest rates (partly a consequence of euro membership, although interest rates were low across much of the developed world in this period) stimulated rapid property price growth, and spurred a building and retailing boom. Indeed, as illustrated in Figure 2.3 below, house prices for both new homes and second-hand homes began to increase significantly from the late nineties, reaching their peak by mid-2007. Between 1990 and mid-2007, prices for new homes and second-hand homes increased by approximately 500 and 600 per cent, respectively.

Figure 2.3: National average house price index for new and second-hand homes, 1990-2010



Source: Central Office of Statistics

2.7 The reliance on house building in fuelling growth was widely recognised, with the IMF in 2007 noting that:[3]

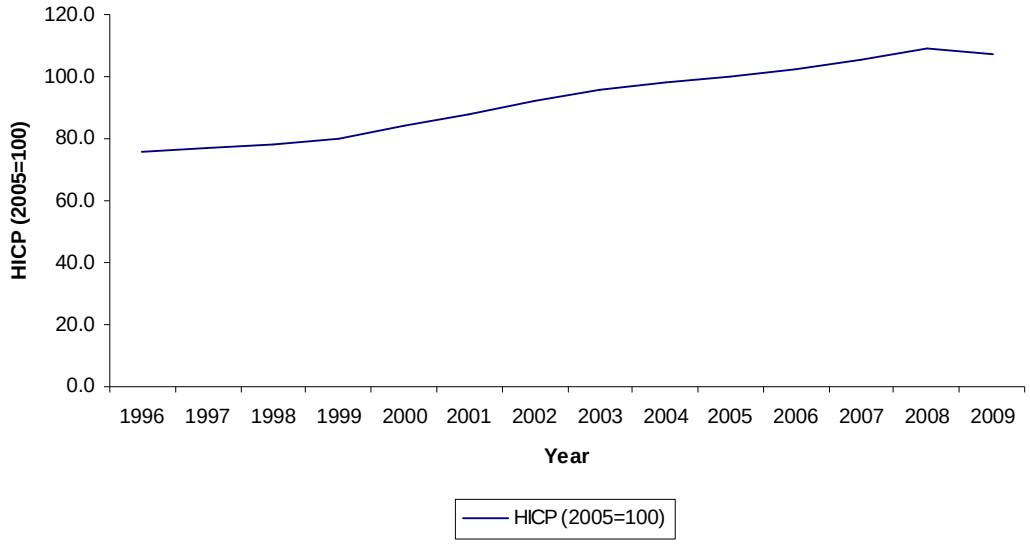
> "Economic performance remains impressive, though in recent years economic growth became increasingly reliant on house building. Competitiveness eroded somewhat, though it is still broadly appropriate. The rise in euro area interest rates has prompted a welcome cooling of the housing market, which will help to rebalance economic growth and reduce inflation, though there is a risk of a sharper slowdown. The key policy challenges are therefore to support adjustment to sustainable growth."

2.8 When the property "bubble" burst, it left a legacy of unsold houses and bad debts.

2.9 In addition, rising inflation in the period 2000-2007, which averaged 4 per cent per year, (see Figure 2.4 below) reduced Irish competitiveness.

[3] IMF, 2 August 2007, Article IV Consultation

Figure 2.4: Annual inflation growth, 1990-2009

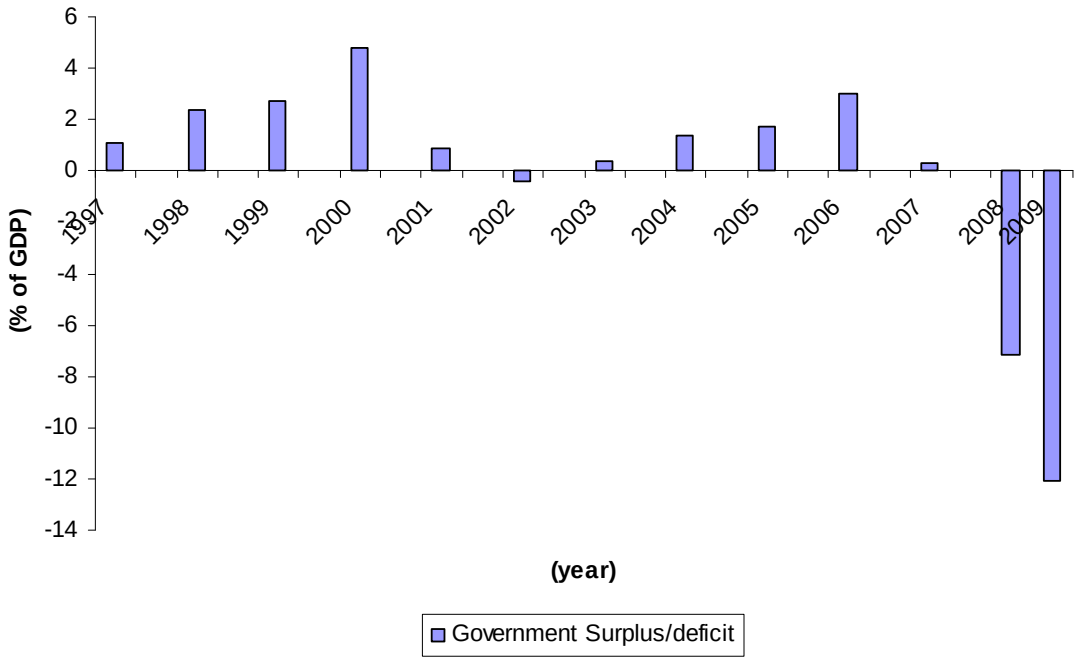


Source: Eurostat

2.10 During this period the growth rate of labour costs far outstripped general inflation, and also rose sharply relative to Ireland's main trading partners. A recent study by the European Central Bank (ECB) found that Irish unit labour costs had risen by one third between 1999 and 2007. Between 1999 and 2007, labour costs increased by approximately 55 per cent (compared with approximately 33.5 per cent in France, 19 per cent in Germany, 26 per cent in Italy and 50 per cent n the UK). This appears to have been an important factor in eroding Ireland's competitiveness.

2.11 The healthy current-account surplus in the mid-1990s turned into a big deficit (-4.2 per cent of GDP in 2006). Public finances also began to deteriorate from 2007, driven by significant rises in public spending from 2004/05 coupled with an over-dependence on one-off property-related taxes. The budget went from a surplus of 3 per cent of GDP in 2006 to a deficit of 7.2 per cent of GDP in 2008 (see Figure 2.5 below).

Figure 2.5: Budget surplus/deficit, 1997-2009*



*Notes: *2009 figure is based on IMF forecasts.*

Source: Eurostat, IMF

2.12 Thus, even before the manifestation of the financial crisis, the Irish economy was characterised by some material sources of fragility which have subsequently interacted with the wider turmoil, increasing risks for the economic system and generating further instability.

Milestones of the Financial Crisis in Ireland

Major world events

- *9 August 2007:* The ECB pumps €95 billion into the banking sector to try to improve liquidity and injects a further €108.7 billion over the next few days.
- *13 September 2007*: Northern Rock asks for and is granted emergency financial support from the Bank of England as savers withdraw their money and the bank's share price plummets. Irish savers are assured their savings are protected.
- *17 February 2008:* Northern Rock is taken into state ownership by the UK government.
- *16 March 2008:* JP Morgan Chase agrees to pay just $236m to buy Bear Stearns, the mortgage portfolio of which had been worth an estimated $33bn as recently as the end of February 2008. Without a buyer it would have had to declare bankruptcy.

- *7 September 2008*: The collapse and bail out of US quasi-government housing agencies Fannie Mae and Freddie Mac. Together Fannie and Freddie held about half the total mortgage debt in the US.

- *15 September 2008:* Investment bank Lehman Brothers files for bankruptcy protection and entered liquidation after failing to find a buyer.

- *16 September 2008*: The US government injected an $85bn lifeline into American International Group (AIG), the world's largest insurer, after collapsing share prices left it on the brink of bankruptcy.

- *17 September 2008*: Lloyds takes over the Halifax Bank of Scotland (HBOS) amid fears about its future. The UK government invoked a national interest clause in order to circumvent competition law as the new bank holds up to one-third of the UK's savings and mortgage market.

- *18 September 2008:* Lloyds TSB confirmed that it was paying £12.2bn to take over HBOS in a move intended to create one of the strongest banks in Britain. HBOS, which owns Halifax and Bank of Scotland, is Britain's biggest mortgage lender and has suffered a dramatic fall in its share price.

- *19 September 2008:* The US Treasury calls for the establishment of a Troubled Assets Relief Program (TARP) which would allow the government to purchase or insure up to $700 billion of 'troubled assets'. The TARP was finally approved on 3 October 2008.

- *September 2008*: Belgium, the Netherlands and Luxembourg injected €11.2bn into the financial services group Fortis, to prevent it becoming the first big casualty of the credit crunch in the continent.

- *12 October 2008:* European governments present plans for rescuing the banking sector. Germany approves a package worth up to €500 billion, France commits approximately €350 billion and Spain commits €100 billion. The majority of the money is intended to be used to guarantee inter-lending between banks.

- *13 October 2008*: The UK government injects £37billion into RBS and HBOS (Lloyds was badly affected by bad debts built up by HBOS in the mortgage market) to stabilise both banks.

- *16 December 2008*: The Federal Reserve cuts interest rates to 0-0.25 per cent, the lowest in its history, to stem a deepening of the recession.

- *8 January 2009:* The Bank of England cuts interest rates to 1.5 per cent, the lowest in its 315-year history.

- *15 January 2009:* The ECB cuts Eurozone interest rates to 2 per cent.

- *14 February 2009:* The US approves a USD$787 billion economic recovery plan which includes a 'buy American clause', raising protectionist fears.

- *13 August 2009:* Germany and France exit recession with GDP in both countries growing by 0.3 per cent between April and June.

- *23 September 2009:* The European Commission proposes the creation of a new European Systemic Risk Board ("ESRB"), the aim of which would be to assess and warn about the threats to financial stability in the region.

- *30 September 2009*: The IMF revises its initial estimates of the total loss to the global economic system from $4 trillion to $3.4 trillion.

- *3 November 2009:* The UK government announces that a further £33.5 billion would be injected into Royal Bank of Scotland to ensure its survival, bringing the government's total investment in the bank to 84 per cent.

- *5 November 2009*: The Bank of England announces a further £25 billion injection into the UK economy, bringing the total amount injected under the quantitative easing programme to £200 billion.

- *November 2009:* The Dutch government announces plans to provide ABN Amro and Fortis Bank Netherland with a further €4.4 billion to ensure their merger goes through.

- *8 December 2009:* Fitch cuts Greece's sovereign credit rating from A- to BBB+ with a negative outlook.

- *14 December 2009:* Standard and Poor cuts Greece's sovereign credit rating from A- to BBB-

- *22 January 2010*: The US government announces a new proposal which would prevent firms from investing in, owning or sponsoring a hedge fund or a private equity fund.

- *4 February 2010*: Moody's credit rating agency issues a warning that if the US economy grows slower than expected given its current deficit levels, its AAA credit rating could be damaged.

- *4 March 2010:* Greece holds a bond sale that is oversubscribed, but has to offer a yield of 6.3 per cent.

- *25 March 2010:* Eurozone and the IMF agree to a bail-out plan for Greece– the largest multi-lateral bail-out ever attempted – with an estimated €30bn in the first year from the **E**urozone and €10-€15bn expected from the IMF.

Major events in Ireland

- *20 September 2008*: the Irish government rushes to increase the statutory limit for deposit protection schemes from €20,000 to €100,000 in an effort to dampen growing fears of a run on banks and building societies. The cover applies to 100 per cent of an individual's deposit and leaves Irish savers better protected than savers in most other European countries.

- *30 September 2008*: the government announces that it will guarantee all deposits, bonds and debts in the country's six biggest banks and building societies for two years to maintain financial stability. Included are AIB, Bank of Ireland, Anglo Irish Bank, Irish Life & Permanent, Irish Nationwide and the Educational Building Society. It represents the biggest potential exposure ever to confront Irish taxpayers.

- *September 2008:* Ireland enters recession, with output contracting by 0.5 per cent in the three months up to the end of June.

- *November 2008*: the chairman of Anglo Irish Bank, Ireland's third largest bank, admits he had hidden a total of €87 million in loans from the bank, triggering a series of incidents which led to the eventual nationalisation of Anglo on 21 January 2009.

- *January 2009*: Anglo Irish Bank nationalised.

- *February 2009:* Announcement of the provision of two €3.5 billion bailouts to *Allied Irish Bank* and *Bank of Ireland* as part of the government's recapitalisation scheme. The plan saw the Minister appoint 25 per cent of the directors at each bank, whilst the banks have agreed to provide a 30 per cent increase in mortgages for first-time buyers and a 10 per cent increase in loans to small and medium businesses, as well as to hold-off on repossessions of mortgage holders for twelve months after they fall into arrears.

- *March 2009*: S&P downgrades Irish Government bonds' rating from AAA to AA+ with a negative outlook.

- *April 2009:* the National Asset Management Agency (NAMA) is established. The NAMA is a government-owned asset Management Company dealing with assets transferred from banks.

- *April 2009*: Fitch downgrades Irish Government bonds' rating from AAA to AA+.

- *June 2009:* S&P downgrades Irish Government bonds' rating from AA+ to AA with a negative outlook.

- *July 2009:* Moody's downgrade Irish Government bonds' rating from AAA to Aa1, with a negative outlook.

- *November 2009*: Fitch downgrades Irish Government bonds' rating for a second time from AA+ to AA-.

- *30 March 2010:* The Irish government recapitalises the Irish banking system by injecting €32 billion into five financial institutions: Allied Irish Banks (AIB), Bank of Ireland, Anglo Irish Bank, Educational Building Society and Irish Nationwide building society.

Impacts of the Financial Crisis in Ireland

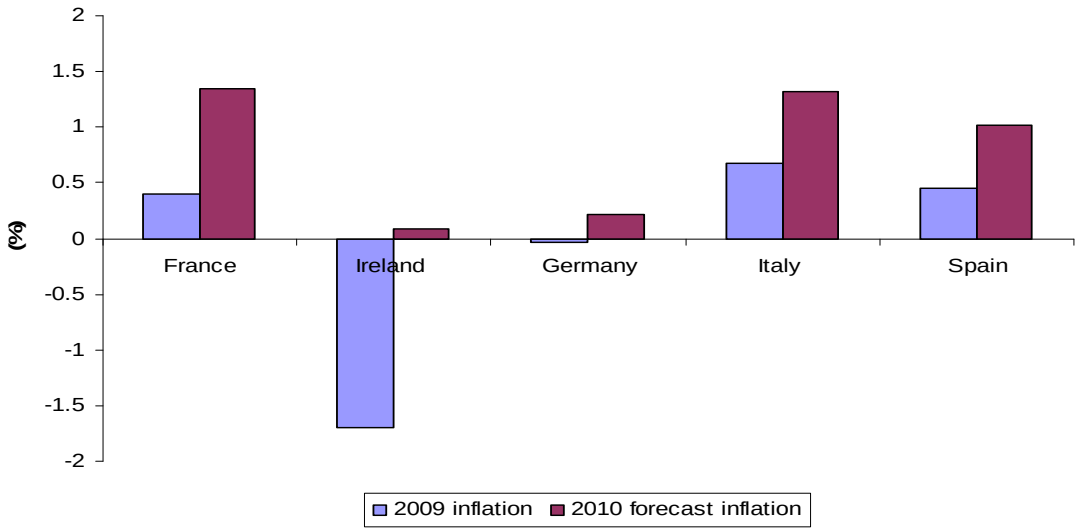
Slowing growth and deflation

2.13 GDP in the last quarter of 2009 was 7.4 per cent lower than that in the same period in 2008, and is expected to contract further in 2010 by between 0.3 and 2.5 per cent.

2.14 The fall in construction activity has contributed to higher unemployment. Both imports and exports fell rapidly as world trade volumes collapsed. The smaller volume of exports probably contributed to the rise in unemployment, which rose to 13 per cent by the end of 2009 and is expected to reach 15.5 per cent in 2010. Some discouraged workers are simply leaving the labour force. These employment trends, along with the anticipated additional decline in nominal wages and the high degree of uncertainty, are expected to pull consumption down sharply.

2.15 Irish prices have declined faster than elsewhere in the Eurozone. Figure 2.6 below sets out actual inflation during 2009 and the IMF's inflation forecasts for Ireland, Germany, France, Italy and Spain. As illustrated in this figure, the Harmonised Index of Consumer Prices (HICP) in Ireland fell by 1.7 per cent in 2009; compared with a fall of 0.03 per cent in Germany and an increase of between 0.4 and 0.7 per cent in France, Italy and Spain. The IMF's forecast for 2010 indicates that price inflation in Ireland is likely to remain considerably below the levels expected for Germany, France, Italy and Spain.

Figure 2.6: Inflation in Ireland, Germany, France, Italy and Spain in 2009 and 2010 IMF forecasts

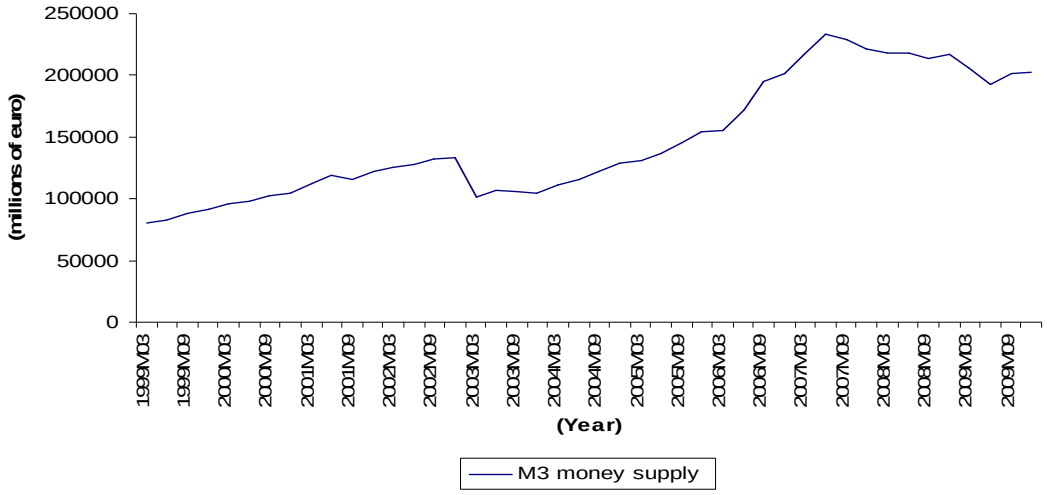


Source: IMF

2.16 The fall in prices has implied higher real interest rates than in the rest of the Euro zone, and ongoing high real interest rates will be a drag on the economy even in the recovery phase. Given the priority being attached to budget consolidation, a fiscal loosening to offset the monetary dampening has not been feasible.

2.17 Deflation in the Irish economy has been accompanied by a significant contraction in the money stock. As indicated in Figure 2.7 below, the stock of broad money (i.e. M3) contracted by approximately 17 per cent between mid-2007 and mid-2009. The supply of broad money (M3) only began to resume growth in September 2009.

Figure 2.7: M3 money supply, 1999-2009

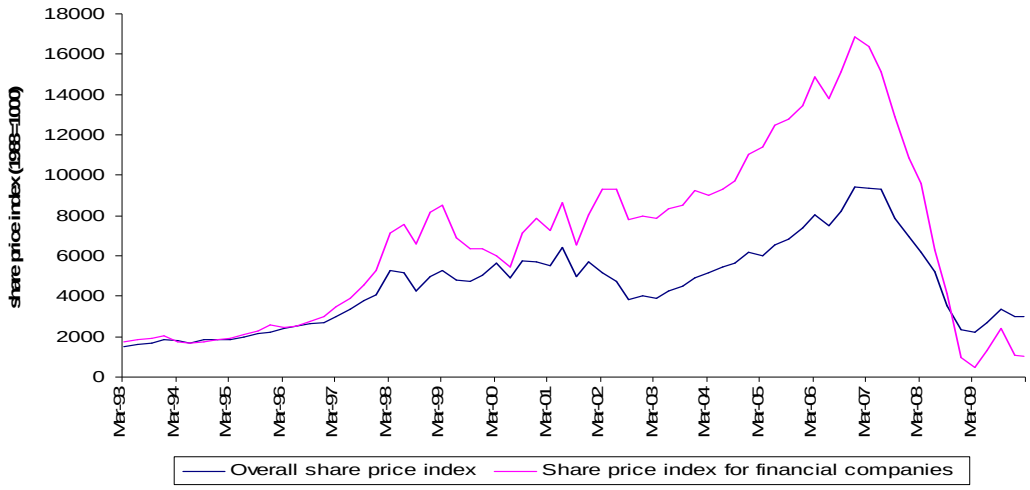


Source: Eurostat

Financial sector distress

2.18 Domestic vulnerabilities are revealed in the sharp decline in the stock prices of Irish banks relative to the overall stock index (see Figure 2.8 below), with the pronounced degree of this fall differentiating Ireland from other euro zone banks.

Figure 2.8: Irish stock exchange overall share price indices and share price indices for financial companies, 1990-2009



Source: Bloomberg

2.19 Three important features of the Irish financial system (which constitute its main elements of vulnerability) help explain this:

(a) The domestic portfolio has been heavily concentrated in residential mortgages, construction and real estate. Residential mortgage servicing has held up, but arrears have grown and are likely to increase further with high and rising unemployment.

(b) In the decade running up to the crisis, Irish banks had very high loan to deposit ratios. With the recent downturn, market funding pressures have been compounded by lack of growth in deposits.

(c) Irish banks are significantly exposed to the UK and US markets: continued financial stress in the United States and the United Kingdom could result in large further losses for them. Also, the deleveraging following global losses of international banks could imply sizeable capital outflows from Ireland by foreign banks with subsidiaries or branches re-focusing credit provision in their home markets.

Public finance

2.20 Well before the crisis hit, public finances had developed serious structural weaknesses.

2.21 In the boom years, personal income tax rates were lowered and expenditure grew rapidly (at about the highest pace among the Organisation for Economic Co-operation and Development [OECD] economies). Buoyant property-related revenues (stamp duties, VAT, and capital-related taxes) masked the growing structural deficit, which reached 12.5 percent of GDP in 2008.

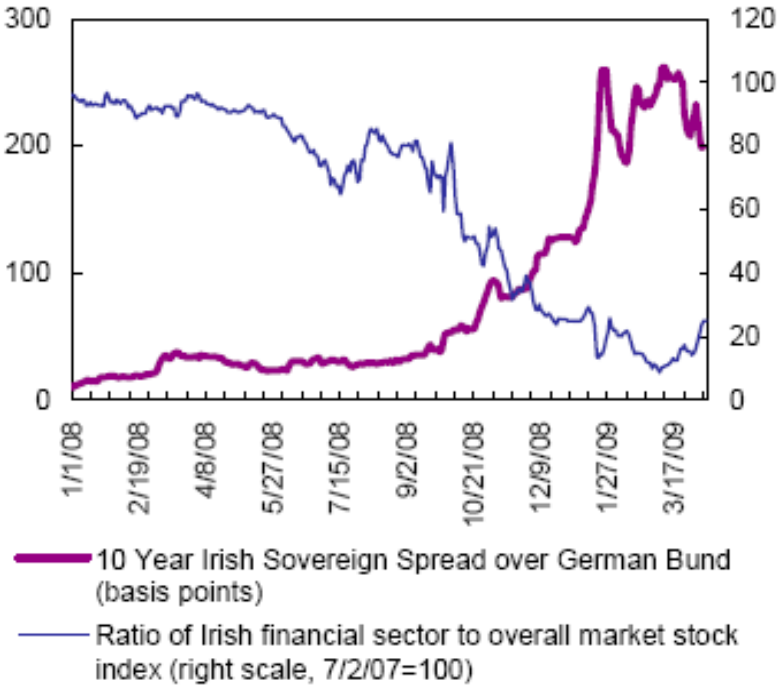
2.22 Following the sharp deceleration of growth and revenues, the fiscal deficit threatened to reach 15 percent of GDP, which compares with Ireland's record 17.5 percent of GDP in 1978. Concerns about the sustainability of public finances triggered Moody's and S&P to downgrade Irish Government bonds. S&P downgraded Irish Government bonds from AAA to AA+ in March 2009 and downgraded them further to AA in June 2009. Moody's followed by downgrading the bonds from AAA to Aa1 in July 2009.

2.23 Following the rescue of Bear Stearns in March 2008, IMF analysis[4] shows that a relationship emerged between financial sector vulnerability and the state of public finances. As financial stocks fell in relation to the overall stock market, the sovereign bond spreads (over the German Bund) increased.

2.24 The relationship intensified following the nationalisation of Anglo Irish in the second week of January 2009 when financial stocks took another pounding, while the spread on the Irish sovereign bonds spiralled to about 250 basis points. Subsequently, Irish sovereign spreads (relative to other Eurozone economies) moderated. However, they remain at elevated levels, and the analysis shows that financial sector, public finances, and economic growth weaknesses could continue to reinforce each other. Ireland could also suffer from significant turbulence in the Eurozone generated by events in Greece, Portugal, and Spain.

[4] See IMF (September 2009) *Article IV Consultation*

Figure 2.9: Financial vulnerability and public finances



Source: IMF (September 2009) Article IV Consultation

Economic Outlook

2.25 On the basis of the economic indicators discussed above, we summarise the economic outlook for the Irish economy over the next two years.

2.26 The extent of downside risk to the Irish economy is substantial. As noted above, GDP is expected to contract further in 2010 (although by less than in either 2008 or 2009) with estimates ranging from 0.3 per cent (ESRI) to 2.5 per cent (IMF).[5] This is largely driven by the collapse in the construction sector, depressed private consumption and negative export growth. ESRI'S forecast of an annual decline in GDP of 0.3 per cent in 2010 is based on the assumption of a continuing decline in output the first half of 2010 followed by a resumption of growth in the second half. Other forecasters, including the Department of Finance/CSO anticipate low quarter-on-quarter growth in late 2010. With regard to growth projections for 2011, there is a general consensus that growth will return to positive territory, with commentators projecting an annual growth of between 1

[5] The IMF (Oct 2009) forecasts an annual decline in GDP of 2.5 per cent, ESRI (Dec 2009) projects an 0.3 per cent decline, the OECD (Nov 2009) forecasts a 2.3 per cent, the Department of Finance (Dec 2009) projects a 1.3 per cent decline and the Central Bank of Ireland (Oct 2009) expects a 2.3 per cent decline.

and 2.5 per cent[6]. Such estimates are still subject to a high degree of uncertainty — for example, the domestic property slump might yet be deeper than anticipated and the international financial crisis might have caused greater damage to the global economy than is currently forecast (or even not yet be over — e.g. sovereign debt problems could yet trigger a further phase of problems).

2.27 As a result of the collapse in aggregate demand (which initial estimates suggest fell by just over 9 per cent in 2009)[7] associated with a very sharp fall in monetary growth, inflation in Ireland was negative with the annual HICP falling by 1.7 per cent over 2009.[8]

2.28 The Irish banking system remains in a precarious state, despite liability guarantees and the most recent bank recapitalisation in March 2010

2.29 As noted earlier, from surplus in 2007 (of 0.3 per cent of GDP) the budget balance fell into a deficit of just over 7 per cent of GDP in 2008, worsening to 11.7 per cent by the end of 2009.[9] This is despite the corrective measures that were included in the 2009 Budget.[10] General government debt as a ratio of GDP increased from 25.1 per cent by the end of 2007 to an estimated 64.5 per cent by the end of 2009. While the general government balance is expected to improve slightly in 2010 by falling to 11.5 per cent of GDP, the ratio of general government debt to GDP is expected to deteriorate further to 78 per cent by the end of 2010[11] and to 92 per cent of GDP by the end of 2011.[12] While a slight reduction in the deficit by the end of 2011 has been forecast,[13] the forecasts are subject to large risks. Deficit funding issues could also arise as large-scale bond issuance by governments across the world creates problems for fiscally weaker countries such as Ireland.

2.30 In 2009 the establishment of the National Asset Management Agency (NAMA) assisted, albeit indirectly, in financing the government deficit by keeping banks as stock market entities. Under the ECB's refinancing operations, banks are, in effect, able to purchase Irish government debt by borrowing from the ECB at a rate of 1 per cent per year[14] in order to buy Irish government bonds which provide a return of about 5 per cent per annum. Through this arrangement, the Irish government has effectively had an "ECB funded buyer for more than 25 per cent of the bonds issued since October 2008".[15]

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6 The IMF predicts a 1 per cent growth in GDP and Eurostat figures quote a forecast of 2.5 per cent growth.
7 ESRII (Winter 2009) "Quarterly economic commentary" noted that Final demand fell by 9.25 per cent between 2008 and 2009.
8 Central Office of Statistics, January 2010.
9 Department of Finance, Monthly Bulletin January 2010.
10 ESRI (Winter 2010) "Quarterly economic commentary
11 ESRI (Winter 2010) "Quarterly economic commentary
12 OECD statistics on government gross financial liabilities as a percentage of GDP
13 The Irish government forecast in December 2009 that the government deficit would fall to 10 per cent of GDP by the end of 2011.
14 On 13 May 2009, the ECB lowered the main refinancing rate to 1 per cent which was the lowest to date. In July 2008, the borrowing rate had been 4.25 per cent.
15 Kings Research (September 2009) http://kingresearch.ie/financial/NAMA_the_Benefits.pdf

2.31 Unemployment also rose sharply following the onset of the financial crisis, rising from 4.7 per cent in 2007 Q4 to 13 per cent in 2009 Q4. It is expected to rise further in 2010 to between 13.75 and 15.5 per cent.[16] The level it reaches will depend in part on the proportion of recent immigrants who choose to remain in the country and the level of emigration.

2.32 The risks are increased by the continuing interaction of **recession and weak recovery**, **financial sector stress** and the **state of public finances**, with each threatening to pull the other down. As pointed out by the IMF[17] "if the distress in the financial sector is larger than currently estimated, this damaging reinforcement could accelerate. Ireland also remains susceptible to disruptions from further external shocks".

Possible Implications for WACC Components

2.33 In this section we discuss some of the possible implications of recent economic developments for the individual components of the WACC.

2.34 Investors are concerned primarily with the return and the risk associated with the investments they make. The events of the recent financial crisis have increased the risks of investment, not only with respect to Irish corporate bonds and shares (i.e. because of the impact of the crisis on corporate sector defaults) but also with respect to Irish government bonds (as reflected in the downgrading by Moody's and S&P). To the extent that investors perceive the system to be unstable (i.e. where systematic risks are high), they may require a higher risk premium.

2.35 Below, we summarise the specific impacts of the financial crisis on the individual components of the WACC: the risk-free rate, the equity risk premium and the debt premium.

Risk-free rate

2.36 The risk-free rate is an important component of the WACC and thus changes in the risk-free rate will have important implications on the cost of capital facing the TAO, TSO and DSO over the forthcoming price control period.

2.37 The financial crisis in Ireland has affected what proxies can be used for the risk-free rate, in that the yields on un-risk-adjusted Irish government bonds are no longer considered an appropriate proxy. The increase in the perceived risk on Irish government debt and alternative proxies for the risk-free rate are discussed further in section 2.

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[16] The IMF forecasts unemployment to rise to 15.5 per cent by the end of 2011 and the EIRS forecasts it to rise to 13.75 per cent.
[17] See IMF (September 2009) *Article IV Consultation*.

Debt premium

2.38 Higher levels of market uncertainty are likely to increase the cost of debt where investors demand a premium above their required return to compensate them for the greater risk and uncertainty of holding corporate debt. The changes in the spreads on debt of different ratings are discussed in section 7.

Equity risk premium

2.39 Higher perceived market risk may also increase the return that investors expect in excess of the risk-free rate in order to compensate them for the greater risk and uncertainty of holding equity. How the ERP may be affected by periods of recession is discussed in section 4.

3 RISK-FREE RATE

Introduction

3.1 This section discusses evidence on the risk-free rate and sets out our recommendation on the range that the CER should use for the TSO, TAO and DSO. It is structured as follows:

(a) yields on government bonds as a proxy for the risk-free rate;

(b) risk on Irish government debt; use of German and French government bonds as a proxy for the risk-free rate;

(c) bond analysis: Ireland – nominal bonds; Germany – nominal bonds; France – inflation-linked bonds;

(d) regulatory precedents;

(e) conclusion – our suggested range.

Yields on Government Bonds as a Proxy for the Risk-Free Rate

Index-linked bond yields

3.2 The yields on government index-linked bonds have traditionally been regarded as a good proxy for the risk-free rate because governments were considered to be one of the entities least likely to default on a loan, and so the rate of interest was considered to be about as close to risk-free as it is possible for a borrower to obtain. In addition, the use of index-linked government bonds means that observed yields are already in real terms, without the need to strip out expectations of inflation. Previous regulatory decisions in the UK have tended to focus on index-linked gilts (ILG) yields.

3.3 Within the Eurozone, the only substantively traded government inflation-linked bonds exist in France. Outside the Eurozone, both the UK and the US have highly liquid markets for index-linked government bonds. However, the use of these bonds to estimate a risk-free rate for Ireland would require projection of movements in the relevant exchange rates and calculation of an exchange rate risk premium.

Nominal government bonds deflated using inflation expectations

3.4 Theoretically, the yields on inflation-linked government bonds should equal the yields on nominal government bonds minus inflation expectations and an inflation risk premium.

The inflation risk premium is defined as the difference between the yields on inflation-linked bonds and equivalent nominal bonds, less expected inflation.[18]

3.5 A conceptual question which arises here is whether the relevant inflation figures to use are for the Eurozone as a whole or specifically for Ireland. If capital markets within the Eurozone are perfectly integrated, then there would be a common risk-free rate across these countries and the relevant rate to use would be the Eurozone inflation rate. If capital markets are not perfectly integrated, however, then each country may have a different risk-free rate. However, even in this instance, it may still be appropriate to use the Eurozone inflation rate on the grounds that once investors have earned a return (even if this return differs across countries due to capital market segmentation), the euros they have earned are then "portable" and can be spent in any Eurozone country. Our approach has been to use Eurozone inflation forecasts to adjust nominal bond yields, but later in the section we also include a comparison of Irish and Eurozone inflation.

3.6 Available empirical evidence on the Euro Area suggests that the inflation risk premium has averaged around 25 basis points since the introduction of the euro, and that it has fluctuated only modestly over time.[19]

Risk on Irish Government Debt

3.7 Although typically government debt has been perceived as close to risk-free, the current economic crisis in Ireland has led to an increase in perceived risk of default for Irish government debt, reflected partly in the downgrading of Ireland's long-term credit rating by Standard & Poor, Fitch and Moody's, between March 2009 and November 2009 (see Table 3.1 below).

Table 3.1: Long-term sovereign credit ratings for Ireland

	Rating agency		
Date	**Fitch**	**Moody's**	**S&P**
June 2008	AAA	Aaa	AAA
March 2009	AAA	Aaa	AA+
April 2009	AA+	Aaa	AA+
June 2009	AA+	Aaa	AA
July 2009	AA+	Aa1	AA
November 2009	AA-	Aa1	AA

Source: Bloomberg

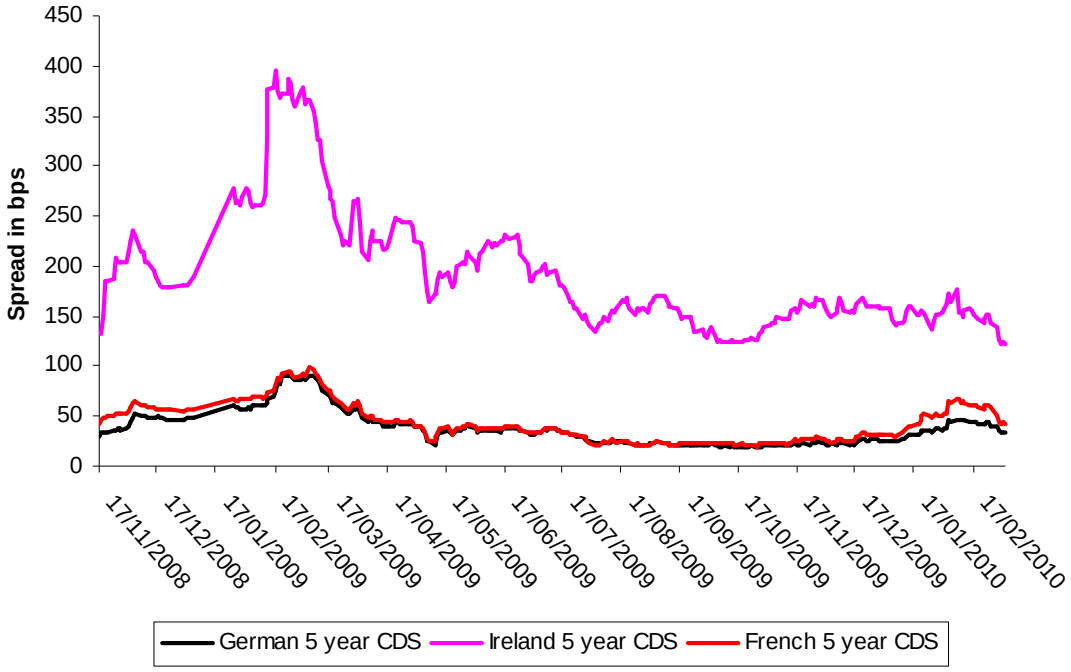
[18] Inflation risk premia arise from the fact that investors holding nominal assets are exposed to unanticipated changes in inflation. In other words, the real payoff – which is what investors ultimately care about – from holding a nominal asset over some time period depends on how inflation evolves over that period, and investors will require a premium to compensate them for the risk associated with inflation fluctuations that they are unable to forecast.

[19] See P. Hordahl (2008), " The Inflation Risk Premium in the Term Structure of Interest Rates", BIS WP.

3.8 Changes in the perception of risk are illustrated by recent movements in the price of credit default swaps (CDS). CDS are a financial instrument for swapping the risk of debt default, where the buyer of a CDS pays a premium in order to insure against the risk of a debt default. The greater the risk of debt default the higher the premium that will be required from a seller of a CDS. In this way, CDS spreads are useful in indicating both the absolute and relative riskiness of Irish sovereign debt.

3.9 Figure 3.1 shows the 5-year CDS spreads (in bps) for Ireland, Germany and France over the period August 2008 to November 2009.

Figure 3.1: Daily Irish, German and French 5-year CDS (bps), August 2008- February 2010

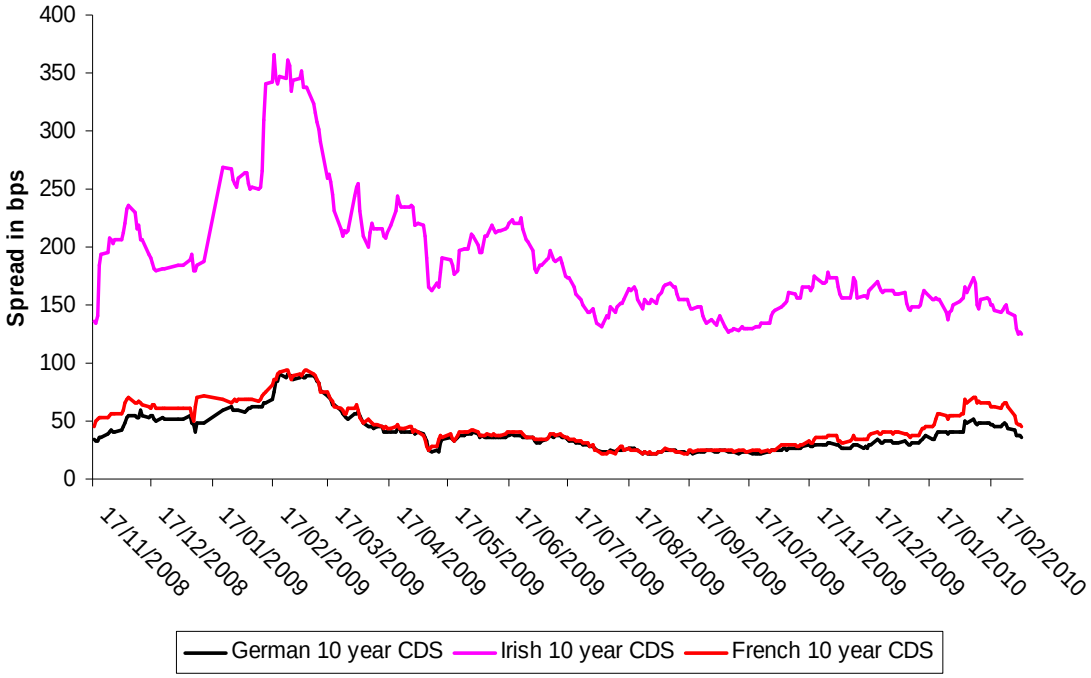


Source: Bloomberg

3.10 As can be seen in Figure 3.1 above, the country risk premium for Ireland, in terms of 5-year CDS, has remained significantly higher than that for Germany and France over the period.

3.11 Figure 3.2 below shows very similar trends for 10-year CDS.

Figure 3.2: Daily Irish, German and French 10-year CDS (bps), August 2008- February 2010



Source: Bloomberg

3.12 As can be seen in the figure above, from late 2008 the country risk premium measured in terms of both 5-year and 10-year credit default swap rates increased for all three European countries. Factors behind this include the introduction of plans by most developed countries to shore up their financial systems in the wake of the collapse of Lehman brothers, and deflation risk. In effect, these plans, which were intended to restore stability to the financial system, meant taking stakes in the largest ailing banks or guaranteeing some of their liabilities. These programmes have resulted in a degree of risk transfer from the banking system to the governments in these countries. As a result, the premia on these countries increased as market participants updated their expectations on the probability of sovereign default. Since their peak in early 2009, however, spreads appear to have come down again, although they began to rise again for a short period at the beginning of 2010.

3.13 As illustrated by Figure 3.1 and Figure 3.2 above, however, the impacts on 5-year and 10-year CDS have been most pronounced for Ireland. In the period we have examined, the spread between Irish and French 5-year and 10-year CDS reached a maximum of 314.9 and 267.7 bps, respectively. The maximum spreads over the period between Irish and German 5-year and 10-year CDS were even higher, at 321 and 290.5 bps, respectively. The maximum as well as the minimum and average spreads between

Irish, French and German 5-year and 10-year CDS are summarised in Table 3.2 and Table 3.3 below.

Table 3.2: Difference between Irish and French CDS over the period from November 2008 to February 2010 (bps)

	5-year CDS	10-year CDS
Minimum	84	80
Average	149	144.5
Maximum	314.9	282

Source: Bloomberg, EE calculations

Table 3.3: Difference between Irish and German CDS over the period from November 2008 to February 2010 (bps)

	5-year CDS	10-year CDS
Minimum	90	89
Average	154	150.3
Maximum	321	290.5

Source: Bloomberg, EE calculations

3.14 One factor behind these differences is the fact that the risk transfer between the banking sector and the government is likely to have been especially important in the case of Ireland. This is because, in contrast to France and Germany, the Irish government guaranteed in full the liabilities of the main banking institutions. Indeed, the spike which occurred in the CDS for Ireland in 2009 coincided with the nationalisation of the Anglo Irish Bank in the second week on January 2009.

3.15 In addition to the above, there are a number of other macroeconomic factors that are likely to have driven not only the CDS increases in general but also the CDS differential between Ireland, France and Germany. These include the recent increases in Ireland's budget deficit, which was approximately 7 per cent of GDP in 2008 (compared with a balanced budget in 2007) and is expected to reach over 12 per cent in 2009-10.[20] Compared with a budget deficit in 2008 of approximately 3.2 per cent of GDP in France and 0.1 per cent of GDP in Germany, Ireland's position appears significantly more precarious and is likely to have been (and indeed is likely to continue to be) an important factor underlying the recent and future developments in the perceived risk associated with Irish government debt.

3.16 Due to this increased perceived risk of default on Irish government debt, we therefore consider German and French government bond yields as another source of information on the risk-free rate.

[20] Economist Intelligence Unit

Use of German and French Government Bonds

3.17 There will be a meaningful common international risk-free rate if a number of conditions hold, namely that:

(a) capital markets are internationally competitive;

(b) there is perfect mobility of capital across borders;

(c) it is not the case that, in each country, uncertainty about international conditions, about the interpretation of data, and the robustness of financial contracts is very much greater than uncertainty about the same things domestically;

(d) other issues such as tax differences do not create market segmentation.

3.18 It is, however, doubtful whether all these conditions are met — a fact acknowledged by, for example, regulatory programmes, such as the EU's Financial Services Action Plan, the point of which is to attempt to increase integration at the EU level.

3.19 In spite of these *caveats*, due to the heightened perception of government default risk in Ireland, we consider it prudent to inform our estimate of the risk-free rate using yields on government bonds from other Eurozone countries in addition to Ireland. We therefore carry out analysis of government bond yields in the following countries:

(a) Ireland – nominal government bonds with inflation expectations and an inflation risk premium stripped out;

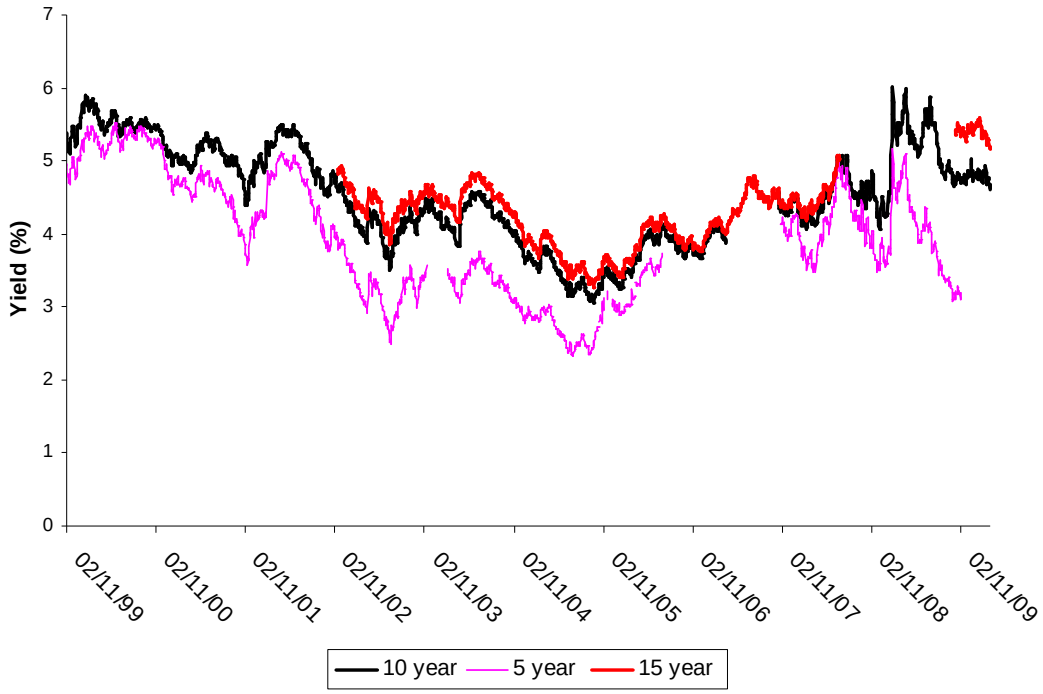
(b) Germany – nominal government bonds with inflation expectations and an inflation risk premium stripped out. We also examine the yields on two inflation-linked bonds;

(c) France – inflation-linked government bonds. As stated earlier, France is the only Eurozone country with substantively traded government inflation-linked bonds.

Irish Nominal Bonds

Government bond yields

Figure 3.3: Nominal yields on 5, 10 and 15-year Irish governments bonds, 1999-2010



Source: Bloomberg

3.20 According to the data presented in Figure 3.3 above, yields on Irish government bonds of a 5, 10 and 15-year maturity moved closely in line with each other over the last 10 years, with the exception of the period between June 2008 and October 2009. During the latter period, the spread between the yields on 5-year and 10-year bonds began to increase relative to the average spread that prevailed between these two maturities over the period as a whole.

3.21 Table 3.4 below summarises nominal bond yields over different time periods. In addition to presenting the raw data, the table also presents figures which have been adjusted using CDS data. The adjustment involved calculating the difference between Irish CDS spreads and the average of CDS spreads for German and French government bonds, and subtracting this difference from Irish government bond yields. The purpose of the adjustment is to remove the premium in yields arising from the additional default risk associated with Irish government bonds.

Table 3.4: Irish nominal bond yields

	5-year[1]	10-year[2]	15-year[3]
Latest market data			
Spot rate 26 February 2010	3.14	4.61	5.171
Spot rate 26 February 2010 (adjusted using CDS data)[5]	2.18	3.20	3.59
Longer run averages			
January 2001 to February 2010	3.72	4.39	4.28
January 2002 to February 2010	3.61	4.31	4.28
April 2006 to February 2010	3.91	4.53	4.46
June 2007 to February 2010	3.95	4.78	4.76
January 2008 to February 2010	3.95	4.93	5.34
Longer run averages – adjusted using CDS data			
January 2001 to February 2010		*CDS data not available*	
January 2002 to February 2010		*CDS data not available*	
April 2006 to February 2010		*CDS data not available*	
June 2007 to February 2010		*CDS data not available*	
January 2008 to February 2010[7]	2.06	3.04	3.45

Source: Bloomberg, EE calculations

1: Data unavailable for the period between 11/11/03-2/02/01, 11/16/05-12/05/05, 06/28/06-10/25/07

2: Data unavailable for the period between 11/11/03-02/02/04, 2/11/05-11/11/05, 16/11/05-5/12/05, 28/06/06-27/10/07

3: Data unavailable for the period between 01/01/02-11/11/02, 24/06/08-10/06/09

5. The risk adjusted yield on 10- and 15-year bonds have been based on the same CDS spread differential between CSD spreads for Irish sovereign debt and the average CDS spreads for French and German sovereign debt.

6. The risk-adjusted yield on 10- and 15-year bonds have been calculated using the CDS spread differential between 10- year CSD spreads for Irish sovereign debt and the average 10-year CDS spreads for French and German sovereign debt.

[7] CDS data was only available from November 2008.

3.22 As also indicated in Figure 3.3 above, the period between mid-2008 and October 2009 was characterised by an increase in the relative volatility of yields on both 5-year and 10-year bonds. Sharp rises in bond yields were particularly apparent between September 2008 and June 2009. This increase in volatility coincided with the recent turbulence in financial markets, in which Ireland's banking sector was particularly affected. Indeed, a number of major events took place during this period of increased volatility relating to Ireland financial sector (all having important implications for Irelands public finances) which may have driven investors away from Irish bonds and thereby driving the changes in yields. These events included the following:

- *20 September 2008*: the Irish government rushes to increase the statutory limit for deposit protection schemes from €20,000 to €100,000 in an effort to dampen growing fears of a run on banks and building societies. The cover applies to 100 per cent of an individual's deposit and leaves Irish savers better protected than savers in most other European countries.

- *30 September 2008*: the government announces that it will guarantee all deposits, bonds and debts in the country's six biggest banks and building societies for two years to maintain financial stability. Included are AIB, Bank of Ireland, Anglo Irish Bank, Irish Life & Permanent, Irish Nationwide and the Educational Building Society. It represents the biggest potential exposure ever to confront Irish taxpayers.

- *September 2008:* Ireland enters recession, with output contracting by 0.5 per cent in the three months up to the end of June.

- *November 2008*: the chairman of Anglo Irish Bank, Ireland's third largest bank, admitted he had hidden a total of €87 million in loans from the bank, triggering a series of incidents which led to the eventual nationalisation of Anglo on 21 January 2009.

- *January 2009*: Anglo Irish Bank nationalized.

- *February 2009:* Announcement of the provision of two €3.5 billion bailouts to *Allied Irish Bank* and *Bank of Ireland* as part of the government's recapitalisation scheme. The plan saw the Minister appoint 25 per cent of the directors at each bank, whilst the banks have agreed to provide a 30 per cent increase in mortgages for first time buyers and a 10 per cent increase in loans to small and medium businesses as well as to hold-off on repossessions of mortgage holders for twelve months after they fall into arrears.

- *March 2009*: S&P downgrades Irish Government bonds' rating from AAA to AA+ with a negative outlook.

- *April 2009:* NAMA is established, a government owned asset Management Company dealing with assets transferred from banks.

- *April 2009*: Fitch downgrades Irish Government bonds' rating from AAA to AA+.

- *June 2009:* S&P downgrades Irish Government bonds' rating from AA+ to AA with a negative outlook.

- *July 2009:* Moody's downgrade Irish Government bonds' rating from AAA to Aa1, with a negative outlook.

- November 2009: Fitch downgrades Irish Government bonds' rating for a second time from AA+ to AA-.

- *30 March 2010:* The Irish government recapitalises the Irish banking system by injecting €32 billion into five financial institutions: Allied Irish Banks(AIB), Bank of Ireland, Anglo Irish Bank, Educational Building Society and Irish Nationwide building society

3.23 The risk transfer from the banking to the public sector in Ireland has been significant both in relative and absolute terms. Further, the recent increases in the governments' liabilities contributed to the downgrading of Ireland's long-term sovereign credit rating in 2009 by S&P and Fitch.

3.24 Given the degree of economic turmoil in Ireland, some market commentators have suggested that yields would have risen further than they have in response to the financial crisis were it not for the indirect financing of a substantial proportion of Irish government debt by the ECB. According to market commentators, under ECB refinancing arrangements, Irish banks have been able to purchase Irish government bonds by borrowing from the ECB at a rate of 1 per cent, allowing them to purchase Irish government bonds on which they are able to earn around 5 per cent a year (this is the average yield on Irish bonds of all three maturities).[21] The analysis conducted by the IMF in its last Article IV document (September 2009) confirmed that Irish banks have made substantial use of ECB refinancing arrangements.[22] Thus, in the absence of such refinancing arrangements, one might have expected the demand for Irish bonds to have declined further and therefore for yields to have risen higher than they have done to date.

3.25 Since late November, however, yields on all three maturities have been falling, with some market commentators attributing this to Ireland's recent acceptance of the Lisbon treaty which some believe has helped to improve market sentiment.

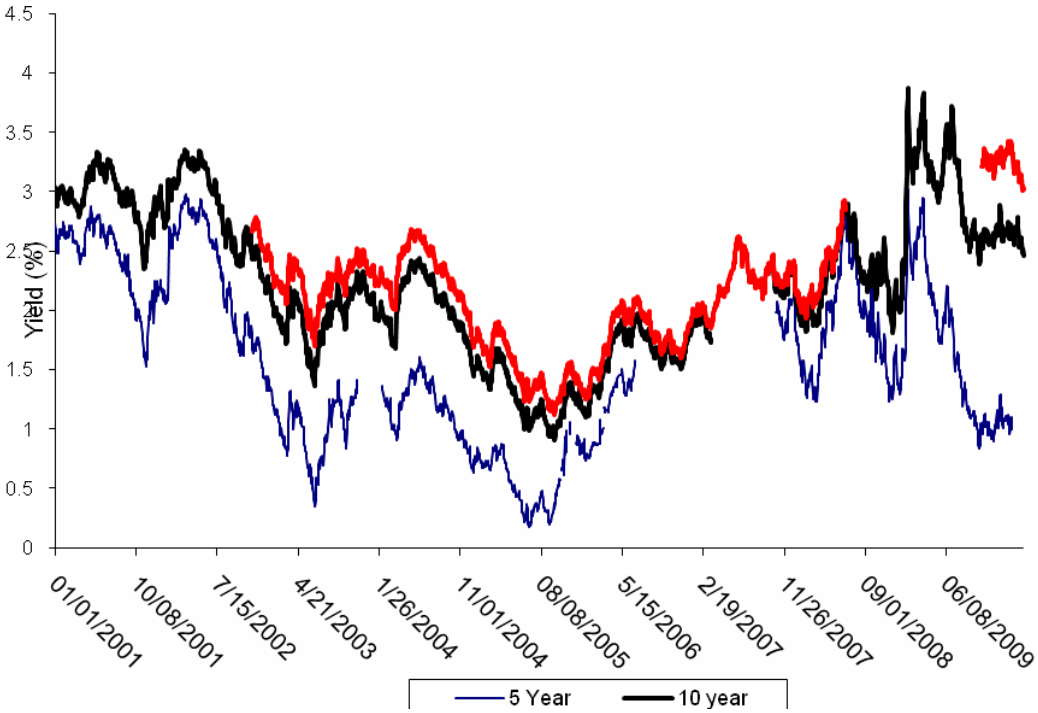
3.26 Figure 3.4 below illustrates the yield on all three maturities after having subtracted from nominal yields inflation expectations in the Eurozone over 5, 10 and 15 years.[23]

[21] http://www.irishtimes.com/newspaper/finance/2009/0919/1224254861624.html

[22] http://www.imf.org/external/pubs/ft/scr/2009/cr09195.pdf

[23] As data on 10 and 15 year inflation forecasts for the Eurozone were unavailable we have assumed that 10 and 15 year forecasts are the same as the 5 year forecasts. Data on inflation forecasts for Ireland over the last 10 years was unavailable

Figure 3.4: Nominal yields on 5, 10 and 15-year Irish government bonds deflated by 5 Eurozone year inflation forecasts



Source: Bloomberg, ECB survey of professional forecasts and EE calculations

3.27 Table 3.5 below summarises bond yields after deducting inflation expectations over different time periods.

Table 3.5: Nominal yields deflated by inflation expectations[4]

	5-year[1]	10-year[2]	15-year[3]
Latest market data			
Spot rate 26 February 2010	0.99	2.46	3.02
Spot rate 26 February 2010 (adjusted using CDS data)[5]	-0.45	1.02	1.58
Longer term averages			
January 2001 to February 2010	1.57	2.24	2.12
January 2002 to February 2010	1.44	2.15	2.12
April 2006 to February 2010	1.72	2.35	2.29
June 2007 to February 2010	1.76	2.58	2.58
January 2008 to February 2010	1.74	2.62	2.74
Longer term averages – adjusted using CDS data			
January 2001 to February 2010	*CDS data not available*		
January 2002 to February 2010	*CDS data not available*		
April 2006 to February 2010	*CDS data not available*		
June 2007 to February 2010	*CDS data not available*		
January 2008 to February 2010	-0.15	0.73	0.85

Source: Bloomberg, EE calculations

1: Data unavailable for the period between 11/11/03-2/02/01, 11/16/05-12/05/05, 06/28/06-10/25/07

2: Data unavailable for the period between 03/06/07

3: Data unavailable for the period between 11/02/99-11/01/02, 06/24/08-10/06/09

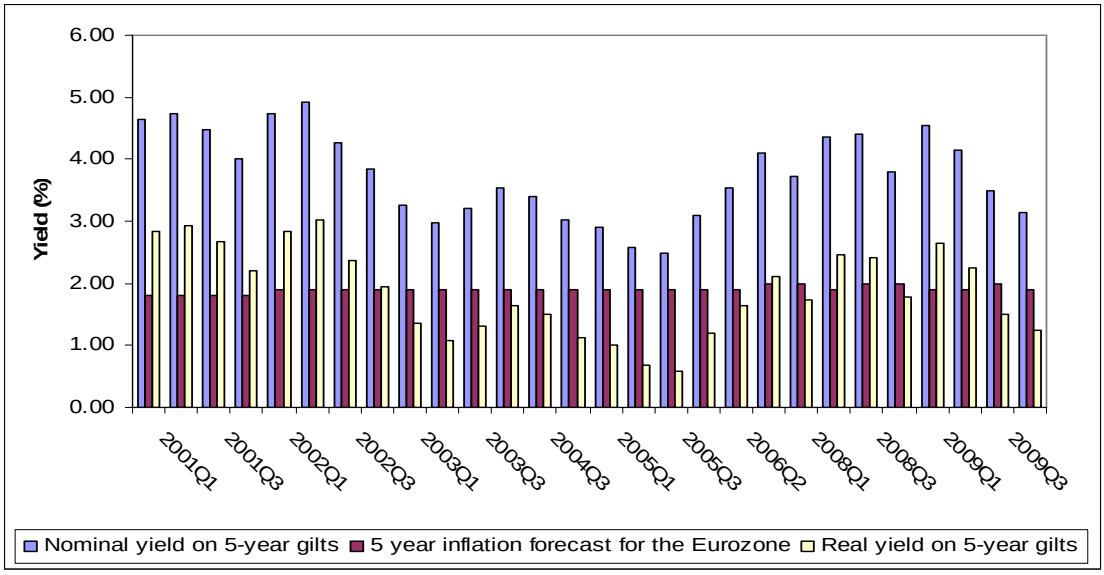
4. Nominal yields have been deflated by inflation forecasts for the Eurozone and by an additional 0.25 inflation risk premium

5. The risk adjusted yield on 10- and 15-year bonds have been based on the same CDS spread differential between CSD spreads for Irish sovereign debt and the average CDS spreads for French and German sovereign debt.

6. The risk adjusted yield on 10- and 15-year bonds have been based on the same CDS spread differential between CSD spreads for Irish sovereign debt and the average CDS spreads for French and German sovereign debt.

3.28 According to Figure 3.5, inflation forecasts for the Eurozone have been relatively stable and thus do not seem to have been driving the volatility (since 2001 to October 2009) in yields for bonds with a 5-year maturity.

Figure 3.5: Yield on 5-year Irish government bonds and 5-year inflation forecasts for the Eurozone

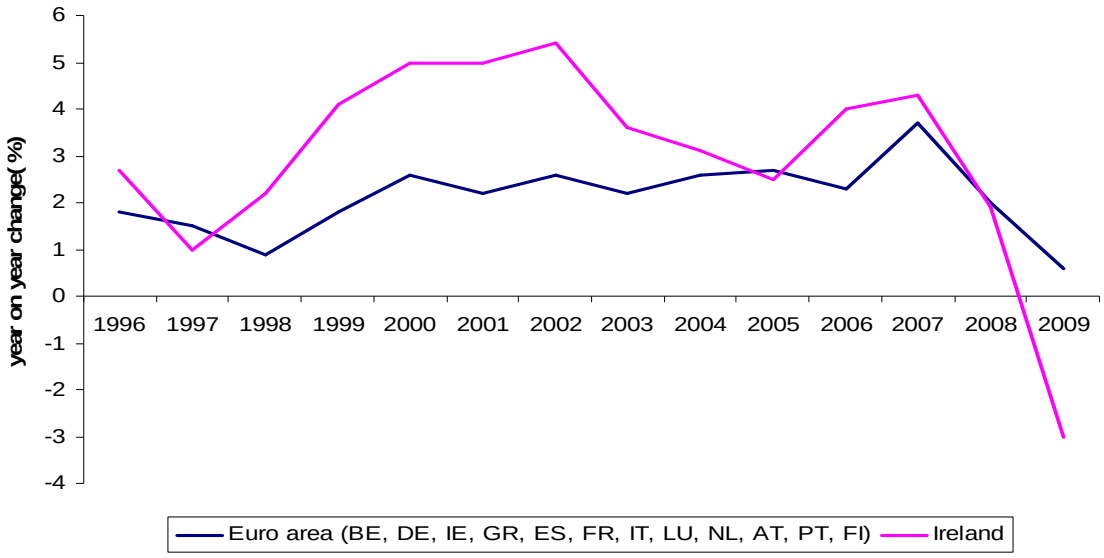


Source: ECB, Bloomberg, Europe Economic calculations

3.29 This additional volatility in nominal yields might in part be explained by the fact that yields may be partly driven by inflation expectations for the Irish economy as opposed to those for the Eurozone alone. Indeed, while Ireland is a member of the Eurozone the inflation rate in Ireland over the last 15 years or so has differed rather considerably from the yearly inflation rate in the Eurozone as a whole (see Figure 3.6). In particular, between 1998 and 2004, yearly inflation in Ireland was considerably higher than in the Eurozone. In 2005 inflation in the Eurozone surpassed that in Ireland, a trend which then reversed again from 2006 until 2008.

3.30 According to the figure below, the recent financial crisis has had a relatively bigger impact on inflation in Ireland compared with the Eurozone, with inflation in the former falling by considerably more than for the Eurozone as a whole.

Figure 3.6: Yearly inflation (HCPI) in Ireland and the Eurozone, 1996-2009



Source: Eurostat

3.31 Thus, real yields on all three maturities in Ireland would be likely to differ from those calculated above (presented in Figure 3.4 and Table 3.5) if inflation forecasts for Ireland were used instead of those for the Eurozone. Further, as there is no consistent pattern in the difference between inflation for Ireland and the Eurozone over the period covered, any assumptions about how inflation expectations are likely to have differed for Ireland (and thus how real yields will have varied over the period) are likely to be subject to a significant margin of error.

German Nominal Bonds

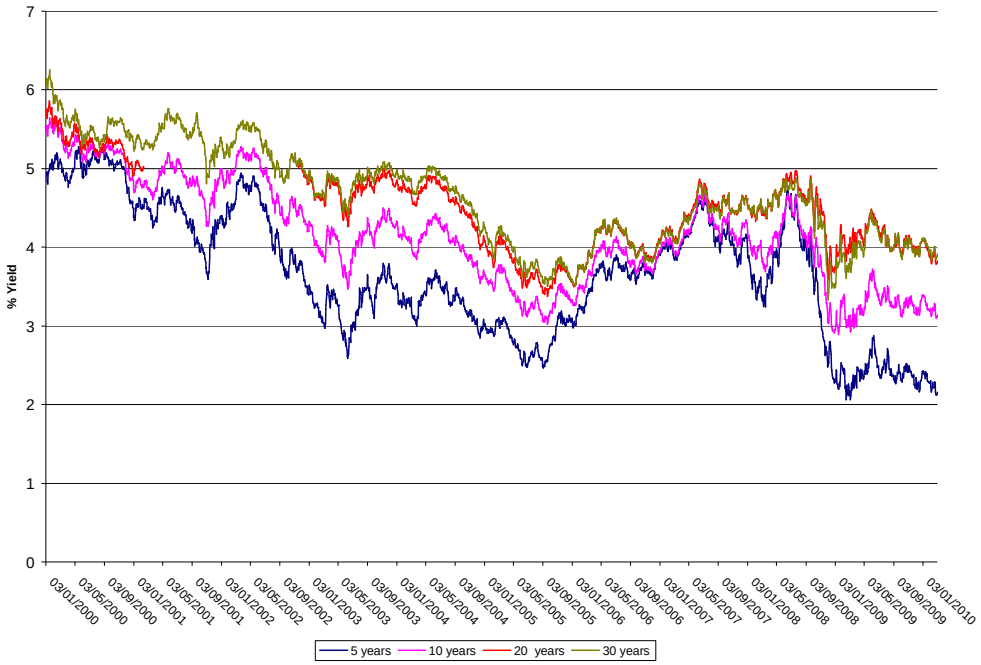
3.32 We analysed nominal bonds (stripping out expected inflation and an inflation risk premium) and inflation-linked bonds to study the path of real yield on German government bonds.[24]

German nominal bonds

3.33 The figure below shows nominal yields on 5, 10, 20 and 30 years' government bonds for Germany.

[24] Data reported for nominal bonds have been downloaded from Bloomberg and they are indices of governments bonds of different maturities at different points in time. Inflation expectations are based on Eurozone forecasts. We reported the only two existing German inflation linked bonds with maturities of 5 and 10 years.

Figure 3.7: Yields on nominal German government bonds



Source: Bloomberg

3.34 We note that there has been a substantial drop in German government bond yield at the peak of the financial market chaos that followed the nationalisation of Fannie Mae and Freddie Mac and the subsequent bankruptcy of Lehman's: this is due probably to a flight to safety effect that pushed up the demand for German government securities, perceived as less risky. Also substantial liquidity injections from the Central Bank to fight the recession seem to have played a significant role.

3.35 The following table summarises nominal government bond yields in Germany over different time periods:

Table 3.6: German nominal government bond yields

	5 years	10 years	20 years	30 years
Latest market data				
Spot rate on February 26 2010	2.13	3.10	3.78	3.85
Long term averages				
January 2001 to February 2010	3.52	4.03	4.32	4.54
January 2002 to February 2010	3.42	3.94	4.31	4.44
April 2006 to February 2010	3.42	3.82	4.29	4.25
June 2007 to February 2010	3.25	3.76	4.35	4.30
January 2008 to February 2010	2.99	3.60	4.28	4.23

Source: EE calculations using Bloomberg data

German real government bond yields

3.36 Real government bond yields can be studied either by examining yields on inflation-linked bonds (where available) or by stripping out inflation expectations from yields on nominal bonds.

Stripping out inflation using inflation expectations from nominal bonds

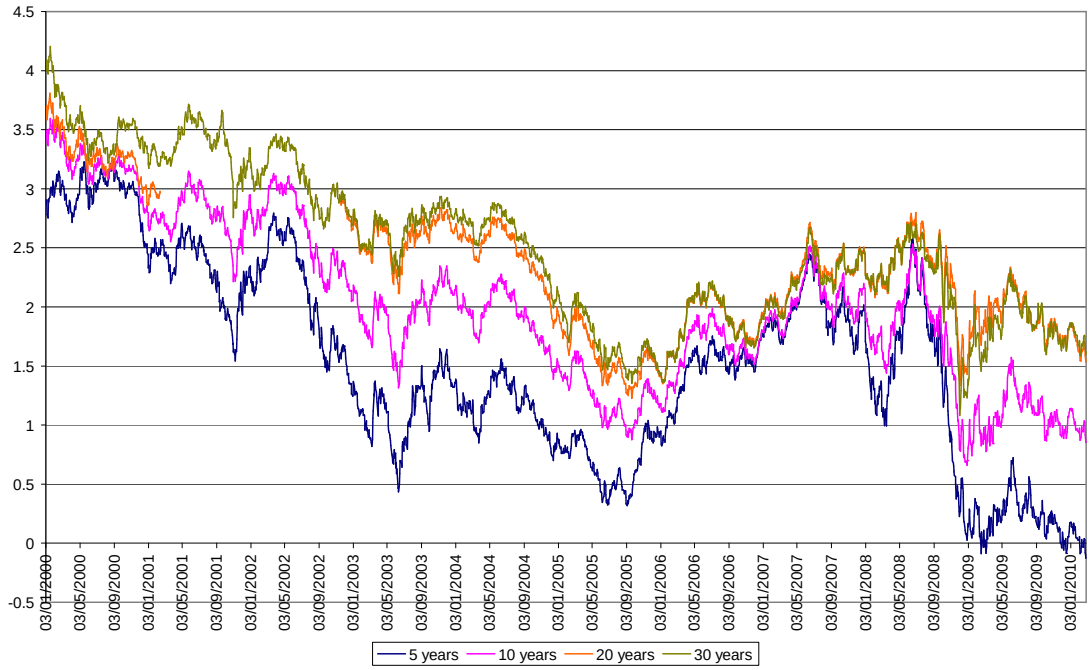
3.37 The figure below shows real yields on 5, 10, 20 and 30 years' government bonds for Germany. These real yields have been obtained by stripping out inflation expectations (sourced from the European Central Bank)[25] and an inflation risk premium[26] from yields on nominal government bonds (as reported in Figure 3.7). Available empirical evidence on the Euro Area suggests that the inflation premium has averaged around 25 basis points since the introduction of the euro, and that it has fluctuated only modestly over time.[27]

[25] Inflation expectations refer to the average annual inflation rate for the five years ahead. Hence our exercise for 10 and 20 years bonds is based on the assumption the expectations for 5, 10 and 20 years Euro area inflation rate are similar. Considering the track record of the ECB in keeping inflation stable and low and its proactive attitude this assumption seems to be realistic.

[26] Inflation risk premia arise from the fact that investors holding nominal assets are exposed to unanticipated changes in inflation. In other words, the real payoff – which is what investors ultimately care about – from holding a nominal asset over some time period depends on how inflation evolves over that period, and investors will require a premium to compensate them for the risk associated with inflation fluctuations that they are unable to forecast perfectly.

[27] See P. Hordahl (2008), " The Inflation Risk Premium in the Term Structure of Interest Rates", BIS W

Figure 3.8: Real yields on German government bonds



Source: Bloomberg and European Central Bank

3.38 The following table summarises real government bond yields in Germany over different time periods.

Table 3.7: Real government bond yields

	5 years	10 years	20 years	30 years
Latest market data				
Spot rate on February 26 2010	-0.12	0.85	1.53	1.60
Long term averages				
January 2001 to February 2010	1.37	1.88	2.16	2.39
January 2002 to February 2010	1.25	1.77	2.14	2.27
April 2006 to February 2010	1.24	1.63	2.10	2.06
June 2007 to February 2010	1.05	1.55	2.15	2.09
January 2008 to February 2010	0.79	1.40	2.08	2.02

Source: Europe Economics calculations using Bloomberg data

3.39 The above table shows that real yields on longer-term government bonds in Germany tend to be higher than on shorter-term government bonds (even though 20-year and 30-year yields tend to be very similar).

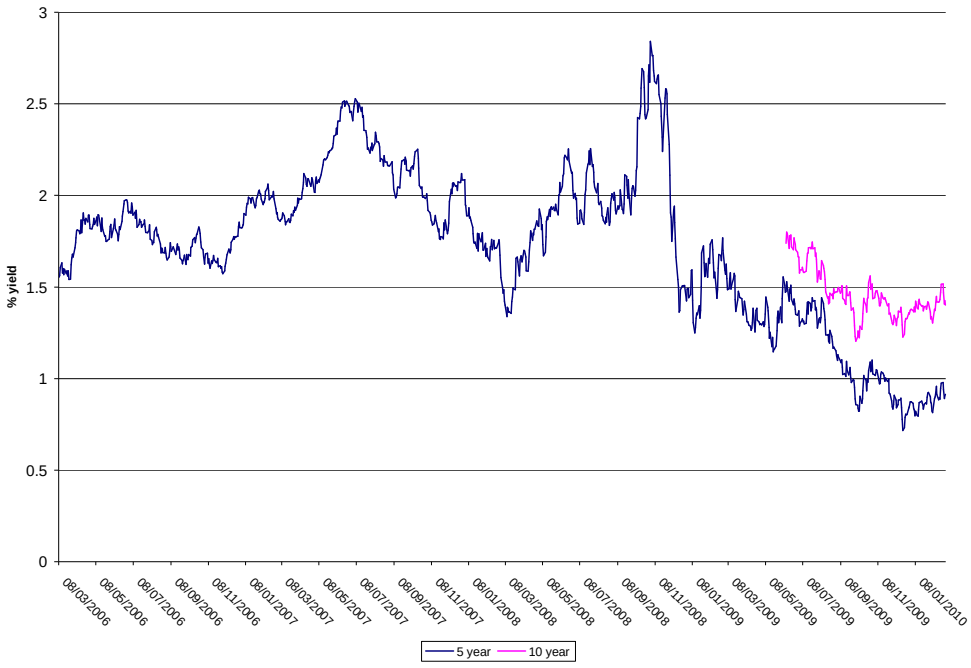
3.40 Spot rates clearly show the depressing effect of the financial crisis on yields with short-term bonds characterised by yields of close to zero (-0.12).

Inflation-linked government bonds

3.41 Another method to study real yields on government bonds is to examine inflation-linked bonds.

3.42 Unfortunately, Germany has only two inflation-linked bonds (5 years and 10 years), which were available only for a subset of our period of interest. The real yields on these bonds are reported in the following figure:

Figure 3.9: German inflation-linked bond yields



Source: Bloomberg

3.43 The following table summarises yields on inflation-linked government bonds in Germany over different time periods.

Table 3.8: Index-linked government bond yields

	5 years	10 years
Latest market data		
Spot rate on February 26 2010	0.91	1.40
Long term averages		
April 2006 to October 2009	1.73	-
June 2007 to October 2009	1.68	-
January 2008 to October 2009	1.54	1.46

Source: Europe Economics calculations using Bloomberg data

3.44 The table shows that the real government bond yield seems to be consistently below 2 per cent.

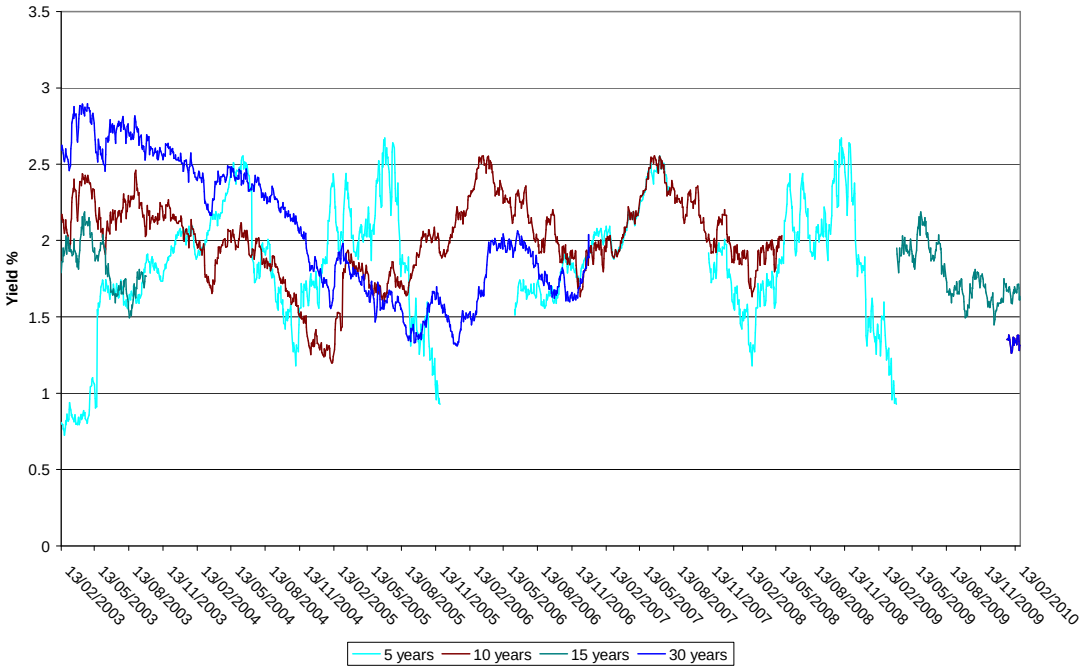
French Inflation-Linked Bonds

3.45 We examined yields on French inflation-linked bonds across a range of maturities over the period 13 February 2003 to 26 February 2010.

3.46 Figure 3.10 shows yields on French inflation-linked (IL) bonds[28] for terms to maturity of 5, 10, 15 and 30 years over the period February 2003 to February 2010. Note that due to unavailability of data the data series are not continuous.

[28] The data series are downloaded from Bloomberg and are labelled "generic EUR France inflation-linked bonds (series OATi)".

Figure 3.10: French inflation-linked bonds for the period February 2003 to February 2010



Source: Bloomberg

3.47 As can be seen from Figure 3.10, yields for the four maturities have tended to move together. Apart from a period in late 2006/ early 2007, shorter-term yields have tended to be lower than yields on longer-term bonds.

3.48 Table 3.7 summarises French inflation-linked government bond yields over different time periods.

Table 3.7: French inflation-linked bond yields

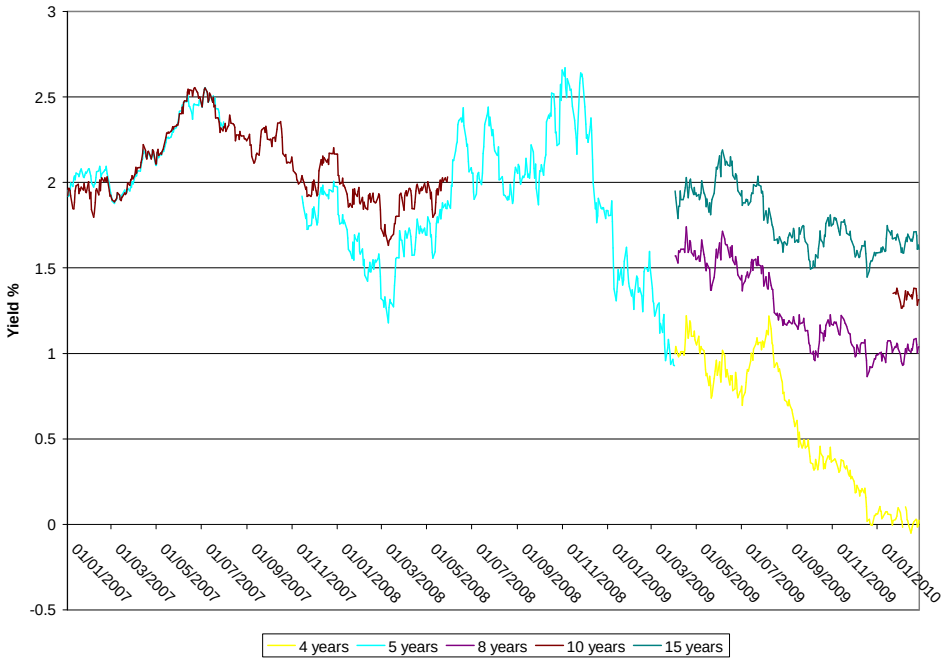
	5 years	10 years	15 years	30 years
February 2003 - February 2010	1.84	1.99	1.80	2.04
April 2006 - February 2010	1.89	2.05	1.77	1.77
January 2007 - February 2010	1.94	2.04	1.77	-
June 2007 - February 2010	1.90	2.03	1.77	1.33
January 2008 – February 2010	1.83	1.79	1.77	1.33

Source: EE calculations using Bloomberg data. Note: due to unavailability of data over the whole of the set periods, the averages refer to the average of the data available within that period, which in several instances does not cover the whole period.

3.49 The average yields of the inflation-linked bonds ranged from 1.80 to 2.04 over the 2003-2010 period. In general, inflation-linked bonds have had slightly higher yields in the period January 2007 to February 2010 than over the longer term. However, there was no clear trend over the period 2003 to 2009.

3.50 The following Figure shows IL bond yields since January 2007 for terms to maturity of 4, 5, 8, 10 and 15 years.

Figure 3.11: French index-linked bonds – latest market data



Source: Bloomberg

3.51 Figure 3.11 shows that, apart from a period of volatility in 2008, there has been a declining trend in these bond yields since 2007. The most pronounced decline in yields since late 2008 has been in the bonds with shortest terms to maturity – 4 and 5 years. Table 3.8 summarises the French inflation-linked bond yields over different time periods.

Table 3.8: French inflation-linked bond yields – latest market

	4 years	5 years	8 years	10 years	15 years
Latest market data					
Spot rate on February 26 2010	0.02	-	1.04	1.31	1.61
Longer run averages					
January 2007 - February 2010	0.57	1.94	1.26	2.04	1.77
January 2008 - February 2010	0.57	1.83	1.26	1.79	1.77

Source: EE calculations using Bloomberg data. Note: due to unavailability of data over the whole of the set periods, the averages refer to the average of the data available within that period, which in several instances does not cover the whole period.

3.52 As can be seen from Table 3.8, the latest spot rates are lower than the longer-term averages. It is unclear whether these recent falls in bond yields are temporary or are indicative of a long-term trend.

Regulatory Precedents

3.53 We now review estimates of the risk-free rate used in previous regulatory decisions. Table 3.9 summarises regulatory decisions on the risk-free rate from Ireland and the UK.

Table 3.9: Previous regulatory decisions on the risk-free rate

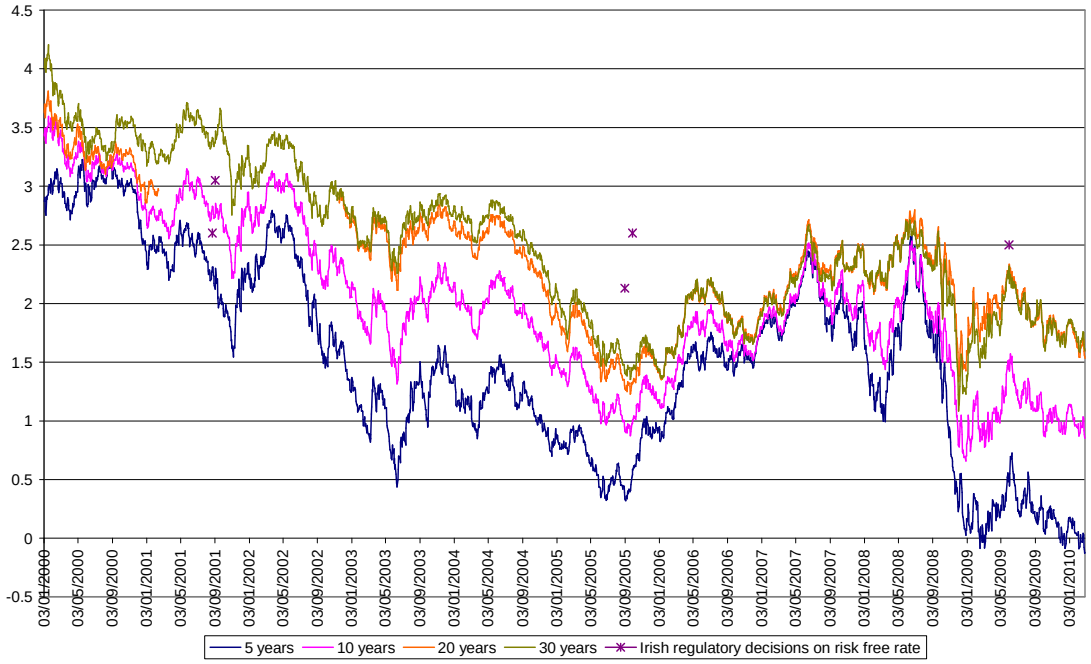
Regulator	Case	Real risk-free rate (%)
Irish regulators		
CAR	Dublin Airport Authority (2009)	2.5
Comreg	Eircom (2008)	4-5 (nominal basis)
CAR	Dublin Airport Authority (2005)	2.6
CER	Transmission and distribution (2005)	2.38
CAR	Aer Rianta (2001)	2.6
CER	Transmission and distribution (2001)	3.05
UK regulators		
Ofwat	Water (2009)	2
Ofcom	Openreach (2009)	2 (4.5 nominal)
NIAUR	SONI (2008)	2.5
Ofgem	Electricity distribution (2009)	"around" 2
CC	Stansted (2008)	2.0
CAA	Heathrow and Gatwick (2008)	2.5
CC	Heathrow and Gatwick (2008)	2.5
Ofgem	Transmission (2006)	2.5
Ofcom	General approach – applied to BT (2005)	2.0
CAA	NATS (2005)	2.5
Postcomm	Royal Mail (2005)	2.5
Ofwat	Water and sewerage (2004)	2.5-3.0
Ofgem	Electricity distribution (2004)	2.25-3.0
Competition Commission	BAA (2002)	2.5-2.75
ORR	Access charges (2000)	3.0
Competition Commission	Mid Kent Water (2000)	3.0
Ofgem	Transmission (2000)	2.5-2.75
Ofwat	Water (1999)	2.5-3.0

Source: Regulatory determinations

Relationship between risk-free rate used by Irish regulators and real yields on German government bonds

3.54 Figure 3.12 illustrates the relationship between the real return on German government bonds and the risk-free rate used in previous Irish regulatory decisions.

Figure 3.12: Previous regulatory decisions on the risk-free rate in Ireland



Source: Bloomberg data and EE review of regulatory determinations

3.55 As can be seen from Figure 3.12., apart from two decisions in 2001, in recent years regulatory decisions in Ireland have tended to estimate the risk-free rate to be above the real yields on German government bonds. In general these have been a material number of basis points — in one case more than 100 — above the risk-free rate as measured using deflated nominal yields. Nonetheless, over time, regulatory decisions have fallen from a range of 2.6–3.05 early in the decade to a range of 2.38–2.6 in more recent years, as shown in Table 3.9.

3.56 One interpretation of this evidence is that regulators have implicitly engaged in a form of Bayesian updating of beliefs, in which a prior belief about the risk-free rate has been only gradually lowered as sustained reductions in ILG yields have provided evidence that the risk-free rate has fallen.

Conclusion

3.57 We have analysed government bond yields in Ireland, Germany and France.

3.58 There is no precise method for determining the risk-free rate and a certain amount of judgment is necessary. Recent market turbulence has resulted in sharp rises and falls in the yields on government bonds in the latter months of 2008 and early months of 2009. It is unclear how indicative of long-term trends current yields are.

3.59 Average yields in the period June 2007 to February 2010 are shown in Table 3.10.

Table 3.10: Real government bond yields – averages June 2007- February 2010

	5 years	10 years	15 years	20 years
Ireland – nominal yields deflated by inflation expectations and an inflation risk premium	1.76	2.58	2.58	
Ireland – above figures adjusted for risk using CDS data		*CDS data not available*		
Germany – nominal yields deflated by inflation expectations and an inflation risk premium	1.05	1.55		2.15
France – yields on inflation-linked bonds	1.90	2.03	1.77	

Source: EE calculations using Bloomberg data. Note: due to unavailability of data over the whole of the set periods, the averages refer to the average of the data available within that period, which in several instances does not cover the whole period.
1. Data on CDS spreads for Irish sovereign debt covering the entire period between June 2007 and February 2010 were not available.

3.60 The following table presents the latest market data as of 26 February 2010.[29] Comparing this information with the previous table, it can be seen that spot rates tend to be somewhat lower than longer-term averages. We consider that the negative figures for 5-year German government bonds and for Irish 5-year government bonds after adjustment using CDS data are likely to reflect data limitations.

[29] Note that although the data cut-off used in this and later section was 28 February 2010, 28 February 2010 was a Sunday and hence the last available data points were 26 February 2010.

Table 3.11: Summary of real government bond yields – current spot rates

Spot rates on 26 February 2010	%
Ireland – nominal yields deflated by inflation expectations and an inflation risk premium	
5-year	0.99
10-year	2.46
15-year	3.02
Ireland – above figures adjusted for risk using CDS data	
5-year	-0.45
10-year	1.02
15-year	1.58
Germany – nominal yields deflated by inflation expectations and an inflation risk premium	
5-year	-0.12
10-year	0.85
20-year	1.53
France – yields on inflation-linked bonds	
4-year	0.02
8-year	1.04
10-year	1.31
15-year	1.61

Source: EE calculations based on Bloomberg data

3.61 As can be seen from both of these tables, the calculated real yields on the Irish government bonds (prior to any adjustment) are higher than those of Germany and France. We consider this to be indicative of a higher perceived default risk of Irish government debt. This is borne out by the higher CDS spreads for Ireland when compared to Germany and France, as shown in Figure 3.1 and Figure 3.2. In the light of this, we do not consider that these unadjusted bond yields can be used to inform the risk-free rate assumption. When adjusted using CDS data, Irish government bond yields are closer to those for Germany and France.

3.62 Table 3.11 shows that the latest spot figures (as at 26 February 2010) calculated for German and French government bonds are in the range 0.85 to 1.6 on medium- to longer-term bonds, with the figures for similar maturity Irish government bonds being in the range 1.0 to 1.6, after adjustments using CDS data.

3.63 Table 3.10 shows that when averages are calculated over a longer time-period (going back to January 2008), the range for German bonds is 1.05 to 2.15 and the range for French bonds is 1.33 to 1.83. (CDS data are not available to produce risk-adjusted figures for Irish government bonds over this period.)

3.64 Alongside government bond yields, we also place weight on regulatory precedents. The most recent Irish regulatory precedent is the Commission for Aviation Regulation's figure of 2.5 (drawn from a range of 1.5 to 2.5). Recent regulatory precedents in the UK have tended to be in the range 2 to 2.5 per cent.

3.65 Our preferred range estimate for the risk-free rate is **1.6 to 2.2 per cent** with a point estimate of **2 per cent**. This is based on the yields of German and French government bonds, and on Irish government bonds after adjustment using CDS data. It also takes into account regulatory precedents, and the tendency for regulators to estimate the risk-free rate to be slightly higher than real yields on government bonds (which is why we do not extend the bottom of our range to encompass all of the market data we have presented).

3.66 It should be noted that the estimate of the RFR has an effect on the ERP if one is to place some weight on the Smithers & Co view, and the view expressed in the recent Competition Commission (CC) recommendations on the cost of capital for the UK's Stansted airport, that the sum of the RFR and ERP is more stable than the individual components.

4 EQUITY RISK PREMIUM

The Equity Risk Premium

4.1 The CAPM equation[30] states that the expected return on a capital asset is equal to the return required on a risk-free asset plus a degree of non-diversifiable risk that is inherent to the market. The right-hand side of the CAPM equation therefore includes a term defined as the Market Risk Premium (MRP) ($E(R_m)-R_f$). Strictly speaking, a fully diversified portfolio might include assets such as land or gold, but no usable all-assets index exists. The normal proxy employed is the Equity Risk Premium (ERP) — the implicit assumption being that stock markets are, by themselves, sufficiently diverse to span all risks and allow of perfect diversification with a stocks-only portfolio. The ERP is the difference in the rate of return expected by shareholders for holding risky equities rather than risk-free securities.

4.2 We note that it is sometimes asserted that stock markets do not have this property and that therefore the CAPM is not strictly correct. However, even if stock markets are not perfectly diversified, it does not follow that CAPM is incorrect — CAPM requires only that a fully diversified portfolio could, in principle, be constructed from all available assets (not merely shares). But it might follow that the ERP is an imperfect proxy, so that measured estimates of the CAPM did not perfectly capture the cost of capital. Specifically, it would mean that the risk on a maximally-diversified pure equity portfolio included risk that was specific to equities but could, in principle, be offset (diversified) in a wider asset portfolio. Hence the ERP would be greater than the MRP. Thus, the risk that stock markets do not permit full diversification is the risk that using the ERP results in an over-estimation of the cost of capital. Similarly, if periods of high stock market volatility are also periods in which stock markets temporarily function less well with the consequence that they lose some of their ability perfectly to diversify, a consequence will be that ERP estimates for those periods will over-estimate MRPs.

4.3 Standard practice of most financial economists estimating ERP is to measure the historical equity premium (i.e. the excess of equity returns over the returns on a benchmark risk-free asset) by analysing historical equity returns over fairly long periods and making extrapolations based on this about the expected ERP. Prior to the end of the technology bubble (2000), the most widely cited US source was Ibbotson Associates' figures, whose equity premium history starts in 1926. Research by Dimson, Marsh and Staunton published in 2002 raised the bar for both data and methods used to estimate the ERP.[31] The study carried out by Dimson *et al*. sought to address the fact that many of the long-run empirical studies on the equity risk premium had been based

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[30] CAPM states that $E(R_i) = R_f + \beta_i (E(R_m) - R_f)$.

[31] Dimson, Elroy, Marsh, Paul and Staunton, Mike (2002) "Global evidence on the equity risk premium" London: London Business School.

on the experience of the US only. Dimson *et al.* argued that, given how successful the US economy had been, the US risk premium was unlikely to be representative. Thus, they extended the evidence on the equity risk premium by examining data on bond and bill returns in 16 countries over a 102 year period (1900-2002). Their results showed that the equity risk premium has typically been lower than previous research had suggested.

4.4 An often cited survey conducted by Welch in 1998,[32] of the opinions of 226 financial economists who were asked to forecast the thirty-year arithmetic mean equity risk premium, showed that a large number of correspondents were calibrating their forecasts relative to the longest-run historical benchmark available from Ibbotson, and then altering the historical number downward based on subjective factors.

4.5 To find the expected future risk premium, extrapolation from the past is not sufficient; consideration has to be given to the question whether the future is likely to reveal a difference in the market preferences or institutional factors that have determined the historic risk premia. There are particular problems if extrapolation is based on a short time period.

Methodological Issues

Limitations of estimates of the risk premium based on short time periods

4.6 Short-term time frames clearly do not provide a solid basis for generalising about future returns — stock markets are far too volatile on a year-to-year basis for good predictions to be made. A common choice of timeframe has been 10 years, but even looking over a decade will not produce robust results since it is not long enough to cancel out "good and bad luck". The high corporate growth rates during the late 1990s, and the subsequent 'burst' of the technology bubble, is an example of extremes which cannot be relied upon for future predictions. For such reasons, Dimson *et al.* argue that judgements should be informed by the full extent of financial history.

4.7 Using the achieved premium in returns to forecast the required risk premium depends on having a long enough period. Even with 102 years of data, market fluctuations have some impact. In addition, the underlying MRP could vary over time (e.g. as tastes for risk evolve). It is, moreover, important to take into account the fact that stock market outcomes are influenced by many factors. For example, non-repeatable events (such as the removal of trade barriers) would feasibly mean projected premia should differ from past premia. The figure below shows how the difference in time frame used can impact the estimated returns, and therefore the ERP.

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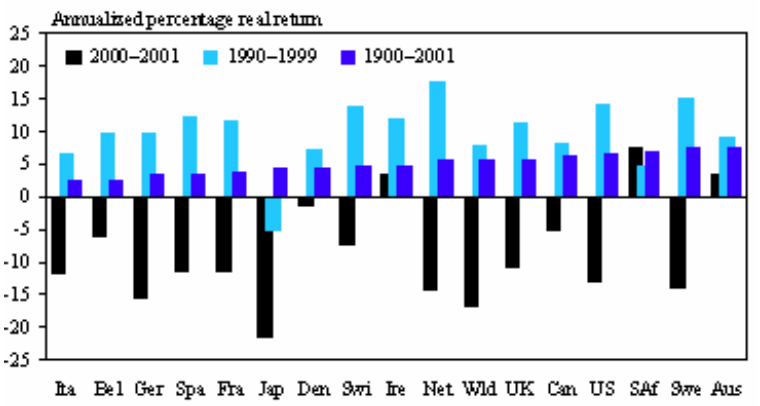
[32] Welch, I, (1998), "Views of Financial Economists on the Equity Premium and Other Issues", *Journal of Business*, Vol. 73, 2000, pp. 501-537

Figure 4.1: Short-term and long-term real returns on equities from around the world



Note: the country names listed in abbreviated form along the horizontal axis are (from left to right) Italy, Belgium, Germany, Spain, France, Japan, Denmark, Switzerland, Ireland, the Netherlands, the world (weighted average of the 16 individual countries), the United Kingdom, Canada, the United States, South Africa, Sweden and Australia.

Source: Dimson, Marsh and Staunton, 2001

4.8 This problem can be illustrated by comparing the first and second halves of the twentieth century. Several factors may have contributed to the high returns achieved during the second half of the twentieth century. These include:

(a) Unprecedented growth in productivity and efficiency and great technological change has led the market outcome to exceed investor expectations. (But higher growth in corporate cash flows then became known to the market and presumably built into higher stock prices.)

(b) Stock prices rose relative to dividends because of a fall in the required rate of return due to diminished business and investment risk. Factors reducing business risk included increased international trade flows and the end of the Cold War. Investment risk may also have diminished through diversification.

(c) Transaction and monitoring costs fell materially over the century.

4.9 A major shortcoming of the Ibbotson Associates, Barclays Capital and CSFB reported premia is the historical success of the US equity market and survivorship bias, alongside bias in the index construction due to narrow coverage.[33,34] Dimson *et al.* point out that even when indices are constructed to account for survivor bias within countries, the very fact that certain markets did not survive through the very long run (a century) means that

[33] Survivorship bias refers to the tendency for markets (and therefore estimates of returns) to include equity from only companies that have been successful but not account for those which have folded, thereby overestimating returns.

[34] Dimson, Elroy, Marsh, Paul and Staunton, Mike (2002) "Global evidence on the equity risk premium" London: London Business School.

certain countries had to be omitted such as Poland, Russia and China. These markets would have been likely to have had smaller measured returns than those in the sample.

Arithmetic or Geometric Mean?

4.10 Discussions of the ERP explore the implications of using the arithmetic or the geometric mean of historical equity premia.[35] The arithmetic mean of a list of numbers is simply the sum of the numbers divided by the number of items in the list (n). To calculate the geometric mean the numbers in the list are multiplied and then the *n*th root of the resulting product is taken. There are reasons for using each when calculating the ERP. In theory, the arithmetic mean treats each estimate as independent of the others (consequently it is considered to be "forward looking"), and therefore corresponds to the "true" expectation. The geometric mean necessarily tracks past estimates, and will therefore always be smaller than the arithmetic mean in the presence of market volatility. Its stickiness renders it a superior indicator of the magnitude of past returns.[36]

4.11 The two means are linked by volatility when returns are distributed along a lognormal distribution, which is commonly assumed in long-term equity markets.[37] Lognormality can often characterise observed returns which exhibit a skewed distribution; allowing returns to be unbounded above zero, but to not drop below -100 per cent (i.e. the distribution is one-tailed).

4.12 The relationship between the arithmetic and geometric mean is perhaps more easily understood through a mathematical explanation, proof and example. Jensen's inequality implies that, under lognormal distribution, the arithmetic average risk premium is approximately equal to the geometric average risk premium plus half the variance.[38] To be clear, if (in the impossible scenario that) there were no volatility in annual returns, the arithmetic mean return would equal the geometric mean return. While the difference between (arithmetic) mean log returns and the geometric mean is typically very small, this relationship gives rise to the counter-intuitive result that an asset may have negative geometric mean returns but positive arithmetic mean returns (i.e. if an investor loses money over a long period of time).

4.13 As an example, Dimson, Marsh and Staunton (2001) suppose that a general estimate for the standard deviation[39] of equity market log returns (over a 102-year period) is 0.2. Let us assume that the true distribution of returns is normal. Then the difference

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35 What is conventionally referred to as the "geometric mean" is technically the compound average return — or the geometric average of 1 + R_{it}, minus one.

36 Abrams, Dr. Jay (1996) "Arithmetic vs. geometric means: empirical evidence and theoretical issues." www.abramsvaluation.com/pdf/Arith_geom.pdf.

37 Wright, Stephen, Mason, Robert, and Miles, David (2003) "A study into certain aspects of the cost of capital for regulated utilities in the UK" London: Smithers & Co Ltd.

38 Gregory, Alan (2007) "How low is the UK equity risk premium?" XFi Centre for Finance and Investment paper number 07/09, University of Exeter.

39 Standard deviation is the square root of the variance ($\sigma = (\sigma^2)^{1/2}$).

between the arithmetic and geometric mean is approximately $(0.2)^2/2=0.02$. A two percentage point difference between the two mean returns is non-trivial. Moreover, as volatility increases, the difference grows more rapidly; for volatility levels of 0.3, the gap becomes 4.5 per cent.

Now let us assume that the true distribution of returns is lognormal: if $E(r)$=0.04, the geometric mean return is $\exp(0.04)-1$, or 4.08 per cent — a very small difference.

4.14 Experts who assume lognormality of returns (Campbell, Dimson *et al.*) opt for using geometric means for part or the entirety of calculating the expected premium. Others such as Fama and French believe that the arithmetic mean is stable and should therefore be used because changes in returns are serially uncorrelated. A sound approach may be found in the report written by Wright *et al.* for Smithers & Co (2003):[40]

> Given the absence of a clear consensus on the best way to model the underlying properties of returns, the only clear-cut recommendation must be to deal consistently with the difference between the two averaging methods, to be precise in noting which estimate is being used in any context, and to be aware of the potentially significant differences between the two.

Historical Estimates

Dimson, Marsh and Staunton

4.15 Dimson *et al.* (2002) created a database of long-run international returns comprising annual returns for 16 countries from 1900-2001. This overcomes some problems in the previous indices (specifically, concerns about biases), through extending the time frame back to 1900, when returns were lower (partly due to events in the lead up to, and including, WWI), and by including premia from countries other than the US (from their data, in fact, the premia for two-thirds of other countries in this sample were lower than for the US).

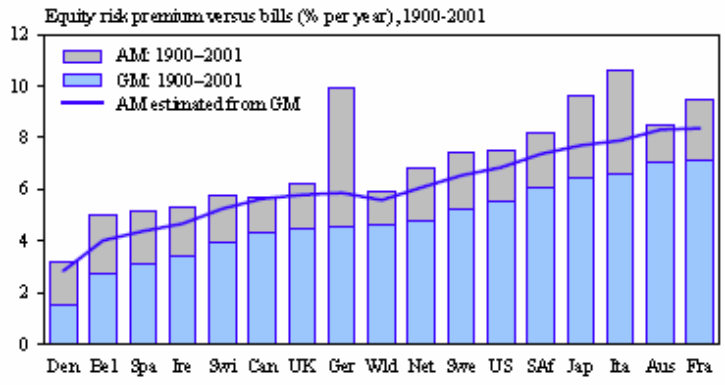
4.16 Before the pivotal Dimson *et al.* dataset was developed, long-run studies took US or UK premia. The twentieth century was a period of remarkable growth in the US and UK economies, which probably exceeded the expectations held by investors in the early twentieth century.

4.17 To extrapolate the prospective risk premium from historic premia, Dimson *et al.* deduct the impact of the growth in cash flows and the gain from falls in the required risk premium. This means that this estimate is lower than the raw historical risk premium, and the estimates given by finance academics in surveys. To reconcile the difference between arithmetic and geometric means, the authors replace the historical difference

[40] p27: Wright, Stephen, Mason, Robert, and Miles, David (2003) "A study into certain aspects of the cost of capital for regulated utilities in the UK" London: Smithers & Co Ltd.

between the two with a difference based on contemporary risk estimates.[41] The following figure illustrates the effect of this method, which the authors describe in their 2001 estimation.

Figure 4.2: Arithmetic mean equity risk premia relative to bills (1900-2001)



Source: Dimson, Marsh and Staunton, 2001

4.18 Their prospective arithmetic risk premia for the world index is 3.9 per cent.[42] They also argue, given the increasingly international nature of capital markets, it may be more appropriate to take a global rather than a country-by-country approach to determine the prospective equity risk premium. This is also a consequence of between-country differences being attributable to individual country shocks that are not likely to repeat themselves. Dimson *et al.* suggest that, due to the inherent difficulty of using historical data to predict future premia, it may be better to use a "normal" equity premium most of the time, and to deviate from this when there are compelling economic reasons to suppose expected premia are unusually high or low.

Smithers & Co

4.19 In the seminal 2003 Smithers Report,[43] Wright *et al.* derive a (global) geometric ERP of 3 per cent and an arithmetic ERP of 4-5 per cent. In the context of cost of capital estimation, the authors argue that it is important to start with average equity returns and calculate the ERP by subtracting the safe rate, due to greater historic uncertainty over the ERP than over the average cost of equity. Put another way, they argue that the overall market return (safe rate plus ERP) is more stable than the ERP alone.

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41 Dimson *et al.* assume a single volatility level for all sixteen national markets used (for simplicity) of 16 per cent, and for the world index of 14 per cent.

42 A separate figure for Ireland was not given in this paper. However, we later quote a 2003 paper by Dimson *et al* . which does give a separate figure for Ireland.

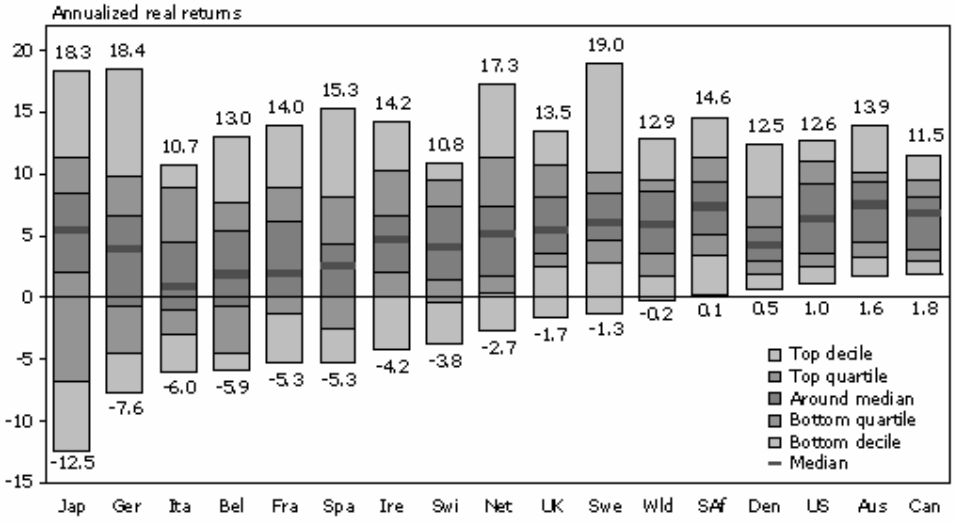
43 Wright, S., Mason, R., and D Miles, (2003), "A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K.", *A paper on behalf of Smithers&Co*

4.20 Wright *et al.* claim that the safe rate is hard to explain, and appears to be unstable in the data. To some degree this is a consequence of the many problems of assuming a constant risk-free rate when estimating the ERP over long time-spans. Siegel (1998)[44] showed that in the period between 1830-1998, while 30-year stock returns appear to move within a relatively narrow range, those returns for bonds and bills were much less stable. This concern may be exacerbated by the so-called "risk-free rate puzzle", which is unable to reconcile historically low average risk-free rates with consumer preferences modelled to prefer consumption today over consumption tomorrow.

Extrapolation of Future ERP from Historical Estimates

4.21 Dimson *et al.* (2003) exposed what they believed at the time to be the predominant trend of "irrational optimism" of investors regarding the expected performance of world stock markets. According to the authors, rewards were being overestimated and risk underestimated. Granted, based on historical experience in the US markets, forecasts were pointing to favourable years to come. However, during the 20th Century the US stock market had both higher real returns and lower volatility (as discussed above in paragraph 4.8) than many other countries which should not be overlooked, especially in an increasingly global financial system: looking at long-run (20-year) return horizons, just two markets outperformed the US between 1900 and 2002 (see figure below). Thus when historic returns were calculated based on world markets, the ERP became much lower than had been previously estimated. The authors concluded that a plausible, forward-looking ERP for the world's major markets would be **3 per cent**.

Figure 4.3: Percentiles of the distribution of 20-year returns (1900-2002)



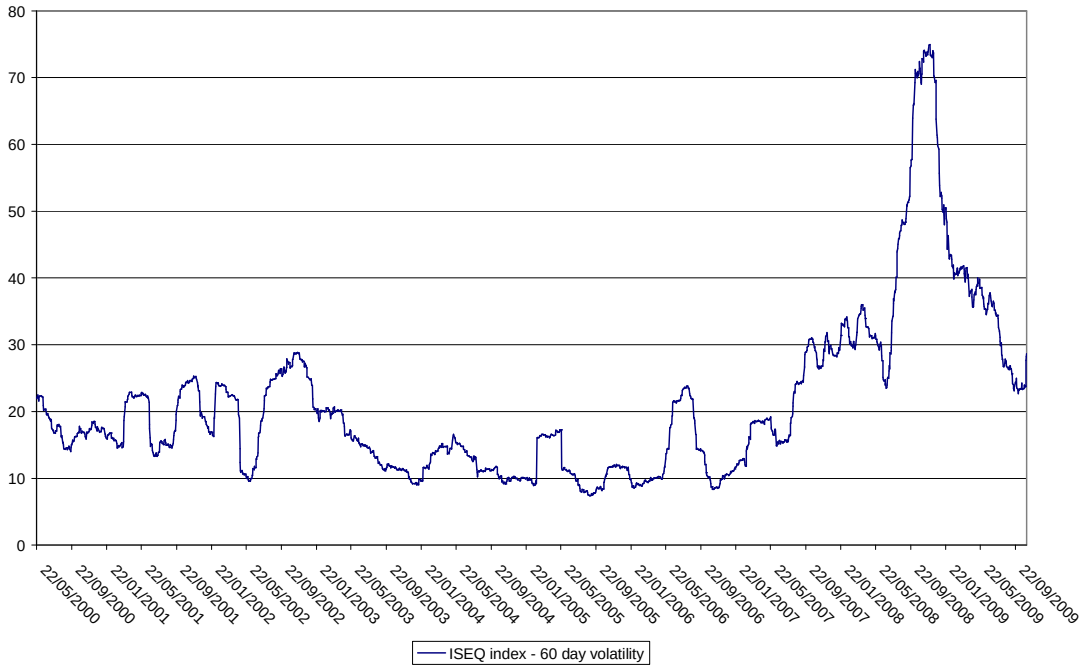
Source: Dimson, Marsh and Staunton, 2003.

[44] Siegel, J,, (1998), "Stocks for the Long Run!, McGraw-Hill, second edition

4.22 Dimson *et al.* expect riskiness of markets to continue, not just in terms of business risk, but also in counterparts of the 20th Century World Wars and Cold War: wars on terror, drugs, or climate change. The current financial crisis may potentially involve, *inter alia*, some change to the forward-looking ERP. However, the effects of this would not appear in the measured data for many years. In the short term, as volatility in markets is high we should expect to see increases in the ERP as measured over the short period. But, as discussed above, this might well be a poor indicator of the true risk premium on equities over a longer timescale. However, in 2007 Dimson *et al.* revised their estimate back up to a geometric world average of 4.1 per cent and arithmetic average of 5.2 per cent, with Ireland values of 3.9 and 5.4, respectively.

4.23 Figure 4.4 below illustrates the recent volatility experienced by the Irish equity market.

Figure 4.4: Irish Stock Exchange (ISEQ) overall index historical volatility



Source: Bloomberg

4.24 The following table displays Dimson, Marsh and Staunton's 2007 ERP estimates and volatility levels for a number of countries.

Table 4.1: ERP estimates and volatility levels

	Arithmetic mean	Geometric mean	Standard error
Belgium	4.6	2.8	1.9
France	6.2	4.0	2.2
Germany	8.5	5.5	2.7
Italy	7.8	4.5	2.9
Netherlands	6.1	4.0	2.1
Spain	4.6	2.6	2.0
UK	5.4	4.2	1.6
USA	6.6	4.6	1.9
Ireland	**5.4**	**3.9**	**1.8**
World	**5.2**	**4.1**	**1.4**

Source: Dimson, Marsh and Staunton, 2007

Regulatory precedents

4.25 Table 4.2 presents some recent regulatory ERP estimations.

Table 4.2: Regulatory precedents of ERP estimates

	Year	Sector/company	ERP %
Irish regulators			
CAR	2009	Dublin Airport Authority	4-5
Comreg	2008	Eircom	6
CAR	2005	Dublin Airport Authority	6.0
CER	2005	Transmission and distribution	5.25
CAR	2001	Aer Rianta	6.0
CER	2001	Transmission and distribution	5.4
UK regulators			
Ofwat	2009	Water	5.4
Ofcom	2009	Openreach (BT's other activities)	5
NIAUR	2008	SONI	4.5
Ofgem	2009	Electricity distribution	3-5
CEPA for Office of Rail Regulation	2008	Network Rail	3 - 5 but may be as high as 7
Civil Aviation Authority	2008	Heathrow and Gatwick (BAA)	4.5
Competition Commission	2007	Heathrow and Gatwick (BAA)	2.5 - 4.5
Ofgem	2007	GDNs	2.5 - 4.5
Smithers & Co for Ofgem	2006	Four electricity and gas licensees	higher end of 2.5 - 4.5

Ofcom	2005	BT	4.0 - 5.0
Postcomm	2005	Royal Mail	3.5-4
Ofwat	2004	Water (WaSCs and WoCs)	higher end of 3.5 - 5.0
Ofgem	2004	Electricity DNOs	higher end of 2.5 - 4.5

Sources: Respective regulator reports

Limitation of the Historical Approach

4.26 The use of the DMS methodology, which we still consider the most robust approach to infer the ERP, presents some problems in the current financial and economic context, in which consistent variations in risk premia are likely to be observed.

4.27 For example, evidence reported in De Paoli and Zabczyk (2009) suggests that the size of this risk premium depends on whether the economy is in a period of stagnation or prosperity. In particular, investors seem to require higher premia during economic slowdowns than during booms. This empirical regularity has been termed "premium counter-cyclicality".[45]

4.28 Cochrane and Piazzesi (2005) argue that the ERP increases by almost 20 per cent in a period of crisis, coming back to its previous "normal level" three years after the end of the recession, on average.

Europe Economics' ERP Range

4.29 Drawing particularly on the DMS 2007 estimates of the Irish ERP (between 3.9 and 5.4 per cent) and on recent regulatory precedents, we believe that the DMS range of 3.9-5.4 would normally represent the appropriate range from which plausible regulatory judgements might be formed.

4.30 As explained above, investors seem to require higher premia during economic slowdowns. We therefore consider that the appropriate ERP to use at the current time is in the upper end of the range obtained from historic DMS data. Hence, in the current context we recommend using an ERP range of 4.5 to 5.4 per cent, with a point estimate near the top of this range of 5.2 per cent.

[45] See B. De Paoli and P. Zabczyk (2009) "Why do risk premia vary over time? A theoretical investigation under habit formation. Harvey (1989) showed that US equity risk premia are higher at business cycle troughs than they are at peaks. Subsequent results of Bekaert and Harvey (1995), He, Kan, Ng and Zhang (1996) and Li (2001) confirmed these findings. Cochrane and Piazessi (2005) find that the term premium is countercyclical in the United States while Lustig and Verdelhan (2007) document strong countercyclicality in the exchange rate risk premium. The two most popular asset pricing models attribute this variation either to countercyclical changes in risk aversion (Campbell and Cochrane (1999)) or to changes in the volatility of the consumption process (Bansal and Yaron (2004))

5 ANALYSIS OF RISKS FACED BY THE TAO, TSO AND DSO

Introduction

5.1 This section sets out a qualitative analysis of the risk exposure of transmission and distribution networks. Its purpose is to:

(a) inform the subsequent choice of comparators which will be used in order to estimate the asset betas for the TAO, TSO and DSO;

(b) determine whether there is a convincing (qualitative) case for setting a different cost of capital for the Transmission Asset Owner (TAO) relative to the Transmission System Operator (TSO), or for the TAO relative to the Distribution System Operator (DSO).

5.2 The section is structured as follows:

(a) an outline of the role and duties of the TAO, TSO and DSO;

(b) the underlying risks in carrying out the business activities;

(c) factors affecting the risk exposure;

(d) the effect of the CER's regulation on the risk exposure of the TAO, TSO and DSO;

(e) is there a case for a different cost of capital for the TAO and TSO?

(f) is there a case for a different cost of capital for the TAO and DSO?

(g) conclusions.

The Transmission and Distribution Networks

Transmission asset owner (TAO) – ESB networks

5.3 ESB Networks[46] is the licensed owner of the transmission system - the transmission asset owner (TAO). The role of the TAO is to ensure that the transmission system is developed and maintained in accordance with the requirements set down by the transmission system operator (EirGrid).

5.4 The TAO has responsibility for the management of the transmission capital and maintenance work programmes. This includes the building of new high-voltage substations and their associated overhead lines and underground cables. It also

[46] ESB Networks is a ring fenced subsidiary within ESB Group.

involves responding to network faults and carrying out planned maintenance and refurbishment works on these assets.

5.5 The TSO EirGrid is responsible for operating the network of high-voltage transmission lines and substations to transport power from the various electricity generators to where it is needed.

5.6 Access to the transmission system is under the control of EirGrid. EirGrid deals with both generator and demand connections in instances where total generation or demand is over 20MVA at a single location.[47]

5.7 There is a legal agreement in place between EirGrid and ESB Networks (the "Infrastructure Agreement") which sets out the terms under which ESB Networks provides infrastructure services to EirGrid. The agreement was approved by CER and came into effect on 1 July 2006 – the same date as the legal establishment of EirGrid as the TSO.

Transmission system operator (TSO) – EirGrid

5.8 EirGrid is the independent state-owned body licensed by the CER to act as transmission system operator (TSO).

5.9 The electricity transmission system (commonly known as the national grid) is a high voltage network for the transmission of bulk electricity supplies around Ireland. Generally the high voltage lines deliver electricity from Ireland's generation sources to the transformer stations, where the electricity voltage is reduced and taken through the distribution system to individual customers' premises. There are also around 18 very large commercial customers directly connected to the transmission system.

5.10 EirGrid is responsible for the operation, development and maintenance of the system. The TSO also offers terms and levies charges for connection to and use of the transmission system. These are regulated by the CER.

5.11 The Connection Agreement is structured in three parts: the Connection Agreement contains the specific provisions in respect of connecting both generation and demand customers; the General Conditions contains the general provisions of the Connection Agreement; and Schedule 10 contains construction and commissioning provisions.

Distribution system operator (DSO) – ESB Networks Ltd

5.12 ESB Networks Ltd is the licensed operator of the electricity distribution system – the distribution system operator (DSO).

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[47] In general, for projects with a total export capacity or demand of less than 20MVA at a single location, a distribution connection should be investigated first.

5.13 The distribution network is the medium- and low-voltage electricity network used to deliver electricity to connection points such as houses, workplaces and street lights.

5.14 ESB Networks as Distribution Asset Owner (DAO) owns and is responsible for building, maintaining and operating the entire distribution level network infrastructure. This includes all overhead electricity lines, poles and underground cables used to bring power to Ireland's customers.

5.15 Distribution tariffs are the charges paid for using the distribution system. The tariffs are paid by the suppliers who use the system (and are ultimately passed on to customers). The CER sets the tariffs to be applied for use of the network. Distribution tariffs are reviewed annually. The CER periodically carries out full reviews of the costs that ESB Networks incurs owning, maintaining and operating the distribution system to ensure that only equitable levels of costs are collected through the distribution tariffs (the price control review).

Underlying Business Risks

5.16 We now discuss the underlying risks in carrying out the business activities of the TAO, TSO and DSO. As only systematic risks affect the appropriate cost of capital, we focus on this type of risk. However, we first include a brief outline of some of the specific risks which may affect the networks.

Specific risks

5.17 Specific risks are those risks that only apply to a particular asset class and which are not correlated with the overall returns of the market portfolio. As these risks can be diversified by investors they do not affect a company's cost of capital.

5.18 An example of a specific risk affecting the TAO, TSO and DSO is the effect of some environmental legislation – e.g. energy efficiency policies. These may affect demand for electricity or subsidise particular types of energy.

Systematic risks

5.19 Systematic risk, also known as market or non-diversifiable risk, is risk that is characteristic of an entire market. As it cannot be diversified away by investors, the extent of the systematic risk affects a company's cost of capital.[48] Risks with a systematic element affecting the transmission and distribution networks include the following:

[48] As explained in section 1, exposure to systematic risk is captured in the CAPM equation by the size of company's equity beta, which is multiplied by the market risk premium and added to the risk-free rate to determine the cost of equity.

Demand volatility

5.20 There are a number of factors that can affect the demand for the services of the TAO, TSO and DSO. Types of demand risk affecting the transmission and distribution networks are:

(a) the number of customers (both existing and new connections);

(b) the voltage transported;

(c) the length of network required.

5.21 Although there would be specific factors affecting demand such as environmental legislation, there would also be systematic components to demand – for example, a country's GDP which could affect the demand for energy. The Republic of Ireland's GDP is also likely to be correlated with the number of new premises built and hence will have an impact on the number of new connections.

5.22 An important factor when considering the effect of demand volatility is the extent to which a regulatory regime shields or exacerbates a firm's exposure to demand risk. This is discussed later in this section.

Bad debts

5.23 Customer defaults affect a company's profitability. The proportion of customers defaulting on their utility bills is likely to rise in a recession and hence bad debts are a systematic risk.

5.24 Customers are also more likely to fall behind on their bills in a recession, even if their bills are still ultimately paid. This will be costly for companies as cash will be received later rather than sooner, either requiring companies to raise working capital to cover their cash requirements (with associated financing costs), or meaning that companies forego the opportunity to earn returns on this cash during the period of delay.

Changes in input costs

5.25 Changes in input costs affect the revenues of the TAO, TSO and DSO. Input costs include the costs of construction materials as well as the costs of paying wages to staff. The networks may also be affected by changes in oil prices and related factor inputs.

5.26 Changes in inputs such as wages are systematic in nature to the extent that they affect the whole economy. However, there may be a specific element to certain inputs if only particular categories of that input are affected (for example, the wages of construction workers).

Interest rate movements

5.27 Changes in interest rates affect the whole economy and are hence a systematic risk.

5.28 Interest rates can affect the costs of raising finance, and the repayment terms of existing debt where debt has a floating rather than a fixed interest rate. Bond prices move inversely to interest rates, with bond prices being lower when interest rates are high and vice versa. This is because with a static coupon bond prices and bond yields are inversely related (the higher the price of the bond, the lower the real yield); and bond holders are prepared to accept a lower rate of return (yield) when interest rates are low; but demand a higher yield when interest rates are high.

5.29 Interest rates will have direct effects on a company's systematic risk but also indirect effects as they may have an impact on demand volatility and input costs.

Changes in inflation/ deflation

5.30 Changes in inflation affect the whole economy and therefore represent a systematic risk. The inflation rate affects the real amount which a firm ends up repaying on nominal debt. Inflation may also affect input costs.

5.31 As a result of the current financial crisis in Ireland, the country experienced negative Consumer Price Index (CPI) inflation of -4.5 per cent in 2009. Deflation increases the real amount repayable on nominal debt, although companies may benefit from lower input costs.

5.32 Like interest rates, the rate of inflation will also have direct effects on a company's systematic risk but also indirect effects on other factors such as demand volatility. Inflation also affects revenues through indexation.

5.33 The extent to which a company is affected by interest rate movements and changes in inflation will be influenced by the amount of finance it needs to raise. Companies which have to undertake large amounts of investment may therefore face higher risks.

Factors Affecting Risk Exposure

5.34 There are certain factors that affect a company's exposure to systematic risk. These include cost structure and the regulatory framework.

Cost structure

5.35 Particular aspects of a firm's cost structure can affect its exposure to systematic risk.

Operational leverage

5.36 The degree of operational leverage of a company is the proportion of its costs that are fixed.

5.37 With all other things held constant, shareholders in regulated companies with a small RAB/profit relative to ongoing costs (i.e. a thin profit margin) are likely to suffer proportionately more when downside shocks occur (and gain more following upside

events) in comparison to shareholders in firms whose RABs/profits are large relative to ongoing costs.

5.38 Higher operational gearing therefore makes companies more risky from the viewpoint of investors (larger variance of returns) causing them to demand higher (expected) returns.

Regulatory framework

5.39 A regulatory framework can either increase or decrease a company's exposure to systematic risk when compared with an unregulated company performing similar functions.

5.40 A firm allowed full cost pass-through or with rate-of-return regulation faces no increase in systematic risk if there is cost uncertainty.

5.41 Whether the price control takes the form of a price cap or a revenue cap affects a company's systematic risk. The two alternatives work as follows:

(a) *Price cap* – the regulator agrees a fixed set of tariffs. The revenue which the company earns from these tariffs would depend on market volumes. Under a pure price cap approach, the company is fully exposed to the revenue consequences of any change in market volumes. In other words, its revenue would increase if market volumes increased, but would fall if market volumes decreased.

However, price cap regulation decreases a firm's beta when compared with an unregulated firm. This is because profits rise less for the regulated firm compared with the unregulated firm when there are positive shocks to demand due to the price cap placing a limit on price rises, but profits will fall due to negative shocks in the same way as for an unregulated firm since prices can (at least in theory) fall below the cap. Overall, profits for the regulated firm are less variable (and on average lower, due to not being able to take full advantage of upside shocks) than when the firm is unregulated. This lower variability in profits leads to a lower beta for the regulated firm when compared to an unregulated firm.

(b) *Revenue cap* – the regulator would agree the revenues that the company should be allowed to earn. Tariffs would be calculated so as to recover these revenues on the basis of projected market volumes. However, in the event that out-turn market volumes differed from these projections, any over- or under-recovery of revenue would be taken into account in finalising the tariffs for the following year. As tariffs are changed annually (to allow a set level of revenues to be earned) the company is exposed to less systematic risk than companies with a pure price cap.

5.42 Regulators are not necessarily restricted to choosing between the pure price cap and revenue cap approaches described above, since it is also possible to employ a hybrid approach. For instance, a price control could be set such that 50 per cent of allowed revenue is fixed, with the company exposed to changes in market volumes in relation to

the other 50 per cent. This type of arrangement is sometimes referred to as including a "volume driver" within the price control.

5.43 There are a number of mechanisms that a regulator can use to reduce a company's exposure to systematic risk. These include the type of price cap, cost pass through items and revenue drivers.

Effect of CER Regulation

5.44 We now discuss the effect the CER regulatory framework has on the systematic risk of the TAO, TSO and DSO.

Type of price cap – TAO, TSO and DSO

5.45 The price caps for the TAO, TSO and DSO are all calculated on an allowed revenue basis. The price control takes the form of a cap on allowed revenues. This revenue increases each year of the price control according to CPI-X, where X is a factor representing efficiency gains.

5.46 At the 2006-2010 ESB (DSO) price control review,[49] the CER decided not to continue the application of a strict CPI-X approach. The CER set X at zero, while it profiled allowed opex to reflect increased efficiencies year-on-year. This in practice had the same effect as putting a value on X and profiling the allowed revenues over the control period to drive efficiencies.

5.47 At the 2006-2010 transmission price control review,[50] the CER decided that CPI-X would continue to be used as the basis for the price control for the TAO and would be extended to the TSO's business. "X" would be set to reflect the year-on-year efficiency improvements the CER expected the TAO and TSO to achieve or improve upon.

5.48 By indexing the allowed revenues, the price control protects the TAO, TSO and DSO from the systematic risk associated with general inflation affecting the economy as a whole. The indexation may, however, differ from the input price changes that matter to ESB/ EirGrid.

Distribution system operator

5.49 The CER regulates the charges for connecting to and using the network.

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[49] CER: 2006-2010 ESB Price Control Review, decision paper on distribution system operator revenues, CER 05/138, 9th September 2005

[50] CER: 1006-2010 Transmission Price Control Review, decision paper, CER 05/143, 9th September 2005.

Revenue regulation

5.50 To set such charges, the CER first determines the revenues that ESB Networks as the DSO is allowed to earn in order to cover the cost of providing the network. This is done every five years.

Tariff regulation

5.51 The revenue the DSO is allowed to collect from customers is reviewed and refined each year and these "allowed revenues" are used to calculate the distribution use of system (DUoS) tariffs. These tariffs are approved by the CER. DUoS tariffs are charged to suppliers on the basis of the amount of energy used by their customers, and include standing charges. There are different DUoS tariffs for different types of customers.

CER regulatory mechanisms which affect systematic risk exposure – TAO and TSO

5.52 CER regulatory mechanisms which affect the systematic risk exposure of the TAO and TSO include:[51]

Cost drivers

5.53 Cost drivers can be used to reduce a company's risk exposure by linking the allowed revenues of a firm to certain factors. There are currently no cost drivers in the price control for the TAO and TSO.

5.54 However, while the 2005 decision stated that the 2006-2010 price control for the TAO and TSO would not include cost drivers, it also stated that these would be considered for use in the future.

Uncertain costs

5.55 These were defined by the CER as costs which could not reasonably be foreseen by the business, and comprised elements such as:

(a) SEM-related costs and other costs related to market opening, most likely to impact on the TSO;

(b) changes in legislation or regulation that impose a cost on the company, such as environmental restrictions; and

(c) restructuring costs driven by changes in legislation.

[51] CER: 1006-2010 Transmission Price Control Review, decision paper, CER 05/143, 9th September 2005.

5.56 Such uncertain costs would be dealt with on a case-by-case basis. The TAO and TSO would be expected to ensure changes in opex or new capex were efficient and this would be reflected in the allowance provided, but there would not be automatic pass-through of such costs.

5.57 These uncertain costs would typically be specific in nature and would therefore not impact on the cost of capital. However, there could potentially be some systematic element to some uncertain costs.

Pass-through items

5.58 Uncertain costs such as the TAO's local authority rates and the TSO's transmission constraint and ancillary services costs which are deemed to lie outside of the businesses' control may be passed through. This reduces the companies' systematic risk.

Additional incentive mechanisms

5.59 The TAO's 2006-2010 price formula contained one incentive: the value of X through which it was incentivised to improve both operational and capital expenditure efficiency.

5.60 For the TSO there were incentives for the secure operation and maintenance of the transmission system through mechanisms linked to transmission system interruptions, losses, and frequency and voltage variations.

CER regulatory mechanisms which affect systematic risk exposure – DSO

5.61 CER regulatory mechanisms which affect the systematic risk exposure of the DSO include:[52]

Cost drivers

5.62 Unlike the TAO and TSO price control, the DSO price control formula contains a cost driver based on customer numbers. This is intended to model the impact of changing numbers year to year on the DSO's costs so that this can be reflected in its allowed revenue. This is the sole cost driver.

Uncertain costs

5.63 These were defined as costs which could not reasonably be foreseen by the business, and comprised elements such as:

[52] CER: 1006-2010 Transmission Price Control Review, decision paper, 9 September 2005.

(a) SEM-related costs and other costs related to market opening, most likely to impact on the DSO;

(b) changes in legislation or regulation that impose a cost on the company, such as environmental restrictions; and

(c) restructuring costs driven by changes in legislation.

5.64 Such uncertain costs would be dealt with on a case-by-case basis. The DSO would be expected to ensure changes in opex or new capex were efficient and this would be reflected in the allowance provided, but there would not be automatic pass-through of such costs.

5.65 These uncertain costs would typically be specific in nature and would therefore not impact on the appropriate cost of capital.

Pass-through items

5.66 Certain costs, such as DSO's business rates, are deemed to lie outside of the businesses' control and may be passed through. This reduces the company's systematic risk. However, as with uncertain costs the CER states that the DSO should provide evidence that it has attempted to minimise such costs through negotiation where possible.

Additional incentive mechanisms

5.67 The DSO's current price formula contains five key incentives:

(a) the value of "X", to drive overall efficiency gains;

(b) an incentive to reduce the level of distribution losses below a target level;

(c) an incentive to reduce customer minutes lost below a target level;

(d) an incentive to reduce the number of customer interruptions below a target level;

(e) an incentive to improve the quality of service from the Customer Contact Centre.

5.68 When setting the targets for the latter four items, the CER sets target levels for each year and a monetary rate to be applied to the differential between actual and target levels. This adjustment is made each year.

5.69 The impact of all incentives was limited to 4 per cent of the DSO's allowed revenue for the years 2007 to 2010, and limited to 2.5 per cent for the year 2006.

Comparison of TAO and TSO

5.70 We now consider whether there is a case for a different cost of capital for the TAO compared to the TSO based on differences in systematic risk exposure. We consider differences in the following:

(a) the nature of the activities;

(b) costs;

(c) regulatory incentives.

The nature of the activities

5.71 As explained above there are clear differences in the nature of the activities of the TAO and TSO. The TAO as owner of the transmission system has responsibility for management of the transmission capital and maintenance work programmes, whereas the TSO as operator of the transmission system is responsible for operating the high-voltage network. We discuss below the implications of this difference for systematic risk exposure.

Costs

5.72 Related to the different activities of the TAO and TSO are different costs. These are set out in more detail below.

RAB

5.73 The majority of the TAO's allowed revenues relate to the depreciation of network assets and a return on the capital employed in the network. Using a replacement-costs approach to valuing the RAB, and indexing its historic value by the Consumer Price Index (CPI) with a couple of adjustments relating to asset lives and valuation of the 2001 RAB, the CER determined a TAO RAB valuation of €839m for 2006.

5.74 The CER determined an opening RAB for the TSO of €17m for 2006. This was based on expected out-turn capex during the previous price control.

Opex and capex

5.75 Table 5.1 summarises transmission-allowed costs for the 2006-2010 price review.

Table 5.1: Transmission expenditure 2006-2010

Transmission expenditure 2006-2010 2004 prices	CER €m	% of total TSO/TAO opex and capex
TSO OPEX	574.38	95%
- internal OPEX	*188.23*	*- 33% of TSO OPEX*
- external OPEX	*386.15*	*- 67% of TSO OPEX*
TSO CAPEX	28.23	5%
Total TSO	602.61	
TAO OPEX	236.77	31%
TAO CAPEX	521.00	69%
Total TAO	757.77	

Source: CER: 2006-2010 Transmission Price Control Review, decision paper, 9 September 2005, p. 2-5.

5.76 Table 5.2 shows the TSO and TAO allowed revenues broken down year by year for the period 2006-2010.

Table 5.2: TSO and TAO allowed revenues 2006-2010

	Revenue allowed by CER €m				
	2006 – ex post (2006 prices)	2007 – ex post (2007 prices)	2008 – ex post (2008 prices)	2009 – ex ante (2007 prices)	2010 – ex ante (2008 prices)
TSO external costs	90.4	64.64	38.5	46.50	45.83
TSO internal costs	48.3	46.80	51.18	47.50	47.70
Sub total adjustments	0.5	7.06	3.33	5.95	5.12
Total TSO revenue	139.2	118.53	93.01	99.95	98.65
Total TAO revenue	114.01	140.19	150.63	155.68	159.23

Sources: CER documents: Determination of 2010 Transmission allowed revenue and use of system tariffs, September 2009; Determination of Transmission allowed revenue and use of system tariffs, September 2008; Determination of Transmission allowed revenue and use of system tariffs, October 2007.

5.77 As shown in Table 5.1, although combined opex and capex for the TSO and TAO are broadly similar, the percentage of costs taken up by capex and opex are very different.

5.78 Capex accounts for a much greater percentage of TAO costs than TSO costs. It follows from this that any systematic factors that affect capex (such as inflation in costs of construction materials) will have a greater effect on the TAO than on the TSO. On the other hand, factors affecting opex costs more than capex (such as wage inflation) will have a greater impact on the TSO rather than the TAO.

5.79 Companies which have higher operational gearing (i.e. fixed costs comprise a greater proportion of their cost base) will have higher systematic risk exposure, *ceteris paribus*.

This is because changes in demand will have a larger impact on profits when costs are fixed. Capex is sometimes regarded as a proxy for fixed costs. How appropriate this is can be debated, since some opex may be a fixed cost whereas it may sometimes be possible to adjust capex in light of changes in demand. However, to the extent that high capex is taken as an indicator of high operational gearing, the above data suggest that the TAO may have higher systematic risk exposure in this regard.

The TSO's opex

5.80 The TSO's costs were split into two categories - internal and external:

(a) Internal costs were considered directly controllable by the management decisions of the TSO.

(b) External costs were considered to be largely beyond the TSO's control and it was not considered appropriate to cap these costs. External costs represent the larger and increasing share of total TSO opex.

5.81 Over the period 2006-2010, the TSO's external costs consisted predominantly of ancillary services and constraint costs. For 2010, the external costs consisted primarily of ancillary services (93 per cent of total external costs). Other external costs included: regulatory levy; inter-TSO compensation; interconnector services; and constraint banking fees. However, up until 2007 a large proportion of external costs were constraints (constraint costs accounted for 45 per cent of total external costs in 2007). In 2006, constraint costs accounted for 62 per cent of total external costs. However, on account of the SEM, from 1 November 2007 constraint costs are no longer recovered by EirGrid but through a levy administered through the all-island SEMO.

5.82 The external costs were effectively treated as pass-through costs and therefore only the internal costs would have an impact on systematic risk.

5.83 The internal opex costs for the TSO consist of: payroll and professional fees; maintenance professional fees; IT operating costs; business overheads; inter-business unit/inter-company charges.

5.84 The opex costs for the TAO consist of: payroll costs; networks repairs and maintenance; field operations; non-capitalised planning and construction; corporate overheads and administration; wayleaves; and insurance.

5.85 The TSO's (non-network) capex related largely to the IT systems required for its transmission and market operation functions.

5.86 The TAO's capex is connected to load related and non-load related projects.

5.87 Once we exclude the external costs of the TSO, it is unclear which of the TSO and TAO is likely to face higher systematic risk as a result of their opex.

Regulatory incentives

5.88 There are different regulatory incentives facing the TSO and TAO. The TSO has a large proportion of its opex costs as pass-through items. Overall, external opex accounted for over half of total opex costs in the period 2006-10. However, external costs as a percentage of total TSO opex has fallen to around 45 per cent of total opex since 2008 due to the fact that the TSO no longer has to pay constraint costs. In 2010, the external costs accounted for 46 per cent of total TSO revenue.

5.89 The TAO has a much greater percentage of costs exposed to systematic risk due to its larger capex costs. The TSO has greater protection from systematic risk (due to its external opex costs being treated as pass-through costs).

5.90 However, the TAO would also have some protection from systematic risk due to prices being indexed. This provides a degree of protection from inflationary price increases in wages and construction materials (although it would not provide total protection as these costs may move differently from the overall price index).

5.91 Overall, it could be argued that the TAO has a greater exposure to systematic risk as the regulatory framework shields the TSO from the major uncertainties relating to its activities (the external costs). Although the large capex programme the TAO has to carry out would not have as much systematic risk as the external costs of the TSO, it is likely to have some systematic risk which would affect the TAO's cost of capital.

Conclusion on cost of capital for TAO *vs* TSO

5.92 There are clear differences in the nature of the activities of the TSO and TAO. Although both are involved in electricity transmission, the TAO is the owner of the assets and responsible for management of the transmission capital and maintenance work programmes; whereas the TSO is responsible for operating the transmission system.

5.93 The differences in activities carried out by the TSO and TAO will expose them to different systematic risks. The main systematic risks facing the TSO involve its internal opex. The main systematic risks facing the TAO are as a result of the large capex programmes it is required to carry out.

5.94 From our analysis it appears that the TSO has greater regulatory protection from the risks associated with its main activity – the operation of the transmission network due to pass-through of external costs. The TAO receives some protection from systematic risks associated with its capex due to the indexing of allowed revenues.

5.95 Due to its greater exposure to systematic risk associated with its capex, we therefore consider that there may be a weak qualitative case for allowing a higher cost of capital to the TAO compared to the TSO. However, in our view the evidence is not sufficiently conclusive to justify a different allowed cost of capital, and hence we recommend that the CER applies the same cost of capital figure to both the TAO and TSO.

Comparison of TAO and DSO

5.96 We now consider whether there is a case for a different cost of capital for the TAO compared to the DSO, based on differences in systematic risk exposure. We consider differences in the following:

(a) the nature of the activities;

(b) costs;

(c) regulatory incentives.

The nature of the activities

5.97 The DSO is responsible for building, maintaining and operating the entire distribution level network infrastructure.

5.98 The DSO therefore performs similar functions to the TSO and TAO (although involving a lower voltage of network). However, the DSO does not face the external costs relating to balancing of the network that the TSO faces.

5.99 The DSO could therefore be considered most similar to the TAO in terms of the nature of the activities which it undertakes, and hence the systematic risks which it faces.

RAB

5.100 The DSO's RAB comprises: network assets, i.e. the wires and switchgear required for the operation of the system; system operation and related IT equipment; tools, vehicles, furniture and fittings; telecoms and other IT equipment; premises involved in the delivery of its services; and IT related to the market-opening implementation programme.

5.101 The CER valued the opening RAB for the DSO in 2006 at €3369.5m. The networks component was by far the largest constituent of the RAB, accounting for over 90 per cent of its value.

5.102 The CER determined a TAO RAB valuation of €839m for 2006.

Opex and capex

5.103 Table 5.3 summarises transmission and distribution allowed costs for the 2006-2010 price review.

Table 5.3: Distribution and transmission expenditure 2006-2010

Distribution/transmission expenditure 2006-2010 2004 prices	CER €m	% of total TSO/TAO/DSO opex and capex
TSO opex	574.38	95%
- internal opex	*188.23*	*- 33% of TSO opex*
- external opex	*386.15*	*- 67% of TSO opex*
TSO capex	28.23	5%
Total TSO	602.61	
TAO opex	236.77	31%
TAO capex	521.00	69%
Total TAO	757.77	
DSO opex	1,904	46%
- controllable	*940*	*- 49% of DSO opex*
- non-controllable	*964*	*- 51% of DSO opex*
DSO capex	2,278	54%
Total DSO	4,182	

Sources: CER: 2006-2010 Transmission Price Control Review, decision paper; CER: 2006-2010 ESB Price Control Review, decision paper on distribution system operator revenues.

5.104 Table 5.4 shows allowed revenues for the DSO for each calendar year of the period 2006-2010.

Table 5.4: DSO allowed revenues 2006-2010 (€m)

	2006	2007	2008	2009	2010
DSO allowed revenue (2004 prices)	535.0	567.4	588.7	601.8	615.4
Actual allowed revenue	561.5	634.9	698.8	737.0	679.2

Sources: CER documents: 2006-2010 ESB Price Control Review, decision paper on distribution system operator revenues; 2006, 2007,2008, 2009, 2010 respective decisions on distribution system operator allowed revenue, distribution use of system tariffs and distribution loss adjustment factors.

5.105 The first row of Table 5.4 shows the level of revenues as detailed in the CER's 2005 decision paper.[53] The 2005 decision paper also detailed how the allowed revenues would be updated each year. The DSO revenues for 2006, 2007, 2008, 2009 and 2010 as updated, consulted upon and set by the CER each year are shown in the third row.[54]

5.106 As can be seen from Table 5.3, the DSO's opex is split into controllable and non-controllable components. Controllable opex are operational costs over which the DSO

[53] CER: 2006-2010 ESB Price Control Review, decision paper on distribution system operator revenues

[54] CER 2006, 2007,2008, 2009, 2010 respective decisions on distribution system operator allowed revenue, distribution use of system tariffs and distribution loss adjustment factors.

has control, such as network maintenance. Other costs are deemed to be non-controllable, such as network depreciation. The non-controllable costs are not passed through but are considered differently when assessing efficiencies.

5.107 A major difference between the DSO and TSO is that the DSO is not subject to external opex in the way that the TSO is. On the other hand, the DSO is subject to large capex in a similar way to the TAO.

5.108 The DSO's capex over the 2006-2010 period is divided as follows: new business (€854m); reinforcements (€530m); network non-load related (€755m); and non-network (€139m).

Regulatory incentives

5.109 There are different regulatory incentives facing the DSO and the TAO.

5.110 The DSO price control formula contains a cost driver based on customer numbers. The TAO does not contain such a cost driver. The DSO's price control also contains incentives relating to distribution losses and customer minutes lost, as well as incentives to reduce customer interruptions and to improve the quality of service from the Customer Contact Centre, and an overall X to drive overall efficiency gains. However, these additional incentives relate more to the operational side of the DSO's activities rather than the investment side, and the risks involved are likely to be specific rather than systematic.

5.111 Both the DSO and TAO have some protection from regulatory risk due to prices being indexed to inflation. This provides a degree of protection from inflationary price increases in wages and construction materials (although it would not provide total protection as these costs may move differently from the overall price index).

Conclusion on cost of capital for TAO *vs* DSO

5.112 Both the TAO and DSO carry out large capex programmes to build and maintain the network. These capex programmes are exposed to similar systematic risks relating, for example, to the costs of construction materials; workers wages; and financing costs. We therefore consider that the TAO and the DSO should have the same equity beta in the cost of capital calculations.

6 ASSET BETA

Introduction

6.1 This section discusses the estimation of the "beta" parameter, which measures a company's exposure to non-diversifiable risk. It is structured as follows:

(a) methodological issues;

(b) comparators' analysis;

(c) regulatory precedents;

(d) conclusions.

Methodological Issues

6.2 The equity beta measures the covariance between the company return over the safe rate with the market return over the safe rate.[55] The equation to be estimated is usually:

$$R_{it} = \alpha + \beta R_{mt} + e_{it}$$

where R_{it} is the log excess return on asset *i* at day *t* (log return net of the logarithmic safe rate), R_{mt} is the log excess return on the market, α is a constant and β is the equity beta. e_{it} is the random noise error term in estimation — the non-systematic component of the return to the asset. The hypothesis in estimation is that α is zero and β is one for the average stock.

6.3 The excess return is constructed as a data manipulation prior to estimation, defined more exactly as:

$$R_{it} = \ln\left(\frac{P_t + D_t}{P_{t-1}}\right) - \ln\left(1 + R_{ft}\right)$$

where P_t is the price today, D_t is dividend per share that becomes known today, P_{t-1} is the price yesterday, and R_{ft} is the safe rate available today.

[55] Note that the weaker is this correlation, the greater the contribution that the stock could make to reducing exposure to systematic risk, and therefore the lower the expected return required.

Asset betas

6.4 When comparing the betas of different firms, one has to take into account the different gearing levels that firms choose since - all other things being equal - a firm with higher gearing will exhibit a higher-equity beta (see the capital structure section for an explanation of this effect).

6.5 Therefore, unless one controls for this effect, there is a danger of confusing the risk that comes from high leverage with the underlying systematic risk that a firm faces by virtue of the nature of its activities.

6.6 Asset betas are calculated in order to control for the effect of differing levels of gearing. An asset beta is a hypothetical measure of the beta that a firm would have if it were financed entirely by equity. By comparing different firms' asset betas it is possible to isolate shareholders' perceptions of underlying systematic risk, and carry out an assessment of the relative riskiness of different companies after controlling for gearing.

6.7 Asset betas are calculated using the following formula:

$$\beta_a = (1 - g) . \beta_e + g . \beta_d$$

6.8 where β_a is a firm's asset beta, β_e is a firm's equity beta, g is gearing and β_d is the firm's debt beta.[56]

Estimation period

6.9 Equity betas vary over time. This might be because of changes in gearing or changes in the underlying correlations between company and aggregate returns (i.e. asset betas). It is sensible, therefore, to choose an estimation window that is as recent as possible, because today's observation is the forward-looking estimate, while still containing sufficient data points to give reasonably accurate estimates.

6.10 Smithers & Co (2003) investigated the matter, noting that the additional gains in estimation accuracy become less as more observations are added. For example, going from one year to two years of daily data (i.e. 250 observations to 500 observations) will reduce the standard error by 40 per cent, but going from three to four years only reduces the error by 15 per cent.

6.11 It is possible to use an explicit time-series estimation technique to account for the time variation. However, these techniques, as noted by Smithers & Co (2003), are

[56] The debt beta measures the covariance between the return on a company's debt with the market return. In this work we assume a debt beta of zero (this is in keeping with a number of regulatory precedents), and also carry out sensitivity analysis assuming non-zero debt betas based on companies' credit ratings.

susceptible to over-fitting and can find apparent time variation where none exists. The techniques are also non-linear and not widely used for regulatory purposes.

Adjustments to estimated betas

6.12 Two main adjustments, the so-called Bayesian and Blume adjustments, have been used in some past estimations of beta, with the effect of bringing the estimated betas closer to one.

6.13 The argument for Bayesian adjustment is that the estimation of beta ignores the fact that the beta of an average company is by definition equal to one.[57] The Bayesian adjustment takes account of measurement uncertainty (as estimated explicitly in the calculation of the raw beta) by employing a weighted average between the beta estimate for the company and a constructed average beta for the market as a whole that would be equal to one. The weights are based on the relative uncertainty in measurement — the higher the uncertainty in the company beta estimates relative to the variance of all betas in the market, the less weight is placed on the company beta:

$$\beta_{adj} = \beta_{OLS} \times \frac{Var(\beta_{pop})}{Var(\beta_{pop}) + Var(\beta_{est})} + 1 \times \frac{Var(\beta_{est})}{Var(\beta_{pop}) + Var(\beta_{est})}$$

6.14 The Blume adjustment is based on an empirical observation (made in 1971) that betas tended to move towards one over a (long) time period. Mean reversion is sometimes offered as an explanation for this observed movement. In later investigations, however, Blume found that the reasons for the movement in the betas had to be explained by some real changes in the perceived risks of the companies — the tendency for companies to evolve could mean that companies of extreme risk (high or low) tend to have less extreme risks over time.[58]

6.15 Our view is that the use of the Blume adjustment is arbitrary and inappropriate. While a Bayesian adjustment has a stronger theoretical rationale, Smithers & Co (2003) found that in practice it may not make much difference if daily data are used in the estimation.

Use of comparators

6.16 While betas for listed companies are usually straightforward to calculate, the fact that ESB Networks and EirGrid do not have any listed equity means that it is not possible to estimate an equity beta for them directly from stock price data.

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[57] Note that this concerns the *average* company. It is straightforward to test whether the estimated beta of an individual stock or portfolio is statistically significantly different from one.

[58] Blume, M.E: "Betas and their regression tendencies" Journal of Finance, 1975 and "Betas and their regression tendencies: further evidence", Journal of Finance, 1979

6.17 In this context, a natural approach is to use beta estimates for a set of comparators – ideally, listed companies carrying out comparable activities and subject to similar economic regulation. A comparator approach depends crucially on the selection of sectors and companies which are likely to have a similar systematic risk exposure to ESB Networks/ EirGrid. In addition, it is important to take account of any differences in equity betas which may be due to differences in levels of gearing.

6.18 Beta estimates for comparators can either be taken direct from existing sources (e.g. Bloomberg or the LBS Risk Management Service), or they can be estimated from data on company and stock market returns. The advantage of the former is that it is less resource-intensive, whereas the advantage of the latter is that it gives greater control over how the estimation is carried out.

Comparator Analysis

6.19 Our approach involved using two types of comparator data:

(a) calculated betas for comparator firms with a stock market listing; and

(b) the beta estimates that regulators have made in recent periodic reviews.

6.20 The first step in calculating betas for comparator firms was to select the sample of comparators. The approach we took to this step is discussed further below.

6.21 We then downloaded un-levered equity betas and gearing data from Bloomberg in order to calculate the asset betas of the comparator companies. The equity betas we downloaded were based on two years of daily data, and do not incorporate either a Bayesian or a Blume adjustment.

6.22 Together, the analysis of comparator company asset betas and our review of regulatory precedents allowed us to derive a range for the asset beta.

Choice of comparators

6.23 We chose comparators which carry out similar activities to those of the TAO, TSO and DSO. Table 6.1 on the next page lists the comparators that we examined.

6.24 Most of the comparators that we have selected operate in the European energy sector and own electricity or gas transmission and distribution networks. In addition, we have included two comparator companies that operate in the UK water sector, reflecting the similarities between water and energy networks.[59] The network businesses of these comparators would in many cases be subject to broadly similar RPI-X regulation. Based

on these similarities, we consider that these comparators are likely to be exposed to a similar level of systematic risk.

6.25 A caveat surrounding this sample of comparators is that many of the companies also operate in other parts of the value chain (i.e. generation and supply) as well as owning and operating transmission and distribution networks. Some companies may also be involved in non-energy activities. Where a company is a "pure play" energy network comparator we have indicated this in the table.

6.26 The group of comparators does not contain any utility networks in Ireland, reflecting the state ownership of companies (e.g. Bord Gais) that might otherwise have been included.

[59] The two UK water and sewerage companies are Severn Trent, and Northumbrian Water. These companies are included as comparators due to the similarities in activities of energy and water companies in terms of network activities, exposure to volume risk and the need for infrastructure investment.

Table 6.1: European utilities used as comparators

	Energy-related activities[60]	Other (non-energy) activities	Main countries operates in	Regulated by
Scottish Power[61]	Electricity: generation; distribution – parts of UK; transmission owner – South Scotland; retail. Gas: supply.		GB	Ofgem - UK
Scottish & Southern Energy (SSE)	Electricity: generation (UK and Ireland); distribution – Scotland and England; transmission owner – parts Scotland; retail. Gas: transmission owner and operator; distribution (Scotland);[62] storage.	SSE Telecoms and Neos Networks – telecoms network.	GB	Ofgem - UK
Viridian[63]	Electricity: major subsidiary – Northern Ireland Electricity: transmission and distribution asset owner (N Ireland); distribution operator (N Ireland). NI Energy: supply (NI). NIE energy power procurement business (PPB): generation. Energia: renewable energy. Gas: Energia: supply (NI and RoI).		Northern Ireland	NIAUR -NI
E.ON[64]	Electricity: generation; distribution; transmission (Germany); renewables. Gas: exploration; production; transport; distribution.		Europe (based Germany); US; Russia.	Ofgem-UK BNA/FNA-Germany
ENEL	Electricity: generation; transmission; distribution; supply. Gas: exploration; production; supply.		23 countries (based Italy) – includes: Europe, North and Latin America.	various
EDF	Electricity: generation; transmission; distribution; supply.		France and others (offers	Ofgem - UK

60 These lists are non-exhaustive.
61 Scottish Power was acquired by Iberdrola on 23 April 2007.
62 SSE holds 50 per cent of the equity of Scotia Gas Networks plc, which owns and operates the Scotland and the Southern gas distribution networks.
63 Note for Viridian the equity beta figures quoted later in this section refer to the group. Northern Ireland Electricity is the main subsidiary but the group also includes: NIE Energy; Powerteam Electrical Services; Viridian Power & Energy.
64 E.ON was delisted from the London Stock Exchange in 2007.

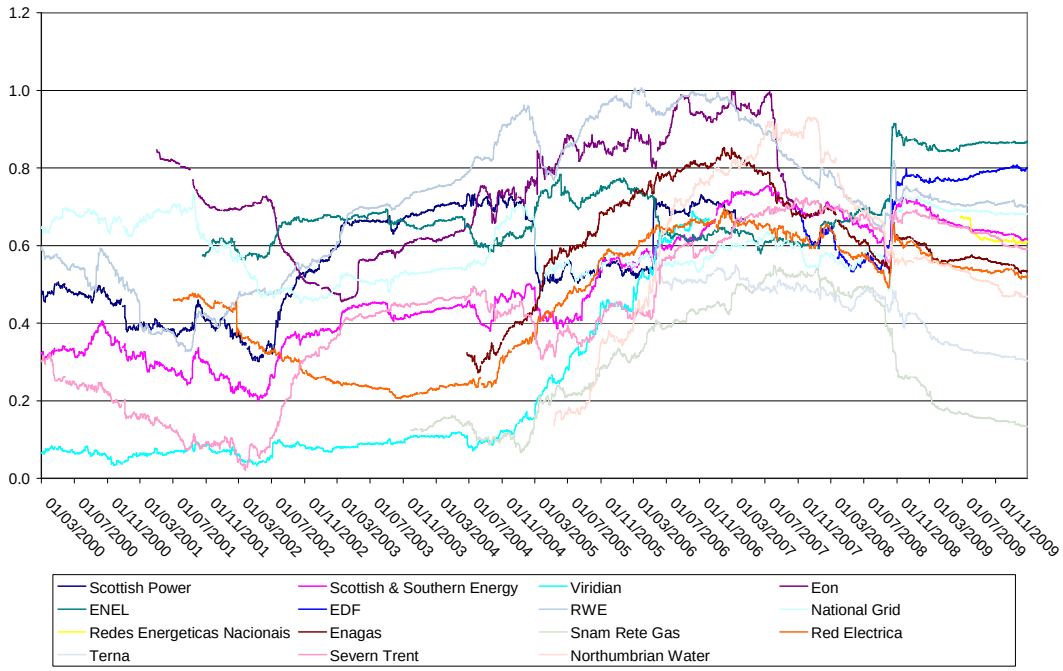
	Gas: supply.		services in 35 countries).	
RWE AG	Electricity: generation; distribution; supply. Gas: exploration; production; transport; distribution.		Europe (based Germany).	BNA /FNA - Germany
National Grid (pure play)	Electricity: transmission owner (E&W); transmission operator (GB). Gas: transmission owner and operator (GB); distribution (parts of England).		GB; Northeast US.	Ofgem - UK
Redes Energeticas Nacionais (pure play)	Electricity: transmission. Gas: transmission operator.		Portugal	
Terna (pure play)	Electricity: transmission.		Italy	
Red electrica (pure play)	Electricity: transmission.		Spain	
Snam rete gas (pure play)	Gas: transmission owner and operator.		Italy	
Enagas (pure play)	Gas: importation; storage; distribution.		Spain	
Severn Trent		Water and sewerage.	GB	Ofwat
Northumbrian Water		Water and sewerage.	GB	Ofwat

Note: the Bloomberg equity beta data used for these companies was calculated based on returns from the London Stock Exchange for all comparators, except RWE (Germany- Xetra); ENEL (Italy- Borsa Italiana); EDF (France – Euronext Paris); Redes Energeticas Nacionais (Portugal – Euronext Lisbon); Terna (Italy – Borsa Italiana); Red electrica (Spain); Snam rete gas (Italy – Borsa Italiana); Engagas (Spain).

Equity betas of European comparator utilities 1999-2010

6.27 Figure 6.1 shows the equity betas for the European comparator utilities over the 10-year period March 2000 – February 2010.

Figure 6.1: Equity betas of European comparator utilities 2000 to 2010



Source: Bloomberg

6.28 Over the 10-year period there have been substantial changes in equity betas for some utilities, most notably Viridian, E.ON, Terna, Enagas, Snam rete gas, Northumbrian Water and Scottish & Southern Energy. Over such a long period, it is likely that some of this observed volatility may have been the result of changes in company structure altering the systematic risks to which a company was exposed. However, there appears to have been a general increasing trend in equity betas over the period, in particular in the 2004-10 period compared to the 2000-2004 period.

6.29 Table 6.2 gives 5 and 10-year averages for the equity betas over the 10-year period.

Table 6.2: Five and 10-year averages for comparators' equity betas

	5-year average (2004-2009)	10-year average (1999-2009)
Scottish & Southern Energy	0.62	0.49
ENEL	0.72	0.69
EDF	0.70	0.70
RWE	0.83	0.71
E.ON	0.88	0.74
National Grid	0.60	0.59
Viridian	0.46	0.18
Scottish Power	0.60	0.56
Redes Energeticas Nacionais	0.62	0.62
Terna	0.44	0.44
Red Electrica	0.58	0.46
Snam rete gas	0.34	0.30
Enagas	0.66	0.63
Severn Trent	0.58	0.43
Northumbrian Water	0.61	0.61

Source: EE calculations using Bloomberg data. Note: due to unavailability of data over the whole of the period for Scottish Power; E.ON, ENEL, EDF and Viridian, the averages for those companies refer to the average of the data available within that period.

6.30 The 5-year averages of the equity betas are in the range 0.34 to 0.88 and the 10-year averages are in the range 0.18 to 0.74.

Gearing measure used to un-lever equity betas

6.31 An important practical issue relates to the choice of gearing measure which is used to un-lever the equity betas in order to estimate asset betas. In particular, a choice has to be made about the measure of asset value which is going to be used in the denominator of the gearing measure.

6.32 At a conceptual level, our preferred measure of gearing would be net debt to RAB, given that the TAO, TSO and DSO are subject to RAB-based price regulation. However, many of the comparator companies include generation and supply businesses as well as network businesses, and in many cases there will not be a RAB figure available for businesses operating in these parts of the supply chain (e.g. generation and supply are not subject to RAB-based price regulation in the UK). Further, where the comparator company owns a number of network businesses, there may be no readily available RAB figure at a group level even if a RAB exists for some or all of the subsidiary companies.

6.33 We have considered two of the gearing measures available in Bloomberg:

(a) total debt / total assets, where total assets are defined as the total of all short- and long-term assets as reported in the statutory company accounts (i.e. based on book values); and

(b) total debt / total capital, where total capital is defined as the short- and long-term borrowings plus common stock, additional paid in capital, preference stock, minority interest and retained earnings. The stocks are valued at par value (taken from company accounts), rather than market values.

6.34 In our view, the asset values in statutory company accounts do not form a good basis for measuring gearing. They may differ substantially from asset values that would be included in a RAB for a number of reasons – for instance, unlike the RAB, asset values in statutory accounts are not indexed to inflation.

6.35 We therefore use Bloomberg data on total debt / total capital as our measure of gearing for most companies.[65] We also conduct a sensitivity using a measure of gearing which is based on market values.

Asset betas

6.36 In Table 6.3 we report deleveraged equity betas with gearing figures sourced from Bloomberg, assuming a debt beta of zero.

[65] For Severn Trent; Northumbrian Water and National Grid (latest point estimate only) we use gearing figures from regulatory accounts.

Table 6.3: Asset betas as of 26 February 2010

	Stock market used to calculate beta	Raw beta	Gearing (%)	Asset beta with debt beta=0
National Grid	London	0.68	58 (87.06)	0.29 (0.09)
Severn Trent	London	0.59	60.60	0.23
Scottish & Southern Energy	London	0.62	64.46	0.22
Northumbrian Water	London	0.47	60.40	0.19
RWE	Germany-Xetra	0.71	50.64	0.35
EDF	France – Euronet Paris	0.80	64.20	0.29
Redes Energeticas Nacionais	Portugal – Euronet Lisbon	0.61	64.52	0.22
Enagas	Spain	0.54	69.45	0.16
Red Electrica	Spain	0.52	68.56	0.16
ENEL	Italy – Borsa Italiana	0.87	70.30	0.26
Terna	Italy – Borsa Italiana	0.30	65.97	0.10
Snam rete gas	Italy – Borsa Italiana	0.13	63.58	0.05
Delisted companies				
E.ON (24 October 07)	London	0.69	20.82	0.54
Scottish Power (19 April 07)	London	0.67	42.93	0.38
Viridian (6 December 2006)	London	0.67	64.44	0.24

Source: Europe Economics calculations using Bloomberg data. At the time of the report the latest gearing data available was generally either end March 2009 or end December 2008. Note: we also include last available data points for E.ON; Viridian; and Scottish Power. Note: for Severn Trent and Northumbrian Water we use gearing figures from: Ofwat: Financial performance and expenditure of the water companies in England and Wales 2008-09 and earlier years; in National Grid's annual report and accounts 2008/09 they include a figure for RAV gearing for National Grid Electricity Transmission plc calculated as net debt expressed as a percentage of RAV – we include this gearing and correlating asset beta in our table, with the figures relating to the Bloomberg gearing figure in brackets.

6.37 Examination of the above data suggests that the asset beta of 0.05 for Snam rete gas, 0.10 for Terna, and 0.54 for E.ON are outliers compared with estimates for the other companies. Excluding these outliers, the asset betas of our comparators fall within the range 0.16 to 0.35. (0.38? Or is Scottish Power excluded?)

6.38 As shown in the table there were a number of different market portfolios used for calculating the raw equity betas. We have concerns regarding how comparable these betas are due to the varying liquidities in the markets used. We would place most weight on beta estimates calculated using data from the more liquid stocks markets.

Asset betas calculated on gearing based on market capitalisation

6.39 As a sensitivity test we also calculate asset betas using a gearing measure based on market capitalisation. This measure of gearing involves taking net debt and dividing by net debt plus market capitalisation. This has the advantage of reflecting the market value of equity and is the measure used by Oxera.[66]

6.40 Under certain conditions (e.g. including that the regulatory WACC reflects the company's true market cost of capital, and that there is no under-performance or out-performance against regulatory assumptions on opex and capex), one would expect the market value of a company to be in line with its RAB.

6.41 In Table 6.4 we report asset betas using gearing methods based on company accounts and using a gearing measures based on:

(a) total debt/ total capital (as used in our main analysis)

(b) net debt/ net debt plus market capitalisation, with market capitalisation taken as of 26 February 2010.[67]

[66] Oxera (2009) "The cost of capital of ESB Networks in PR3: Prepared for ESN Networks", 9 December 2009

[67] We have taken the point estimate on a fixed date rather than average over time. We believe this to be equally valid as market capitalisations on any given date partly reflect expectations of future performance and implicitly gearing.

Table 6.4: Asset betas as of 26 February 2010 using different gearing measures

	Stock market used to calculate beta	Raw beta	Gearing measure 1 - original method (%)	Asset beta with debt beta=0	Gearing measure 2 - based on market capitalization (%)	Asset beta with debt beta=0
National Grid	London	0.68	58 (87.06)	0.29 (0.09)	59	0.28
Severn Trent	London	0.59	60.6	0.23	58	0.25
Scottish & Southern Energy	London	0.62	64.46	0.22	33	0.42
Northumbrian Water	London	0.47	60.4	0.19	61	0.18
Redes Energeticas Nacionais	Portugal – Euronet Lisbon	0.61	64.52	0.22	58	0.26
RWE	Germany-Xetra	0.71	50.64	0.35	28	0.51
EDF	France – Euronet Paris	0.8	64.2	0.29	44	0.45
Enagas	Spain	0.54	69.45	0.16	45	0.30
Red Electrica	Spain	0.52	68.56	0.16	43	0.30
ENEL	Italy – Borsa Italiana	0.87	70.3	0.26	63	0.32
Terna	Italy – Borsa Italiana	0.3	65.97	0.1	98	0.01
Snam rete gas	Italy – Borsa Italiana	0.13	63.58	0.05	45	0.07

Notes: Market capitalisation and net debt figures taken from Bloomberg. Those companies that have been delisted have not been included in this sensitivity, since we consider that their market capitalisation in the period leading up to de-listing is likely to have been affected by the prospective change in ownership.

6.42 Using this measure of gearing, there is a cluster of comparator companies with an asset beta of around 0.3 (including National Grid, Enagas, Red Electrica and ENEL), with similar numbers of companies either side of this cluster (once Terna has been dropped as an outlier).

Asset betas calculated assuming a non-zero debt beta

6.43 As a sensitivity test we also calculate asset betas assuming non-zero debt betas. We assume different debt betas based on company credit rating and the probability of default and loss given default associated with that credit rating.

6.44 The debt betas were calculated using the debt premiums and debt default premiums calculated in the cost of debt chapter (see paragraph 7.39). Debt betas were calculated

by dividing the default risk premium (calculated by subtracting the point estimates for the default premium from the debt premium) by the indicative point estimate for the ERP (5.2 per cent). This resulted in a debt beta of 0.28 for A rated companies and a debt beta of 0.34 for BBB rated companies.[68]

6.45 The debt betas assumed for each comparator company and credit rating are shown in Table 6.4.

Table 6.4: Debt betas assumed given issuer credit rating

Company	Issuer credit rating (Moody's)	Debt beta assumed
Redes Energeticas Nacionais	A2	0.28
RWE	A2	0.28
ENEL	A2	0.28
Enagas	A2	0.28
Red Electrica	A2	0.28
Terna	A2	0.28
Scottish & Southern Energy	A3	0.28
National Grid	Baa1	0.34
Severn Trent	Baa1	0.34
Northumbrian Water	Baa1	0.34

Note: for this sensitivity analysis we only include companies for which latest equity beta data is available, therefore excluding: E.ON; Scottish Power; and Viridian. We also exclude Snam rete gas due to its very low raw equity beta and EDF due to its higher issuer rating (Aa3).

6.46 In Table 6.5 we report asset betas calculated assuming both zero and non-zero debt betas.

[68] The corresponding debt beta ranges were 0.25 to 0.32 for A rated companies and 0.31 to 0.40 for BBB rated companies.

Table 6.5: Asset betas as of 26 February 2010

	Issuer credit rating (Moody's)	Non-zero debt beta assumed	Gearing (%)	Raw beta	Asset beta with debt beta=0	Asset beta with non-zero debt beta
RWE	A2	0.28	50.64	0.71	0.35	0.49
ENEL	A2	0.28	70.30	0.87	0.26	0.45
Redes Energeticas Nacionais	A2	0.28	64.52	0.61	0.22	0.40
Enagas	A2	0.28	69.45	0.54	0.16	0.36
Red Electrica	A2	0.28	68.56	0.52	0.16	0.36
Terna	A2	0.28	65.97	0.30	0.10	0.29
Scottish & Southern Energy	A3	0.28	64.46	0.62	0.22	0.40
National Grid	Baa1	0.34	58 (87.06)	0.68	0.29 (0.09)	0.48 (0.38)
Severn Trent	Baa1	0.34	60.60	0.59	0.23	0.44
Northumbrian Water	Baa1	0.34	60.40	0.47	0.19	0.39

Source: Europe Economics calculations using Bloomberg data. Note: for Severn Trent and Northumbrian Water we use gearing figures from: Ofwat: Financial performance and expenditure of the water companies in England and Wales 2008-09 and earlier years; in National Grid's annual report and accounts 2008/09 they include a figure for RAV gearing for National Grid Electricity Transmission plc calculated as net debt expressed as a percentage of RAV – we include this gearing and correlating asset beta in our table, with the figures relating to the Bloomberg gearing figure in brackets.

6.47 The asset betas calculated using non-zero debt betas are in the range 0.29 to 0.49. If we exclude Terna as an outlier the range is 0.36 to 0.49.

6.48 Whilst the asset beta range is higher when a positive debt beta is assumed, it is important to note that this does not necessarily increase the equity beta range since a positive debt beta will also affect the re-levering of asset betas to obtain equity betas. The effect of assuming a positive debt on the final equity beta range is considered later.

Historical asset betas

6.49 We now analyse changes to asset betas over time. The asset betas described here are all calculated assuming a debt beta of zero.

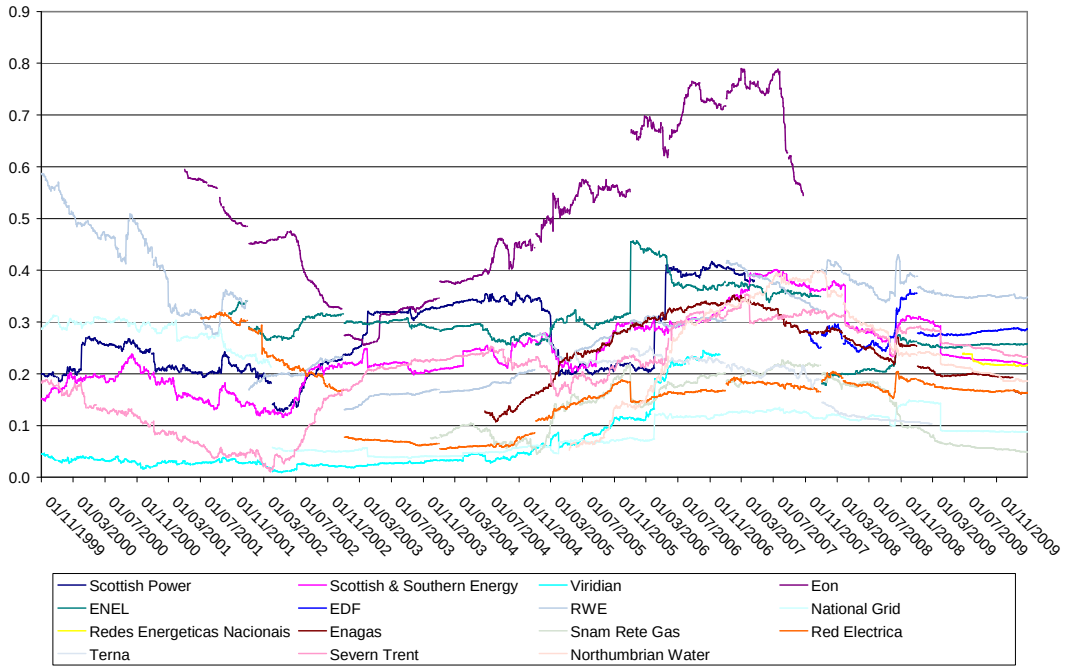
6.50 Figure 6.2 shows the asset betas for the European comparator utilities over the period March 2000 to February 2010. The asset betas in Figure 6.2 have been calculated using Bloomberg data on companies' gearing,[69] and assume a debt beta of zero. The following observations can be made:

[69] Bloomberg gearing data is used to calculate all asset betas except for Severn Trent and Northumbrian Water, where gearing figures from regulatory documents are used.

(a) There has been some volatility in asset betas, particularly in the period 2004 to 2007. This period of volatility coincides with the period of volatility in equity betas discussed earlier.

(b) Certain companies experienced far more volatility than others. In particular, Viridian's asset beta rose dramatically from less than 0.05 to around 0.25 between 2004 and 2006.[70] E.ON's asset beta gradually rose and then fell sharply before it was delisted from the LSE in 2007.

Figure 6.2: Asset betas of European comparator utilities since 2000



Source: Europe Economics calculations using Bloomberg data

6.51 Table 6.6 shows asset beta averages over 5- and 10-year periods.

[70] Other reports have also presented very low asset beta estimates for Viridian in past years – see, for instance, the beta estimates produced by Smithers and Co for Ofgem in 2004: http://www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/DPCR4/Documents1/6593-Beta%20Estimates%20for%20Ofgem%20Final.pdf

Table 6.6: Comparator utilities average asset betas values

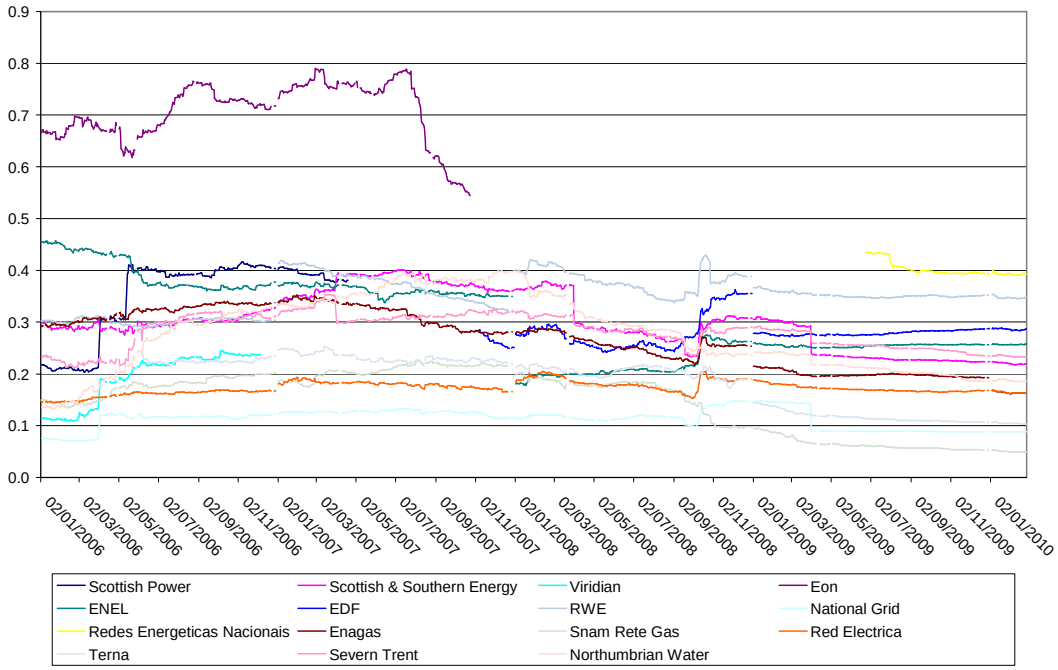
	5-year average (2004-2009)	10-year average (1999-2009)
E.ON	0.66	0.51
Scottish & Southern Energy	0.29	0.25
ENEL	0.30	0.30
EDF	0.28	0.28
RWE	0.34	0.30
National Grid	0.11	0.12
Viridian	0.14	0.06
Scottish Power	0.30	0.27
Redes Energeticas Nacionais	0.22	0.22
Terna	0.19	0.19
Red Electrica	0.17	0.16
Snam rete gas	0.15	0.14
Enagas	0.26	0.25
Severn Trent	0.27	0.21
Northumbrian Water	0.25	0.25

Source: EE calculations using Bloomberg data. Note: due to unavailability of data over the whole of the set periods for Scottish Power; E.ON. ENEL, EDF and Viridian, the averages for those companies refer to the average of the data available within that period.

6.52 The 5-year averages were in the range 0.11 to 0.66, and the 10-year averages were in the range 0.06 to 0.51. However, inspection of data shows that the low ends of these ranges are driven by the beta estimates for National Grid and Viridian and the high end is driven by E.ON. The 5-year and 10-year beta estimates for all of the other companies were within a narrower range of 0.14 to 0.34.

6.53 We now examine the movement in asset betas since 2006 (the time of the previous price control). Figure 6.3 shows asset betas since 2006.

Figure 6.3: Asset betas since 2006



Source: Europe Economics calculations using Bloomberg data

6.54 As can be seen from Figure 6.3, with the exception of E.ON, asset betas have been relatively stable throughout most of this period. The evidence from these comparators suggests that in the absence of any significant changes to their cost structures or regulation, the asset betas of the TAO, TSO and DSO may not have changed significantly since the last price review. To the extent that this conclusion is valid, it would strengthen the argument for placing some weight on the asset beta range of 0.2 to 0.4 which the CER estimated at the last price review.

Regulatory Precedents

Asset beta estimates used in recent regulatory reviews

6.55 Table 6.7 below shows equity betas, gearing levels and asset betas used in recent regulatory reviews. As we consider the decisions of energy regulators to be most relevant as comparators, these decisions are shown first and shaded in the table.

Table 6.7: Previous regulatory decisions on asset betas

Regulator	Case	Equity beta	Gearing	Asset beta
Irish regulators				
CER	Transmission and distribution (2005)	0.6-1.0 [0.8]	50-60 [50]	0.2-0.4 [0.4]
CER	Transmission and distribution (2001)	[0.8]	[50]	[0.41]
CAR	Dublin Airport Authority (2009)	1.0-1.4 [1.22]	37-50 [50]	0.5-0.7 [0.61]
Comreg	Eircom (2008)	0.64-1.39 [1.02]	30-50 [40]	0.45-0.7 [0.57]
CAR	Dublin Airport Authority (2005)	[1.1]	[46]	*0.59*
CAR	Aer Rianta (2001)	[0.93]	[50]	[0.5]
GB and Northern Irish regulators				
Ofcom	Openreach / BT's other activities (2009)	0.76 / 0.96	35	*0.62/0.49*
NIAUR	SONI (2008)	[0.58]	[57.5]	*0.25*
Ofgem	Electricity distribution (2009)	0.69-0.97	[65]	0.24-0.34
Ofgem	Transmission (2006)	[<0.6]	[60]	*<0.24*
Ofgem	Electricity distribution (2004)	0.6-1.0	60-65	0.21-0.4
Ofwat	Water and sewerage (2009)	[0.9]	55-65 [57.5]	[0.4]
CC	Stansted (2008)	1.0-1.24	[50]	0.55-0.67 [0.61]
CAA	Heathrow (2008)	0.9-1.15	[50]	0.55-0.67 [0.61]
CAA	Gatwick (2008)	1.0-1.3	[60]	*0.4-0.52*
Ofcom	General approach – applied to BT (2005)	1.14-1.23	30-35	*0.74-0.86*
Postcomm	Royal Mail (2005)	0.81-0.94	[20]	0.65-0.75
Ofwat	Water and sewerage (2004)	[1.0]	[55]	*0.45*

Source: Regulatory determinations. Note: point estimates are shown in square brackets; asset betas shown in italics were calculated from equity betas and gearing assuming debt beta=0.

6.56 The asset betas used by regulators vary significantly from one sector to another. The asset beta ranges for each sector are summarised in Table 6.8.

Table 6.8: Sector asset beta ranges

Sector	Asset beta range
Energy	0.2-0.41
Water	0.4-0.45
Airports	0.4-0.7
Post	0.65-0.75
Telecoms	0.45-0.86

Source: Regulatory determinations. Note: some asset betas were calculated from equity betas and gearing assuming debt beta=0.

6.57 The regulatory precedents give an asset beta range of 0.2 to 0.41 for energy transmission and distribution companies. As can be seen from Table 6.8 this is significantly below the asset beta ranges for airports, post and telecoms, but has some overlap with the range for water and sewerage companies.

6.58 This suggests that the energy sector is exposed to less systematic risk than the other sectors. One of the reasons for the differing systematic risks between sectors is different volume risk. For example, airports tend to be exposed to much greater volume risk than utilities as air travel has a higher income elasticity of demand.

6.59 However, we acknowledge that a degree of caution should be exercised when using previous regulatory decisions as an indicator of a company's asset beta due to the risk of propagating any errors made in previous regulatory decisions.

Conclusions on Asset Beta

6.60 In order to estimate the equity beta of the TAO, TSO and DSO we analysed the asset betas of a selection of European utilities. We also reviewed the main regulatory precedents.

6.61 We calculated asset betas assuming a debt beta of zero. We also carried out a sensitivity analysis assuming non-zero debt betas. The non-zero debt betas were based on companies' credit ratings, and the default probabilities and loss given default associated with particular ratings.

Asset betas calculated assuming debt betas of zero

6.62 As of 26 February 2010, asset betas of the European comparator utilities were in the range 0.16 to 0.35, after the exclusion of outliers and companies which have been delisted. A sensitivity using an alternative measure of gearing found a cluster of comparator asset betas around the value of 0.3 with a similar number of companies on either side of this cluster. Examining recent regulatory determinations gave the range 0.2 to 0.41 for the asset betas of similar (i.e. energy) companies (these asset betas were calculated assuming debt betas of zero).

Asset betas calculated assuming non-zero debt betas

6.63 As of 26 February 2010, asset betas of the European comparator utilities calculated assuming non-zero debt betas were in the range 0.36 to 0.49, after the exclusion of outliers.

Overall conclusion

6.64 We have shown in our analysis (see Figure 6.3) that asset betas of the comparator companies have tended to be relatively stable since 2006 (the time of the previous price control). This suggests that, without any significant changes to their cost structure or regulation, the asset betas of the TAO, TSO and DSO may not have changed significantly since the last review, when the asset beta was estimated as 0.2 to 0.4.

6.65 Based on evidence from comparator companies and previous regulatory precedents, we consider that **0.2 to 0.4** with a working point estimate of **0.3** is the most appropriate range for CER to use for the asset beta of the TAO, TSO and DSO if a zero debt beta is assumed. We present a corresponding re-leveraged equity beta range for our suggested notional gearing range in section 9.

6.66 If a non-zero debt beta is assumed, we consider an asset beta range of **0.35 to 0.55** is most appropriate with a working point estimate of **0.45**. We present a corresponding re-leveraged equity beta range for our suggested notional gearing range in appendix 3.

7 COST OF DEBT

7.1 This section analyses the cost of debt for the forthcoming price control period for ESB Networks distribution and EirGrid's transmission businesses. This component of the cost of capital estimation is a particularly important part of the analysis given the recent turbulence in financial markets and the resulting credit constraints, which saw bond spreads rise to historically high levels.

7.2 The analysis set out in the remainder of this section is organised under the following headings:

(a) our approach to the estimation of the cost of debt;

(b) evidence from spreads on comparator company bonds;

(c) evidence from wider market indices; and

(d) conclusions on the cost of debt.

Our Approach to the Estimation of the Cost of Debt

7.3 In estimating the cost of debt, one of the key methodological choices which has to be made relates to the credit rating which should be assumed for ESB Networks and EirGrid. When estimating the cost of debt for the 2001-2005 price control period, the CER assumed that ESB Networks would maintain an A credit rating over the regulatory period (which was deemed consistent with a notional assumed gearing of 50 per cent). In its 2006 price control review, on the other hand, the CER assumed a credit rating of A or BBB for the price control period (which was deemed to be consistent with a notional assumed level of gearing of 50-60 per cent). However, in its response to a questionnaire sent by CER, ESB Networks stated that it did not have a formal target rating.

7.4 In contrast, no reference was made in either of these price reviews to the target credit rating for EirGrid and according to its response to a questionnaire sent out by the CER, EirGrid also does not have a formal target rating.

7.5 Our working assumption for estimating the cost of debt, is that the ESB Networks and EirGrid will be able to issue bonds with a rating of between BBB and A. In estimating the cost of debt, we have adopted the approach of building up the cost of debt by summing the risk-free rate (i.e. the return required by investors for investing in risk-free assets) and a company-specific debt premium. This approach will ensure consistency with the way in which the cost of equity is calculated, since the same risk-free rate assumption is being used.

7.6 ESB Networks and EirGrid do not have any listed bonds. Hence, we informed our analysis of the debt premium for ESB Networks and EirGrid with data on spreads from

comparator companies (i.e. other electricity suppliers and utilities), evidence on wider market indices and data on new bond issuance by other utility companies.

7.7 Analysing the impacts of the recent turbulence in financial markets is a key issue in estimating the cost of debt for the forthcoming review period, given the profound impact it has had on bond spreads. In this context, an important question is the relative weight that should be placed on historical as opposed to more recent bond spread data.

ESB Network's Debt Profile

7.8 As can be seen from Figure 7.1, as of 2008, almost [✂] per cent of ESB Networks' debt is characterised by a term to maturity of more than [✂] years; [✂] per cent of total borrowings have terms to maturity of more than [✂] years.

7.9 With the Strategic Framework to 2020, ESB Networks' debt is expected to grow to €5bn over the next five years. It is expected that this will be funded via bond issuance, and bank borrowing from ESB Networks' relationship banks and other funding markets.

7.10 [✂]

Figure 7.1: ESB Networks borrowings' maturity profile (2008)

[✂]

EirGrid's Debt Profile

7.11 As it can be seen from Figure 7.1, as of 2008, almost [✂] per cent of EirGrid's debt is characterised by term to maturity of more than [✂] years.

7.12 [✂]

Figure 7.2: EirGrid borrowings' maturity profile (2008)

[✂]

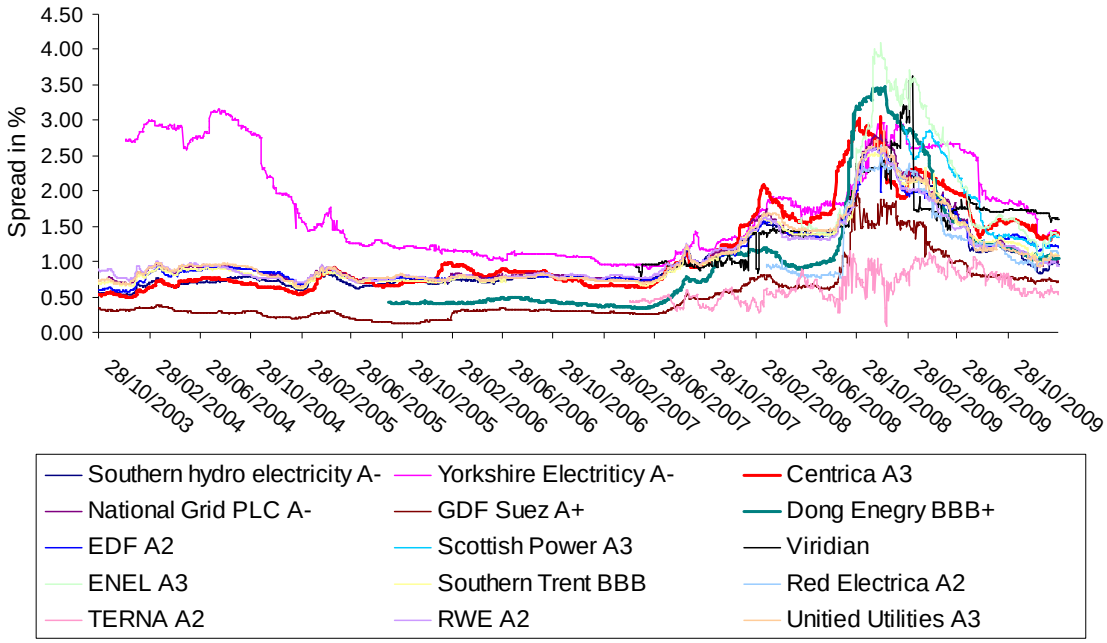
Evidence from Spreads on Comparator Company Bonds

7.13 The spread on a corporate bond is the difference between the yield on the bond and the yield on a risk-free benchmark bond (i.e. government bond). Figure 7.3 below shows spread data since October 2003 for selected nominal energy company bonds. The bonds were selected to include bonds with terms to maturity of approximately 5, 10, and 20 years and with credit ratings between BBB and A. The bonds were also selected to include those with spread data going back to 2003/4. Spreads were calculated against relevant government bonds with matching maturity and currency.

7.14 The data presented below show that following the onset of the financial crisis in mid-2007, spreads on energy company bond rose dramatically. As can also been seen in

the figure below, spreads on all of the selected company bonds began to decline from the end of February 2009 onwards. These reductions might be indicative of an easing in credit markets which have recently been affected by significant credit constraints. At the same time, however, the reductions could also be indicative of a temporary (rather than enduring) easing in credit markets, much like that which occurred in mid-2008. Despite the recent reductions, however, spreads still appear to be somewhat higher than their pre-crisis values.

Figure 7.3: Bond spreads of comparator companies



Notes: Ratings quoted are based on composite ratings based on ratings given by Standard and Poor, Moody's and Fitch
Source: Bloomberg

7.15 As can been in Table 7.1 below, there is a large dispersion between the maximum and the minimum spreads for all of the selected bonds in the sample. As illustrated in the table, the smallest maximum average spread on the A rated bonds is approximately 30bps lower than the smallest maximum average spread on the A- rated bonds (i.e. 1.13 compared to 2.62). The difference between the largest maximum spread on the A rated bonds and the largest maximum spread on the A- rated bonds was even larger (i.e. the maximum spread on the latter was approximately 145bps larger than on the former). With regard to spot spreads, these differences remain, although they are slightly smaller.

Table 7.1: Spreads for comparator corporate bonds (2003-2009)

Description of bond	Spot spread as of 26 February 2010	Average spread	Max spread	Min spread
A+ / A1 rated bonds				
GDF Suez; 01/2013 A+	0.71	0.52	1.9	0.14
A / A2 rated bonds				
EDF; 03/25 A2	1.20	1.08	2.63	0.61
Red Electrica; 09/13 A2	1.13	1.41	2.65	0.76
TERNA; 10/24 A2	0.58	0.64	1.13	0.33
RWE; 12/23 A2	0.94	1.08	2.6	0.7
Range for A bonds	**0.58-1.20**	**0.64-1.41**	**1.13-2.65**	**0.33-0.76**
A- / A3 rated bonds				
Centrica; 11/2012 A3	1.34	1.13	3.12	0.9
Southern Hydro Electricity; 06/2032 A-	0.891	1.04	3.05	0.5
Yorkshire Electricity; 09/2024 A-	1.34	1.77	2.62	0.61
National Grid PLC; 07/2028 A-	1.00	1.11	2.76	0.67
Scottish Power; 05/41 A3	1.21	1.90	2.91	1.06
ENEL; 03/29 A3	1.26	2.20	4.1	1.23
United Utilities PLC; 12/27 A3	1.03	1.10	2.72	0.93
Range for A- bonds	**0.89-1.34**	**1.04-2.20**	**2.62-4.10**	**0.50-1.23**
BBB+ rated bonds				
Southern Trent; 02/24 BBB+	1.03	1.07	2.51	0.63
Dong Energy 04/2012 BBB+	1.06	1.06	3.4	0.39
Range for BBB+ bonds	**1.03-1.06**	**1.06-1.07**	**2.51-3.4**	**0.39-0.63**
Other bonds				
Viridian[1]; 09/18	1.60	1.56	3.63	0.93

[1] The is no credit rating for Viridian

Source: Bloomberg and Europe Economics

Recent new issues by other utility companies

7.16 There have been a number of bond issues (both EUR and GBP denominated) by various utility companies in both 2009 and early 2010. A non-exhaustive list of the details of utility bond issues (both in EUR and GBP) are set out in the table below.

7.17 As can been seen in these tables, the most recent bond issues by utility companies covered within our sample include the following:

(a) The most recent issuance with an A category credit rating denominated in EUR had a spread of 97.6 bps on a 10 year bond (Iberdrola on 23 March 2010).

(b) The most recent issuance with a BBB category credit rating denominated in EUR had a spread of 109 bps on a 5 year bond (Edison Spa on 17 March 2010), although other recent BBB issues denominated in EUR showed higher spreads.

(c) The most recent issuance with an A category credit rating denominated in GBP had a spread of 109 bps on a 30 year bond (Western Power on 23 March 2010);

(d) The most recent issuance with a BBB credit rating denominated in GBP had a spread of 248 bps on a 7 year bond (Phoenix Natural on 9 November 2009).

Table 7.2: Utility bond issuances (euro)

Issue Date	Issuer	Ratings	Size (EURm)	Tenor	Spread *vs* ms
13-Jan-09	National Grid Plc	Baa1/A-/BBB	500	5y	365
16-Jan-09	EDF	Aa3	2000	6y	205
	EDF	Aa3	2000	12y	255
27-Jan-09	TMS Water Cayman Finance	A3/BBB+	500	4y	330
03-Feb-09	RWE	A1/A	2000	6y	190
	RWE	A1/A	1000	12y	255
20-Mar-09	E.ON	A2/A/A	750	13y	155
15-Apr-09	Veolia Environment	A3/BBB+	750	10y	330
15-Apr-09	Veolia Environment	A3/BBB+	1250	5y	250
06-May-09	Vattenfall	A2/A-	1350	5y	165
18-May-09	E.ON	A2/A	750	2.5y	85
23-Jun-09	BEWAG	NR/NR	200	5y	190
24-Jun-09	Gas Natural	Baa2/BBB+	2000	5y	235
24-Jun-09	Gas Natural	Baa2/BBB+	500	10y	275
01-Jun-09	ENBW	A2/A-	600	30y	215
01-Jun-09	ENBW	A2/A-	750	6y	105
07-Jul-09	EWE	A2/A-	500	12y	160
08-Jul-09	Verbund	A1/A	840	10y	130
16-Jul-09	Edison	Baa2/BBB+	700	5y	145
22-Jul-09	Suez Environment	A3/NA	500	14y	111
28-Jul-09	E.ON	A2/A	50	29y	113
17-Sep-09	ENEL	A2/A-	1,500	6y	102
17-Sep-09	ENEL	A2/A-	2,500	12y	110
12-Oct-09	Suez Environment	A3/NA	150	7y	135
02-Nov-09	Gas Natural	Baa/BBB+	1,000	6y	157
02-Nov-09	Gas Natural	Baa2/BBB+	750	11y	110
02-Nov-09	A2A SPA	A3/BBB+	1,000	6y	158
02-Nov-09	Gas Natural	Baa2/BBB+	500	2y	105
19-Nov-09	ENEL	A2/A-e	125	9y	124
24-Nov-09	ENEL	A2/A-	100	10y	116
03-Dec-09	HERA SPA	A2/A-	500	9y	130
16-Dec-09	Dong A/S	Baa1/A-	500	11y	98
16-Dec-09	Dong A/S	Baa1/A-	500	6y	116
27-Jan-10	Gas Natural	Baa2/BBB+	650	5y	129
27-Jan-10	Gas Natural	Baa2/BBB+	700	8y	141
27-Jan-10	Gas Natural	Baa2/BBB+	850	10y	129
09-Feb-10	Tennet	A3/A-	500	12y	99.6
29-Feb-10	ENEL	A2/A-	2,000	6y	114
16-Mar-10	ACEA SPA	A+e/A-	500	10y	128

16-Mar-10	EDP	A3/A-	1,000	5y	127
17-Mar-10	Edison	Baa2/BBB+	500	5y	109.1
23-Mar-10	Iberdrola	A3/A-	500	10y	97.6

Source: Bloomberg

Table 7.3: Utility bond issuances (sterling)

Issue Date	Issuer	Ratings	Size (GBPm)	Tenor	Spread *vs* UKT
13-Jan-09	Severn Trent Utilities Finance	A2/A	400	9y	285
13-Jan-09	E.ON Int Finance	A2/A/A+	700	30y	280
14-Jan-09	E.ON Int Finance	A2/A/A+	350	5y	245
28-Jan-09	National Grid Plc	Baa1/BBB+	400	5y	335
23-Feb-09	Southern Water Services Finance	A3/A-	300	10y	265
27-Feb-09	Centrica	A3/A/A	250	5y	260
	Centrica	A3/A/A	400	13y	270
25-Mar-09	United Utilities Water	A3/A-	200	13y	240
01-Apr-09	Vattenfall	A2/A-	350	10y	295
01-Apr-09	Vattenfall	A2/A-	1000	30y	275
23-Apr-09	E.ON Intl	A2/A/A+	250	10y	215
21-May-09	EDF	Aa3/A+	250	25y	187.5
21-May-09	BG Energy	A2/A/A+	500	8Y	205
28-May-09	Anglican Water	Baa3/BBB	100	15Y	425
24-Jun-09	Northern Gas Networks	Baa1/BBB+	200	10y	220
25-Jun-09	RWE AG	A1/A	500	13y	185
25-Jun-09	RWE AG	A1/A	1000	30y	165
03-Jul-09	Wales & West Utilities	Baa1/NR	250	12y	245
10-Jun-09	ENW	NR/BBB	300	6y	375
10-Jun-09	ENW	NR/NR	200	12y	240
14-Jul-09	Yorkshire Water	A-/A3	275	10y	230
14-JuL-09	Yorkshire Water	A-/A3	200	30y	200
21-Jul-09	United Utilities Water Plc	A-/A3	70	30y	Index-linked
09-Sep-09	Wessex Water	BBB/+A3	50	30y	Index-linked
30-Sep-09	Scottish & South	A3/A-	500	8y	147
02-Nov-09	Southern Gas	Baa1/BBB	300	8y	162
09-Nov-09	Phoenix Natural	Baa2/NA	275	7y	248
12-Nov-09	EDF	A2/A	350	26y	154
12-Nov-09	EDF	A3/A	300	21y	162
12-Nov-09	EDF	A2/A	300	6y	160
02-Dec-09	Wales & West	Baa1/A-	200	6y	211
23-Mar-10	Western Power	Baa1/BBB+	200	30y	108
23-Mar-10	Western Power	Baa1/BBB+	200	30y	109

Source: Bloomberg

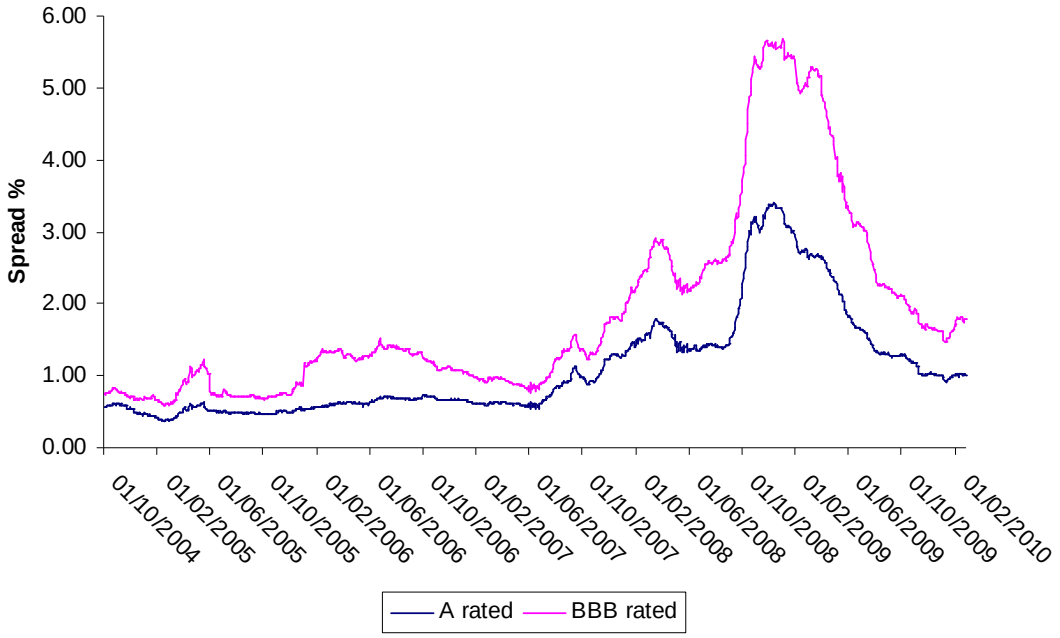
Evidence from Wider Market Indices

7.18 In addition to examining the spreads on bonds issued by comparator companies, we have also examined yields on wider market bond indices denominated in both sterling and euros.[71]

7.19 Figure 7.4 below reports spread data on A and BBB rated corporate bonds denominated in euros between October 2004 and February 2010.

7.20 Spreads on A and BBB rated bonds prior to the financial crisis were between 0.7 and 1.2 per cent, respectively, and spiked to 3.32 and 5.62 towards the end of 2008. As can be seen from this figure, while the spread on both A and BBB rated corporate bonds increased significantly during the height of the financial crisis compared with their pre-crisis levels, the spread on BBB rated bonds spiked at a much higher rate than that for A rated bonds.

Figure 7.4: Spread data for EUR-denominated A and BBB rated corporate bonds (non-financials), 2004-2010



Note: data is for bonds with 7-10 year maturity issued by non- financials
Source: Europe Economics calculations using data from iBoxx and Bloomberg

[71] Note that this data does not differentiate between ratings within each category.

Table 7.4: Spot, average, maximum and minimum spreads on A and BBB rated EUR-denominated corporate bonds (non-financials)

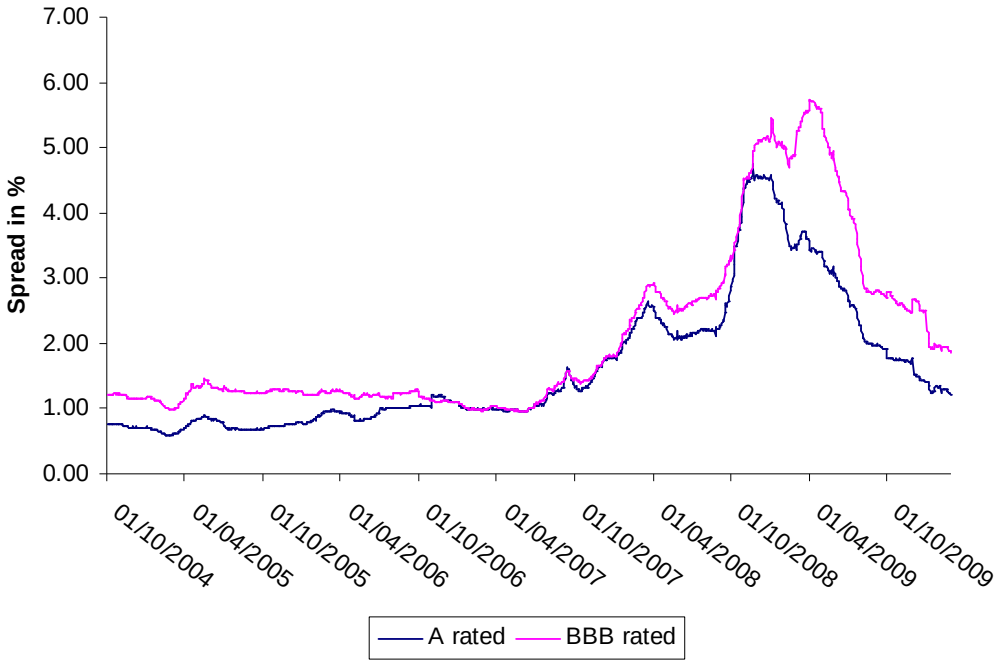
Bond rating	Spot spread 26/02/10	Average spread	Max spread	Min spread
A	1.01	1.1	3.36	0.40
BBB	1.78	1.86	5.62	0.61

Note: data is for bonds with 7-10 year maturity issued by non-financials
Source: Europe Economics calculations using data from iBoxx and Bloomberg

7.21 Figure 7.5 below presents data on spreads on A and BBB rated corporate bonds denominated in sterling between October 2004 and February 2010

7.22 Spreads on A and BBB rated bonds prior to the financial crisis were between 0.9 and 1.2 per cent respectively and spiked at 4.59 and 5.68 in 2008. In contrast to the spreads on euro denominated A and BBB rated corporate bonds, the spike in the spread for BBB rated corporate bonds denominated in sterling came about slightly later than did the spike in the sterling denominated A rated corporate bonds.

Figure 7.5: Spread data for GBP denominated A and BBB rated corporate bonds (non-financials), 2004-2010



Note: data is for bonds with 7-10 year maturity issued by non-financials
Source: Europe Economics calculations using data from iBoxx and Bloomberg

7.23 According to spot data on spreads as of 26 February 2010 presented in Table 7.5 above and Table 7.5 below, spot spreads on sterling-denominated A and BBB rated corporate bonds were on average 0.65 per cent greater than the spot spreads on euro-denominated A and BBB rated corporate bonds.

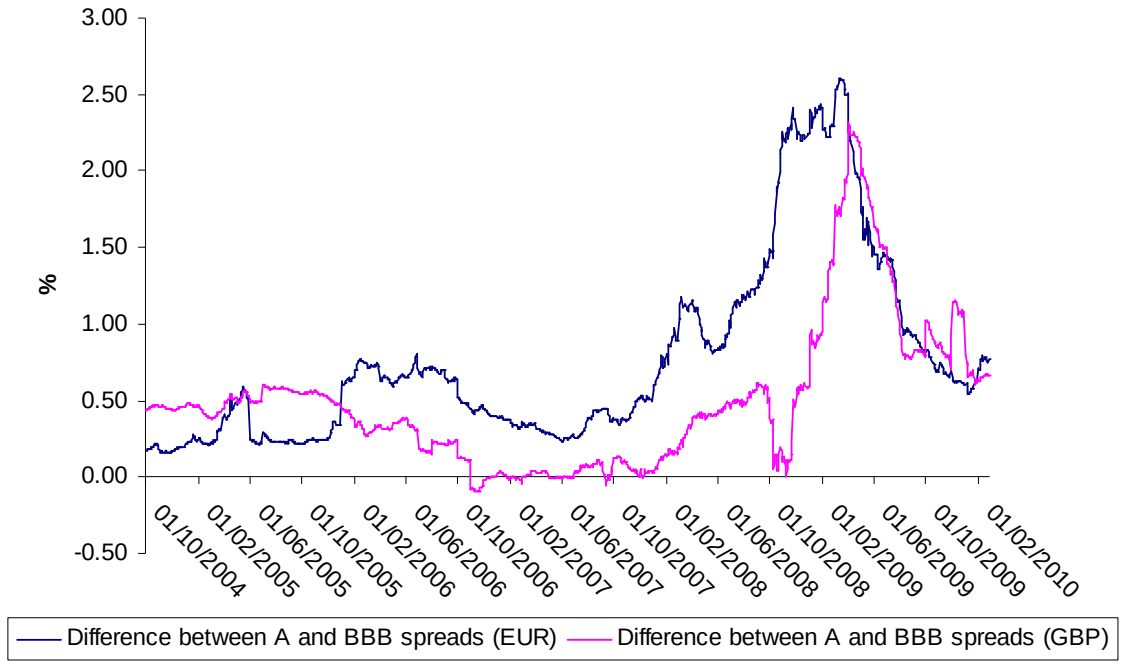
Table 7.5: Spot, average, maximum and minimum spreads on A and BBB rated GBP-denominated corporate bonds (non-financials)

Bond rating	Spot spread 26/02/10	Average spread	Max spread	Min spread
A	1.20	1.61	4.59	0.60
BBB	1.87	2.10	5.68	0.95

Note: data is for bonds with 7-10 year maturity issued by non-financials
Source: Europe Economics calculations using data from iBoxx and Bloomberg

7.24 Figure 7.6 below illustrates the difference between spreads on euro-denominated A and BBB rated bonds, and the difference between spreads on sterling-denominated A and BBB rated bonds.

Figure 7.6: Differences between A and BBB bond spreads for euro- and sterling-denominated bonds, 2004-2010



Note: data is for bonds with 7-10 year maturity issued by non- financials
Source: Europe Economics calculations using data from iBoxx and Bloomberg

7.25 As can be seen from this figure, the difference between the spreads on sterling-denominated A and BBB rated corporate bonds began to increase later in 2008 than did the spike in the difference between euro-denominated A and BBB rated corporate bonds. Since April 2009, however, the differences between spreads on euro and sterling A and BBB rated bond have been almost identical, apart from a period between November 2009 and January 2010, following a downward trend. The most recent data presented in this report indicate that the difference is currently 0.77 per cent and 0.67 per cent for euro- and sterling-denominated A and BBB bonds, respectively. In contrast, the average difference between A and BBB rated bonds spreads denominated in euros and sterling between October 2004 and mid-2007 was 0.41 and 0.32 per cent, respectively.

7.26 In summary, the data presented above (both for euro- and sterling-denominated bonds for non-financial companies) showing the differences between A and BBB rated bonds, suggest that the perception of the relative risk between bonds of these ratings increased during the financial crisis.

7.27 It is likely that, until market confidence improves, the gap between A and BBB spreads will continue to remain above the levels which prevailed during the crisis (albeit less than the gaps witnessed in the midst of the financial crisis). Further, to the extent that a relatively significant gap between these two bond spreads persists, this will strengthen the case for using a target credit rating of A rather than BBB.

Previous Regulatory Decisions on Debt Premium Ranges

7.28 We report in Table 7.6 below recent regulatory precedents on the debt premium in the UK and in Ireland.

Table 7.6: Recent regulatory precedents of the debt premium

Regulator and case	Target credit rating	Debt premium range (%)	Debt premium point estimate (%)
Irish Regulators			
CAR, airports (2009)	Investment grade	-	1.6[3]
ComReg, Eircom (2008)	Investment grade	1.20-1.55	-
CER, ESB (2005)	A or BBB	1-1.5	1.35
CAR, airports (2005)	Investment grade	-	1.1
CAR, airports (2001)	(not specified)	-	1.13[2]
CER, ESB (2001)	A	1.37-1.67	1.5
UK Regulators			
Ofgem (2009)	Investment grade	1.3-1.7[1]	1.6
Ofcom (2009)	Baa2/BBB	2-3	3
Ofwat, water (2009)	BBB+/Baa1	-	1.6
CC, Stansted (2009)	A3/A-	1.4-1.7	-
CAA, Heathrow (2008)	Investment grade	1.0-1.0	1.0
NAIUR, electricity (2008)	(not specified)	-	1.05
CCR, telecoms (2008)	Investment grade	1.2-1.9	-
Ofgem, DNOs (2007)	Investment grade	-	3.5 (cost of debt)
Ofgem, TPCR (2006)	Investment grade	1.0-1.5[4]	1.25
Ofcom, BT (2005)	Investment grade	-	1
Postcomm, post (2005)	Investment grade	-	0.5
Ofcom, telecoms (2005)	(not specified)	-	1
Ofwat, water (2004)	Investment grade	0.8-1.4	-
Ofgem, distribution (2004)	A3 (A-)	1.0-1.8	-

[1]Ofgem concluded on a cost of debt in the range of 3.3 and 3.7 per cent and a ris- free rate of 2 per cent. This implies a debt premium range of 1.3 to 1.7 per cent.

[2] The CAR concluded the cost of debt was 113bps above the risk-free rate which implies a debt premium of 1.13 per cent

[3] The CAR concluded that the cost of debt was 4.1 per cent and that the riskfree rate was 2.5 per cent. This implies a debt premium of 1.6 per cent

[4]Ofgem concluded that the cost of debt was in the range 3.5-4 per cent and that the appropriate risk-free rate was 2.55 per cent. This implies a debt premium in the range 1-1.5 per cent

Conclusions on the Cost of Debt

7.29 We have reviewed a range of market data including comparator listed bond spreads, new bond issues by utility companies, wider market indices and regulatory precedents. In this sub-section, we draw conclusions about the debt premium range which should be assumed for ESB and EirGrid.

7.30 We have considered whether the default premium (i.e. the difference between the yield on a bond and the expected return once the possibility of default is taken into account) should be deducted from our cost of debt estimate. The rationale for making such an adjustment is considered in Appendix 2. Our conclusion is that such an adjustment is

theoretically defensible, although it lacks regulatory precedent and is unlikely to be understood by stakeholders.

7.31 In the light of this, we present our conclusions as follows:

(a) first, we present range estimates for the debt premium without the above adjustment;

(b) second, we apply the above adjustment to calculate a revised debt premium;

(c) third, we conclude on the appropriate debt premium and cost of debt.

Unadjusted debt premium estimates

7.32 Based on the evidence set out in this chapter, our assessment of the cost of debt for different credit ratings is set out below in Table 7.7. The real cost of debt is calculated by adding our debt premium assumptions to our estimates of the risk-free rate.

Table 7.7: Cost of debt assumptions for ESB and EirGrid – not adjusted for default

Bond rating	Debt premium (%)		Real cost of debt [1](%)	
	Low	High	Low	High
A	1.0	1.4	2.6	3.6
BBB	1.4	1.9	3.0	4.1

Notes: [1]Our estimated range for the risk-free rate is 1.6 to 2.2 per cent

7.33 The debt premium range of 1.0 to 1.4 per cent for A rated bonds is based on the following evidence, as presented earlier in this section:

(a) Recent euro-denominated utility bond issues have included an A- rated bond with a spread of 97.6.

(b) Our analysis of a sample of comparator bonds found spreads of 1.0 to 1.4 per cent on bonds with an A- rating (the minimum rating within the A category).

(c) Evidence from wider market indices shows the spot spread on A rated corporate bonds as 1.0.

(d) This range is consistent with some of the older regulatory determinations which pre-dated the financial crisis, reflecting the substantial easing of bond spreads since the peak of the crisis.

Adjustment for default premium

7.34 We now adjust the debt premium calculated above for the default premium. As mentioned above, we have explained our rationale for this adjustment in Appendix 2.

7.35 To calculate the default premium we use default probabilities estimated from data provided by the rating agency Moody's. This gives us an estimated average annual default risk of 0.12 per cent for A rated bonds, and 0.42 per cent for BBB rated bonds.[72]

7.36 We then assume an average loss given default (LGD) of 58 per cent for both A and BBB rated bonds (based on figures from Moody's[73]).

7.37 Multiplying the risk of default by the LGD gives us a default risk premium of 0.07 percentage points for A rated bonds and 0.24 percentage points for BBB rated bonds. These are subtracted from the debt premium figures calculated above to give the figures for the real cost of debt adjusted for default premium in Table 7.8.

Table 7.8: Cost of debt assumptions for ESB and EirGrid – adjusted for default premium

Bond rating	Unadjusted debt premium (%)		Debt premium (%) adjusted for default premium		Real cost of debt [1](%) adjusted for default premium	
	Low	High	Low	High	Low	High
A	1.0	1.4	0.93	1.33	2.68	3.53
BBB	1.4	1.9	1.16	1.66	2.91	3.86

Notes: [1]Our estimated range for the risk-free rate is 1.6 to 2.2 per cent

Credit rating assumption

7.38 Above, we have presented debt premium figures for both A and BBB rated debt. In setting the cost of debt, a decision must be reached about which rating to assume for EirGrid and ESB.

7.39 The chosen rating may not necessarily reflect the actual rating that Eirgrid and ESB would achieve if they were rated, given that their credit rating would depend on their gearing, and the notional gearing level we assume could in principle differ from their actual gearing.

7.40 Instead, what is important is that the WACC calculation is internally consistent – in other words, that the credit rating that we assume in setting the cost of debt reflects the rating that EirGrid and ESB could achieve *at our assumed notional level of gearing*.

7.41 In the light of this, there is a choice to be made in determining the WACC:

(a) assume a (lower) gearing level consistent with an A rating, and use a debt premium relating to A- rated debt; or

[72] Moody's Idealised Default Probability Table Moody's document dated 2003, http://www.globalriskguard.com/resources/crderiv/Moody's%20synthetic%20CDO.pdf

[73] Loss recovery rates from Exhibit 27 in Moody's, "Corporate Default and Recovery Rates, 1920-2008", February 2009

(b) assume a (higher) gearing level consistent with a BBB rating, and use a debt premium relating to BBB-rated debt.

7.42 The choice between these two depends on what one views as an optimal capital structure for ESB and EirGrid.

7.43 In our view, the appropriate credit rating to assume for ESB and EirGrid is A rather than BBB, reflecting the analysis earlier in this section of the substantial premium that exists for BBB rated debt. As discussed in section 8, we have adopted a gearing assumption which we believe to be consistent with an A rating; and in section 9 we have re-levered our asset betas to this level of gearing. In this way, we have ensured that the assumption of an A rating is reflected throughout the WACC calculation.

Recommended debt premium and cost of debt

7.44 Given the assumption of an A category rating, our view on the debt premium is **1.0 to 1.4 per cent** with a point estimate of **1.2 per cent** if the CER chooses to employ no adjustment for the default premium.

7.45 If the CER does decide to employ an adjustment for default our view on the range for the debt premium is **0.9 to 1.3 per cent** with an indicative point estimate of **1.1 per cent**.

8 CAPITAL STRUCTURE

8.1 In calculating a WACC estimate, it is necessary to make an assumption about the gearing level of the company so as to know the weight which should be placed respectively on the cost of equity and the cost of debt. However, as discussed below, the choice of gearing does not necessarily affect the vanilla WACC since both the cost of equity and the cost of debt change with gearing. The choice of gearing does, however, affect the tax liabilities which the CER has to allow for within price limits.

8.2 The notional level of gearing on which the WACC calculation is based is not intended to represent second-guessing of companies' decisions about their optimal financing structure, or to provide any guidance on the gearing level that firms should adopt.

Capital Structure and CAPM: MM Proposition I

8.3 The starting point in thinking about the effect of gearing is the Modigliani-Miller insight (MMI) that the riskiness of a company depends on the riskiness of its real cash-flows — volatility in the costs and in the demand for its products. The implication is that where there are no taxes, incentive or information problems, the way a project or firm is financed does not affect its value or its cost of capital — the market value of any firm is independent of its capital structure. This is because the overall risk on the company's asset base, the asset beta, does not change with the capital structure of the firm (i.e. the chosen combination of equity and debt).

8.4 This section first explains the MMI more fully, and then investigates situations where the proposition may not apply.

Understanding MMI

8.5 A company can be thought of as a bundle of investment projects (installation of different physical assets, different marketing schemes, etc.). MMI is easiest to explain in terms of raising finance to undertake a project. A project can be represented by a stream of uncertain, future cash flows or (net) revenues. Each set of future revenue is equivalent to some amount of cash today; the exact amount is obtained by discounting by the cost of capital. Adding all the cash equivalents together gives the total value of the project, V, say.

8.6 Suppose the project costs an initial amount C. Then the project is worth undertaking if, and only if, $V > C$, that is, if, and only if, it contributes positive net value. This brings us back to MM proposition I, as follows. The financiers of the project — who put up the C — have to get their C back. They can get it back in a variety of ways: they could be given a share s of future revenues, where $sV = C$, or they could get some debt (risk-less or risky) that has a present value equal to C. Regardless of the method, they must get

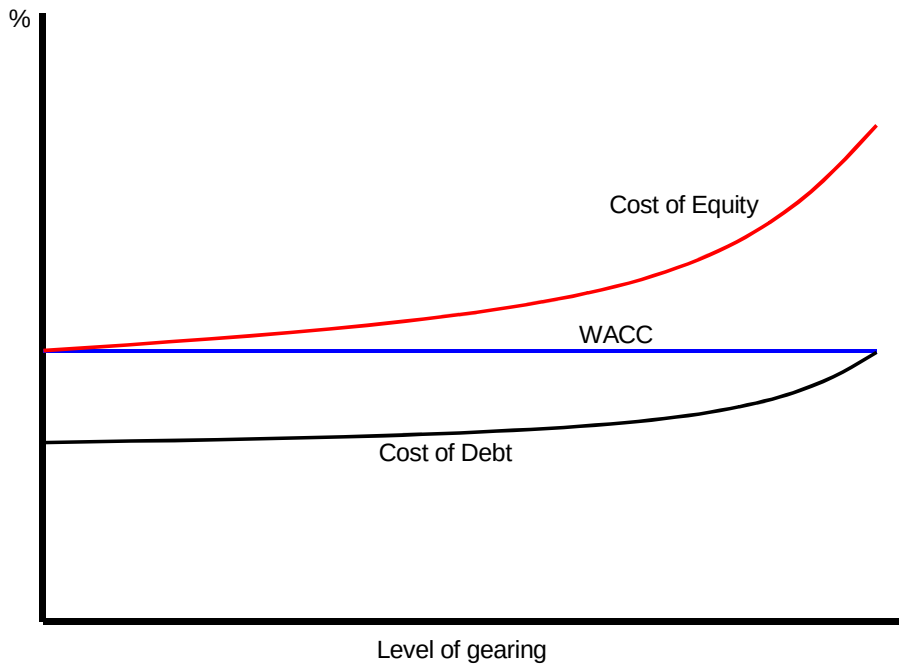
C, and simple arithmetic tells us that the entrepreneur that sets up the project will get the remainder *V - C*. That is, from the entrepreneur's point of view (and from the financiers') the method of financing doesn't matter. (It does not matter how the C is sliced up.)[74]

8.7 Since the riskiness of the asset is determined by its real features, not its method of financing, causality runs from the asset cost of capital to the costs of debt and equity, via the capital structure, rather than the other way around. Many people, first encountering corporate finance, have a thought along the following lines — if the cost of equity is 11 per cent, the cost of debt is 1 per cent, and the gearing level is 50 per cent, then the cost of capital will be 6 per cent (0.5 x 11 + 0.5 x 1). But (they think) if gearing rises to 75 per cent, then the cost of capital must fall to something like 3.5 percent (0.25 x 11 + 0.75 x 1). If that were so then causality would run from the costs of debt and equity to the overall asset cost of capital, via the capital structure (the cost of capital would depend on the costs of debt and equity and the gearing). The Modigliani-Miller theorem reverses this, saying that the asset cost of capital is fixed by the real nature of the asset, so, in fact, it is the costs of debt and equity that depend on the level of gearing, not the asset cost of capital.

8.8 The proposition is illustrated in Figure 8.1 below. At zero level of gearing the weighted average cost of capital is equal to the cost of equity. As gearing increases, the weight on the (lower) cost of debt increases. However, cost of equity and debt both adjust such that the combined WACC remains unaltered, until at 100 per cent gearing WACC simply equals the cost of debt.

[74] Miller used to illustrate MM proposition I with one of baseball legend Yogi Berra's famous (mis-)sayings: "You better cut the pizza in four pieces because I'm not hungry enough to eat six."

Figure 8.1: Modigliani-Miller proposition I



8.9 Since capital structure is irrelevant according to MMI, if that were all there were to it, we might expect to see completely random capital structures of companies. But we do not. MMI then points us to the reasons why capital structures might matter for a company, particularly through noting for us the matters from which MMI abstracts.[75] These are the things the proposition abstracts from:[76]

(a) Taxes — differential tax treatment of equity and debt finance may imply that increasing gearing will save tax and in this way increase company value.

(b) Costs of financial distress — in the absence of other distortions, the expected costs of financial distress will rise with the level of gearing, at least partially offsetting the potential benefit from tax effects.

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[75] Note that it is sometimes naively asserted that the MMI result "does not hold" — i.e. that it is not true that the cost of capital is invariant to the level of gearing — if the assumptions the MMI theorem's proof requires do not hold. That is fallacious. For example, if we take as an assumption given, that my sister is currently in my house, it follows that my house has not fallen down (there is a quasi-logical proof). But just because my sister is not, in fact, currently in my house (just because our assumption does not hold) it does not follow that my house has, in fact, fallen down. Likewise, we are not entitled to assume, upon observing a world of information asymmetry or costs of bankruptcy, that *therefore* the cost of capital will vary with the capital structure. That remains to be proven one way or another. Many claims concerning conditions that, if they held, the MMI result would not hold, have turned out upon subsequent analysis not to be convincing. The MMI result, once one understands the intuition, is amongst the most compelling, elegant, and universal in all corporate finance theory, and has been recognised as such ever since its publication.

[76] MM proposition I also assumes efficient well functioning capital markets, but that is an assumption we will keep throughout this paper.

(c) Incentive problems — financial structure may affect incentives that, for example, the managers have to maximise the net present value of the company.

(d) Information problems — the information that different market participants have access to at different times might vary.

(e) Transaction costs — for example, in changing the level of gearing.

8.10 The figure below illustrates possible effects these factors might have on the market value of the company. The horizontal line represents the situation under the MMI – the level of gearing has no effect on company value. Once we move to a situation with taxes, however, gearing may have an effect due to the tax advantage of interest payments, as illustrated by the rising straight line. Considering only the effects of taxation would imply that the best possible capital structure involved holding no equity.[77] However, as gearing rises, so do the risks and expected costs of financial distress. Therefore there is some optimal level of gearing as illustrated by the higher of the curved lines in Figure 8.2. If in addition there are some incentive problems associated with high levels of gearing, the optimal level of gearing might be lower still, as represented by the lower of the curved lines in Figure 8.2.[78]

8.11 The same can be shown with the rate of return on the vertical axis rather than the market value of the company. Figure 8.2 shows the effects of the value of the tax shield in pre- and post-tax WACC settings. A pre-tax approach allows the company to earn a return out of which to settle tax expenses. In a post-tax approach, on the other hand, taxes are modelled separately from the return (WACC) as a cost item. Therefore, as gearing increases, pre-tax WACC falls due to the value of the tax shield, until the expected costs of financial distress begin outweighing the benefit from the tax shield.

8.12 In a post-tax setting the WACC allows only for returns to investors, after taxes have been paid. Therefore only the costs of financial distress show on the WACC diagram (we are here ignoring the other possible distortions), and it would seem there is no obvious optimal level of gearing. This is, however, more apparent than real — taxes have merely been moved out of this equation. Their effect, including the tax shield value that varies with the level of gearing, still exists in the separate modelling, and the company will take their value into account when selecting its financial structure.

8.13 We will turn to the effects outside of MMI after considering the basic proposition in the CAPM framework in slightly more detail.

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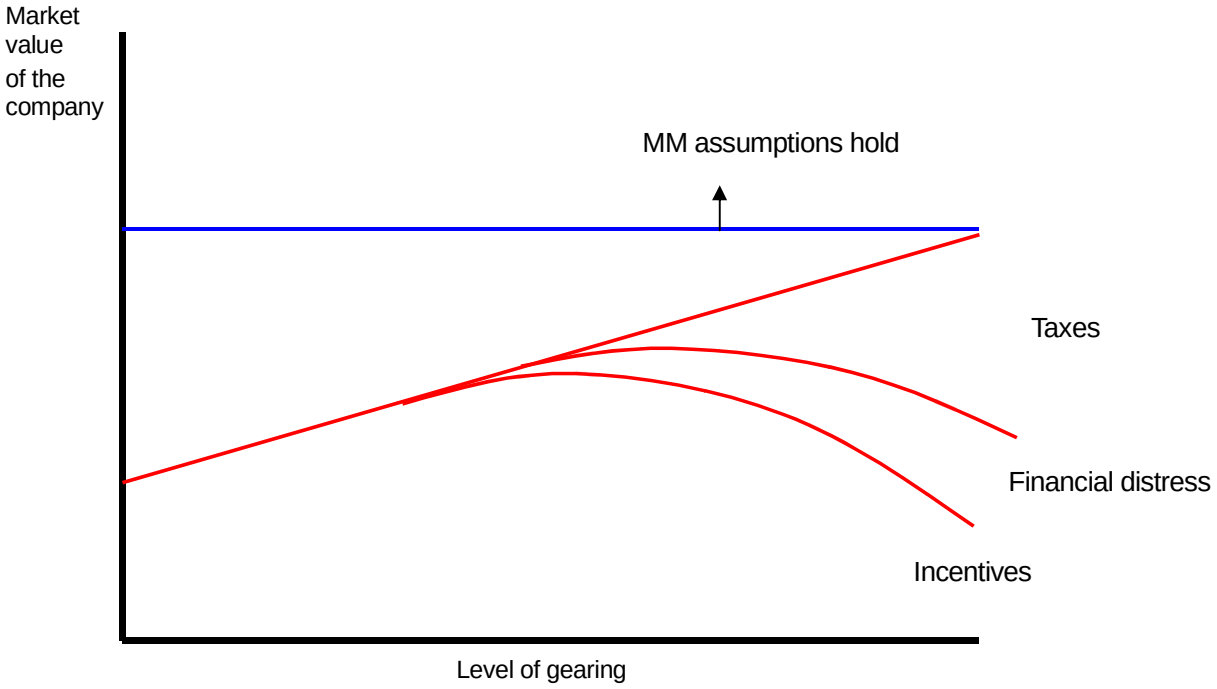
[77] Taxation however introduces a distortion, such that the value in a world with taxation will never actually reach the value of the company in a world without any taxation, as in the MMI. Hence the MMI line lies above the "world with distortions" lines.

[78] The drawing of the "incentive problem line" in Figure 5.2 is not intended to imply that incentive problems arise before significant effects on cost of financial distress. This does not have to be the case, and the titling of the curved lines could as easily be reversed.

Figure 8.2: Illustration gearing and market value of company



Implications within the WACC Framework

8.14 In order for the financiers of the above project to be willing to put up the cost of the project, they must determine what level of risk they are taking on and, therefore, what level of return they require for their investment. To do this in a CAPM framework, they have to estimate the risk on all of the company's stock, the asset beta. As discussed in previous sections, the asset beta is a measure of how the net returns on the asset as a whole (the relevant "asset" in this context being the whole energy transmission and distribution sectors) is correlated with changes in returns across the wider economy.

8.15 The asset beta is relevant to the total WACC of the company, as opposed to just the cost of equity:

$$WACC = r_E \cdot \frac{E}{D+E} + r_D \frac{D}{D+E} \; ; \; \beta_A = \beta_E \cdot \frac{E}{D+E} + \beta_D \frac{D}{D+E}$$

8.16 If the firm uses no leverage, then the shareholders get all the project revenues, and $\beta_A = \beta_E$. However, when the firm uses debt as well as equity, β_E overstates the risk of the company, and the equity beta must be "un-levered" to get the asset beta. This is straightforward in the well-functioning capital markets we are still assuming — we can utilise the above formula.

8.17 Recalling MM proposition I, the value of the company is determined by its future revenues, and how those revenues are split between different types of financiers does not matter. This means that the asset beta is constant — as the company gears up (D increases), the weight on the equity beta decreases relative to the weight of debt beta, and therefore something has to adjust to compensate (as typically $\beta_D < \beta_E$). Assuming that the risk on the debt providers does not change, the risk on equity holders must increase. This in fact is the case; the risk on the firm's equity is affected by its capital structure as well as the riskiness of the underlying business.[79]

8.18 We have now illustrated MMI in the CAPM framework. In perfect capital markets, the fact that a company gears up does not matter because the risk on equity rises in proportion to exactly compensate, leaving the asset beta - and therefore the company WACC - unaffected. In fact, it is the asset beta that drives the level of equity and debt betas — the overall risk on the asset base is what matters, the cost of equity and debt only adjust to reflect this depending on their relative amounts.

8.19 However, things are not as clear as we relax the assumptions behind MMI. The most clear-cut effects are those associated with taxation, which can be directly analysed in the CAPM framework, and to which we now turn.

Value of tax shield in CAPM

8.20 Bringing taxation into the picture, it is now possible that a company's value is affected by its capital structure due to the tax advantage enjoyed by debt finance — interest payments are tax deductible, whereas dividends and capital gains are not.

8.21 Roughly speaking, the impact of a change in the level of gearing on the WACC due to the change in the tax shield value could therefore be calculated as follows. First, estimate the values of the debt and the equity beta for the previous level of gearing, and using them construct the asset beta. Also remember that as gearing increases, the company value might be affected by the factors described in paragraph 8.9, such that the trade-offs imply that an increase in gearing would not be desirable above a certain point.

8.22 Second, remember that the asset beta will change only as a result of the change in the present value of the tax shield due to gearing up, which would have to be projected throughout the regulatory price review period. If there is no additional value from the tax shield compared to current gearing (i.e. current gearing is optimal), the asset beta can either only stay the same or *increase*, leading to a fall in the company valuation (as,

[79] Occasionally, studies are produced in which the cost of equity appears to be invariant to issuance of new debt, with the argument offered that this is incompatible with MMI. But that is not correct — for example, something happening to reduce the company's cost of capital (e.g. greater certainty over its future revenue stream) might naturally be associated with a decision to issue additional ("securitising" those future revenue streams). It might well be natural for the amount of debt issued in such a circumstance to be that amount that leaves the cost equity as it was before the cost of capital fell. (This is particularly likely if the determinant of the

other things being the same, the discount rate on the future income is now higher).

8.23 Aiming for an "optimal capital structure" implies equating the marginal benefit of debt financing with its marginal cost. Optimal gearing ratios are likely to vary by sector and even, in principle, by company within each sector.

Determining Notional Gearing Levels

Notional gearing and financeability

8.24 A regulator's duties may include a requirement to ensure companies are able to finance their activities. Where this requirement has been included it has typically meant ensuring that projected financial ratios (calculated using a notional gearing assumption) will allow companies to maintain an appropriate credit rating.

8.25 Neither EirGrid nor ESB Networks is rated by any of the three main rating agencies – Fitch, Moody's, and Standard & Poor's. However, in the last price review the CER indicated its intention that the gearing level should not result in an implied credit rating that would be inconsistent with a reasonable commercial level.[80]

Actual gearing

ESB Networks

8.26 Table 8.1 presents gearing levels for ESB Networks at both group and subsidiary level for the period 2005 to 2008, taken from ESB's questionnaire response.

Table 8.1: ESB Networks' gearing %

[✂]

8.27 As can be seen from the table, the ESB Group's gearing was in the range [✂] to [✂] per cent during the period 2005 to 2008.

8.28 The imputed gearing for ESB Networks (the DSO) was in the range [✂] to [✂] per cent in the period 2005 to 2008. We note the large increase in gearing for ESB Networks from [✂] per cent in 2007 to [✂] per cent in 2008. [✂]

capital structure operates through or has the effect of placing a cap on the cost of equity — debt issuance would continue until that cap was reached.)

80 CER: 2006-2010 Transmission Price Control Review, decision paper, CER 05/143, 9th September 2005.

EirGrid

8.29 Table 8.2 presents gearing levels for EirGrid, both including the East West Interconnector (EWIC)[81] and excluding the EWIC for the period 2006 to 2010.[82]

Table 8.2: EirGrid's gearing %

8.30 [✂]

8.31 As can be seen from Table 8.2, EirGrid's gearing level began at zero in 2006 (the year in which EirGrid took over operation of the transmission system) and has increased substantially since. [✂]

Regulatory precedents

8.32 Table 8.3 shows recent notional gearing choices of Irish and UK regulators. Although there is some time variation in the table, we can see that the CER's 2005 decision of a gearing range of 50 to 60 per cent, with a point estimate of 50 per cent for the TAO, TSO and DSO, ranks around the middle of the gearing ranges.

[81] The EWIC reflects a single "lumpy" asset on EirGrid's balance sheet which is highly geared with significant regulatory backing and support. It is not reflective of the normal application of the regulatory model.

[82] [✂]

Table 8.3: Recent regulatory notional gearing decisions

Regulator	Year	Sector/company	Notional gearing %
CAR	2009	Dublin Airport Authority – draft determinations	37-50
NIAUR	2009	SONI – draft determinations	57.5
Ofgem	2009	Electricity distribution	65
Ofwat	2009	Water (WaScs and WoCs)	57.5 (WaSCs) 52.5 (WoCs)
Ofcom	2009	Telecoms - Openreach	35
Civil Aviation Authority	2008	Stansted	50
CEPA for Office of Rail Regulation	2008	Network Rail	60-65
NIAUR	2008	SONI	57.5
Comreg	2008	Eircom	30-50
Ofgem	2007	GDNs	62.5
Civil Aviation Authority	2007	Heathrow and Gatwick (BAA)	60
Smithers & Co for Ofgem	2006	Four electricity and gas licensees	60
Ofgem	2006	Transmission	60
Ofcom	2005	BT	30-35
CER	2005	Transmission and distribution	50-60
CAR	2005	Airports	46
Ofwat	2004	Water (WaSCs and WoCs)	55-65
Ofgem	2004	Electricity DNOs	57.5
CER	2001	Transmission and distribution	50
CAR	2001	Airports	50

Source: Individual regulator reports

Suggested notional gearing figure

8.33 At the 2006 price reviews, the CER used a notional gearing figure of 50 per cent when calculating the WACC, taken from a range of 50 to 60 per cent. Its view was that the gearing level selected should not imply a commercial level that would be inconsistent with what was reasonable. The CER considered that its assumed gearing of 50 per cent was consistent with the approach taken by regulators internationally, and reflected the debt rating of companies consistent with ESB.

8.34 We consider that a gearing range of **50 to 60 per cent** with a point estimate of **55 per cent** is an appropriate level of notional gearing to assume for the TAO, TSO and DSO. This figure should be understood in the context of the increased costs of raising debt due to the financial crisis in Ireland, and our reflection that a higher notional gearing range may encroach upon the ability of firms to finance their debt. More specifically, this range is based on a number of factors, including the following:

(a) While neither ESB nor EirGrid are currently rated, we consider that gearing at this level would enable them (subject to performance against other financial ratios) to

achieve a rating in the A range, if they were to be rated.[83] We have assumed an A rating in our cost of debt analysis, and hence use of this range ensures that our WACC calculations are internally consistent.

(b) A range of 50 to 60 per cent is consistent with a number of regulatory precedents (although not all of them). For instance, 50 to 60 per cent is the range that the CER used in its 2005 determinations for transmission and distribution, and recent figures used by the NIAUR for SONI and by Ofwat for the UK water industry lie within this range. We note, however, that Ofgem has tended to use a somewhat higher gearing assumption for energy networks in Great Britain. (The gearing range used by telecoms regulators in Ireland and the UK has typically been lower, but this sector would seem a less good comparator for electricity networks.)

(c) Gearing of 50 to 60 per cent is not too far out of line with actual imputed gearing for ESB Networks. In particular, the imputed gearing for ESB Networks was within this range in 2006 and 2007 (although it shot up above it in 2008). The actual gearing for EirGrid has been subject to significant change in recent years, and hence we do no consider that a comparison of our range with EirGrid's actual gearing is meaningful.

[83] For example, Moody's have published the gearing bands that they consider consistent with different credit ratings for the UK water sector, which can be taken as a comparator sector for electricity distribution. According to these figures, gearing in the range of 50 to 60 per cent would be consistent with a straight A credit rating.

9 ESTIMATED MARKET COST OF CAPITAL

9.1 In this section, we present our views on the overall range for the market cost of capital, based on the parameter ranges set out in previous sections.[84]

Range for the market cost of capital

9.2 Our view is that the real, pre-tax cost of capital for the TAO, TSO and DSO lies within the range **3.2 to 5.6 per cent** with a best point estimate of the market cost of capital of **4.6 per cent**. This is based on a pre-tax cost of equity of 3.9 to 8.7 per cent and a pre-tax cost of debt of 2.6 to 3.6 per cent. The parameter estimates on which this range is based are shown in the table below.

9.3 We have used the Irish corporation tax rate of 12.5 per cent to uplift the cost of equity in order to calculate a pre-tax cost of capital.

Table 9.1: Recommended WACC range

	Low	High	Point estimate
Cost of equity			
Risk-free rate	1.6	2.2	2.0
Equity risk premium	4.5	5.4	5.2
Asset beta	0.2	0.4	0.3
Equity beta	0.4	1.0	0.67
Post-tax cost of equity	3.4	7.6	5.5
Pre-tax cost of equity	3.9	8.7	6.2
Cost of debt			
Debt premium	1.0	1.4	1.2
Pre-tax cost of debt	2.6	3.6	3.2
Post-tax cost of debt	2.3	3.2	2.8
WACC			
Notional gearing (%)	50	60	55
Corporation tax rate (%)	12.5	12.5	12.5
Post-tax WACC	2.8	4.9	4.0
Vanilla WACC	3.0	5.2	4.2
Pre-tax WACC	3.2	5.6	4.6

Source: Europe Economics

9.4 As well as the range presented in Table 9.1 above we also carried out a sensitivity analysis, calculating the WACC range based on a cost of debt with a default premium

[84] The WACC range presented here is calculated using a debt premium based on observed yields i.e. no adjustment has been made to deduct the default premium. The asset beta is calculated and equity beta re-levered assuming a debt beta of zero.

adjustment and assuming non-zero debt betas to calculate the asset beta and re-lever the equity beta. The result of this sensitivity analysis (set out more fully in Appendix 3) was an almost identical range[85] to that presented in Table 9.1.

9.5 In this report we gave consideration as to whether, within these ranges, the TSO should be given a different cost of capital from the TAO and DSO. As explained in section 5 we recommend against setting different allowed costs of capital.

9.6 We also considered whether EirGrid required an additional small company premium. As explained in Appendix 1 we recommend against granting Eirgrid an additional small company premium.

Asymmetry of consequences and the regulatory cost of capital

9.7 It is sometimes argued that when estimating the cost of capital for a regulated firm there are asymmetric consequences to getting the estimate either too low or too high. In particular, if the estimate is too high, consumers pay more than necessary over the next price review period; whereas if it is too low, the regulated firm may not be able to raise the finance necessary to carry out investment, potentially causing more serious detriment to consumers in the long run.

9.8 In section 10, we consider this issue more fully and set out our recommendations on the regulatory WACC that should be adopted by the CER.

[85] The range calculated was 3.1 to 5.6 per cent with a working point estimate of 4.5 per cent.

10 REGULATORY COST OF CAPITAL

Introduction

10.1 This section sets out our recommendations on the regulatory WACC that should be adopted by the CER. As we shall explain further below, this number can differ from the estimate of the "true" market cost of capital due to asymmetry of consequences of setting the regulatory WACC either too high or too low. The section is set out as follows:

(a) Asymmetry of consequences

(b) Aiming up

(c) Recommended markup for CER

Asymmetry of Consequences

10.2 Reaching a judgement on the likely "true" value of ESB Networks and Eirgrid's cost of capital over the period 2011-2015 is inherently subject to uncertainty. In the light of this, it is important to consider how this uncertainty itself should be taken into account. In particular, what would be the consequences of either over-estimating or under-estimating the WACC?

10.3 The consequence of setting the regulatory WACC higher than the market cost of capital is that investors will receive a windfall gain at the expense of electricity customers, who will pay more than necessary for their electricity.[86] In the current economic circumstances, the impact of this on some electricity customers in both the domestic and non-domestic sectors may be particularly undesirable. Indeed, any perception that the cost of capital has been set too high is likely to be politically controversial in the current economic environment.

10.4 On the other hand, there are also negative consequences to setting the regulatory WACC lower than the market cost of capital. First, when prices are below the competitive level there is inefficiently due to too much of the regulated product being consumed. Furthermore, at the margin the return that companies make on new investment projects may not be sufficient to cover the cost of raising finance, thus reducing incentives for the companies to invest. The impact of this on customers would be mitigated by the fact that companies might have to invest anyway in order to meet licence conditions. However, if under-estimation of the WACC was serious, companies could face difficulties raising the finance which they need, both in debt and equity markets.

[86] This assumes that all other elements of the price control have been set at an appropriate level. In practice, it is of course possible that errors in setting one part of the price control may be offset by errors in the opposite direction made elsewhere in the regulatory settlement.

10.5 While customers might benefit from lower bills in the short run if the WACC is set too low, ultimately they would be expected to suffer in the long run if investment in the electricity sector does not go ahead. Such negative consequences could potentially last for years into the future.

10.6 This issue of asymmetry of consequences in setting the WACC too low was considered explicitly by the UK Competition Commission when advising on the economic regulation of the London airports in 2007.[87]

> Given the uncertainties in cost of capital estimates, we considered the cost of setting an allowed WACC that was too high or too low. If the WACC is set too high then the airports' shareholders will be over-rewarded and customers will pay more than they should. However, we consider it a necessary cost to airport users of ensuring that there are sufficient incentives for BAA to invest, because if the WACC is set too low, there may be underinvestment from BAA or potentially costly financial distress. [...]
>
> Taking these factors into account, we concluded that the allowed WACC should be set close to the top of our range. […]
>
> We note that a WACC that is above our mid-point for the purpose of avoiding a WACC which is too low, is likely to over-reward equity, and is, therefore, beneficial to BAA. However, we consider it a necessary cost to airport users of ensuring that there are sufficient incentives for BAA to invest.

10.7 In a policy update on the price control for NATS, the UK CAA noted:[88]

> "When choosing a point from a range, regulators have generally balanced the risk (and cost) of over charging customers (from a WACC that is too high) with the risks (and costs) of the company not undertaking capital investment (because the WACC is too low). This has generally resulted in regulators choosing a WACC in the upper half of the range."

10.8 The issue has also been considered by Ofcom, in the context of selecting a point estimate for the ERP:[89]

> The principal issue for Ofcom in choosing an appropriate ERP within the plausible range of estimates is to balance the relative risks of setting a cost of capital that is too high with one that is too low. Ofcom must take into account both the short and long term impacts on consumers and firms.
>
> In following its statutory duties, Ofcom has considered the impact of under- or overstating the level of risk inherent in equity investments (and hence the appropriate ERP).
>
> Excessive rewards may lead to:

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87 Competition Commission (2007), "BAA Ltd — A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd)", Appendix paragraphs 150-156.

88 CAA, "NATS (En Route) plc price control review for Control Period 3, 2011-2015; CAA Policy Update", February 2009.

89 Ofcom (2005), "Ofcom's approach to risk in the assessment of the cost of capital".

> • consumers paying prices that are above the competitive level, leading to an overall welfare loss; and
>
> • investments that are not fully justified by consumer demand being made (and, possibly, investments in other areas that are justified by consumer demand not being made as a result)
>
> However, while setting rewards too low will lead to consumers benefiting from lower prices in the short run; it may also lead to discretionary investment being discouraged, meaning that the levels of infrastructure-based competition and innovation are at sub-optimal level.
>
> Given the duties and objectives outlined above, Ofcom believes that the costs associated with setting too low a cost of capital are greater than those associated with setting it too high. This has been taken into account in the arguments outlined in its discussion of the ERP.

10.9 While there are material consequences from both over-estimation and under-estimation of the cost of capital, we consider that on balance the long-term consequences of under-estimation are worse. This implies that, once one has formed a view about the "true" value of the WACC or its components, one should aim up to take account of the asymmetry of consequences from getting the decision wrong. However, whether or not such an adjustment should be made is ultimately a matter of regulatory judgment.

10.10 It should be noted that the above discussion of asymmetric consequences does not mean that it is necessary to be certain that the estimate is not too low — given that estimates of each WACC parameter are subject to significant uncertainty this might require such a high mark-up that it would not be in consumers' interests. Rather, one needs to balance the benefit from reducing the risk of negative consequences from setting the WACC too low with the additional costs to consumers of aiming up.

Aiming Up – Some Practical Issues

Aiming up on components versus aiming up on the overall result

10.11 The next question is whether the aiming up judgement to reflect asymmetry of error is best exercised on individual components of the WACC — the beta, the risk-free rate, the MRP, the debt premium, the gearing — or only on the overall answer.

10.12 The clear advantage of the latter approach is that it is to the final answer that the issue of asymmetry applies. If the beta is a bit low and the risk-free rate rather high and the ERP about right and so on, but the overall WACC is precisely correct, then it did not matter that the beta was low. The beta in and of itself is only a calculating device — it is the WACC that enters the price control.

10.13 Further, if we aim up on each of the individual components, we can only guarantee that the overall result on the WACC aims up enough-but-not-too-much by taking account of

the degree to which the final answer is raised. But then we might as well have simply worked straight off the overall WACC.

10.14 On the other hand, there are some potential advantages in aiming up on individual components. First, it is possible that the degree of uncertainty differs considerably between components, and estimates of individual components take into account the conclusions of other regulators. Appropriate confidence in regulatory precedent (and hence reduced regulatory risk) might potentially be better served by adjustments to specific components. However, this argument presents a danger that one mixes up the issues of asymmetry in the probability distribution of ranges for components with the overall argument for aiming up. The deliberate aiming up we have in mind is not that intended to address asymmetry in probability distributions.

10.15 It is also possible that regulatory estimates of individual components of the cost of capital serve as market focal points or other mechanisms that guide expectations in respect of particular elements of the cost of capital. For example, the cost of equity, *per se*, does not enter the price control. But the regulator's estimate of the cost of equity might affect expectations for investors and firms when companies seek to raise equity capital or consider their dividend policies.

10.16 We therefore consider that in the case of the CER it is more appropriate to aim up on the overall WACC rather than its individual components.

Factors affecting the degree of aiming up which is appropriate

10.17 This leads to the question of by how much one should aim up. This depends on at least two factors:

(a) First, the *extent* to which the consequences of setting the WACC too high or too low are asymmetric. As discussed above, we consider that there are potentially material negative consequences from both over- and under-estimation, but on balance we consider the consequences of the latter to be more serious in the long run.

(b) Second, the degree of uncertainty which surrounds one's best view of the "true" value of the WACC. The more uncertainty that surrounds estimation, the more one should aim up to avoid the negative consequences of underestimation.

Derivation of Mark-Up

10.18 In the discussion which follows, we explore two basic approaches to deciding on a markup:

(a) Taking our best point estimate of the market cost of capital and applying a percentage mark-up; and

(b) Examining our range for the WACC and drawing on regulatory precedents about how far to go across the range in selecting a regulatory WACC.

Applying percentage mark-up to best point estimate

The Competition Commission's approach at Q5

10.19 We begin by explaining the approach taken to the issue by the UK Competition Commission (CC) in the London airports price control review.

10.20 In its advice on the London airports price control for Q5, the CC aimed up a number of estimated parameters in the WACC calculation (such as the equity beta) by considering the 95 per cent confidence interval on the grounds that if the true mean return is constant, then there is approximately a 95 per cent chance that the true mean lies between two standard deviations either side of the mean.[90]

10.21 The CC recommended that the appropriate cost of capital at Heathrow was 6.2 per cent and at Gatwick was 6.5 per cent. The range estimates for each airport were 4.77 to 6.39 per cent and 4.91 to 6.77 per cent respectively. The point estimates represented numbers which were only 10 to 15 per cent below the top of the range and approximately an estimated two standard errors above the mid-point of the range.[91]

10.22 The confidence interval tells us that, when repeated infinite times, the true parameter's mean lies within two standard deviations of the mean with 95 per cent probability. When aiming up WACC estimates using such an approach the risk of aiming up too much, taking the upper end of the range, becomes a statistical certainty (95 per cent probability). Or to put matters another way, it becomes *statistically certain* that the WACC resulting from such an aiming up is not too low — which, as we have seen, is not the goal of aiming up.

10.23 Instead, taking a narrower confidence interval (for example a 66 per cent level of confidence — one standard deviation) allows a more balanced trade-off between the risk of aiming up too much and the risk of picking too low a value.

Approach used by EE when advising Ofwat at PR09

10.24 In its recommendations for Ofwat at PR09 Europe Economics recommended that a 66 per cent confidence for each of the parameters should be used. This lowered the risk of aiming up too much (see discussion of CC's approach above).

10.25 Our view was that an appropriate degree of marking up would employ the upper 66 per cent confidence value for each of the individual parameters so as to provide one overall markup.

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[90] See for example: Competition Commission (2007), "BAA Ltd — A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd)", Appendix paragraph 154.

[91] The percentage above the mid-point of the range were 40 per cent and 35 per cent respectively.

10.26 Europe Economics estimated the 66 per cent confidence interval for each of the key parameters. This produced an overall markup of 14.4 per cent.

10.27 We considered that the markup should ensure that, even if we had made errors in our estimate of the underlying cost of capital, companies should still be able to raise the finance that they need to fund their investment programmes.

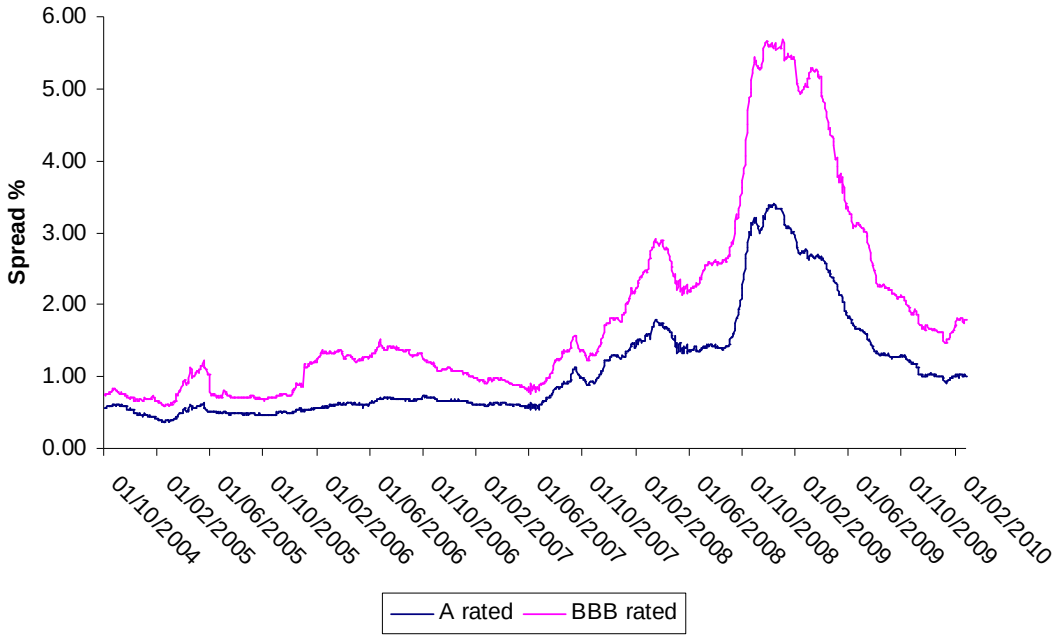
Implications of this approach for PR3

10.28 The precise percentage markup that is appropriate will differ between different contexts, and hence the fact that 14.4 per cent was considered appropriate in advising Ofwat does not necessarily mean that the same figure would be appropriate for the TAO, TSO and DSO at PR3.

10.29 It is not possible to produce a mark-up estimate for PR3 directly comparable to that which we derived in advising Ofwat, due to differences in the estimation context. For example, we cannot derive a statistical confidence interval around a single industry beta estimate as we did in the case of Ofwat, since the fact that ESB and EirGrid are not listed means we have had to use multiple comparators to estimate the beta.

10.30 We consider that the appropriate mark-up is likely to have decreased somewhat since we advised Ofwat. This is because the improvement in credit market conditions which has taken place (as illustrated by the chart below, which is taken from our main report) is likely to have reduced uncertainty.

Figure 10.1: Spread data for EUR-denominated A and BBB rated corporate bonds (non-financials), 2004-2010



Note: data is for bonds with 7-10 year maturity issued by non- financials
Source: Europe Economics calculations using data from iBoxx and Bloomberg

10.31 We would therefore suggest that a 14.4 per cent markup represents an *upper bound* to the markup that would be appropriate. Applied to our market cost of capital estimate of 4.6 per cent,[92] this would give a pre-tax regulatory WACC of 5.2 per cent. (Note that in this calculation we have applied the markup to the unrounded market cost of capital estimate in our original spreadsheet, and not to the rounded figure presented to 1 decimal place in our report.)

10.32 On the assumption that the improvement in credit market conditions has reduced uncertainty and hence reduced the appropriate markup, a somewhat lower percentage markup may in fact be appropriate. If, for instance, a 10 per cent markup is applied (again, to our unrounded market cost of capital estimate), this would give a pre-tax regulatory WACC of 5.0 per cent.

Examination of regulatory precedents on where to select within range

10.33 The approaches employed by the Competition Commission at Q5 and by Europe Economics when advising Ofwat were somewhat innovative. Regulators typically do not explicitly identify a markup to allow for asymmetry of consequences when determining their point estimate for the WACC.

10.34 However, in regulatory determinations regulators do typically choose a point estimate in the upper half of the range. This choice may be for a number of reasons; however, it is likely that the asymmetry of consequences from choosing a point estimate which was too low would be factored into this choice. One should exercise caution in looking at this evidence, however, since in some cases regulators may have included a degree of aiming up in the range estimate itself, and not only in their choice of where within the range to select a point estimate.

10.35 In the following table we list the pre-tax WACC range estimates from some recent regulatory decisions[93] together with the point estimates. The last two columns of the table have been calculated by Europe Economics, and show the width of the range (second to last column) and the difference between the regulatory WACC and the top of the range expressed as a percentage of the width of the range (last column). Note that a number of regulators use a post-tax approach to the cost of capital (with projected tax liabilities provided separately within price limits), and these are listed at the bottom of the table.

[92] Our main report shows how we derived our estimate of 4.6 per cent, based on data up to the end of February 2010.
[93] These WACC estimates are taken from appendix 4 of our main report, and include those decisions for which a WACC range and point estimate were identified.

Table 10.1: Regulatory decisions on WACC ranges and point estimates

Regulator	Case	Pre-tax WACC estimate				
		Low	High	Point estimate	Width of range	% of point estimate from top of range
Ofcom	Openreach (2009)	9.25	10.75	10.1	1.5	43.3
Ofcom	Rest of BT (2009)	10.25	11.75	11	1.5	50.0
CAA	Stansted (2009)	5.2	7.54	7.1	2.34	18.8
Comreg	Eircom (2008)	7.77	11.08	10.21	3.31	26.3
CAA	Heathrow (2007)	4.77	6.39	6.2	1.62	11.7
CAA	Gatwick (2007)	4.91	6.77	6.5	1.86	14.5
CER	Transmission and distribution (2005)	3.26	6.85	5.63	3.59	34.0
Postcomm	Royal Mail (2005)	6.71	8.81	8	2.1	38.6
Ofcom	BT copper access (2005)	9.99	10.04	10	0.05	80.0
Ofcom	BT other activities (2005)	11.37	11.42	11.4	0.05	40.0
Ofgem	Distribution (2004)	6	7.2	6.9	1.2	25.0
		Post-tax WACC estimate				
Ofgem	DRPC5 (2009)	3.7	4.3	4	0.6	50.0
Ofwat	Water and sewerage (2009)	2.9	5.4	4.5	2.5	36.0
Ofwat	Water and sewerage (2004)	4.2	5.3	5.1	1.1	18.2
				Highest		80.0 (outlier)
						50.0 (exc. outlier)
				Lowest		11.7
				Average		34.7

Source: EE calculations and review of regulatory precedents

10.36 A number of the figures in the last column should be treated with caution. For instance, the figure of 80 per cent for BT copper access in 2005 is clearly an outlier and has little meaning given the very narrow range from which the regulatory WACC was chosen in this instance.

10.37 However, in general regulators within this sample of precedents have used a WACC figure lying between 12 per cent and 50 per cent from the top of the range, with an average figure of 35 per cent from the top of the range.

10.38 Our unmarked up pre-tax WACC range for the TAO, TSO and DSO at PR3 is 3.2 to 5.6 per cent. If we were to take a regulatory WACC figure 35 per cent from the top of the range, in line with the average for the above precedents, then the regulatory WACC figure would be 4.8 per cent.

10.39 However, we consider that this approach yields a *lower bound* estimate of the appropriate regulatory WACC. This is because, as stated earlier, the regulatory ranges may in some

cases already include a degree of aiming up – illustrated by the fact that few of the ranges go as low as our low estimate of 3.2 per cent. Since our range does not include any aiming up, it therefore follows that one needs to aim up further *within* our range than regulators may typically have needed to do within their ranges.

Recommended Regulatory WACC

10.40 The analysis in this note has identified that:

(a) *An upper bound estimate of the appropriate regulatory WACC is 5.2 per cent*, based on applying a 14.4 per cent mark-up (used in advising Ofwat) to our best estimate of the market cost of capital. However, we consider that the improvement in credit market conditions since then is likely to have reduced uncertainty, meaning a somewhat lower markup may now be appropriate.

(b) *A lower bound estimate of the appropriate regulatory WACC is 4.8 per cent*, based on regulatory precedents about how far across the estimated range to select a regulatory WACC. However, given that regulatory ranges may already include some aiming up (whereas ours does not), we consider that it may be appropriate to aim up further within our range than regulators may typically have done within their ranges.

10.41 Based on this analysis, we recommend that the CER should select a pre-tax regulatory WACC **within the range 4.8 to 5.2 per cent**, thus aiming up on our best estimate of the market cost of capital of 4.6 per cent to take account of asymmetry of consequences.

10.42 The precise point that is taken from within this range is ultimately a matter of regulatory judgment, depending on the degree of confidence that the regulator wishes to achieve that it is not setting the WACC too low. However, our recommendation would be that the CER takes the mid-point of this range, and uses a pre-tax regulatory WACC of **5.0 per cent**. This would be consistent with a 10 per cent mark-up on our (unrounded) best estimate of the market cost of capital.

11 CONCLUSIONS

11.1 In this section we summarise our final conclusions on the market cost of capital and our recommendations on the regulatory WACC, as set out in sections 9 and 10.

Market cost of capital

11.2 As set out in section 9, our view is that the real, pre-tax cost of capital for the TAO, TSO and DSO lies within the range **3.2 to 5.6 per cent,** with a best point estimate of the market cost of capital **4.6 per cent**. This range is based on a pre-tax cost of equity of 3.9 to 8.7 per cent and a pre-tax cost of debt of 2.6 to 3.6 per cent.

Regulatory cost of capital

11.3 In section 10, we explained the rationale for setting the regulatory WACC somewhat above one's best estimate of the market cost of capital, on the grounds that there is uncertainty in estimating the WACC and the consequences of setting the regulatory WACC too low could be considered worse than the consequences of setting it too high. We also set out a number of approaches for calculating an appropriate mark-up for the market cost of capital.

11.4 Based on this analysis, we recommend that the CER should select a pre-tax regulatory WACC within the range **4.8 to 5.2 per cent**, thus aiming up on our best estimate of the market cost of capital of 4.6 per cent to take account of asymmetry of consequences.

11.5 The precise point that is taken from within this range is ultimately a matter of regulatory judgment, depending on the degree of confidence that the regulator wishes to achieve that it is not setting the WACC too low. However, our recommendation is that the CER takes the mid-point of this range, and uses a pre-tax regulatory WACC of **5.0 per cent**. This would be consistent with a 10 per cent mark-up on our (unrounded) best estimate of the market cost of capital.