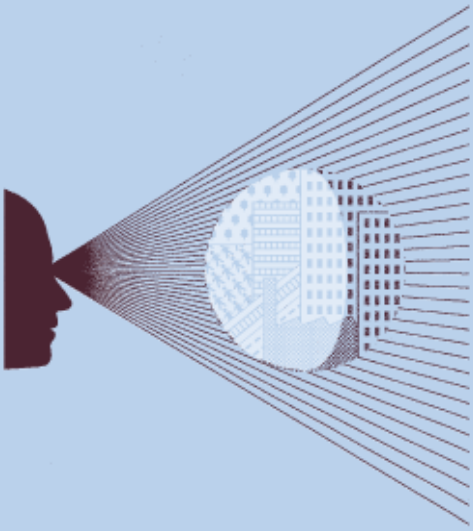
Oxera

Cost of capital of KPN

Prepared for KPN

December 1st 2008



Executive summary

Overview

Oxera has been asked by KPN to undertake an independent assessment of its cost of capital. This report presents the results of Oxera's analysis. The objective of the report is to assist OPTA in the context of its regulatory review in providing a robust estimate of KPN's cost of capital, which could be used in setting the cap for KPN's wholesale prices. Oxera would be happy to discuss the analysis and conclusions of this report directly with OPTA and its advisers in detail, when convenient.

Although Oxera has had full access to KPN's relevant financial information and key staff for this analysis, the results presented in this report are independent of KPN's own cost of capital estimates submitted to OPTA.

This report provides an estimate of the nominal cost of capital for KPN. Oxera's report on the compensation for inflation in the case of KPN addresses separately the issue of the appropriate treatment of inflation and the choice between the real and nominal cost of capital.[1]

Under the current regulatory regime, the price cap for KPN's regulated products for a given control period is set on the basis of cost projections as at two dates. Therefore, the allowed cost of capital needs to be estimated according to these two dates, in line with the other components of the price cap; specifically, the cost of capital needs to be estimated as of June 2007 and as of June 2011.

In this report, the first cost of capital estimate is derived as at June 2007 on the basis of the information available at that time, and assuming that prices as of that particular date incorporate all relevant information.

The second cost of capital estimate is derived according to the most recent information available at the time of the analysis (November 2008), in order to reflect appropriately the implications of the financial turmoil for KPN's cost of capital, and to ensure that the allowed price cap allows investors to earn the appropriate required rate of return, given recent market evidence.

Business and financial context for analysis

Evolution of business risks faced by telecoms incumbents

The cost of capital represents the rate of return that investors require as compensation for taking risks. It is a reflection of underlying business and market characteristics of the firm and the industry, and its assessment should be grounded in business and market analysis.

Recent developments in the telecoms markets in Europe indicate that the business risk of telecoms incumbents is increasing. Developments such as increasing competition and the rapid pace of technological change, as well as convergence across technologies, require telecoms companies to transform from utility-like incumbents to innovative competitors entering into new lines of business and products. The necessity to innovate created by

[1] Oxera (2008), 'Compensation for Inflation', December.

market pressures by definition increases the risks and therefore the returns expected by investors.

An increasing risk of asset-stranding, driven by uncertain business models in the future as well as greater investment requirements created by the potential technological paradigm shift, further increase required returns of the leading telecoms companies.

From the investor's perspective, this means that telecoms companies migrate from an asset class that is well known and perceived to have relatively predictable cash flows to one that has significantly less well-understood risks and considerably more uncertain future scenarios.

Structural changes in financial markets

This analysis of the cost of capital is undertaken in the context of one of the most severe financial crises over recent decades and the associated major structural changes made in response to problems in the financial system, which have become apparent over the last few months. The financial institutions that provide credit are faced not only with a combination of large and growing write-downs on their assets, a lack of liquidity, and the loss of consumer confidence, but also with a fundamental revision of the underlying business models adopted for the provision of different forms of funding that were associated with the benign conditions in debt capital markets between 2003 and early 2007.

These events have initiated the process of de-levering of the portfolios of financial institutions and investors, which has led to a decrease in the total amount of funding available to corporations.[2] This has been accompanied by the expected contraction of the European economy and the possibility of a prolonged recession, which could result in a further deterioration of the financial positions of banks and corporates. It is unclear how these processes could be reversed in the short term.

These developments have significantly increased the cost of raising capital and, in some cases, made capital unavailable to European corporates. KPN is, and will have to continue, raising capital at the market rates going forward, given its refinancing requirements, which makes the analysis of the cost of capital particularly important in this case.[3]

In this report the cost of capital is estimated using the conceptually most appropriate framework, according to which the estimates need to reflect all available forward-looking information. Therefore, where appropriate, the analysis should rely on spot prices reflecting latest expectations; in this respect past developments in the financial markets may be of limited use in the cost of capital analysis.

However, where there is limited or no relevant market activity, or price signals exhibit high volatility and uncertainty as a result of market turmoil, and hence where the observed prices may not reflect the underlying economic fundamentals, it may be appropriate to rely on short- to medium-term averages with an allowance for the fundamental re-pricing of risk.

[2] See, for example, *The Economist* (2008), 'Deleveraging: A Fate Worse than Debt', September 25th, http://www.economist.com/finance/displayStory.cfm?source=hptextfeature&story_id=12306060.

[3] For example, KPN raised € 3.0 billion of debt after the start of the turmoil at the prevailing market price, which was considerably higher than before the onset of the turmoil. Furthermore, several recent bonds issued by the European telecoms companies after the start of the turmoil were priced at a much higher yield than before. These include, for example, the Deutsche Telecom €250m 20-year bond priced at 8.9%, the Vodafone Group €450m ten-year bond priced at 8.2%, and the France Telecom €500m 20-year bond priced at 8.3%, all of which were priced in November 2008. In order to ensure that KPN complies with its financing policy, equity financing (and not just debt financing) will also have to be raised to fund KPN going forward (eg, retained earnings). This will also have to be undertaken at a higher required rate of return as a result of structural changes in the market.

Cost of capital parameters

The main parameters in the weighted average cost of capital (WACC)—gearing, the debt premium and asset beta—are specific to the company being assessed. The other parameters that need to be estimated—the risk-free rate and equity risk premium (ERP)—are generic to all applications of the capital asset pricing model (CAPM) at any given time.

Risk-free rate

The range for the risk-free rate as at June 2007 is 4.5–4.7%, estimated on the basis of the evidence on nominal and real yields in the Netherlands, the four other top-five countries in the Eurozone (France, Germany, Italy, Spain), and the UK.

The markets for government debt have been significantly affected by the ongoing financial turmoil. This was reflected in higher volatility of Dutch nominal yields, which have increased by more than 61% since June 30th 2007 for bonds with a maturity of 5–7 years, and lower bid–ask spreads (a proxy measure for liquidity), which have more than tripled over the same period. In addition, in November 2008 the implied nominal yields, based on real yields and independent inflation forecasts, were considerably higher than the observed nominal yields at that date (eg, 4.7% versus 3.4% for France).

The estimated range for the risk-free as of 2011 (approximated using the current estimates as of November 2008) is the same as for 2007 in light of the evidence on potential market inefficiencies, such as limited liquidity combined with large capital movements, high volatility and significant changes in implied inflation.

Cost of debt

As at June 2007 the range for the cost of debt including transaction costs is 5.5–6.8%. The range is based on the evidence on average yields to maturity of KPN's bonds (5.7% net of transaction costs), as well as on the yield to maturity for the most recently issued bonds as at June 2007. The midpoint estimate for the transaction costs of 17bp is included in the cost of debt estimate.

The evidence from primary and secondary markets suggests that after June 2007 the cost of debt for KPN increased considerably, in line with the impact of the financial market turmoil. The spot yields on KPN's bonds increased over the period from June 2007 to November 2008 by 130bp on average. Similarly, the yield at issue for KPN's bonds issued after the onset of the turmoil, but before the most recent increases in the cost of debt, was already 130bp higher than that for bonds issued before the onset of the turmoil.

The estimated range for the cost of debt (net of transaction costs) as of November 2008 is 6.5–7.2%.

– The lower end is based on the yield at issue for bonds issued after the onset of the turmoil with maturity similar to the average maturity of KPN's bonds. The fact that KPN issued debt at these high yields is indicative of market activity that is sufficient to ensure that these market prices reflect economic fundamentals.

– The upper end is based on the trading yields for these bonds in November 2008.

Given the midpoint estimate for the transaction costs of 17bp, the range for the all-in cost of debt in November 2008 is 6.7–7.4%.

It could be argued that a form of mean reversal might eventually occur in debt markets, even if it is not currently reflected in the evolution of market prices, simply because the current situation might not be sustainable in the long run. At the same time, it does not appear reasonable to expect prices to revert back to the levels of the benign market conditions that

characterised the period immediately before the financial turmoil. At the very least, market participants are expected to correct the fundamental mispricing of risk that appears to have characterised prices in debt capital markets before the market turmoil. Furthermore, KPN is, and will have to continue, raising debt at current market prices, given its refinancing requirements, which makes it essential for the company to be able to recover returns expected by investors.

Significant increases in KPN's cost of debt observed after the onset of the turmoil mean that the forward-looking required return on KPN's debt would differ from the rates locked in by KPN at previous issues (cost of embedded debt). In the regulatory context, embedded debt poses particular challenges in terms of both consistencies across economic cycles and across regulatory periods, as well as in terms of ensuring that the company faces appropriate incentives to choose an efficient financing structure, while limiting regulatory intervention in its corporate finance policy. In light of these considerations and in line with the corporate finance theory, more weight should be placed on the evidence of spot yields at the time of the analysis than on the cost of embedded debt.

Gearing

The range for the forward-looking gearing in June 2007 is 25–30%. The lower end of this range reflects the spot estimates of gearing as at June 2007 (24%), while the upper end reflects the average gearing over the four quarters preceding June 2007 (27%).

The range for the forward-looking gearing in November 2008 is 30–35%. The upper end of the range reflects a spot estimate in Q3 2008 (35%), while the lower end reflects the average over the four quarters preceding Q3 2008 (32%).

Given high volatility in the equity markets, spot estimates of gearing at a given date are highly uncertain. It would not be appropriate, therefore, to set the forward-looking gearing at present with reference to recent spot estimates (eg, gearing in November 2008 was approximately 41%)— particular given that recent increases in gearing have been driven largely by developments in equity markets. Importantly, the range from 30% to 35% is also consistent with KPN's long-term financing policy and hence should, on average, correspond to the actual level of gearing.

Equity risk premium

The estimated ERP for June 2007 is 6%. This is based on regulatory precedent for KPN in January 2007, given that there is no robust evidence to suggest that the ERP changed significantly from January to June 2007. Although this estimate is used for the analysis of the cost of capital, it should be noted that this estimate seems conservative, given the evidence from Dimson, Marsh, Staunton and Elgeti (2008).

The current turmoil has resulted in a sharp rise in share price volatility and declines in equity valuations. The implied volatility on AEX, which is a measure of market expectation of the forward-looking uncertainty, has more than doubled since June 2007, and has reached a level not previously observed since this indicator was introduced in 1994. In this context, any increase in the implied volatility of equity reflects the uncertainty surrounding the future value of assets, and is therefore indicative of the higher return on equity required by investors to commit capital.

There is robust academic and empirical evidence that higher implied volatility leads to a higher ERP. To reflect these developments in capital markets, the ERP of 6.25% is used for the analysis of the current cost of capital.

Asset beta

The only risk factor priced by the CAPM is the market risk factor (beta). There have been a number of significant developments in the European telecoms sector over the recent years, which lead to greater risk faced by incumbent telecoms companies in different European jurisdictions. This, however, may not be fully observed in the estimates based on historical data (where distortions might lead to temporary higher or lower estimates) due to general developments in the financial markets owing to impacts of the unwinding of the dot.com bubble and the ongoing market turmoil.

The analysis of market data points at an equity beta for KPN of approximately 0.85, with a 95% confidence interval from 0.7 to 1.0. This estimate is based on the two-year period ending June 2007. The average gearing over this period was approximately 28%. This results in an asset beta estimate of 0.5–0.7. The analysis of comparators points at an asset beta in the range of 0.3–0.8, with an overall average of 0.62.

The range for the asset beta used for estimating the cost of capital in this report is approximately 0.55–0.65. The midpoint of the range corresponds to the relevant estimates of KPN's beta; it is also supported by evidence on KPN's comparators. It should be noted that the chosen range is likely to be narrower than the actual uncertainty of the beta in order to ensure that the resulting estimates of the cost of capital could be practically used for setting the price cap.

This range for the asset beta, levered at the appropriate forward-looking gearing, is used for the cost of capital estimates in June 2007 and for the current cost of capital estimates, which are used as a proxy for the cost of capital in 2011.

Final estimates

Estimated ranges for the cost of capital

Based on the extensive analysis and the evidence presented in this report, the range for the appropriate pre-tax nominal cost of capital for KPN in June 2007 is 10.3–11.7%. The range in 2011 (estimated on the basis of the evidence in November 2008, and assuming a limited degree of mean reversion) is 10.9–12.1% as set out in Table 1.

Table 1 Cost of capital parameters for KPN

	June 2007		2011 (estimated in November 2008)	
	Low	**High**	**Low**	**High**
Risk-free rate (nominal, %)	4.5	4.7	4.5	4.7
Cost of debt (pre-tax, %)	**5.5**	**6.8**	**6.7**	**7.4**
Gearing (%)	25	30	30	35
Asset beta	0.55	0.65	0.55	0.65
Tax rate (%)	25.5	25.5	25.5	25.5
Equity risk premium (%)	6.0	6.0	6.25	6.25
Equity beta	0.7	0.9	0.8	1.0
Cost of equity (post-tax, %)	8.9	10.3	9.4	11.0
Cost of equity (pre-tax, %)	**11.9**	**13.8**	**12.6**	**14.7**
WACC (vanilla, %)	8.1	9.2	8.6	9.7
WACC (pre-tax, %)	**10.3**	**11.7**	**10.9**	**12.1**

Source: Oxera analysis.

It should be noted that the actual uncertainty about the cost of capital is unlikely to be fully captured in the ranges reported above—ie, the 95% confidence interval, for example, is likely to be significantly wider than the presented ranges. This is in order to derive a final range that they can be practically used for setting the price cap.

Choosing a midpoint within the range

There are several reasons why it may be appropriate to set the point estimate of the cost of capital above the midpoints of estimated ranges. These are, in particular, uncertainty of the estimates, and welfare losses of setting the cost of capital at too low a level.

The uncertainty surrounding the individual cost of capital parameters means that it is important to select a point estimate that provides adequate headroom above the mean estimate for the WACC in anticipation of situations in which KPN's actual cost of capital is either already higher than currently estimated, or turns out to be higher in the future.

There is likely to be significant asymmetry in the loss function, with losses arising from under-estimation likely to exceed those from over-estimation. In order to appropriately address this asymmetry, the point estimate in the range should be set above the midpoint.

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1 Introduction

Oxera has been asked by KPN to undertake an independent assessment of its cost of capital. This report presents the results of Oxera's analysis. The objective of the report is to assist OPTA, in the context of its regulatory review, in providing a robust estimate of KPN's cost of capital, which could be used in setting the cap for KPN's wholesale prices. Oxera would be happy to discuss the analysis and conclusions of this report directly with OPTA and its advisers.

Although Oxera has had full access to KPN's relevant financial information and key staff for this analysis, the results presented in this report are independent of KPN's own cost of capital estimates submitted to OPTA.

1.1 Implications of the ongoing turmoil in financial markets

This analysis of the cost of capital is carried out in the context of one of the most severe financial crises in recent decades, and the associated major structural changes made in response to problems in the financial system that have become apparent over the last few months. These fundamental developments pose considerable challenges for the analysis of the cost of raising capital, given that some cost of capital parameters are very high relative to historical averages, while other parameters have exhibited unprecedented volatility.

In this report the cost of capital is estimated using the most appropriate framework from a conceptual point of view, according to which the estimates need to reflect all available forward-looking information. Therefore, where appropriate, the analysis should rely on spot prices reflecting the latest expectations; in this respect past developments (pre-financial crisis) in the financial markets may be of limited use in the cost of capital analysis.

The reliance on spot prices in the cost of capital analysis is appropriate given the assumption that capital markets are efficient. However, where there is limited or no relevant market activity—and hence where the observed prices may not reflect the underlying economic fundamentals—it may be appropriate to rely on short-term averages with an allowance for the fundamental re-pricing of risk (ie, for the fact that prices in the future are very unlikely to revert back to the levels of recent historical means due to fundamental, structural changes in financial markets that have occurred over the past year).

The use of forward-looking information does not represent a fundamental innovation in the cost of capital analysis, but rather a conceptually more appropriate application of the same risk-pricing models under the current market conditions as used by OPTA and its advisers in the past.

1.2 Business and market context

The cost of capital represents the rate of return that investors require as compensation for taking risks. In this respect it is not an abstract concept developed in financial theory, but a reflection of underlying business and market characteristics of the firm. Hence, the estimates of the cost of capital have to be grounded in business analysis in order to capture the key drivers of risks and required returns.

Recent developments in the telecoms markets in Europe indicate that the business risk of telecoms incumbents is increasing. Such developments as increasing competition and the pace of technological change, as well as convergence across technologies, transform

telecoms companies from utility-like monopolists to innovative competitors. From the perspective of investors, necessity to innovate created by market pressures by definition increases the required returns.

Increasing risk of asset-stranding, driven by telecoms companies' search for value and greater reliance on riskier strategies, as well as greater investment requirements created by the technological paradigm shift, further increase required returns of the telecoms companies.

Similarly, individual cost of capital parameters should not be estimated without consideration of broader economic and financial developments. For example, increasing uncertainty in the equity markets by definition has to translate into higher returns required by investors for committing equity capital, which the equity risk premium (ERP) is trying to estimate. In addition, the extent to which recent sharp falls in nominal yields on government bonds is indicative of decreasing required returns on government debt seems limited, given the possibility of recession and higher projected government spending required for funding the special assistance programmes for the financial institutions.

1.3 Implications for the regulatory regime

This report provides an estimate of the nominal cost of capital for KPN, setting out each component of the cost of capital as well as specifying the underlying evidence. The issue of the appropriate treatment of inflation and the choice between the real and nominal cost of capital is addressed in the accompanying Oxera report on the compensation for inflation in the case of KPN.[4]

Under the current regulatory regime, the price cap for KPN's regulated products for a given control period is set on the basis of cost projections at two dates. The first date corresponds to the point in time 18 months prior to the start of the control period; the second date corresponds to the end of the control period. Therefore, the allowed cost of capital needs to be estimated as of these two dates, in line with the other components of the price cap.

Given that the next price control period covers the three years from 2009 to 2011, the cost of capital needs to be estimated as of June 2007 and as of June 2011. These two estimates are then combined using a linear interpolation mechanism to estimate the price cap in each year of the price control.

Over the past 18 months structural changes in financial markets have led to considerable increases in the costs of raising capital for companies across Europe and worldwide. Given the timing of these developments, it appears that the crisis started after the first date at which the cost of capital for KPN needs to be estimated. Thus, from a conceptual perspective, the implications of the financial turmoil would not be captured in the cost of capital as of that date. Furthermore, if some degree of mean reversion in the cost of capital parameters is assumed over the medium-to-long term, the second cost of capital estimate (as of 2011) would also not fully capture the implications of the current crisis.

However, it would not be appropriate to abstract from the impact of the ongoing crisis, given that KPN is, and will have to continue, raising capital at the market rates going forward, given its refinancing requirements.[5] In this report, the first cost of capital estimate is derived as at

[4] Oxera (2008), 'Compensation for Inflation', December 1st.

[5] For example, KPN raised €3.0 billion of debt after the start of the turmoil at the prevailing market price, which was considerably higher than before the onset of the turmoil. Furthermore, several recent bonds issued by European telecoms companies after the start of the turmoil were priced at a much higher yield than before. These include the Deutsche Telecom €250m 20-year bond priced at 8.9%, the Vodafone Group €450m ten-year bond priced at 8.2%, and the France Telecom €500m 20-year bond priced at 8.3%, all of which were priced in November 2008. In order to ensure that KPN complies with its financing policy, equity financing (and not just debt financing) will also have to be raised to fund KPN going forward (eg, retained earnings). This will also have to be undertaken at a higher required rate of return as a result of structural changes in the market.

June 2007 on the basis of the information available at that time, and assuming that prices as of June 2007 incorporate all relevant information.

The second cost of capital estimate is derived according to the most recent information available at the time of the analysis (November 2008), in order to reflect appropriately the implications of the turmoil for KPN's cost of capital and to ensure that the allowed price cap allows investors to earn the appropriate required rate of return, given recent market evidence. This is consistent with the principle of market efficiency and the assumption that all relevant information about the future is already incorporated in the prices observed today.

The current estimate is based on spot rates (where there is sufficient activity at observed market prices) to reflect the forward-looking nature of the cost of capital. A degree of mean reversion is also incorporated in the relevant cost of capital parameters (eg, in the cost of debt). Where there is evidence that market prices may be distorted relative to economic fundamentals, the analysis is based on alternative evidence such as that available before the start of the turmoil (eg, the nominal risk-free rate).

2 Application of the CAPM

This section discusses the application of the capital asset pricing model (CAPM), used to derive the weighted average cost of capital (WACC). OPTA and its advisers have used a similar asset-pricing model in the past.

2.1 Principles of the CAPM

The cost of capital for a company is the appropriately weighted average of different types of capital that it employs. For simplicity, this is often restricted to the cost of debt and the cost of equity weighted by the market value of debt and equity, respectively the weighted average cost of capital.

The pre-tax WACC is calculated according to the following formula:

$$(r_d \times g) + [r_e \times (1 - g)] / (1 - t_c)$$

where:

g = gearing;
r_d = pre-tax cost of debt;
r_e = post-tax cost of equity
t_c = corporation tax rate.

The required return to equity is not directly observable. This report estimates the cost of equity for KPN using the CAPM.[6]

The CAPM is used to estimate the cost of equity where the required return on a given asset is determined by the relative contribution of that asset risk to the risk of the overall market portfolio. The central tenet of this model is that investors hold a broad portfolio of assets so that the idiosyncratic risk of any single asset is diversified away, leaving only the systematic risk component. Therefore, only the systematic risk component is remunerated through the expected return.

According to the CAPM, the required return on an asset is estimated as follows:

$$r_f + \text{MRP} \times \text{beta of the asset}$$

where:

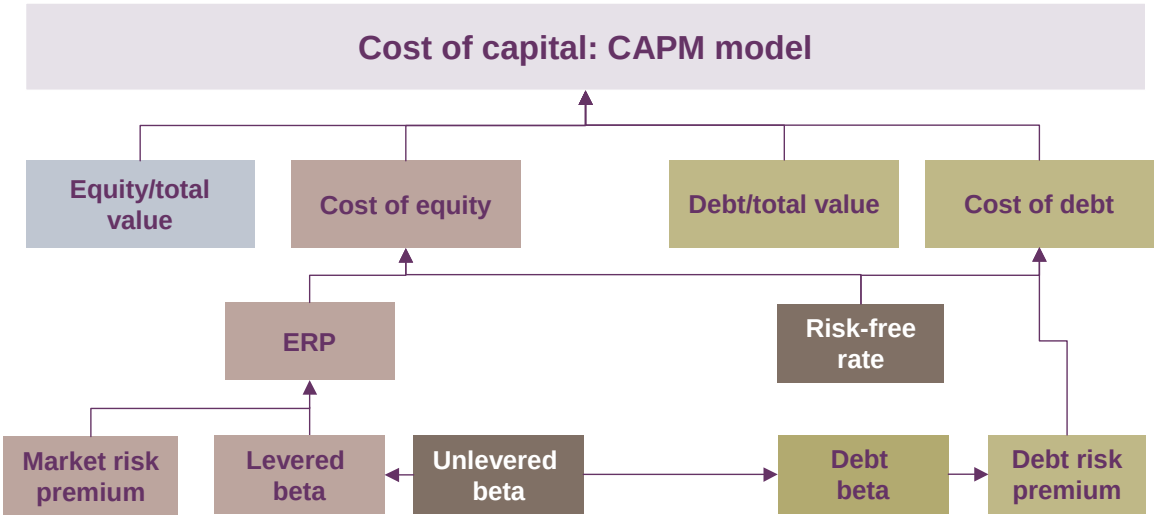
– r_f is the risk-free rate;
– beta is the risk of the asset relative to the market;
– MRP is the market risk premium.

Since KPN's cost of debt can be approximated by the weighted average yield on its debt, which is directly observable, the CAPM does not need to be used to estimate the cost of debt.

[6] The reasons for adopting the CAPM are discussed in section 5.3.

Figure 2.1 presents a stylised illustration of the relationship between the individual cost of capital parameters under the CAPM and WACC.

Figure 2.1 WACC and CAPM



Source: Oxera.

The main parameters in the WACC—gearing, the debt premium and asset beta—are specific to the company being assessed. The other parameters that need to be estimated—the risk-free rate and the ERP—are generic to all applications of the CAPM at any given time.

2.2 Multi-factor models and alternatives to the CAPM

Multi-factor models such as the Fama–French three-factor model or Cahart's four-factor model represent alternatives to the CAPM.[7] The critical difference between the CAPM and the multi-factor models is that the latter allow for more than one risk factor.

Many empirical studies suggest that multi-factor risk models capture the overall risk drivers more effectively and explain assets' returns more accurately than the CAPM model because there are relevant and significant risk factors other than the CAPM's beta that are priced by investors. Nonetheless, robust estimates of multi-factor models are difficult and require a considerable amount of data.

In the case of KPN, the application of multi-factor models is problematic due to the lack of data that would be required to derive robust estimates. Similarly, there appears to be insufficient data to apply multi-factor models in the context of the analysis of comparators, which is one of the approaches used in this report.

Therefore, for the purposes of consistency and robustness, this report uses the CAPM to estimate required returns where direct data on those required returns is not available.

[7] Cahart, M. (1997), 'On Persistence in Mutual Fund Performance', *Journal of Finance*, **52**, 57–82.

3 Risk-free rate

This section discusses the estimates of the nominal risk-free rate.

- **Evidence on nominal yields**. In June 2007 nominal yields on Dutch government bonds with a maturity of five–seven years were on average 4.6%. A similar level of yields was observed for the other top-five countries in the Eurozone. Yields in UK government bonds with a similar maturity were higher—at around 5.8%. Over the period from June 2007 to November 2008, nominal yields on Dutch government bonds fell significantly and reached the level of 3.4%; similar developments were observed in other Eurozone countries and the UK.

- **Evidence on real yields**. In June 2007 real yields for government bonds with a maturity of five–seven years issued by European governments (Italy, France and the UK) were in the range of 2.4–2.7%. Over the period from June 2007 to November 2008 real yields in these countries increased, moving in the opposite direction to nominal yields, and reached the level of 2.7–3.3%.

- **Impact of the ongoing turmoil**. The markets for government debt have been significantly affected by the ongoing financial turmoil. This was reflected in the higher volatility of Dutch nominal yields, which have increased by more than 61% since June 30th 2007 for bonds with a maturity of five–seven years, and lower bid–ask spreads (a proxy measure for liquidity) that have more than tripled over the same period. In addition, in November 2008 the implied nominal yields, based on real yields and independent inflation forecasts, were considerably higher than the observed nominal yields at that date (eg, 4.7% versus 3.4% for France).

- **Final ranges**. The risk-free rate as at June 2007 was 4.5–4.7%, estimated using evidence on nominal and real yields in the Netherlands for the four other largest countries in the Eurozone. The estimated range for the risk-free as of 2011 (approximated using the current estimates as of November 2008) is the same as for 2007 in light of the evidence on potential market inefficiencies at that date, such as limited liquidity combined with large capital movements, high volatility and significant changes in implied inflation.

3.1 Introduction

The prices observed in the market for government debt are typically used as a source of evidence on the risk-free rate. These markets have been significantly affected by the ongoing financial turmoil, where large movements of capital, significant volatility, and varying inflation expectations appear to have had a considerable impact on the evolution of yields.

In this context, there are specific recent developments that are likely to affect the levels and robustness of the price/yield signals observed in these markets.

- **Changes in the shape of the yield curve in some European countries after the onset of the turmoil**. For example, in June 2007 yields for UK nominal government bonds with a 20-year maturity were 80 basis points (bp) lower than the yields of similar bonds with five-year maturity. In November 2008, after the onset of the turmoil, the reverse is observed—five-year bonds are 120bp below 20-year bonds.

- **Movements in nominal and real yields in the opposite direction, leading to significant changes in implied inflation**. For example, over the period from June 2007 to November 2008, nominal yields on French government bonds with a maturity of five–seven years decreased by 120bp, while real yields increased by 30bp, resulting in implied inflation of less than 70bp, which is considerably lower than independent

inflation forecasts, with the latter varying from 190bp to 340bp, depending on the forecast period.[8]

– **Considerable increases in the volatility of yields and reductions in trading liquidity for some government securities**. For example, the volatility of Dutch nominal yields with a maturity of five–seven years has increased by more than 61% since June 30th 2007; similarly, the bid–ask spreads for Dutch nominal bonds, which can be used as a proxy measure for liquidity, have more than tripled.

These developments have been accompanied by higher government expenditure on the special assistance programmes to financial institutions and growing concerns about the long-term strength of the European economy.[9] Together, they pose significant challenges for the analysis of the risk-free rate since the onset of the ongoing financial turmoil.

– First, the evidence on increasing required rates of return for the government bonds obtained from the real markets is not entirely compatible with the developments in nominal markets and independent estimates of actual realised, as well as forecast, inflation.

– Second, the considerable volatility in yields highlights growing uncertainty about the current and future levels of the underlying risk-free rate, while reductions in liquidity associated with the recent reduction in nominal yields suggest that observed prices in government debt markets may not be reflective of the economic fundamentals.

In this report, the current risk-free rate is estimated on the basis of a comprehensive review of evidence on the evolution of real and nominal yields, as well as broader evidence from the global fixed-income markets. More weight has been placed on the estimates derived from the proxies for the real risk-free rate, as explained below.

The risk-free rate as at June 2007 is estimated using evidence on nominal and real yields in the Netherlands, the four other largest countries in the Eurozone (France, Germany, Italy and Spain; the Netherlands is the fifth-largest country by GDP after adjusting for purchasing power parity[10]), and the UK.

The estimated range for the risk-free as of 2011 (approximated using the current estimates as of November 2008) is the same as for 2007.

The remainder of this section is structured as follows:

– sections 3.2 and 3.3 present evidence on nominal yields and real yields (based on index-linked bonds);
– section 3.4 summarises the evidence and reports the final ranges for the risk-free rate used in the cost of capital analysis.

3.2 Risk-free rate estimates from nominal yields

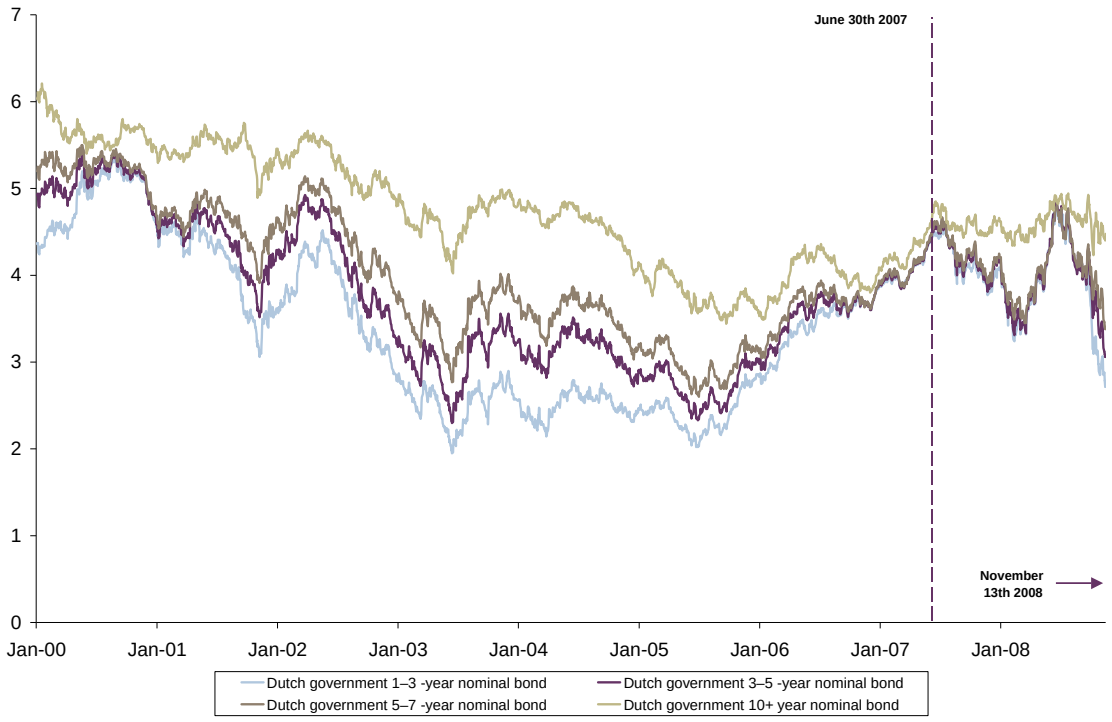
This section presents evidence on nominal yields in the government bond markets from several European countries, used to approximate the risk-free rate.

[8] European Central Bank survey of professional forecasters: Harmonised Index of Consumer Prices forecast: http://www.ecb.int/stats/prices/indic/forecast/html/table_hist_hicp.en.html.
[9] Reuters (2008), 'OECD: Euro Zone to Contract '09—Room for ECB Cuts', November.
[10] The official exchange rate of 2008 is used to produce the rankings by GDP.

3.2.1 Evolution of nominal yields on government bonds

Figure 3.1 shows the evolution of yields for nominal Dutch government bonds over the period from January 2000 to November 2008. The yields as at June 2007 are highlighted in the chart with a vertical line.

Figure 3.1 Evolution of nominal yields for Dutch government bonds (indices, %)



Note: FTSE Global Government Indices are used in this analysis.
Source: Datastream.

As can be seen from the figure, over the period from late 2002 to late 2005, nominal yields were at historical lows. From early 2006 to mid-2007 nominal yields were increasing and by June 2007 have partly reverted from the period of historical lows. The observed evolution of yields until mid-2007 is broadly consistent across different maturities, while that from mid-2007 to the end of 2008 appears more differentiated across maturities.

Table 3.1 shows yields on five–seven-year nominal government securities as at June 30th 2007 and November 13th 2008—the dates used for estimating the risk-free rate in June 2007 and in 2008 (used as a proxy for 2011). The countries shown in the table represent the five largest Eurozone economies and the UK.

Table 3.1 Yields on 5–7-year nominal government securities' index (%)

	The Netherlands	Germany	France	Italy	Spain	UK
June 30th 2007	4.6	4.6	4.6	4.7	4.6	5.8
November 13th 2008	3.4	3.1	3.4	4.2	3.6	3.7

Source: Datastream.

According to Table 3.1, yields on government bonds in June 2007 in selected countries ranged from 4.6% to 5.8%. By November 2008, the yields had declined significantly, and ranged from 3.1% to 4.2%. Tables A1.1 and A1.2 in Appendix 1 show similar evidence for bonds with other maturities.

This evidence indicates that there was relatively little difference between yields on different maturities in June 2007 (ie, the yield curve was relatively flat), but by November 2008 the yield curve had become upward-sloping, such that bonds with shorter maturities exhibited significantly lower yields than those with longer maturities. This is because yields on shorter maturities have fallen significantly since June 2007, while those on longer maturities have remained relatively stable.

Table 3.2 presents forward yields for Dutch government bonds in November 2008.

Table 3.2 Three-year forward rates on Dutch nominal government bonds as at November 13th 2008

Maturity	Three-year forward rate (%)
5-year	4.3
7-year	4.5

Source: Bloomberg and Oxera analysis.

The evidence on forward yields indicates that the implied yields in 2011 (with a maturity of five–seven years: 4.3–4.5%) will be higher than the current spot yields (3.4%) and closer to spot rates in June 2007 (4.6%). This evidence is consistent across the top five Eurozone countries and the UK.

3.2.2 Choice of maturities for the analysis of the risk-free rate

The yield curves as at June 30th 2007 were relatively flat for countries considered in this analysis. This means that the estimates of the risk-free rate as at June 2007 would not differ significantly depending on the choice of maturity. In November 2008, the yield curve was sharply upward-sloping, which suggests that the estimates of the risk-free rate based on shorter maturities would be lower than those based on longer maturities. Dutch yield curves as at these two dates are shown in Figure A1.3 in Appendix 1.

When choosing which bonds to use in the analysis of the risk-free rate as the best proxy, it might be more appropriate to compare the duration of the bond with the life of the assets of the regulated company than to focus on the length of the regulatory review. The former implies that the company can adopt some asset-liability-matching and thereby minimises the regulator's implicit involvement in the company's corporate financial management. It also allows for the profile of allowed revenues to be linked to the duration of the underlying assets.

The duration of KPN's assets is approximately six years.[11] This suggests that it may be appropriate to focus on bonds with a maturity of approximately six years in the analysis of the risk-free rate.

3.2.3 Volatility and trading liquidity of yields

The evolution of nominal yields since June 2007 needs to be considered in the context of broader developments in financial markets. The months of June to August 2007 represent the starting point of the financial turmoil. This poses considerable challenges for interpreting the evidence on prices and yields from these markets at that time. In particular, two factors might need to be taken into account in this respect: volatility of yields and trading liquidity.

[11] The duration of an asset is a measure of how long, on average, the holder of the asset has to wait before receiving cash payments. For example, a zero-coupon bond that matures in n years has a duration of n years. However, a coupon bond maturing in n years has duration of less than n years. This is because the holder receives some of the cash payments prior to year n. In this report, duration of KPN's assets (six years) is estimated using a stylised model, which assumes that the useful economic life of KPN's assets is approximately 15 years, and that the invested capital is repaid according to straight-line depreciation (in line with the regulatory regime). In this model the Macaulay duration is estimated.

There has been a significant increase in the volatility in capital markets over the past year. Figure A1.1 in Appendix 1 shows the evolution of volatility of nominal yields for Dutch nominal bonds with 5–7-year maturity, as measured by the six-month rolling standard deviation of first differences. The figure indicates that, from June 2007 to November 2008, the volatility of nominal yields increased by more than 60%. Higher volatility of yields highlights increasing uncertainty about the true current and future level of the underlying risk-free rate and the challenge of estimating this parameter from market data.

In addition to observed volatility, there have been marked decreases in the trading liquidity of Dutch nominal gilts, as measured by the bid–ask spread. Figure A1.2 in Appendix 1 shows that, since August 2007, the onset of the financial turmoil, the bid–ask spread for a ten-year Dutch nominal bond has increased significantly. Similarly, after September 2008, when nominal yields were falling sharply, the bid–ask spread was high as well as volatile, implying lower trading liquidity. As lower trading liquidity indicates that the market price might not reflect the underlying fundamentals, it seems that the recent spot evidence on nominal yields may not represent a robust basis for setting the risk-free rate.

Overall, it is not clear that the evolution in nominal yields since the onset of the turmoil reflects the economic fundamentals.

3.2.4 Inflation risk premium

When estimating the risk-free rate on the basis of nominal yields, it is important to consider the inflation risk premium (IRP). The main concern in relation to the IRP is that it may be included in yields on nominal government bonds. This would mean that nominal yields do not represent a 'truly' risk-free rate from a conceptual perspective, given exposure to inflation risk. At the same time, the final cost of capital estimate may overcompensate for the IRP, as it may also be included in the ERP.

The financial literature suggests that the IRP estimates are highly uncertain and sensitive to the underlying assumptions. For example, Buraschi and Jiltsov (2005) find that an average US inflation risk premium is 70bp,[12] whereas D'Amico, Kim and Wei (2008) find a relatively stable ten-year inflation premium of around 50bp (although their results are highly sensitive to the dataset used).[13] It is likely that both nominal and index-linked bonds contain some element of the IRP. Therefore, the estimates of the risk-free rate based on the index-linked bonds might also be skewed due to the presence of the IRP.

3.3 Nominal risk-free rate estimates from real yields and inflation forecasts

This section considers the evidence on real yields to supplement the evidence on nominal yields.

The estimates of the risk-free rate based on nominal yields can be compared with the estimates derived on the basis of real yields and inflation expectations (as discussed in section 3.2). This approach would not include any IRP that may be contained in nominal yields over and above real yields. Consistent results indicate that the final estimates of the risk-free rate are unlikely to be biased by the IRP.

[12] Buraschi, A. and Jiltsov, A. (2005), 'Inflation Risk Premia and the Expectations Hypothesis', *Journal of Financial Economics*, February.
[13] D'Amico, S., Kim, D. and Wei, M. (2008), 'Tips from TIPS: The Informational Content of Treasury Inflation-protected Security Prices', BIS Working Papers.

3.3.1 Evolution of real yields on government bonds

Figure 3.2 shows the evolution of real yields (across all maturities) for France and the UK. These countries have been selected as relevant comparators because data is available on the index-linked bonds over a sufficiently long period.[14]

In general, the evidence on observed real yields to June 2007 shows a pattern similar to that observed for nominal yields. However, unlike nominal yields, which are currently trading below their June 2007 levels, the real yields have not decreased since June 2007, although they did decrease over the months following June 2007.

Figure 3.2 Evolution of real yields for French and UK index-linked bonds (%)

Source: Bloomberg and Oxera analysis.

Table 3.3 shows the spot yields as at June 30th 2007 and November 13th 2008 on index-linked government bonds with a maturity of five years for Italy, France and the UK. Of the sample of countries considered in section 3.2, only Italy, France and the UK appear to have issued index-linked bonds.[15] Table A1.3 in Appendix 1 includes the data for other maturities.

Table 3.3 Yields on five-year inflation-linked government bonds (%)

Date	Italy[1]	France[2]	UK[3]
Spot June 30th 2007	2.5	2.4	2.7
Spot November 13th 2008	3.3	2.7	3.2

Notes: [1] BTPS 1.85 09/15/12 for June 30th 2007, BTPS 2.15 09/15/14 for November 13th 2008. [2] FRTR 3 07/25/12 for June 30th 2007, FRTR 3 07/25/12 for November 13th 2008. [3] UKTI 2.5 08/23/11 for June 30th 2007, UKTI 2.5 08/16/13 for November 13th 2008.
Source: Bloomberg and Oxera analysis.

[14] Figure A1.4 in Appendix 1 shows the index-linked yields for Germany, Italy, France and the UK for a shorter time period.
[15] There are also German index-linked bonds; however, the data on yields for German bonds is not available in the financial databases used in this report (ie, Bloomberg and Datastream).

Table 3.3 indicates that yields on index-linked bonds in Italy, France and the UK were in the range of 2.4% to 2.7% in June 2007 and are currently in the range of 2.7% to 3.3%.

3.3.2 Independent inflation forecasts and derived nominal yields

The observed real yields could be used to provide an independent estimate of the nominal risk-free rate in the case where the estimates of the (nominal) risk-free rate based on observed nominal yields might not be robust, as explained above.

The process of estimating the nominal risk-free rate from observed real yields requires up-rating the real yields by a forecast rate of inflation of an appropriate maturity.

The rate of inflation implied by the difference in the observed real and nominal yields would not offer an independent estimate, and would suffer from similar potential distortions as the nominal yield. For example, in the UK, the implied inflation derived from real and nominal three-year government bonds as at November 13th 2008 was around –0.3%. This compares with an independent inflation projection in November of approximately 2.8% for comparable maturities.[16]

Instead of the inflation rate implied by the difference between nominal and real yields, the inflation rate from the European Harmonised Index of Consumer Prices (HICP) can be used for bonds issued by European governments. In this context it is used to up-rate both the Italian and French index-linked securities. For the UK, the relevant inflation rate is the UK retail price index (RPI).[17] In June 2007 the medium-term inflation forecasts for the HICP and UK RPI were 1.9% and 2.8%, respectively; in November 2008 the forecasts were 2.0% and 2.8%. [18]

Table 3.4 shows the estimated nominal yields from up-rating the real yields presented in Table 3.3 using the appropriate measure of forecast inflation.

Table 3.4 Implied nominal yields from five-year index-linked government bonds (%)

Date	Italy	France	UK
June 30th 2007	4.5	4.4	5.5
November 13th 2008	5.4	4.7	6.1

Note: The additions in this table have been carried out using Fisher's equation where (1 + nominal yield) = (1+ real yield) * (1 + inflation rate).
Source: Eurostat, Bank of England, Bloomberg and Oxera analysis.

The implied nominal yields as at June 30th 2007 are very close to the yield data presented in Table 3.1 for all three countries. This pattern is not repeated for the yields as at November 2008. For Italy and France, the implied nominal yield is just above one percentage point higher than the observed nominal value at that date. This difference is even more noticeable in the UK, where the estimated nominal rate stands at some 2.4% higher than the market yield as at November 13th 2008.

This analysis suggests that while the implied nominal yields calculated in June 2007 are similar to the observed market yields from that date, this is not the case for November 2008. More specifically, the nominal yields observed in the market in November 2008 are considerably lower than those derived using real yields and combined with an independent

[16] See, for example, Bank of England (2008), 'Inflation Report', November, p. 47, Table 1. The forecast for RPI has been calculated by using the forecast for the Consumer Price Index (CPI) (2%) and adding the historical differential between CPI and RPI (0.8 percentage points).
[17] European Commission (2006), 'Quarterly note on the Euro-denominated Bond Market', June.
[18] Eurostat: http://www.ecb.int/stats/prices/indic/forecast/html/table_hist_hicp.en.html.

inflation forecast. This suggests that the observed nominal yield might be a biased (downwards) estimate of the underlying nominal risk-free rate.

3.4 Final range

This section summarises the evidence presented above and derives the final estimate of the risk-free rate.

3.4.1 Risk-free rate in June 2007

The estimated range for the nominal risk-free rate used in the analysis of the cost of capital as of June 2007 is 4.5–4.7%. The midpoint of this range is based on nominal yields on Dutch government bonds in June 2007 as well as nominal yields on bonds of several European countries, which are listed in Table 3.1. As discussed in section 3.2, more weight is placed on yields for bonds with medium-term maturity of five–seven years, in line with the evidence on the duration of KPN's assets.

3.4.2 Current risk-free rate estimates

The analysis presented above suggests that the recent evidence on real yields may provide a more robust indication of the evolution of the risk-free rate than the evolution of the nominal yields.

More specifically, decreases in nominal yields might reflect market inefficiencies, such as limited liquidity combined with large capital movements. Significant reductions in the trading liquidity associated with recent decreases in nominal yields indicate that the observed market signals in this context may not be reflective of the fundamentals. Furthermore, inconsistency across implied levels of inflation (at different maturities) from prices in capital markets, currently observed inflation, and independent inflation forecasts, suggests that the current spot nominal yields may be biased.

The concerns over the state of the European economy expressed by market participants, as well as significant government spending, suggest that the underlying required return on government bonds has increased. In addition, the upward-sloping nominal yield curve suggests that the market is pricing in higher nominal yields in the future.[19]

At the same time, there is some uncertainty about the robustness of the price signals reflected in the real yields. A recent increase in real yields can be attributed, at least in part, to the reversal of depressed real yields observed during the past year.

High uncertainty around the current real and nominal spot yields suggests that any particular observation is a realisation of a highly uncertain process. Caution is therefore required when relying on very high or very low values at any specific point in time.

In light of this evidence, the proposed range for the current risk-free rate is the same as in June 2007—ie, 4.5–4.7%.

It should be noted that using the same range for the cost of debt in November 2008 as that used for June 2007 seems to represent a conservative approach, given that some evidence suggests that the underlying required rate of return on government debt has increased as a result of the turmoil.

[19] The yield curves for the Dutch government as at June 2007 and November 2008 are shown in Figure A1.3 of Appendix 1. The figure shows that both curves are upward-sloping, suggesting that yields for longer maturity bonds are higher than yields for shorter-term bonds.

4 Cost of debt and gearing

This section estimates the cost of debt and gearing for KPN, which are used to estimate the cost of capital.

- **Evidence on yields on KPN's debt**. The weighted average trading yield for KPN's bonds in June 2007 was 5.7%. The evidence from primary and secondary markets suggests that after this period the cost of debt for KPN increased considerably, in line with the impact of the financial market turmoil. Similar evidence can be observed for other European telecoms companies. The current weighted average trading yield on KPN's bonds (analysed as at November 13th 2008) is 7.0%.

- **Treatment of embedded debt**. Significant increases in KPN's cost of debt observed after the onset of the turmoil mean that the forward-looking required return on KPN's debt would differ from the rates locked in by KPN at previous issues. In the regulated context, embedded debt poses particular challenges in terms of both consistencies across economic cycles and across regulatory periods, as well as in terms of ensuring that the company faces appropriate incentives to choose an efficient financing structure, while limiting regulatory intervention in its corporate finance policy. In line with these considerations, this report places more weight on the evidence of spot yields at the time of the analysis than on the cost of embedded debt.

- **Transaction costs of issuing debt**. These represent a component of the cost of debt in addition to the interest costs captured by yields and spreads. The estimated transaction costs for KPN range between 12bp and 22bp as at June 2007, and from 11bp to 24bp as at November 2008. The midpoint of these ranges (17bp) is included in the estimates of the cost of debt.

- **Final ranges for cost of debt**. The estimated range for the cost of debt (net of transaction costs) as of November 2008 is 6.5–7.2%. The lower end is based on the yield at issue for bonds issued after the onset of the turmoil with maturity similar to the average maturity of KPN's bonds. The fact that KPN issued debt at these high yields is indicative of market activity that was sufficient to ensure that these market prices reflect economic fundamentals. The upper end is based on the trading yields for these bonds in November 2008. Given the midpoint estimate for the transaction costs of 17bp, the range for the all-in cost of debt in November 2008 is 6.7–7.4%. As at June 2007 the range for the cost of debt (net of transaction costs) is 5.3–6.6%, consistent with the evidence on average yields to maturity of KPN's bonds at that time, as well as on the yield to maturity for the most recently issued bonds as at June 2007. The range for the cost of debt including transaction costs is 5.5–6.8% based on a midpoint estimate of transaction costs of 17bp.

- **Final ranges for gearing**. The range for the forward-looking gearing in November 2008 is 30–35%. The upper end of the range reflects a spot estimate in Q3 2008 (35%), while the lower end reflects the average over the four quarters preceding Q3 2008 (32%). Given high volatility in the equity markets, spot estimates of gearing at a given date are highly uncertain. Hence, it is not appropriate to set the forward-looking gearing at present with reference to recent spot estimates (eg, in November 2008)—in particular, given that recent increases in gearing have been driven largely by developments in equity markets. The range from 30% to 35% is also consistent with KPN's long-term financing policy. The range for the forward-looking gearing in June 2007 is 25% to 30%. The lower end of this range reflects the spot estimates of gearing as at June 2007 (24%), while the upper end reflects the average gearing over the four quarters preceding June 2007 (27%).

4.1 Impact of financial turmoil on debt markets

The ongoing financial turmoil has significantly increased the cost of debt financing and, in some cases, made such funding unavailable to European companies. In this respect, the current situation poses a significant challenge to all companies in terms of raising funding for their ongoing activities and for financing new investments.

In addition to the observed increases in the cost of raising debt of all forms (where such debt funding is in fact available), major structural problems in the financial system have become

apparent over the past year. The conditions of financial institutions—banks in particular—have deteriorated sharply, with significant implications for the availability of credit.

The deterioration in market conditions has led to large losses on loans, growing capital requirements (which many institutions are unable to meet), and a significant increase in funding costs, which the banks have started to pass on to their customers. As such, the difficulties faced by financial institutions have direct implications for the funding of corporates, reducing their ability to access financing, and significantly increasing the risk premiums required by investors to commit any form of capital.

The recent developments in the financial services sector also demonstrate that the ongoing turmoil might be one of the most severe crises to affect the entire financial system in recent decades. The financial institutions that provide credit are faced not only with a combination of large and growing write-downs on their assets, a lack of liquidity, and the loss of consumer confidence, but also with a fundamental revision of the underlying business models adopted for the provision of various forms of funding—eg, structured finance—that were associated with the benign conditions in debt capital markets between 2003 and early 2007.

All of the above events have initiated the process of de-levering of the portfolios of financial institutions and investors, which has led to a decrease in the total amount of funding available to corporations.[20] This has been accompanied by the expected contraction of the European economy and the possibility of a prolonged recession, which could result in a further deterioration of the financial positions of banks and corporates. It is unclear how these processes could, in any way, be reversed in the short term.

4.2 The cost of debt for KPN: introduction

There is consistent evidence from primary and secondary debt markets that the cost of debt for KPN has increased recently, in line with the impact of the financial market turmoil. The spot yields on KPN's bonds increased over the period from June 2007 to November 2008 by on average of 130bp. Over the same period, trading spreads increased by 300bp. This is consistent with the evidence on the rising cost of debt for other European telecoms companies.

These observations are supported by evidence from primary markets. For example, the yield at issue for KPN's bonds issued after the onset of the turmoil, but before the most recent increases in the cost of debt, was already 130bp higher than that for bonds issued before the onset of the turmoil.

It could be argued that a form of mean reversal might eventually occur in debt markets, even if this is not currently reflected in the evolution of market prices, simply because the current situation might not be sustainable in the long run. At the same time, it does not appear reasonable to expect that the prices would revert back to the levels of the benign market conditions that characterised the period immediately before the financial turmoil, nor that the method of pricing the credit risk, or the prices themselves, will return to the pre-crisis levels, as the previous models have been found to be unsustainable. At the very least, market participants are expected to correct the fundamental mispricing of risk that appears to have characterised prices in debt capital markets before the market turmoil.

Overall, this suggests that the recently observed increases in the cost of debt might persist for some time, and eventually only partly revert to the levels observed before the financial turmoil.

[20] See, for example, *The Economist* (2008), 'Deleveraging: A Fate Worse than Debt', September 25th, http://www.economist.com/finance/displayStory.cfm?source=hptextfeature&story_id=12306060.

The remainder of the section is structured as follows:

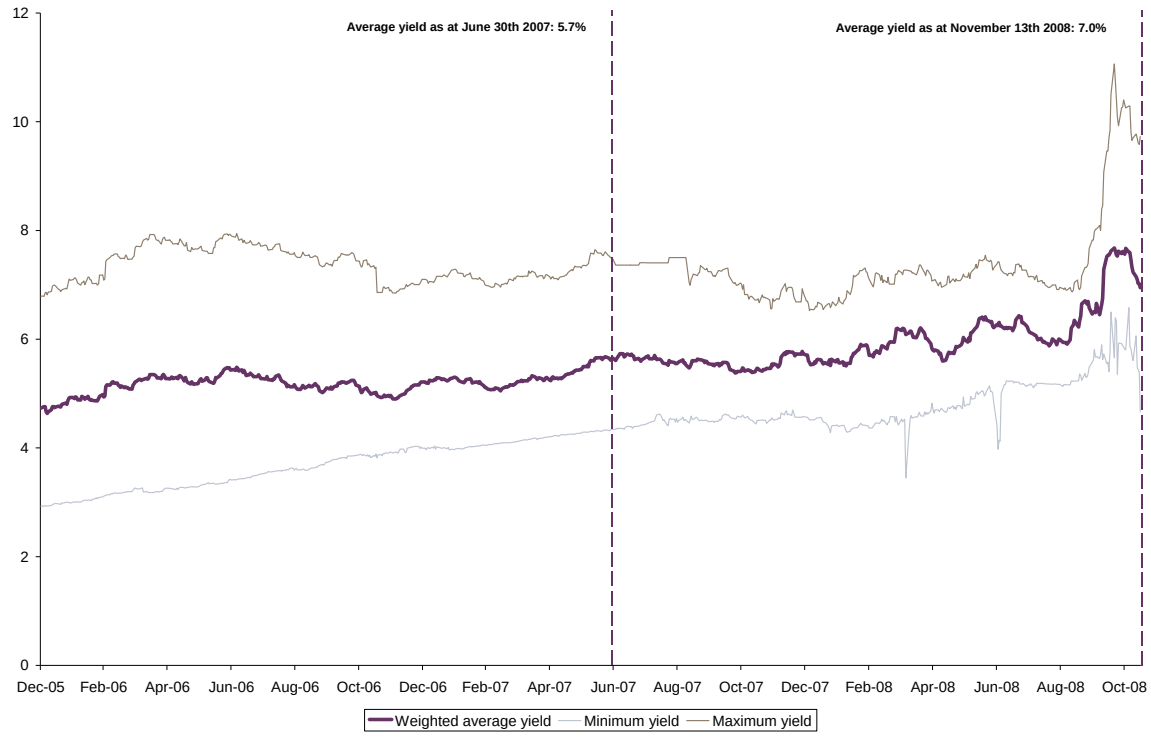
– section 4.3 shows the estimates of yields and spreads for KPN bonds used as the basis for the analysis of the cost of debt;
– section 4.4 shows the analysis of the transaction costs of issuing debt (ie, underwriting fees, arrangement fees, legal and rating fees) that are included in the estimates of the cost of debt;
– section 4.5 discusses the estimates of gearing;
– section 4.6 summarises the evidence and reports the final ranges for the cost of debt and gearing.

4.3 Estimates of yields and spreads

The evidence on the evolution of yields in spreads for KPN's bonds shows clearly that the cost of debt for KPN has increased significantly over the past year, and over recent months in particular.

Figure 4.1 shows the evolution of yields on KPN's bonds over the period from December 2005 to November 2008. The average increase across all outstanding bonds amounts to 136bp, while the maximum increase was 210bp.[21]

Figure 4.1 Yields on selected KPN bonds (%)



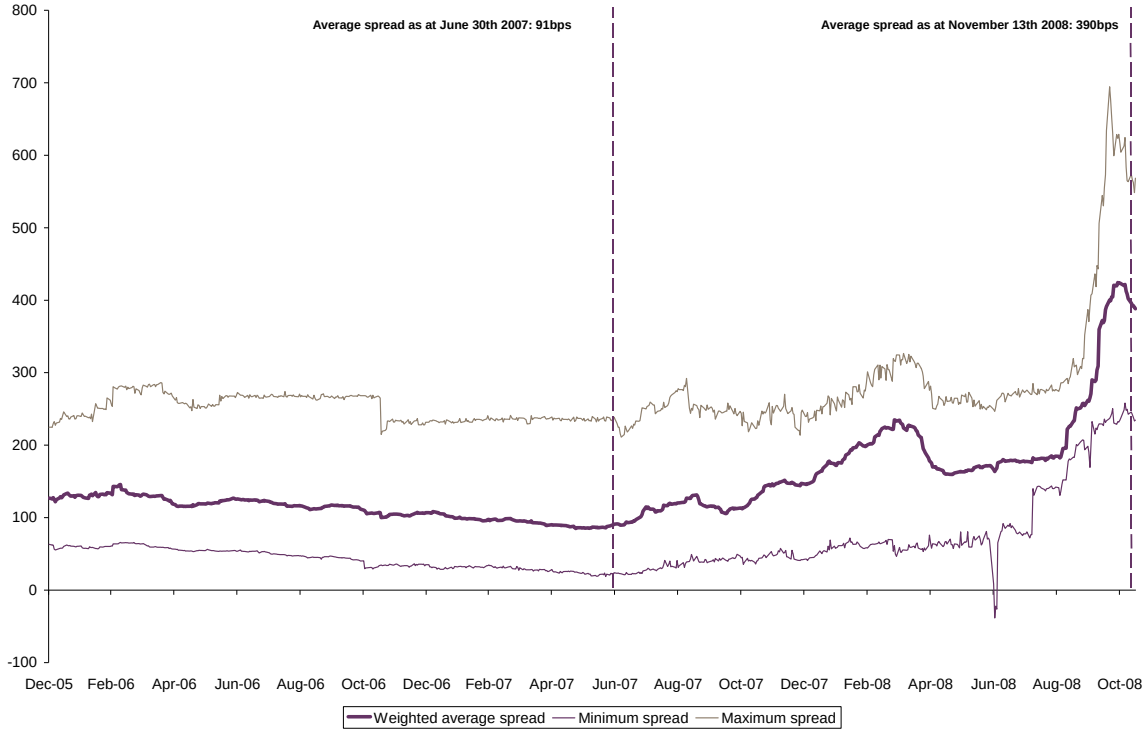
Note: The minimum and maximum yields represent, at any point in time, the highest and the lowest yield on the selected bonds.
Source: Datastream and Oxera analysis.

Figure 4.2 shows the evolution of spreads over the same period. The increases in spreads appear to have been more significant than those in yields, reflecting in part reductions in the

[21] Increases are based on changes in yields between June 30th 2007 and November 13th 2008. The bond with the maximum increase was the US$-denominated October 2030 bond. This compares with 188bp as the largest increase on euro-denominated bonds, which was observed on the January 2017 bond.

underlying benchmark. The average increase in spreads was 299bp, while the maximum increase was 327bp.[22]

Figure 4.2 Spreads on selected KPN bonds (bp)



Note: The minimum and maximum yields represent the highest and the lowest yield on the selected bonds at any point in time.
Source: Datastream and Oxera analysis.

Primary markets provide similar evidence on the evolution of yields and spreads. Table 4.1 shows yields and spreads at the time of issue for two similar bonds issued by KPN, where one bond was issued before and the other was issued after the onset of the financial turmoil.

Table 4.1 Impact of the turmoil on KPN yields and spreads at issue

	Issue date	Maturity	Coupon (%)	Amount issued (€m)	Offer price	Yield to maturity at issue (%)	Spread at issue (bp)	Rating at issue
Before	May 07	May 14	4.75	650	98.97	4.9	56	BBB+
After	Sept 08	Sept 13	6.25	850	99.93	6.3	269	BBB+
Difference						**+1.3**	**+213**	

Source: Dealogic, Datastream and Oxera analysis.

As can be seen from Table 4.1, the observed yield at issue has increased by approximately 130bp.

[22] Increases are based on changes in spreads between June 30th 2007 and November 13th 2008. The bond with the largest increase was the euro March 2013 bond.

4.3.1 Estimates of the forward-looking cost of debt

The appropriate cost of debt that should be used in the analysis of the cost of capital is the forward-looking rate of return required by investors. However, in any given year, the actual cost of debt that the company will pay to its creditors may be different from the required rate of return on its debt owing to the impact of existing (embedded) debt issued in the past at historical yields.

Significant increases in KPN's cost of debt observed after the onset of the turmoil mean that estimates of the forward-looking required return on KPN's debt would differ from the rates locked in by KPN at previous issues (ie, the cost of embedded debt).

The cost of embedded debt is measured as the yield to maturity at issue for each outstanding bond. The cost of new debt is estimated by assuming that the new bonds are issued at the average spot yield on all outstanding KPN bonds at the time of the analysis.

The current weighted average cost of KPN's embedded debt (analysed as at November 13th 2008) is 5.4%; the average spread is 134bp over the relevant benchmark for each bond, as detailed in Table 4.2. This is lower than the average current trading yield (7.0%) and spread (390bp). The latter provide the estimates of the forward-looking required rate of return on debt issued by KPN.

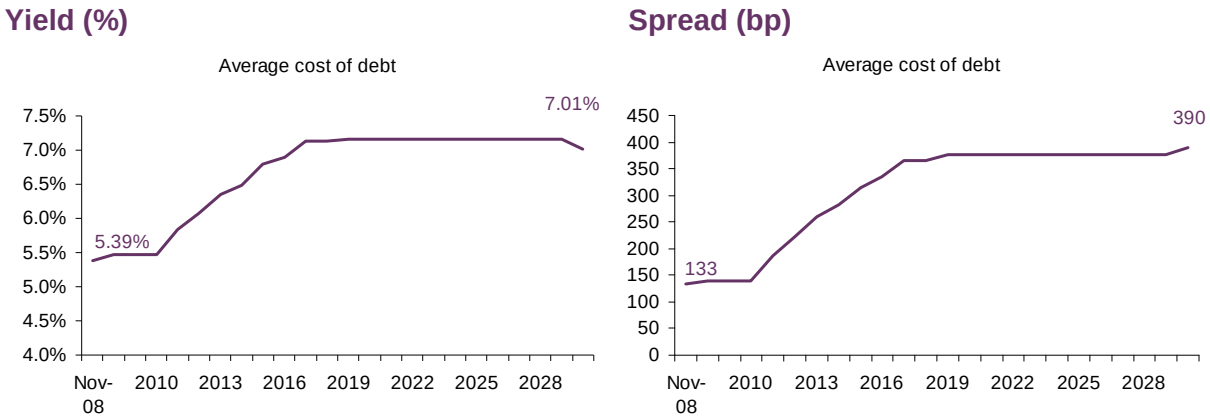
Table 4.2 Yields and spreads on KPN bonds (November 13th 2008)

Issue date	Maturity	Years to maturity	Yield to maturity at issue	Yield to maturity Nov 2008	Spread at issue	Spread at Nov 2008
Sept 00	Oct 30	21.9	8.6%	9.6%	240	549
July 04	July 11	2.7	4.6%	5.9%	70	350
June 05	June 15	6.6	4.1%	6.9%	81	371
Mar 06	Mar 13	4.3	4.6%	6.6%	103	388
Mar 06	Mar 16	7.3	5.8%	7.4%	147	350
Nov 06	Jan 17	8.2	4.8%	7.3%	105	390
May 07	May 14	5.5	4.9%	6.7%	56	375
May 07	May 19	10.5	6.3%	7.8%	109	356
Nov 07	Nov 12	4.0	5.2%	6.5%	115	383
Mar 08	Jan 16	7.2	6.5%	7.2%	272	391
Sept 08	Sept 13	4.8	6.3%	6.6%	269	376
Weighted average			**5.4%**	**7.0%**	**134**	**390**

Note: Averages exclude the October 2010 bond owing to inaccurate market yield data, and the July 2009 floating rate bond owing to missing data on yields to maturity at issue.
Source: Oxera analysis based on Dealogic and Datastream information.

The evolution of the weighted average cost of debt for KPN, which takes full account of the cost of embedded debt, is illustrated in Figure 4.3. Here, it is assumed that the maturing debt is refinanced at the market rates (ie, with a yield to maturity of 7.0% and spread of 390bp).

Figure 4.3 Projected average cost of debt (by refinancing maturing bonds at November 2008 average yield or spread)



Source: Oxera analysis based on Dealogic and Datastream information. Daily spread data is obtained from Datastream, and spread at issuance is obtained from Datastream and Dealogic.

As shown in Figure 4.3, the estimated yield (spread) evolves from the initial average cost of 5.4% (133bp) to 7.0% (390bp) in 2030 after all bonds have been refinanced. It is also useful to consider the range of yields and spreads for bonds with maturity corresponding to the average maturity of all bonds outstanding. As such, the estimated yield evolves from the initial range of 5.0–5.8% to 6.6–7.4% in 2030 after all bonds have been refinanced. The range for the spread evolves from 93–134bp in 2008 to 350–391bp in 2030.[23]

These ranges take full account of the cost of embedded debt, given that yields and spreads on existing debt are included in the averages every year, and that only new debt issued by KPN to refinance the maturing debt attracts the current yield and spread.

4.3.2 Treatment of embedded debt

As shown above, the forward-looking required rates of return on debt exceed historical yields and hence the cost of embedded debt. However, when estimating the cost of capital, it would not be appropriate to use the cost of embedded debt at issue.

In the regulatory context, embedded debt poses particular challenges in terms of both consistency across economic cycles and across regulatory periods, as well as in terms of ensuring that the company faces appropriate incentives to choose an efficient financing structure, while limiting regulatory intervention in its corporate finance policy.

In line with these considerations, this report places more weight on the evidence of spot yields at the time of the analysis than on the cost of embedded debt.

The use of embedded debt is not consistent with the forward-looking nature of the cost of capital review, the determination of other cost of capital parameters, or the expectations that the company might have acted upon when raising debt in the past. In contrast, the use of current market rates to reflect the cost of raising a marginal amount of debt from the market today typically ensures 'ex ante consistency'. This approach has several advantages in that it:

– accurately reflects current debt market conditions;
– reflects the market risk assessment for a particular asset and credit rating;
– limits regulatory interference in financing decisions;

[23] The upper and lower bound are based on the maximum and minimum yield (or spread) of bonds maturing between 2013 and 2017 (corresponding to a two-year interval around the average maturity of the bonds).

– provides an incentive to raise debt capital in the most efficient manner.

Furthermore, regulated businesses differ from non-regulated businesses in that their revenue-generation capacities are linked to the cost of capital through the effect of the allowed rate of return on the regulated price cap. Therefore, if the regulator were to use the cost of embedded debt as a measure of the overall cost of debt, the estimated cost of financing would be offset by a higher revenue allowance. This would result in the actual cost of debt being passed through to the allowance. In the extreme case, under this approach, the company might be indifferent to the gap between its actual cost of debt and the current market rates.

In contrast, using the market rates for the cost of debt estimates provides an incentive for the company to outperform the current market rates—ie, to achieve the lowest possible financing costs, which is economically efficient. In other words, while the company is not rewarded for inefficient financing decisions, the approach allows it to retain the benefits of its corporate financial management when successfully outperforming the market.

4.3.3 Yields and spreads in June 2007

The weighted average trading yield to maturity on KPN's debt in June 2007 was 5.7% and the corresponding spread was 91bp. This is similar to the cost of embedded debt. The weighted average yield at issue for KPN's bonds outstanding in June 2007 was 5.2% and the spread was 109bp (see Table 4.3).

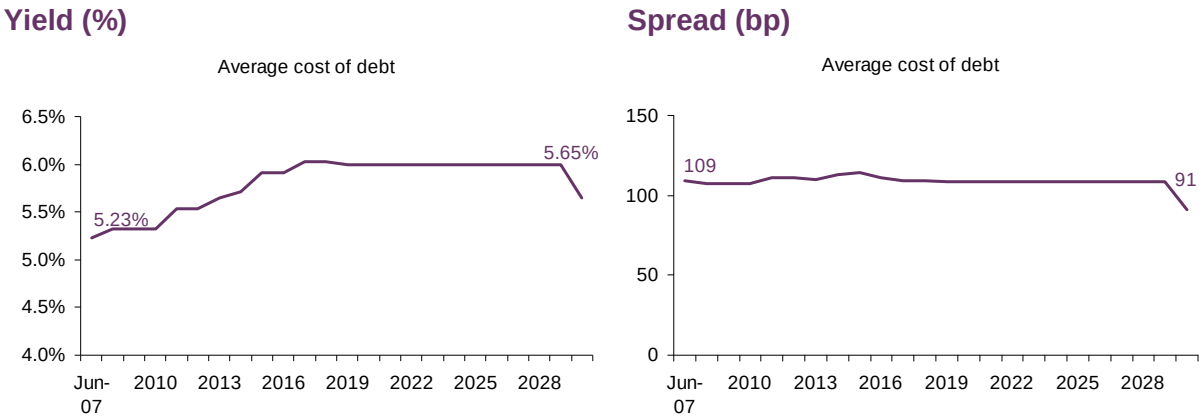
Table 4.3 Yields and spreads on KPN bonds (June 30th 2007)

Issue date	Maturity	Years to maturity	Yield to maturity at issue	Yield to maturity June 2007	Spread at issue	Spread at June 2007
Feb 99	Nov 08	1.4	4.3%	4.7%	71	24
Oct 00	Oct 30	23.3	8.6%	7.5%	240	239
Apr 01	Apr 08	0.8	8.3%	6.2%	325	14
July 04	July 11	4.1	4.6%	5.2%	70	64
June 05	June 15	8.0	4.1%	5.5%	81	98
Mar 06	Mar 13	5.7	4.6%	5.2%	103	61
Mar 06	Mar 16	8.7	5.8%	6.5%	147	104
Nov 06	Jan 17	9.6	4.8%	5.4%	105	87
May 07	May 14	6.9	4.9%	5.3%	56	69
May 07	May 19	11.9	6.3%	6.6%	109	118
Weighted average		**8.2**	**5.2%**	**5.7%**	**109**	**91**

Note: Averages exclude the October 2010 bond owing to inaccurate market yield data, and the July 2009 floating rate bond owing to missing data on yields to maturity at issue.
Source: Oxera analysis based on Dealogic and Datastream information.

The weighted average cost of debt for KPN going forward, which takes into account the impact of the existing debt, is illustrated in Figure 4.4. It is assumed that all debt maturing at a given point in time is refinanced at the latest market rates (ie, 5.7% and 91bp, which are the average yield and spread as at June 2007).

Figure 4.4 Projected average cost of debt (by refinancing maturing bonds at June 2007 average yield or spread)



Source: Oxera analysis based on Dealogic and Datastream information.

As shown in Figure 4.4, the estimated yield (spread) evolves from the initial average cost of 5.2% (109bp) to 5.7% (91bp) in 2030 after all bonds have been refinanced. It is also useful to consider the range of yields and spreads for bonds with maturity corresponding to the average maturity of all bonds outstanding. As such, the yield evolves from the initial range of 4.7–6.1% (which represents the cost of existing debt) to a range of 5.1%–6.5% in 2030, once all bonds have been refinanced. The range in the spread moves from 79bp–122bp in 2007 to 61bp–104bp in 2030.

4.4 Transaction costs of debt issuance

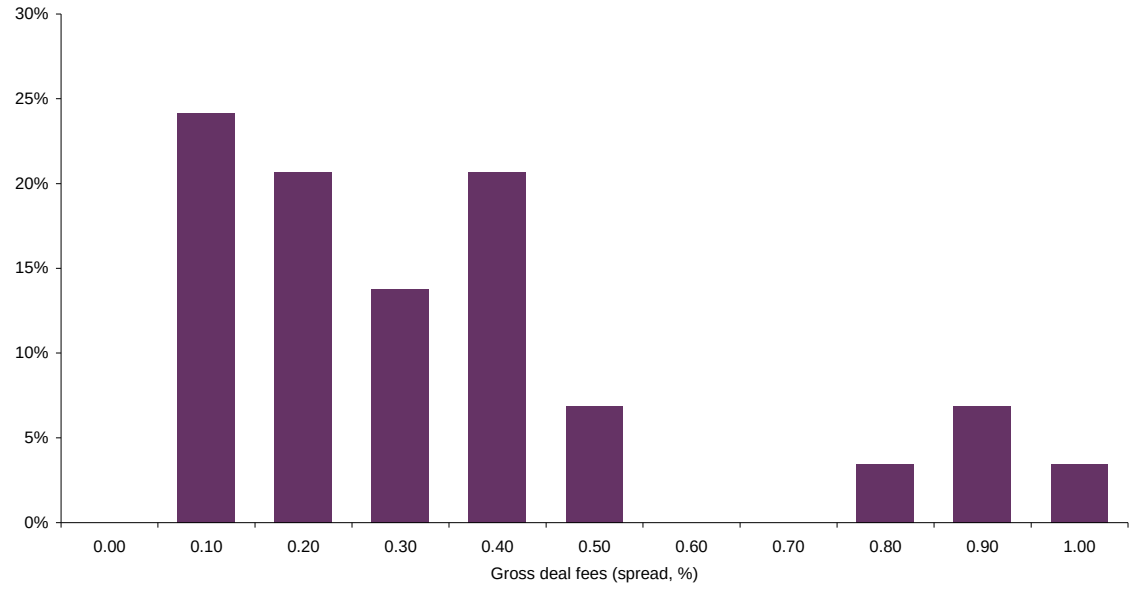
The transaction costs of issuing debt represent a component of the cost of debt in addition to the interest costs captured by yields and spreads. These costs include the fees paid upon issue of the bonds (such as agent, arranger, underwriting, legal and administration fees), as well as recurring fees over the life of the bonds (eg, rating agency fees).

The transaction costs should be included in the estimate of the cost of debt provided that they are not included as part of the allowed operating expenditure (OPEX). In this report, transaction costs are added to the cost of KPN's debt.

The data on the transaction costs was provided to Oxera by KPN. In particular, KPN indicated that arranger fees are currently 35–45bp; legal and admin fees are €120,000 (€900,000 for US$ issues); and annual rating agency and legal fees are €660,000 per bond.

The data on typical underwriting fees was obtained from Dealogic, as this information was not available from KPN. Figure 4.5 shows the distribution of underwriting fees for the sample of all investment-grade bonds of at least $500m issued by European telecoms companies since January 1st 2006. The range for the underwriting fees used in the analysis is 10–100bp.

Figure 4.5 Distribution of underwriting fees for a sample of European telecoms companies' bonds (%)



Source: Dealogic and Oxera analysis.

These fees are annualised using the internal rate of return (IRR) method applied to each bond individually. The impact of the transaction costs is estimated as the difference between the yield to maturity for bonds with and without non-negligible fees. This method is used to take into account the time value of money. The average fee is obtained from a weighted average based on the amount outstanding for each bond.

Using the estimates and methodology described above, the weighted average transaction costs of issuing bonds range between 12bp and 22bp as at June 2007 (the corresponding range as at November 2008 is 11–24bp).[24] These fees are added to the estimates of the interest cost reported in section 4.4.

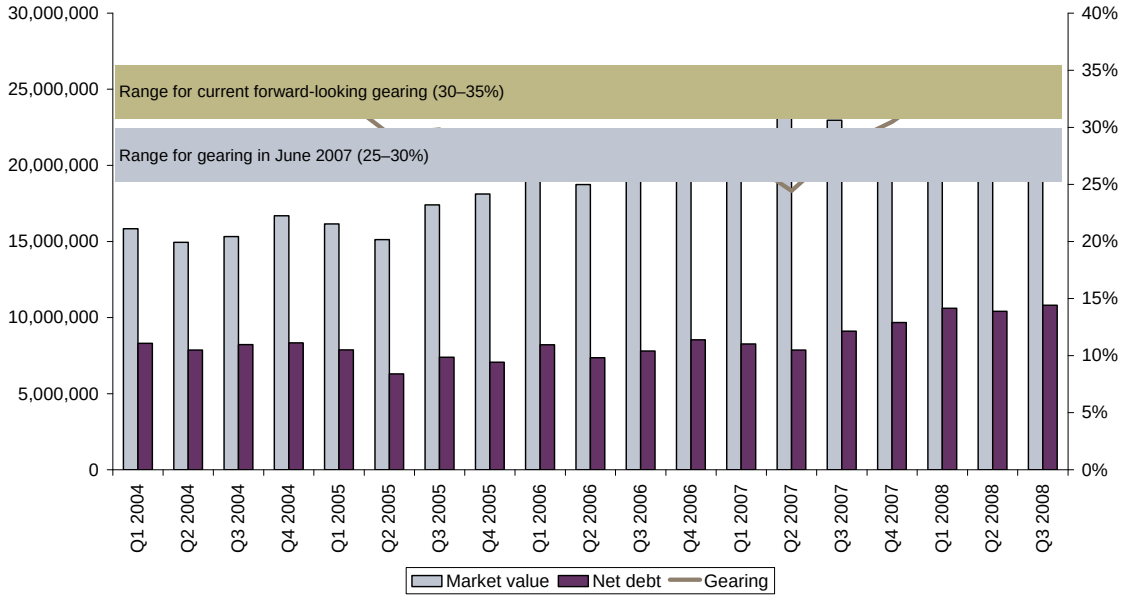
4.5 Gearing estimates

Similar to the other cost of capital parameters, the appropriate estimates of gearing should reflect the expected forward-looking level of gearing. In this report, the gearing estimates are based on the actual, rather than notional, level of gearing, estimated using the market value of equity and the book value of net debt. These estimates are also cross-checked against the data on the market value of debt, as provided by KPN.

This sub-section estimates the forward-looking gearing for KPN, which is used in the estimate of the cost of capital. Figure 4.6 shows quarterly estimates of gearing from Q1 2004 to Q3 2008, based on the book value of net debt.

[24] Fees data was obtained from Dealogic. Some confidential fees data from KPN was also used.

Figure 4.6 Market value of KPN's equity, book value of net debt (€m) and gearing (%), Q1 2004–Q3 2008



Source: Datastream and Oxera analysis.

As shown in the figure, the gearing estimate was falling over the period from Q4 2001 to Q2 2007. The key driver of this decline seems to have been the appreciation in the value of KPN's equity, given that the amount of debt remained relatively stable. Gearing fell to its minimum of approximately 24% in Q2 2007. Over the period from Q3 2007 to Q3 2008, it was rising, reaching its peak of 35% in Q3 2008.[25] The increase in gearing over this period seems to have been driven primarily by decreases in the market value of equity and slight increases in the amount of debt.

Given the data presented in Figure 4.6, it seems appropriate to set the forward-looking gearing in June 2007 in the range 25–30%. The lower end of this range reflects the spot estimates of gearing as at June 2007 (24%), while the upper end reflects the average gearing over the four quarters preceding June 2007 (27%).

It may not be appropriate to rely on only one point estimate in June 2007 (24%), given that spot estimates of gearing represent an uncertain estimate of long-term gearing owing to the volatility of equity markets and the potential time differences between refinancing and redemptions of debt. For example, as can be seen from Figure 4.6, the decline in gearing over the period before June 2007 seems to be driven largely by appreciation in the market value of equity, rather than by fundamental changes in the capital structure. Therefore, when projecting gearing forward, it is more appropriate to adopt a range.

Given the combination of KPN's financing policy and implications of the ongoing turmoil, it would be appropriate to assume that its gearing increased after the onset of the turmoil. Therefore, forward-looking gearing at present would be expected to be higher than forward-looking gearing as at June 2007. This is because the ongoing turmoil is expected to lead to reductions in equity valuations, all else being equal, due to higher required returns on equity driven by the fundamental re-pricing of risk. KPN's financial policy, however, links the amount of debt to cash flows (KPN indicated to Oxera that its long-term target is to maintain the amount of debt in a range of 2.0–2.5 times EBITDA (earnings before interest, tax, depreciation and amortisation) rather than to equity values. Therefore, the company's target

[25] The latest data for October 2008 suggests that gearing increased further to 41%, largely owing to continual reductions in the market value of KPN's equity.

debt levels would not necessarily follow equity values, leading to changes in gearing. Against a background of falling equity values (due to a higher cost of capital), gearing would be expected to increase.

The extent of such an increase does seem significant, given the evidence. Figure 4.6 shows that the evolution in equity markets over the period after June 2007, together with slight increases in the amount of KPN's debt, have led to higher estimates of gearing. Given these increases, the appropriate range for forward-looking gearing currently seems to be 30–35%—ie, 5% above the range for gearing as at June 2007. The upper end of the range reflects a spot estimate in Q3 2008 (35%), while the lower end reflects the average over the four quarters preceding Q3 2008 (32%).

As a result of the ongoing turmoil, volatility in the equity markets increased significantly over the period after June 2007, reaching its peak (to date) in November 2008.[26] This makes the spot estimates of gearing at a given date highly uncertain. Hence, it is not appropriate to set the forward-looking gearing at present with reference to recent spot estimates—in particular, given that recent increases in gearing have been driven largely by developments in equity markets; it is more appropriate to set a range, reflecting the uncertainty surrounding the estimates.

Furthermore, from a regulatory perspective, setting gearing at too high a level might provide inappropriate incentives for the regulated company in terms of its corporate financial management.

The range from 30% to 35% is also consistent with KPN's long-term financing policy. Depending on the assumptions with respect to the EBITDA multiple, KPN's target debt-to-EBITDA ratio (2.0–2.5×) implies long-term gearing in the range from 35% to 37%.[27]

4.6 Final ranges

This sub-section summarises the evidence presented above and shows the estimates of the ranges of the cost of debt and gearing for the cost of capital analysis.

4.6.1 The current cost of debt and gearing as of November 2008

The cost of debt estimates need to take appropriate account of the implications of the market turmoil. In general, it is appropriate to base the estimates on spot prices and yields provided that there is evidence of relevant market activity at these prices to ensure that they reflect economic fundamentals.

The estimated range for the cost of debt (net of transaction costs) as of November 2008 is 6.5–7.2%.

- The lower end is based on the yield at issue for bonds issued after the onset of the turmoil with maturity similar to the average maturity of KPN's bonds. The fact that KPN issued debt at these high yields is indicative of market activity that is sufficient to ensure that these market prices reflect economic fundamentals.

- The upper end is based on the trading yields for these bonds in November 2008.

This range can be seen as conservative since its lower end does not take full account of the spot prices in November 2008, and assumes a partial reversal of the current yields.

[26] The volatility of KPN's equity value (measured as the annualised standard deviation of daily changes) has increased by more than 35% since the onset of the turmoil in financial markets, and has more than doubled since 2005.

[27] The estimates are based on the minimum (5.7×) and maximum (6.7×) EBITDA multiple observed for KPN over the past three years, and lower (2.0×) and higher (2.5×) ranges for the debt-to-EBITDA ratio, in line with KPN's financing policy.

The estimates of transaction costs are based on the evidence reported in section 4.4. Given the midpoint estimate for the transaction costs of 17bp, the range for the all-in cost of debt in November 2008 is 6.7–7.4%.

As discussed in section 4.5, the estimated level of gearing is 30–35%, as shown in Table 4.4.

Table 4.4 Cost of debt and gearing (as at November 2008)

	Low	High
Cost of debt (excluding fees, %)	6.5	7.2
Fees (bp)	17	17
Cost of debt (including fees, %)	**6.7**	**7.4**
Gearing (%)	**30**	**35**

Source: Oxera analysis.

The estimates of the cost of debt based on yields are cross-checked using the evidence on spreads and the estimates of the risk-free rate. The range for the spread used in this analysis (270–390bp) is based on the same bonds as the range for the yields discussed above. The estimates of the risk-free rate are reported in section 3. The resulting cost of debt is presented in Table 4.5.

Table 4.5 Combination of spread and risk-free rate (as at November 2008)

	Low	High
Spread (bp)	270	390
Risk-free rate (%)	4.5	4.7
Cost of debt (excluding fees, %)	**7.2**	**8.6**
Fees (bp)	17	17
Cost of debt (including fees, %)	**7.4**	**8.8**

Source: Oxera analysis.

According to Tables 4.4 and 4.5, the estimates based on spreads and the risk-free rate (7.4–8.8%) are higher than those based on yields (6.7–7.4%). This is driven by the difference between the benchmark used to estimate the cost of debt and the estimates of the risk-free rate.

In this context, the estimates of the cost of debt based on yields, rather than on the combination of spreads and the risk-free rate, assume a degree of mean reversion in spreads. This is because the latter approach assumes that, as yields on nominal government bonds increase from current lows to equilibrium levels, spreads will decrease in order to keep the yields constant.

An alternative approach would be to assume that spreads, as an appropriate estimate of the required risk premium, would remain constant as nominal yields revert to long-term equilibrium. As shown in Table 4.5, this would lead to higher estimates of the cost of debt.

4.6.2 Cost of debt and gearing as at June 2007

The estimates of the cost of debt as at June 2007 are based on the observed yields at the time.

Table 4.3 above shows yields to maturity on KPN's outstanding bonds as at June 2007. The range is 4.7–7.5%, and the average is 5.7%. The upper end of the range is represented by a single long-term bond (23 years to maturity at the date of analysis), and may not be

informative for the analysis of the required rate of return on KPN's debt, given that the average maturity of its bonds is eight years the second-largest yield to maturity is 6.6%. Furthermore, as at June 2007, the two bonds most recently issued (in May 2007) had similar yields to maturity—ie, in the range from 5.3% to 6.6% and maturity from 7 to 12 years.

On the basis of this evidence, the range for the cost of debt excluding transaction costs used in the cost of capital analysis is 5.3–6.6% as at June 2007. Both ends of the range are consistent with the evidence on average yields to maturity of KPN's bonds, as well as on the yield to maturity for the most recently issued bonds as at June 2007.

Section 4.4 presented evidence on transaction costs, concluding that as at June 2007 they accounted for 12–22bp, depending on the estimate of the underwriting fees. The midpoint of the range (17bp) is added to the cost of debt, excluding fees as discussed above. The resulting cost of debt ranges from 5.5% to 6.8%.

Section 4.5 discussed the estimates of KPN's gearing, concluding that, as at June 2007, the appropriate range for the forward-looking gearing was 25–30%.

These estimates are summarised in Table 4.6.

Table 4.6 Cost of debt and gearing (as at June 2007)

	Low	High
Cost of debt (excluding fees, %)	5.3	6.6
Fees (bp)	17	17
Cost of debt (including fees, %)	**5.5**	**6.8**
Gearing (%)	**25**	**30**

Source: Oxera analysis.

The range for the cost of debt based on yields is cross-checked using the evidence on spreads on KPN's debt and the estimate of the risk-free rate. The range of 70–120bp for the estimate of the spreads is based on trading spreads for KPN's two most recently issued bonds as at June 2007 (see Table 4.7). This range is added to that for the risk-free rate (4.5–4.7%) discussed in section 3.

Table 4.7 Combination of spread and risk-free rate (June 2007)

	Low	High
Spread (bp)	70	120
Risk-free rate (%)	4.5	4.7
Cost of debt (excluding fees, %)	**5.2**	**5.9**
Fees (bp)	17	17
Cost of debt (including fees, %)	**5.4**	**6.1**

Source: Oxera analysis.

The lower end of the range based on spreads (5.4%) is similar to the lower end of the range based on yields (5.3%). The upper end of the range based on spreads (6.1%), however, is lower than the upper end of the range based on yields (6.8%). This is because the upper end of the range for the risk-free rate is lower than the benchmark used in the calculation of the spreads. This is driven by a combination of the upward-sloping yield curve in June 2007 and reliance on shorter maturities in the risk-free rate analysis.

5 Equity risk premium

This section discusses estimates of the ERP.

- **Estimate of the ERP in the previous regulatory determination**. OPTA and its advisers have been consistently using an ERP of 6% to estimate the cost of equity of KPN, most recently in January 2007.

- **Developments in equity markets**. The current turmoil has resulted in a sharp rise in share price volatility and declines in equity valuations. The implied volatility on AEX, which is a measure of market expectations of the forward-looking uncertainty, has more than doubled since June 2007, and has reached a level not previously observed since the indicator was introduced in 1994. In this context, any increase in the implied volatility of equity reflects the uncertainty surrounding the future value of assets, and is therefore indicative of the higher return on equity required by investors to commit capital. There is robust academic and empirical evidence that higher implied volatility leads to a higher ERP.

- **Final ranges**. The estimated ERP for June 2007 is 6%. This is based on regulatory precedent for January 2007, given that there is no robust evidence to suggest that the ERP changed significantly from January to June 2007. The estimate of 6% seems conservative given evidence from Dimson, Marsh, Staunton and Elgeti (2008). An ERP of 6.25% is used for the analysis of the current cost of capital. The increase in the estimates reflects developments in capital markets—the sharp increases in market volatility and reductions in valuations that point towards higher required returns, as supported by the results of empirical research.

The ERP cannot be observed directly, and has to be estimated using either ex ante or ex post evidence on market returns.

Reliance on historical data might provide a reasonable approximation of the forward-looking required returns in stable market conditions and for a limited period. However, at a time of major market turmoil, historical rates of return on their own cannot provide a reliable measure of the price that investors demand in order to commit capital going forward. In such circumstances, forward-looking measures that accurately reflect current investors' expectations provide a more appropriate basis for the analysis.

European equity markets have recently experienced unprecedented volatility. These high levels of volatility are expected to persist going forward, given the evidence on implied volatility derived from the derivative instruments. For example, the current level of implied volatility in the Dutch equity market is more than twice that in June 2007. This suggests that investors are currently significantly more uncertain about the future values of equity instruments than they were 18 months ago.

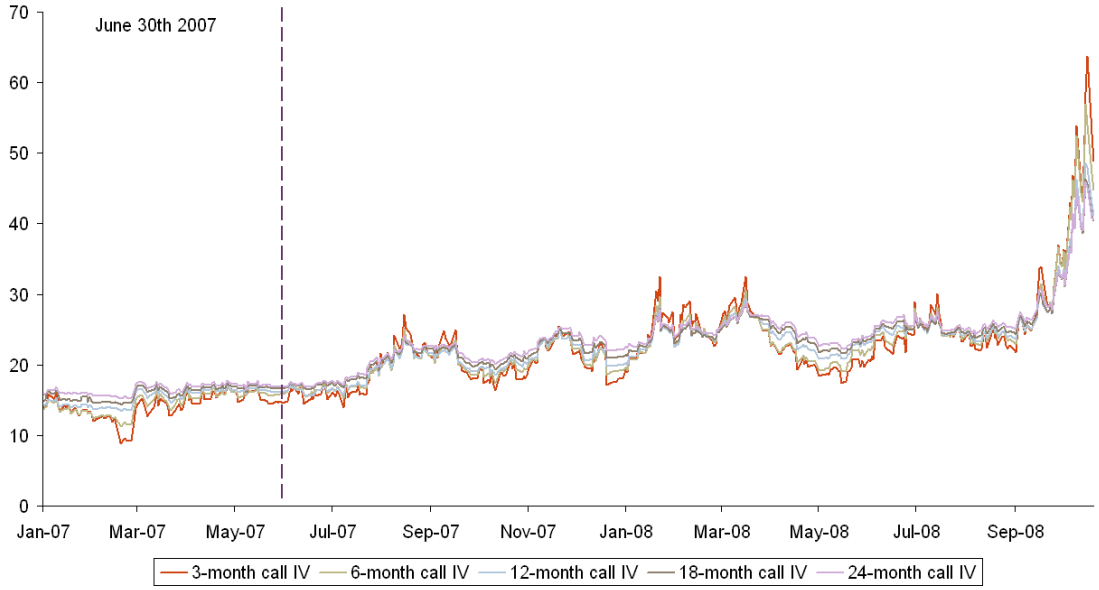
Higher forward-looking volatility and uncertainty is likely to be associated with a higher ERP. This is intuitive, as equity investors require higher expected returns in order to commit capital at a time of greater uncertainty. This assumption is also supported by theoretical and empirical research in corporate finance.

The evidence on higher volatility in the equity markets needs to be reflected in the ERP used to estimate the current cost of capital. Given that the required rate of return on equity investments seems to have increased as a result of the turmoil, the ERP used to estimate the cost of capital in November 2008 should be higher than that used in the cost of capital in June 2007.

5.1 Recent developments in European equity markets

The current turmoil has resulted in a sharp rise in share price volatility. Figure 5.1 shows the evolution of implied volatility (IV) for the Dutch AEX index based on call options with a range of maturities. It highlights the marked increase in implied volatility at the time of the onset of the market turmoil in August 2007.

Figure 5.1 Implied volatility for AEX (%)

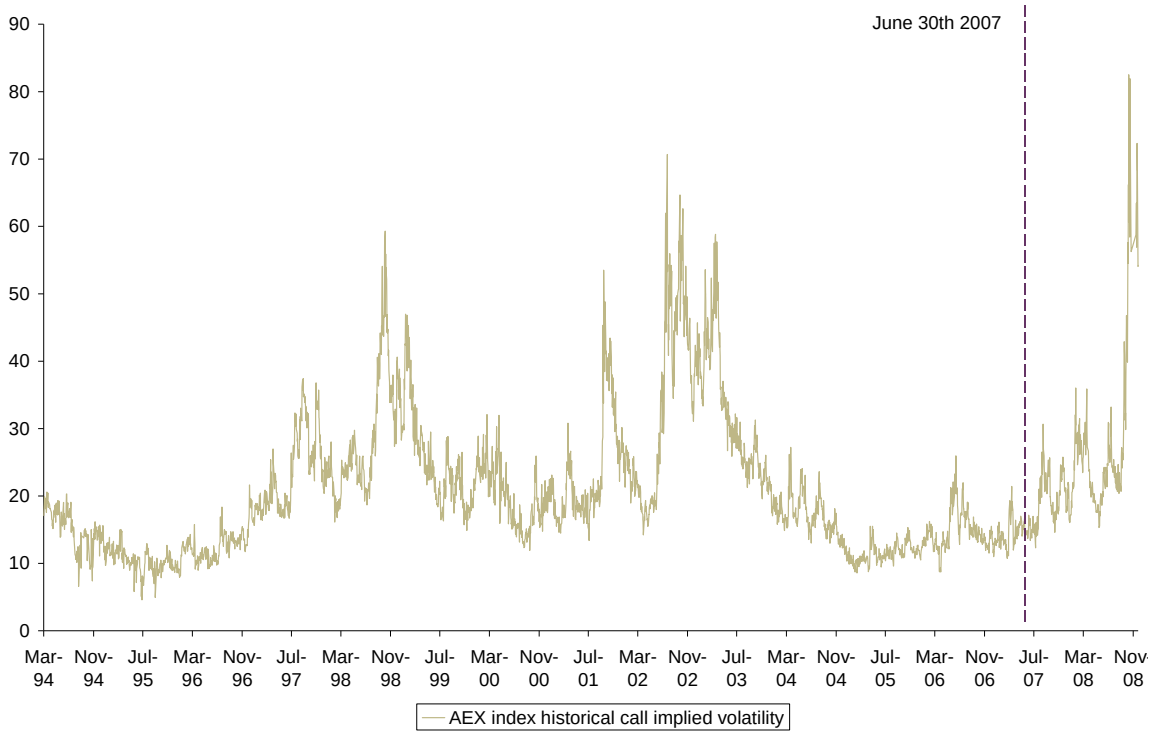


Note: The six-month rolling average is taken as the average across all volatility values.
Source: Bloomberg and Oxera calculations.

As shown in Figure 5.1, implied volatility has more than doubled since June 2007. In this context, any increase in the implied volatility of equity reflects the uncertainty surrounding the future value of assets, and is therefore indicative of the higher return on equity required by investors to commit capital.

Figure 5.2 provides a longer-term perspective on the current level of volatility. As can be seen, the implied volatility for AEX has reached a level never observed since this indicator was introduced in 1994.

Figure 5.2 Historical perspective—long-term implied volatilities for AEX (%)



Source: Bloomberg and Oxera calculations.

Similar evidence can be observed for other European equity markets (eg, the UK).

There are several factors underlying the currently observed situation in the equity markets. These include deterioration in global growth prospects, perception of increasing risk, the continuing process of re-pricing of risks by investors, increased risk aversion, and the liquidation of assets by some financial institutions as part of the de-leveraging process.

The evolution of implied volatility also highlights the atypically low levels of uncertainty assumed by investors and reflected in the prices observed between 2004 and 2007, as shown in Figure 5.2 above.

5.2 The relationship between implied volatility and the ERP

The evolution of implied volatility can be used to examine the impact of the market turmoil on the ERP. The current level of implied volatility indicates that equity returns are expected to be volatile in the future; there is also no robust evidence to suggest that this is likely to change in the near term. This supports the view that the required return for committing equity capital has increased recently as a result of the ongoing market turmoil.

The relationship between the ERP and the variance in the portfolio returns has been studied extensively. Most of the literature shows that there is a significant positive relationship. That is, increases in the volatility of the index are accompanied by an increase in the ERP, as suggested by the evidence from the early studies of French, Schwert and Stambaugh (1987), Harvey (1989), Turner, Startz and Nelson (1989), and Baillie and DeGennaro (1990).[28]

[28] French, K., Schwert, G.W. and Stambaugh, R.F. (1987), 'Expected Stock Returns and Variance', *Journal of Financial Economics*, **19**, 3–19. Harvey, C. (1989), 'Time-varying Conditional Covariances in Tests of Asset Pricing Models, *Journal of Financial Economics*, **24**, 289–317. Turner, C., Startz, R. and Nelson, C. (1989), 'A Markov Model of Heteroskedasticity, Risk,

More recent studies include that of Campbell and Hentschel (1992), who investigate the effect of volatility on the ERP in the USA over the period 1926–88 and find that the ERP increases with the volatility of the log returns of the market index.[29] Moreover, they find that:

> during periods of high volatility, the feedback effect can become dramatically more important.

In other words, the impact of volatility on the ERP is greatest during periods of relatively high volatility.

Similarly, Campbell, Lo and MacKinley (1997) point out that this link is intuitive, as an increase in the volatility of the market portfolio leads to an increase in the ERP.[30] Scruggs (1998) also finds that there is a positive relationship between the variance of returns of the index and the ERP.[31] Furthermore, Bliss and Panigirtzoglou (2004) state that:

> An increase in equity volatility generally leads to an increase in the risk premium though the expected change is model dependent.[32]

A number of academic studies have considered how the forward-looking volatility of the market portfolio, proxied by the implied volatility of options on market indices such as the S&P 100 and S&P 500, or by other indices such as BARRA's 'value and growth' stocks, affects the ERP.

Copeland and Copeland (1999) find a positive relationship between movements in the CBOE volatility index (VIX), a measure of market expectations of stock return volatility, and stock returns.[33] Similarly, Guo and Whitelaw (2006) find that there is a positive relationship between market returns and implied volatility.[34]

Graham and Harvey (2007) also examine the relationship between implied volatility and the ERP, based on the results of the most recent survey of US chief financial officers, which looked ahead to the first quarter of 2007 and beyond.[35] They present expectations of the ERP measured over a ten-year horizon relative to a ten-year US Treasury bond. Among their findings is evidence suggesting a positive relationship between implied volatility, captured by the VIX and the ERP.

Banerjee, Doran and Peterson (2007) undertook a detailed study of the relationship between the VIX (level and innovations) and the ERP, defined as the difference between S&P index returns and the risk-free rate.[36] Their study encompasses the period June 1986 to June 2005, where they focus on 30- and 60-day horizons to quantify the relationship between the VIX and the (ex post) ERP, and find that this relationship is positive.

It should be noted that Banerjee, Doran and Peterson (2007) demonstrated that there is a positive relationship between IV and ERP for a period of up to 60 days. The same analysis

and Learning in the Stock Market', *Journal of Financial Economics*, **25**, 3–22. Baillie, R.T. and DeGennaro, R.P. (1990), 'Stock Returns and Volatility', *Journal of Financial and Quantitative Analysis*, **25**, 203–14.

[29] Campbell, J.Y. and Hentschel, L. (1992), 'No News is Good News. An Asymmetric Model of Changing Volatility in Stock Returns', *Journal of Financial Economics*, **31**, 281–318.

[30] Campbell, J.Y., Lo, A. and MacKinley, C. (1997), *The Econometrics of Financial Markets*, Princeton University Press.

[31] Scruggs, J.T. (1998), 'Resolving the Puzzling Intertemporal Relation Between the Market Risk Premium and the Conditional Market Variance: A Two Factor Approach', *Journal of Finance*, **53**:2.

[32] Bliss, R. and Panigirtzoglou, N. (2004). 'Option-implied Risk Aversion Estimates', *The Journal of Finance*, **59**, 407–43.

[33] Copeland, M. and Copeland, T. (1999), 'Market Timing: Style and Size Rotation Using the VIX', *Financial Analysts Journal*, **55**, 73–81.

[34] Guo, H. and Whitelaw, R. (2006), 'Uncovering the Risk–Return Relationship in the Stock Market', *Journal of Finance*, **61**, 1433–63.

[35] Graham, J.R. and Harvey, C.R. (2007), 'The Equity Risk Premium in January 2007: Evidence from the Global CFO Outlook Survey', working paper, Duke University.

[36] Banerjee, P.S., Doran, J.S. and Peterson, D.R. (2007), 'Implied volatility and future portfolio returns', *Journal of Banking & Finance*, **31**:10, 3183–99, October.

could be undertaken for the Netherlands and the UK for longer maturities. For example, Bloomberg contains data on implied volatility of the AEX and FTSE 100 indices options of 24 months.

5.3 Estimates of the ERP before the turmoil

At the last price review for KPN, OPTA/NERA estimated the ERP to be 6%.[37] According to the evidence on the ERP from Dimson, Marsh, Staunton and Elgeti (2008),[38] the ERP range based on arithmetic averages is between 6.1% and 6.7% for the Netherlands.[39] Similarly, the average range across all European countries for which Dimson, Marsh and Staunton publish estimates of the ERP is 5.7–6.9%. In this respect, OPTA's previous determination appears to be towards the lower end of the range.

Table 5.1 ERP relative to bills and bonds, 1900–2007 (%)

	Over bills		Over bonds	
Country	**Geometric mean**	**Arithmetic mean**	**Geometric mean**	**Arithmetic mean**
Belgium	2.9	5.1	2.7	4.5
Denmark	3.0	4.6	2.3	3.5
France	6.8	9.3	4.1	6.2
Germany	4.1	9.2	5.6	8.6
Ireland	3.9	5.9	3.5	5.1
Italy	6.5	10.4	4.4	7.7
Norway	3.3	6.0	2.9	5.6
Spain	3.7	5.7	2.7	4.6
Sweden	5.8	8.0	5.3	7.6
Switzerland	3.7	5.3	1.9	3.4
The Netherlands	**4.6**	**6.7**	**4.1**	**6.1**
UK	4.4	6.1	4.1	5.4
Average	**4.4**	**6.9**	**3.6**	**5.7**

Note: [1] The dataset used by Dimson, Marsh, Staunton and Elgeti (2008) runs to December 31st 2007. [2] The average of the ERP of countries whose stocks make the Dow Jones Stoxx 600 index. This average excludes Austria, Finland, Greece, Iceland, Luxembourg and Portugal (no information available).
Source: Dimson, Marsh, Staunton and Elgeti (2008) and Oxera analysis.

There is some debate as to whether it is more appropriate to use the arithmetic or geometric average of historical returns when estimating ERP. The arguments on the suitability of the two means have yet to be resolved.

The evidence on the ERP used to cross-check the past regulatory determination for KPN is based on arithmetic means.

[37] NERA (2007), 'The Cost of Capital of KPN for Sub-loop Unbundling (SLU)', January.
[38] Dimson, P., Marsh, E., Staunton, M. and Elgeti, R., (2008), 'Global Investment Returns Yearbook 2008', ABN AMRO.
[39] The lower end of the range refers to the ERP measured relative to bonds, and the upper end of the range to the ERP relative to bills.

5.4 Final ranges

The estimated ERP for June 2007 is 6%. This estimate is based on regulatory precedent for January 2007, given that there is no robust evidence to suggest that the ERP has changed significantly from January to June 2007.

As discussed in section 5.2, the estimate of 6% seems conservative given the evidence from Dimson, Marsh, Staunton and Elgeti (2008). In line with the regulatory precedent, a point estimate was chosen for the purposes of this analysis rather than a range, despite the fact that all measures of the ERP are characterised by significant uncertainty.

The ERP of 6.25% is used for the analysis of the current cost of capital. The increase in the estimates reflects developments in capital markets—the sharp increases in market volatility and reductions in valuations that point towards higher required returns, as supported by the results of empirical research. It is of note that Ofcom's recent recommendation for BT provides a regulatory precedent for a 25bp uplift to the ERP in order to reflect the impact of the market turmoil.[40]

[40] Ofcom (2008), 'A New Pricing Framework for Openreach', May.

6 Systematic risk factor: the beta

This section estimates KPN's asset beta.

- **Issues in the analysis of betas for European telecoms companies**. There have been a number of significant developments in the European telecoms sector over recent years, which, all else being equal, are expected to lead to greater risk faced by incumbent companies in different European jurisdictions. This could be expected to translate into higher betas for the industry. This, however, may not be observed in the estimates based on historical data because of the developments in the financial markets owing to impacts of the unwinding of the dot.com bubble and ongoing market turmoil.

- **Estimates of betas**. The analysis of market data points to an equity beta for KPN of approximately 0.85, with the 95% confidence interval from 0.7 to 1.0. This estimate is based on the two-year period ending June 2007. The average gearing over this period was approximately 28%. This results in an asset beta estimate of 0.5–0.7. The analysis of comparators points at an asset beta in the range 0.3–0.8, with an overall average of 0.62.

- **Final ranges**. The range for the asset beta used for estimating the cost of capital in this report is approximately 0.55–0.65. The midpoint of the range corresponds to the estimates for KPN; it is also supported by evidence on KPN's comparators. It should be noted that the chosen range is narrower than the actual uncertainty of the beta in order to ensure that the resulting estimates of the cost of capital could be practically used for setting the price cap. This range for the asset beta, levered at the appropriate forward-looking gearing, is used for the cost of capital estimates in June 2007 and for the current cost of capital estimates, which are used as a proxy for the cost of capital in 2011.

6.1 Introduction

The asset beta represents a measure of business risks faced by a company. In this respect it is not an abstract financial concept, but a reflection of underlying business and market characteristics of the company. Thus, the analysis of betas should be grounded in business analysis.

In the absence of direct data on betas, the analysis needs to be based on historical data. Given that betas are a forward-looking measure of risks, the reliance on historical data may lead to situations where beta estimates are biased compared with actual levels. These concerns are particularly important in this case, given the unwinding of the implications of the dot.com bubble (which affects betas measured over a longer term) and current volatility in equity markets owing to the turmoil (which affects beta measures over a shorter term).

Hence, the analysis of betas for KPN needs to take into account the following considerations:

- implications of the developments in the European telecoms sector for the business risk of the incumbent companies;
- implications of the bursting of the dot.com bubble as well as the ongoing market turmoil on the measurement of beta.

6.1.1 Evolution of business risks of telecoms companies

Electronic communications services are experiencing a period of transformation, which is creating fundamental challenges to incumbent telecoms companies. There have been a number of significant developments in the European telecoms sector over the past few years, which, all else being equal, are expected to lead to greater risk faced by incumbent companies in different European jurisdictions. These developments include, among others:

– intensifying competition across all elements of the supply chain;
– accelerating pace of technological developments, with traditional PSTN networks being increasingly replaced with fibre-based networks, and with boundaries between the delivery of traditional audio-visual and IP-based services becoming increasingly blurred;
– the use of a broadband platform in the provision of multiple-play offers, which include television (IPTV);
– increased convergence across technologies and the emergence of new technologies, such as mobile TV, blurring the boundaries across sectors.

These market developments, intensified by the asymmetric nature of the existing regulatory regime, lead to reductions in the market shares and margins of incumbents. As a result, the incumbents face increasing risk of asset-stranding associated with the transformation of the traditional business model and asset mix as required by the changing market environment. An uncertain future market framework, given the existing assets of telecoms incumbents, further increases the risk of asset-stranding. In addition, a paradigm shift and development of the next-generation networks may lead to significant increases in capital intensity going forward.

From the investor's perspective, this means that telecoms companies migrate from an asset class that is well known and perceived to have relatively predictable cash flows, to one that has significantly less well-understood risks and more uncertain future scenarios. This would be expected to lead to a re-pricing of telecoms companies' business risks, and hence to higher relative required returns manifested in higher asset betas.

6.1.2 Measurement of telecoms betas in light of the dot.com bubble and ongoing market turmoil

Under the CAPM framework, higher business risks would be expected to translate into higher betas for the industry. In the case of telecoms companies, this may not be immediately observed in the estimates based on historical data because of the developments in the financial markets; more specifically:

– betas measured over shorter time periods, which may be able to capture changes in business risks, may not fully reflect increasing risks due to the impact of the ongoing turmoil;

– betas measured over longer time periods may be disproportionately affected by the bursting of the dot.com bubble. They would also not be able to capture changes in business risks of the telecoms companies due to an implicit assumption that the true beta is constant over the estimation period.

During the period of the market turmoil, beta estimates of relatively non-cyclical stocks (such as those of telecoms companies) based on short-term data would be depressed compared with the true beta. This is because such estimates would be capturing the time period when non-cyclical companies perform better than other assets in the market. Hence, in light of this, the beta estimates for the telecoms companies may need to be measured using longer-term data in order to avoid downward biases that may be created by the ongoing turmoil.

Longer-term estimation periods in the case of telecoms companies may have their drawbacks. First, long-term betas may be affected by the unwinding of the dot.com bubble (and hence may be biased upwards). Second, beta estimates based on the long-term data would not capture increasing business risks of the telecoms incumbents (and hence may be biased downwards).

Betas for the telecoms companies increased significantly before the burst of the dot.com bubble. Subsequently, as the extent of losses was revealed and transformation of the business models was completed, telecoms companies' betas declined. This decline, however, was observed in the estimates only with a lag, given reliance on historical data.

Therefore, betas measured around the bursting of the dot.com bubble (or using data for a long-term period, a significant part of which *is* the dot.com bubble) may be capturing the short-term behaviour of telecoms stocks during the crisis, rather than the long-term pattern relevant for the beta analysis.

Furthermore, beta estimates based on long-term data implicitly assume that the true beta is constant over the period of the analysis. Hence estimates based on long-term data would not be able to capture the changing pattern of the telecoms incumbents' business risks.

In light of these concerns, this report places more weight on beta estimates based on medium-term data before the onset of the turmoil. However, the estimates of betas based on historical data may be still biased compared with the betas of the telecoms incumbents.

The remainder of the section is structured as follows:

– section 6.2 provides an overview of the methodology employed to transform an equity beta into an asset beta;
– section 6.3 provides the analysis of comparators;
– section 6.4 presents direct beta estimates for KPN;
– section 6.5 summarises final beta estimates.

6.2 Approach to de-levering equity betas

Asset betas for comparators and KPN are estimated using the equity beta measured from the market data. This involves de-levering equity betas using gearing and debt beta estimates (the analysis assumes debt betas of zero, as discussed below) according to the formula:

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

where:

β_a = asset beta;
β_e = equity beta;
β_d = debt beta;
g = gearing.

In de-levering an equity beta computed using historical data, it is necessary to take account of the factors that have driven share prices over this period. Share prices at a given date are driven only by information available before this date. Therefore, equity betas measured over a given period are de-levered using an average gearing for this period.

In this report the debt beta for comparators and for KPN was assumed to be zero. This approach is broadly consistent with the view that debt betas are applicable mainly in the case of high gearing, high financial risk, and sub-investment-grade debt.

In general, the debt beta could be estimated using two approaches: the spread decomposition approach and direct beta estimates. There are also third-party estimates of debt betas for debt with different investment grades.[41]

The spread decomposition approach involves the decomposition of the total spread into the component that corresponds to the systematic risk of debt and that drives the debt beta, and compensation for other risk drivers. In the empirical research the latter typically includes the

[41] See, for example, Naik, V., Trinh, M., Balakrishnan, S. and Sen, S. (2003), 'Hedging Debt with Equity', November, Lehman Brothers Fixed Income Quantitative Credit Research; Schaefer, S.M. and Strebulaev, I.A. (2007), 'Structural Models of Credit Risk are Useful: Evidence from Hedge Ratios on Corporate Bonds', June, London Business School and Stamford Business School working paper, under revision with the *Journal of Financial Economics*.

liquidity premium and the default premium. This method is likely to overstate the debt beta because it does not account for other components of the spread (such as the impact of the supply and demand factors or tax), and assumes that all premiums for risk are associated with the compensation for systematic risk.

The direct approach to debt beta estimation involves using a market model regression.[42] This regresses the returns of the asset against the market returns for a given period, as shown below:

$$R_{it} = \hat{a} + \hat{b}R_{mt}$$

- for t = 1,2...T, where T is the time period of the regression;
- R_{it} is the return on the asset; R_{mt} is the return on the market;
- $\hat{a}$ is the estimate intercept;
- $\hat{b}$ is the estimated slope of the regression that can be used as an estimate of beta.

Given that the academic literature has identified a significant number of problems with this approach, it is unlikely to produce sufficiently robust estimates of the debt beta.

A review of the empirical research containing debt beta estimates indicates that the assumption that debt betas are zero is commonplace. Furthermore, given the low gearing for KPN and the fact that its debt has investment-grade, high-liquidity premiums in the current markets,[43] and considerable uncertainty about the estimate of debt betas, it seems reasonable to assume a zero debt beta for this analysis.

6.3 Analysis of comparators

This sub-section analyses the evolution of betas for a sample of European telecoms companies and examines the evolution of betas over time. It also shows the estimates of the betas for KPN's closest comparators in June 2007.

The sample of telecoms companies used in this analysis includes the top five largest European telecoms companies (BT Group, Deutsche Telekom, France Telecom, Telefónica, and Telecom Italia), as well as a number of other telecoms companies identified as close comparators to KPN on the basis of the clustering analysis reported in section 6.3.2 (Belgacom, TDC, Telekom Austria, and Elisa).[44]

6.3.1 European telecoms companies

The evidence suggests that, following the period of declining betas after the bursting of the dot.com bubble, betas for a sample of European telecoms companies started to increase. The starting point and the scale of this increase differs depending on the time period used to estimate the beta. More specifically, beta estimates based on a shorter time period seem to point towards an earlier increase in the beta, while betas based on a longer time period appear to start increasing later, due to the greater reliance on historical data.

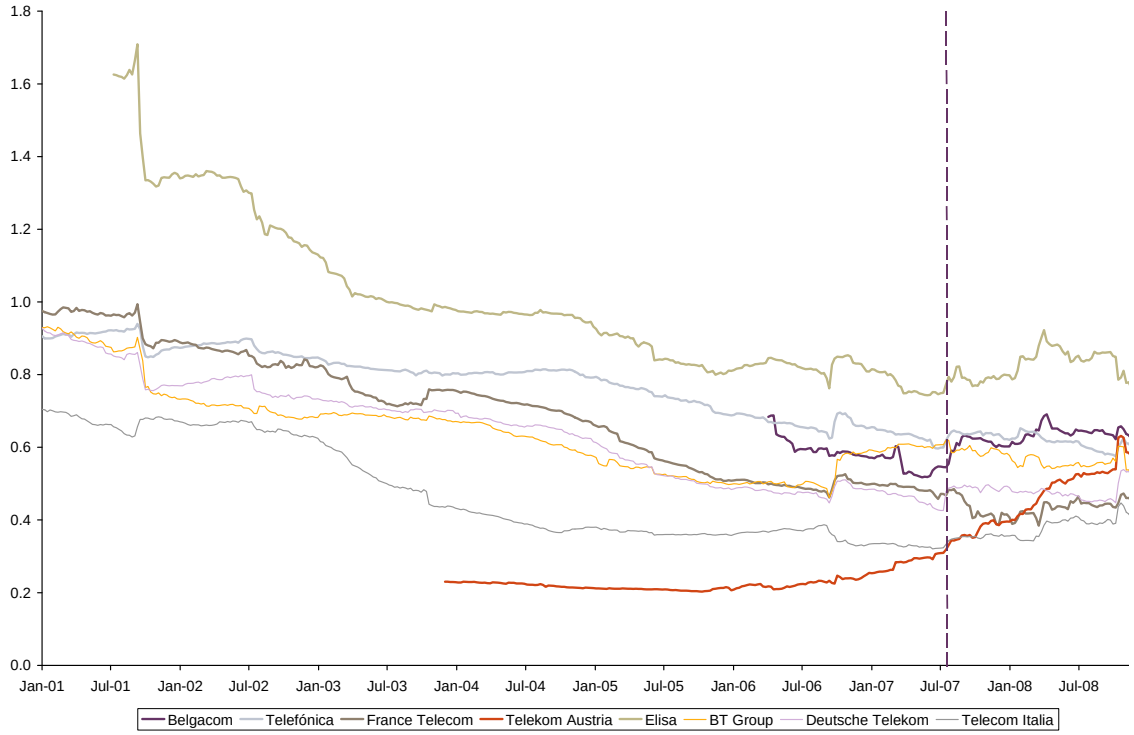
[42] This was first introduced in Jensen, M. (1969), 'The Performance of Mutual Funds in the Period 1945–1964', *Journal of Finance*, **23**:2, 389–416.

[43] For example, the Bank of England's analysis indicates that the systematic component of the cost of debt has not increased significantly as a result of the turmoil and that recent increases in spreads have been largely driven by other factors (see, for example, Bank of England (2008), 'Financial Stability Report', October, p. 11, Chart 2.6).

[44] TDC was subsequently removed from the sample of comparators due to its illiquid stock, which may create biases in the measurement of its beta. The liquidity of a stock can be evaluated by observing the time it takes before the full float is traded. It took more than two-and-a-half years for the volume of TDC's stock traded to reach its total shares outstanding. This compares with around six months for KPN.

Figure 6.1 shows the evolution of five-year asset betas estimated using weekly data from 2001 to 2008.

Figure 6.1 Evolution of asset betas for a sample of European telecoms companies (based on a five-year estimation period)



Source: Datastream and Oxera analysis.

As can be seen from Figure 6.1, the downward-sloping trend in the betas observed from 2001 seems to have reversed by around 2007 (for five-year betas). Since then, the betas have, on average, increased.

Similar evidence on two-year betas points to a reversal in around 2003/04. This is consistent with increasing business risks faced by the European telecoms companies examined, which have been reflected in beta estimates with a lag due to the reliance on historical data. Moreover, the longer the time period used for the beta analysis, the longer the lag between changes in the true beta and beta estimates.

Table 6.1 shows changes in betas over time. To reflect the length of the period used to estimate the beta, changes for the two-year betas are reported from 2004 to 2008, and for the five-year betas from 2007 to 2008.

Table 6.1 Changes in the asset betas of a sample of European telecoms companies

	2 years, weekly (June 2004–October 2008)	5 years, weekly (June 2007–October 2008)
Belgacom	–0.10	+0.11
BT	–0.01	+0.01
Deutsche Telekom	+0.16	+0.11
Elisa	+0.07	+0.06
France Telecom	+0.12	+0.01
Telecom Italia	+0.16	+0.12
Telefónica	–0.04	+0.03
Telekom Austria	+0.46	+0.32
Average	**+0.10**	**+0.10**

Source: Datastream and Oxera analysis.

The evidence in Table 6.1 demonstrates that the betas of telecoms have, on average, increased slightly over the period under consideration. The scale of the observed increase might provide a downward-biased estimate of the change in the actual beta, given the impact of the ongoing market turmoil.

Overall, this evidence (weakly) indicates that higher business risk faced by the telecoms incumbents is partially reflected in the higher beta estimates with a lag.

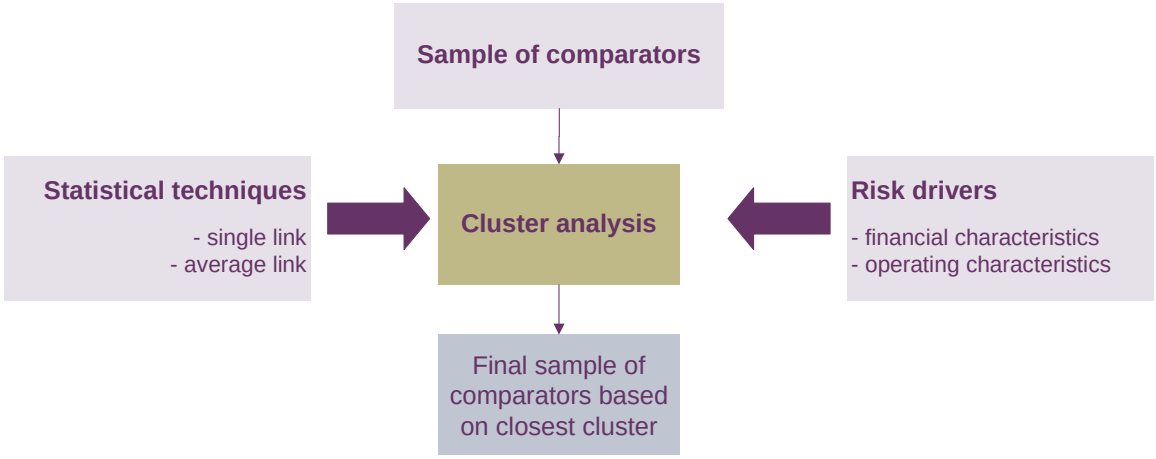
6.3.2 Closest comparators for KPN

This sub-section presents estimates of asset betas for the closest identified comparators to KPN. This evidence is used as a cross-check on the estimates of KPN's beta reported in section 6.6. The analysis involves two steps: the closest comparators to KPN are identified from a set of listed European telecoms incumbents; and the asset betas for the closest comparators in June 2007 are then estimated.

Given KPN's business profile, the most appropriate peer group consists of other national incumbent telecoms operators within the EU. Thus, in the first step, the listed fixed line incumbents have been identified in 21 European countries.[45] In the second step, cluster analysis has been used to identify the closest comparators for KPN among these companies. Cluster analysis is a statistical technique that identifies clusters of observations based on a set of predetermined characteristics. Figure 6.2 illustrates these analytical steps.

[45] Belgium, Czech Republic, Denmark, Germany, Estonia, Greece, Spain, France, Ireland, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, the Netherlands, Austria, Poland, Portugal, Slovenia, Slovak Republic, Finland, Sweden, UK.

Figure 6.2 Identification of closest comparators using cluster analysis



Source: Oxera.

The characteristics used in the cluster analysis include the following.

Market structure

– The number of major players in the fixed telephony market (including the incumbent, as at December 2005).

– The incumbents' market share (in volumes) in the fixed telephony market (as at December 2005).

– The incumbent's broadband market share excluding resale lines by alternative operators (as at October 2006).

– The penetration rate of broadband in the EU (as at October 2006).

– The market share of the mobile market of leading operators based on subscribers (as at October 2006).

Business risk

– The revenue of the largest fixed line incumbent in 2006.

– CAPEX/total assets.

– EBITDA margin.

A number of specifications of the cluster analysis have been used in order to test the robustness of the analysis. These specifications differ in terms of the statistical method employed to identify the closest comparators.

All clusters identified in this exercise are reported in Appendix 3. There is some limited variation in the composition of clusters depending on the choice of the statistical technique.

Estimates of the asset beta for the identified closest comparators are used to cross-check the direct beta estimates for KPN. Table 6.2 presents the estimates.

Table 6.2 Asset beta estimates for KPN's closest European comparators (June 29th 2007)

	2 years, daily	2 years, weekly	2 years, monthly	5 years, daily	5 years, weekly	5 years, monthly
Belgacom	0.6	0.5	0.7	0.7	0.5	0.6
Telefónica	0.5	0.5	0.4	0.7	0.6	0.6
France Telecom	0.5	0.6	0.6	0.6	0.5	0.6
Telekom Austria	0.6	0.6	0.8	0.4	0.3	0.6
Elisa	0.8	0.6	0.9	0.6	0.7	1.3
Range	**0.5–0.8**	**0.5–0.6**	**0.4–0.9**	**0.4–0.7**	**0.3–0.7**	**0.6–1.3**
Average	**0.6**	**0.5**	**0.7**	**0.6**	**0.5**	**0.8**

Note: Betas shown above are measured against the DJ Stoxx 600 index. A Bayesian adjustment has been performed on the beta estimates.
Source: Datastream and Oxera calculations.

The range for the asset beta for comparators is approximately 0.3–0.8, excluding such extreme observations as 0.9 and 1.3; the overall average is 0.62.

6.4 Direct beta estimates for KPN

Estimates of KPN's equity beta using market data are presented in this sub-section. These are used to set the range for the asset beta for the analysis of the cost of capital. When setting the final range for the beta, these estimates are cross-checked against the asset beta estimates for KPN's closest comparators, reported above

A number of options are explored regarding the index used to proxy the market portfolio, the appropriate data frequency, and the time period over which to carry out the beta estimation. A selection of time periods from two to five years is used, together with daily, weekly and monthly data points. The indices considered in the analysis include the Dutch AEX, European DJ Stoxx 600 and global FTSE World.

The betas are estimated using data from Datastream as the ratio of the covariance between returns on KPN's stock and the appropriate index divided by the variance of the index (see Table 6.3). Bayesian-adjusted equity betas are reported, calculated as follows: (two-thirds × raw beta) + (one-third × 1). This adjustment controls for the fact that statistical analysis tends to overestimate betas higher than 1 and underestimate betas lower than 1.[46]

[46] Blume, M.E. (1968), 'On The Assessment of Risk', *Journal of Finance*, issue March.

Table 6.3 KPN's equity beta estimates (as at June 2007)

Period	Data frequency	AEX (Dutch index)	DJ Stoxx 600 (European index)	FTSE World (Global world index)
2 years	Daily	0.82	0.82	0.67
	Weekly	0.79	0.85	0.83
	Monthly	0.77	0.83	0.83
5 years	Daily	0.77	0.88	0.82
	Weekly	0.68	0.78	0.77
	Monthly	0.68	0.68	0.74

Note: The end date of the estimation period is June 29th 2007. Betas are reported after the Bayesian adjustment.
Source: Datastream and Oxera analysis.

According to Table 6.3, two-year betas range from 0.67 to 0.85 and five-year equity betas range from 0.68 to 0.88.

There does not seem to be a systematic relationship between different estimation methods and the level of beta. For example, daily betas are generally higher than weekly and monthly betas for the five-year estimation window, and generally lower for the two-year estimation window (with the exception of betas measured against the AEX index). Similarly, betas estimated against the DJ Stoxx 600 index are generally higher than betas estimated against the FTSE World and AEX indices for the daily and weekly data, and lower for the monthly data (with the exception of betas measured against the AEX index). This can also be seen from Table 6.4, which reports average equity betas. According to this table, all averages cluster around 0.8.

Table 6.4 Average equity betas for KPN (as at June 2007)

	Option 1	Option 2	Option 3
Data frequency	Daily	Weekly	Monthly
	0.80	0.78	0.76
Market index	AEX	DJ Stoxx 600	FTSEW
	0.75	0.81	0.78
Estimation period	2 years		5 years
	0.80		0.75

Note: The end date of the estimation period is June 29th 2007. Betas are reported after the Bayesian adjustment.
Source: Datastream and Oxera analysis.

Appendix 3 shows third-party beta estimates from Bloomberg obtained according to the same estimation methods. As can be seen, there are no material differences.

Although the estimates of the equity beta for KPN derived under various approaches seem broadly consistent, a decision is required with respect to a more appropriate method in this context in order to reach a range for the equity beta.

6.4.1 Data frequency

There is no practical consensus regarding the frequency of data to use in such analysis. On the one hand, from a theoretical perspective, betas measured using more frequent data are likely to be less affected by statistical biases such as autocorrelation than those measured using less frequent data. This is because of the impact of factors such as thin and non-synchronous trading. On the other hand, betas measured using shorter frequencies tend

to be less uncertain (as would be reflected by the confidence intervals). This is because the use of longer frequencies leads to fewer observations for the same estimation period.

In this analysis Oxera places more weight on weekly data to ensure that sufficient numbers of data points are available for the analysis (and hence less weight is placed on monthly data). This also seeks to ensure that the estimates are not affected by statistical biases and noise that could be introduced by more frequent data (and hence less weight is placed on daily data).

6.4.2 Relevant market index

The choice of the appropriate index should reflect the investment opportunity set of investors in KPN's stock in order to capture the impact of any home bias. In the absence of home bias, it would be more appropriate to use a world index.

KPN listed stock is largely owned by international investors.[47] This suggests that it is more appropriate to use a broader index for the beta analysis. Therefore, less weight is placed here on betas estimated using the AEX index. With respect to the choice between European and a world index, there is evidence on the presence of home bias between US and European capital markets.[48] Therefore, in this context, more weight is placed on betas estimated using the European index, given that, from the investor's perspective, KPN is a European asset.

This approach is also consistent with KPN's regulatory precedent.[49] Furthermore, as evident from Table 6.3, the difference in betas estimated using the European and world indices is small.

6.4.3 Time periods

There are two key considerations when choosing the appropriate time period for the beta estimation. First, it is important to ensure that a sufficiently long period is considered in order to capture the full spectrum of risks that drive the beta. Second, the implicit assumption behind the analysis of betas is that it remains constant over the period of the estimation (unless this is specifically taken into account through the use of a time-varying beta coefficient). Therefore, using time periods that are too long may not take into account changes in the beta over time.

Table 6.3 reports betas estimated over the two- and five-year periods. The beta estimates over the shorter periods were not reported because of the first consideration, as they may not appropriately take into account business cycles. Therefore, when choosing between two- and five-year betas in this context, the important consideration is whether KPN's beta may have changed over the period of the analysis, making longer-term periods less informative.

Figure 6.3 shows the rolling asset beta estimated over the two- and five-year periods in order to illustrate the evolution of betas over time.[50] The evolution of the two-year beta suggests that KPN's asset beta may have changed around 2005. (This change is likely to have occurred earlier as a result of the end of the period of higher volatility after the dot.com bubble, but is reflected in the beta in 2005 owing to the use of the two-year estimation period).

As can be seen, the two-year asset beta was declining over the period from 2002 to 2005, potentially as a result of the unwinding of the effect of the dot.com bubble. After 2005, the

[47] Based on Oxera's analysis of Bloomberg data; KPN (2008), 'Annual Report and Form 20-F 2007'.

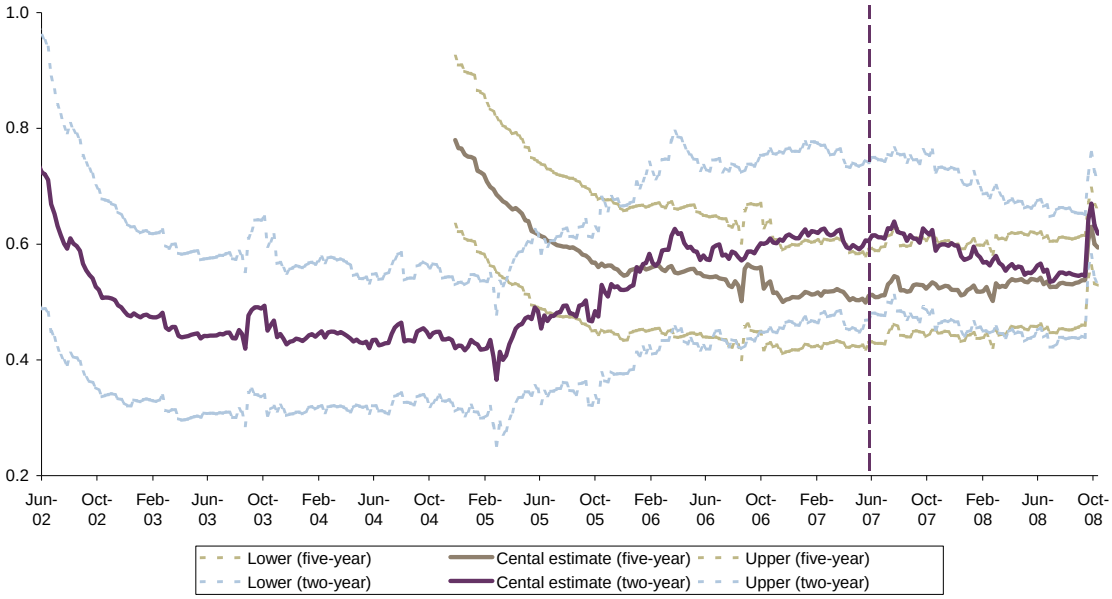
[48] See, for example, Carey, M. and Nini, G. (2007), 'Is the Corporate Loan Market Globally Integrated? A Pricing Puzzle', *The Journal of Finance*, **62**:6.

[49] NERA (2005), 'The Cost of Capital for KPN's Wholesale Activities: A Final Report for OPTA', December.

[50] The asset beta at each date was estimated as the equity beta de-levered at the average gearing over the estimation period.

two-year beta started to increase. This could be indicative of a permanent change in the value of KPN's beta. The five-year beta, however, moved in the opposite direction after 2005. This is likely to be driven by the fact that the five-year window, used in the estimation of the five-year beta, was capturing the declining trend observed before 2005.

Figure 6.3 Rolling KPN asset beta estimates (two- and five-year windows)



Note: Betas shown above are measured against the DJ Stoxx 600 indices, and are based on weekly data. The asset betas are estimated as equity betas de-levered at the average gearing calculated over the period corresponding to the period for the beta estimation.
Source: Datastream and Oxera analysis.

In this context, more weight is placed on two-year betas, given that the five-year beta may not appropriately capture the change in the value of KPN's asset beta due to the estimation window being too long.

Overall, more weight in the analysis is placed on the beta estimated over the two-year period using the weekly data against the European DJ Stoxx 600 index. As shown in Table 6.3 this method results in an equity beta of 0.85. The 95% confidence interval around the estimate is (0.7–1.0).

6.5 Final beta estimates

This sub-section summarises the evidence on the equity beta and reports the final estimates used in the cost of capital analysis.

The analysis presented in section 6.4 points at an equity beta for KPN of approximately 0.85, with the 95% confidence interval from 0.7 to 1.0. This estimate is based on the two-year period ending June 2007. The average gearing over this period was approximately 28%. This results in an asset beta estimate of 0.5–0.7.

The analysis of comparators reported in section 6.3 points towards an asset beta in the range 0.3–0.8, with an overall average of 0.62.

On the basis of this evidence taken together, the range for the asset beta used for estimating the cost of capital in this report is approximately 0.55–0.65.

– The midpoint of the range corresponds to the two-year estimate against the DJ Stoxx weekly estimate (0.85 equity beta, or 0.6 asset beta at 28% gearing). This is supported by the evidence on KPN's comparators, for which the asset betas is on average 0.62 (see Table 6.2 for details).

– The range reflects the uncertainty of beta estimates within each estimation approach as well as across approaches. It should be noted, however, that the chosen range is narrower than the actual uncertainty of the beta in order to ensure that the resulting estimates of the cost of capital could be practically used for setting the price cap.

This range for the asset beta is used for the cost of capital estimates in June 2007 and for the current cost of capital estimates, which are used as a proxy for the cost of capital in 2011. More specifically, it is used to estimate the equity beta as at these dates, based on the appropriate estimates of gearing.

7 Cost of capital estimates

This section discusses the overall, nominal cost of capital estimates for KPN as of June 2007 and as of June 2011 (based on the estimates as of November 2008).

- **Estimated ranges**. According the evidence reported in sections 3–6, the range for the appropriate pre-tax nominal cost of capital for KPN in June 2007 is 10.3–11.7%. The range in 2011 (estimated on the basis of the evidence in November 2008 and assuming a limited degree of mean reversion) is 10.9–12.1%.

- **Choosing a point estimate within the range**. There are at least two reasons why it may be appropriate to set the point estimate of the cost of capital above the midpoint of the range: uncertainty of the estimates and welfare losses of setting the cost of capital at too low a level. In this respect it should be noted that the actual uncertainty about the cost of capital is not fully captured in the ranges reported above—ie, the 95% confidence interval, for example, is significantly wider than the ranges. The actual uncertainty is not used to determine the ranges in order to ensure that they can be practically used for setting the price cap.

7.1 Estimated ranges for the cost of capital

Table 7.1 summarises the Oxera estimates of the individual cost of capital parameters and presents the overall WACC estimate for KPN as of 2007.

Table 7.1 Estimates of the forward-looking cost of capital in June 2007

	Low	High
Risk-free rate (nominal, %)	4.5	4.7
Cost of debt (pre-tax, %)	5.5	6.8
Gearing (%)	25	30
Asset beta	0.55	0.65
Tax rate (%)	25.5	25.5
ERP (%)	6.0	6.0
Equity beta	0.7	0.9
Cost of equity (post-tax, %)	8.9	10.3
Cost of equity (pre-tax, %)	11.9	13.8
WACC (vanilla, %)	**8.1**	**9.2**
WACC (pre-tax, %)	**10.3**	**11.7**

Source: Oxera analysis.

According the evidence reported in sections 3–6, the range for the appropriate pre-tax nominal cost of capital for KPN in June 2007 (assuming that spot evidence at this date reflects all available information) is 10.3–11.7%.

Table 7.2 summarises the Oxera estimates of the individual cost of capital parameters and presents the overall WACC estimate for KPN as of 2011 (estimated in November 2008).

Table 7.2 Estimates of the forward-looking cost of capital in November 2008

	Low	High
Risk-free rate (nominal, %)	4.5	4.7
Cost of debt (pre-tax, %)	6.7	7.4
Gearing (%)	30	35
Asset beta	0.55	0.65
Tax rate (%)	25.5	25.5
ERP (%)	6.25	6.25
Equity beta	0.8	1.0
Cost of equity (post-tax, %)	9.4	11.0
Cost of equity (pre-tax, %)	12.6	14.7
WACC (vanilla, %)	**8.6**	**9.7**
WACC (pre-tax, %)	**10.9**	**12.1**

Source: Oxera analysis.

The range for the appropriate pre-tax nominal cost of capital for KPN in 2011 (estimated on the basis of the evidence in November 2008 and assuming a limited degree of mean reversion) is 10.9–12.1%.

The actual uncertainty of the cost of capital estimates is not captured in the ranges reported above—the 95% confidence interval, for example, is significantly wider than the ranges. The actual uncertainty is not used to set the ranges in order to ensure that they can be practically used for setting the price cap.

7.2 Choosing a point estimate within the range

The estimate of each individual cost of capital parameter contributing to the overall WACC estimates discussed above is characterised by significant uncertainty. This uncertainty needs to be accounted for when determining the point estimate if the objective is to make sure, with a certain degree of confidence, that the point estimate is not below the true current value of that parameter and will not fall below the true value of a given parameter over the regulatory period.

There are at least two reasons why it may be appropriate to set the point estimate of the cost of capital above the midpoint of the range: uncertainty of the estimates and welfare losses of setting the cost of capital at too low a level.

7.2.1 Uncertainty of cost of capital estimates

There are at least two sources of underlying uncertainty, which exists regardless of the assumed ranges:

– the uncertainty around the true current value of the parameter being estimated;
– the uncertainty about the potential evolution of the true value of a given parameter in the future.

The former reflects the underlying distribution of parameter estimates within any proposed range, while the latter leads to uncertainty with respect to the future distribution of that parameter over the regulatory period (in terms of both first and second moments). Both types of uncertainty are amplified by the ongoing financial turmoil and therefore need to be taken into account explicitly when selecting a point estimate within the WACC range.

The uncertainty surrounding the individual cost of capital parameters means that it is important to select a point estimate that provides adequate headroom above the mean estimate for the WACC in anticipation of situations in which KPN's actual cost of capital is either already higher than currently estimated, or turns out to be higher in the future.

7.2.2 Asymmetries in welfare loss

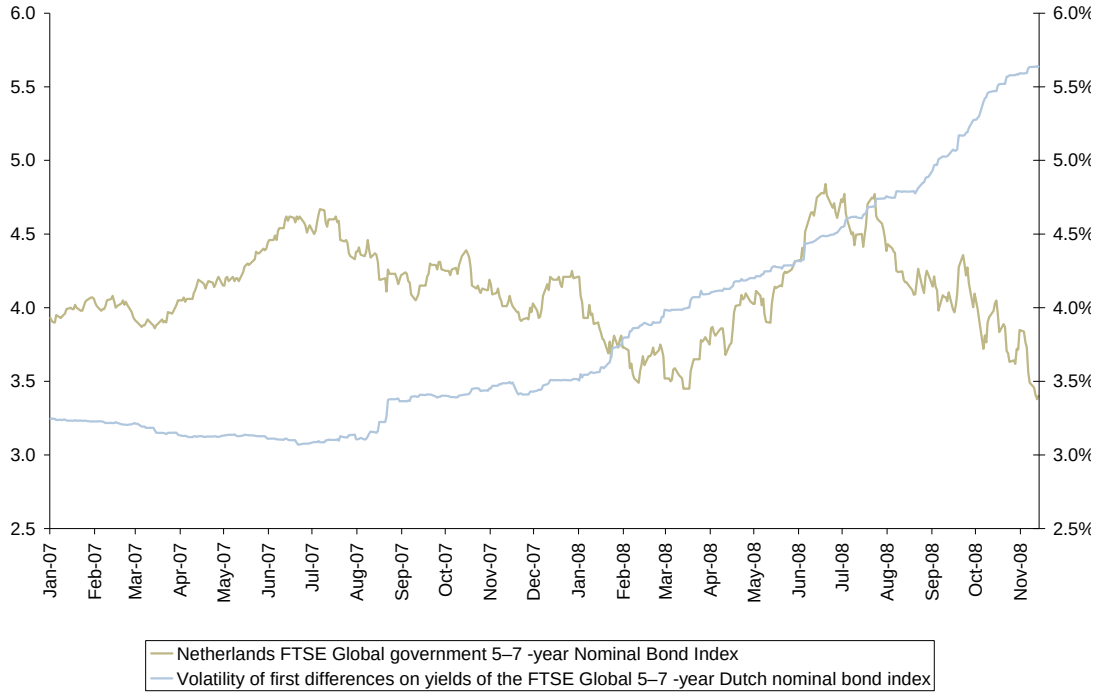
The choice of the point estimate within the range also needs to take into account asymmetries in welfare loss arising from under/over-estimation. More specifically, there is likely to be significant asymmetry in the loss function, with the losses arising from under-estimation likely to greatly exceed those from over-estimation.

In order to appropriately address this asymmetry, the point estimate in the range should be set above the midpoint. The appropriate percentile depends on the shape of the loss function and the true distribution of the cost of capital, which captures the full uncertainty.

A1 Further evidence supporting the analysis of the risk-free rate

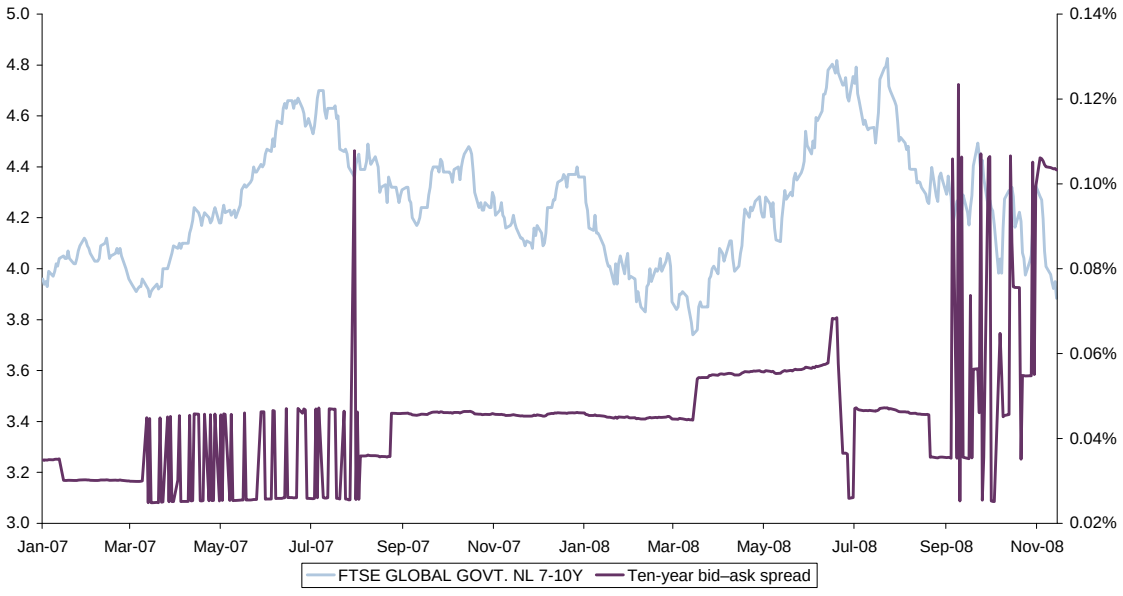
This appendix provides additional evidence on the risk-free rate, as discussed in section 2 of the report.

Figure A1.1 Volatility of Dutch government bond yields (5–7-year FTSE Global index)



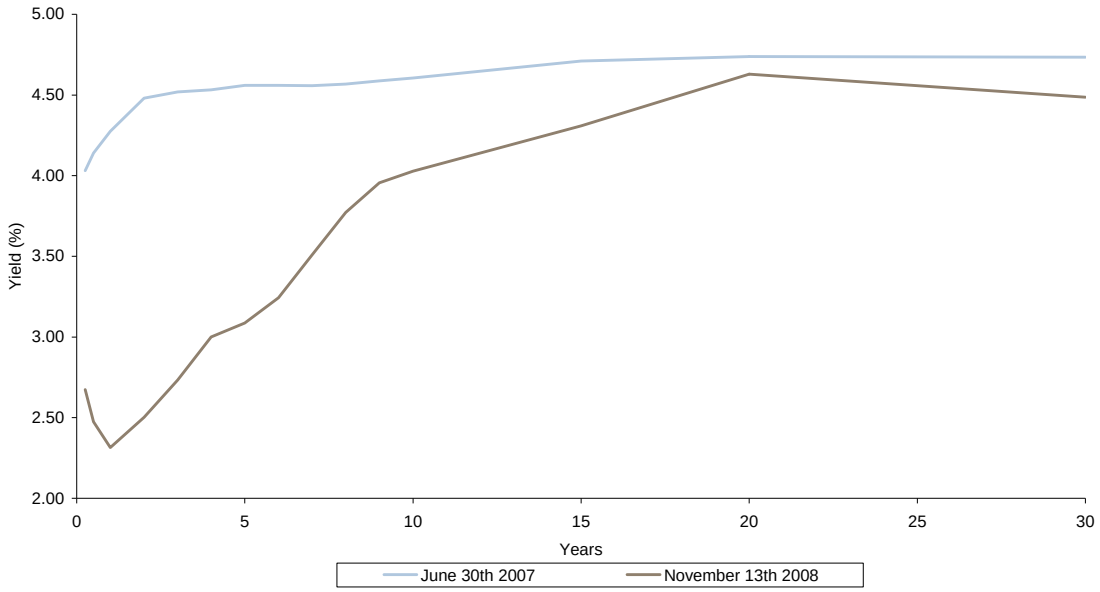
Source: Datastream and Oxera analysis.

Figure A1.2 Evolution of bid–ask spreads for Dutch nominal yields



Source: Bloomberg, Datastream and Oxera analysis.

Figure A1.3 Comparison of yield curves for Dutch government bonds



Source: Bloomberg.

Table A1.1 Spot yields on 3–5-year nominal government securities' indices (%)

	The Netherlands	Germany	France	Italy	Spain	UK
Spot June 30th 2007	4.5	4.5	4.5	4.6	4.6	5.9
Spot November 13th 2007	3.1	2.8	3.1	3.9	3.3	3.2

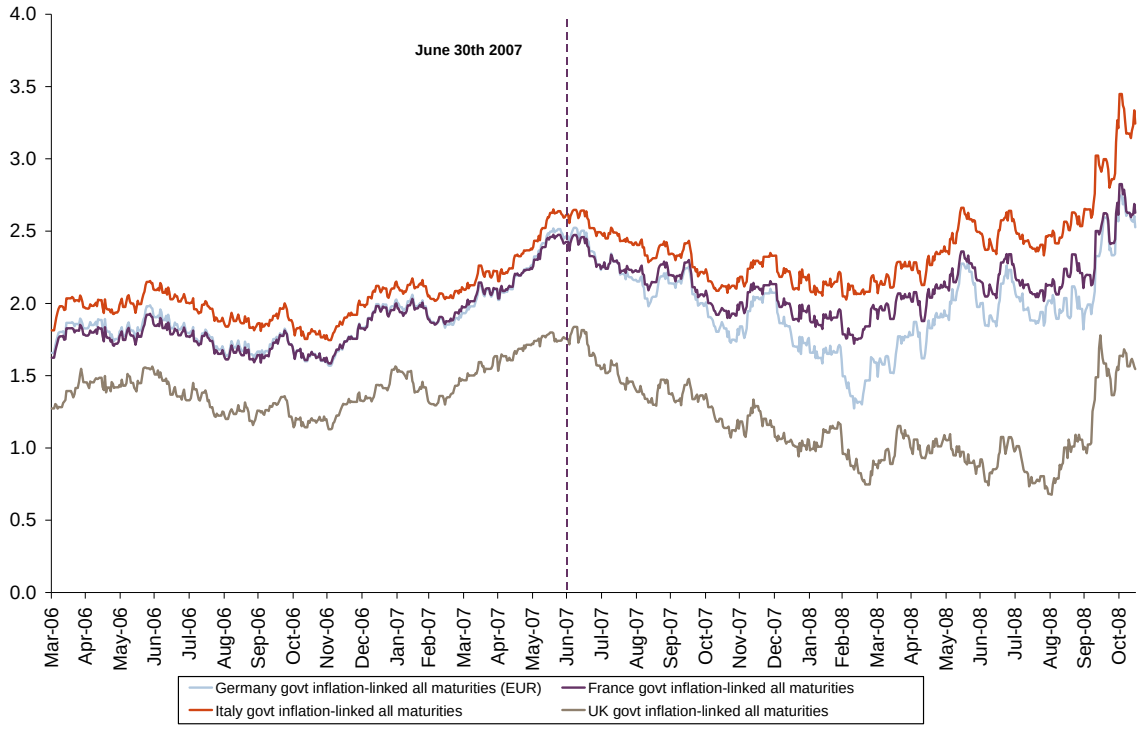
Source: Bloomberg.

Table A1.2 Spot yields on 7–10-year nominal government securities' indices (%)

	The Netherlands	Germany	France	Italy	Spain	UK
Spot June 30th 2007	4.6	4.6	4.6	4.8	4.6	5.6
Spot November 13th 2007	3.9	3.5	3.8	4.5	4.0	4.1

Source: Bloomberg.

Figure A1.4 Yields in index-linked bonds for Germany, Italy, France and the UK (2006-08, indices)



Source: Bloomberg.

Table A1.3 Yields on inflation-linked government securities as at June 29th 2007 (%)

Term	Italy	Term	France	Term	UK
Three years	2.53	Five years	2.41	Four years	2.72
Five years	2.52	Eight years	2.41	Six years	2.61
Ten years	2.59	15 years	2.43	Ten years	2.15

Source: Bloomberg.

Table A1.4 CDS premiums for selected financial institutions as at June 29th 2007 (bp)

Institution	Three-year	Five-year	Ten-year
Lloyds TSB	0.04	0.06	0.13
ABN AMRO (USA)	0.06	0.10	0.15
RBS (London)	0.06	0.09	0.16
Bank of America	0.09	0.14	0.22
Barclays	0.08	0.12	0.19
Average	**0.07**	**0.10**	**0.17**

A2 KPN's debt structure

This appendix provides an overview of KPN's debt structure.

Given that the analysis of the cost of debt and gearing are carried out as at two dates, the current debt structure is analysed alongside that of June 2007.

As at June 30th 2007, approximately 94% of KPN's debt consisted of bonds.[51] Two-thirds of its bonds were denominated in euros (see Table A2.1), compared with 11% of the amount outstanding being denominated in pounds sterling and the remaining 23% in US dollars.

Table A2.1 KPN bonds outstanding as of June 2007 and issued since then

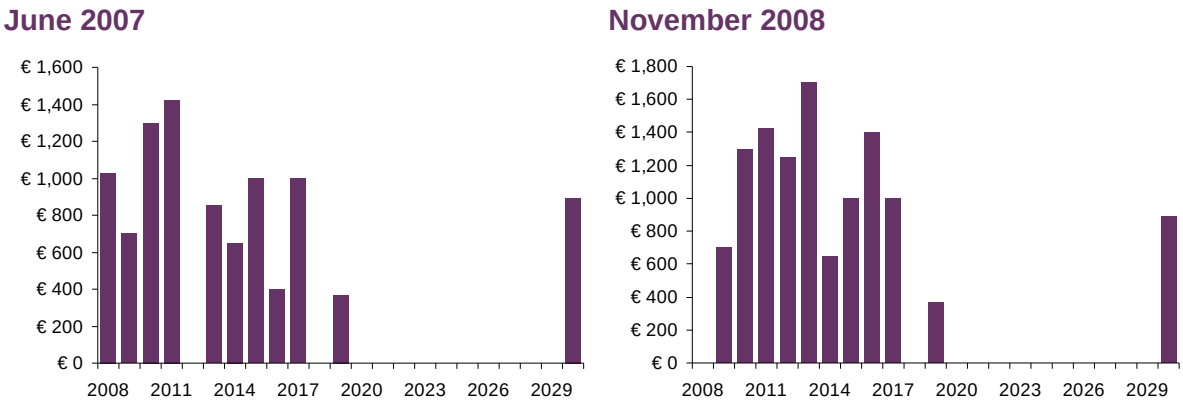
Issue date	Maturity	Term (years)	Amount issued	Coupon
Nov 98	Nov 08	10	€1,023	4.75%
Feb 98	Nov 08	11	€477	4.75%
Oct 00	Oct 10	10	$39	8.00%
Feb 01	Oct 10	10	$1,711	8.00%
Oct 00	Oct 30	30	$8	8.38%
Oct 00	Oct 30	30	$992	8.38%
Apr 01	Apr 08	7	£175	8.25%
July 04	July 09	5	€700	EURIBOR + 40bp
July 04	July 11	7	€1,425	4.50%
June 05	June 15	10	€1,000	4.00%
Mar 06	Mar 13	7	€850	4.50%
Mar 06	Mar 16	10	£275	5.75%
Nov 06	Jan 17	10	€1,000	4.75%
May 07	May 14	7	€650	4.75%
May 07	May 19	12	£250	6.00%
Nov 07	Nov 12	5	€1,250	5.00%
Apr 08	Jan 16	8	€850	6.50%
June 08	Jan 16	8	€75	6.50%
Sept 08	Sept 13	5	€850	6.25%

Note: Shaded area denotes bonds issued after June 2007.
Source: Oxera analysis based on KPN annual reports, Dealogic and Datastream information.

The average maturity of the bonds was approximately eight years, and almost half (ie, 46%) of the bonds outstanding were due to mature before the end of the next regulatory review period in 2011 (see Figure A2.1).

[51] KPN annual reports and Dealogic. Assumes that €250m is drawn on KPN's multi-currency credit facilities (as at December 31st 2006) and that €374m of bank overdrafts is used.

Figure A2.1 Maturity profile of KPN bonds, 2008–30



Source: Oxera analysis based on KPN annual reports, Datastream and Dealogic data.

In the current debt structure (analysed as at November 13th 2008), the share of bonds decreased to around 90% of the total KPN debt.[52]. The share of euro-denominated bonds increased to three-quarters of total bonds. The share of outstanding bonds due to mature before the end of 2011 fell to 29%.

The estimates of the cost of debt presented in this report are based on yields and spreads on KPN's bonds; they do not take into account other debt instruments issued by KPN (such as the overdraft and multi-currency credit facilities).

It is unlikely that considering these additional instruments would lead to any significant change in the cost of debt estimates, given that, as shown above, bonds represent at least 90% of KPN's total, outstanding, interest-bearing debt.

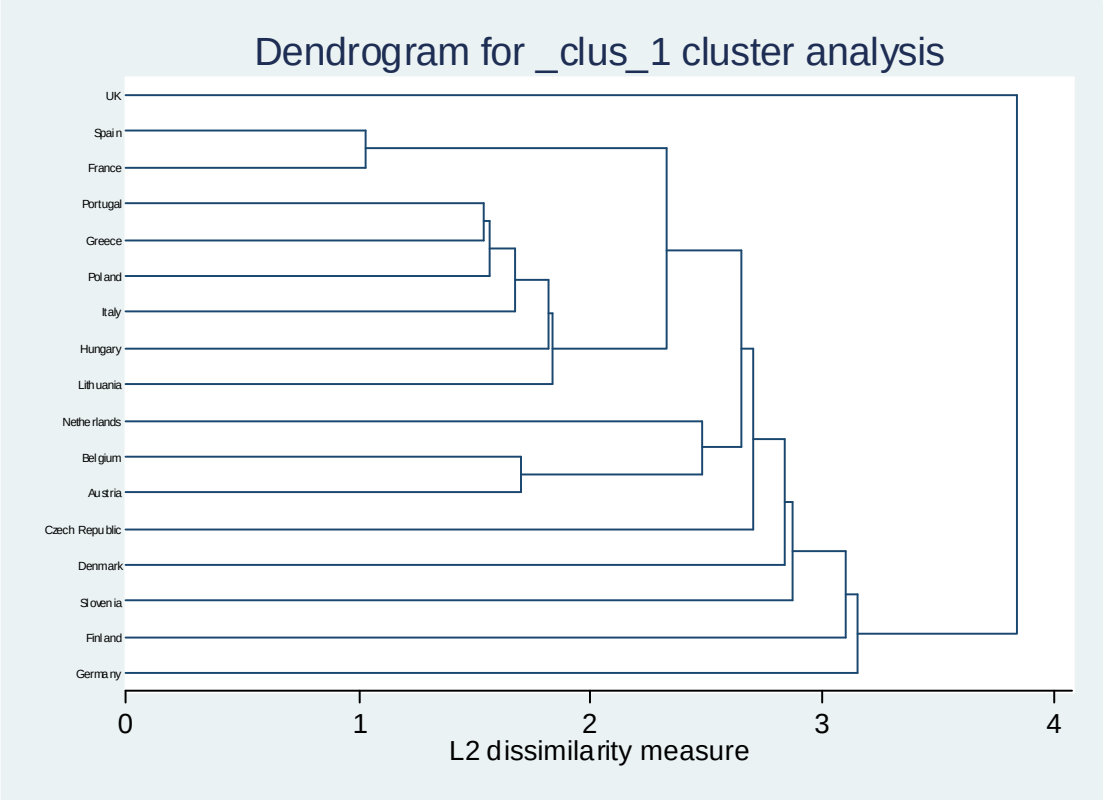
[52] KPN annual reports and Dealogic. Assumes that €800m is drawn on KPN's multi-currency credit facilities (as at December 31st 2007) and that €476m of bank overdrafts is used.

A3 Estimates of equity beta for KPN under different scenarios

This appendix provides estimates of equity beta for KPN under different scenarios and the details of the clustering analysis.

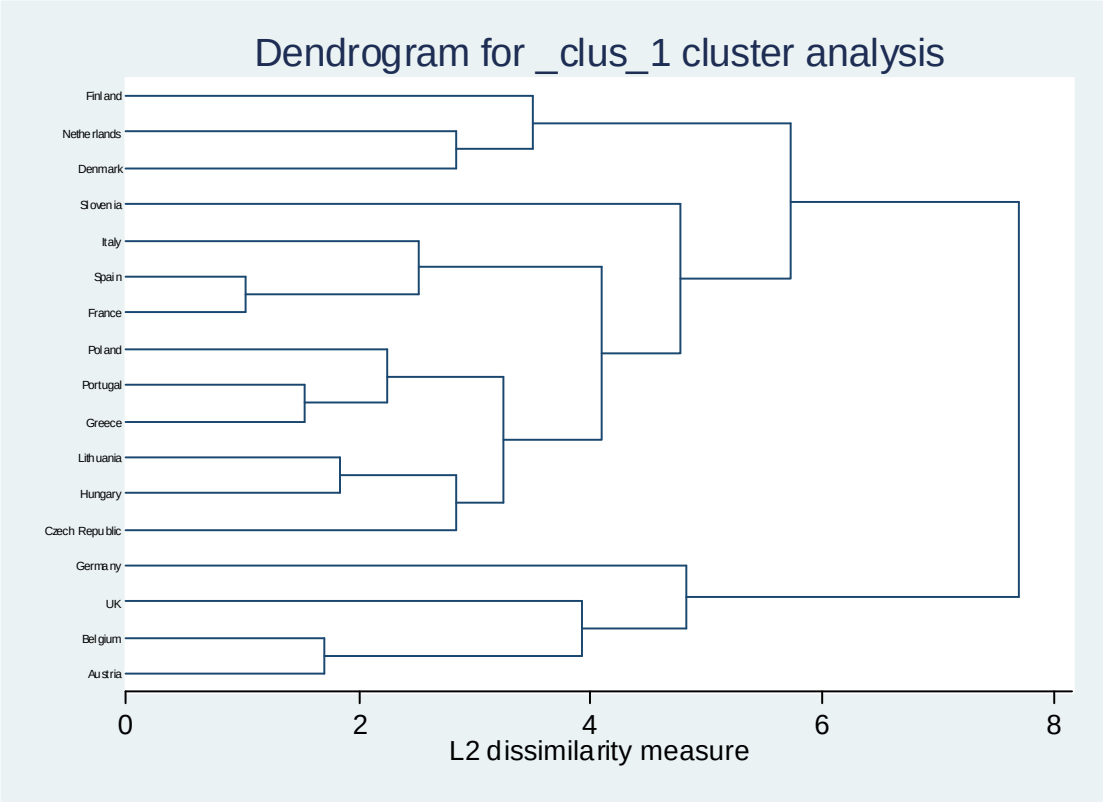
A3.1 Results of the clustering analysis

Figure A3.1 Single linkage method



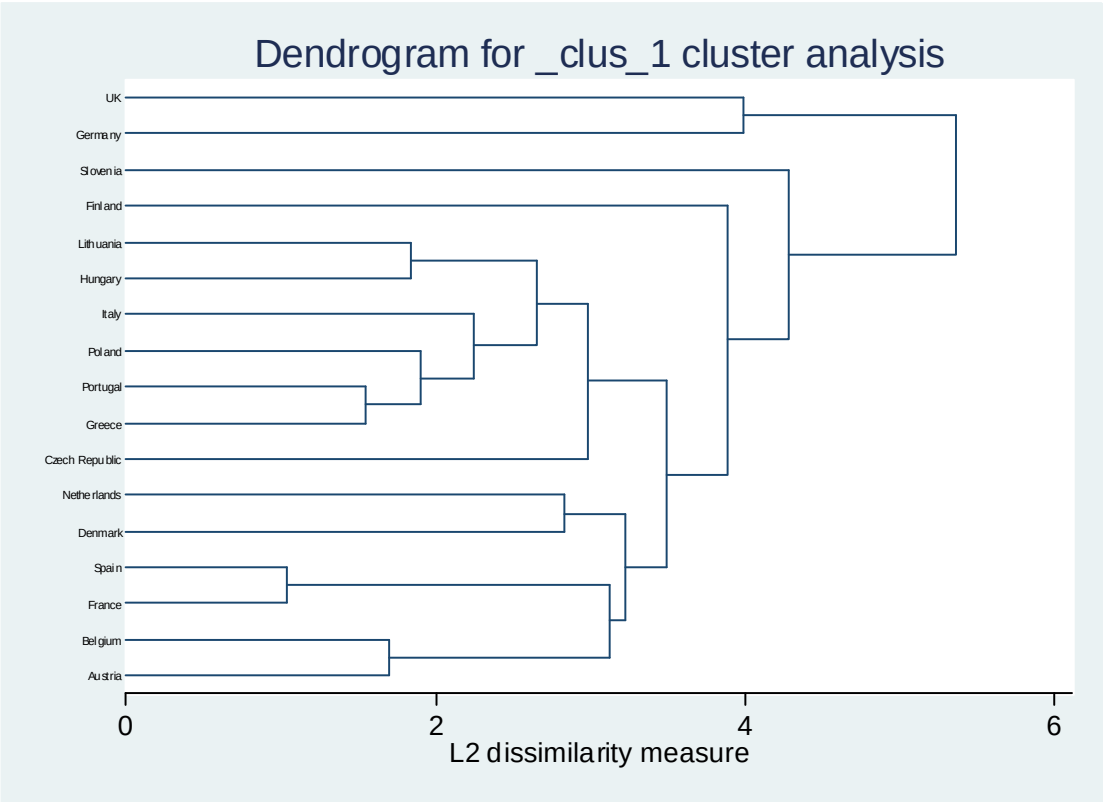
Source: Oxera analysis.

Figure A3.2 Complete linkage method



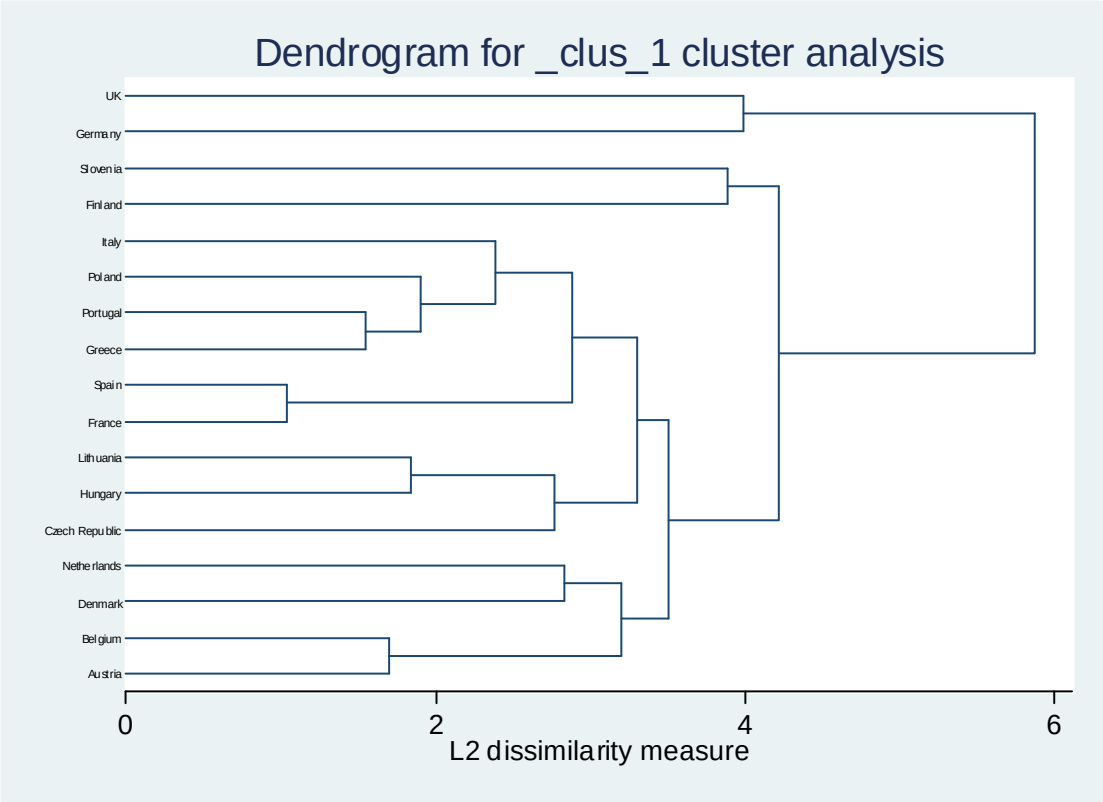
Source: Oxera analysis.

Figure A3.3 Average linkage method



Source: Oxera analysis.

Figure A3.4 Weighted average linkage method



Source: Oxera analysis.

A3.2 Third-party beta estimates for KPN

Table A3.1 Equity beta estimates for KPN (Bloomberg, as at June 2007)

		AEX (the Netherlands)	DJ Stoxx 600 (Europe)	FTSE World (Global)
2 years	Daily	0.82	0.83	0.74
	Weekly	0.78	0.85	0.86
	Monthly	0.51	0.50	0.57
5 years	Daily	0.77	0.88	0.84
	Weekly	0.68	0.78	0.78
	Monthly	0.66	0.69	0.74

Note: The end date of the estimation period is June 29th 2007. Betas are reported after the Bayesian adjustment.
Source: Bloomberg and Oxera analysis.

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