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The Cost of Capital for KPN's Wholesale Activities: A 3-year Estimate for 2009-2011

A Final Report for OPTA

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Executive Summary

This report sets out our best estimates of the cost of capital for KPN's wholesale fixed line telecommunications services as an input to the calculation of the price cap applying over the period 1st January 2009 to 31st December 2011. Our estimates are based on the following key principles:

- Estimates of each component of the WACC should be internally consistent, based on objective and consistent data sources, and must be empirically verifiable.
- Estimates of a "forward-looking" WACC to be applied over a three year price control period to December 2011 are based on the use of a risk-free rate maturing in 2011. Our estimate of the WACC is therefore implicitly based on market expectations over the period to 2011 and therefore this single WACC estimate is appropriate for the price control period from 2009 to 2011.
- Estimates of a "forward-looking" WACC should be based on the use of averages of time-series data, given recent evidence that there is current evidence of exceptionally low interest rates that cannot be reasonably expected to prevail over the near future. This is in line with the approach, previously accepted by the IG, set out in NERA (2005).[1]

Table 1:
Cost of Capital for KPN's Wholesale Fixed Line Telecomm Services

Cost of Equity	
Inflation	2.0%
Real risk-free rate	1.9%
ERP	6.2%
Asset beta	0.57
Financial gearing (D/(D+E))	36.7%
Equity beta	0.9
Real post-tax return on equity	7.48%
Cost of Debt	
Nominal cost of debt	5.15%
Real cost of debt	3.09%
WACC	
Corporate tax rate	25.5%
Real post-tax WACC (Net of Debt Tax Shield)	6.14%
Nominal pre-tax WACC	10.41%
Real pre-tax WACC	**8.25%**

Source: NERA analysis.

Our best estimate of the real pre-tax cost of capital for KPN's wholesale activities in estimating the regulatory price cap over the period 2009 to 2011 is 8.25%.

1 NERA (2005) "*The Cost of Capital for KPN's Wholesale Activities*"

1. Introduction

In this report we have estimated the cost of capital for KPN's wholesale fixed line telecommunications services as an input to the calculation of the price caps applying over the three-year period 1st January 2009 to 31st December 2011.

1.1. Structure of the Report

The structure of the report is as follows:

- Section 2 discusses choice of appropriate datasets in estimating CAPM parameters;
- Section 3 presents risk free rate estimates;
- Section 4 presents equity risk premium estimates;
- Section 5 presents beta estimates;
- Section 6 sets out cost of debt and gearing assumption;
- Section 7 concludes by presenting the WACC estimates; and
- Appendix A presents supporting information relating to the risk-free rate.

2. Choice of Appropriate Datasets in Estimating CAPM Parameters

This section discusses two key practical issues in estimating the cost of capital, and particularly with respect to the application of the CAPM: the choice of reference market and the choice of current or historic evidence as a basis for the parameter estimates.

2.1. Choice of Reference Market

From an investor's standpoint, the cost of capital should be estimated with reference to the financial market that best represents their investment opportunity set, as the cost of capital for any single investment is defined by the whole portfolio of investment opportunities to which an investor has access. This "set" is commonly referred to as the "market portfolio".

In theory the "market portfolio" should include both traded and non-traded assets. However, in practice WACC parameters are calculated with respect to readily available stock market indices, and therefore the "market portfolio" only captures assets listed on a stock exchange, to the exclusion of unlisted assets.

The next key question is whether to use a domestic, regional or worldwide index. Recent Dutch regulatory precedent has tended to use the Euro market as the reference capital market. The highly integrated nature of the financial markets suggests that the opportunity set facing investors is significantly wider than the Dutch domestic market.

Transaction costs and taxation barriers to investment in securities across countries have declined significantly over time. It is now a simple matter to purchase and sell shares traded on exchanges in other countries. For example, the purchase of ADRs and ADSs[2] provides a simple means for accessing equity in foreign companies, as do a wide range of mutual funds in Europe that hold an international portfolio of equity investments.[3]

It is also true that by spreading risks among different domestic equity markets, investors can achieve lower risks and/or improve investment returns. Not only have global portfolios outperformed individual domestic markets over the 1969-2008 period, but investors have also achieved reductions in risk through diversification across different countries, which reduces exposure to shocks in the domestic market.

Our approach in estimating the cost of capital for Dutch regulated companies is to draw on market evidence from the Eurozone and world markets in setting WACC parameter values, where relevant.

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2 American Depository Receipts and Shares

3 To illustrate, low-cost foreign index funds called "WEBS", an acronym for World Equity Benchmark Shares, eliminate some of the guesswork and costs involved in investing internationally. Each WEBS Index Series seeks to match the performance of a specific Morgan Stanley Capital International (MSCI) index.

2.2. Current or Historic Evidence

From a practical viewpoint, it is widely recognised that robust estimates of both the equity risk premium and beta can only be obtained using historic time series data. International regulators are increasingly use historic time series data as the main basis for deriving estimates of beta and the equity risk premium.[4] With regard to the risk-free rate, estimates can be based on either very short term (or spot) data or longer term yield evidence. A choice must therefore be made regarding the appropriate measurement time frame on which to base the risk-free rate estimate.

In estimating the risk-free rate to be used in estimating the cost of capital applied in the calculation of the price cap applying over the period 2009 to 2011 we must choose the measure that best proxies forward looking expectations of the interest rate prevailing over the period of the price cap. There are two key reasons why current or "spot" market data might not provide the best estimate of the forward looking risk-free rate:

- Excess volatility; and
- Biases/distortions to yields arising from institutional factors.

These issues are discussed in further detail below.

2.2.1. Volatility

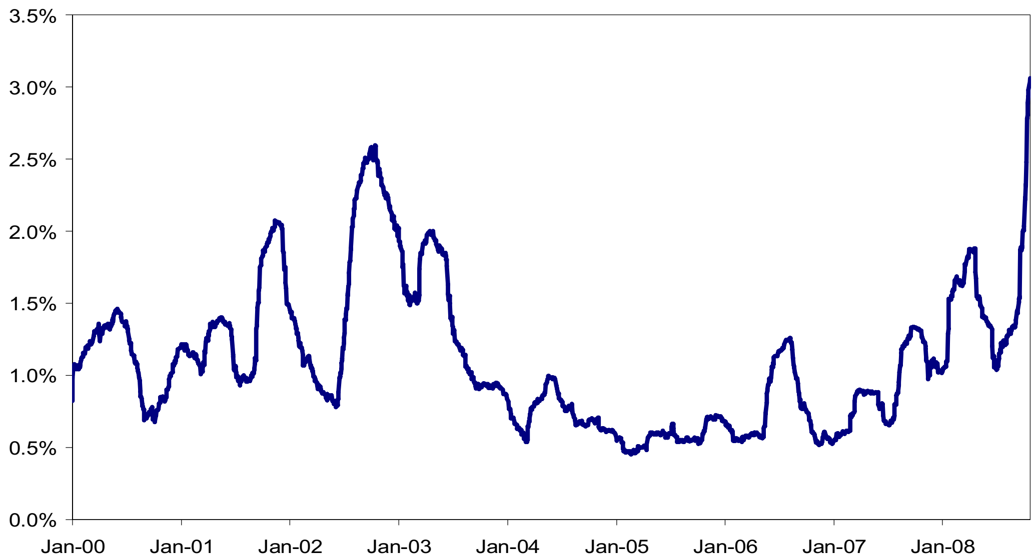
There is widespread evidence that financial markets have exhibited periods of "excess volatility" that cannot be explained by standard economic paradigms such as the Efficient Markets Hypothesis (EMH). The implication of "excess volatility" and "stock market bubbles" is that current "spot" prices do not provide complete information regarding expected future values. Since "excess" volatility is by its nature only temporary phenomena, the use of historic time-series evidence on WACC parameters may be a better guide to true fundamentals.

4 In its (2004) Final Determinations, Ofwat used the top end of a 2.5% to 3.0% range for the real risk-free rate, "*based on a period average level of yields on medium-term index-linked gilts rather than recent yields which appear historically low*". Ofgem (2004) also used a risk free rate of around 3.0% in setting the cost of capital for the DNOs.

A paper by Smithers and Wright[5] (2002) argued that there is powerful recent evidence of mis-valuation in world stocks markets and also predictability ('mean reversion') in stock price returns over long investment horizons.[6] They conclude by saying *"There are strong reasons, both in principle and in practice, to doubt the applicability of the EMH to the valuation of the stock market as a whole."* A number of other empirical studies have shown that stock prices regularly display evidence of "excess" stock market volatility.[7]

The chart below presents evidence that shows significant changes in levels of market volatility over relatively short periods of time. Figure 2.1 shows the volatility of the Dow Jones European 600 Index since 2000. In this chart, volatility is measured on an historic basis using the standard deviation of daily returns over the prior three months.[8]

Figure 2.1
3-Month Rolling Standard Deviation of Daily Returns on Dow Jones European 600 Index (January 2000 – October 2008)



5 Smithers A. and Wright S. (2002), Stock Markets and Central Bankers: The Economic Consequences of Alan Greenspan, available at www.smithers.co.uk.

6 Smithers and Wright were also authors of a study on the cost of capital commissioned by the UK Joint Regulators Price Control Group, (See Smithers (2003)).

7 As examples of the literature, McConnell and Perez Quiros (1999) find evidence that the volatility of aggregate output has actually fallen since the early 1980s. Cochrane (1991), amongst others, has confirmed that increased market volatility is not matched by the fundamentals and has therefore found evidence of "excess" market volatility. Shiller (1981) attributed this excess volatility to changes in sentiment, and not to fundamentals such as ex post dividend volatility.

8 The variance is the average squared deviation from the mean daily return over the 3-month period; the standard deviation is defined as the square root of the variance and is measured in the same percentage units as the returns of the stock price index.

Source: NERA analysis of Bloomberg data.

The first period of high volatility shown in Figure 2.1 occurred in the aftermath of the terrorist attacks of September 11, 2001. The standard deviation of daily returns reached just over 1.8% at its peak. A second period of high volatility began around June 2002 and peaked in August 2002 at over 2.6%. Uncertainty over the military position regarding Iraq was probably the main driving factor for this period of market turbulence. Volatility declined between October and March of the same year although remaining at a higher than average level until March 2003 when the war in Iraq began. Since mid-2003, the European equity market was relatively less volatile. In 2007 volatility rose again with the onset of the credit crunch. Volatility is currently higher than at any other point since 2000.

Evidence of periods of exceptional volatility in recent years place the Efficient Markets Hypothesis assumption underpinning the use of "spot" data in doubt, implying that caution should be exercised in interpreting "spot" or short term estimates of market parameters . Indeed, current volatility in 2008 is well above-average. Since by definition periods of excess volatility are short lived, longer term historical evidence may provide a better reflection of true fundamentals.

2.2.2. Distortions to yields arising from institutional factors

Higher than average levels of volatility have been one reason why global interest rates have fallen to lower levels in recent years.

A number of commentators have suggested that current historical lows may be partially caused by a number of "artificial" distortions to yields which do not reflect changes in the true underlying rate demanded by investors for holding a risk-free asset. These distortions include the influence of pension and insurance fund regulations which inflate demand for government yields, supply side distortions and mass purchase of US Treasuries by Asian Central Banks.

Without being able to fully explain current historical lows in interest rates, it is not clear that these levels will continue to persist in the future. This is exemplified by commentary suggesting that current lows are unsustainable. For example, Morgan Stanley states that "*We estimate that long-term real rates are close to 1 percentage point below sustainable levels.*" and "*we assess where sustainable – or equilibrium - real rates might be and conclude that they are likely to be significantly in excess of current levels.*"[9]

We therefore consider that the use of historical time-series evidence will prevent estimates being unduly influenced by anomalous current market conditions, which represent distortions to yields from the true risk-free rate demanded by investors.

As explained in Section 3, simply using historical averages will not necessarily avoid such distortions when using some approaches for calculating the risk-free rate. In these cases the particular approach is best avoided altogether. Nevertheless using historical data provides more appropriate estimates than spot data in all situations.

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9 Morgan Stanley (09/03/05) "*Where Should Long-Term Interest Rates be Today? A 300-Year View*".

2.2.3. Conclusion on current vs time series evidence

In summary, our recommendation is that, while accepting the general principle that estimates of the cost of capital should be forward-looking, there is current evidence of exceptionally low interest rates that cannot be reasonably expected to prevail over the future. The use of longer term historical data will ensure that estimates of WACC parameters are not affected by temporary factors that cannot be reasonably expected to continue to prevail, such as shocks to capital markets that cause excess volatility and factors driving the abnormally low interest rates currently observed.

We consider that a three year historical period, consistent with the length of the regulatory period, is an appropriate measurement period which minimises biases to forward-looking estimates of the cost of capital arising from temporary or abnormal distortions, whilst is short enough to reflect any fundamental medium term changes in underlying market conditions. The use of a measurement period equal in length to the regulatory period is consistent with our approach adopted in NERA (2005)[10] where the risk-free rate used in calculating the cost of capital applying over a three year price cap period (of 1st January 2006 to 31st December 2008) was estimated using three year's historical yield evidence.

2.3. Length of Maturity Period

The CAPM model is a so-called 'one-period' model which does not explicitly define the length of the underlying time horizon for the risk-free rate. Since the risk-free rate is typically estimated using government bonds, the choice of the redemption period can have an important impact on the estimate of this key parameter.[11]

An appropriately designed regulatory regime needs to ensure that investors are compensated for risk over the lifetime of the investments. This means before the investment decision, in order for investors to commit capital, they need to expect to break even on average and earn a risk-reflective rate of return on the investment over their investment horizon. There are two main approaches when considering the appropriate length of the maturity period used to determine a risk-free rate:

- Setting the underlying maturity equal to the end of the regulatory review period; or
- Setting the underlying maturity equal to the life of the asset.

The right approach depends on the investment horizon of a typical investor. For instance, an investment in a greenfield project (with yet unknown demand and technological uncertainties) would need to ensure its investors an appropriate compensation for the risks over the entire project live. In this case, the investment horizon would be the asset life of the new investment. Therefore, the risk free rate would need to be estimated with respect to the lifetime of the project.

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[10] NERA (2006) *"The Cost of Capital of Wholesale Activities: A Final Report for OPTA"*.

[11] We note economic theory (e.g. the Liquidity Theory) predicts that the government bond yield cure is upward sloping (meaning long-dated bonds trade at higher yields).

By contrast, the likely investment horizon of an investor investing in an already existing regulated utility business - where new investments mainly reflect replacement capex - is likely to be equal to the regulatory period. This is because the uncertainty surrounding the allowed regulatory rate of return is revised at the beginning of each new regulatory period. In this case, the risk-free rate should be based on the length of the regulatory review period.

The use of a maturity profile equal to the regulatory review period has also been proposed in Lally (2002):

> *"To summarise, the use of an interest rate of longer term than the regulatory period for setting output prices leads to two problems in a presence of a non-flat term structure. If the non-flat term structure is due to a liquidity premium, and therefore unpredictability in future spot rates, the use of the long-term spot rate for setting prices will lead to the revenues being too large ex ante, i.e., their present value will exceed the initial investment. In addition, if the non-flat term structure is due to predictable change over time in the short term spot rate, then the use of the longer term interest rate for setting prices will lead to revenues that are sometimes too large and sometimes too small, ex ante. <u>The only policy that leads to future cash flows whose present value matches the initial investment is the setting of prices using an interest rate whose term matches the regulatory period</u>. This is a basic test that any formula for setting output prices of regulated firms should satisfy"* (emphasis added).

To conclude, it is reasonable to assume that the investment horizon for a typical investor in a mature regulated utility business is equal to the length of the regulatory review period. In this case financial theory tells us that the risk free rate should be calculated with an underlying maturity equal to the length of the review period. Further, we note that OPTA has used a maturity equal to the regulatory period since 1997, and this approach has been accepted several times by the IG.

3. The Risk Free Rate

3.1. Methodology

The expected return on a risk-free asset, ($E[r_f]$), or the "risk-free rate", is the return on an asset which bears no systematic risk at all – i.e. the risk-free asset has zero correlation with the market portfolio. Alternatively, the real risk-free interest rate can be thought of as the price that investors charge to exchange certain current consumption for certain future consumption. In part, it is determined by investors' subjective preferences and in part by the nature and availability of investment opportunities in the economy.

There has some recent debate about the best methodology for estimating the real risk-free rate. The dominant methodology used by practitioners and regulators in the past is to use government bond yield evidence. There are two types of bonds that can be used – index-linked and nominal bonds. An alternative approach uses swap rates as a basis for a risk-free rate.

In a UK context, our preferred measure is the swap-based real risk-free rate. As explained below, index-linked bond yields are biased downward. As stated in previous NERA reports, we believe that in a UK context this bias spills over into the nominal gilt market. We therefore use swaps as the basis for a risk-free rate as this measure is free of such biases and the market has no liquidity problems.

However, this spill-over into nominal bonds is less apparent in a European context (as is discussed below). Furthermore, no regulator (to our knowledge) has used the swap-based approach as the predominant method for estimating the risk-free rate. So we believe that using deflated nominal bond yields is the most appropriate method for estimating the real risk-free rate in this context.

3.1.1. The Different Approaches

Index-linked Government Bonds

The approach we took in our 2006 report for OPTA[12] was to use government bond evidence. In terms of bonds, we ideally have a preference for the use of index-linked evidence wherever possible. In practice it is generally difficult to identify an asset that fulfils the criteria of zero correlation with the market since inflation, and other factors, has been shown to lead to covariance between theoretically risk-free government debt and equity returns. By being insulated from both inflation (and therefore inflation risk), yields on index-linked government bonds are less correlated with the market than the yields on nominal government bonds, and are therefore closer to satisfying the theoretical requirement of having a zero beta.[13] For this reason various regulatory precedent relies on index-linked bond yields to provide the closest proxy to the risk-free asset.

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12 NERA (2006) *"The Cost of Capital of Wholesale Activities: A Final Report for OPTA"*.

13 This point was made by Stephanie Holmans in Ofwat RP5 (1996), Section 2.5.

However, we believe that index-linked government bond markets are currently biased due to demand by pension funds and other institutional investors. Excess demand has pushed yields downward, especially for long-dated index-linked bonds. Yield data on Eurozone bonds, as shown in Section 3.2, provides evidence for this theory. There is also anecdotal evidence from central banks and the OECD describing the issue.

Recent commentary by the Bank of England outlines the issue:

> *"... strong pension fund demand for inflation-protected bonds has pushed down their yields ...this demand may reflect several regulatory and accounting changes over the the past few years that have encouraged pension funds to seek to match their liabilities more closely with inflation-linked assets"* (Bank of England (2008) Quarterly Bulletin, May)

The OECD has noted that this is a global phenomenon:

> *"Very long-dated and [index-linked] bonds seem to be currently undersupplied relative to perceived or expected demand"*[14]

Due to this downward bias in yields on index-linked bonds, we do not believe it will be an accurate measure of the real risk-free rate.

Nominal Government Bonds

An alternative method to using index-linked yields for estimating the risk-free rate is to use nominal bond yields, and derive the real risk-free rate by deflating nominal yields by inflation expectations. The use of nominal bonds as the basis for a real risk free rate is advantageous *if* the nominal government bond market is less distorted than the inflation-protected government bond market. There is precedent amongst European and Australian regulators for the use of deflated nominal bonds to estimate the risk free rate.

There is the possibility that the bias in index-linked markets will spillover into the nominal bonds market as investors weigh up the costs and benefits of different bonds. If this is the case in the Eurozone, then using deflated nominal yields is as problematic as using index-linked bond yields. But the yield data illustrated later shows that this does not appear to be the case fro the Eurozone. If the nominal bond market is not biased, then this appears to be a fairly reasonable approach to estimating the risk-free rate.

Swap-Rates

In this section we describe a third method for estimating the risk-free rate.

An interest rate swap involves two parties, one of which agrees to pay fixed-rate interest payments in return for receiving floating-rate interest payments. The payments are based on a notional principal, which never actually changes hands. The fixed rate is set at the inception of the contract, while the floating rate is tied to six-month Libor. Because the floating interest rate is not entirely risk-free – Libor includes an inter-bank credit risk premium (i.e.

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[14] As reported in Dow Jones International News (30 January 2006) *"Euro Yield Curve is Unlikely to Invert"*.

AA risk) – neither is the swap rate. Therefore, typically, a swap rate will exceed the rate on a government Treasury even abstracting from any distortions in the Treasury market.

A nominal risk-free rate can be obtained from the swap rate by subtracting some measure of the AA interbank credit risk. A measure of inter-bank - or AA credit risk - can be readily obtained from market data on default insurance premiums, so-called "Credit Default Swap" (CDS) or market indices thereof. Specifically, in deriving a swap-based risk-free rate, we base our estimate of inter-bank default risk on a CDS index for 5 year Senior Financials.

A swap-based *real* risk-free rate can be obtained by stripping out inflation expectations from the nominal risk-free rate. We do this by applying the Fisher formula to our nominal rate using OEF forecasts of RPI inflation.

In previous NERA reports we have advocated this approach as the most appropriate in a UK setting. Our primary reasoning has been that both the markets for index-linked and nominal government bonds in the UK are biased due to pension fund demand. The swap-based measure is free from any such distortions.

However we do not present swap-based evidence in this report. Unlike the UK setting it is not apparent that biases have spilled over from the index-linked bond market into the nominal bond market. Furthermore, regulators have shown little inclination to use this approach in practice.

3.1.2. Other Considerations

Our estimate is based on the following key principles:

- ***Use of three years of historical averages.*** As discussed in Section 2, it is widely acknowledged that interest rates are currently at an all-time low. Coupled with evidence of recent periods of excess market volatility, "spot" evidence may not be a robust proxy for the expected risk-free rate over a future time frame. We consider that the use of historical evidence will prevent undue bias to forward-looking estimates arising from such temporary influences on observed yields. Our preferred estimate of the risk-free rate is based on three year averages of yield evidence, consistent with the length of the regulatory period.
- ***Use of Eurozone Government bond yields as our primary source of evidence.*** Our preferred reference market to be used in estimating the risk-free rate for KPN's cost of capital is the Eurozone market. However, as set out in Section 1, wider European and global evidence is also relevant, and we cross-check our primary risk-free rate estimates against this evidence accordingly.

- ***Use of 2011 maturity in estimating the risk-free rate to be used in estimating the cost of capital applied in the calculation of the price cap applying over the period 1st January 2009 to 31st December 2011***. In previous reports for OPTA – where the cost of capital is used as a binding constraint to set regulated prices – we have advised on the use of a maturity equal to the regulatory period. In line with this methodology as accepted by the IG (see NERA (2005)) we estimate the risk-free rate for use in calculating the price cap using 2011 maturity (or as close as feasible) government bonds, as the WACC is being used to set cash flows for the prospective three year price control period and that period only. Since the regulated rate of return will be re-set in at the end of the price control period, in December 2011, the use of a risk free rate maturing at the end of the regulatory price control period to estimate the cost of capital at each regulatory price review means that the investor's expected rate of return over the whole of the asset life will be equal to the average prospective level of risk free rates with a maturity equal to the price control period length over the period of the asset life.

3.2. Index-Linked Government Bonds

In this Section we present evidence on international index-linked government bond yields. This Section summarises Appendix A which presents full details of the evidence assessed.

Eurozone Index-Linked Bonds

As stated above, we consider that the appropriate primary reference market to be used in estimating WACC parameters for KPN cost of capital is the Eurozone market. We present evidence on Eurozone yields in Appendix A.1. We summarise key points regarding this evidence below:

- Five governments in the Eurozone currently have index-linked bonds outstanding; France (known as OATis), Germany, Italy, Austria and Greece. France is the dominant issuer as shown in Appendix A.1.
- With the exception of the Austrian bond, we consider that the liquidity of all Eurozone bonds presented is comparable to the liquidity of nominal German government bonds.[15]
- Our preferred methodology as set out above uses the three year historical average of yield evidence and a maturity of as close as possible to the end of the regulatory period in 2011. Only France has bonds with a close maturity (one in 2011, one in 2012) issued before 2006, therefore ensuring three years of historical data.
- We therefore consider 2 French bonds, maturing in 2011 and 2012, as our best evidence from the index-linked bond markets. This evidence is presented in Table 3.1.

[15] Such that yields can be robustly used to estimate the real risk-free rate without requiring consideration of the presence of liquidity premia in observed yields.

Table 3.1
Conclusion on Index-Linked Bond Evidence on the Real Risk-Free Rate

	Issue Date	Maturity	3Y Average Yield to Maturity
France	22/06/2004	25/07/2011	1.8%
France	31/10/2001	25/07/2012	1.7%

Source: NERA analysis of Bloomberg data

The table shows that the average yield to maturity for the Eurozone index-linked bonds meeting out methodological criteria is 1.7-1.8% on a three year historical basis for application to the price cap calculation.

Given the small size of the sample, we consider additional European evidence as a cross-check on the French evidence. In particular we look at other European (non-Eurozone) index-linked evidence. We also consider nominal yields on German and Dutch government bonds, in order to further ensure robustness of our estimate. This additional evidence is presented in the following sections.

Other European and Developed Country Index-Linked Bonds

We also consider index-linked bond evidence based on wider European (non-Eurozone) markets. Whilst we consider that the Eurozone represents the best proxy of the reference market for the typical investor in Dutch equity markets, the significant erosion of barriers to capital movement, particularly between developed country markets, in recent years has resulted in the widening of investment opportunities to investors. In particular, the increase in diversification options and currency hedging instruments has significantly reduced the cost to and uncertainty associated with investing in different currency areas. Evidence of substantial cross-border equity holdings, particularly in government securities demonstrates the increasing openness of international capital markets. We therefore consider that wider European and developed market evidence is relevant in assessing the rate demanded by the typical Eurozone investor for holding risk-free assets.

We present evidence on wider European (non-Eurozone) index-linked bond yields in Appendix A. We summarise key points regarding this evidence below:

- Two wider European (non-Eurozone) governments currently have index-linked bonds outstanding; the UK (known as ILGs) and Sweden. Of these two issuers, the UK is the larger issuer as shown in Appendix A.
- With the exception of the Swedish 2028 bond, we consider that the liquidity of all wider European bonds presented is comparable to the liquidity of nominal German government bonds, such that yields can be robustly used to estimate the real risk-free rate without requiring consideration of the presence of liquidity premia in observed yields.
- The wider European market shows greater maturity than the Eurozone index-linked market, with the majority of bonds issued before 2004.
- One UK ILG and one Swedish bond are issued with maturity close to the end of the price cap period and sufficient historical evidence to estimate a three year historical average

yield in line with our methodological approach in estimating the risk-free rate for the price cap.

- While we present yields on a UK ILG, significant and widely acknowledged distortions to yields arising from institutional factors mean that UK ILG evidence cannot be robustly used in estimating the forward-looking risk-free rate. Yields have been widely acknowledged to be downwardly biased by factors since 1997 which have artificially inflated demand for UK ILGs, primarily the MFR[16] and later the FRS17.[17] [18]

- Our concluding set of wider European evidence on the real risk-free rate for the price cap is therefore based on the Swedish bond with a maturity of 2012, along with the UK ILG with maturity 2011, measured over a three year period.

Table 3.2
Other European Evidence on the Real Risk-Free Rate

	Issue Date	Maturity	3Y Average Yield to Maturity[1]
UK	28/01/1982	23/08/2011	1.9%
Sweden	27/09/2005	01/04/2012	1.7%

Source: NERA analysis of Bloomberg data. (1) Daily data from 01/11/2005 – 27/10/2008.

The Table shows that the average yield to maturity for wider European index-linked bonds meeting our methodological criteria is 1.7-1.9%. We further consider wider market evidence on index-linked bonds below.

We present evidence on wider developed market (non European) index-linked yields in Appendix A. We summarise key points regarding this evidence below:

- Three significantly sized wider market governments currently have index-linked bonds outstanding; the US (known as TIPS), Australia and Canada. Of these three issuers, the US is the largest issuer as shown in Appendix A.
- With the exception of the Australian bonds, we consider that the liquidity of all wider market bonds presented is comparable to the liquidity of nominal German government bonds, such that yields can be robustly used to estimate the real risk-free rate without requiring consideration of the presence of liquidity premia in observed yields.

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16 Minimum Funding Requirement

17 FRS17 refers to Financial Reporting Standard 17. This sets out the requirements for accounting for retirement benefits in company accounts and will replace SSAP24 'Accounting for Pension Costs' when it is fully implemented. The Debt Management Office (DMO) recently argued that the introduction of FRS17 may lead to an increase in demand for government gilts and strong corporate bonds as companies reallocate their pension portfolios from equities into gilts. The DMO cites the extreme example of Boots PLC which moved all its pension fund assets, around £2.3bn, predominantly from equities into long-dated gilts in 2001(DMO (2002) "Annual Review 2001-02", p11).

18 Regulators in the UK have widely acknowledged the downward bias in UK ILG yields – see for example, Competition Commission (2003) "Vodafone, O2, Orange and T-Mobile: Reports on references under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks", para 7.208.

- We note that reduced supply may have downwardly impacted on long maturity US yields, however we consider that these influences are not significant enough to warrant the exclusion of US evidence from our assessment of wider market evidence.
- With regard to the criteria of a 2011 maturity and at least three years of historical yield evidence available, several US TIPS maturing in 2011 and early 2012 are available. These bonds are presented in Table 3.3.

Table 3.3
Conclusion on Second-Tier Wider Market Evidence on the Real Risk-Free Rate

	Issue Date	Maturity	3Y Average Yield to Maturity
US	16/01/2001	15/01/2011	1.7%
US	28/04/2006	15/04/2011	1.8%
US	15/01/2002	15/01/2012	1.8%
US	30/04/2007	15/04/2012	1.5%

Source: NERA analysis of Bloomberg data.

The Table shows that the average yield to maturity for the US TIPS meeting our methodological criteria is 1.5-1.8%.

3.3. Nominal German and Dutch Government Bond Evidence

As stated in Section 2.1, our preferred reference market for estimating the risk-free rate in assessing the cost of capital for KPN is the Eurozone market. In the sections above we have assessed index-linked bonds. Given the relatively limited availability of direct Eurozone index-linked evidence and in order to ensure comprehensiveness in deriving a robust estimate of the risk-free rate, we further consider nominal yields on German and Dutch Government bonds. The use of German Government bonds is in line with standard regulatory and practitioner precedent in estimating the nominal risk-free rate for the Eurozone area. As a further consistency check, we also consider evidence on nominal Dutch Government bond yields. In line with our methodology set out in Section 3.1, we consider evidence on bonds fulfilling the following criteria:

- Issuance prior to October 2006, in order to enable estimation of three year historical average yields in line with our methodology set out earlier;
- Sufficient liquidity as indicated by the bid-ask spread (proxied by a bid-ask spread no higher than 0.2%); and
- Maturity as close to December 2011 as possible.

Table 3.4 presents evidence on nominal yields on German and Dutch Government bonds fulfilling the criteria set out above.

Table 3.4
Three-Year Average Yields on German and Dutch Government Bonds (Risk-Free Rate for Price Cap)

Issue Date	Maturity	3Y average nominal yield to maturity	Average (to 2011) Eurozone inflation forecast over 3Y(1)	3Y implied average real yield to maturity
Germany				
20/10/2000	04/01/2011	3.80%	1.9%	1.8%
25/05/2001	04/07/2011	3.83%	1.9%	1.9%
04/01/2002	04/01/2012	3.85%	1.9%	1.9%
05/07/2002	04/07/2012	3.87%	1.9%	1.9%
Average		**3.84%**	**1.9%**	1.9%
Netherlands				
11/01/2008	15/01/2011	3.91%	1.9%	2.0%
16/03/2001	15/07/2011	3.85%	1.9%	1.9%
15/02/2002	15/07/2012	3.90%	1.9%	2.0%
Average		**3.89%**	**1.9%**	**2.0%**
Average all			**1.9%**	**1.9%**

Source except where noted: NERA analysis of Bloomberg data
(1) Source for Eurozone inflation forecasts: Consensus Economics (2005-2007). Average inflation calculated for all bonds as average of average inflation expected in 2005, 2006 and 2007 for the maturity of the bond (to 2011).

The table shows that the average deflated yield on Eurozone nominal government bonds is 1.9%.

3.4. Conclusion on Real Risk-free Rate

Table 3.5 presents summary evidence on the real-risk-free rate.

Table 3.5
Conclusion on Real Risk-Free Rate

1st-Tier ILG Evidence	
Eurozone	**1.8%**
2nd-Tier ILG Evidence	
Europe (non Eurozone)	1.8%
North America	1.7%
2nd-Tier ILG Average	**1.8%**
Nominal Evidence	
Germany	1.9%
Netherlands	2.0%
Nominal Evidence Average	**1.9%**

Source: NERA analysis of Bloomberg data

Our primary estimate of the real risk-free rate is 1.9% based on Eurozone deflated nominal bond evidence.

This estimate is higher (albeit only slightly) than either estimates indicated by the index-linked yields, consistent with the evidence which suggests that index-linked yields are biased downward. It is nevertheless broadly consistent with the index-linked evidence.

All estimates outlined in the table are in the small range of 1.7-2.0%, despite being derived from two different instruments across a variety of countries. Our primary estimate of 1.9% is in the centre of this range, which gives us confidence in this estimate.

Our concluding estimate of the real risk-free rate is therefore 1.9%.

4. The Equity Risk Premium

The equity risk premium (ERP) is the difference between the expected return on the market portfolio and the expected return on a risk-free asset (formally stated as $E[r_m] - E[r_f]$ i.e. it is the reward investors demand for bearing the risk they expose themselves to by investing in equity markets.

In Section 4.1 we summarise recent Dutch and international regulatory precedent on estimates of the ERP. Section 4.2 summarises academic evidence on the ERP. In Section 4.3 we summarise the findings from analyses of long-run historical returns. Section 4.4 concludes.

4.1. Regulatory Precedents on the Equity Risk Premium

Table 4.1 presents other recent Dutch (DTe) regulatory precedent on the equity risk premium.

Table 4.1
Dutch Regulatory Precedent on the Equity Risk Premium

Regulator	Case (date)	ERP
DTe	TenneT (2005) (based on Tabors Caramanis & Associates)	6.4%
DTe	TenneT (2005) (based on Bratte Group)	5.7 - 7.9%
DTe	GTS (2005)	5%
DTe	TenneT (2006)	5%
DTe	(2008)	4 - 6%

Source: *Tabors Caramanis & Associates (May 2004) "Cost and Risk Analysis for a Norway-Netherlands HVDC Interconnector, Brattle Group (June 2004) "The Cost of Capital for the Nor-Ned Cable".*

Recent DTe precedent shows estimates of the ERP lying between 4% and 8%.

We also consider recent regulatory precedent on the ERP in the UK and other European countries, summarised in Table 4.2.

Table 4.2
Recent UK and European Regulatory Decisions on the Equity Risk Premium

Institution	Case	ERP
Ofgem (UK)	Transmission Price Review (2006)	5.2%
CER (Ireland)	Gas Distribution Review (2007)	4 – 5%
CC/CAA (UK)	BAA – Heathrow & Gatwick airports (2007)	4.5%
BNetzA (Germany)	Electricity and Gas Price Review (2008)	4.55%
CRE (France)	Gas Distribution Review (2008)	4.5%
Comreg (Ireland)	Eircom Review (2008)	6%

UK and European regulatory precedent shows slightly lower ERPs than those allowed by the DTe and the CER, in the range of 4 – 6%. Most recent decisions have tended to be around 4.5%, with the exception of Comreg. In most cases, some consideration has been given to evidence on historic average returns, however UK authorities have generally judged that the historic ERP overstates the current risk premium. Estimates of the ERP have generally relied heavily on small sample survey evidence on the expectations of investors. Surveys that have been considered by the authorities include CLSE (1999), Price Waterhouse (1998), NERA (1998) and other evidence from investment bank analysts. The reliance on survey evidence has prevailed despite the CC itself recognising that *"this evidence may be subject to biases that are difficult to quantify and assess"* (Competition Commission, 2000a, paragraph 8.28).

However, more recently, justification for the ERP allowed by regulators has focused more on a range of evidence including long run historical evidence of equity returns, ex-ante evidence (price-earnings) in addition to survey evidence. This move away from the reliance on survey evidence, which has been subject to a number of criticisms, has paralleled recent increases in the ERP allowed by UK regulators.

Outside the UK, in countries including the US, and Australia the ERP has generally been set at a higher level. In the US, although the CAPM is not widely used to estimate the cost of equity, it is often used as a check on the DCF results. The most widely quoted source used in US hearings to assess the level of the ERP is the Ibbotson data.[19] The method recommended by Ibbotson is to compute the arithmetic average of stock market returns against long-term Treasury bond yields.

4.2. Academic Evidence on the Equity Risk Premium

A large amount of academic literature exists discussing the ERP. In particular, the ERP has attracted significant recent academic debate, partly in response to the bullish equity markets observed in the US economy in the 1990s. Table 4.3 below presents selected academic estimates of the ERP, illustrating the large wide range of estimates of the ERP that have been derived in the literature.

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19 Ibbotson Associates publish data on the ERP every year in a handbook, "Stocks, Bonds, Bills & Inflation".

Table 4.3
Recent Academic Evidence on the Equity Risk Premium

Source	ERP estimate	Details
Brealey and Myers (1996)	8.5%	Long-run historical data
Bowman (2001)	7.5%	Summary of various US based literature including historical and ex-ante evidence
Franks (2001)	5%	N.A
Dimson, Marsh and Staunton (2001)	5%-10% (Eurozone)	Ex post estimates based on 101 years of data. Based on arithmetic averages
Welch (2001)	5.5% (average)	Mean long-term expected risk premium of respondents to survey of financial economist professors
Fama and French (2001)	2.6%-4.3%	Estimates derived from dividend and earnings growth models over 2nd half of 20th century. Compares with estimate from average returns of 7.43%.
Ibbotson and Chen (2001)	5.9-6.2%	Historical and supply side models.
Oxera (undated)[(1)]	4.7%-8.5%	Ex post estimates of one year and five years returns averaged using various periods over the last 100 years. Using the whole period the ERP was around 5%
Ibbotson (2002)	6.7%	US real returns over 1926-2001
Ibbotson and Chen (2003)	5.9%	Arithmetic basis, decomposing equity returns into inflation, earnings, dividends, P/E, dividend payout ratio, book value, return on equity and GDP per capita.
Lally and Marsden (2004)	5.5%	New Zealand historical returns 1931-2000
Siegel (2004)	3.0%	Dividend Growth Model, assuming that only a portion of dividend yield contributes to earnings growth
Dimson, Marsh and Staunton (2005)	5.9%	Average arithmetic returns on equity relative to bonds over period 1900 – 2004 for seven Eurozone countries

(1) Cited in Franks and Mayer (2001).

Of these studies, the Ibbotson and Chen (2001) study is widely quoted in international regulatory contexts.[20] The authors used historical evidence for the US market and supply side models (egg. dividend growth models) to predict future equity risk premia. The authors conclude:

> *"Contrary to several recent studies that declare the forward-looking equity risk premium to be close to zero or negative, we find the long term supply of equity risk premium is only slightly lower than the pure historical return estimate. The long-term equity risk premium is estimated to be about 6%*

[20] See IPART (2002) and related submissions.

arithmetically and 4% geometrically. Our estimate is in line with both the historical supply measures of public corporations (i.e. earnings) and the overall economic productivity (GDP per capita)".

4.3. Historical Evidence on the Equity Risk Premium

LBS/ABN AMRO Studies

Dimson, Marsh and Staunton (2007) based on data up to end year 2006 report returns on equity markets for 17 countries around the world over the last 107 years over the period from 1990 - 2006, and compares them against the returns on treasury bills and bonds. The results are summarised in Table 4.4 for the Eurozone markets reported by Dimson, Marsh and Staunton, US, UK and the world average.

Table 4.4
LBS / ABN AMRO Estimates of the Equity Risk Premium, Relative to Bonds, Arithmetic Averages (1900 – 2006)

Ireland	5.4%
Belgium	4.6%
Netherlands	6.1%
Spain	4.6%
France	6.2%
Italy	7.8%
Germany[1]	8.5%
Eurozone average	**6.2%**
USA	6.6%
UK	5.4%
World average (unweighted)[2]	**6.1%**
World (DMS weighted index)	**5.2%**

Source: LBS / ABN AMRO (2007) "Global Investment Returns Yearbook. The German estimates are based on returns over 105 years of data, with 1922/3 excluded where hyperinflation had a major impact on the risk premia and bills returned –100%. .(2) This is a NERA-calculated unweighted average of: Australia, Belgium, Canada, Denmark (from 1915), France, Germany, Ireland, Italy, Japan, Netherlands, Norway, South Africa, Spain, Sweden, Switzerland (from 1911), UK and USA.

In line with our approach set out in Section 2.1 our primary estimates of the cost of capital components for KPN's wholesale activities are based on Eurozone data. The Table shows that the unweighted Eurozone average arithmetic ERP relative to bonds measured over the period 1900-2006 ranging from 4.6% to 8.5%, with an average of 6.2%.

This estimate is broadly consistent with the unweighted world average (average of 17 countries) of 6.1%. DMS report a slightly lower figure of 5.2% for their constructed market cap weighted World Index, however, we note that this index is dominated by the US (in 2006 DMS report that the US comprised 48% of world market capitalisation and the UK 10%. These proportions are likely to be even higher historically). This average may therefore not be as relevant as a secondary source of supporting evidence as the unweighted world average.

Both the Eurozone and unweighted world averages are broadly consistent with the Netherlands average of 6.1%.

In conclusion, the updated Dimson, Marsh and Staunton data shows an equity risk premium for the Eurozone ranging broadly from 4.5% to 8.5% and averaging 6.2%. This is consistent with World and Netherlands evidence.

Choice of averaging process

Substantial debate has taken place over whether average realised historical equity returns should be calculated using either geometric or arithmetic averages.

A large number of academic papers have stated a preference for the use of arithmetic means of historical data to estimate a prospective equity risk premium. Two examples of the arguments presented are as follows:

- Dimson, Marsh and Staunton (2000) argue (p.9) that "When decisions are being taken on a forward-looking basis, however, the arithmetic mean is the appropriate measure since it represents the mean of all the returns that may possibly occur over the investment holding period".[21]
- In his book "Regulatory Finance", Morin (1994) argues, "One major issue relating to the use of realized returns is whether to use the ordinary average (arithmetic mean) or the geometric mean return. Only arithmetic means are correct for forecasting purposes and for estimating the cost of capital."

Consistent with recent mainstream academic wisdom, NERA favour the use of the arithmetic rather than the geometric mean in deriving an average measure to calculate the ERP using historical data.

In their Millennium Book, Dimson, Marsh and Staunton (2001) note that historical evidence on the equity risk premium may overestimate the prospective risk premium. In particular, they argue (p.134) that periods of extreme volatility observed during the 20th century may mean that arithmetic averages of historical data may overestimate the prospective risk premium. They present recalculated arithmetic averages of the risk premia based on projections of early 21st century levels of volatility. Based on this evidence they show that arithmetic averages are around 0.6% lower when re-based for assumed lower levels of market volatility.[22] However, we note that this adjustment is contested (see for example Wright, Mason and Miles (2003).[23] Caution over adjustments for differences in forward looking volatility relative to long run historical levels may be particularly relevant with respect to recent market behaviour since 2001 (occurring after DMS (2002)) which has demonstrated

[21] Dimson, Marsh and Staunton (2000) "*Risk and Return in the 20th and 21st Centuries*", Business Strategy Review 2000, Volume 11 Issue 2, pp1-18.

[22] In Table 28 of their report, Dimson, Marsh and Staunton show that the predicted arithmetic mean equity risk premia versus bills for the UK is 5.9%. This compares to historical evidence presented in Table 25 that shows the UK equity risk premia relative to bills of 6.5%.

[23] Wright, Mason, Miles (2003), "A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK", Smithers and Co Ltd.

periods of volatility significantly higher than previous average levels. Other arguments are presented by Dimson, Marsh and Staunton that also suggest that future ERPs may differ from historical estimates. These arguments can be summarised as:[24]

- Systematic underestimation of inflation by investors;
- High levels of technological, productivity and efficiency growth over the 20th Century that they (DMS) consider are unlikely to be repeated; and
- Observed rising stock prices (and therefore returns) are also suggested to be a sign of lowered long term investment risk which would result in a reduction in *required* rates of return.

Dimson, Marsh and Staunton's conclusion that the prospective equity risk premium is lower than the historical equity risk premium is not without controversy. There are a number of criticisms of DMS' approach to and justification for deriving downward adjustments to historical returns evidence, made both by other academic commentators and by DMS themselves.

We do not incorporate this contested analysis in our estimate, particularly given that recent long run estimates of the ERP are downwardly influenced by recent consecutive and significant losses in global equity markets associated with the bear market of the early 2000s. This decrease in the measure of the ERP is counterintuitive; the bear market is widely reported to have been associated with an increase in the ERP. Further, DMS themselves recognise the exceptional nature of recent falls. We therefore conclude that 2007 evidence may be on the low side as an estimate of the forward looking ERP.

In summary, Dimson, Marsh and Staunton present long-run ex-post evidence over the period from 1990 to 2006 that suggests an ERP for Netherlands and the major Eurozone markets ranging from 4.6% to 8.5%, averaging 6.2% and a world average of 6.1%, based on arithmetic historic averages. We object to any adjustment of historic averages without a formal proof that historic ERP estimates are biased. In the absence of such a reliable proof (and with it a robust and transparent methodology to adjust historic data) any adjustment of historic data is highly arbitrary. We therefore, rely on Dimson, Marsh and Staunton's analysis of long-run historical evidence of the ERP, which shows an equity risk premium of 6.1% for the Netherlands.

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[24] The authors show, by decomposing the historical ERP and subtracting the estimated impact of unanticipated cash flows and reductions in investors' required rates of return, that predicted ERPs are likely to be greater than historical estimates. Overall, the authors conclude that factors such as these would have likely led to a reduction in investors required rates of return and a reduction in the equity risk premium. They conclude that this evidence suggests (p.149) that the net effect of these factors means an expected equity risk premium on an annualised basis is around 3-4 percent; and on an arithmetic mean basis is around 4-5 percent. This is around 1.5% lower than the ERP implied by the historical averages.

4.4. Summary and Conclusions on the Equity Risk Premium

We summarise evidence presented in this section:

- OPTA and DTe regulatory precedent shows estimates of the ERP in the range of 4.0% to 8.0%.
- Recent UK and European regulatory precedent shows central estimates of the ERP in the range of 4% to 6%.
- Recent academic papers generally conclude that the equity risk premium lies in a range of 4% to 8%. The widely quoted Ibbotson and Chen (2001) study estimates an equity risk premium in the range of 4% to 6%.
- Long-run arithmetic historical averages of the ERP for Eurozone and World countries, presented by ABN AMRO and LBS (Dimson, Marsh and Staunton (2007) suggest an ERP lying in the centre of the range of 4.5% to 8.5%, with their point-estimate being 6.2%.

Overall, we conclude that Dimson, Marsh and Staunton's analysis shows that the equity risk premium is most likely lie around 6.2%. This is consistent with the midpoint of the range and average arithmetic ERP for Eurozone countries, and is consistent with the average ERP for the World and Netherlands measured over the period 1900-2006.

Of all the evidence presented we consider the LBS/ABN AMRO data on the historical equity risk premia over 1900-2006 to be the most compelling. This data source is widely recognised as the most comprehensive and consistent dataset of historical returns. It also produces estimates of the ERP that are remarkably consistent across countries over a long period of time.

We conclude that 6.2%, the central point indicated by the Dimson, Marsh and Staunton analysis is the appropriate ERP for our Eurozone reference market, taking into account regulatory precedent and other academic evidence.

5. Beta

There are two key issues involved in the estimation of a beta coefficient for KPN. These are:

- The appropriate time-frame over which to estimate the betas; and
- The method of de-leveraging our observed equity betas to derive comparable asset betas.

We discuss these two issues below.

5.1. The Time Frame

Beta estimates are generally obtained by means of regression analysis using historical evidence of the relationship between the returns to a company and the returns to the market as a whole. However, using historical evidence raises the question of the appropriate time period over which to estimate beta.

It is standard practice to estimate betas over a range of time periods between 6 months and 10 years and for data periodicities ranging from daily to monthly. Since the beta estimate is to be used as a forward looking measure of risk, under the assumption of market efficiency, the most economically relevant estimation time frame is the most recent period. However, there are three reasons why consideration should be given to betas derived from longer time periods.

- Beta estimates require a sufficiently long time period to smooth out the effects of business cycles
- Short term excess volatility can distort beta estimates
- A longer time period provides more statistically robust regression results.

For these reasons, we consider betas based on returns data over periods ranging from 6 months to five years.

5.2. Estimating Asset Betas from Observed Equity Betas

There are two adjustments we have to make to our observed equity (or regression) betas to derive asset betas.

The Blume Adjustment process

First, the raw betas (or historical betas, i.e. those betas obtained from the regression of the company's stocks against the market index) have been adjusted according to a simple deterministic formula:

$$\beta_{Equity\text{-}adjusted} = (0.67)*\beta_{Equity\text{-}raw} + (0.33)*1.0.$$

This is referred to as the Blume technique.

Blume tested to see if forecasting errors on based on historical estimates were biased. Blume demonstrated that a tendency for estimated betas to regress towards their mean value of one.

The adjustment formula above captures this tendency. There is also an alternative adjustment process, referred to as the Vasicek process. Vasicek developed a method for adjusting betas that took into account differences in the degree of sampling error for individual firm betas rather than applying the same adjustment process to all stocks.

There has not been extensive research into their comparative accuracy. Klemkosky and Martin (1975) discovered that the Vasicek technique had a slight tendency to outperform the Blume technique[25]. However, a slightly later study by Eubank and Zumwalt (1979) concluded that the Blume model generally outperforms the Vasicek model over shorter timeframes, with little difference between the over long time periods[26].

Allowing for financial risk

The value of the equity beta (ie the beta obtained from regression analysis) will not only reflect business riskiness, but also financial riskiness.[27] Equity betas have been adjusted for financial risk ("de-levered") to derive asset (or "unlevered") betas according to the following formula:[28]

(5.1) Miller formula: $\beta_{equity} = \beta_{asset}\ (1+(D/E))$

where D represents a company's debt, and E represents a company's equity.[29]

An alternative formula for unlevering betas is the following, attributable to Modigliani and Miller:

(5.2) Modigliani-Miller formula: $\beta_{equity} = \beta_{asset}\ (1+(1-t_e)\ (D/E))$

where tc is the effective tax rate.

The basic difference between the Modigliani-Miller theory and the Miller theory is as follows: Modigliani-Miller assume that debt is treated more favourably than equity, which in practice occurs through the effect of corporate tax shields on debt. Miller, subsequently, raised the possibility that debt could be treated more favourably than equity when there are different personal tax rates on debt that offset the effect of the corporate tax shields.

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25 Klemkosky and Martin, The Adjustment of Beta Forecasts", Journal of Finance, X, No. 4 (1975); cited in Elton and Gruber, Modern Portfolio Theory and Investment Analysis, Fifth Edition, page 145.

26 Eubank and Zumwalt, "An analysis of the Forecast Error Impact of Alternative Beta Adjustment Techniques and Risk Classes", Journal of Finance, 33 (5), 1979; cited in The Cost of Capital, Theory and Estimation, C S Patterson, page 127.

27 As a company's gearing increases, the greater the variability of equity returns, since debt represents a fixed prior claim on a company's operating cashflows. For this reason, increased gearing leads to a higher cost of equity.

28 This formula is attributed to Miller (1977).

29 This formula does not include the debt beta. The debt beta is immaterial for the cost of equity in this situation because KPN's actual gearing is very similar to the assumed notional level (since we base the notional level on actual gearing). The observed equity beta is both de-levered and re-levered using the Miller formula, and if the gearing level is the same for each of these then the final equity beta is independent of the debt beta value. Therefore, since the debt beta is immaterial, we have ignored it for ease of exposition.

Some recent empirical evidence suggests that the more appropriate formula for levering and un-levering betas is the Miller formula.[30] We also prefer to use this formula for its simplicity since it does not require estimation of forward-looking effective tax rates for telecommunications companies.

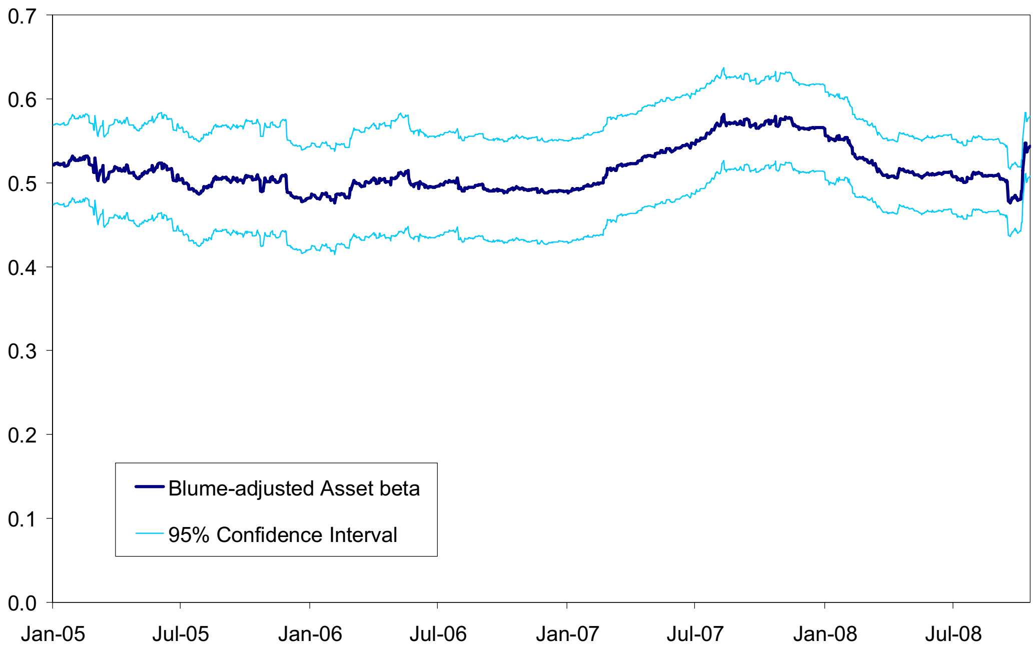
The impact of using the Miller formula rather than the Modigliani-Miller formula is the derived asset beta is lower. However, when the beta is levered back up to an assumed gearing the overall impact on the WACC is very small (provided the assumed gearing is broadly similar to the actual gearing used for de-levering).

5.3. Empirical Evidence

Figure 5.1 shows a time series of KPN's Blume-adjusted asset beta estimates from January 2005 to October 2008 (represented by the darker blue line). This time series consists of 2-year rolling asset betas, i.e. the first historic rolling asset beta in 03/01/2005 has been estimated using two years of daily returns data from 06/01/2003 – 03/01/2005. Beta estimates have been estimated against the DJ Stoxx European 600 Index. We also calculated the 95%-confidence interval for our KPN's (mean) beta estimate, i.e. we can be reasonably sure that the "true" beta estimate is within the range of the upper- and lower blue lines.

30 A recent study by Graham (2002) in the Journal of Finance suggests that personal taxes in the US can offset 50% of the debt interest tax shield. Other recent theories originating with Miles and Ezzell (1980) have noted that the expected value of the corporate debt tax shield declines with increasing debt since as a firm increases its debt it becomes less likely that the firm will pay tax in any given state of nature. These theories are particularly relevant for the current volatile circumstances of the telecom industry where the value of the interest tax shield is lower.

Figure 5.1
KPN 2-Year Rolling Asset Beta, Blume-adjusted
(Mean Estimate, 95%-Confidence Interval)



Source: NERA analysis of Bloomberg data

Figure 5.1 shows that KPN's historic two-year asset betas have been quite unstable over the past 2 years. The rolling beta was stable at around 0.5 during 2005 and 2006, but since then increased to 0.58 in the second half of 2007 before falling again to earlier levels. The estimated beta has been around 0.5 for much of 2008, with a 95% confidence interval of around 0.45-0.55. We note that there has been considerable volatility in the most recent months, and the most recently estimated beta is around 0.55.

Table 5.1 presents estimates of KPN's beta values using daily and weekly frequencies and different time intervals ranging from six months to 5 years. Table 5.2 presents beta estimates of other European comparator companies.

Table 5.1
Beta Estimates for KPN

	Debt-to-Equity	Market Gearing	Beta, 6 months (daily)		Beta, 1 year (daily)		Beta, 2 years (weekly)		Beta, 5 years (weekly)	
Company	**D/E**	**D/(D+E)**	**Equity**	**Asset**	**Equity**	**Asset**	**Equity**	**Asset**	**Equity**	**Asset**
KPN	59%	37%	0.84	0.53	0.79	0.51	0.78	0.52	0.77	0.50
95%-Confidence Interval			0.75 - 0.92	0.48 - 0.58	0.72 - 0.85	0.47 - 0.55	0.62 - 0.93	0.42 - 0.63	0.66 – 0.89	0.42 - 0.57

Table 5.2
Beta Estimates for European Telecommunications Companies

	Debt-to-Equity[1]	Market Gearing	Beta, 6 months		Beta, 1 year		Beta, 2 years		Beta, 5 years	
Company	**D/E**	**D/(D+E)**	**Equity[2]**	**Asset[3]**	**Equity[2]**	**Asset[3]**	**Equity[2]**	**Asset[3]**	**Equity[2]**	**Asset[3]**
Teliasonera	28%	22%	0.77	0.61	0.73	0.60	0.76	0.65	0.76	0.65
BT Group	77%	44%	0.99	0.58	0.96	0.60	0.91	0.62	0.86	0.53
France Telecom	94%	48%	0.91	0.50	0.91	0.50	0.91	0.48	1.10	0.36
Deutsche Telekom	102%	50%	0.92	0.47	0.85	0.46	0.75	0.42	0.78	0.42
Telefonica SA	67%	40%	0.89	0.54	0.90	0.56	0.88	0.52	0.87	0.54
Portugal Telecom SGPS	102%	50%	0.85	0.43	0.81	0.45	0.66	0.40	0.70	0.43
Average (ex KPN)	**78%**	**42%**	**0.89**	**0.52**	**0.86**	**0.53**	**0.81**	**0.52**	**0.85**	**0.49**

Source: NERA analysis of Bloomberg data. Betas have been estimated against the DJ Stoxx European 600 Index (SXXP), over time periods which end on 20/10/2008 (1) The gearing rates used for unlevering are the averages over the time period in question. Market gearing value quoted is most recent available: usually 10/08; for longer term betas, the value used for gearing is matching the term. (2) Raw equity betas have been adjusted using the following formula: $\beta_{equity\_adjusted} = (0.67)*\beta_{equity\_raw} + (0.33)*1.0$. *The equity betas reported in the table are the adjusted betas. (3) Adjusted equity betas have been unlevered using equation the following formula:* $\beta_{equity\_adjusted} = \beta_{asset}\,(1+(Debt/Equity))$.

The evidence on asset beta estimates presented in Table 5.1 and Table 5.2 is summarised inTable 5.3.

Table 5.3
Asset Beta Estimates for KPN and Eurozone Telecom Companies

	6 month daily asset beta	1 year daily asset beta	2 year weekly asset beta	5 year weekly asset beta
KPN	0.53	0.51	0.52	0.50
KPN 95% conf. interval	0.48 - 0.58	0.47 - 0.55	0.42 - 0.63	0.42 - 0.57
Industry Average	0.52	0.53	0.52	0.49

Source: NERA analysis of Bloomberg data

Our analysis of returns data for KPN reveals that in 2007 the range of asset beta estimates lies between 0.50 and 0.53 depending on the considered time window. Our asset beta estimates for the European comparator telecommunications companies are similar to KPN's asset betas. The average asset beta of our proxy comparators ranges from 0.49 to 0.53. However we note, the beta estimate is based on a regression analysis and will therefore contain a statistical error. In Table 5.3 we present the 95%-confidence interval for KPN's asset betas – that is, KPN's "true" asset beta is very unlikely to be larger or lower than these values.

Our preferred beta estimate is the 95%-confidence upper bound of KPN's 5 year beta estimate of 0.57. The 95%-confidence upper bound gives us confidence that KPN's true asset beta is very unlikely to be larger than 0.57. This is in line with the methodology used in previous NERA reports on the WACC for KPN, including NERA (2005)[31].

5.4. Beta – Conclusions

NERA's 2005 report *"The Cost of Capital for KPN's Wholesale Activities"* (December 2005) estimated an asset beta for telecommunications interconnection in the Netherlands from 2006-2008 of 0.6.

In reaching our conclusions regarding the appropriate current beta for telecommunications services in the Netherlands we note that the central beta estimates for Telecommunications Interconnection in the Netherlands and its comparators, shown in Table 5.1, Table 5.2 and Table 5.4 lie in the range of around 0.36 to around 0.65. In 2005, the central asset beta estimates for KPN and its comparators lay between 0.5 and 0.9.

Given that the current level of market volatility can lead to estimates of beta that are different than they would be under normal market conditions, we consider that most weight should be attached to the 5-year beta estimates, taking into account both KPN's empirical beta and the beta of comparators. On the basis of the 5-year weekly estimates for KPN and average telecoms stocks, we consider that the appropriate level of the "true" asset beta for KPN is 0.57, which is equal to KPN's 95%-confidence upper bound for the empirical numbers, and in line with the industry's five-year average empirical asset beta.

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[31] NERA (2005) *"The Cost of Capital for KPN's Wholesale Activities"*

6. The Cost of Debt and Gearing

6.1. Cost of Debt

NERA's approach to estimating a cost of debt is based on *actual* market evidence of historic debt issues by KPN. This reflects most closely both KPN's likely cost of debt finance prevailing over the near future (such as the regulatory price cap period 2009 to 2011) and historical actual debt costs. Table 6.1 presents information on the average spreads over government bonds of debt issued by KPN and comparator companies.

Table 6.1
KPN's EURO Debt Issues
(Excluding Callable/Convertible Bonds)

Issue date	Maturity	Coupon	YTM[1]	S&P Rating
12/04/2001	11/04/2008	8.25%	N/A	N/A
05/11/1998	05/11/2008	4.75%	7.30%	BBB+
21/07/2004	21/07/2009	5.45%	8.18%	BBB+
21/07/2004	21/07/2011	4.50%	6.37%	BBB+
13/11/2007	13/11/2012	5.00%	6.84%	BBB+
16/03/2006	18/03/2013	4.50%	6.90%	BBB+
16/09/2008	16/09/2013	6.25%	6.97%	BBB+
29/05/2007	29/05/2014	4.75%	7.07%	BBB+
22/06/2005	22/06/2015	4.00%	7.21%	BBB+
02/04/2008	15/01/2016	6.50%	7.25%	BBB+
Weighted Average[2]		**5.03%**		

Source: NERA analysis of Bloomberg data. (1) YTM stands for yield to maturity (2) Averages have been weighted by total amount outstanding

According to the data presented above, the average weighted[32] coupon of all of KPN's normal (non callable/convertible) bonds outstanding (denominated in euros) is 5.03%.

The outstanding bonds have a mixture of coupons with no discernable trend in coupon over time. A cost of debt based on recent and historic coupon rates will reflect KPN's actual cost of debt during its business cycle. We believe that the average weighted coupon of KPN's actual debt cost of 5.03% is a reasonable estimate of KPN's cost of debt over the regulatory period.

It is important to emphasise that the costs of debt finance associated with the coupon in the table exclude the costs of issue, Bank, Legal, Trustee and Paying Agent fees. In addition, corporate issues are usually made at a discount to par to meet investors preferred tax positions (discount part of returns is treated as capital gain) and to round the coupon payment

32 We used the total amount outstanding of each bond issue to weigh the different coupons.

to the nearest 1/8% (market practice). We understand that typically, an extra 10-15 bps[33] to bond coupons for fees and discounting arrangements must be added in order to adequately reflect KPN's cost of debt finance.

To conclude, our preferred estimate of the nominal cost of debt for KPN is 5.15%. This reflects both, future coupon payments as well as any additional costs associated with the issuance of bonds born by KPN.

6.2. Gearing

Table 6.2 presents the capital structure for KPN. We calculated KPN's debt-to-equity ratio as total debt outstanding divided by the market value of equity, using quarterly figures and averaged over the year. Based on this we also calculated the market gearing, which is total debt over enterprise value (D/(D + E)).

Table 6.2
KPN's level of Gearing
(Average Quarterly Gearing from 2003- 2008)

Financial Year	Debt-to-Equity D/E	Market Gearing D/(D+E)
2003	77%	43%
2004	66%	40%
2005	59%	37%
2006	51%	34%
2007	42%	30%
2008	58%	37%

Source: NERA analysis of Bloomberg data.

Table 6.2 shows that KPN's average market gearing decreased from 43% in 2003 to 30% in 2007, but has risen to 37% in 2008. For our purpose of calculating the average weighted cost of capital for KPN, we rely on KPN's most recent 2008 market gearing of 37%.

We would not expect the gearing assumption to matter significantly to the cost of capital estimate as the benefits of increased debt finance above 40% are largely offset through a higher cost of equity.

33 Bps stands for 'basis points' and 1 bps is equal to 0.01%.

7. WACC Estimates

Table 7.1 presents our overall estimate of the cost of capital for KPN's wholesale fixed line telecommunications services as an input to the calculation of the price cap applying over the period 1st January 2009 to 31st December 2011.

Table 1
Cost of Capital for KPN's Wholesale Fixed Line Telecomm Services

Cost of Equity	
Inflation	2.0%
Real risk-free rate	1.9%
ERP	6.2%
Asset beta	0.57
Financial gearing (D/(D+E)	36.7%
Equity beta	0.9
Real post-tax return on equity	7.48%
Cost of Debt	
Nominal cost of debt	5.15%
Real cost of debt	3.09%
WACC	
Corporate tax rate	25.5%
Real post-tax WACC (Net of Debt Tax Shield)	6.14%
Nominal pre-tax WACC	10.41%
Real pre-tax WACC	**8.25%**

Source: NERA analysis.

Our best estimate of the *real pre-tax* cost of capital for KPN's wholesale activities is 8.25%. On a nominal basis, the pre-tax WACC is 10.41%.

Appendix A. Evidence on the Risk-Free Rate

One possible method for estimating the risk-free rate to be used in calculating KPN's cost of capital is to use evidence on international index-linked government bond yields.

The international index-linked government debt market, led by the earlier development of the UK market, has grown very rapidly. The three largest index-linked bond markets are the US, the UK and France, however, rapid growth in other markets, notably Italy, has seen the size and diversity of issues in the global market increase significantly in recent years.

We consider the characteristics of the index-linked bond markets further in assessing the use of these bonds evaluating the real risk-free rate in the following sections.

A.1. Eurozone ILGs

Table A.1 presents yield and liquidity evidence on quoted Eurozone ILGs.

Table A.1
Eurozone ILGs

Issuer	Issue Date	Maturity	Currency	5Y bid-ask spread
France	29/09/1998	25/07/2009	EUR	0.023%
France	22/06/2004	25/07/2011	EUR	0.013%
France	31/10/2001	25/07/2012	EUR	0.010%
France	11/02/2003	25/07/2013	EUR	0.008%
France	23/11/2004	25/07/2015	EUR	0.008%
France	20/09/2005	25/07/2017	EUR	0.009%
France	22/01/2004	25/07/2020	EUR	0.008%
France	20/02/2008	25/07/2023	EUR	0.003%
France	01/10/1999	25/07/2029	EUR	0.005%
France	31/10/2002	25/07/2032	EUR	0.004%
France	14/03/2007	25/07/2040	EUR	0.002%
Germany	26/10/2007	15/04/2013	EUR	0.002%
Germany	15/03/2006	15/04/2016	EUR	0.007%
Italy	06/02/2004	31/07/2019	EUR	N/A
Italy	01/02/2007	15/09/2057	EUR	N/A
Italy	23/01/2008	15/09/2058	EUR	N/A
Austria	28/02/2003	28/02/2013	EUR	N/A
Austria	02/05/2003	02/05/2023	EUR	N/A
Greece	27/03/2003	25/07/2025	EUR	N/A
Greece	16/04/2007	25/07/2030	EUR	0.014%

Source: NERA analysis of Bloomberg data

The Table shows the following:

- ***Majority of issues after 2003.*** Of the 20 bonds shown, only four were issued prior to 2003. This is indicative of the rapid growth in the Eurozone ILG market in recent years. All of the bonds issued before 2003 were issued by France, consistent with the French market's position as the largest and most developed in the Eurozone.

- ***High liquidity for the majority of bonds.*** A concern voiced in the UK by the Competition Commission regarding the use of international index-linked bonds in estimating the real risk-free rate is that lower liquidity in international markets may mean that liquidity premia exist in yields relative to the more mature UK market. This concern should also be addressed in the context of the use of international index-linked bond yields in estimating the risk-free rate for Eurozone countries. The Table shows that all bonds have a five year average bid-ask spread of less than 0.03%. This is a considerably narrower spread that observed in our 2005 report. These bid-ask spreads are significantly lower than those seen in highly liquid commercial debt markets, confirming the qualitative evidence of strong liquidity in index-linked government bond markets relative to nominal markets.

A.2. Wider European ILG evidence

Table A.2
Other European ILGs

Issuer	Issue Date	Maturity	Currency	5Y bid-ask spread
UK	19/10/1982	20/05/2009	GBP	0.011%
UK	28/01/1982	23/08/2011	GBP	0.005%
UK	21/02/1985	16/08/2013	GBP	0.004%
UK	19/01/1983	26/07/2016	GBP	0.004%
UK	08/02/2006	22/11/2017	GBP	0.010%
UK	12/10/1983	16/04/2020	GBP	0.004%
UK	11/07/2007	22/11/2022	GBP	0.006%
UK	30/12/1986	17/07/2024	GBP	0.003%
UK	26/04/2006	22/11/2027	GBP	0.006%
UK	16/06/1992	22/07/2030	GBP	0.003%
UK	29/10/2008	22/11/2032	GBP	0.003%
UK	11/07/2002	26/01/2035	GBP	0.004%
UK	21/02/2007	22/11/2037	GBP	0.004%
UK	21/11/2007	22/11/2047	GBP	0.002%
UK	23/09/2005	22/11/2055	GBP	0.002%
Sweden	01/12/1995	01/12/2008	SEK	0.041%
Sweden	27/09/2005	01/04/2012	SEK	0.026%
Sweden	01/04/1994	01/04/2014	SEK	0.017%
Sweden	03/05/1999	01/12/2015	SEK	0.012%
Sweden	01/12/1995	01/12/2020	SEK	0.008%
Sweden	22/04/1999	01/12/2028	SEK	0.005%

Source: NERA analysis of Bloomberg data

The Table shows the following:

- ***Greater market maturity versus the Eurozone market.*** All but four bonds shown in the Table were issued prior to 2007, with many issues occurring prior to 2000. This contrasts with the relatively short period since issue of the majority of the Eurozone ILGs presented in Table A.1, and reflects the greater maturity of the Swedish and UK ILG markets.

- ***High liquidity for the majority of bonds.*** As with the Eurozone bonds, we consider the liquidity of wider European ILG bonds in assessing the appropriateness of their use in estimating the real risk-free rate. The Table shows that all bonds have a five year bid-ask spread average of less than 0.05%. As expected, the bid-ask spreads on the UK ILGs are generally lower than those observed for Eurozone and other ILG evidence (and nominal German Government bonds), reflecting the higher liquidity of the UK ILG market arising from its greater size and maturity relative to other ILG markets.

- ***Downward sloping yield curve for UK ILGs.*** Current UK ILG yields are generally negatively correlated with maturity, in contrast to other ILGs evidence which generally exhibits an upward sloping yield curve. An upward sloping yield curve is consistent with theory which predicts that investors will demand a term premium for holding longer maturity instruments, due to the higher risk associated with less certain cashflows.[34] The downward slope of the UK ILG yield curve is associated with the widely recognised downward bias to yields by institutional factors which have artificially inflated demand for UK ILGs, primarily the MFR and later the FRS17. [35] [36] [37]

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[34] Whilst it should be noted that spot curves can be downward sloping when future interest rates are expected to fall relative to current rates, due to the outweighing of the term premium effect by the expectation of lower future returns, longer period historical averages will contain yield evidence over the period of a business cycle, such that changing interest rate expectations, which are pro-cyclical, will generally have less influence on yields. Yields will therefore be more likely to demonstrate the upward sloping nature of the yield curve with respect to the term premium.

[35] See for example the Bank of England: "*The Minimum Funding Requirement led to strong institutional demand for ILGs. The combination of strong and rather price-insensitive demand (largely from pension funds) with limited supply has pushed real yields down, perhaps more than in the conventional gilt market. Consequently, real yields in the ILG market may not be a good guide to the real yields prevailing in the economy at large"*[35] (Bank of England (1999) *Quarterly Bulletin*, May).

[36] FRS17 refers to Financial Reporting Standard 17. This sets out the requirements for accounting for retirement benefits in company accounts and will replace SSAP24 'Accounting for Pension Costs' when it is fully implemented. The Debt Management Office (DMO) recently argued that the introduction of FRS17 may lead to an increase in demand for government gilts and strong corporate bonds as companies reallocate their pension portfolios from equities into gilts. The DMO cites the extreme example of Boots PLC which moved all its pension fund assets, around £2.3bn, predominantly from equities into long-dated gilts in 2001(DMO (2002) "Annual Review 2001-02", p11).

[37] Regulators in the UK have widely acknowledged the downward bias in UK ILG yields – see for example, Competition Commission (2003) "Vodafone, O2, Orange and T-Mobile: Reports on references under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks", para 7.208.

A.3. Wider Market ILG Evidence

Table A.3
Wider Market ILGs

Issuer	Issue Date	Maturity	Currency	5Y bid-ask spread
Australia	22/02/1993	20/08/2010	AUD	0.031%
Australia	18/05/1994	20/08/2015	AUD	0.030%
Australia	14/10/1996	20/08/2020	AUD	N/A
Canada	10/12/1991	01/12/2021	CAD	0.004%
Canada	07/12/1995	01/12/2026	CAD	0.003%
Canada	08/03/1999	01/12/2031	CAD	0.005%
Canada	09/06/2003	01/12/2036	CAD	0.002%
Canada	04/06/2007	01/12/2041	CAD	0.008%
US	15/01/1999	15/01/2009	USD	0.030%
US	18/01/2000	15/01/2010	USD	0.020%
US	29/10/2004	15/04/2010	USD	0.022%
US	16/01/2001	15/01/2011	USD	0.015%
US	28/04/2006	15/04/2011	USD	0.012%
US	15/01/2002	15/01/2012	USD	0.012%
US	30/04/2007	15/04/2012	USD	0.015%
US	15/07/2002	15/07/2012	USD	0.011%
US	30/04/2008	15/04/2013	USD	0.014%
US	15/07/2003	15/07/2013	USD	0.010%
US	15/01/2004	15/01/2014	USD	0.009%
US	15/07/2004	15/07/2014	USD	0.009%
US	18/01/2005	15/01/2015	USD	0.009%
US	15/07/2005	15/07/2015	USD	0.008%
US	17/01/2006	15/01/2016	USD	0.008%
US	17/07/2006	15/07/2016	USD	0.008%
US	16/01/2007	15/01/2017	USD	0.007%
US	16/07/2007	15/07/2017	USD	0.007%
US	15/01/2008	15/01/2018	USD	0.007%
US	15/07/2008	15/07/2018	USD	0.007%
US	30/07/2004	15/01/2025	USD	0.004%
US	31/01/2006	15/01/2026	USD	0.004%
US	31/01/2007	15/01/2027	USD	0.004%
US	31/01/2008	15/01/2028	USD	0.004%
US	15/04/1998	15/04/2028	USD	0.003%
US	15/04/1999	15/04/2029	USD	0.003%
US	15/10/2001	15/04/2032	USD	0.003%

Source: NERA analysis of Bloomberg data.

The Table shows the following:

- ***Greater market maturity versus the Eurozone market but lower maturity versus the wider European market (UK and Sweden).*** The Table shows that the Australian and Canadian ILG markets are significantly more mature than the Eurozone markets and the US markets, with issuance in these markets as early as 1991 (Canada) and 1993 (Australia). The US market is a slightly younger, with the first issue in 1998 consistent with the first French issue in 1998.

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