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# The Cost of Capital for KPN's Wholesale Activities

A Final Report for OPTA

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## Executive Summary

In this report we have estimated the cost of capital in 2004 for KPN's wholesale fixed line telecommunications services as an input to the calculation of the price caps applying over the three-year period 1<sup>st</sup> January 2006 to 31<sup>st</sup> December 2008. The price caps from 2006 to 2008 are set by OPTA with a step function following a straight line from the cost prices in 2004 to the cost prices in 2008. Given this method of setting the price cap, the cost of capital in 2004 should be estimated as if a price cap for the period 2004 to 2006 was set. Therefore, the cost of capital estimated for 2004 can also be used for estimating the cost of capital in 2005. Our cost of capital estimate is based on latest data up to end year 2004 and is 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.
- § Our estimate of the cost of capital is based on our best estimate of market expectations over the period from 2004 to 2006.
- § Estimates of a "forward-looking" WACC should be based on the use of averages of time-series data, given recent evidence of exceptionally low yields on government bonds. <sup>1</sup>

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

<b>Cost of Equity</b>	
Inflation	1.59%
Real risk-free rate	2.09%
ERP	6.00%
Asset beta	0.66
Financial gearing (D/(D+E))	38.94%
Equity beta	1.08
Real post-tax return on equity	8.58%
<b>Cost of Debt</b>	
Nominal cost of debt	5.30%
Real cost of debt	3.65%
<b>WACC</b>	
Corporate tax rate <sup>1</sup>	33.17%
Real post-tax WACC (Net of Debt Tax Shield)	6.19%
<b>Real pre-tax WACC</b>	<b>9.26%</b>

*Source: NERA analysis. (1) The corporate tax rate in the Netherlands is 34.5% in 2004 and 2005; from 1<sup>st</sup> January 2006 the tax rate is 30.5%. We calculated a weighted average tax rate for the regulatory period from 1st January 2004 to 31st December 2006 of 33.17% (=34.5%\*2/3 + 30.5%\*1/3).*

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 2004 to 2006 is 9.3%.

<sup>1</sup> This is in line with the approach, previously accepted by the IG, set out in NERA (2003) "Re-estimating the Cost of Capital of Telecommunications Interconnection Services in Holland: A Final Report for OPTA".

## 1. Introduction

In this report we have estimated the cost of capital in 2004 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 2006 to 31st December 2008. The price caps from 2006 to 2008 are set by OPTA with a step function following a straight line from the cost prices in 2004 to the cost prices in 2008. Given this method of setting the price cap, the cost of capital in 2004 should be estimated as if a price cap for the period 2004 to 2006 was set. Therefore, the cost of capital estimated for 2004 can also be used for estimating the cost of capital in 2005. Our cost of capital estimate is based on latest data up to end year 2004.

### 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 domestic 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 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.<sup>2</sup>

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 1969-2001 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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<sup>2</sup> 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.<sup>3</sup> 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 2004 to 2006 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 recently 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.

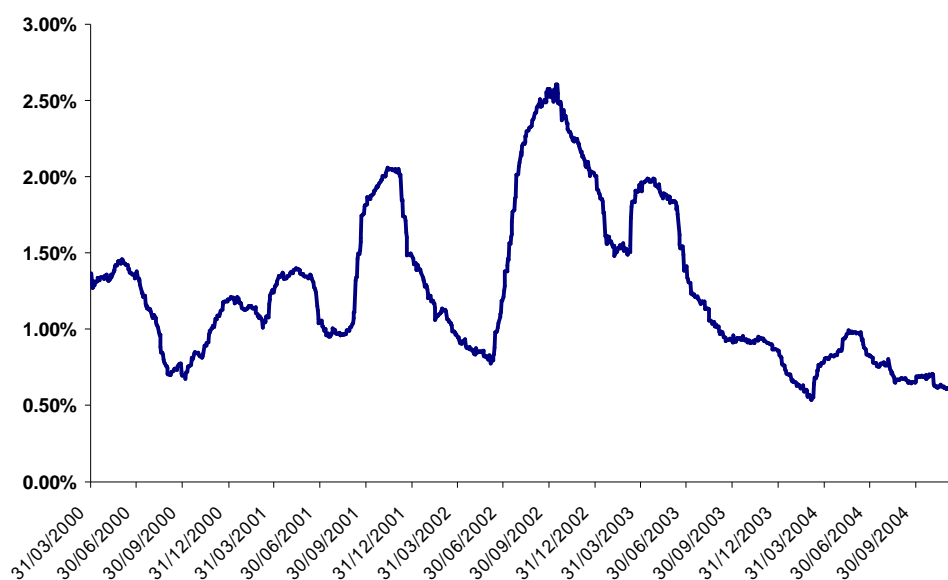
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<sup>3</sup> In its recent (2004) Final Determinations, Ofwat used the top end of a 2.5% to 3.0% range for the real risk-free rate, “based on a period average level of yields on medium-term index-linked gilts rather than recent yields which appear historically low”. Ofgem (2004) also used a risk free rate of around 3.0% in setting the cost of capital for the DNOs. The Competition Commission eg BAA plc (2002) has also noted that current yields should be used with caution when estimating the risk free rate because of market volatility.

A recent paper by Smithers and Wright<sup>4</sup> (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.<sup>5</sup> 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.<sup>6</sup>

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 over the past five years. In this chart, volatility is measured on an historic basis using the square root of the variance of daily returns over the three months prior to the date on the chart. 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.

**Figure 2.1**  
**3-Month Rolling Standard Deviation of Daily Returns on**  
**Dow Jones European 600 Index (March 2000 – December 2004)**



Source: Bloomberg

<sup>4</sup> Smithers A. and Wright S. (2002), *Stock Markets and Central Bankers: The Economic Consequences of Alan Greenspan*, available at [www.smithers.co.uk](http://www.smithers.co.uk).

<sup>5</sup> 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)).

<sup>6</sup> 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.

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 finally began. Volatility increased during this period until the war ended in April 2003. Since mid-2003, the European equity market has become significantly less volatile. The average level of volatility has been higher in 2002-2003 than in 2004.

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. 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. However, even though volatility has returned to more normal levels in 2004, global interest rates remain at very low levels.

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.*”<sup>7</sup>

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.

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<sup>7</sup> 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 (2003)<sup>8</sup> where the risk-free rate used in calculating the cost of capital applying over a one year price cap period (of 31<sup>st</sup> July 2003 to 30<sup>th</sup> June 2004) was estimated using one year's historical yield evidence.

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<sup>8</sup> NERA (2003) *“Re-estimating the Cost of Capital of Telecommunications Interconnection Services in Holland: A Final Report for OPTA”*.

### 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.

In line with the dominant methodology employed by practitioners and regulators we estimate the risk-free rate using government bond yield evidence. Our estimate is based on the following key principles:

- § ***Preference for the use of index-linked evidence where possible.*** In practice it is generally difficult to identify an asset that fulfils the criteria of zero correlation with the market since inflation, as do 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 (ILGs) are less correlated with the market than the yields on Treasury bills and other government bonds, and are therefore closer to satisfying the theoretical requirement of having a zero beta.<sup>9</sup> For this reason various regulatory precedent, including the UK, relies on index-linked-gilts (ILGs) yields to provide the closest proxy to the risk-free asset.
- § ***Supplementation of ILG evidence with nominal Government bond evidence.*** In order to provide a cross-check on the risk-free rate estimates obtained using ILG evidence, we further consider nominal Dutch and German Government bond yield evidence, deflated by inflation expected at the time of yield measurement.
- § ***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.

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<sup>9</sup> This point was made by Stephanie Holmans in Ofwat RP5 (1996), Section 2.5.

§ *Use of close maturity.* 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 broadly in line with the regulatory period, since the regulated rate of return (and with it the risk free rate) will be re-set at the end of the price control period.

### 3.2. Index-Linked Government Bonds

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

#### Eurozone ILGs

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 therefore consider Eurozone ILG yields as primary evidence in estimating the appropriate risk-free rate for KPN. We present evidence on Eurozone ILGs in Appendix A.1. We summarise key points regarding this evidence below:

- § Four governments in the Eurozone currently have ILGs outstanding; France, 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.<sup>10</sup>
- § 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 2006. Only France has a bond with a close maturity (2009) and issued before 2002 in order to ensure at least three years of historical data by 2004.
- § We therefore consider the French ILG bond as our primary source of evidence on the real risk-free rate for the price cap. This evidence is presented in Table 3.1.

**Table 3.1**  
**Conclusion on Primary Evidence on the Real Risk-Free Rate**

	Issue Date	Maturity	3Y Average Yield to Maturity <sup>1</sup>
France	29/09/1998	25/07/2009	2.09%

*Source: NERA analysis of Bloomberg data. (1) Weekly data from 04/01/2002 – 31/12/2004 (inclusive).*

<sup>10</sup> 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 Table shows that the average yield to maturity for Eurozone ILGs meeting our methodological criteria is 2.09% on a three year historical basis for application to the price cap calculation. Given that we have only one observation, we consider additional European evidence as a cross-check. In particular we look at other European (non-Eurozone) ILG evidence as well as at 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.

### 3.3. Other European and Developed Country ILGs

We also consider ILG 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) ILGs in Appendix B.2. We summarise key points regarding this evidence below:

- § Two wider European (non-Eurozone) governments currently have ILGs outstanding; the UK and Sweden. Of these two issuers, the UK is the larger issuer as shown in Appendix B.2.
- § 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 ILG market, with the majority of bonds issued before March 2000.
- § A single Swedish bond is 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.

- § 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 and later the FRS17.<sup>11 12 13</sup>
- § Our concluding set of wider European evidence on the real risk-free rate for the price cap is therefore based on the Swedish ILG with a maturity of 2008 measured over a three year period.

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

	<b>Issue Date</b>	<b>Maturity</b>	<b>3Y Average Yield to Maturity<sup>1</sup></b>
Sweden	01/12/1995	01/12/2008	2.45%

*Source: NERA analysis of Bloomberg data. (1) Weekly data from 04/01/2002 – 31/12/2004 (inclusive).*

The Table shows that the average yield to maturity for wider European ILGs meeting our methodological criteria is 2.45%. We further consider wider market evidence on ILGs below.

We present evidence on wider developed market (non European) ILGs in Appendix B.3. We summarise key points regarding this evidence below:

- § Three significantly sized wider market governments currently have ILGs outstanding; Australia, Canada and the US. Of these three issuers, the US is the largest issuer as shown in Appendix B.3.
- § With the exception of the Australian ILGs, 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.
- § We note that reduced supply may have downwardly impacted on long maturity US ILG 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

<sup>11</sup> 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*”<sup>11</sup> (Bank of England (1999) *Quarterly Bulletin*, May).

<sup>12</sup> 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).

<sup>13</sup> 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.

§ With regard to the criteria of a maturity close to the end of the regulatory period in 2006 and at least three years of historical yield evidence available by 2004, two US bond are available. These bonds are presented in Table 3.3.

**Table 3.3**  
**Other Wider Market Evidence on the Real Risk-Free Rate**

	Issue Date	Maturity	3Y Average Yield to Maturity <sup>1</sup>
US	06/02/1997	15/01/2007	1.09%
US	15/01/1998	15/01/2008	1.42%
<b>Average</b>			<b>1.26%</b>

*Source: NERA analysis of Bloomberg data. (1) Weekly data from 04/01/2002 – 31/12/2004 (inclusive).*

The Table shows that the average yield to maturity for US ILGs meeting our methodological criteria is 1.26%.

### 3.4. 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 ILG evidence in accordance with our preference for the use of index-linked instruments in estimating the real risk-free rate. Given the relatively limited availability of direct Eurozone ILG 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 2002, 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 2006 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	Years to Maturity at End 2004	3Y Average Mid Yield to Maturity	Average Eurozone Inflation Forecast over 3 Yr <sup>1</sup>	3 Yr Implied Average Real Yield to Maturity
<b>Germany<sup>2</sup></b>					
25/04/1997	04/07/2007	2.5	3.4%	2.0%	1.39%
09/01/1998	04/01/2008	3.0	3.5%	2.0%	1.50%
30/10/1998	04/07/2008	3.5	3.6%	2.0%	1.60%
10/07/1998	04/07/2008	3.5	3.6%	2.0%	1.59%
<b>Average</b>		<b>3.1</b>	<b>3.6%</b>	<b>2.0%</b>	<b>1.52%</b>
<b>Netherlands</b>					
15/09/1992	15/09/2007	2.7	3.5%	2.0%	1.5%
26/01/1998	15/07/2008	3.5	3.7%	2.0%	1.6%
<b>Average</b>		<b>3.1</b>	<b>3.6%</b>	<b>2.0%</b>	<b>1.57%</b>

Source: NERA analysis of Bloomberg data

(1) Source for Eurozone inflation forecasts: Consensus Economics (2002-2004). Average inflation calculated for all bonds as average of average inflation expected in 2002, 2003, and 2004 for the maturity of the bond (to 2008).

(2) Evidence based on Bundesobligationen, which have a time to maturity at issuance of consistently 10 years.

### 3.5. Conclusion on Real Risk-free Rate

Table 3.5 presents summary evidence on the real-risk-free rate for 2004.

**Table 3.5**  
**Conclusion on Real Risk-Free Rate for 2004**

<b>Primary ILG Evidence</b>	
Eurozone	2.09%
<b>Wider European ILG Evidence</b>	
Europe (non Eurozone)	2.45%
<b>Nominal Evidence Eurozone</b>	
Germany	1.52%
Netherlands	1.57%
Nominal Evidence Average	1.55%
<b>US ILG Evidence</b>	
US	1.42%

Source: NERA analysis of Bloomberg data

Our primary estimate of the real risk-free rate for 2004 is 2.09% based on Eurozone ILG evidence. As a consistency check on our primary ILG evidence we consider a number of further sources of supporting evidence, summarised as:

- § Wider European evidence indicates a real yield of 2.45% based on index-linked gilts;
- § Nominal German and Dutch government bond evidence indicates an average implied real yield of 1.55%.

§ Consistent with our Europe-wide investment opportunity set, we consider US evidence as less relevant in estimating the risk free rate for the Eurozone of the three-year regulatory period starting in 2004.

Nominal German and Dutch evidence indicate a slightly lower implied real risk-free rate of 1.55% than our preferred Eurozone ILG evidence of 2.09%. However, wider European evidence, based on Swedish ILG, suggests a higher real risk free rate of 2.45%. The mid-point of the implied risk-free rate based on nominal yields and wider European ILG evidence is around 2.00% and therefore closely in line with our preferred measure of the risk free rate of 2.09%, based on Eurozone ILG.

**Our concluding estimate of the real risk-free rate for 2004 is 2.09%.**

## 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

OPTA (2003) previously use an equity risk premium of 6% in setting the terminating interconnection price control for KPN in 2003.

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 (2004) (based on Tabors Caramanis & Associates)	6.4%
DTe	TenneT (2004) (based on Brattle Group)	5.7%-7.9%
DTe	Regional Electricity Networks (2000)	4%-7%
DTe	GTS (2005)	5%

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" and DTe (2000) "Guidelines for price cap regulation of the Dutch electricity sector in the period from 2000 to 2003", February 2000.*

Recent DTe precedent shows estimates of the ERP lying between 4% and 8%, with the weight of evidenced balanced towards the upper end of this range.

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

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

Institution	Case	ERP
Ofgem	Final Proposals for DNOs (2004)	2.5%-4.5%
Ofwat	Final Determinations (2004)	~5.0%
Ofcom	Various (2004) e.g. Partial Private Circuits charge control, TV licence renewal, mobile termination charges	5.0%
CAR	Dublin Airport Authority (2005)	6.0%

UK regulatory precedent shows lower ERPs than those allowed by the DTe and the CER, ranging between 2.5% and 5.0%. Most recent decisions have tended to the upper end of this range. 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.<sup>14</sup> 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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<sup>14</sup> 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 2 <sup>nd</sup> half of 20 <sup>th</sup> 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) <sup>(1)</sup>	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%	DGM 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.<sup>15</sup> 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%”*

<sup>15</sup> 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 (2005) based on data up to end year 2004 report returns on equity markets for 17 countries around the world over the last 103 years over the period from 1900 - 2004, 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 – 2004)**

Ireland	5.1%
Belgium	4.2%
Netherlands	5.8%
Spain	4.1%
France	5.8%
Italy	7.7%
Germany <sup>1</sup>	8.3%
<b>Eurozone average</b>	<b>5.9%</b>
USA	6.6%
UK	5.2%
<b>World average (unweighted)<sup>2</sup></b>	<b>5.9%</b>
<b>World (DMS weighted index)</b>	<b>5.1%</b>

*Source: LBS / ABN AMRO (2005) “Global Investment Returns Yearbook. The estimates are based on returns over 103 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 1900-2004 ranging from 4.2% to 8.3%, with an average of 5.9%.

This estimate is consistent with the unweighted world average (average of 17 countries reported by DMS) of 5.9%. DMS report a slightly lower figure of 5.1% for their constructed market cap weighted World Index, however, we note that this index is dominated by the US (in 2004 DMS report that the US comprised 51% 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 5.8%.

In conclusion, the updated Dimson, Marsh and Staunton data shows an equity risk premium for the Eurozone ranging broadly from 4% to 8% and averaging about 6%. 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 recent 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”.<sup>16</sup>
- § 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 20<sup>th</sup> 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 21<sup>st</sup> 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.<sup>17</sup> However, we note that this adjustment is contested (see for example Wright, Mason and Miles (2003)).<sup>18</sup> 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

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<sup>16</sup> Dimson, Marsh and Staunton (2000) “*Risk and Return in the 20<sup>th</sup> and 21<sup>st</sup> Centuries*”, Business Strategy Review 2000, Volume 11 Issue 2, pp1-18.

<sup>17</sup> 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%.

<sup>18</sup> 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:<sup>19</sup>

- § Systematic underestimation of inflation by investors;
- § High levels of technological, productivity and efficiency growth over the 20<sup>th</sup> 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 2004 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 2004 that suggests an ERP for Netherlands and the major Eurozone markets ranging from 4.1% to 8.3%, averaging 5.9% and a world average of 5.9%, 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 around 6% for the Netherlands.

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<sup>19</sup> 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 Ireland regulatory precedent shows central estimates of the ERP in the range of 3.5% to 6.0%.
- § International regulatory precedent shows central estimates of the ERP in the range of 5.0% to 7.0%.
- § Recent academic papers generally conclude that the equity risk premium lies in a range of 4% to 8%. The widely quoted Ibbotsen 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 (2005) suggest an ERP lying in the centre of the range of 4% to 8%.

Overall, we conclude that Dimson, Marsh and Staunton's analysis shows that the equity risk premium is most likely lie around 6%. 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 1900-2004.

Of all the evidence presented we consider the LBS/ABN AMRO data on the historical equity risk premia over 1900-2004 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%, 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. We note further that our estimate is highly consistent with other recent regulatory precedent (eg. DTe) in Holland.

## 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:

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

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<sup>20</sup>. 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<sup>21</sup>.

### *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.<sup>22</sup> Equity betas have been adjusted for financial risk (“de-levered”) to derive asset (or “unlevered”) betas according to the following formula:<sup>23</sup>

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

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

One IG respondents queried NERA’s use of formula 3.4, stating that the following formula attributable to Modigliani and Miller is preferable for unlevering Betas:

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

**where  $t_c$  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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<sup>20</sup> 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.

<sup>21</sup> 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.

<sup>22</sup> 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.

<sup>23</sup> This formula is attributed to Miller (1977).

Some recent empirical evidence suggests that the more appropriate formula for levering and un-levering betas is the Miller formula.<sup>24</sup> 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 of 25% or 50% the overall impact on the WACC is very small.

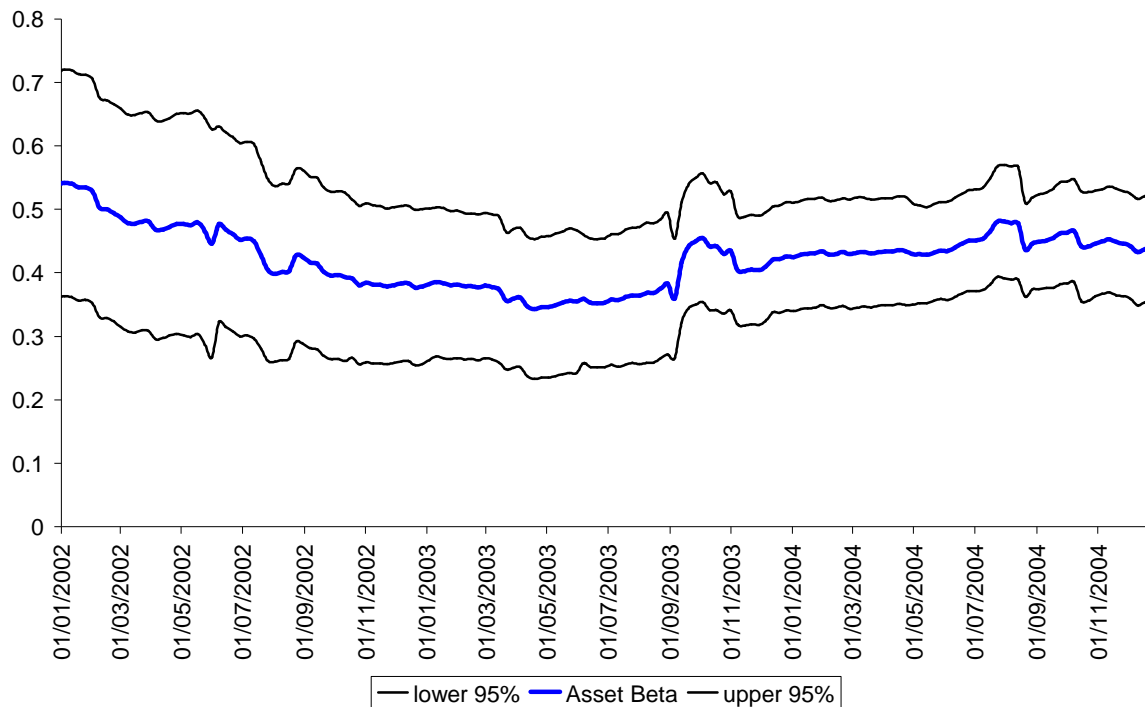
### 5.3. Empirical Evidence

Figure 5.1 shows a time series of KPN's asset beta estimates from January 2002 to December 2004 (represented by the big blue line). This time series consists of 2-year rolling asset betas, i.e. the first historic rolling asset beta in 28/12/2001 has been estimated using two years of weekly returns data from 07/01/2000 – 28/12/2001. 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 (represented by the upper and lower black lines), i.e. we can be reasonably sure that the "true" beta estimate is within range of the upper- and lower black lines.

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<sup>24</sup> 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**  
**(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 reasonably stable over the last year ranging from around 0.40 to 0.50, with the most recent two-year asset beta of 0.44. The 95%-confidence interval of our (mean) asset beta estimate ranges from 0.30 to 0.60.

Table 5.1 presents estimates of KPN’s beta values using daily and weekly data 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**

	Market Gearing	Market leverage	Beta, 1Y (daily)		Beta, 2Y (weekly)		Beta, 6M (daily)		Beta, 5Y (weekly)	
Company	D/E	D/(D+E)	Equity	Equity	Asset	Asset	Equity	Asset	Equity	Asset
KPN	64%	39%	0.82	0.77	0.49	0.47	0.74	0.44	1.24	0.56
95%-Confidence Interval			0.64 - 0.99	0.63 - 0.89	0.38 - 0.60	0.38 - 0.54	0.59 - 0.87	0.35 - 0.52	1.01 - 1.46	0.46 - 0.66

**Table 5.2**  
**Beta Estimates for European Telecommunications Companies**

	Market Gearing <sup>1</sup>	Market leverage	Beta, 6M (daily)		Beta, 1Y (daily)		Beta, 2Y (weekly)		Beta, 5Y (weekly)	
Company	D/E	D/(D+E)	Equity <sup>2</sup>	Asset <sup>3</sup>	Equity <sup>2</sup>	Asset <sup>3</sup>	Equity <sup>2</sup>	Asset <sup>3</sup>	Equity <sup>2</sup>	Asset <sup>3</sup>
TDC A/S	67%	40%	0.82	0.49	0.77	0.47	0.74	0.44	1.24	0.56
Teliasonera	16%	14%	0.69	0.42	0.82	0.48	0.76	0.41	0.68	0.44
BT Group	80%	45%	1.16	1.02	1.07	0.93	1.03	0.86	1.07	0.87
France Telecom	79%	44%	1.05	0.59	0.92	0.51	1.01	0.53	0.85	0.47
Deutsche Telekom	85%	46%	1.33	0.75	1.27	0.71	0.99	0.54	1.47	0.65
Telefonica SA	41%	29%	1.04	0.61	1.12	0.60	1.10	0.55	1.25	0.68
Portugal Telecom SGPS	48%	32%	1.14	0.82	1.14	0.81	1.10	0.76	1.27	0.86
Average (ex KPN)	<b>59%</b>	<b>36%</b>	<b>1.03</b>	<b>0.67</b>	<b>1.02</b>	<b>0.64</b>	<b>0.96</b>	<b>0.58</b>	<b>1.12</b>	<b>0.65</b>

Source: NERA analysis of Bloomberg data. Betas have been estimated against the DJ Stoxx European 600 Index (SXXP), over time periods which end on 16/5/2003 (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 12/04; for longer term betas, the value used for gearing is matching the term. (2) Raw equity betas have been adjusted using the following formula:  $b_{equity\_adjusted} = (0.67) * b_{equity\_raw} + (0.33) * 1.0$ . The equity betas reported in the table are the adjusted betas. (3) Adjusted equity betas have been unlevered using equation the following formula:  $b_{equity\_adjusted} = b_{asset} (1 + (Debt/Equity))$ .

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

**Table 5.4**  
**Asset Beta Estimates for KPN and Eurozone Telecom Companies**

	<b>6 month daily asset beta</b>	<b>1 year daily asset beta</b>	<b>2 year weekly asset beta</b>	<b>5 year weekly asset beta</b>
KPN	0.49	0.47	0.44	0.56
KPN 95% conf. interval	0.38 - 0.60	0.38 - 0.54	0.35 - 0.52	0.46 - 0.66
Industry Average	0.67	0.64	0.58	0.65

*Source: NERA analysis of Bloomberg data*

Our analysis of returns data for KPN reveals that in 2004 the range of asset beta estimates lies between 0.44 and 0.56 depending on the considered time window. Our asset beta estimates for the European comparator telecommunications companies are consistently higher than KPN's asset betas. The average asset beta of our proxy comparators ranges from 0.58 to 0.67. However we note, the beta estimate is based on a regression analysis and will therefore contain a statistical error. In Table 5.4 we present therefore 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. The 95%-confidence upper bound is in fact close to the average of our proxy comparators.

Our preferred beta estimate is the 95%-confidence upper bound of KPN's 5 year beta estimate of 0.66. The 95%-confidence upper bound gives us confidence that KPN's true asset beta is very unlikely to be larger than 0.66. Moreover, our preferred estimate of 0.66 is in line with the industry's average of 5 year asset betas of 0.65.

## 5.4. Beta – Conclusions

NERA's 2003 report "*Re-estimating the Cost of Capital of Telecommunications Interconnection Services in Holland*" (June 2003) estimated an asset beta for telecommunications interconnection in Holland in 2003 of 0.7.

In reaching our conclusions regarding the appropriate current beta for telecommunications services in Holland we note that the central beta estimates for Telecommunications Interconnection in Holland and its comparators, shown in Table 5.1, Table 5.2 and Table 5.5 lie in the range of around 0.5 to around 0.9. In 2003, the central asset beta estimates for KPN and its comparators lay between 0.4 and 0.7.

Since 2003, there is evidence in the market to suggest that betas for telecommunications services have fallen slightly. Given that the current low level of low volatility can lead to estimates of beta that are lower 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 0.66, 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.

## 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 2004 to 2006) and historical actual debt costs. Table 6.1 below 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 <sup>1</sup>	S&P Rating
13/02/2001	04/10/2005	6.25%	2.56%	A-
04/10/2000	04/10/2005	6.25%	N/A	A-
04/10/2000	04/10/2005	6.25%	8.29%	A-
12/04/2001	12/04/2006	7.25%	2.76%	A-
05/11/1998	05/11/2008	4.75%	3.51%	A-
21/07/2004	21/07/2009	2.52%	2.42%	A-
21/07/2004	21/07/2011	4.50%	3.82%	A-
<b>Weighted Average<sup>2</sup></b>		<b>5.15%</b>		

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<sup>25</sup> coupon of all of KPN's normal (non callable/convertible) bonds outstanding (denominated in euros) is 5.15%.

All bonds with a coupon larger than 5.0% will be matured by 12/04/2006. However, we cannot assume that from 12/04/2006, KPN can raise debt finance at current low coupon costs. A cost of debt which is based on recent coupon rates will likely underestimate KPN's actual cost of debt during its business cycle since there is evidence that yields on bonds are at exceptionally low levels (see Section 3). Moreover, until then, KPN has to meet its debt obligation and pay out relatively high coupons of 6.25% and 7.25%, which will have a direct impact on KPN's cash flows. We therefore believe that the average weighted coupon of KPN's actual debt cost of 5.15% 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

<sup>25</sup> 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<sup>26</sup> 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 5.30%. 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 market gearing level as total debt outstanding divided by the market value of equity. We used quarterly figures and averaged the market gearing for every year from 2000 to 2004. Based on market gearing we also calculated the financial gearing, which is total debt over enterprise value ( $D/(D + E)$ ).

**Table 6.2**  
**KPN's level of Gearing**  
**(Average Quarterly Gearing from 2000- 2001)**

Financial Year	Market Gearing D/E	Financial Gearing D/(D+E)
2000	185%	65%
2001	290%	74%
2002	132%	57%
2003	69%	41%
2004	64%	39%

*Source: NERA analysis of Bloomberg data.*

Table 6.2 shows that KPN's average financial gearing decreased substantially from its peak of 74% in 2001 to 39% in 2004. For our purpose of calculating the average weighted cost of capital for KPN, we rely on KPN's most recent 2004 market gearing of 39%.

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.

<sup>26</sup> 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 based on data up to end year 2004.

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

<b><u>Cost of Equity</u></b>	
Inflation	1.59%
Real risk-free rate	2.09%
ERP	6.00%
Asset beta	0.66
Financial gearing (D/(D+E))	38.94%
Equity beta	1.08
Real post-tax return on equity	8.58%
<b><u>Cost of Debt</u></b>	
Nominal cost of debt	5.30%
Real cost of debt	3.65%
<b><u>WACC</u></b>	
Corporate tax rate <sup>1</sup>	33.17%
Real post-tax WACC (Net of Debt Tax Shield)	6.19%
<b>Real pre-tax WACC</b>	<b>9.26%</b>

*Source: NERA analysis. (1) The corporate tax rate in the Netherlands is 34.5% in 2004 and 2005; from 1<sup>st</sup> January 2006 the tax rate will be 30.5%. We calculated a weighted average tax rate for the regulatory period from 1st January 2004 to 31st December 2006 of 33.17% (=34.5%\*2/3 + 30.5%\*1/3).*

Our best estimate of the *real pre-tax* cost of capital for KPN's wholesale activities is 9.3%.

## Appendix A. Evidence on the Risk-Free Rate

As stated in Section 3, our preferred methodology 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 (ILG) yields. Table A.1 sets out the key characteristics of the main issuers in the global ILG market.

**Table A.1**  
**Global ILG Market**

	Market value (\$US bn)	Number of Indexed Bonds	Longest Maturity	2Y Average bid-ask spread <sup>(1)</sup>
<b>Eurozone</b>				
France	109	8	2032	0.08%
Italy	46	4	2035	0.07%
Austria	-	3	2023	N/A
Greece	-	3	2025	0.12%
<b>Other Europe</b>				
UK	181	9	2035	0.05%
Sweden	32	5	2028	0.11% <sup>(2)</sup>
<b>Other</b>				
US	300	16	2032	0.12%
Canada	24	4	2036	0.08%
Australia	-	12	2020	1.02%

*Except where noted, source: UK Debt Management Office (www.dmo.gov.uk).*

*(1) Average bid-ask spread is calculated as  $[\text{bid price} - \text{ask price}] / \text{average}(\text{bid price}, \text{ask price})$ , where square brackets [ ] denote absolute value. Average 2Y bid-ask spread is assessed for all bonds quoted for more than 2/3 of the 2 year period to date. It should be noted that bid-ask spreads are not adjusted for differences in average maturity of debt issued by each country. N/A denotes insufficient quoted evidence to assess bid-ask spread. Source for bid-ask spreads: NERA analysis of Bloomberg data.*

*(2) Sweden average bid-ask spread excludes the bid-ask spread on the 2028 bond, which is a significant outlier.*

The international index-linked government debt market, led by the earlier development of the UK market, has grown very rapidly. As shown in the Table, the three largest ILG 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 ILG market increase significantly in recent years.

We consider the characteristics of the ILG markets set out in the Table further in assessing the use of these bonds evaluating the real risk-free rate in the following sections.

## A.1. Eurozone ILGs

Table A.2 presents yield and liquidity evidence on quoted Eurozone ILGs.

**Table A.2**  
**Eurozone ILGs**

<b>Issuer</b>	<b>Issue Date</b>	<b>Maturity</b>	<b>Currency</b>	<b>5Y bid-ask spread</b>
France	10/31/2002	7/25/2032	EUR	0.11%
France	10/1/1999	7/25/2029	EUR	0.12%
France	1/22/2004	7/25/2020	EUR	0.12%
France	11/23/2004	7/25/2015	EUR	0.12%
France	2/11/2003	7/25/2013	EUR	0.07%
France	10/31/2001	7/25/2012	EUR	0.07%
France	6/22/2004	7/25/2011	EUR	0.06%
France	9/29/1998	7/25/2009	EUR	0.06%
Italy	9/17/2003	9/15/2008	EUR	0.07%
Italy	2/18/2004	9/15/2014	EUR	0.11%
Italy	10/27/2004	9/15/2035	EUR	0.12%
Austria	2/28/2003	2/28/2013	EUR	1.72%
Greece	3/27/2003	7/25/2025	EUR	0.12%

*Source: NERA analysis of Bloomberg data*

The Table shows the following:

- § **Majority of issues after 2003.** Of the 14 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 four of the bonds issued before 2003 were issued by France, consistent with the French ILG 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 ILGs 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 ILG yields in estimating the risk-free rate for Eurozone countries. The Table shows that, with the exception of the Austrian bond, all bonds have a five year average bid-ask spread of less than 0.12%. This is not significantly different from the five year average bid-ask spread of 0.06% observed on German nominal Government bonds, measured on the same basis. 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. As an example recent bid-ask spreads on quoted bonds issued by quoted UK WaSC water and sewerage companies bonds range from 0.43% -to 1.24%.<sup>27</sup> The exception to this is the Austrian bond; a bid-ask spread of 1.72% is high, relative to

<sup>27</sup> See NERA (2003).

commercial and nominal Government debt. This reflects the relatively immature status and small size of the Austrian ILG market.<sup>28</sup>

## A.2. Wider European ILG evidence

**Table A.3**  
**Other European ILGs**

Issuer	Issue Date	Maturity	Currency	5Y bid-ask spread
UK	7/8/1981	7/19/2006	GBP	0.03%
UK	10/19/1982	5/20/2009	GBP	0.03%
UK	1/28/1982	8/23/2011	GBP	0.03%
UK	2/21/1985	8/16/2013	GBP	0.05%
UK	1/19/1983	7/26/2016	GBP	0.06%
UK	10/12/1983	4/16/2020	GBP	0.06%
UK	12/30/1986	7/17/2024	GBP	0.06%
UK	6/16/1992	7/22/2030	GBP	0.07%
UK	7/11/2002	1/26/2035	GBP	0.12%
Sweden	4/22/1999	12/1/2028	SEK	2.09%
Sweden	12/1/1995	12/1/2020	SEK	0.10%
Sweden	5/3/1999	12/1/2015	SEK	0.11%
Sweden	4/1/1994	4/1/2014	SEK	0.16%
Sweden	12/1/1995	12/1/2008	SEK	0.11%

Source: NERA analysis of Bloomberg data

The Table shows the following:

- § **Greater market maturity versus the Eurozone market.** All bonds shown in the Table were issued prior to 2003, with the majority of issues occurring at least five years ago, prior to 2000. This contrasts with the relatively short period since issue (less than two years) of the majority of the Eurozone ILGs presented in Table A.2, 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, with the exception of the Swedish 2028 bond, all bonds have a five year bid-ask spread average of less than 0.16%, with the majority of spreads lying in the 0.03% - 0.12% range. As discussed above, this range is consistent with bid-ask spreads observed on nominal German Government bonds. As expected, the bid-ask spreads on the UK ILGs are generally significantly 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.

<sup>28</sup> The bid-ask spread on the Austrian bond compares with the 0.12% observed on the Greek bond. Whilst the bonds shown in the Table indicate similar times of issuance, it should be noted that both Greece and Austria have two other bonds issued. These are not shown due to lack of quoted yields. The Greek bonds were issued in 1997, whilst the Austrian bonds were issued in 2003. This difference in market maturity may explain the differential in liquidity observed between the two quoted bonds.

§ ***Downward sloping yield curve for UK ILGs.*** Current UK ILG yields are generally negatively correlated with maturity,<sup>29</sup> 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.<sup>30</sup> 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.<sup>31 32 33</sup>

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<sup>29</sup> For example, the current yield on the 50Y UK bond is 1.024%, comparing to a yield of 1.509% on the 2020 bond and 1.695% on the 2009 bond.

<sup>30</sup> 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.

<sup>31</sup> 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*”<sup>31</sup> (Bank of England (1999) *Quarterly Bulletin*, May).

<sup>32</sup> 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).

<sup>33</sup> 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.4**  
**Wider Market ILGs**

Issuer	Issue Date	Maturity	Currency	5Y bid-ask spread
Australia	10/14/1996	8/20/2020	AUD	0.90%
Australia	5/18/1994	8/20/2015	AUD	0.91%
Australia	2/22/1993	8/20/2010	AUD	0.94%
Australia	8/20/1985	8/20/2005	AUD	1.05%
Canada	6/9/2003	12/1/2036	CAD	0.07%
Canada	3/8/1999	12/1/2031	CAD	0.12%
Canada	12/7/1995	12/1/2026	CAD	0.12%
Canada	12/10/1991	12/1/2021	CAD	0.15%
US	10/29/2004	4/15/2010	USD	0.05%
US	7/15/2003	7/15/2013	USD	0.10%
US	1/15/2004	1/15/2014	USD	0.09%
US	7/15/2004	7/15/2014	USD	0.09%
US	7/30/2004	1/15/2025	USD	0.16%
US	7/15/2002	7/15/2012	USD	0.10%
US	2/6/1997	1/15/2007	USD	0.06%
US	1/15/2002	1/15/2012	USD	0.09%
US	10/15/2001	4/15/2032	USD	0.19%
US	1/16/2001	1/15/2011	USD	0.08%
US	1/15/1998	1/15/2008	USD	0.07%
US	4/15/1998	4/15/2028	USD	0.15%
US	1/15/1999	1/15/2009	USD	0.07%
US	4/15/1999	4/15/2029	USD	0.14%
US	1/18/2000	1/15/2010	USD	0.07%

*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 1997 consistent with the first French issue in 1998.
- § **Liquidity is low for Australian ILGs.** The five year average bid-ask spreads observed for the Australian bonds are significantly higher, at over 0.9%, than the range of 0.03% - 0.15% generally observed for Eurozone, wider European, Canadian and US ILGs. This is likely to reflect significantly lower liquidity in the Australian market, and may partially explain the higher yields observed for the Australian ILGs vis-à-vis comparable maturity US and Canadian bonds. Due to the low liquidity of Australian ILGs indicated by the high bid-ask spreads, we consider that the yields on these bonds may include significant liquidity premia and we therefore exclude them from wider market evidence used in assessing the risk-free rate.

§ ***Low yields on US ILGs vs other markets.*** US ILG yields vis-à-vis comparable maturity and liquidity bonds in other markets are currently relatively low. This has been attributed by some commentators to the restriction in supply of ILGs (known as TIPS in the US) at longer maturities – the Treasury announced its intention to cease the issuance of 30 year TIPS in October 2001.<sup>34</sup> Whilst we recognise that supply pressures may downwardly impact on long term US TIP yields, we do not believe it appropriate to exclude US evidence on the basis that i) the influence of reduced supply is likely to have only been felt over the recent couple of years and therefore not the whole of the five year historical period of our preferred five year average and ii) the extent of the impact of reduced supply vis-à-vis other “natural” influences that reflect underlying movements in the risk-free rate (such as increased demand from pension funds arising from demographic factors) cannot be robustly ascertained.

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<sup>34</sup> The first TIP with a maturity greater than ten years issued since 2001 was issued in July 2004.

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