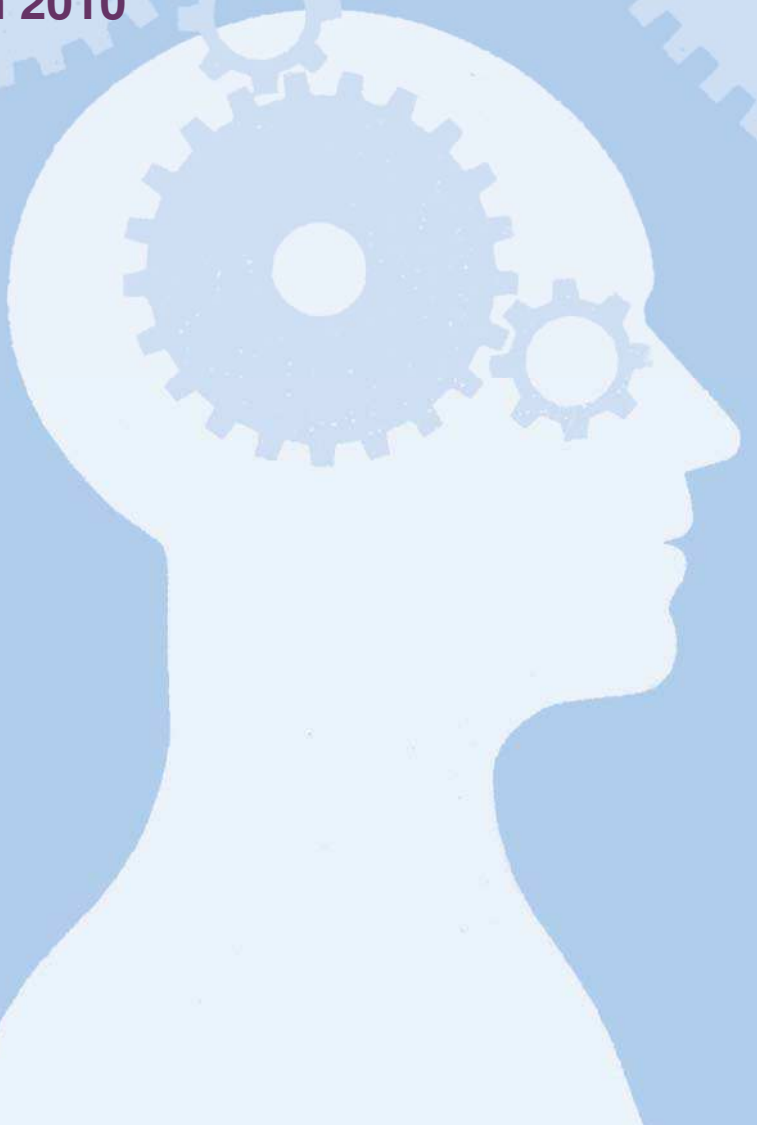
Oxera

Updating the WACC for energy networks

Quantitative analysis

Prepared for Energiekamer

February 5th 2010



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1 Introduction and summary

Energiekamer has asked Oxera to update the parameters of the WACC for energy networks, based on the methodology established in previous decisions.[1] An earlier version of this report by Oxera, appended to EK's initial consultation in September 2009, presented an overview of the relevant market evidence for the WACC assessment.[2] This present report is an updated version of the September 2009 report. It presents market evidence updated to December 1st 2009 and provides additional commentary on the cost of debt issuance. The updated WACC range provided in this report (5.3-6.9%) is not significantly changed from the WACC range provided in September (5.2-6.9%).

The main findings are as follows.

– The range for the **risk-free rate** is broadly unchanged from the 2008 Determination, reflecting the long-term approach taken by EK for this parameter.

– The range for the **debt premium** is both higher and wider than in the 2008 Determination, reflecting recent turbulence and uncertainty in debt markets; the estimate includes an allowance for debt issuance costs.

– The range for the **ERP** remains unchanged from previous determinations.

– The top end of the range for the **asset beta** is slightly higher, reflecting increases in individual betas for certain comparators.

– **Gearing** is slightly reduced, reflecting the study of the financing policies of comparator companies (the analysis supporting this assumption is developed in a separate report).

– The **inflation** assumption is slightly reduced compared with the 2008 determination, reflecting a long-term approach to the estimation of investors' inflation assumptions (the analysis supporting this assumption is developed in a separate report).

– The resulting range for the **pre-tax WACC** is equally wide, but slightly higher than the range adopted in 2008.

[1] NMa decisions: NMa (2006), 'Method decision in relation to the X factor and the volume parameters of regional grid managers for the third regulatory period—Addendum C—determination of the cost of capital allowance', Decision 102106-89 of June 27th; NMa (2006), 'Method decision in relation to TenneT for the third regulatory period—Addendum C—determination to the cost of capital allowance', Decision 102135-46 of September 5th; NMa (2008), 'Determination of the WACC—Addendum 2—Decision 102610-1/27'. Supporting documents: Frontier Economics (2005), 'The cost of capital for regional distribution networks—a report for DTe', December 2005; Frontier Economics (2008), 'Updated cost of capital for energy networks—paper prepared for DTe', April.

[2] Oxera reports: Oxera (2009), 'Updating the WACC for energy networks: Quantitative analysis', September 22nd.

Table 1.1 WACC estimates

	December 2009		July 2009		2008 Determination		2006 Determination	
	Low	High	Low	High	Low	High	Low	High
RFR (nominal) (%)	3.9	4.0	3.9	4.2	3.9	4.1	3.7	4.3
Debt premium (%)	1.1	1.9	0.9	1.6	0.6	1.0	0.6	0.8
Cost of debt (%)	5.0	5.9	4.8	5.8	4.5	5.1	4.3	5.1
ERP (%)	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0
Asset beta	0.39	0.45	0.39	0.46	0.39	0.42	0.28	0.39
Equity beta	0.68	0.95	0.68	0.97	0.83	0.89	0.58	0.80
Cost of equity (%)	6.6	9.7	6.6	10.0	7.2	9.4	6.0	9.1
Gearing (%)	50	60	50	60	60	60	60	60
Tax rate (%)	25.5	25.5	25.5	25.5	25.5	25.5	29.1	29.1
Pre-tax WACC (nominal) (%)	6.9	8.8	6.8	8.9	6.6	8.1	6.0	8.2
Inflation (%)	1.6	1.7	1.6	1.8	1.8	1.8	1.25	1.25
Pre-tax WACC (real) (%)	**5.3**	**6.9**	**5.2**	**6.9**	**4.7**	**6.3**	**4.7**	**6.9**

Note: Figures may not add up due to rounding. (The pre-tax WACC ranges expressed to two decimal places are 5.16–6.95% for July 2009 and 5.26–6.94% for December 2009.)
Source: EK decisions, Oxera analysis.

In previous decisions, EK determined the WACC for distribution network operators and for TenneT as follows.

– For **distribution network operators**, EK considered the full range of WACC estimates, and adopted the mid-point of that range for the purpose of setting the price control. This approach would yield a WACC estimate of 6.1% in the current conditions.

– For **TenneT**, EK focused on a narrower range of WACC estimates, based on the low end of the range for the asset beta. The rationale underlying this approach was that TenneT is subject to a revenue cap and, therefore, shielded from volume risk to a greater extent than its peers. Applying this approach under the current circumstances would yield a WACC range for transmission of 5.3–6.5%, and a point estimate of 5.9%.

2 The risk-free rate

2.1 Methodology

In previous decisions, EK estimated the risk-free rate based on the two- and five-year average yield on Dutch sovereign debt with a maturity of ten years (Table 2.1).

Table 2.1 EK estimation methodology for the risk-free rate

Estimation question	EK methodology
Type of debt	Conventional (nominal)
Nationality of debt	Dutch sovereign
Maturity	Ten years
Averaging period	Two to five years

Source: EK decisions and supporting documents.

2.2 Updated market evidence

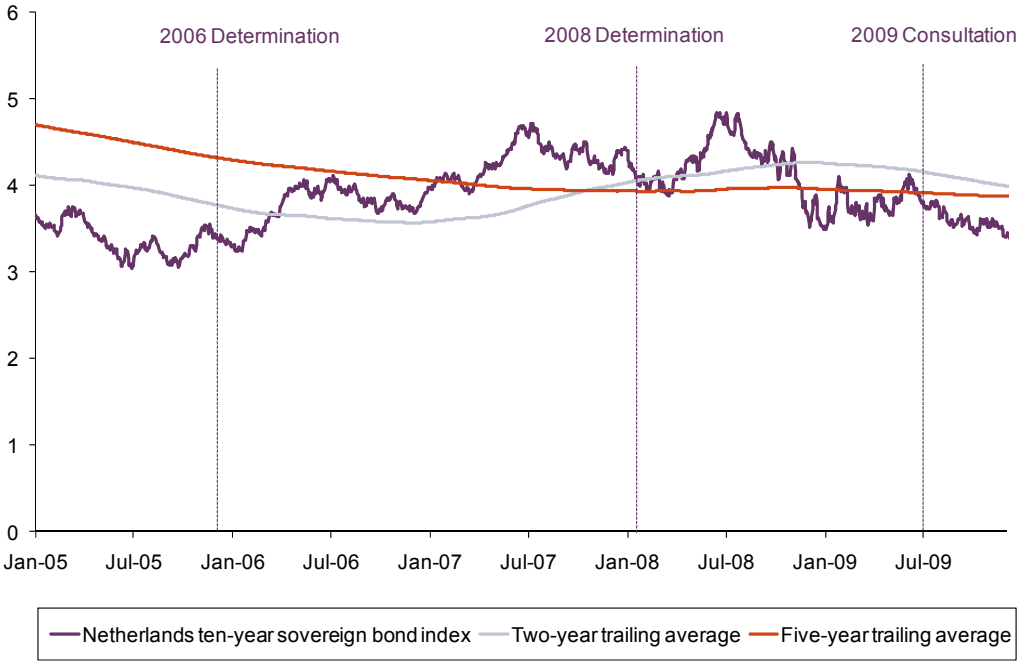
Updated market data shows the following.

– After the last determinations were adopted in 2008, the sovereign yield for a ten-year maturity increased slightly, before decreasing markedly after July 2008 (see Figure 2.1). This recent drop in the risk-free rate might reflect investors' flight to quality, albeit it is also consistent with a longer-term downward trend in sovereign yields.

– As a result, the two- and five-year averages are broadly unchanged from the 2008 estimates (see Table 2.2).

– The recent turbulence in capital markets has led to an increase in volatility over 2008 and 2009 (see Figure 2.2), albeit the most recent estimates of annualised volatility are consistent with their pre-crisis levels. The short and long ends of the yield curve have seen significant shifts compared to 2005 (see Figure 2.3); in contrast, yields for ten-year maturities—the main reference used by EK—have remained more stable.

Figure 2.1 Yield on ten-year Dutch sovereign and trailing averages (%)



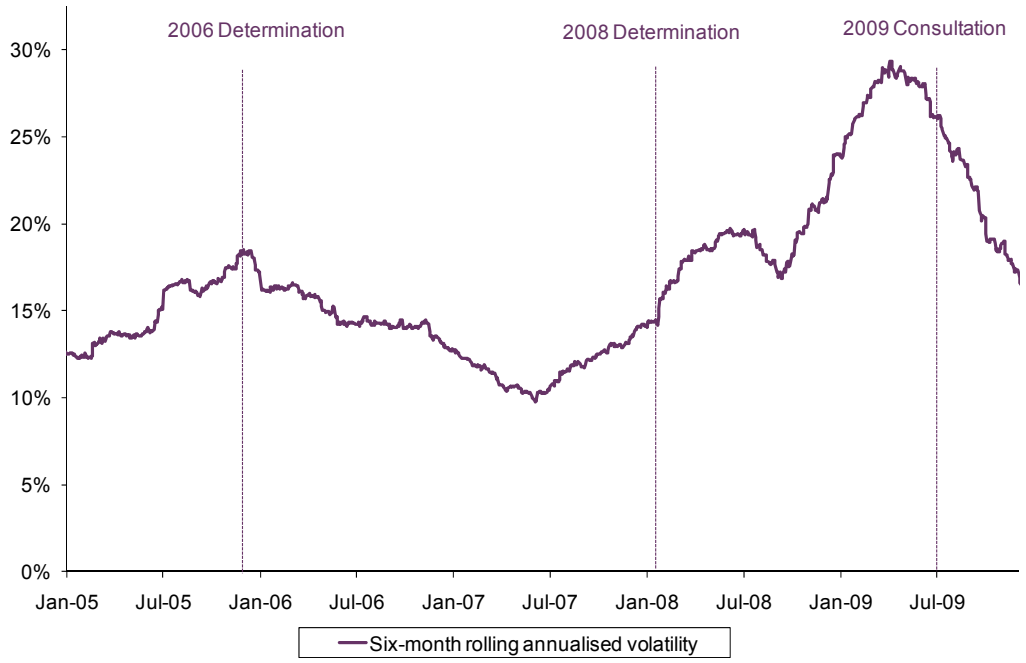
Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Datastream and Oxera analysis.

Table 2.2 Yield on ten-year Dutch sovereign and averages

Averaging period	December 2009	January 2008	November 2005
Six months	3.7	4.3	3.3
One year	3.7	4.3	3.4
Two years	**4.0**	**4.1**	**3.8**
Three years	4.1	3.8	3.9
Five years	**3.9**	**3.9**	**4.3**

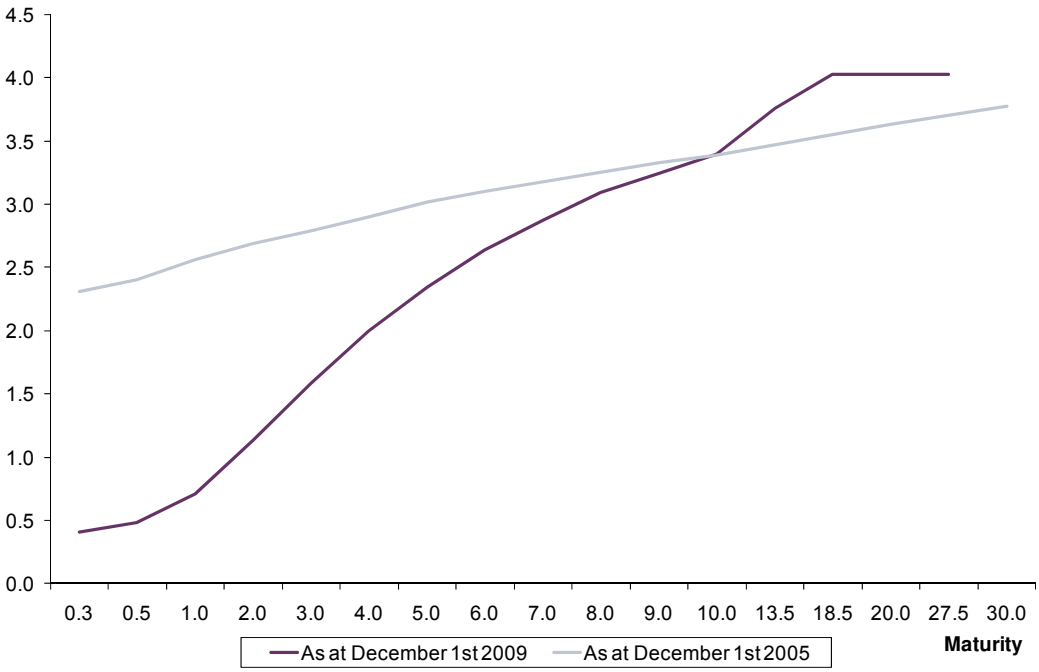
Source: Datastream and Oxera calculations.

Figure 2.2 Annualised volatility in ten-year Dutch sovereign yield (%)



Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Datastream and Oxera analysis.

Figure 2.3 Dutch sovereign yield curves as at December 2005 and December 2009 (%)



Source: Bloomberg and Oxera analysis.

2.3 Conclusions

In the current conditions, applying the methodology adopted previously would yield a range for the risk-free rate of 3.9–4.0% (Table 2.3). The low end of the range corresponds to the

five-year average of the sovereign yield, and the high end of the range corresponds to the two-year average.

Table 2.3 Conclusions—risk-free rate

	December 2009		July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High	Low	High
Risk-free rate	3.9	4.0	3.9	4.2	3.9	4.1	3.7	4.3

Source: Datastream, Oxera analysis.

3 The debt premium

3.1 Methodology

In previous decisions, EK estimated the debt premium for energy networks based on the five-year average spread for corporate bond indexes and the two-year average spread on a sample of reference bonds issued by comparator companies (Table 3.1).

Table 3.1 EK estimation methodology for the debt premium

Estimation question	EK methodology
References	Spread on general corporate bond indexes Spread on traded bonds for comparator companies
Maturity	Around ten years
Credit rating	Single A
Averaging period	Five years (bond indices) Two years (specific bonds)

Source: EK decisions.

The comparator companies were chosen on the basis of three criteria: business focus on energy networks; traded bonds with a maturity of around ten years at the time of the assessment; and a credit rating in the 'single A' category or close.

EK adopted a value towards the top of the range produced by this analysis, in part to account for debt issuance costs. Debt issuance costs are reviewed in this report and included in the debt estimates.

3.2 Updated market evidence

Updated market data shows the following.

– Yields and spreads on corporate bonds increased markedly after EK adopted its previous determination in 2008 before decreasing again after March 2009. Although all-in yields in December 2009 are back at their levels of January 2008, spreads remain above historical averages (Figure 3.1).

– The trailing averages on which EK relies to set the debt premium are significantly higher than at the last determination since they incorporate the effects of the crisis.

– The five-year average spread on an index of A-rated bonds has increased from 55 basis points (bp) in January 2008 to 96bp in December 2009 (Figure 3.2).

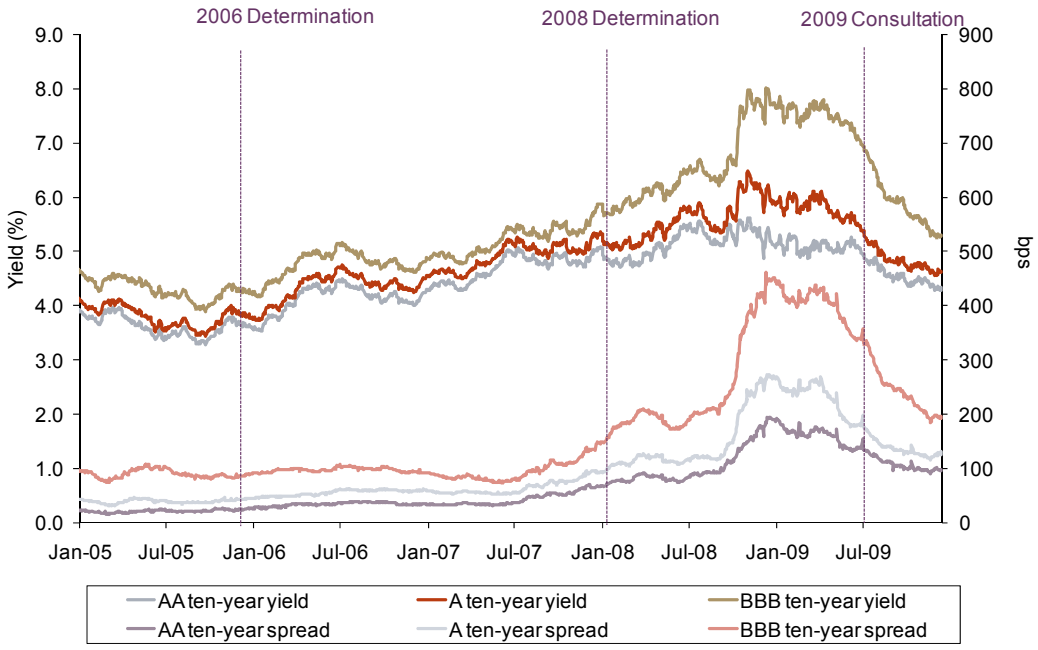
– The median of two-year average spreads has increased from 53bp to 166bp for the sample of bonds used in 2005 (Table 3.2) and from 85bp to 175bp for the sample of bonds used in 2008 (Table 3.3). However, the validity of these references is limited because the residual maturity of some of these bonds is now shorter than that targeted by EK.

– The median of two-year average spreads for an amended sample of bonds (comprising some of the bonds used in previous determinations and new bonds that meet EK's criteria) is 168bp for bonds rated in the A range (Table 3.4). This is consistent with the

two-year average spread on the general bond index for A-rated debt (163bp—see Figure 3.2).

– Oxera understands that the bonds previously issued by Nuon have been retained by the new network entity, Alliander.[3] These bonds present characteristics consistent with EK's assessment criteria in terms of residual maturity (five and ten years) and rating (A) and are, therefore, informative for the assessment of the debt premium. Movements in yields and spreads for these bonds have been broadly in line with market trends (see Figures 3.3 and 3.4), which provides a useful cross-check for the use of market-wide estimates.

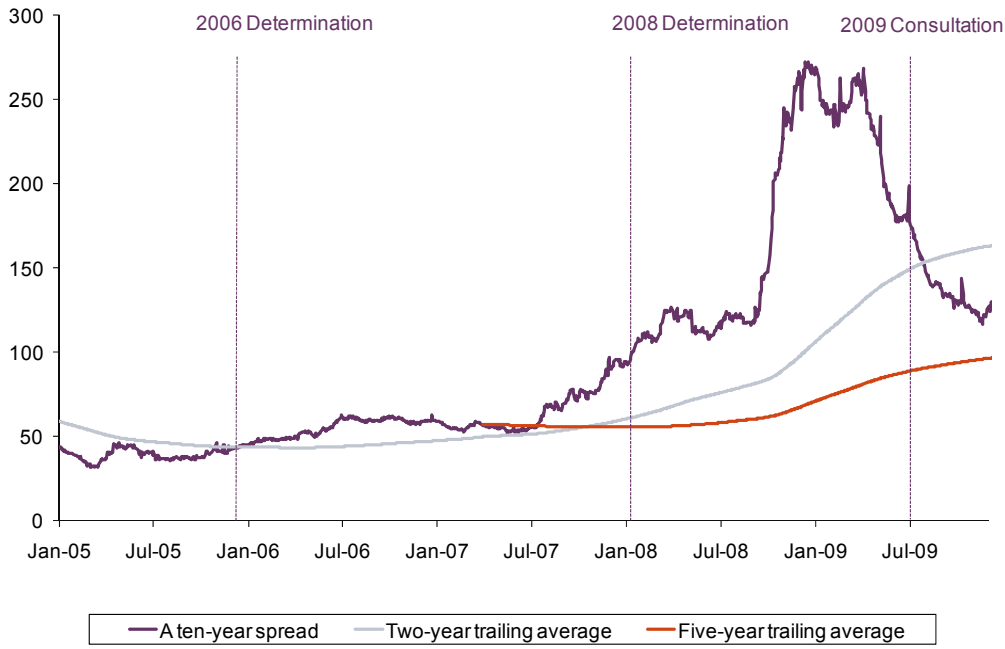
Figure 3.1 Yields and spreads on EUR-denominated ten-year corporate bond indices (BBB to AA ratings)



Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Bloomberg and Oxera analysis.

[3] Company website: http://www.alliander.com/investor-relations/financing/bond-issues.jsp.

Figure 3.2 Spreads on EUR-denominated ten-year corporate bond index (A rating) and trailing averages (bp)



Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Bloomberg and Oxera analysis.

Table 3.2 Spreads on a sample of corporate bonds—sample used in the 2005 review (bp)

		September 2005		December 2009	
	Rating	Residual maturity (years)	Two-year average spread (bp)	Residual maturity (years)	Two-year average spread (bp)
Red Electrica	AA–	8	43	4	135
Energias de Portugal	A	12	92	8	197
Essent	A+	8	53	–	–
Eneco	A+	5	47	1	102
Transco	A	12	78	8	168
Scottish Power	A–	11	77	6	340
United Utilities	A–	13	81	9	176
Iberdrola	A+	7	42	3	163
RWE	A+	11	38	7	97
Median		**11**	**53**	**6**	**166**
Mean		**10**	**61**	**5**	**172**
With maturity < 5 years					133
With maturity > 5 years					196

Note: The Essent bond used in 2005 is no longer traded. Credit ratings are as at September 2005 as reported by Frontier Economics (2005).
Source: Frontier Economics (2005), 'The cost of capital for Regional Distribution Networks', a report for DTE, December; Datastream and Oxera calculations.

Table 3.3 Spreads on a sample of corporate bonds—sample used in the 2008 review (bp)

		January 2008		December 2009	
	Rating	Residual maturity (years)	Two-year average spread (bp)	Residual maturity (years)	Two-year average spread (bp)
Eastern	A	5	75	–	–
E.ON	A	5	76	3	160
Transco	A	10	80	8	168
Yorkshire Electricity	BBB+	12	87	10	191
Northern Electric	BBB+	13	87	11	198
RWE	A+	14	79	12	167
Scottish & Southern	A+	15	87	13	164
RWE	A+	16	79	14	175
Eastern	A	17	88	–	–
Transco	A–	17	85	15	181
National Grid	A	17	87	15	183
Median		**14**	**85**	**12**	**175**
Mean		**12**	**83**	**11**	**176**
With maturity below 10 years					**164**
With maturity above 10 years					**180**

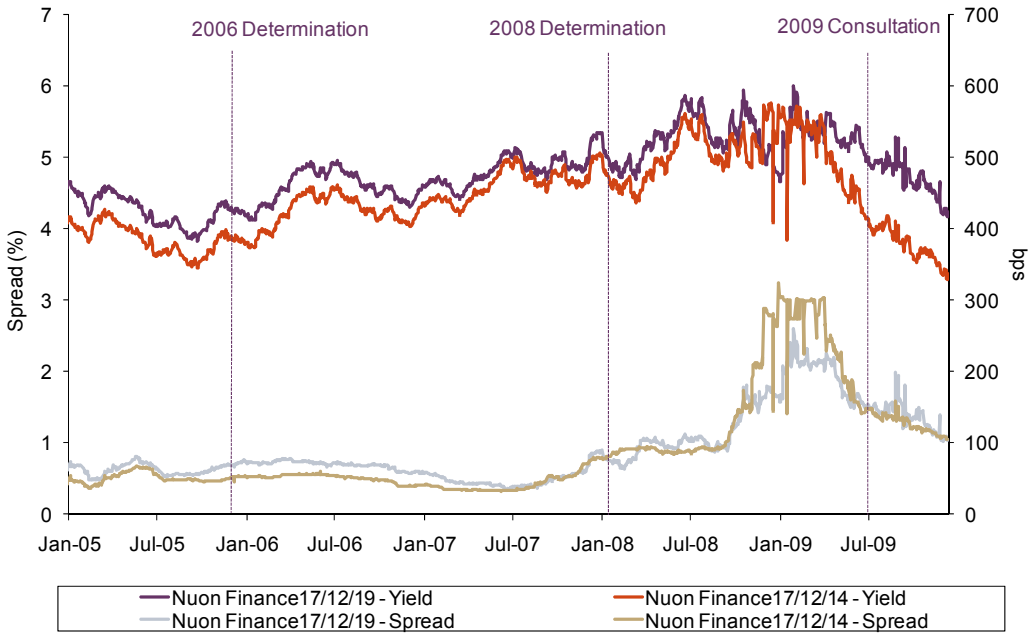
Note: Credit ratings are as at January 2008 as reported in Frontier Economics (2008).
Source: Frontier Economics (2008), 'Updated cost of capital estimate for energy networks', prepared for DTE, April; Datastream and Oxera calculations.

Table 3.4 Spreads on a sample of corporate bonds—sample proposed for this review (bp)

	Issue rating at issuance	Residual maturity (years)	Two-year average spread (bp)
Terna	A+	10	127
RWE	A+	12	167
Scottish & Southern	A+	13	164
RWE	A+	14	175
Nuon/Alliander	A	10	136
Transco	A	8	168
United Utilities	A	9	176
RWE	A	7	97
Transco	A	8	168
National Grid	A	15	183
Severn Trent	A–	8	181
National Grid	A–	11	196
Elia system operator	A–	10	122
Energias de Portugal	A–	8	197
Transco	A–	15	181
Median: A range		10	**168**
Mean: A range		10	**162**
With maturity < 10 years			**158**
With maturity > 10 years			**166**

Source: Datastream and Oxera calculations.

Figure 3.3 Yields and spreads of Nuon bonds



Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Datastream.

Figure 3.4 Spread on Nuon bond compared with general market index (bp)

Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Datastream.

3.4 Debt issuance fees and debt-related overhead costs

EK has asked Oxera to review additional evidence on debt issuance costs, and to reflect these costs in the cost of debt as appropriate.

In addition to interest, companies could face additional costs of issuing and managing their debt. These costs could include upfront fees (eg, arranging and underwriting fees), annual fees (eg, commitment fees on bank loans) as well as overhead costs (eg, legal, administrative and rating costs), depending on the form of financing. If these costs are not incorporated in the OPEX allowance then there is a case for taking them into account in the allowed WACC.

– **Upfront fees**. Companies that raise finance using bonds or bank loans might be liable to pay an upfront fee to the underwriter. Figure 3.5 shows the distribution of disclosed underwriting fees paid to book runners by European utility and energy companies that have issued bonds since 2000. A significant portion of those companies for which bond issuance costs have been disclosed paid fees of between 30bp and 40bp to the book runner at issuance. This estimate of underwriting costs can be annualised over a ten-year period using an annuity formula, resulting in annualised costs of 4–5bp per year.[4]

  Upfront fees for bank loans are less transparent and less widely reported. They are therefore harder to quantify precisely using publicly available information. Some evidence suggests that, at least in some cases, they might not be significantly different from bond issuance fees. For example, RWE recently paid an arranger fee of 22bp on a

[4] The following annuity formula is used in the calculations:

$$\text{present value of payments} = \frac{\text{Annual payments}}{r} \times \left\{1 - \frac{1}{(1+r)^n}\right\},$$

where r is the cost of debt, present value of payments is the upfront fees in basis points, and n is the period over which the payments are made. In this case, r is assumed to be the average of the cost of debt used in the last price control review—ie, 4.7%. The formula assumes that the costs are recovered over the period until maturity rather than over one regulatory control period.

revolving credit facility. (This is equivalent to approximately 3bp in annual costs, using the method described above).[5] This is likely to differ on case by case basis and depend on the company's banking relationships.

– **Annual commitment fees**. Some forms of credit might also carry annual fees in the form of commitment fees. Such fees are typically paid on the undrawn balance of loans (not the outstanding balance), and are best seen as a cost of managing liquidity. . Reported commitment fees for selected Dutch energy companies range between 7bp and 16bp of undrawn balances, with an average of 10bp.[6] Because the average commitment fee paid by companies varies according to the amount of loan drawn, a precise estimate cannot be obtained. However, these figures represent a cap on the annual fee actually paid by a borrower as it is only fully charged if the loan is fully undrawn. A study by Altunbaşa and Kara reports median annual fees of 8–13bp for syndicated loans issued to small and medium-sized companies of low risk.[7]

– **Annual overhead costs**. Companies might also need to bear annual costs of debt financing (in addition to interest payments), including legal, administrative and rating costs, in order to maintain their financing instruments in place and manage their debt portfolio. Such costs can be recovered through an uplift in the cost of debt rather than through the OPEX allowance. Because information on such costs is not always publicly available, their indicative size is estimated based on using illustrative examples. These annual costs could represent up to 5bp for large energy networks, and 7bp for smaller networks.[8]

Regulatory treatment of debt issuance fees has differed across regulators. Box 3.1 highlights examples of regulators that have not explicitly included in the cost of capital compensation for debt issuance fees, and Table 3.5 lists specific uplifts used by other regulators to allow for issuance fees.

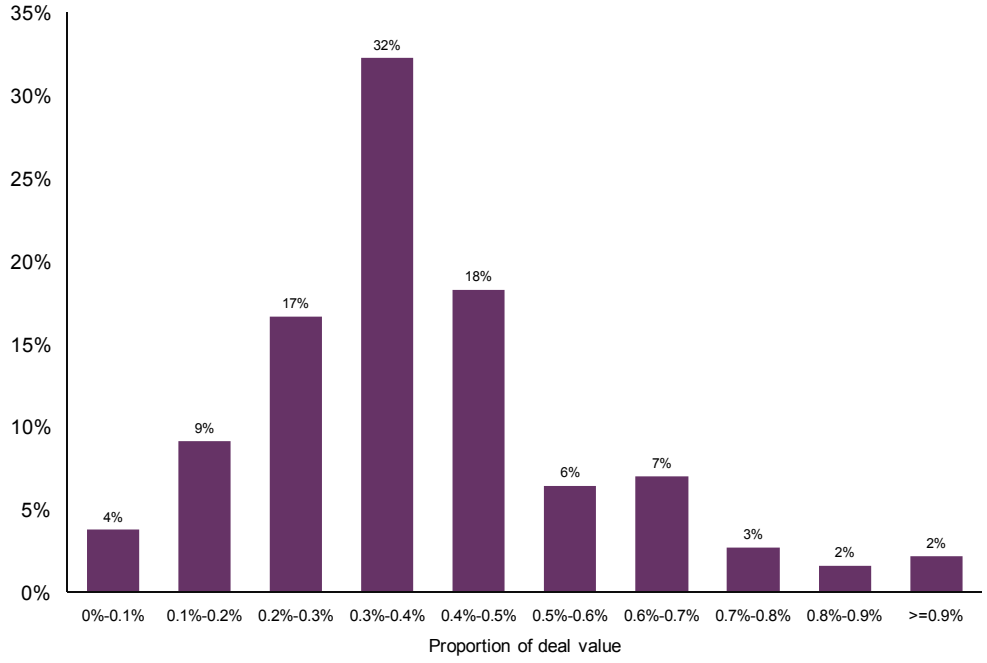
[5] Euroweek (2009), 'Scramble for top names as RWE, Sanofi fly', October.

[6] Based on 15 bank loans for ENECO Holding N.V., Essent N.V. and Nuon N.V. Source: Bloomberg.

[7] Small companies are defined as those with total assets less than US$ 1billion, and medium companies as those having total assets between US$1 billion and US$10 billion. Low risk refers to companies with an Aaa, Aa or A credit rating. Source: Altunbaşa, Y. and Kara, A., (2007), 'Does concentrated arranger structure in US syndicated loan markets benefit large firms?', p. 14.

[8] For illustration purposes, regulated asset values of €1,500m and €150m are assumed for large and small networks, respectively. Total debt is assumed to represent 55% (the midpoint of the gearing range) of asset value. Annual legal and administrative overhead costs are assumed to equal €150k and €50k for large and small networks, respectively. Rating fees of €200k are assumed to apply to large networks only.

Figure 3.5 Distribution of underwriting and arranging fees paid by utility and energy companies in Europe since 2000



Note: These issuance costs relate to the gross disclosed costs paid to the book runner at the time of bond issuances, by utility and energy companies between 2000 and 2009.
Source: Dealogic and Oxera calculations.

Box 3.1 Regulatory treatment of debt issuance fees

Some regulatory bodies did not explicitly recognise debt issuance fees as an uplift to the cost of capital:

Ofgem, DPCR5 (UK)

> We do not think it is appropriate to make an explicit allowance for these [transaction] costs. But there is a spread (approximately 30bps) between our allowed cost of debt and the trailing average which creates headroom to fund any transaction costs.

Commerce Commission (New Zealand)

> It is often argued before the Commission that debt issuance costs should be included as a margin on the cost of debt. The Commission agrees that the costs associated with prudent refinancing are legitimate expenses that ought to be compensated. However, the Commission considers that, rather than imputing these into the cost of debt, debt issuance costs are more naturally viewed as expenses to be amortized over the regulatory period (which, as explained later, is taken to be the notional term of borrowing for regulatory purposes) and included in the allowed cash flows. In line with the adoption of such a time period, the Commission would expect any allowance for refinancing costs to be consistent with the overall financial structure implied within its cost of capital assessment.

Sources: Ofgem (2009), 'Electricity Distribution Price Control Review Final Proposals – Allowed Revenues and Financial Issues', December 7th. Commerce Commission (2009), 'Revised Draft Guidelines The Commerce Commission's Approach to Estimating the Cost of Capital', June 19th. para78.

Table 3.5 Regulatory allowance for debt issuance fees

Regulatory precedent	Industry	Country	Year	Allowance for debt issuance fees (bp)
Ofwat (PR09)	Water	UK	2009	20
Competition Commission (Stansted Airport)	Transport	UK	2008	10
Competition Commission (Heathrow and Gatwick)	Transport	UK	2007	15
Queensland Competition Authority	Energy	Australia	2004	12.5

Source: Ofwat (2009), 'Future water and sewerage charges 2010-15: final determinations', November. Competition Commission (2008), 'Stansted Airport Ltd: Q5 price control review', October 23rd, Appendix L; and Competition Commission (2007), 'BAA Ltd: a report on the economic regulation of the London airport companies (Heathrow Airport Ltd and Gatwick Airport Ltd)', September 27th, Appendix F. Queensland Competition Authority (2004),'Regulation of Electricity Distribution: Draft Determination', December.

On balance, the evidence presented above suggests an uplift of 10–20bp above market yields to account for debt issuance fees and debt-related overhead costs.

3.5 Conclusions

A possible approach to the selection of a range for the cost of debt is to base the low end of the range on the five-year average spread of the bond index for A-rated debt, and the high end of the range on the median of the two-year average spreads for selected issuances. This methodology for determining the debt premium would be consistent with that used to determine the risk-free rate. This yields a range of 100bp to 170bp for the debt premium, before issuance fees. Including a compensation of 10–20bp for debt issuance costs, the final recommended range for the cost of debt is 110–190bp (Table 3.6).

Since the September 2009 version of this report, the estimated debt premium has increased by 10bp (excluding the impact of debt issuance costs), despite a fall in yields and spreads during that time (as shown in Figure 3.3). This is because the averaging methodology used for this exercise, and notably the use of a two-year averaging period to establish the high end of the range, imply that the effect of the crisis are fully reflected in these estimates

Table 3.6 Conclusions—debt premium

	December 2009		July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High	Low	High
Debt premium	110	190	90	160	60	100	60	80

Source: Datastream, Oxera analysis.

4 The equity risk premium

4.1 Methodology

The ERP is the difference between the expected return on a diversified portfolio of risky equity securities and the expected return on a risk-free asset. It represents the compensation that investors require to bear the risk to which they expose themselves by investing in equity markets. The ERP is not directly observable and must be estimated using indirect approaches (Box 4.1).

Box 4.1 Approaches to estimating the ERP

The approaches to estimating the ERP fall broadly into three categories.

- **Ex post (realised) premium**—this measures the returns earned in the past on equities relative to riskless securities, and assumes that investors' expectations looking forward are based on past returns.
- **Ex ante (implied) premium**—this uses fundamental information on future cash flows to investors (such as dividends, earnings, or overall economic productivity) to estimate the ERP implied in the price of traded assets today.
- **Ex ante (stated) premium**—this involves surveying sub-sets of investors and managers to get a sense of their expectations about equity returns in the future.

The ex post method has the advantage of being widely understood, and relies on measurable data rather than disputable input assumptions. It is not without its methodological issues, however, and its validity in the present market context is questionable. In practice, UK regulators use both ex post and ex ante approaches..

The most widely used dataset for estimating historical ERPs in mature equity markets is that of Dimson, Marsh and Staunton. Dimson, Marsh and Staunton (2008) provide long-term time series on annual returns on stocks, bonds, bills and inflation for 17 developed economies over the period from 1900 to 2007.

Source: Dimson, E., Marsh, P. and Staunton, M. (2008), 'Global Investment Returns Year Book 2008', February, and Oxera.

In previous decisions, EK used both historical and forward-looking evidence to set the ERP (see Table 4.1).

Table 4.1 EK estimation methodology for the ERP

Estimation question	EK methodology
Ex post evidence	
Source of data	Focus on Dimson, Marsh and Staunton estimates
Averaging methodology	Both arithmetic and geometric means considered
Geographic scope	Dutch and 'world' returns
Ex ante evidence	
Dividend growth model	Review of academic studies
Surveys	Review of independent surveys
Current market data	Current earning yields in NL, UK and USA

Source: EK decisions and supporting documents.

4.2 Updated market evidence

In the current context, the evidence provided by ex post and ex ante methodologies is somewhat conflicting.

– On the one hand, ex post estimates of long-term returns have dropped (see Figure 4.1 and Table 4.2). For example, long-term arithmetic returns for the 'world' market have fallen from 5.1% when measured over 1900–2005, to 4.6% when measured over 1900–2008. [9] This is because the 1900–2008 estimates incorporate the recent negative performance of capital markets (although they do not incorporate the rally in equity markets observed over 2009—see Figure 4.2).

– On the other hand, direct surveys of market practitioners and academics suggest that ex ante expectations of the ERP have increased (Table 4.3). Graham and Harvey, whose survey spans two recessions, note that this seems to be a recurring pattern: during recessions, the risk premium is 3.97% while during non-recessions, the premium is 3.37% (Figure 4.3). A more focused investor survey commissioned earlier this year by the UK trade association for the water industry also found that a majority of investors in the UK utility sector thought that the ERP was higher now than in 2004/05.[10]

– Furthermore, the recent market turbulence has been characterised by a sharp rise in share price volatility, both when measured according to historical time series (ie, the observed volatility in share prices—see Figure 4.4) and from a forward-looking perspective(ie, the implied volatility inferred from call options—see Figure 4.5). These measures of volatility in equity markets indicate an increase in the uncertainty surrounding future equity returns. This might, in turn, constitute an additional factor of risk in equity markets, at least over the short term (see Box 4.2).

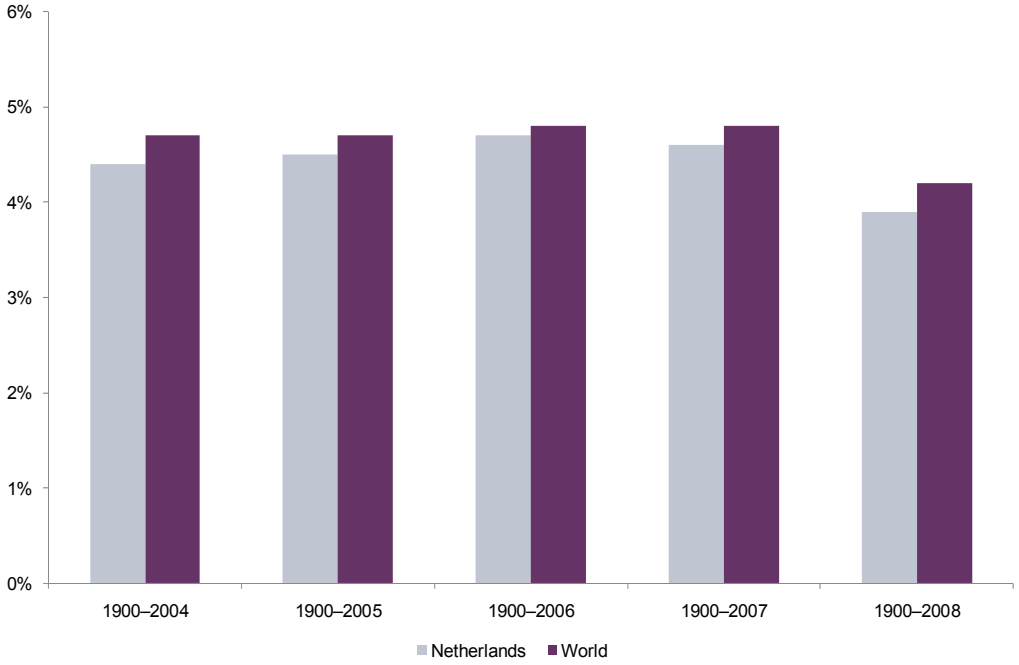
– Finally, recent regulatory determinations have shown an absence of consensus about the impact of the crisis on the ERP, at least in the UK. While the telecommunications regulator, Ofcom, and the water regulator, Ofwat, have increased their ERP estimates to take account of recent market developments, the Competition Commission has determined that total equity returns would be expected to remain constant over time, and that any change in the ERP would be offset by an opposite change in the risk-free rate (see Box 4.3).

– These pieces of evidence are indicative of different phenomena working in opposite directions. On the one hand, the crisis has led to a reduction in earnings expectations (due to lower demand, pressures on leveraged structures, and more structural frailties in corporate structures and business models). On the other hand, the recent crisis might have increased the level of uncertainty present in capital markets, and the level of investors' aversion with regard to this equity risk.

[9] The 1900–2005 and 1900–2008 figures were selected to represent the information available at the time of the 2006 and 2009 price reviews, respectively.

[10] Indepen (2009), '2009 Investor Survey: A Report by Indepen for Water UK', March.

Figure 4.1 Historical estimates of the ERP from Dimson, Marsh and Staunton, 1900–2005 and 1900–2008



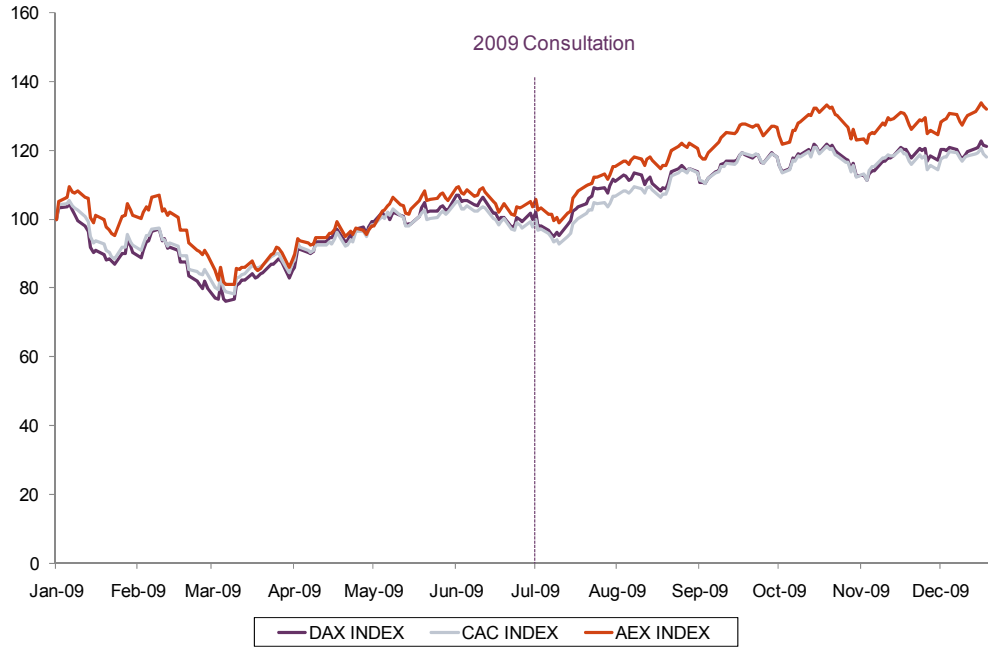
Source: Dimson, E., Marsh, P. and Staunton, M. (2009), 'Credit Suisse Global Investment Returns Sourcebook 2009', Dimson, E., Marsh, P. and Staunton, M. (2008), 'Credit Suisse Global Investment Returns Yearbook 2008', Credit Suisse; ABN AMRO (2006), 'Global Investment Returns Yearbook', February; ABN AMRO (2005), 'Global Investment Returns Yearbook', February; Frontier Economics (2008), 'Updated cost of capital estimate for energy networks', prepared for DTE, April.

Table 4.2 Historical estimates of the ERP by Dimson, Marsh and Staunton (%)

	Over Treasury bills		Over bonds	
	Geometric mean	Arithmetic mean	Geometric mean	Arithmetic mean
Netherlands	3.9	6.1	3.2	5.6
Europe	3.5	5.5	3.6	5.0
World ex-USA	3.7	5.6	3.5	4.7
World	4.2	5.7	3.4	4.6

Source: Dimson, E., Marsh, P. and Staunton, M. (2009), 'Credit Suisse Global Investment Returns Sourcebook 2009', Credit Suisse.

Figure 4.2 Performance of European equity markets in 2009 (base 100 in January 2009)



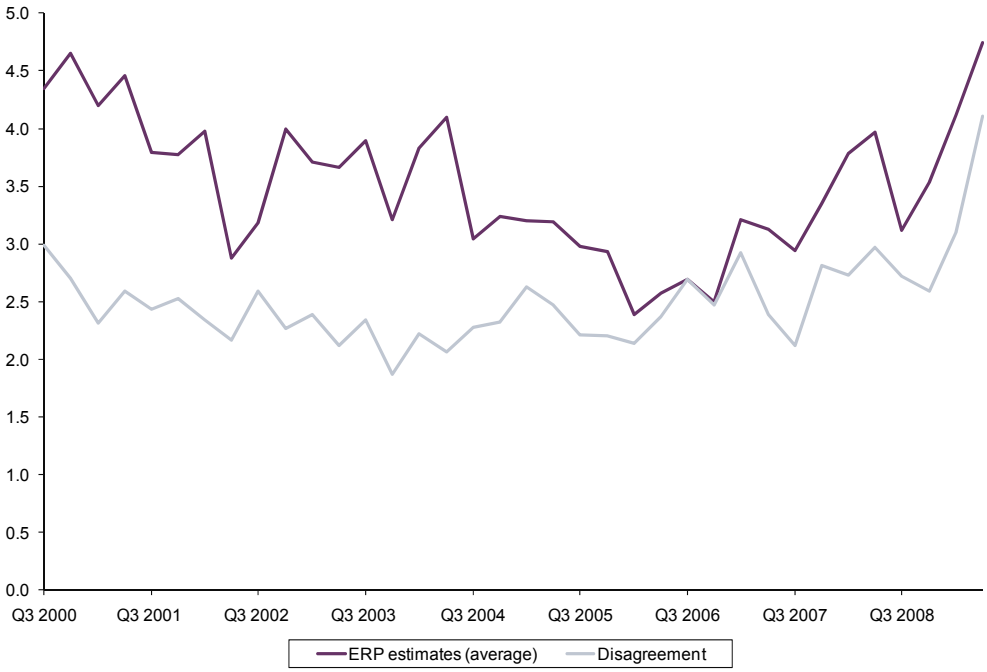
Source: Bloomberg.

Table 4.3 Survey evidence of ERP expectations

Survey	Survey	Most recent value	Previous value
Fernández (2009)	Survey of MRP used by European finance and economics professors (224 answers)	5.3% (2008)	5.0% (2007)
	Survey of MRP used by US finance and economics professors (487 answers)	6.3% (2008)	6.0% (2007)
	Survey of MRP used by European companies (416 answers)	6.4% (2008)	N/C
Graham and Harvey (2009)	Survey of MRP used by US CFOs conducted in February 2009 (452 answers)	4.7% (2009 Q2)	4.1% (2009 Q1)
Welch (2009)	Survey of finance or economics professors (143 answers)	5–6%	N/C

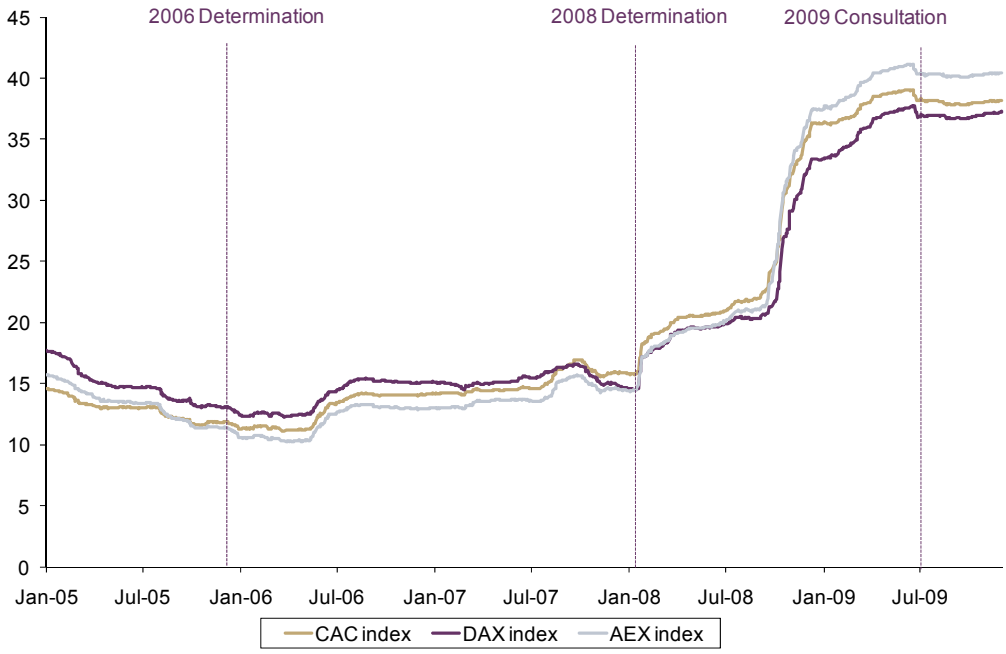
Source: Fernández, P. (2009), 'Market Risk Premium used in 2008 by Professors: a survey with 1,400 answers', April, pp. 1–21; Graham, J. and Campbell, H. (2009), 'The Equity Risk Premium Amid a Global Financial Crisis', May, pp. 1–18; Welch, I. (2009), 'Views of Financial Economists On The Equity Premium And Other Issues', *The Journal of Business,* October unpublished working paper available at http://welch.econ.brown.edu/academics/equpdate-results2009.html.

Figure 4.3 ERP expectations surveyed by Graham and Harvey (2009)



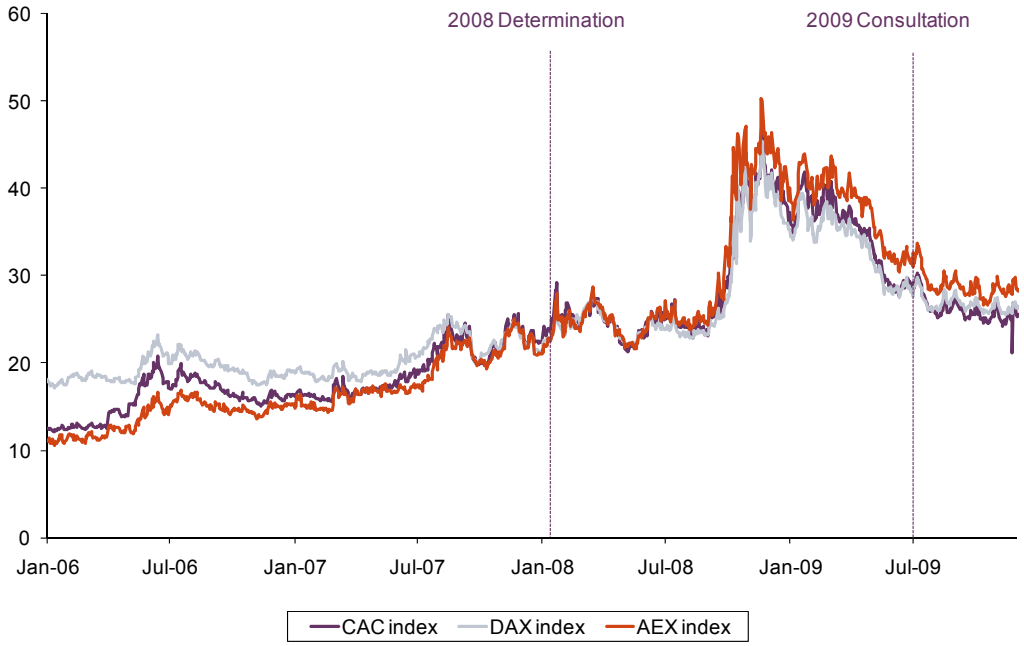
Source: Graham, J. and Campbell, H. (2009), 'The Equity Risk Premium amid a Global Financial Crisis', May, pp. 1–18. The 'disagreement' indicator refers to the standard deviation in survey responses.

Figure 4.4 Volatility on European indexes—historical (%)



Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Bloomberg.

Figure 4.5 Volatility on European indexes—implied over 18 months (%)



Note: '2009 Consultation' refers to the consultation published by EK in September 2009, based on data as at July 2009.
Source: Bloomberg.

Box 4.2 Academic evidence on the relationship between share price volatility and the ERP

The relationship between the ERP and the variance in the portfolio returns is broadly confirmed in the academic literature.

- Investigating the effect of volatility on the ERP in the USA over the period 1926–88, Campbell and Hentschel (1992) find that the ERP increases with the volatility of the log returns of the market index.
- Scruggs (1998) also finds a positive relationship between the variance of returns of the index and the ERP.
- Copeland and Copeland (1999) find a positive relationship between movements in the CBOE volatility index (VIX) (a measure of market expectations of stock return volatility) and stock returns.
- Guo and Whitelaw (2006) find a positive relationship between market returns and implied volatility.
- Graham and Harvey (2007) examine the relationship between implied volatility and the ERP, based on the results of the most recent survey of US CFOs, which looked ahead to the first quarter of 2007 and beyond. They present expectations of the ERP measured over a ten-year horizon relative to a ten-year US Treasury bond. Among their findings is evidence suggesting a positive relationship between implied volatility, captured by the VIX and the ERP.
- Banerjee, Doran and Peterson (2007) undertook a detailed study of the relationship between the VIX (level and innovations) and the ERP, defined as the difference between S&P index returns and the risk-free rate. Covering the period June 1986 to June 2005, the authors focus on 30- and 60-day horizons to quantify the relationship between the VIX and the (ex post) ERP, and find this relationship to be positive.

Sources: Campbell, J.Y. and Hentschel, L. (1992), 'No News is Good News. An Asymmetric Model of Changing Volatility in Stock Returns', *Journal of Financial Economics*, **31**, pp. 281–318; Scruggs, J.T. (1998), 'Resolving the Puzzling Intertemporal Relation Between the Market Risk Premium and the Conditional Market Variance: A Two Factor Approach', *Journal of Finance*, **53**:2; Copeland, M. and Copeland, T. (1999), 'Market Timing: Style and Size Rotation Using the VIX', *Financial Analysts Journal*, **55**, pp. 73–81; Guo, H. and Whitelaw, R. (2006), 'Uncovering the Risk–Return Relationship in the Stock Market', *Journal of Finance*, **61**, pp. 1433–63; Graham, J.R. and Harvey, C.R. (2007), 'The Equity Risk Premium in January 2007: Evidence from the Global CFO Outlook Survey', working paper, Duke University; Banerjee, P.S., Doran, J.S. and Peterson, D.R. (2007), 'Implied Volatility and Future Portfolio Returns', *Journal of Banking & Finance*, **31**:10, pp. 3183–99, October.

Box 4.3 The debate over the impact of current market conditions on the ERP in the UK

The most recent determinations have shown a lack of consensus on the effect of the turmoil on equity returns.

Ofcom has recognised that current market conditions might lead to an increase in the forward-looking ERP. It consequently adopted an estimate of 5.0% in its final determination in May 2009, a slight increase on its first proposals of 4.5–4.75% in May 2008:

> We would note that the recent consensus suggests that there has been some upward pressure on the ERP since we last reviewed BT's cost of capital, perhaps in line with increased volatility in equity markets.
>
> Our decision to choose a point estimate at the top of our prior range is in response to increased market volatility and turbulence, which is likely to lead to investors requiring increased returns in exchange for holding equity rather than risk-free assets.

The **Competition Commission**, in contrast, has argued that there was no indication that total expected returns on the market portfolio were changing in reaction to short-term market conditions. The increase in the ERP range in the Stansted recommendations, compared with the earlier Heathrow and Gatwick recommendations, reflected a reduction in the risk-free rate, not an increase in expected returns:

> The nature of the 'Rm' term in the CAPM is such that estimates are unlikely to change significantly in any 12-month period … and notwithstanding the existence of some estimates above and below our estimates, our interpretation of the evidence was that the expected return on the market portfolio continues to be broadly in the range of 5.0 to 7.0 per cent.

More recently, **Ofwat** adopted an ERP assumption of 5.4% in its final determination for the forthcoming regulatory period, which is above the figure used in 2004, noting that this was intended to reflect current economic conditions.

In contrast, in its final determination for electricity distribution networks, Ofgem considered that there was no reason to assume any shift in the ERP (albeit Ofgem's central estimate for the ERP is lower than that of EK).

> We recognise that the recovery from recession will be not be straightforward or entirely predictable but we see no reason to believe that there has been a fundamental departure from the long-term trend in equity risk premium which is generally estimated by academics to be in the 3 to 5 per cent range.

Sources: Ofcom (2009), 'A New Pricing Framework for Openreach: statement', May; Competition Commission (2008), 'Stansted Airport Ltd: Q5 Price Control Review', October; Ofwat (2009), 'Future water and sewerage charges 2010-15: final determinations', November., Ofgem (2009), 'Electricity Distribution Price Control Review Final Proposals', December

4.3 Conclusions

The evidence on the ERP is mixed. On the one hand, equity returns have dropped, and it is conceivable that investors are incorporating this information into their expectations. On the other hand, indicators of risk and risk aversion have increased, which might suggest an effect working in the opposite direction.

For these reasons, at this stage there does not seem to be any sufficient basis for departing from the range used at the last determinations (Table 4.4). In particular, the selected range for the ERP is close to the range measured from historical Dutch returns, which is relevant given the consistency with the evidence taken into account to estimate the risk-free rate.

Table 4.4 Conclusions—ERP

	December 2009		July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High	Low	High
ERP	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0

Source: Oxera analysis.

5 The asset beta

5.1 Methodology

In previous decisions, EK estimated the asset beta by reference to the beta of comparator companies (see Table 5.1).

Table 5.1 EK estimation methodology for the beta

Estimation question	EK methodology
Choice of comparators	Criteria based on business mix, liquidity and regulatory risk
Statistical approach	
Data frequency and sample period	Two years (daily returns) and five years (weekly)
Market index	National index
Raw estimate correction	Vasicek method
Equity/asset beta conversion	Modigliani–Miller formula with zero debt beta
Range	Median for daily and weekly asset beta

Source: EK Decisions and supporting documents.

For TenneT, EK adopted a beta at the low end of the range under this approach, on the grounds that TenneT was not exposed to volume risk.

5.2 Updated market evidence

Updated market data shows the following.

– Asset betas measured in accordance with EK's methodology have remained broadly stable. The median beta for the sample used for the 2008 Determination is now 0.38 to 0.45 (calculated on weekly and daily data, respectively), compared to 0.39 to 0.42 originally.

– Beta estimates based on market data are, in general, characterised by a degree of uncertainty, but are widely used and generally accepted as the basis for deriving cost of capital. The beta estimates for the peer samples used in previous determinations are shown in Tables 5.2 and 5.3. The beta coefficients for individual comparators in the sample are statistically significant at a 95% level.

Table 5.2 Asset beta estimates for previous samples updated as at December 1st 2009

	2005		2008		2009	
Company Name	**Daily**	**Weekly**	**Daily**	**Weekly**	**Daily**	**Weekly**
Australia Gas Light	0.39	0.16	n/a	n/a	n/a	n/a
Envestra	0.21	0.10	0.27	0.20	0.19	0.19
Canadian Utilities	0.26	0.32	0.37	0.43	0.26	0.33
Emera	0.10	0.11	0.26	0.24	0.18	0.24
Terasen	0.16	0.14	n/a	n/a	n/a	n/a
Red Electrica	0.30	0.21	0.48	0.36	0.40	0.45
National Grid	0.35	0.28	0.43	0.39	0.39	0.44
Scottish Power	0.40	0.38	n/a	n/a	n/a	n/a
United Utilities	0.26	0.20	0.49	0.40	0.42	0.48
Viridian	0.31	0.11	n/a	n/a	n/a	n/a
Atlanta Gas Light	0.49	0.32	0.49	0.51	0.41	0.47
Atmos Energy	0.69	0.33	0.42	0.47	0.34	0.44
Duquesne Light Holdings	0.60	0.32	n/a	n/a	n/a	n/a
Exelon	0.54	0.27	0.85	0.64	0.76	0.76
Transener	n/a	n/a	0.32	0.35	0.43	0.50
Australian Pipeline Trust	n/a	n/a	0.38	0.29	0.31	0.33
Snam Rete Gas	n/a	n/a	0.42	0.35	0.10	0.19
Enagas	n/a	n/a	0.56	0.48	0.41	0.49
Kinder Morgan	n/a	n/a	0.31	0.33	0.36	0.46
TC Pipelines	n/a	n/a	0.18	0.41	0.38	0.64
Mean	**0.36**	**0.23**	**0.42**	**0.39**	**0.36**	**0.43**
Median	**0.33**	**0.24**	**0.42**	**0.39**	**0.38**	**0.45**

Source: Frontier Economics (2008), 'Updated cost of capital estimate for energy networks', prepared for DTE, April; Frontier Economics (2005), 'The cost of capital for Regional Distribution Networks', a report for DTE, December; Bloomberg and Oxera calculations.

Table 5.3 Raw equity betas as at December 1st 2009 and 95% confidence intervals

	Daily raw beta	95% CI	Weekly raw beta	95% CI
Transener	0.82	0.73–0.91	0.93	0.79–1.06
Envestra	0.60	0.45–0.75	0.48	0.29–0.66
Australian Pipeline Trust	0.69	0.58–0.81	0.61	0.44–0.78
Emera	0.28	0.23–0.33	0.35	0.26–0.44
Canadian Utilities	0.33	0.26–0.4	0.41	0.29–0.52
Snam Rete Gas	0.14	0.09–0.19	0.25	0.16–0.35
Red Electrica	0.54	0.47–0.6	0.63	0.51–0.74
Enagas	0.56	0.49–0.63	0.63	0.5–0.75
National Grid	0.69	0.62–0.76	0.70	0.58–0.81
United Utilities	0.64	0.56–0.72	0.72	0.59–0.84
Atlanta Gas Light	0.62	0.57–0.68	0.70	0.6–0.79
Kinder Morgan	0.50	0.44–0.56	0.60	0.5–0.7
TC Pipelines	0.50	0.43–0.58	0.74	0.6–0.88
Atmos Energy	0.53	0.48–0.59	0.65	0.55–0.74
Exelon	0.89	0.82–0.97	0.91	0.78–1.04

Source: Bloomberg and Oxera calculations.

The estimates have also been tested for autocorrelation and heteroschedasticity, and the overall range of the sample estimate is not significantly impacted by the removal of individual estimates that failed either of these tests (see Appendix 1 for details).

Additional considerations—composition of the sample

The peer group has been chosen based on a set of appropriate criteria applied to a broad set of potential comparators. A number of different comparators included in the peer group ensures that relevant, available market information is captured in the estimates rather than left out. Oxera has reviewed the sample of comparators used by EK in light of the criteria and methodology set out in previous decisions (see Table 5.4).

– **Changes in business mix**—some companies have divested part of their regulated businesses, or have made acquisitions in unregulated sectors, thereby reducing the share of energy networks in the business mix: United Utilities has sold its electricity distribution network in 2008;[11] Canadian Utilities now has a significant stake in non-regulated businesses (generation, cogeneration, gas storage, electricity supply, etc); Atmos Energy now derives nearly half of its revenues from non-regulated activities in gas supply and storage; Exelon has expanded into non-regulated generation and wholesale businesses, which now account for almost half of its revenues. On this basis, it seems appropriate to exclude these companies from the sample.

– **Regulatory and policy developments**—the concession contract of Transener is currently under review and rating agencies consider that the company is exposed to significant political and regulatory risk as a result.[12] On this basis, it seems appropriate to exclude Transener from the sample.

[11] The company is still involved in the operations of the business through a contractual arrangement with the new owners, and still owns its regulated water business in full.

[12] S&P rates the business risk profile of Transner as 'vulnerable' and observes that 'the ratings on Transener mainly reflect the high political and regulatory risk in Argentina and its relatively high leverage and foreign-exchange risk'. S&P (2009) 'Transener Research Update' February 13th (S&P rates Transener B–).

Apart from the case of Transener, Oxera is not cognisant of any major change in the price control regimes of these companies that would warrant a modification in their treatment for this exercise. In general, most European and Australian companies are regulated under incentive-based regimes under which access charges are fixed for a certain period of time and companies are exposed to the risk of under- or over-recovery within the regulatory period. In contrast, most American and Canadian companies are regulated in accordance with cost-of-service principles whereby access charges are reset frequently on the basis of observed costs. There are certain variations around this, however, depending on the segment and the state considered. In gas distribution, for example, certain regulatory commissions are progressively incorporating performance-based mechanisms that involve frozen rates for determined periods (for example in New Jersey or Virginia). In interstate gas transmission (one of the main activities of Kinder Morgan), operators are free to enter into negotiated rate agreements with network users, and there is a certain degree of pipeline-to-pipeline competition.

– **Gearing**—Oxera notes that two of these companies (Australian Pipeline Trust and Envestra) exhibit a relatively high level of gearing. At this level of gearing, the assumption (employed in previous decisions) that the debt beta is zero might not be valid.

More generally speaking, this review indicates that European companies offer better references for the assessment of the beta of Dutch energy networks. The incentive-based regulatory frameworks applied by other European regulators are more directly comparable to the regime applied in the Netherlands than the cost-of-service approach most commonly used in the USA and Canada. Moreover, more stringent unbundling requirements have ensured that most European network companies have only minimal involvement in non-regulated activities.

However, insofar as non-European comparators were used in precedent determinations, it appears desirable to retain such comparators in the beta sample to ensure regulatory consistency. Moreover, the two main differences between European and North American comparators might be expected to have opposite effects on their overall business risk: incentive-based regulation should in principle expose European companies to a higher degree of business risk than their North American peers, while stricter unbundling requirements in Europe might imply that the business portfolio of European companies is less risky than that of their American peers.

Table 5.4 Review of existing comparators

Company	Country	Share of energy networks (%)	Gearing (%)	Turnover (€m)	Regulatory regime	Still meeting EK's criteria?
Transener	Argentina	73	59	328	Under review	No
Australian Pipeline Trust	Australia	89	65	570	Price cap	No
Envestra	Australia	100	77	220	Five-year price cap	No
Canadian Utilities	Canada	45	32	1,782	Cost of service regulation	No
Emera	Canada	90	46	854	Cost of service regulation	Yes
Snam Rete Gas	Italy	98	43	1,902	Four-year price cap	Yes
Enagas	Spain	97	34	813	Four-year revenue cap	Yes
Red Electrica	Spain	93	34	1,155	Four-year revenue cap	Yes
National Grid	UK	98	53	18,801	Five-year revenue cap	Yes
United Utilities	UK	0	43	2,930	n/a	No
Atlanta Gas Light	US	71	47	1,913	Cost of service + performance-based adjustments	Yes
Atmos Energy	US	47	50	4,811	Cost of service + performance-based adjustments	No
Exelon	US	58	22	12,888	Cost of service regulation	No
Kinder Morgan	US	70	39	8,023	Cost of service + negotiated agreements	Yes
TC Pipelines	US	100	35	427	Cost of service + negotiated agreements	Yes

Notes: The gearing figure reported in this table is averaged over the past two years; the share of energy networks is calculated on the basis of EBIT where available, and on the basis of turnover otherwise; the 'share of energy networks' figures for Emera, Atlanta Gas Light, Atmos Energy and Exelon include regulated supply activities reported by these companies as part of their distribution segment.
Source: Annual reports; company websites; Bloomberg; S&P ratings reports; and Oxera calculations.

In addition, Oxera has added to this sample a number of comparators that match EK's criteria: the Italian transmission system operator, Terna, and the Portuguese energy network company, REN, as well as three US-based energy network companies (see Table 5.5). A larger sample helps to ensure representativeness of the estimates and reduce the impact of any potential outliers.

Table 5.5 Additional comparators

Company	Country	Share of energy networks (%)	Gearing (%)	Turnover (€m)	Regulatory regime	Meeting EK's criteria?
Terna	Italy	95	37	1,336	Four-year price cap	Yes
REN	Portugal	99[1]	52	494	Cost of service regulation	Yes
ITC Holdings	US	100	49	422	Cost of service regulation	Yes
Northwest Natural Gas	US	95	36	709	Cost of service regulation	Yes
Piedmont Natural Gas	US	75	35	1,401	Cost of service + performance-based adjustments	Yes

Notes: The gearing figure reported in this table is averaged over the past two years; the share of energy networks in the business mix is calculated on the basis of turnover. The 'share of energy networks' figure for Northwest Natural Gas and Piedmont Natural Gas includes regulated supply activities reported by these companies as part of their regulated segment.
Source: Annual reports; company websites; Bloomberg; S&P ratings reports; and Oxera calculations.

The median beta for this amended sample is similar to the median beta for the former sample (Table 5.6).

Table 5.6 Asset beta estimates for amended sample updated as at December 1st 2009

Company name	Daily	Weekly
Snam Reta Gas	0.10	0.19
Terna	0.22	0.23
REN	0.35	0.39
Red Electrica	0.40	0.45
Enagas	0.41	0.49
National Grid	0.39	0.44
Emera	0.18	0.24
Kinder Morgan	0.36	0.46
Atlanta Gas Light	0.41	0.47
Piedmont Natural Gas	0.54	0.48
Northwest Natural Gas	0.43	0.39
ITC holdings	0.49	0.60
TC Pipelines	0.38	0.64
Mean	**0.36**	**0.42**
Median	**0.39**	**0.45**
Median for European companies	0.37	0.41
Median for North American companies	0.41	0.47

Source: Bloomberg and Oxera calculations.

Appendix 1 to this paper investigates the statistical properties of these estimates.

5.3 Conclusions

In previous decisions, EK set its range for the asset beta on the basis of the median estimate for weekly data and the median estimate for daily data. Applied in current conditions, this approach would yield a range of 0.39–0.45. This range for the asset beta has been constructed in order to capture different estimates in the sample and, at the same time, render the overall WACC estimates applicable in the regulatory context.

Table 5.7 Conclusions—beta

	December 2009		July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High	Low	High
Asset beta	0.39	0.45	0.39	0.46	0.39	0.42	0.28	0.39

Source: Oxera analysis.

For TenneT, EK focused on the low end of the beta range provided by this analysis. In this case, this approach would yield a beta estimate of 0.39 for transmission.

A1 Statistical tests of beta estimates

The ordinary least squares (OLS) regressions used to estimate the beta build on a set of 'standard assumptions', notably that the error term in the regression follows a normal distribution and does not exhibit heteroscedasticity or autocorrelation.

In practice, violation of these assumptions does not invalidate the estimate of the beta, but it undermines its reliability: while OLS estimates remain unbiased, the procedure no longer produces the least variance estimator, meaning that the beta estimate may be more uncertain than indicated by the OLS standard errors. Failure of normality could indicate the presence of outliers, which raises questions about the robustness of the estimates.

A number of standard diagnostic tests have been carried out to detect heteroscedasticity, autocorrelation and non-normal distribution of the regression residuals. Separate tests were conducted based on daily and weekly data. The following tests were conducted:

– Durbin alternative test for autocorrelation;
– Durbin–Watson test for autocorrelation;
– Breusch–Pagan/Cook–Weisberg test for heteroscedasticity;
– White test for heteroscedasticity;
– skewness and kurtosis test for normality.

The results are tested at the 5% significance level.

In general, the results vary from company to company, and a test failure tends to occur more frequently for weekly estimates. In general, heteroscedasticity is detected in about half of the companies concerned. Around a third of the companies exhibit some degree of autocorrelation. The error terms do not seem to follow a normal distribution based on skewness and kurtosis tests.

However, removing the beta estimates affected by autocorrelation does not affect the median estimates for the sample, while removing the beta estimates affected by heteroscedasticity only affects the median of daily estimates (Table A3.1). For these reasons, the beta range presented in section 5 of this paper is considered sufficiently robust in statistical terms to serve as a basis for the determination of the WACC.

Table A3.1 Beta estimates updated as at December 1st 2009

	Asset beta (daily)	Asset beta (weekly)
Full sample	0.39	0.45
Amended sample excluding estimates affected by autocorrelation	0.39	0.45
Amended sample excluding estimates affected by heteroscedasticity	0.35	0.46

Note: The second sample ('excluding estimates affected by autocorrelation') consist of estimates that do not fail at least one of the two autocorrelation tests; similarly, the third sample ('excluding estimates affected by heteroscedasticity') consist of estimates that do not fail at least one of the two heteroscedasticity tests.
Sources: Bloomberg; Datastream; Oxera calculations.

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