Oxera

Updating the WACC for energy networks

Quantitative analysis

Prepared for Energiekamer

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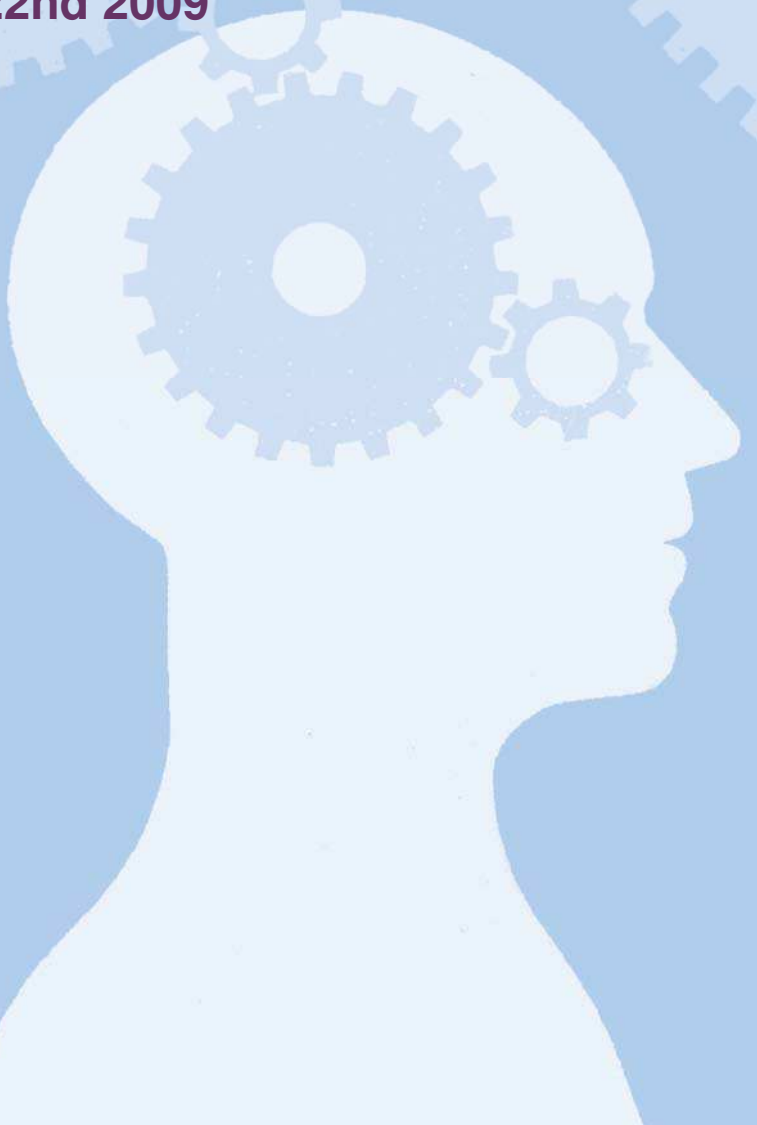

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1 Introduction and summary

EK has asked Oxera to update the parameters of the WACC for energy networks, based on the methodology established in previous decisions.[1] This report presents an overview of the relevant market evidence for the WACC assessment.

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 current turbulence and uncertainty in debt markets.

– The preliminary 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 increased, 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 preliminary range for the **pre-tax WACC** is slightly higher and broader than that 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.

Table 1.1 WACC estimates

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

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 5.2% to 6.5%, and a point estimate of 5.8%.

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

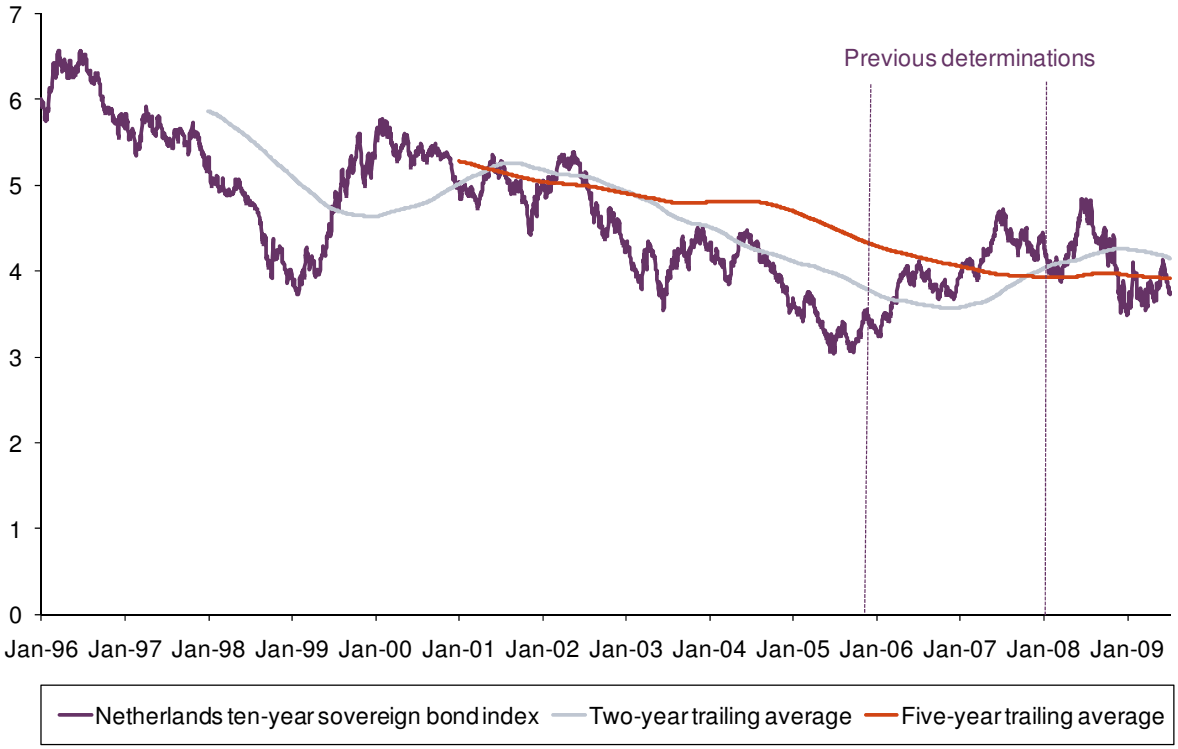
Updated market data shows the following.

– 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).

– Although the recent turbulence in capital markets has led to an increased in volatility in sovereign yields (see Figure 2.2), only the short and long ends of the yield curve have seen significant shifts compared to 2005 (see Figure 2.3); in contrast, yields for five- to ten-year maturities have remained more stable.

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



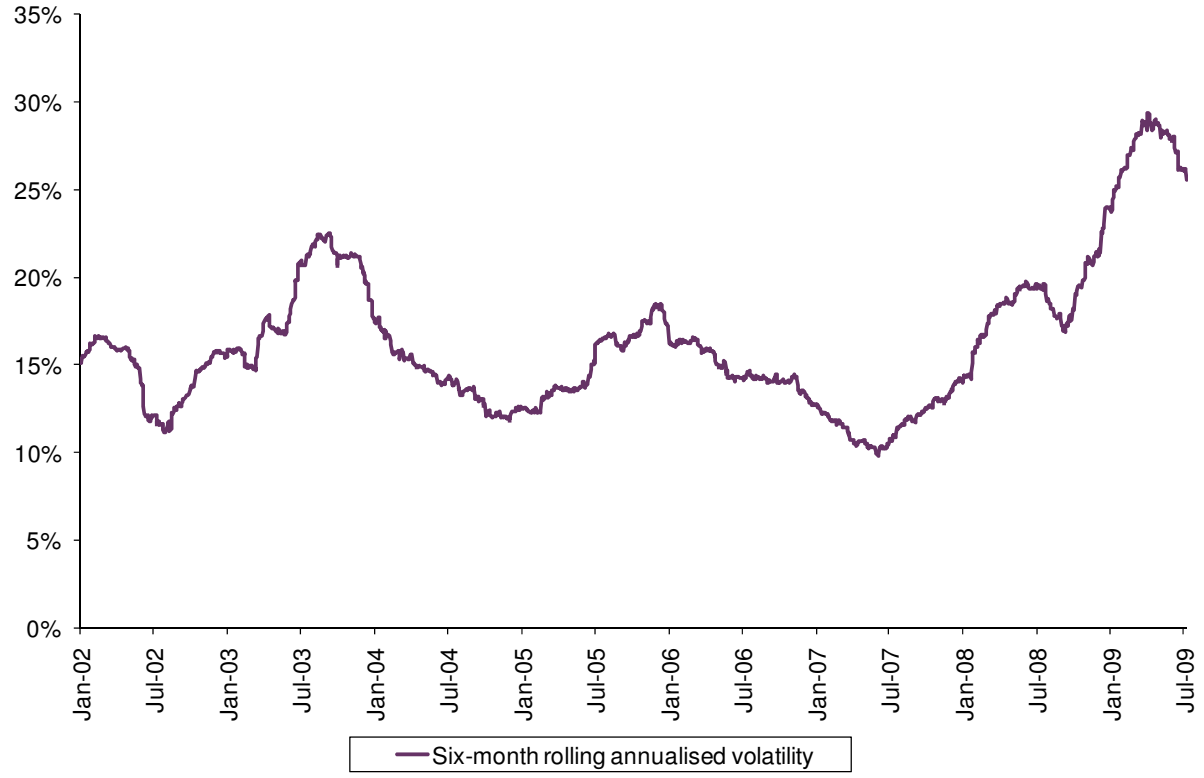
Source: Datastream and Oxera analysis.

Table 2.2 Yield on ten-year Dutch sovereign and averages

Averaging period	July 2009	January 2008	November 2005
Six months	3.8	4.3	3.3
One year	4.0	4.3	3.4
Two years	**4.2**	**4.1**	**3.8**
Three years	4.1	3.8	3.9
Five years	**3.9**	**3.9**	**4.3**

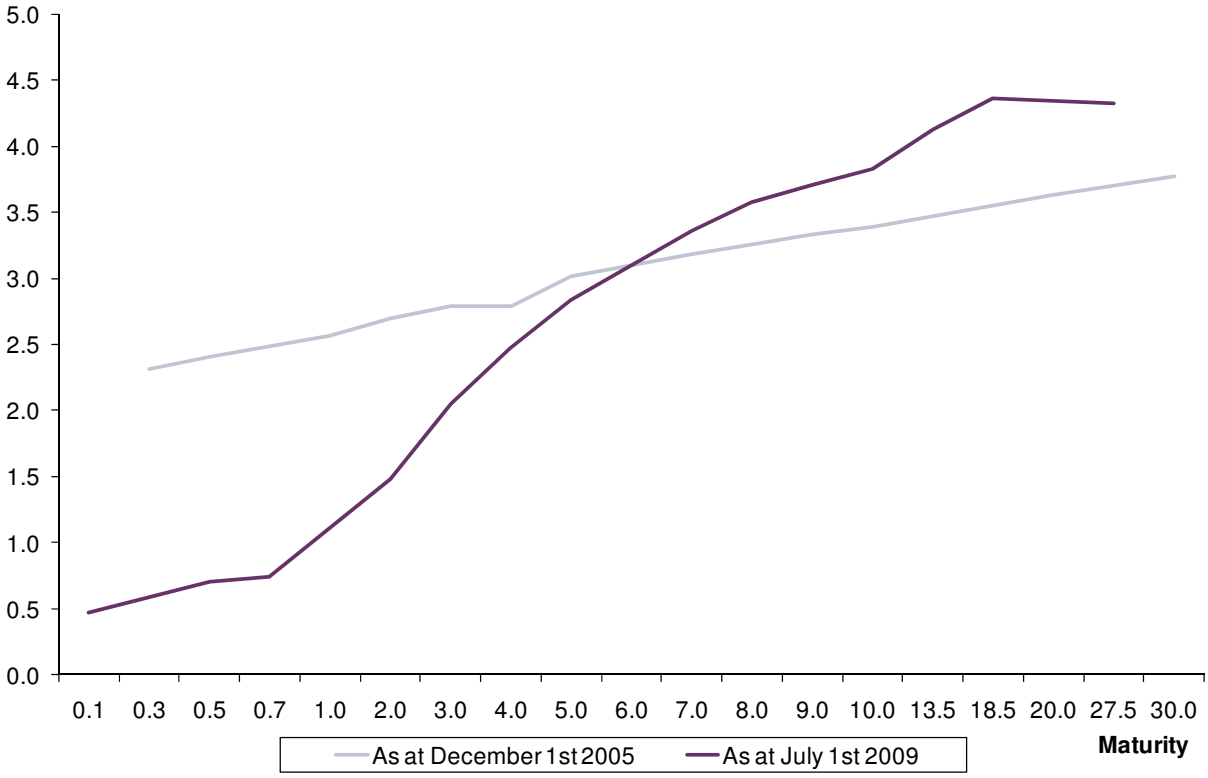
Source: Datastream and Oxera calculations.

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



Source: Datastream and Oxera analysis.

Figure 2.3 Dutch sovereign yield curves as at December 2005 and July 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 3.9–4.2% (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

	July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High
Risk-free rate	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 (which were not explicitly quantified).

3.2 Updated market evidence

Updated market data shows the following.

– Yields and spreads on corporate bonds have increased since EK adopted its last determination, particularly for BBB-rated bonds (Figure 3.1).[2]

– The five-year average spread on an index of A-rated bonds has increased from 55bp in January 2008 to 89bp now (Figure 3.2).

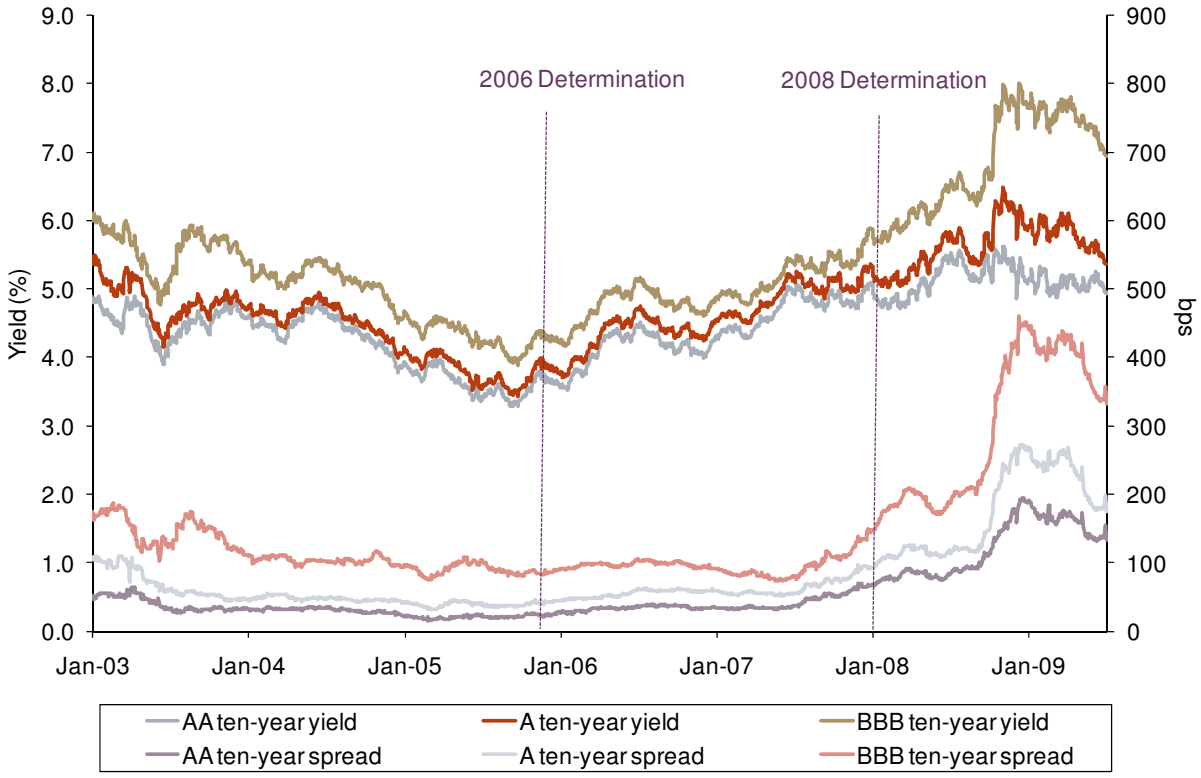
– The median of two-year average spreads has increased from 53bp to 156bp for the sample of bonds used in 2005 (Table 3.2) and from 85bp to 167bp for the sample of bonds used in 2008 (Table 3.3). However, the validity of these references is limited because the residual maturity of some of these bonds 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 161bp for bonds rated in the A range (Table 3.4). This is slightly above the two-year average spread on the general bond index provided (149bp—see Figure 3.2).

[2] There is some uncertainty regarding the reliability of price signals for BBB debt, given the low volumes of issuances in this segment of the market.

– 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.

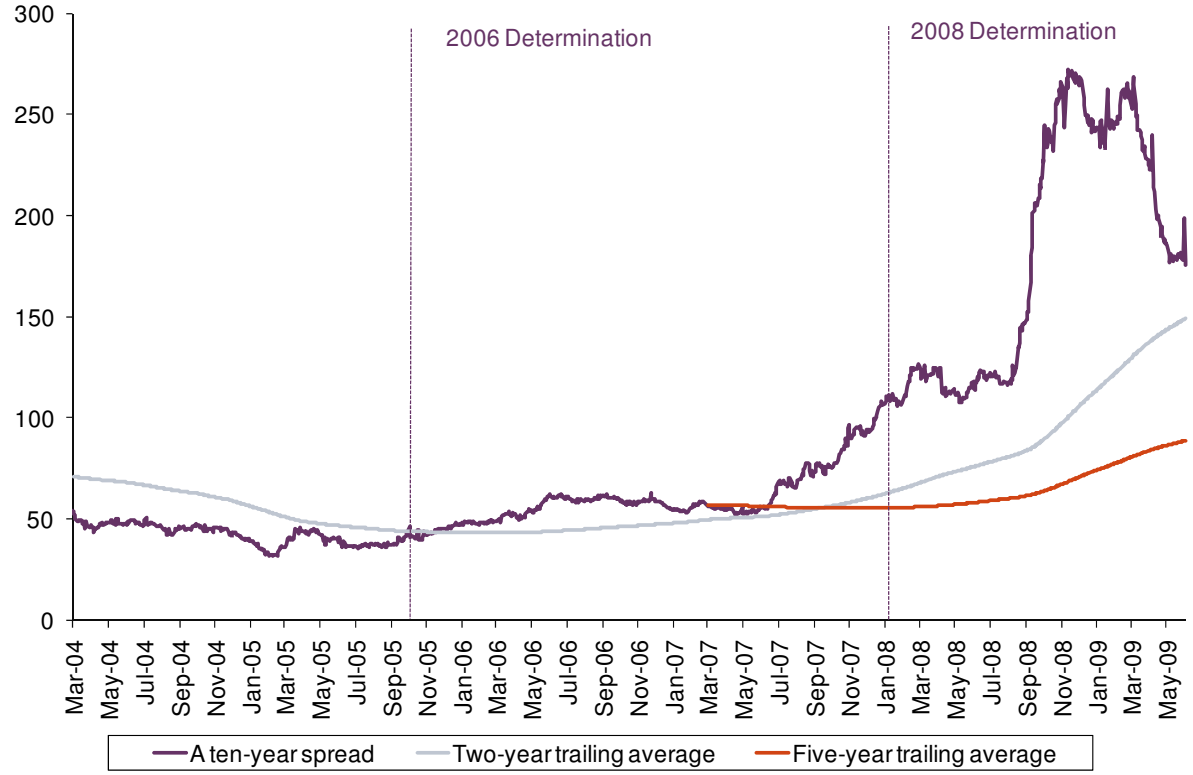
Figure 3.1 Yields and spreads on EUR-denominated ten-year corporate bond indices (BBB to AA ratings)



Source: Bloomberg and Oxera calculations.

[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)



Source: Bloomberg and Oxera calculations.

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

		September 2005		July 2009	
	Rating	Residual maturity (years)	Two-year average spread (bp)	Residual maturity (years)	Two-year average spread (bp)
Red Electrica	AA–	8	43	4	119
Energias de Portugal	A–	12	92	8	185
Essent	A+	8	53	–	–
Eneco	A–	5	47	1	82
Transco	A	12	78	8	156
Scottish Power	A–	11	77	6	318
United Utilities	A	13	81	9	164
Iberdrola	A–	7	42	4	156
RWE	A	11	38	7	89
Median		**11**	**53**	**7**	**156**
Mean		**10**	**61**	**6**	**159**
With maturity < 5 years					119
With maturity > 5 years					182

Note: The Essent bond used in 2005 is no longer traded.
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		July 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	159
Transco	A	10	80	8	156
Yorkshire Electricity	BBB+	12	87	10	169
Northern Electric	BBB+	13	87	11	176
RWE	A+	14	79	12	161
Scottish & Southern	A+	15	87	13	157
RWE	A+	16	79	14	167
Eastern	A	17	88	-	-
Transco	A–	17	85	15	171
National Grid	A	17	87	15	172
Median		**14**	**85**	**12**	**167**
Mean		**12**	**83**	**11**	**165**
With maturity < 10 years					157
With maturity > 10 years					168

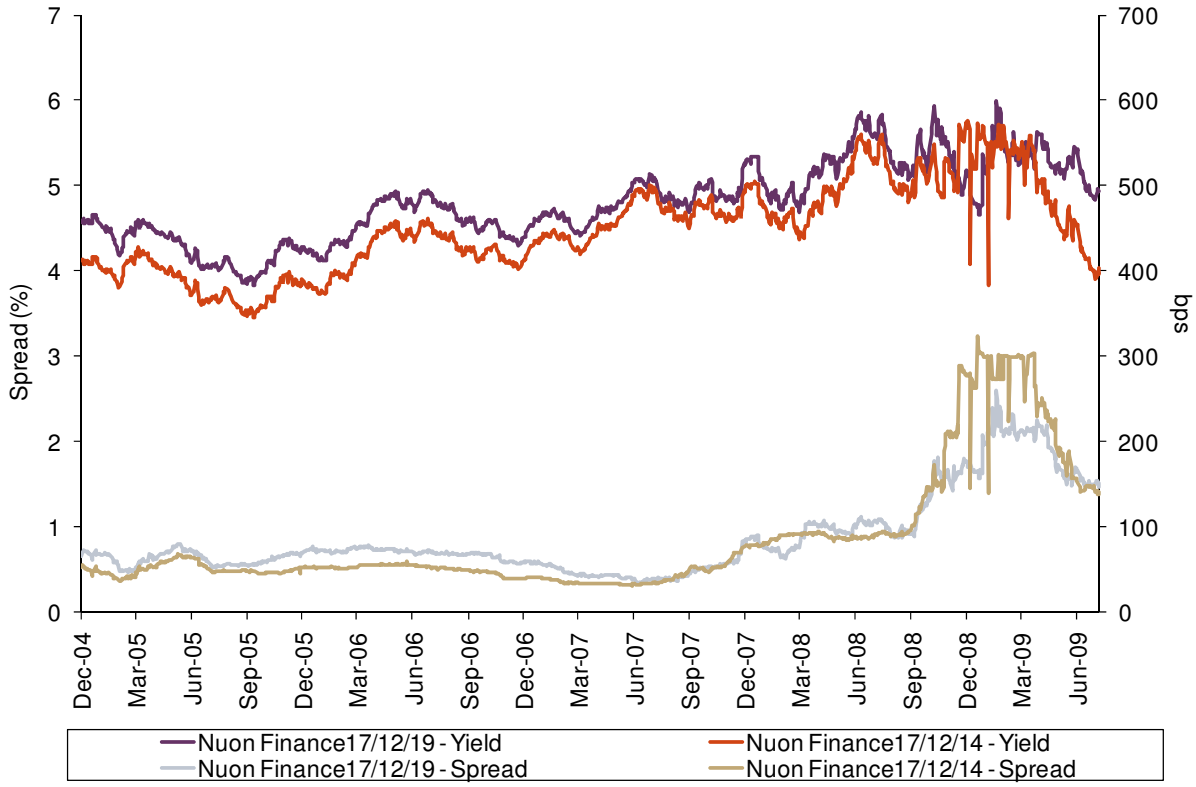
Source: Frontier Economics (2008), 'Updated cost of capital estimate for energy networks', prepared for DTE, April; Datastream and Oxera calculations.

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	144
RWE	A+	12	161
Scottish & Southern	A+	13	157
RWE	A+	14	167
Nuon / Alliander	A	10	117
Transco	A	8	156
United Utilities	A	9	164
RWE	A	7	89
Transco	A	8	156
National Grid	A	15	172
Severn Trent	A-	9	205
National Grid	A-	11	210
Elia system operator	A-	10	110
Energias de Portugal	A-	8	185
Transco	A-	15	171
Median: A range		**10**	**161**
Mean: A range		**11**	**158**
With maturity < 10 years			*159*
With maturity > 10 years			*157*

Source: Datastream and Oxera calculations.

Figure 3.3 Yields and spreads of Nuon bonds



Source: Datastream

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

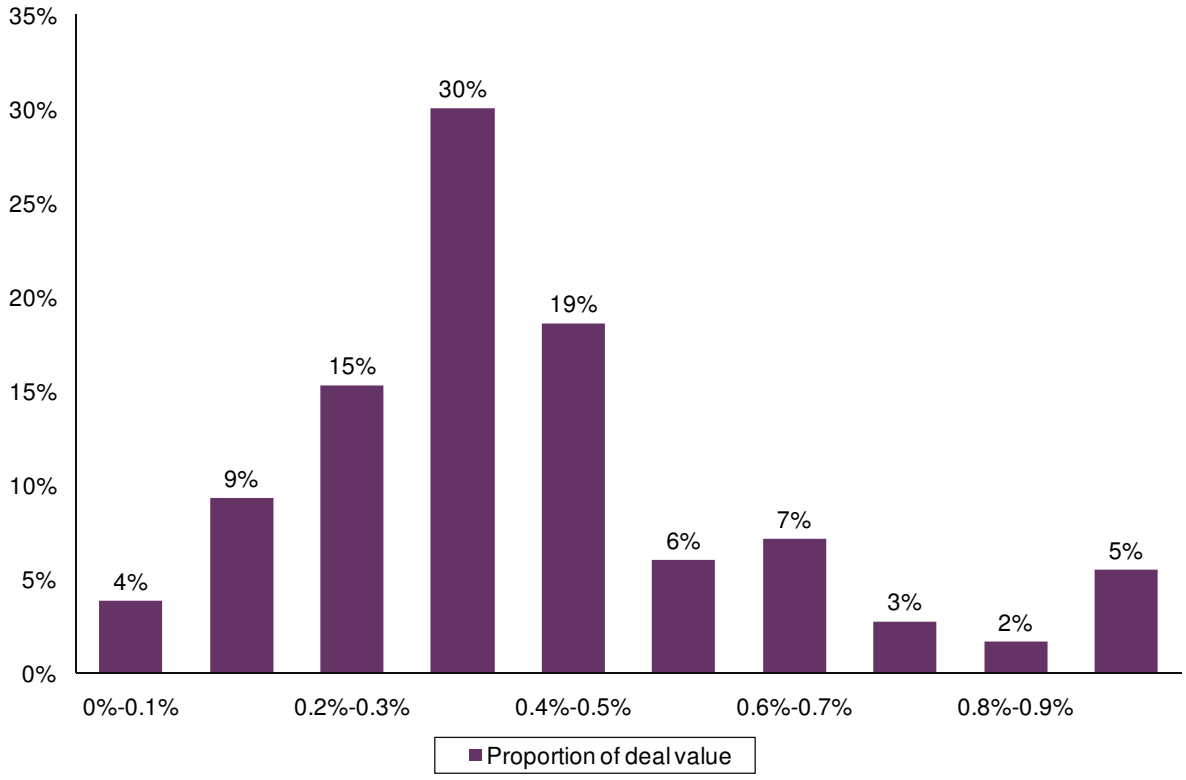
Source: Datastream.

Additional evidence and considerations—transaction and issuance costs

In addition to interest, companies face the costs of issuing and managing their debt. These costs include arranging and underwriting fees, as well as legal, rating and audit costs.

An estimate of underwriting fees can be obtained from financial databases such as Dealogic. Figure 3.5 shows the distribution of disclosed underwriting fees paid to book runners by utility and energy companies in Europe since 2000.

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.

A significant portion of those utility and energy companies for which issuance costs have been disclosed paid fees of between 0.3% and 0.4% to the book runner at issuance. This estimate of underwriting costs can be annualised over a ten-year period (the maturity assumed by EK to estimate the cost of debt) using an annuity formula.[4] This results in annualised costs of 3.8–5.1bp per year.

In addition to such underwriting fees, companies bear legal and rating costs to issue and manage their debt portfolio. These costs are typically not made public, but can be significant. As a point of reference, the UK Competition Commission recently determined that the sum of underwriting fees, rating costs and other expenses for airports operator BAA represented an additional 15bp that had to be included in the allowed cost of debt.[5]

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

[5] Competition Commission (2007), 'BAA Ltd: a report on the economic regulation of the London airport companies', September 27th.

3.3 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 90bp to 160bp (Table 3.5).

Table 3.5 Conclusions—debt premium

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

Source: Datastream, Oxera analysis.

4 The equity risk premium

4.1 Methodology

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	'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 2000–05, to 4.6% when measured over 2000–08. This is because the new estimates incorporate the recent negative performance of capital markets.

– 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 4.2). 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.[6]

– Furthermore, the current market turbulence is 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 4.3) and from a forward-looking perspective (ie, the implied volatility inferred from call options—see Figure 4.4). These measures of volatility in equity markets indicate an increase in the uncertainty surrounding future

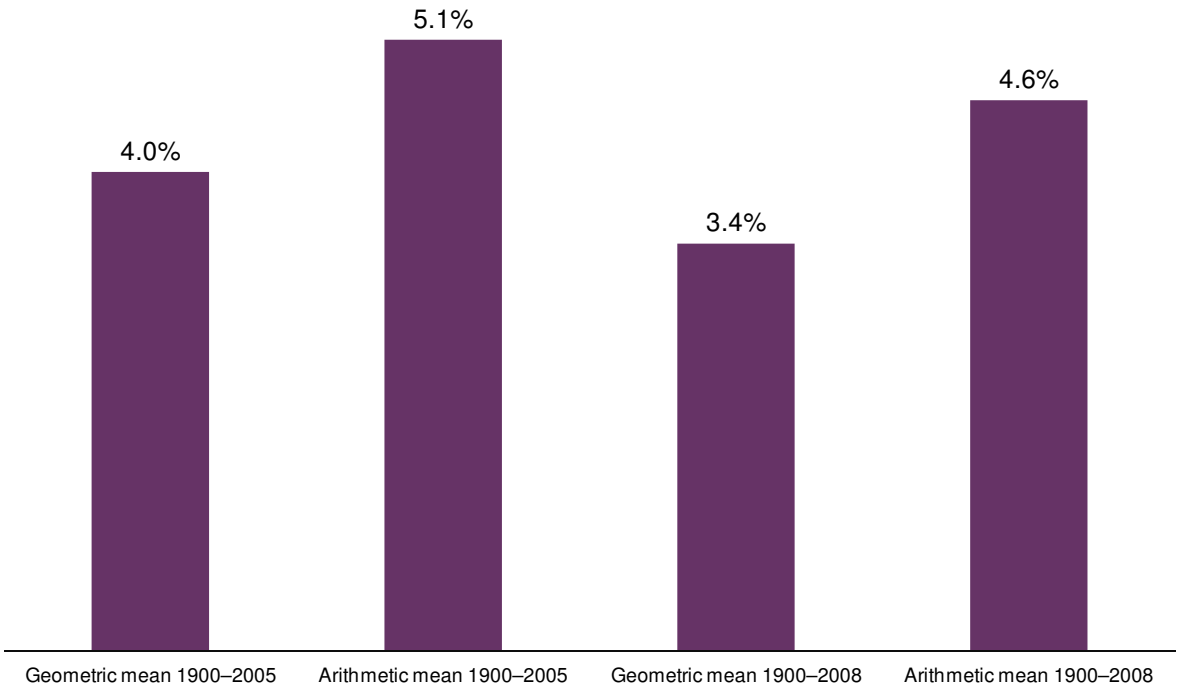
[6] Indepen (2009), '2009 Investor Survey: A Report by Indepen for Water UK', March.

equity returns. This might, in turn, constitute an additional factor of risk in equity markets, at least over the short term (see Box 4.1).

– 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 4.2).

– 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 crisis might have increased the level of uncertainty present in capital markets, and the level of investors' aversion with regard to this equity risk. It is possible that the current low equity valuations are reflective of an increase in discount rates as well as a reduction in forward-looking earnings.

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,* Credit Suisse; ABN-AMRO (2006), 'Global Investment Returns Yearbook', February. Figures are for 'world' estimates measured over bonds.

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

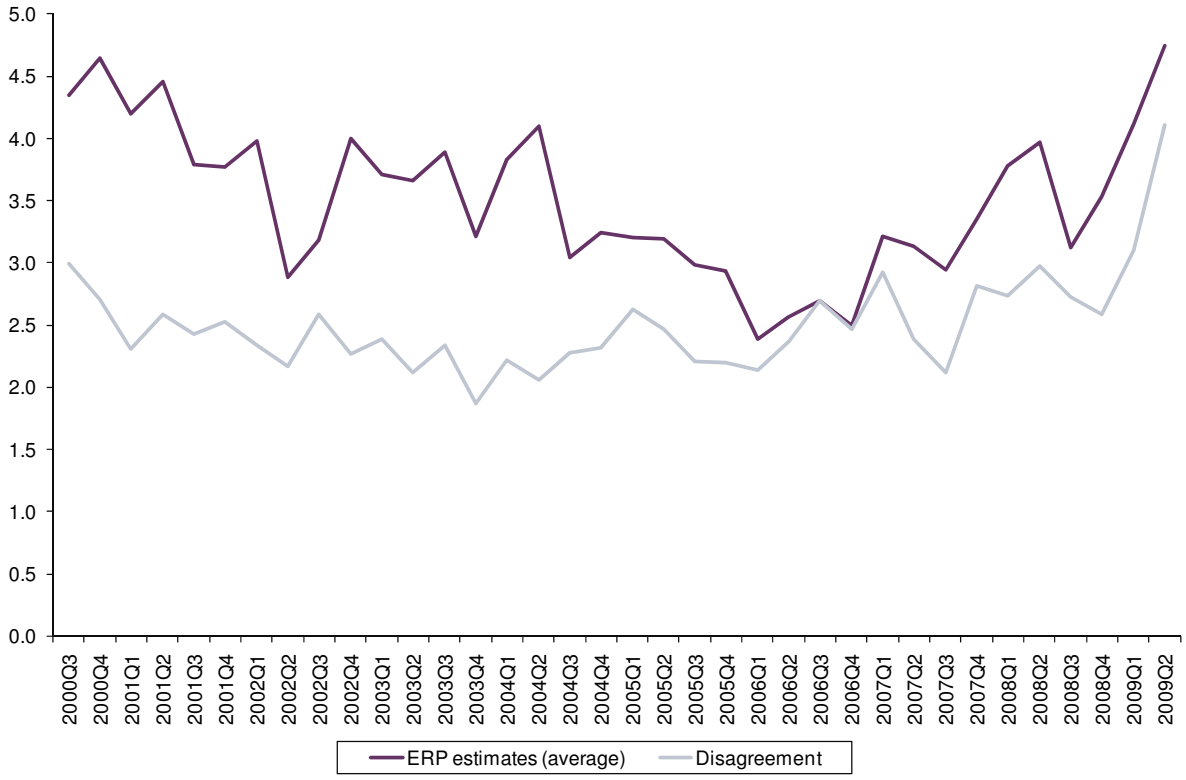
Source: Dimson, E., Marsh, P. and Staunton, M. (2009), *Credit Suisse Global Investment Returns Sourcebook 2009,* Credit Suisse.

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

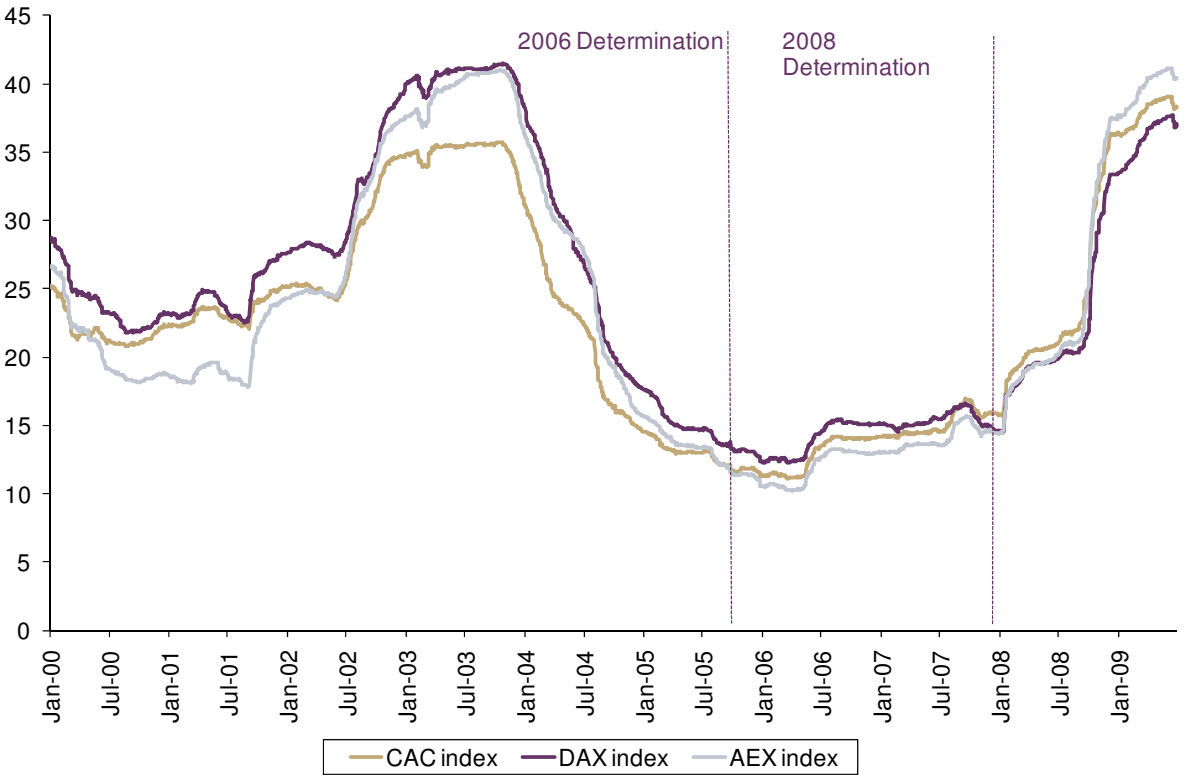
Source: Fernández, P. (2009), 'Market Risk Premium used in 2008 by Professors: a survey with 1,400 answers', April, pp. 1–21; Graham, J. and Campbell, H. (2009), 'The Equity Risk Premium Amid a Global Financial Crisis', May, pp. 1–18; Welch, I. (2009), 'Views of Financial Economists On The Equity Premium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

Figure 4.2 ERP expectations surveyed by Graham and Harvey (2009)



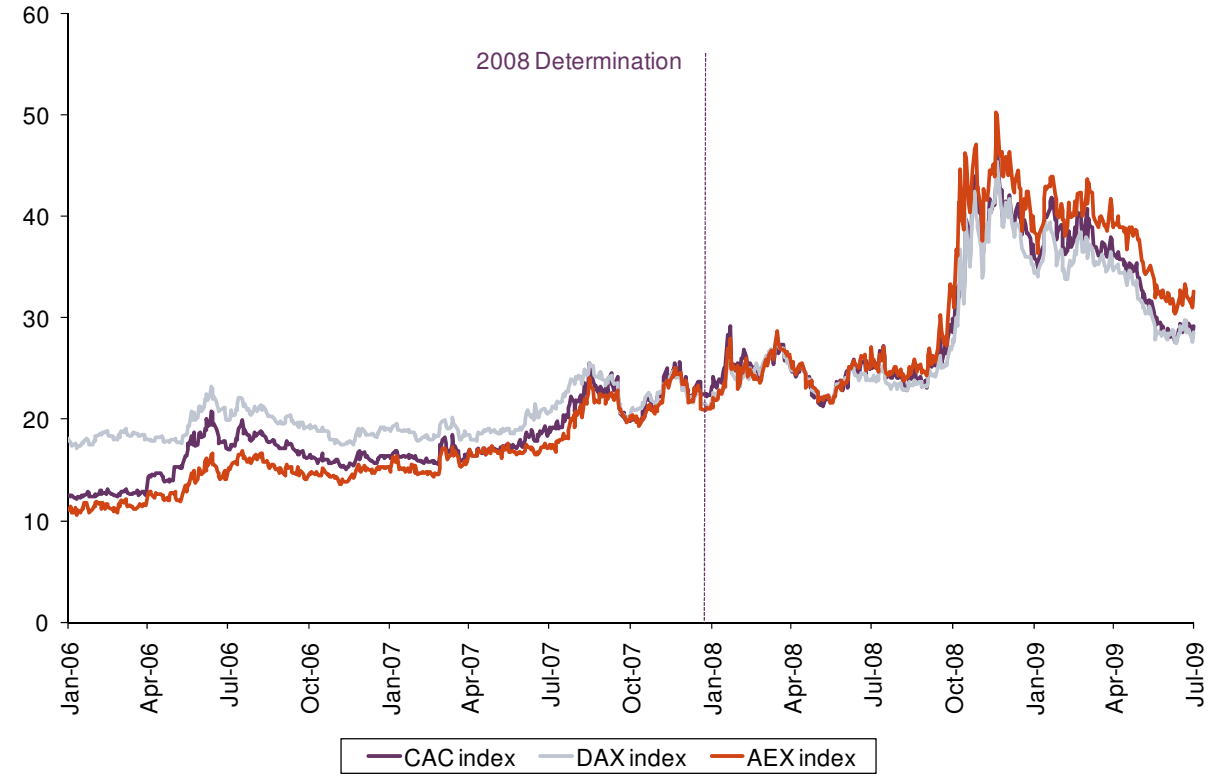
Source: Graham, J. and Campbell, H. (2009), 'The Equity Risk Premium amid a Global Financial Crisis', May, pp. 1–18. The 'disagreement' indicator refers to the standard deviation in survey responses.

Figure 4.3 Volatility on European indexes—historical



Source: Bloomberg.

Figure 4.4 Volatility on European indexes—implied over 18 months



Source: Bloomberg.

Box 4.1 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 4.2 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 used a range of 4.5–5.0% in its Final Determination in December 2008, 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.

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.

The Competition Commission's approach in the Stansted price review is similar to that taken by Ofgem since the fourth Electricity Distribution Price Control Review. The UK energy regulator focuses on total expected returns on equity, which it considers to be stable over time.

More recently, **Ofwat** has stated its intention to adopt an ERP assumption of 5.4% in its forthcoming regulatory review, which is above the figure used in 2004, noting that this was intended to reflect current economic conditions.

Sources: Ofcom (2008), 'A New Pricing Framework for Openreach', December; Competition Commission (2008), 'Stansted Airport Ltd: Q5 Price Control Review', October; Ofwat (2009), 'Future water and sewerage charges 2010-15: draft determinations', July.

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).

Table 4.4 Conclusions—ERP

	July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High
ERP	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 0.46 (calculated on weekly and daily data, respectively), compared to 0.39 to 0.42 originally.

– The confidence intervals also indicate a degree of uncertainty surrounding these estimates (Table 5.3).

Table 5.2 Updated asset beta estimates for previous samples

	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	0.18
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	0.22
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	0.46
National Grid	0.35	0.28	0.43	0.39	0.39	0.46
Scottish Power	0.40	0.38	N/A	N/A	N/A	N/A
United Utilities	0.26	0.20	0.49	0.40	0.44	0.50
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	0.33	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	0.78	0.75
Transener	N/A	N/A	0.32	0.35	0.44	0.50
Australian Pipeline Trust	N/A	N/A	0.38	0.29	0.31	0.31
Snam Rete Gas	N/A	N/A	0.42	0.35	0.11	0.20
Enagas	N/A	N/A	0.56	0.48	0.42	0.50
Kinder Morgan	N/A	N/A	0.31	0.33	0.35	0.45
TC Pipelines	N/A	N/A	0.18	0.41	0.38	0.65
Mean	**0.36**	**0.23**	**0.42**	**0.39**	**0.36**	**0.43**
Median	**0.33**	**0.24**	**0.42**	**0.39**	**0.38**	**0.46**

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 and 95% confidence intervals

	Daily raw beta	95% CI	Weekly raw beta	95% CI
Transener	0.84	0.75–0.93	0.93	0.80–1.07
Envestra	0.62	0.47–0.76	0.44	0.25–0.63
Australian Pipeline Trust	0.70	0.59–0.81	0.57	0.40–0.75
Emera	0.28	0.22–0.33	0.33	0.24–0.42
Canadian Utilities	0.33	0.26–0.41	0.40	0.28–0.52
Snam Rete Gas	0.16	0.1–0.21	0.26	0.16–0.37
Red Electrica	0.55	0.47–0.62	0.64	0.52–0.75
Enagas	0.57	0.50–0.64	0.64	0.51–0.77
National Grid	0.70	0.63–0.77	0.72	0.60–0.83
United Utilities	0.67	0.59–0.75	0.74	0.62–0.87
Atlanta Gas Light	0.63	0.58–0.68	0.70	0.60–0.79
Kinder Morgan	0.49	0.43–0.55	0.58	0.48–0.69
TC Pipelines	0.50	0.42–0.57	0.76	0.61–0.90
Atmos Energy	0.53	0.47–0.59	0.64	0.54–0.74
Exelon	0.91	0.83–0.99	0.90	0.76–1.03

Source: Bloomberg and Oxera calculations.

Additional considerations—sample review

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;[7] 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.[8] On this basis, it seems appropriate to exclude Transener from the sample.

  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

[7] 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.

[8] 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–).

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 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.

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 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). This improves the representativeness of the beta estimates derived from this exercise

Table 5.5 Additional comparators

Company	Country	Share of energy networks (%)	Gearing (%)	Turnover (€m)	Regulatory regime	Meeting EK's criteria?
Terna	Italy	95	37	1336	Four-year price cap	Yes
REN	Portugal	99	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	100	35	1401	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.
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

Company name	Daily	Weekly
Snam Reta Gas	0.11	0.20
Terna	0.24	0.24
REN	0.38	0.41
Red Electrica	0.40	0.46
Enagas	0.42	0.50
National Grid	0.39	0.46
Emera	0.18	0.22
Kinder Morgan	0.35	0.45
Atlanta Gas Light	0.41	0.47
Piedmont Natural Gas	0.56	0.49
Northwest Natural Gas	0.46	0.40
ITC holdings	0.50	0.61
TC Pipelines	0.38	0.65
Mean	**0.39**	**0.43**
Median	**0.39**	**0.46**
Median for European companies	0.39	0.43
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 0.39–0.46.

Table 5.7 Conclusions—beta

	July 2009		January 2008		December 2005	
	Low	High	Low	High	Low	High
Asset beta	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

	Asset beta (daily)	Asset beta (weekly)
Full sample	0.39	0.46
Amended sample excluding estimates affected by autocorrelation	0.39	0.46
Amended sample excluding estimates affected by heteroscedasticity	0.31	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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