Oxera

Cost of capital for GTS:
annual estimates from 2006 onwards

Prepared for the NMa

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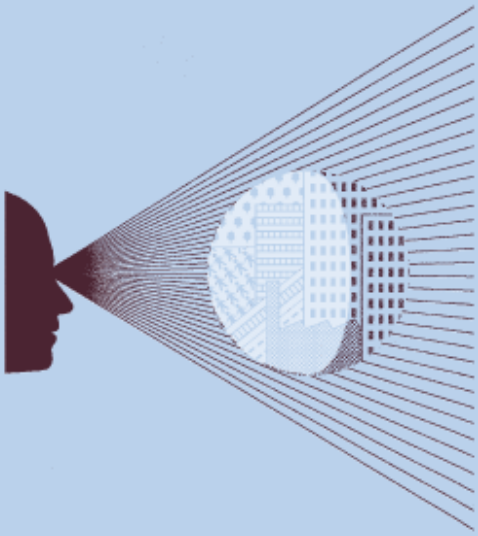

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1 Introduction and summary

The NMa asked Oxera to estimate the weighted average cost of capital (WACC) for the gas transmission network operated by Gas Transport Services BV (GTS). For the purposes of calculating the WACC, Oxera was requested to follow the approach previously adopted by the NMa, which is based on the methodology originally developed by Frontier Economics.[1]

As a result of an appeal by Gasunie against previous tariff decisions, and subsequent legal challenges by the Dutch Trade and Industry Appeals Tribunal (CBb), the WACC needs to be determined retroactively for price control periods starting in January 2006. Moreover, it needs to be determined such that past decisions are restated using the most up-to-date approach, while relying on market data observable up to a clearly defined cut-off date. The NMa asked Oxera to estimate the WACC annually from 2006 onwards, in order to inform its price control tariff decisions.

Each annual estimate represents a forward-looking cost of capital estimate based on market data available up to the start of the year. For example, the 2006 parameter estimates are based on data up to and including December 31st 2005. Estimates for years subsequent to 2011 are based on the most recent data available, which corresponds to the dataset used for the 2011 WACC estimate. Unless indicated otherwise, the 2011 estimate also refers to the estimates for subsequent years.

1.1 Should the cost of capital be differentiated across GTS segments?

Oxera understands that, on instructions from the government, Energiekamer (EK) determined a different cost of capital for business assets in its previous decision based on two types of asset: low-pressure gas pipelines, for transmission within the Netherlands, and high-pressure pipelines, for transportation of gas across the Netherlands to other countries. Therefore, the NMa asked Oxera to consider whether it is appropriate to set different costs of capital for the two types of asset.[2]

The relevant economic criterion is whether the two types of asset have significantly different degrees of exposure to various sources of risk. In each case, it is necessary to assess both the overall business risk of the activity, and how much of that risk is allocated to GTS under the regulatory framework and how much is borne by customers (see Box 1.1). In general, one could expect differences in risk exposure to affect the estimates for the asset beta, gearing and the debt premium (although the asset beta would be affected only by exposure to systematic sources of risk).

[1] EK determinations: Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC', *Methodebesluit voor de systeemtaken van TenneT vastgesteld*; Oxera (2010), 'Updating the WACC for energy networks: Quantitative analysis', February (hereinafter referred to as the 'Quantitative paper'); Oxera (2010), 'Updating the WACC for energy networks: methodology paper', February (hereinafter referred to as the 'Methodology paper'); NMa (2006), 'Method determination 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; Frontier Economics (2008), 'Updated cost of capital for energy networks—paper prepared for DTe', April.

[2] NMa (2010), 'Request for Proposal: Determining the WACC for the Dutch Gas Transmission System Operator', paragraph 12.

Box 1.1 Risk exposure of gas pipelines

A high-level assessment of the main types of risk is outlined below.

- **Revenue risk**. The revenue generated by both types of asset may be affected by changes in volume. If, for example, international transmission faces greater competition from alternative sources of supply, it is conceivable that volume fluctuation is greater for international transmission than for transmission within the Netherlands. This would suggest that high-pressure pipelines bear more high risk than low-pressure ones do.[3] Oxera understands that GTS typically enters into ten-year contracts for high-pressure gas transmission, whereas contracts for low-pressure transmission tend to be of shorter duration, which would be expected partly to offset the higher demand risk for high-pressure pipelines. Ultimately, GTS's residual risk exposure will be determined by the structure of the regulatory regime. Both types of pipeline would be included in the regulatory asset base (RAB), and therefore GTS would recover its investment (provided that this investment is deemed efficient) over the lifetime of the assets. As a result, any under- (or over-) recovery due to volume fluctuations would be limited to the maximum length of a single price control period and is similar for both types of asset.
  - On the one hand, if the volume change occurs towards the beginning of the price control period, the potential for under-recovery is considerable. Nevertheless, volume risk would be limited to the duration of the price control period, since the regulatory framework would guarantee the recovery of assets included in the RAB over their lives.
  - On the other hand, if the volume contract remains in force until the end of the price control period, the risk to the operator is negligible because prices are re-set at the beginning of each price control period.
- **Regulatory risk**. Both activities are regulated under the same regime, and therefore GTS would appear to face similar regulatory risks for both types of asset.
- **OPEX and CAPEX risk**. Oxera is not aware of reasons why OPEX or CAPEX risks would differ across the pipeline types in either their nature or the extent to which such risks are allocated between the company and customers under the regulatory regime.
- **Funding risk**. Provided that regulation treats both types of asset similarly, and that they have equal or similar asset betas, the funding risk is the same across both.

Overall, the factors examined above do not suggest a significant difference in GTS's residual risk exposure to investments in different types of gas transmission pipelines. As a result, Oxera finds it appropriate that a single cost of capital be determined for GTS.

1.2 Summary of WACC parameters from 2006 onwards

The NMa has asked Oxera to provide annual WACC estimates using the methodology previously applied to energy networks, unless modifications are required to reflect accurately any differences that relate either to GTS or to the time periods under consideration. Such estimates may be required by the Dutch court in the context of estimating the WACC for previous price control periods.

[3] Both types are exposed to variability in demand from end-users. However, in principle, international transmission might be affected by greater competition from alternative routes for obtaining gas—for example, gas could instead be transported via German ports. Historically, GTS has not built pipelines to transmit gas across the Netherlands without first securing a ten-year contract with gas suppliers, in order to provide security of demand.

The annual WACC estimates reported below (Tables 1.1 and 1.2) represent forward-looking estimates of the cost of capital for gas transmission networks at the time of the cut-off date for each year. The main findings are as follows.

– The nominal **risk-free rate** range is relatively stable, with a midpoint of approximately 4% in most periods. The exception is for 2011 onwards, where the range is lower, at 3.3–3.8%. Estimates for this parameter are based on the methodology developed by Frontier.

– The range for the **equity risk premium** (ERP) for all periods with the exception of 2009 remains unchanged from EK's previous determinations for energy distribution and electricity transmission, at 4.0–6.0%.[4] Estimates for this parameter are based on the methodology developed by Frontier, and the selected range estimate ensures regulatory consistency with determinations by EK at similar times to each period for local distribution networks and electricity transmission. For 2009, the ERP range is higher, at 4.3–6.6%, reflecting the uncertainty in financial markets that characterised the height of the credit crisis, around December 2008 (the cut-off date).

– The range for the **asset beta** increases gradually (with respect to the midpoint) from a low in the 2006 period at 0.33–0.41 to a high in the 2009 period at 0.43–0.49. These ranges are slightly lower for 2010 and 2011 onwards. Estimates for this parameter are based on the methodology developed by Frontier. The differences across periods result in part from changes in the composition of the sample of comparators across the periods, but also from an increase in the asset betas of the same comparators that are included in all sample periods. In comparison, EK determined an asset beta range of 0.39–0.45 for energy distribution networks in 2010.[5] This is in line with the 2010 range of 0.38–0.47.[6]

– The ranges estimated for the **debt premium** contain a midpoint of approximately 1% for each period from 2006 up to 2008, with higher ranges for 2009, 2010 and 2011 onwards. These higher ranges largely reflect the increased cost of borrowing by corporates during the financial crisis, while the widening of the range reflects the increased volatility in funding costs. Estimates for this parameter are based on the methodology developed by Frontier, with an additional allocation for debt transaction costs of 10–20 basis points (bp), as assumed by the NMa in its most recent determination for energy networks.[7] The 2010 range of 1.1–1.9% is consistent with EK's 2010 determination for energy networks (1.1–1.9%).

– The **gearing** estimates are constant at 50–60% across all periods. Estimates for this parameter are based on the methodology developed by Oxera in the 2010 methodology paper.[8] The estimates reflect evidence from market gearing and regulatory precedent, and are based on a target credit rating of BBB/A for 2006–08 and A for 2009 onwards. This is consistent with the target credit rating used by EK in its determination for energy networks.[9]

– The **inflation** estimates are generally consistent with EK's recent determination for energy networks (1.5–1.6%),[10] with the exception of 2011 which is slightly lower at 1.3–1.5%. The low range for 2011 onwards reflects both lower realised and forecast inflation.

[4] Frontier Economics (2005), 'The cost of capital for Regional Distribution Networks: a report for DTe', December.

[5] Oxera (2010), Quantitative paper, p. 2.

[6] The minor variation arises as a result of a one-month difference in the cut-off date used for the analysis.

[7] Oxera (2010), Methodology paper.

[8] Oxera (2010), Methodology paper.

[9] Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC', *Methodebesluit voor de systeemtaken van TenneT vastgesteld*.

[10] Ibid.

Estimates for this parameter are based on the methodology developed by Oxera in the 2010 methodology paper.[11]

The calculated ranges for real **pre-tax WACC** across all periods are presented in Tables 1.1 and 1.2. These compare with 5.3–6.9% in EK's 2010 determination for energy networks.[12]

Table 1.1 Annual WACC estimates, 2006–08

	2006 (Dec 2005 cut-off)		2007 (Dec 2006 cut-off)		2008 (Dec 2007 cut-off)	
	Low	**High**	**Low**	**High**	**Low**	**High**
Risk-free rate (nominal) (%)	3.7	4.3	3.6	4.1	3.9	4.0
ERP (%)	4.0	6.0	4.0	6.0	4.0	6.0
Asset beta	0.33	0.41	0.36	0.44	0.37	0.46
Equity beta	0.56	0.85	0.63	0.93	0.65	0.97
Cost of equity (%)	6.0	9.4	6.1	9.7	6.5	9.8
Debt premium (%)	0.9	1.1	0.9	1.1	0.9	1.1
Cost of debt (%)	4.6	5.4	4.5	5.2	4.8	5.1
Gearing (%)	50	60	50	60	50	60
Tax rate (%)	29.1	29.1	25.5	25.5	25.5	25.5
Pre-tax WACC (nominal) (%)	6.5	8.5	6.4	8.3	6.8	8.3
Inflation (%)	1.3	2.3	1.4	1.8	1.7	1.7
Pre-tax WACC (real) (%)	**5.1**	**6.1**	**4.9**	**6.4**	**5.0**	**6.5**

Note: Figures may not add up due to rounding.
Source: Oxera analysis.

[11] Oxera (2010), Methodology paper.
[12] Ibid.

Table 1.2 Annual WACC estimates, 2009 onwards

	2009 (Dec 2008 cut-off)		2010 (Dec 2009 cut-off)		2011 onwards (Dec 2010 cut-off)	
	Low	**High**	**Low**	**High**	**Low**	**High**
Risk-free rate (nominal) (%)	4.0	4.3	3.9	4.0	3.3	3.8
ERP (%)	4.3	6.6	4.0	6.0	4.0	6.0
Asset beta	0.43	0.49	0.38	0.47	0.35	0.45
Equity beta	0.75	1.04	0.66	1.00	0.61	0.96
Cost of equity (%)	7.2	11.1	6.6	10.0	5.7	9.5
Debt premium (%)	0.8	1.5	1.1	1.9	1.3	1.6
Cost of debt (%)	4.8	5.8	5.0	5.9	4.6	5.4
Gearing (%)	50	60	50	60	50	60
Tax rate (%)[1]	25.5	25.5	25.5	25.5	25.0	25.0
Pre-tax WACC (nominal) (%)	7.3	9.5	6.9	8.9	6.1	8.3
Inflation (%)	1.6	1.8	1.5	1.6	1.3	1.5
Pre-tax WACC (real) (%)	**5.6**	**7.5**	**5.3**	**7.2**	**4.8**	**6.7**

Note: Figures may not add up due to rounding. 2010 values differ slightly from the results in the Oxera (2010) quantitative paper due to a difference of a month in the cut-off date used for the analysis. [1] From 2011, the corporate tax rate in the Netherlands was lowered to 25.0%.
Source: Oxera analysis.

In previous determinations for energy distribution networks (which are also regulated under a price cap), EK determined the WACC by adopting the midpoint of the range estimate, following the methodology of Frontier. In the case of GTS, this approach would yield WACC estimates of:

- 5.6% for 2006;
- 5.6% for 2007;
- 5.8% for 2008;
- 6.5% for 2009;
- 6.2% for 2010; and
- 5.7% for 2011 onwards.

2 The risk-free rate

2.1 Methodology

In previous determinations for energy distribution and electricity transmission networks, EK estimated the risk-free rate based on the two- and five-year averages of yields on Dutch sovereign debt with a maturity of ten years (see Table 2.1). The risk-free rate is estimated to lie within a range, the upper and lower bounds of which are set by these two averages.

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 determinations and supporting documents.

2.2 Market evidence

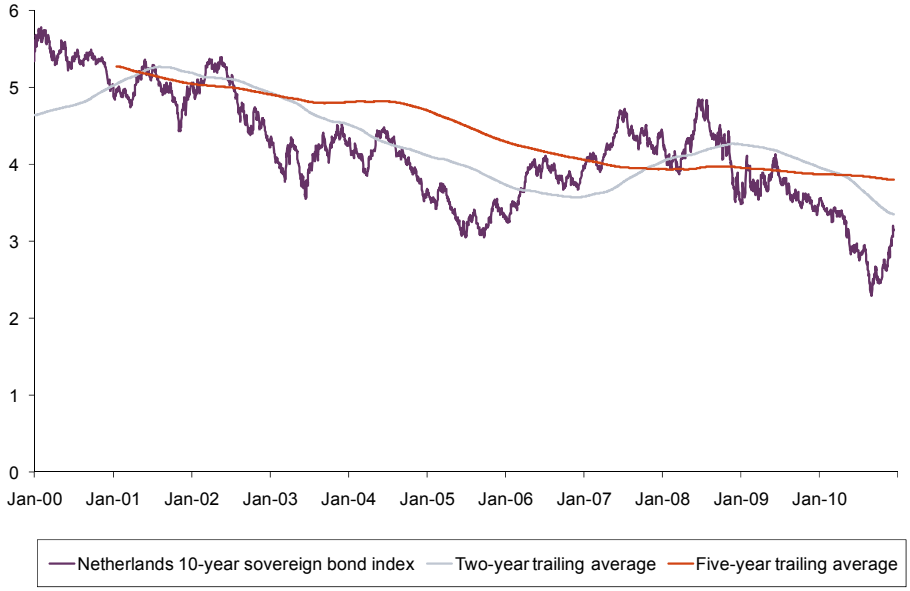
Updated market data shows the following. Yields followed a downward trend in the period 2000–05. They rose again until mid-2008, before declining rapidly towards the end of 2008 (see Figure 2.1).

– For most periods (with the exception of 2011 onwards), 4% is contained within range estimates. The ranges are narrowest for 2008 and 2010 (3.9–4.0% in both cases), at which point the two- and five-year averages broadly converge.

– The estimated range for 2009 (4.0–4.3%) is the highest of all the periods considered. This is largely due to the two-year average, which does not capture the low yields from 2005–06 or the subsequent decline in yields on government bonds following the start of the credit crisis.

– The relatively low range for 2011 onwards (3.3–3.8%) is largely due to the impact of yields falling below 3% during 2010. This may reflect the impact of a 'flight to quality' during the sovereign debt crisis, which resulted in an increase in yields on sovereign bonds for European countries considered to be of higher credit risk (such as Greece and Ireland) and a decrease in yields on sovereign bonds for 'safer' countries (such as the UK and Netherlands).

Figure 2.1 Yield on ten-year nominal Dutch sovereign bonds and trailing averages, 2000–11 (%)



Source: Datastream, and Oxera analysis.

Table 2.2 Yield on ten-year nominal Dutch sovereign bonds, 2006–11 (%)

Year	2006	2007	2008	2009	2010	2011
Spot (as at cut-off date)	3.3	4.0	4.4	3.5	3.5	3.1
Six months	3.3	3.8	4.4	4.2	3.6	2.7
One year	3.4	3.8	4.3	4.2	3.7	3.0
Two years	**3.7**	**3.6**	**4.0**	**4.3**	**4.0**	**3.3**
Three years	3.9	3.8	3.8	4.1	4.1	3.6
Five years	**4.3**	**4.1**	**3.9**	**4.0**	**3.9**	**3.8**

Note: Years denote each annual estimate, which is based on market data available up to the start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005. 'Spot' refers to the yield available in the market on a given day, rather than an average. 2010 values differ slightly from the results in Oxera (2010) quantitative paper due to a difference in the cut-off date used for the data.
Source: Datastream, and Oxera analysis.

2.3 Summary

The methodology adopted previously involved calculating two- and five-year averages of yields on ten-year Dutch bonds. The risk-free rate is estimated to be within a range. The upper and lower bounds of the range are provided by these two- and five-year averages.

The resulting ranges for the risk-free rate were highest at 4.0–4.3% for 2009 and lowest at 3.3–3.8% for 2011 onwards (Table 2.3 below). The five-year averages provide the lower bound of the range for some periods, such as 2010, with the upper bound determined by the two-year average. In other periods, such as 2006, the two-year average provides the lower bound of the range, and the five-year average provides the upper bound.

Table 2.3 Conclusions—risk-free rate, 2006 onwards (%)

Year (cut-off date)	**Low**	**High**
2006 (Dec 2005)	3.7	4.3
2007 (Dec 2006)	3.6	4.1
2008 (Dec 2007)	3.9	4.0
2009 (Dec 2008)	4.0	4.3
2010 (Dec 2009)	3.9	4.0
2011 onwards (Dec 2010)	3.3	3.8

Source: Oxera analysis.

3 The equity risk premium

3.1 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 in order to bear the additional risk of investing in equity markets over and above that which is obtainable on risk-free securities. The ERP is not directly observable and must be estimated using indirect approaches.[13]

In previous determinations, EK used both historical and forward-looking evidence to set the ERP (see Table 3.1).

Table 3.1 EK estimation methodology for the equity risk premium

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 the Netherlands, UK and USA

Source: EK determinations and supporting documents.

The EK has previously estimated the ERP in the context of its determinations for energy distribution and electricity transmission companies.

– In 2006, it estimated the ERP for energy networks to be in a range of 4.0–6.0%.[14]

– In 2008, EK's advisers judged that the likely increase in ERP resulting from the start of the sub-prime crisis did not invalidate the prevailing range.[15] The transport regulator in the Netherlands, Vervoerkamer, set the ERP at 4.0–6.0% in 2008, in its determination on pilotage services provided by harbour tugs.[16]

– Two years later, in 2010, EK adopted the same estimate for the ERP, 4.0–6.0%, at a time when equity markets had largely stabilised from the crisis.[17]

The next section summarises the market evidence examined to determine the ERP ranges for the years 2006 onwards.

[13] Three estimation approaches—ex post (realised), ex ante (implied) and ex ante (state)—are described in Oxera (2010), Quantitative paper, Box 4.1.

[14] NMa (2006), 'Method decision in relation to the X factor and the volume parameters of regional grid managers for the third regulatory period: Determination of the cost of capital allowance (102106-89)', Addendum C.

[15] Frontier Economics (2008), 'Updated cost of capital estimate for energy networks', April, pp. 9–10.

[16] Vervoerkamer (2008), *Besluit* 200101/14.BT763. WACC-Besluit.

[17] Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC', *Methodebesluit voor de systeemtaken van TenneT vastgesteld*.

3.2 Market evidence

For the years under consideration, the market evidence suggests the following.

– Evidence on ex post estimates range between 3.2% and 6.1% for long-run Dutch returns (Figure 3.1 below). This range comprises both the geometric and arithmetic means. While there is debate around which is the most appropriate averaging method in any given context, on balance the evidence suggests that more weight should be given to arithmetic averages when selecting the ERP for estimating future required equity returns.[18]

– Ex ante indicators, such as surveys of professors and companies, provide ranges of estimates for each period. In all periods, the majority of these estimates are in the range of 3.5–6% (see Table 3.2 below).

– Implied and historical volatility on equity indices peaked around 2002 and in late 2008 (see Figures 3.2 and 3.3).[19] The peaks in historical volatility correspond to the bursting of the dotcom bubble and the collapse of Lehman Brothers, respectively. Academic evidence suggests a positive link between volatility in equity returns and the risk premia required by investors (see Box 3.1). The decline in forward-looking implied volatility following its peak in late 2008 and early 2009 suggests that any increase in the ERP as a result of the financial crisis was substantially reversed after 2009. During the post-crisis period, both historical and implied volatility have decreased towards their long-term average.[20]

– Evidence from dividend growth model (DGM), such as that published by the Bank of England (BoE) (see Figure 3.4), suggests that the ERP for the US and UK markets increased temporarily towards the end of 2008 before falling back in subsequent years.[21] The same evidence suggests that the ERP for the European markets rose again in 2010 towards its crisis peak. To test whether this would also hold for the Dutch market, the Bank of England's multi-stage DGM analysis has been replicated using data from the Dutch stock markets over the period between December 2007 and December 2010 (see Figure 3.5).[22] The results show that, although the ERP for the Netherlands may have increased slightly in 2010 compared with pre-crisis levels, it is still far below its crisis peak. This suggests that the increase in the ERP for European markets in 2010 could have been driven by countries such as Greece, Ireland and Portugal experiencing difficulties with their public finances.

– Ex ante estimates increased by 30–60bp as the financial crisis intensified from 2007 to 2008, based on data from comparable and consecutive surveys that reported estimates for both years (Table 3.3).

[18] For example, Dimson, Marsh and Staunton (2010) recommend the arithmetic average: 'The corresponding arithmetic mean risk premium would be around 4.5–5.0% (see our 2008 paper, The Worldwide Equity Risk Premium; a Smaller Puzzle, cited in the Bibliography). This is our best estimate of the equity risk premium for use in asset allocation, stock valuation, and corporate capital budgeting applications.' Dimson, E., Marsh, P. and Staunton, M. (2010), 'Credit Suisse Global Investment Returns Sourcebook 2010', February, p. 34.

[19] Historical volatility is measured over the preceding year, so the peak in this measure lags the actual volatility. Implied volatility is from based on option prices, and so reflects expectations, at a given point in time, of future volatility.

[20] The long-term averages for historical and implied volatility, 21.8% and 20.9%, are based on annual returns for Dutch equity markets over the 1900–2010 period, and on the average level of the VIX index of option-implied volatility since 1986, respectively. See Dimson, E., Marsh, P. and Staunton, M. (2011), 'Credit Suisse Global Investment Returns Sourcebook 2011', pp.12 and 35.

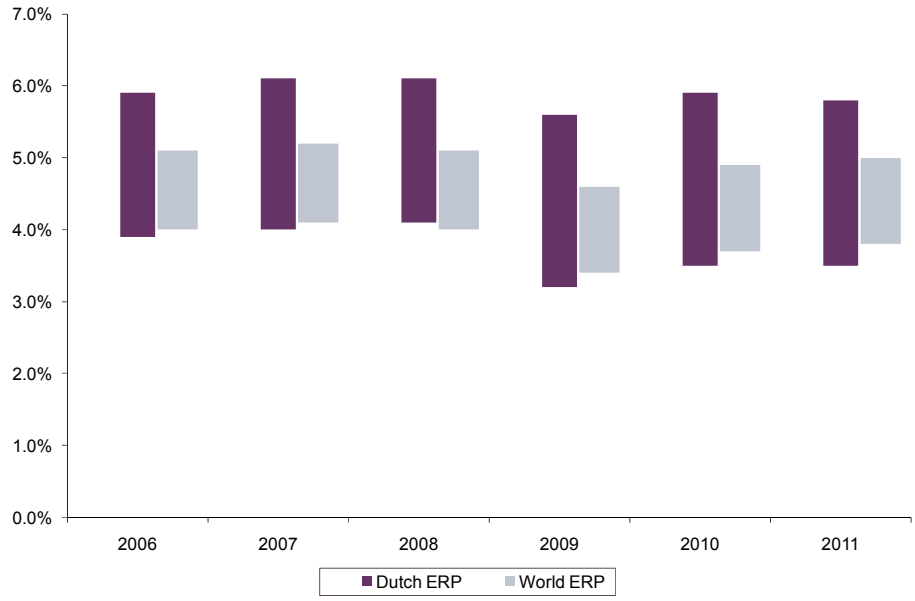
[21] While the evidence from the Bank of England was not available across all the periods considered in this report for the estimation of the WACC, the DGM analysis on Dutch market returns could be replicated across all periods since 2007 using available market data.

[22] Despite the limitation of the multi-stage DGM, the results of which are highly sensitive to the underlying assumptions, the analysis is nevertheless informative about the evolution of ERP through time, at least in terms of the direction it has taken.

– Some regulators have changed their ERP range as a result of the credit crisis. For example, Ofwat, the economic regulator for the water sector in England and Wales, increased its ERP estimate to 5.4% in 2009 from 4.9% in 2004.[23] Also, Ofcom, the UK telecoms regulator, returned to 5% in 2009, having decreased the ERP to 4.5% from 5% in 2005.[24] There have also been cases where regulators have recognised that a wider ERP range would be appropriate. For example, Ofcom commented that:

> Our widening of the range is in response to increased market volatility, and the likelihood that, following large recent market falls, investors may look for increased returns in exchange for holding equity rather than risk-free assets.[25]

Figure 3.1 Historical estimates of the ERP over bonds from Dimson, Marsh and Staunton, 2006–11



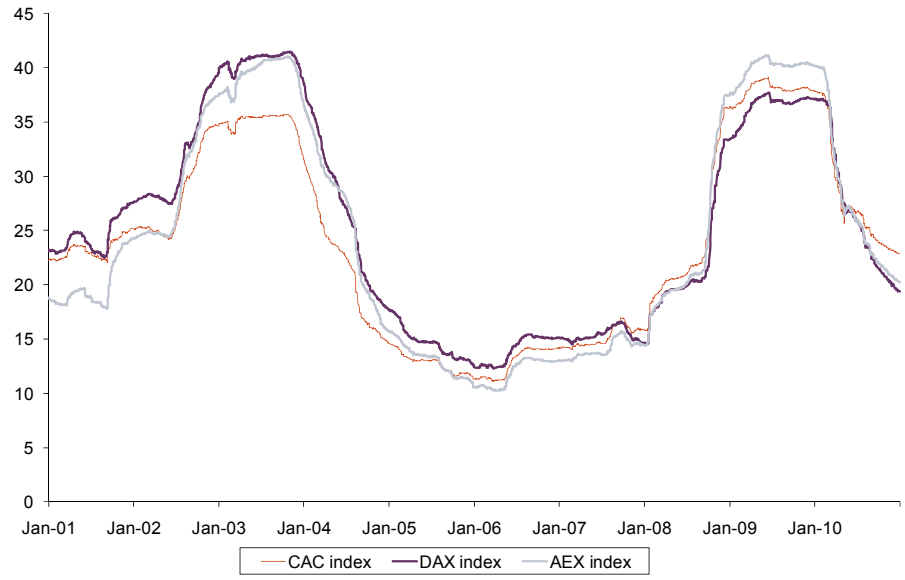
Note: Measured as the geometric mean (low) and arithmetic mean (high) of excess equity returns over government bonds. Using the spread over bonds is consistent with Frontier Economics (2005), 'The Cost of Capital for GTS', July, but not with Frontier Economics (2008), 'Updated cost of capital estimate for energy networks', April, in which Frontier took the spread over bills. Ranges are reported for periods that correspond to the annual WACC estimates. For example, the 2006 ranges are based on the DMS (2006) results, which reports results up to December 2005.
Sources: Dimson, E., Marsh, P. and Staunton, M. (2010), 'Credit Suisse Global Investment Returns Sourcebook 2010'; Dimson, E., Marsh, P. and Staunton, M. (2009), 'Credit Suisse Global Investment Returns Sourcebook 2009'; ABN AMRO (2008), 'Global Investment Returns Yearbook 2008', February; ABN AMRO (2007), 'Global Investment Returns Yearbook 2007', February; ABN AMRO (2006), 'Global Investment Returns Yearbook 2006', February; ABN AMRO (2005), 'Global Investment Returns Yearbook 2005'.

[23] Ofwat (2009), 'Future Water and Sewerage Charges 2010-15: Final Determinations', November; Ofwat (2004), 'Future Water and Sewerage Charges 2005-10: Final Determinations', December.
[24] Ofcom (2009), 'A New Pricing Framework for Openreach; Statement', May 22nd; Ofcom (2005), 'Ofcom's approach to risk in the assessment of the cost of capital', August 18th. Oftel (2001), 'Proposals for Network Charge and Retail Price Controls from 2001', February. (Oftel was the predecessor of Ofcom.)
[25] In the second consultation for Openreach, Ofcom increased the top end of the range by 25bp to 4.5–5.0%. In its final decision, Ofcom selected a point estimate at the top end of the range for ERP. It maintained this position in a recent consultation on the charge control for Wholesale Broadband Access (WBA). Ofcom (2008), 'A New Pricing Framework for Openreach; Second Consultation', December 5th, p. 251; Ofcom (2009), 'A New Pricing Framework for Openreach; Statement, May 22nd; Ofcom (2011), 'Proposals for WBA charge control: Consultation document and draft notification of decisions on charge control in WBA Market 1', January 20th.

Table 3.2 Survey and other evidence of ERP expectations, 2006–10 (%)

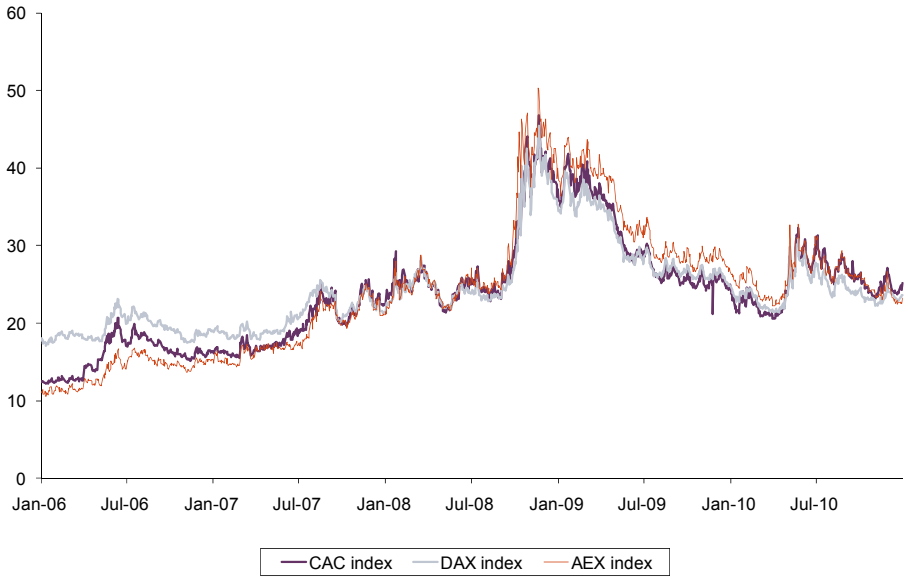
Study	Information on which estimate is based	ERP (%)	Source
Welch (2001)	Survey of finance or economics professors (nationality unclear: world or USA)	5–5.5	Welch, I. (2001) 'The Equity Premium Consensus Forecast Revisited', *Cowles foundation discussion paper number 1325*
O'Neil, Wilson and Masih (2002)	Goldman Sachs clients	3.9	As reported in Fernandez, P. (2006), 'Equity Risk Premium: Historical, Expected, Required, and Implied', p. 14
Grabowsky (2006)	Unspecified	3.5–6.0	
Maheu and McCurdy (2006)	Unspecified	4.0–5.0	
Graham and Harvey (2006)	Quarterly survey of US CFOs (November 2005)	2.4	Graham, J. and Harvey, C.R. (2006), 'The Equity Risk Premium in January 2006: Evidence from the Global CFO Outlook Survey'
Fernández (2009)	Survey of market risk premium used by European finance and economics professors (2008)	5.3	Fernández, P. (2009), 'Market Risk Premium used in 2008 by Professors: a survey with 1,400 answers', April, pp. 1–21
	Survey of market risk premium used by European companies (2008)	6.4	
	Survey of market risk premium used by Dutch finance and economics professors (2008)	5.3	
Graham and Harvey (2009)	Quarterly survey of US CFOs (November 2008)	4.1	Graham, J. and Harvey, C.R. (2009), 'The Equity Risk Premium amid a Global Financial Crisis'
Welch (2009)	Survey of market risk premium by finance or economics professors (January 2009)	5–6	Welch, I. (2009) 'Views of Financial Economists On The Equity Premium And Other Issues', *The Journal of Business,* 73-4, October 2000, 501-537, with January 2009 update, available at http://research.ivo-welch.info/equpdate-results2009.html
Fernandez and Campo (2010)	Survey of market risk premium used by European analysts (2010)	5.0	Fernandez, P. and del Campo, J. (2010), 'Market risk premium in 2010 used by Analysts and Companies: a survey with 2,400 answers', May 21st
	Survey of market risk premium used by Dutch companies (2010)	4.1–6.8 (average 5.3)	
	Survey of market risk premium used by European finance and economics professors (2010)	5.3	Fernandez, P. and del Campo, J. (2010), 'Market risk premium in 2010 used by Professors: a survey with 1,500 answers', May 15th
Graham and Harvey (2010)	Quarterly survey of US CFOs (December 2009)	3.2	Graham, J.R. and Harvey, C.R. (2010), 'The Market Risk Premium in 2010', August 9th
Graham and Harvey (2010)	Quarterly survey of US CFOs (June 2010)	3	

Figure 3.2 Volatility on European indices—historical (%)



Note: Historical volatility over 360 days before the date given.
Source: Bloomberg.

Figure 3.3 Volatility on European indices—implied over 18 months (%)



Note: Data series begins in January 2006.
Source: Bloomberg.

Box 3.1 Equity volatility and the ERP

The relationship between the ERP and variance in portfolio returns has been studied widely. Most of the literature on the subject finds that increases in the volatility of equity indices are accompanied by an increase in the ERP. This finding is consistent with the evidence from the early studies of French, Schwert and Stambaugh (1987), Harvey (1989), Turner, Starz and Nelson (1989), and Baillie and DeGennaro (1990).[26]

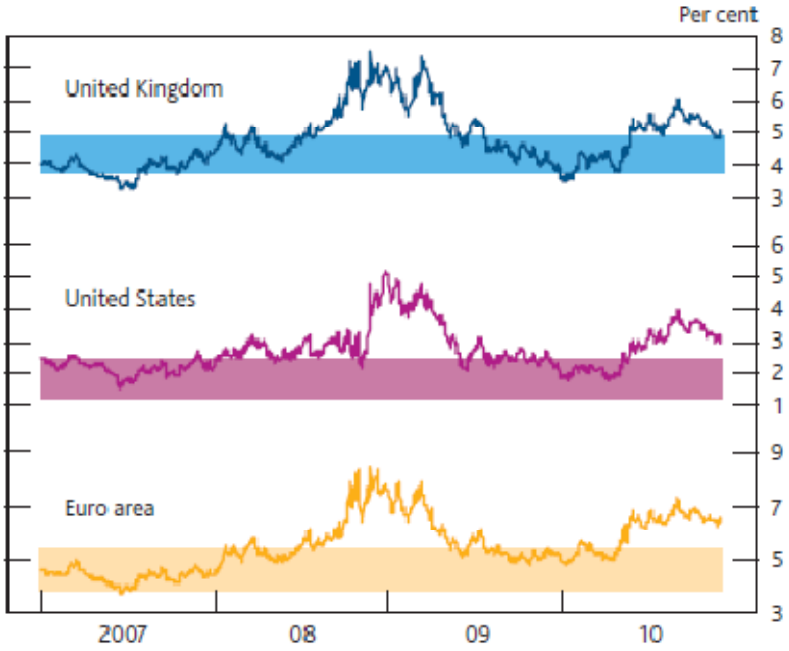
[26] French, K., Schwert, G.W. and Stambaugh, R.F. (1987), 'Expected Stock Returns and Variance', *Journal of Financial Economics*, **19**, 3–19. Harvey, C. (1989), 'Time-varying Conditional Covariances in Tests of Asset Pricing Models, *Journal of*

Similarly, Campbell, Lo and MacKinley (1997) point out that this link is intuitive, since an increase in the volatility of the market portfolio leads to an increase in the ERP.[27] Scruggs (1998) also finds that there is a positive relationship between the variance in returns on the index and the ERP.[28] Furthermore, Bliss and Panigirtzoglou (2004) state that:

> An increase in equity volatility generally leads to an increase in the risk premium though the expected change is model dependent.[29]

A number of academic studies have also found a positive relationship between market returns and forward-looking volatility, proxied by the implied volatility of options on market indices. These studies include Copeland and Copeland (1999), Guo and Whitelaw (2006), Graham and Harvey (2007), and Banerjee, Doran and Peterson (2007).[30]

Figure 3.4 International equity risk premia based on multi-stage DGM (%)



Note: Shaded areas show interquartile ranges for implied risk premia since 1998 for the UK, 1991 for the USA and 2000 for the Euro Area.
Source: Bank of England (2010), 'Financial Stability Report', Issue No 28, December, p. 19.

Financial Economics, **24**, 289–317. Turner, C., Starz, R. and Nelson, C. (1989), 'A Markov Model of Heteroskedasticity, Risk, and Learning in the Stock Market', *Journal of Financial Economics*, **25**, 3–22. Baillie, R.T. and DeGennaro, R.P. (1990), 'Stock Returns and Volatility', *Journal of Financial and Quantitative Analysis*, **25**, 203–14.

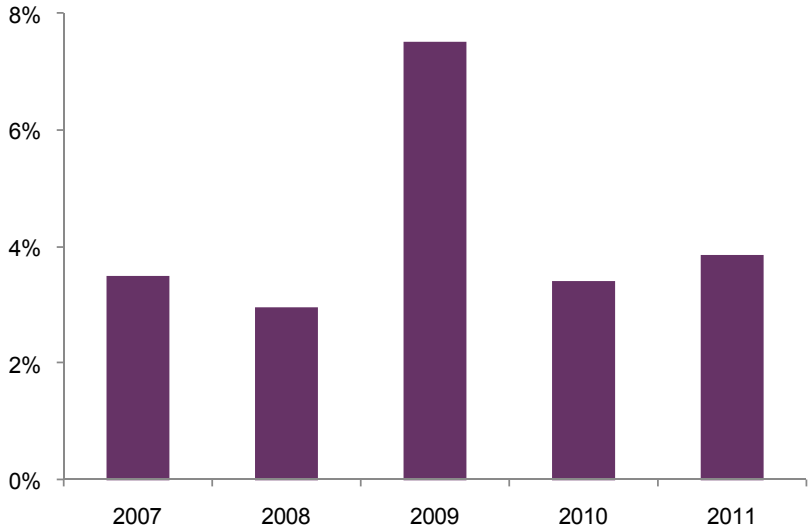
[27] Campbell, J.Y., Lo, A. and MacKinley, C. (1997), *The Econometrics of Financial Markets*, Princeton University Press.

[28] 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.

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

[30] Copeland, M. and Copeland, T. (1999), 'Market Timing: Style and Size Rotation Using the VIX', *Financial Analysts Journal*, **55**, 73–81; Guo, H. and Whitelaw, R. (2006), 'Uncovering the Risk–Return Relationship in the Stock Market', *Journal of Finance*, **61**, 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, 3183–99, October.

Figure 3.5 Dutch risk premium based on multi-stage DGM (%)



Note: The figure reported for each year is based on the index value of the Amsterdam Exchange Index as at December 31st of the previous year. Dividend growth rates are estimated using Bloomberg EPS (earnings per share) forecasts for the first three years, while the terminal growth rate for the fourth year onwards is based on long-term average growth in Dutch GDP. The risk-free rate component of the discount rate is estimated using current and implied forward rates on Dutch zero coupon bonds.
Source: Bloomberg, Datastream, and Oxera analysis, based on Inkinen, M., Stringa, M. and Voutsinou, K. (2010), 'Interpreting equity price movements since the start of the financial crisis', *Bank of England Quarterly Bulletin*, Q1 2010.

Table 3.3 Increase in ERP estimates from survey following start of financial crisis

Survey	Survey	Change in ERP estimate
Graham and Harvey (2009)	Survey of market risk premium used by US CFOs	+0.6%
Welch (2008 and 2009)	Survey of market risk premium by finance or economics professor	+0.3%

Note: The change in the ERP estimate was assessed based on the change between estimates in consecutive surveys that were conducted before and after the fall of Lehman Brothers in October 2008. The 60bp increase from Graham and Harvey (2009) is the difference between the September 5th 2008 survey value, of 3.5%, which represented the Q4 2008 ERP estimate, and the November 28th 2008 survey value, of 4.1%, which represented the Q1 2009 ERP estimate. The 30bp increase from Welch is the difference between the arithmetic ERP in a December 2007 survey (5.7%) and the arithmetic ERP in a January 2009 survey (6.0%). The author suggests that the purpose of the January 2009 update was to assess the impact of the crisis.
Sources: Graham, J. and Harvey, C.R. (2009), 'The Equity Risk Premium amid a Global Financial Crisis'; Welch, I. (2009), op. cit.; Welch (2008). 'The Consensus Estimate for the Equity Premium by Academic Financial Economists in December 2007; An Update to Welch (2000)', working paper, January 18th.

3.3 ERP and the credit crisis

Various market participants, analysts and regulators have provided different interpretations of the evidence on the evolution of the ERP since the credit crisis. These varying positions can be categorised broadly as follows:

– **No impact**: the evidence from historical ERP estimates (as reported in Figure 3.1) implicitly assumes that any deviation is temporary and should not affect the ERP. For

example, Dimson, Marsh, and Staunton did not change their long-run forward-looking estimate of the ERP as a result of the crisis.[31]

– **Short-term rise**: the evidence from forward-looking volatility, as implied by option prices (see Figure 3.3), suggests a temporary rise in the ERP in late 2008, with a gradual decline back towards pre-crisis levels during 2009. Evidence from the multi-stage DGM analysis for the Dutch equity market also suggests a temporary increase in the ERP in late 2008 (see Figure 3.5). A similar trend can be observed in some of the survey evidence. For example, the ERP reported by US CFOs in the Graham and Harvey survey fell back towards 3% in 2009–10, having increased by around 60bp following the fall of Lehman Brothers (see Tables 3.2 and 3.3).

– **Longer-term rise**: the evidence from multi-stage DGM in international markets, as reported by the Bank of England (see Figure 3.4), shows that, following the crisis, the ERP for European, UK and US markets was below the crisis peak, but tended to remain above the levels in the period preceding the credit crisis. This is one interpretation of some regulatory precedents, such as that of Ofcom in the UK, which increased its ERP range estimate in a 2008 consultation to a level equal to its ERP estimate prior to 2005 (ie, 5%) and maintained the same estimate in 2011.[32]

The evidence summarised above suggests a lack of consensus among market participants, regulators and other stakeholders about the effects of the recent financial crisis on the ERP. On balance, the evidence points to a rise in the ERP, at least temporarily, as a result of the credit crisis.

3.4 Summary

A range of 4.0–6.0% for the ERP is consistent with the evidence presented for all periods, with the exception of 2009 (see Table 3.4 below).

For all years leading up to the start of the crisis, the evidence does not justify a departure from EK's 4–6% range. At the 2008 cut-off date (December 2007), the most up-to-date surveys suggest a range of 2.4–6.0% (see Table 3.2), while historical returns range between 4.1% and 6.1%. Implied volatility had risen slightly compared with previous years. On the whole, the evidence for that period does not justify a departure from the 4–6% range for 2008.

At the 2009 cut-off date (December 2008), historical evidence suggested a range of 3.2–5.6%, while survey evidence suggested a higher range, at 4.1–6.4%. Importantly, equity volatility had risen substantially following the fall of Lehman Brothers, with implied volatility more than double pre-crisis levels. Given the unprecedented market conditions at the end of 2008, a higher and wider range for the ERP is appropriate. A wider range is also consistent with the approach taken by Ofcom.[33] On that basis, Oxera considers that it is appropriate to increase the ERP range to take into account the unprecedented market conditions that prevailed at the end of 2008. Because it is difficult to quantify the precise amount by which the range should be increased, it is necessary to rely on proxies. One such proxy can be obtained from survey evidence, which despite its limitations (eg, the inability to control for the quality of survey responses) can provide a high-level indication of the evolution of ERP over time. As shown in Table 3.3, survey evidence suggests an increase of between 30 and 60bp

[31] The long-term forward-looking world ERP presented by DMS remains constant from 2007–11, at 3–3.5% based on a geometric mean and 4.5–5% based on an arithmetic mean. See Dimson, E., Marsh, P. and Staunton, M. (2011), 'Credit Suisse Global Investment Returns Sourcebook 2011'; (2010), 'Credit Suisse Global Investment Returns Sourcebook 2010'; (2009), 'Credit Suisse Global Investment Returns Sourcebook 2009'; (2008), 'Credit Suisse Global Investment Returns Sourcebook 2008'; and (2007), 'Credit Suisse Global Investment Returns Sourcebook 2007'.

[32] Ofcom (2005), op. cit.; Ofcom (2009), op. cit.

[33] Ofcom (2008), op. cit.

in the ERP following the start of the crisis (45bp on average). Hence the ERP range for 2009 is increased to 4.3–6.6%. The widening of the ERP range estimate as at December 2008, to 4.3–6.6%, reflects the significant uncertainty in financial markets around that time.

Note that the evidence for the 2009 determination is made on a cut-off date at the end of 2008, when the financial crisis was at its height. This means that it uses a different information set from those available when EK made its determinations in 2008, before the fall of Lehman Brothers, and in 2010, by which time financial market conditions had returned to more normal levels.

For subsequent years, evidence from equity markets suggests that implied volatility has reduced significantly and stabilised at more normal levels (see Figure 3.3).[34] Forward-looking ERP estimates from DGM analysis of Dutch returns also point to a reduction of the ERP from its crisis peak (see Figure 3.5). This evidence is consistent with a reversion of ERP towards its long-term average, which, according to evidence from the DGM, could conceivably be higher than before the crisis. In light of the evidence, it is not unreasonable to maintain the original EK range (4–6%) for the years after 2009. This is also consistent with the view expressed by Dimson, Marsh, and Staunton (2011):

> We have seen that when markets are very volatile, we can expect the period of extreme volatility to be short-lived, elevating the equity premium only for the relatively short-run[35]

This does not necessarily imply that the resulting ERP point estimate would be the same as before the crisis. The recent crisis is likely to have increased investors' aversion to equity risk, which would put upward pressure on the ERP. At the same time, equity returns have fallen, and it has been argued that investors may have incorporated this into their expectations.

Table 3.4 Conclusions—equity risk premium (%)

Year (cut-off date)	**Low**	**High**
2006 (Dec 2005)	4.0	6.0
2007 (Dec 2006)	4.0	6.0
2008 (Dec 2007)	4.0	6.0
2009 (Dec 2008)	4.3	6.6
2010 (Dec 2009)	4.0	6.0
2011 onwards (Dec 2010)	4.0	6.0

Source: Oxera analysis.

[34] While historical volatility remained elevated for a slightly longer period, implied volatility is generally regarded as more relevant for determining the ERP. This is consistent with the position of Dimson, Marsh, and Staunton, who state that 'Chart 13 shows historical volatilities, but the equity risk premium will be based on future estimates of risk. To focus on the market's view of future (short-run) volatility, Chart 14 plots the VIX index…' Dimson, E., Marsh, P. and Staunton, M. (2011), 'Credit Suisse Global Investment Returns Sourcebook 2011', p. 35.

[35] Dimson, E., Marsh, P. and Staunton, M. (2011), 'Credit Suisse Global Investment Returns Sourcebook 2011'.

4 The asset beta

4.1 Methodology

In previous determinations for energy distribution and electricity transmission networks, EK estimated the asset beta by reference to the beta of comparator companies (see Table 4.1).

Table 4.1 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 determinations and supporting documents.

The Vasicek method involves adjusting the asset beta by applying some weight to a prior expectation of the beta. That is, the Vasicek adjusted beta is equal to a weighted average of the raw asset beta estimate and a prior expectation. Specifically, the weight applied to a given unadjusted beta estimate (β_i) is calculated as follows:

$$w_i = \frac{\sigma^2_{prior}}{\sigma^2_{prior} + se_i^2}$$

For a given beta estimate, the larger the standard error, the less weight will be placed on the raw beta estimate. Two parameter assumptions must be made to apply the Vasicek adjustment: a prior expectation of the beta and a prior variance. The approach adopted for the estimation of these parameters is that of Frontier (2008). The prior variance is calculated by taking the variance of the cross-section of raw equity beta estimates within each respective sample, and the prior beta is assumed equal to one.

4.2 Composition of the sample

For the current assessment, Oxera began by reviewing the set of energy network comparators considered in previous EK determinations. Comparators were added or removed from the sample across the different control periods depending on whether they continued to satisfy EK's criteria.

Changes in the comparator sample across periods would be based on the following criteria.

– **Changes in business mix**. Comparators must generate the majority of their earnings from energy network businesses (including gas transmission activities) in the time periods considered.[36]

– **Liquidity**. A necessary condition for beta estimates is that markets for their securities are sufficiently liquid.[37] Therefore, using EK's methodology, only those companies with non-zero trading volume on at least 90% of all trading days were included in the sample. Furthermore, as the shares of smaller companies tend to be less actively traded, a criterion on minimum size is included (ie, annual revenue in excess of €100m).

– **Regulatory framework**. The regulatory framework under which a network operates can influence its exposure to systematic risk, and thus its asset beta. Consistent with previous EK methodology, a mixture of companies under price cap, revenue cap, and cost of service regulation were included. Regulatory risk was also considered so that a regulated company could be excluded if it was exposed to excessive regulatory risk, or if there was lack of a clearly defined regulatory framework.[38]

In addition to the above criteria, data on each comparator must be available for at least the majority of the regression period (ie, companies that were acquired or delisted during the period were excluded to the extent that this restricted data availability). Also, comparators with high gearing were excluded.

Table 4.2 presents a comprehensive summary of the comparators that were included for each year, and, where applicable, reasons for their exclusion.

[36] Business mix was assessed for most comparators as at 2004 and 2007. Intermediate years were considered only when comparators satisfied the business mix requirement in one but not both of these years.

[37] Illiquidity imposes additional trading costs on investors, breaching the assumption in the capital asset pricing model (CAPM) of zero transaction costs.

[38] For example, Transener, the electricity transmission system operator in Argentina, and Vector, a gas and electricity distribution network operator in New Zealand, were excluded for these reasons.

Table 4.2 Comparator selection

Company	Country	2006	2007	2008	2009	2010	2011
Australian Pipeline Trust	Australia	✓	✓	✓	High gearing	High gearing	High gearing
Emera	Canada	✓	✓	✓	✓	✓	✓
Terasen Inc	Canada	✓	Acquired Nov 2005	Acquired Nov 2005	Acquired Nov 2005	Acquired Nov 2005	Acquired Nov 2005
Snam Rete Gas	Italy	✓	✓	✓	✓	✓	✓
Terna	Italy	Listed June 2004	✓	✓	✓	✓	✓
REN	Portugal	Listed July 2007	Listed July 2007	Listed July 2007	Listed July 2007	✓	✓
Red Electrica	Spain	✓	✓	✓	✓	✓	✓
Enagas	Spain	✓	✓	✓	✓	✓	✓
National Grid	UK	✓	✓	✓	✓	✓	✓
United Utilities	UK	✓	✓	✓	Sold networks in 2007	Sold networks in 2007	Sold networks in 2007
Viridian	UK	✓	✓	Acquired in 2006	Acquired in 2006	Acquired in 2006	Acquired in 2006
Atlanta Gas Light	USA	✓	✓	✓	✓	✓	✓
Duquesne Light Holdings	USA	✓	✓	✓	Delisted June 2007	Delisted June 2007	Delisted June 2007
Exelon	USA	✓	✓	Insufficient % networks[1]	Insufficient % networks	Insufficient % networks	Insufficient % networks
ITC Holdings	USA	Listed July 2005	Listed July 2005	✓	✓	✓	✓
Kinder Morgan	USA	✓	✓	✓	✓	✓	✓
Northwest Natural Gas	USA	✓	✓	✓	✓	✓	✓
Piedmont Natural Gas	USA	✓	✓	✓	✓	✓	✓
TC Pipelines	USA	✓	✓	✓	✓	✓	✓

Note: ✓ indicates comparators that were included in the sample for a given year. If not included, the primary reason for exclusion is given. Companies included have a minimum of approximately 2.5 years of data (either subsequent to listing, or prior to acquisition). Additional comparators which were considered but did not meet the criteria in any period include Envestra (high gearing), Horizon (illiquid), and Fluxys (illiquid). [1] 'Insufficient % network' refers to the percentage of operating profit or revenue (depending on availability of data) generated from gas or electricity transmission or distribution networks.
Source: Annual reports, Bloomberg, and Oxera analysis.

4.2.1 Additional considerations

Regulatory frameworks in the EU and Australia often involve an element of incentive, under which prices (or revenues) are set for a regulatory period, often five years, and over- or under-performance on OPEX, CAPEX or revenue results in a change in profit that cannot be passed on to the consumer. In the USA and Canada, by contrast, regulators often allow firms to recover their costs under the principles of cost of service regulation, whereby access charges are re-set regularly (usually annually) to ensure that costs are recovered. There are some variations on this general pattern, however. In particular, US energy pipeline company, Kinder Morgan Energy Partners, has a more competitive market than other USA comparators, since its main operations are in interstate transmission, which is not regulated due to the potential for competition between routes. Similarly, New Jersey and Virginia are moving towards the European system.

While, in principle, a cost of service regulatory system (as adopted in the USA) is less risky than a price (or revenue) cap (as generally adopted in Europe), the following factors would tend to increase the risk of US companies relative to European ones and narrow (or even reverse) the gap between the risk exposure of companies in the two regions:

– US companies are more likely to undertake other, unregulated activities because the authorities are less likely to require firms to unbundle these services. These activities tend to increase the risk faced by USA comparators;

– in some cases, the implementation of cost of service regulation departs from the traditional model in ways that may increase companies' risk exposure. For example, the New York Public Service Commission recently postponed National Grid's recovery of certain expenses in order to prevent a bill increase. It also implemented a 50% increase in the revenue reduction that would result if customer service performance measures are not met.[39]

In general, European (and Australian) companies are better comparators for GTS due to the greater similarity of their regulatory frameworks. However, North American comparators have been included in this assessment in order to maintain regulatory consistency with previous EK determinations and because it is not clear to what extent US firms have a risk exposure that is different to those of European firms, since the lower risks resulting from cost of service regulation are at least partially offset by the higher risks resulting from non-regulated business segments, and in some cases by the more stringent implementation of regulation by some US regulators.

The regulatory approach to assessing expenditure efficiency can also affect a company's overall risk exposure. For example, it is important to assess whether a company's potential to benefit from efficiency gains is equivalent, or symmetrical, to the potential costs from an equivalent loss in efficiency.[40]

4.3 Market evidence

EK's method is to form a range using the median of daily betas (measured over a two-year period) and the median of weekly betas (measured over a five-year period).

– The estimated range for the asset beta is lowest in 2006, where the median asset betas for the sample of comparators point to a range of 0.33–0.41 (see Table 4.3 below).[41]

[39] State of New York Public Service Commission (2011), 'No rate increase for average grid customers' bills'.

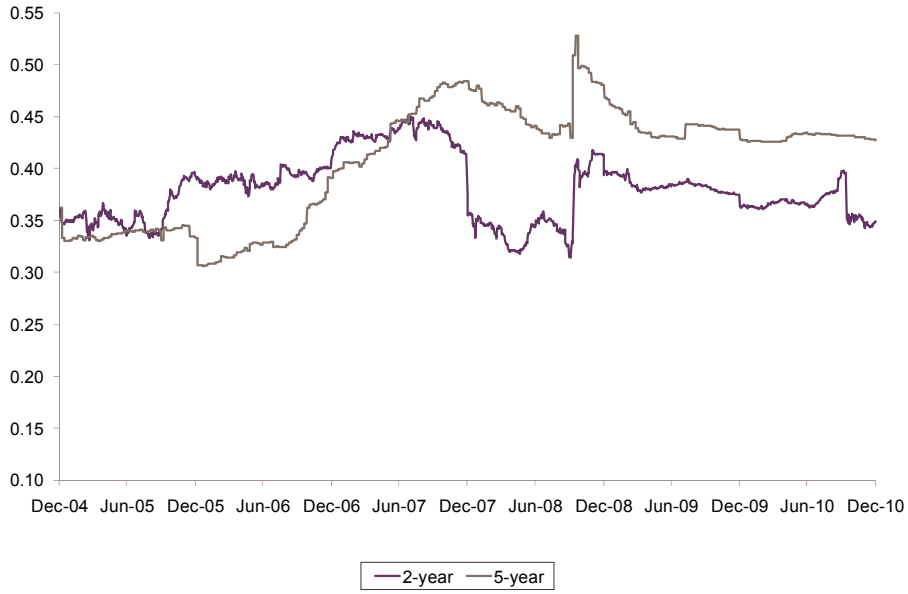
[40] As the NMa's policy to that effect is currently being designed, the estimates contained in this report assume that, on the whole, the treatment of expenditure efficiency would be broadly similar to that of the average comparator.

[41] In 2005, Frontier Economics proposed a range of 0.23–0.36 for energy networks, and 0.21–0.29 for GTS. It its reports, it used different ranges of dates and different, although overlapping, comparator sets. Frontier Economics (2005), 'The cost of

– The estimated range of the asset beta is highest in 2009 at 0.43–0.49 (see Table 4.3). This increase compared with 2006 reflects an upward trend in asset betas for the comparators, as illustrated in Figure 4.1.

– There is a sharp increase in the asset beta averages towards the end of 2008 (see Figure 4.1). This seems to be a consequence of the overall decline in market equity prices following the collapse of Lehman Brothers in September 2008.

Figure 4.1 Median rolling beta estimates of comparators



Note: Median two-year and average five-year rolling betas of 2006 comparator sample up to December 31st 2005; 2008 comparator sample from January 1st 2006 to December 31st 2007; 2009 sample from January 1st 2008 onwards. Bayesian adjustment has been applied to the asset betas, with the 2008 weights applied to data prior to December 31st 2007, and 2009 weights applied to data from January 2008 onwards. The sharp decrease on January 1st, 2008 is due to a change in the comparator sample with United Utilities and Australian Pipeline Trust being removed from the sample, and a change in the weights as described. The above figure is only representative, and the figures are not intended to match up directly with those below, due to a difference in comparators and weights (as described), and, to a lesser extent, a difference in data source.
Source: Datastream, Bloomberg, and Oxera calculations.

4.4 Summary

In previous determinations, 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. This approach would yield ranges as shown in Table 4.3 for each annual estimate.

capital for regional distributions networks', December, p. 52; and Frontier Economics (2005), 'The cost of capital for GTS', July, p. 42.

Table 4.3 Conclusions—beta

Year (cut-off date)	**Low**	**High**
2006 (Dec 2005)	0.33	0.41
2007 (Dec 2006)	0.36	0.44
2008 (Dec 2007)	0.37	0.46
2009 (Dec 2008)	0.43	0.49
2010 (Dec 2009)	0.38	0.47
2011 onwards (Dec 2010)	0.35	0.45

Source: Oxera analysis.

5 Gearing

In the previous determination for energy distribution and electricity transmission, EK had asked Oxera to review the estimation methodology for the gearing parameter. The methodology proposed by Oxera addressed the following questions in light of market evidence and regulatory precedents:

– what is the appropriate target credit rating?
– what gearing assumption is consistent with this target credit rating?[42]

The following section addresses these questions in the context of WACC determinations for gas transmission for the relevant time periods. The target credit rating is selected based on evidence that includes the credit rating of comparator companies and regulatory precedents (as detailed in section 5.1). On the basis of that target credit rating, a range for notional gearing is estimated using evidence from comparators with similar credit ratings and regulatory precedents (as detailed in section 5.2).

5.1 What target credit rating is appropriate?

According to the information set available before each price review period, the evidence examined for setting a reasonable target credit rating is summarised below.

– **Credit rating of comparator companies**. Throughout the period 2006–11, among rated European energy or water networks, between 80 and 90% of companies were rated BBB or A, with a small minority being rated AA or higher (see Figure 5.1 below).

– **Market data on issuance volumes and costs**. Spreads on BBB rated European corporate bond indices were significantly higher than for A rated debt during late 2008 and 2009 (see Figure 6.1 in section 6). This indicates that, following the credit crisis, it may have been considered more prudent for corporates to target a credit rating of A.

– **Regulatory precedents**. As noted in the Oxera report for energy networks, while not all regulators report the target credit rating underlying their cost of capital determinations,[43] UK regulators tended to use BBB+ before 2008, with a gradual shift towards A– as the credit crisis developed. In addition, EK's determination for energy networks in 2010 relied on a target rating within the A range.[44]

– **Credit rating of parent company**. While there is no credit rating for GTS itself, inferences can be drawn from the credit rating of its parent company, Gasunie. Standard & Poor's (S&P) started rating Gasunie in 2005, with an initial rating of AA+. It was downgraded to AA– in 2008, a rating reaffirmed in 2010. S&P makes an upward adjustment of one notch to account for the company's implicit government guarantees; this would imply a stand-alone rating for Gasunie of A+ in 2008 and AA in 2007.[45] At a given point in time, the credit rating of GTS's parent may differ from the credit rating applicable to the regulated operations of GTS. This could be explained by the net effect

[42] Oxera (2010), Methodology paper, February.

[43] Ibid. p. 21.

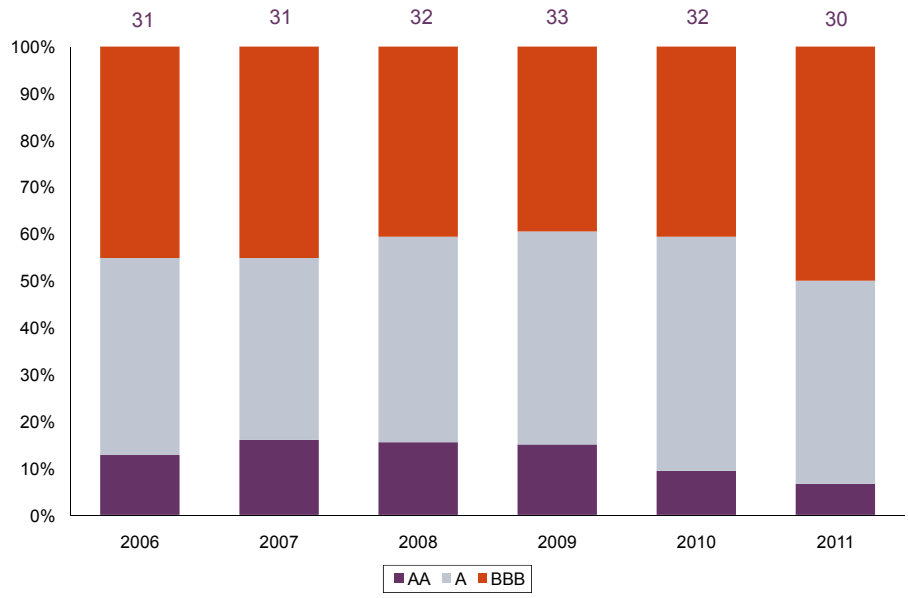
[44] Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC'.

[45] As inferred from a recent S&P report, the difference between stand-alone and actual credit ratings is that S&P assesses as 'high' the likelihood that the Dutch government would support the firm in the event of financial difficulty. This raises Gasunie's rating by one notch (although not as high as the Dutch government's AAA rating). Standard and Poor's (2010), 'N.V. Nederlandse Gasunie', *Ratings Direct*. June 23rd.

of two opposing factors. On the one hand, the risk exposure of stand-alone network operations would be increased as these would not benefit from the parent's implicit government guarantees or from the co-insurance from Gasunie's other divisions. On the other hand, the risk exposure of stand-alone regulated network assets would be lowered by the very nature of those assets, which are less risky than Gasunie's unregulated activities.

– **Legal requirements**. Dutch legislation requires energy networks either to maintain at minimum an investment-grade credit rating; or to demonstrate that they meet a specified threshold on selected credit ratios.[46]

Figure 5.1 S&P issuer rating of comparable network companies, 2006–11



Note: The full sample of firms used is listed in Appendix 2. The values above each bar indicate the number of firms in the sample for each year (eg, the figures for 2006 represent the number of firms in the sample as at the end of 2005).
Source: Bloomberg, S&P, and Oxera analysis.

[46] Decision of July 26th 2008, available at http://mijnwetten.nl/besluit-financieel-beheer-netbeheerder.

Table 5.1 Summary of regulatory precedent: rating assumption for regulated utilities, 2004–10

Review	Year	Stated rating reference
Ofwat (England and Wales—water)	2004	Investment grade (BBB/A)
Ofgem (GB—electricity transmission)	2006	BBB+
Energiekamer (Netherlands—electricity distribution networks)	2006	A
CC/CAA (UK—Gatwick and Heathrow Airports)	2008	BBB+
Ofcom (UK—telecoms)	2008	BBB+
CC/CAA (UK—Stansted Airport)	2008	A–
ORR (UK—rail)	2008	A–
CC/CAA (UK—Stansted Airport)	2009	A–
Ofwat (England and Wales—water)	2009	A– (targeted), BBB+ (minimum)
Ofgem (GB—electricity distribution)	2009	'Investment grade'
Energiekamer (Netherlands—electricity transmission)	2010	A

Source: Ofwat (2004), 'Future water and sewerage charges 2005-10: Final Determinations'. Ofgem (2004), 'Electricity Distribution Price Control Review: Final Proposals', 265/04, November. Energiekamer (2006), 'Method decision in relation to the X factor and the volume parameters of regional grid managers for the third regulatory, period – Addendum C to the method decision', June. Civil Aviation Authority (2008), 'Economic Regulation of Heathrow and Gatwick Airports, 2008–13'. Ofcom (2008), 'A New Pricing Framework for Openreach'. Competition Commission (2008), 'Stansted Airport Ltd. Q5 price control review', October. Office of Rail Regulation (2008), 'Determination of Network Rail's Outputs and Funding for 2009–14'. Civil Aviation Authority (2009), 'Economic Regulation of Stansted Airport, 2009–14'. Ofwat (2009), 'Future Water and Sewerage Charges 2010–15: Final Determinations', November. Ofgem (2009) 'Final proposals', Electricity Distribution Price Control Review, 147/09, December. Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC', September.

5.1.1 Conclusions on target credit rating

Overall, the evidence presented above suggests that the majority of regulated networks have been able to maintain an investment-grade credit rating in the range of BBB and A across several years, consistent with a target credit rating towards the low end of the A range or towards the high end of the BBB range (hereafter referred to as BBB/A). For the earlier years, most regulatory precedents relied on a target rating of BBB+ and the difference in spreads for A and BBB bonds was not large, suggesting a minimal cost of downgrade from A to BBB. On balance, a target credit rating range of BBB/A is appropriate for 2006–08. For 2009 onwards, the evidence tilts towards the low end of the A range as a target credit rating. This is consistent with a tendency by regulators to raise the target credit rating above BBB+ towards A– following the credit crisis, as well as with the increased cost (in the form of higher bond spreads) associated with a downgrade to BBB during and after the financial crisis.

5.2 What gearing level is consistent with the target credit rating?

In its 2010 determination for energy networks, EK judged that an appropriate level for the notional gearing was 50–60%, on the basis of a range of evidence, including book gearing, market gearing, debt to RAB ratios, and regulatory precedents. This section considers evidence from earlier periods to assess whether this range is also appropriate for all other years considered.

– **Observed gearing for rated companies (book value)**. Figure 5.2 below shows gearing levels based on book value of equity for a sample of comparators. The widest range occurs in 2008, where a BBB/A rating suggests gearing of 54–67%. In all periods, the midpoint of the range (for 2006–08) and the point estimate (for 2009 onwards) are within the range of 55–65%.

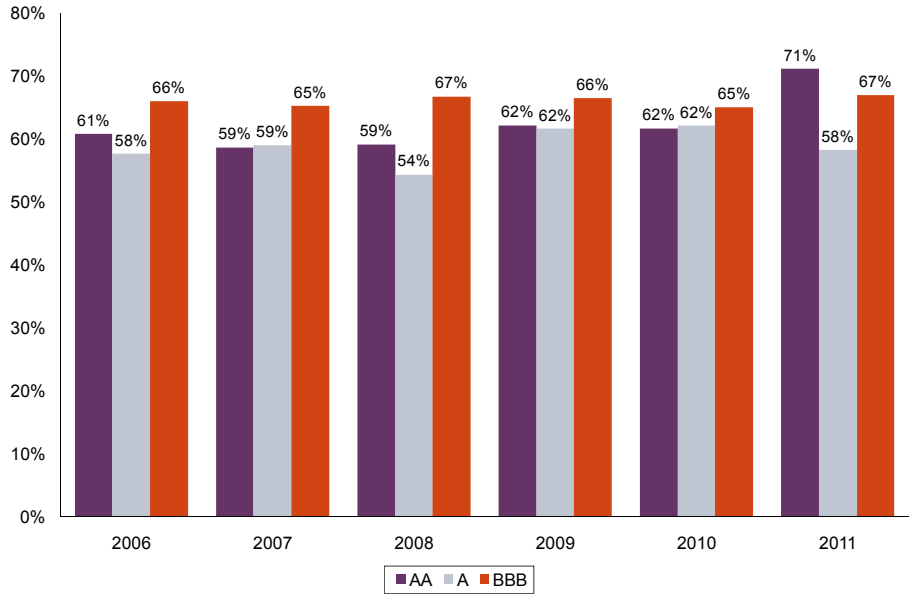
– **Observed gearing for rated companies (market value)**. Gearing levels based on market value of equity for a sample of comparators are shown in Figure 5.3 below. Average gearing levels are highest for BBB rated companies (with the exception of 2010) and lowest for AA rated companies, as expected. In all cases the midpoint of the range (for 2006–08) and the point estimate (for 2009 onwards) are within the range of 40–50%. Following the start of the financial crisis, market gearing for A rated companies increased broadly to the pre-crisis gearing level for BBB companies (around 45–50%).

– **Regulatory precedents for notional gearing**. In a sample of European regulatory determinations of notional gearing for utility networks, all but three set gearing in the range 50–60% (see Table 5.2 below).

– **Debt/RAB ratios**. In its report for energy networks (2010), Oxera presented evidence of gearing for regulated companies as a proportion of the RAB.[47] (This evidence is reproduced in Table 5.3 below.) The average gearing for A and BBB rated companies is 60% and 67%, respectively. Given that market values for utilities frequently stand at a premium to their RAB, the implied market value gearing ratios will be lower than the gearing to RAB.

These considerations suggest that a gearing range of 50–60% is appropriate for all periods under review.

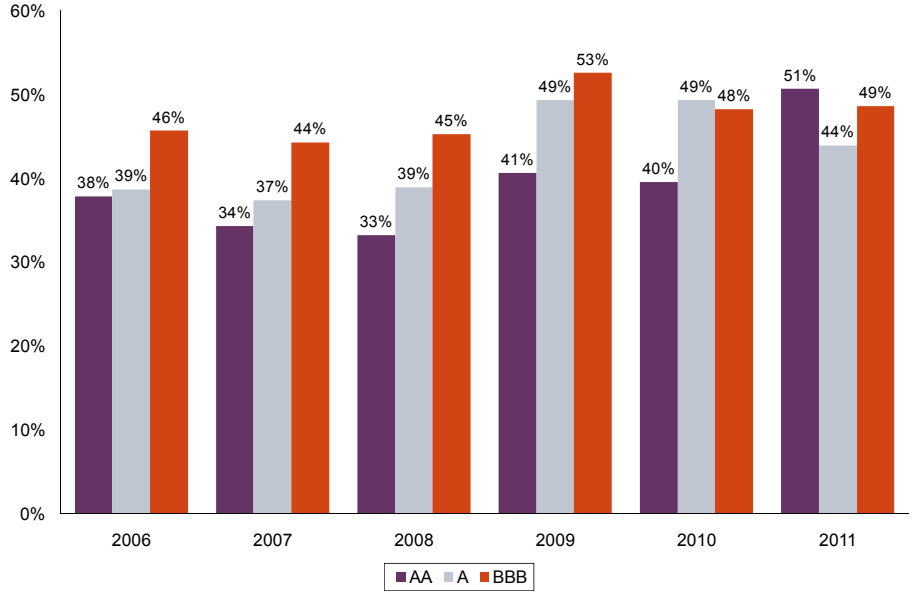
Figure 5.2 Gearing levels for rated utilities companies—book value (book value of equity and book net debt)



Note: Years denote each annual estimate, with these being based on market data available up to start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005. Average number of firms: four for AA, nine for A and eight for BBB.
Source: S&P reports, Bloomberg, and Oxera analysis.

[47] Oxera (2010), Methodology paper, February.

Figure 5.3 Gearing levels for rated utility companies—market value (market capitalisation and book net debt)



Note: Years denote each annual estimate, with these being based on market data available up to start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005. Average number of firms: four for AA, seven for A and eight for BBB.
Source: S&P reports, Bloomberg, and Oxera analysis.

Table 5.2 Summary of regulatory precedent: gearing assumptions for UK and European regulated utilities

Review	Year	Gearing (%)
Ofgem (GB—electricity distribution)	1999	50
NIAUR (Northern Ireland—electricity transmission and distribution)	2002	50
CER (Ireland—gas transmission)	2003	55
Ofwat (England and Wales—water)	2004	55
Ofgem (GB—electricity distribution)	2004	57.5
Ofgem (GB—electricity distribution)	2006	60
Energiekamer (Netherlands—electricity transmission)	2006	60
Energiekamer (Netherlands—electricity distribution)	2006	60
AEEG (Italy—energy networks)	2007	44–47
CER (Ireland—gas transmission and distribution)	2007	55
Ofgem (GB—gas distribution)	2007	62.5
Ofwat (England and Wales–water and sewerage companies)	2009	57.5
Ofwat (England and Wales–water-only companies)	2009	52.5
Ofgem (GB—electricity distribution)	2009	65
Energiekamer (Netherlands—electricity transmission)	2010	50–60

Sources: Ofgem (1999), 'Distribution Price Control Review: Consultation Paper', Review of Public Electricity Suppliers 1998–2000, May. Northern Ireland Authority for Utility Regulation (2002), 'Transmission and Distribution Price Control Review – Final Proposals for Northern Ireland Electricity', June. Commission for Energy Regulation (2003), 'Commission's Decision on Transmission Use of System Revenue Requirement and Tariff Structure 1 October 2003 – 30 September 2007', Table 3.1. Ofwat (2004), 'Future Water and Sewerage Charges 2005-10: Final Determinations', Table 45. Ofgem (2004), 'Electricity Distribution Price Control Review: Final Proposals', 265/04, November. Ofgem (2006), 'Transmission Price Control Review: Final Proposals', 206/06, December. Energiekamer (2006), 'Method decision in relation to the X factor and the volume parameters of regional grid

managers for the third regulatory period – Addendum C to the method decision', June. AEEG (2007), 'Tariffe per l'erogazione dei servizi di transmission, distribuzione e misura dell'energie electtrica per il period 2008-2011— Orientamenti finali'. Commission for Energy Regulation (2007), 'Bord Gáis Networks: Revenue Review 2007/8–2011/12'. Ofgem (2007), 'Gas Distribution Price Control Review: Final Proposals', 285/07. Ofwat (2009), 'Future Water and Sewerage Charges 2010–15: Final Determinations', November. Ofgem (2009), 'Electricity Distribution Price Control Review: Final proposals', 147/09, December. Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC'. December.

Table 5.3 Debt to RAB ratios of comparators, 2007/08

Company	Sector	Rating	Debt/RAB (%)
REN	Energy	A+	70
National Grid Electricity Transmission	Energy	A–	49
United Utilities	Water	A–	53
Severn Trent Water	Water	A–	58
Terna	Energy	A+	54
Northumbrian Water	Water	BBB+	58
Wessex Water	Water	BBB+	64
Northern Gas Networks	Energy	BBB+	67
Scotia Gas Networks	Energy	BBB	68

Note: Figures for United Utilities, Severn Trent, Northumbrian Water and Wessex Water are reported as at March 2009.
Source: Annual accounts, company websites, company press releases, and REN Investor Day Presentation (2009).

5.3 Summary

Overall, the evidence presented above suggests that a range of 50–60% is appropriate for the gearing parameter across all periods. This is because the 50–60% range lies somewhere between market gearing (generally towards the lower end of the range) and gearing to RAB (generally towards the upper end of the range). Moreover, a 50–60% range is consistent with the majority of regulatory precedents presented above.

The recommended ranges for gearing (50–60% across all years) and target credit rating (BBB/A for 2006–08 and A for 2009 onwards) were also checked for time consistency. The 2010 estimate is based on evidence collected as part of the Oxera (2010) methodology paper. For that year, the majority of comparators were rated A– or higher, and most regulatory precedents pointed to a target credit rating of A.[48] The 2010 estimate can be compared to separate time periods, as considered below.

– **Pre-crisis period**—a lower credit rating (BBB/A), as assumed for the years prior to the credit crisis, would be consistent with a higher gearing ratio for those years relative to the post-crisis period. In turn, higher gearing ratios for the pre-crisis period would have the effect of decreasing the WACC for those years. However, the impact on the WACC would be expected to be minimal (eg, in the order of 5bp for a 5% gearing increase). Thus the recommended range of 50–60% for notional gearing, which is consistent with the evidence presented in this section, is considered reasonable for the 2006–08 period.

– **Post-crisis period**—the constant gearing range assumption and the corresponding move from a target credit rating of BBB/A for the years 2006–08 to A for 2009 onwards is consistent with market gearing evidence, which shows that the difference in market

[48] For 2010, 19 of the 32 comparators listed in Table A2.7 had a credit rating of A– or higher, compared with 13 companies with a credit rating of BBB+ or lower.

gearing ratios of BBB and A comparators contracted from around 6% before the crisis to 3% following the crisis.

– **2011 and onwards**—in 2011, the majority of companies had a credit rating in the BBB range. However, it is reasonable for a regulator to encourage companies to maintain a higher credit rating, consistent with the regulatory precedents listed in Table 5.1. This is partly because the credit crisis has exposed the costs of lenient credit standards, raising concern that a significant amount of the costs of financial distress could be borne by consumers, either through under-investment or through insolvency. As a result, Oxera recommends that the NMa continues to target a credit rating of A for 2011 and going forward.

6 The debt premium

6.1 Methodology

In its previous determinations for energy distribution and electricity transmission networks, 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 6.1).

Table 6.1 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	Investment-grade, consistent with target credit rating
Averaging period	Five years (bond indices)
	Two years (specific bonds)

Source: EK determinations.

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 of or close to A. The comparator set is similar to those used to estimate asset beta, but may differ insofar as it may include companies that issue bonds without being listed, or exclude listed companies that do not issue bonds.

6.2 Updated market evidence

– Spreads on corporate bond indices—which remained largely stable between 2004 and mid-2007—started to rise slightly in mid-2007, and rose substantially shortly before the 2009 cut-off date (see Figure 6.1 below).[49] As shown in Table 6.2 below, the five-year average for BBB/A corporate bond indices was 89bp for 2006 before debt issuance fees.[50] The five-year average for A-rated bonds decreased to a low of 71bp for 2009, and increased to a high of 116bp for 2011 onwards (in both cases, before debt issuance fees).

– The median of the two-year trailing average spread on bonds issued by comparators increased from 82bp in 2006 to 173bp in 2010 (see Figure 6.2). The considerable difference compared with the bond indices for 2010 mainly reflects the sharp rise in bond yields towards the end of 2008 and early 2009, which is given more weight in the two-year average than in the longer averaging period considered for bond indices.

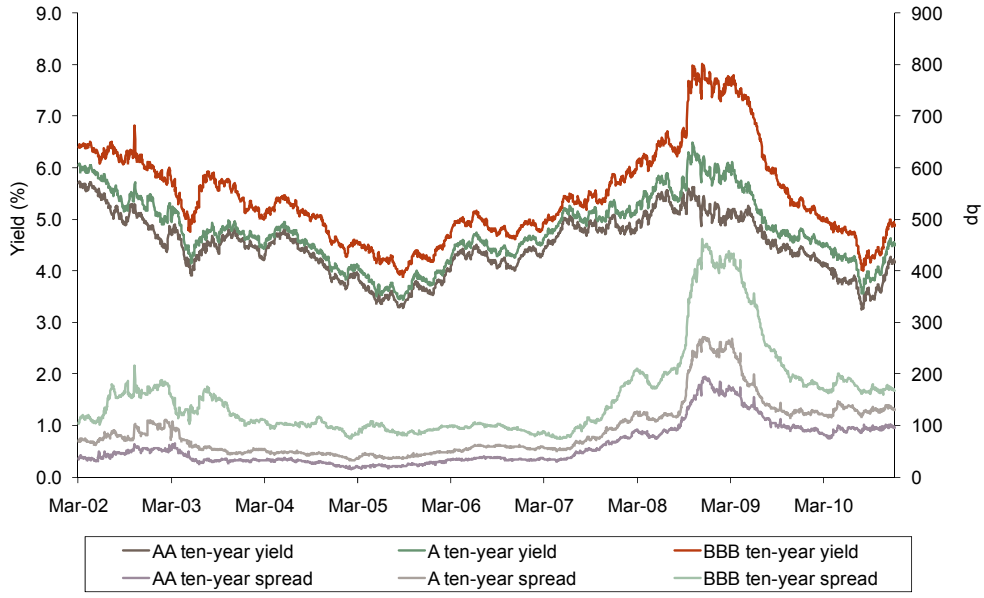
– Spreads on all comparators included across 2008 and 2009 sample periods increased between the two periods by 20–50bp. This broad-based increase in spreads leads to a

[49] Nominal bond yields followed a similar trend, although their rise in 2007–08 was less pronounced due to declines in the risk-free rate.
[50] For 2006, the average spread is based on the period from February 2002 (the inception of the index) to December 2005 (the cut-off date).

higher sample average for 2009 than 2008 (see Figure 6.2), despite the exclusion of BBB rated issues for the 2009 sample period.

– Similarly, the two-year averages for selected bonds increased by 30–60bp from 2009 to 2010, reflecting the greater weight attributed to post-crisis bond spreads within the average period. The largest increases were attributable to a bond of Alliander, which increased from 80bp to 139bp, and one of Energias de Portugal, which increased from 142bp to 198bp.

Figure 6.1 Yields and spreads on EUR-denominated ten-year corporate bond indices (BBB to AA ratings)



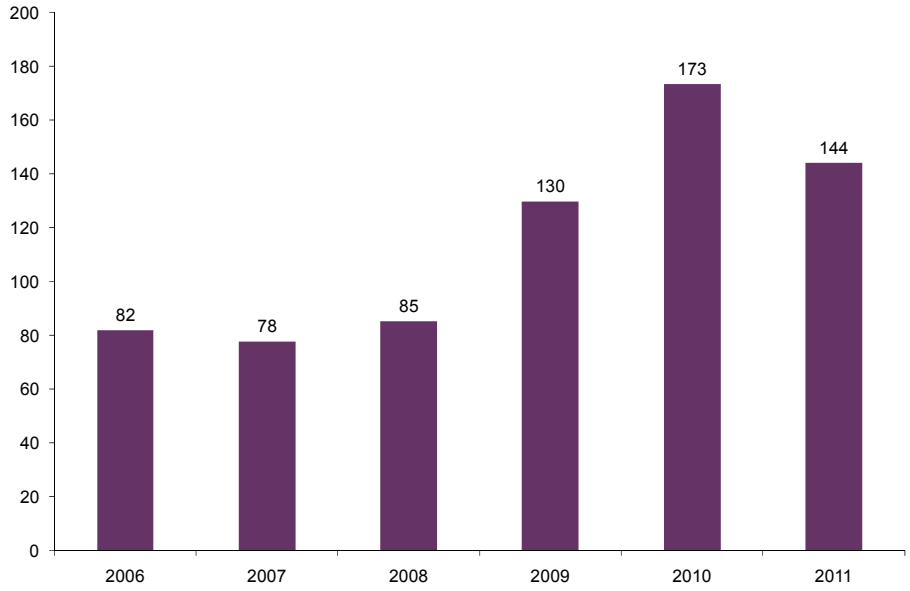
Note: Spreads of Bloomberg Fair Value (BFV) ten-year corporate bond indices over European sovereign index.
Source: Bloomberg, and Oxera analysis.

Table 6.2 Average spreads on corporate bond indices, 2006–11 (bp)

	2006	2007	2008	2009	2010	2011
BBB index	119	115	107	–	–	–
A index	58	57	56	71	98	116
Index average	**89**	**86**	**81**	**71**	**98**	**116**

Note: Years denote each annual estimate, with these being based on market data available up to start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005. For 2006, due to data limitations, average index spreads are from March 2002 to December 2005. Index spreads are ten-year corporate bond indices over the European sovereign index.
Source: Bloomberg, and Oxera analysis.

Figure 6.2 Spreads on comparator bonds (bp)



Note: Averages for comparator spreads are over two years, subject to data availability. See section A2.1 for comparator bond spreads in each period.
Source: Datastream, and Oxera analysis.

6.3 Debt issuance fees and debt-related overhead costs

In its determination for energy networks, EK considered evidence on debt issuance fees and other non-interest costs of debt. Transaction fees considered included up-front fees paid to underwriters, commitment fees on credit facilities, and annual overhead costs. Overall, it was determined that a range of 10–20bp would provide accurate compensation for debt issuance fees.[51] While such costs may fluctuate over time, the estimated range is based on evidence over the ten years to 2009 and is therefore assumed to remain appropriate across all periods considered.

6.4 Summary

Consistent with EK's earlier approach, and with the approach adopted for the risk-free rate, the range for the debt premium has been estimated on the basis of the five-year trailing average spread on the bond index for A rated debt and the median two-year trailing average spread on the sample of comparators. Adding 10–20bp for debt issuance costs gives the following conclusions (see Tables 6.3 and 6.4 below).

[51] Energiekamer (2010), 'Bijlage 2 Uitwerking van de methode voor de WACC', *Methodebesluit voor de systeemtaken van TenneT vastgesteld.*

Table 6.3 Conclusions—debt premium, 2006–08 (bp)

	2006		2007		2008	
	Low	High	Low	High	Low	High
Spread	80	90	80	90	80	90
Debt issuance costs	10	20	10	20	10	20
Debt premium	**90**	**110**	**90**	**110**	**90**	**110**

Note: Years denote each annual estimate, with these being based on market data available up to start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005.
Source: Datastream, and Oxera analysis.

Table 6.4 Conclusions—debt premium, 2009 onwards (bp)

	2009		2010		2011 onwards	
	Low	High	Low	High	Low	High
Spread	70	130	100	170	120	140
Debt issuance costs	10	20	10	20	10	20
Debt premium	**80**	**150**	**110**	**190**	**130**	**160**

Note: Years denote each annual estimate, with these being based on market data available up to start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005.
Source: Datastream, and Oxera analysis.

These estimates can be compared against the actual yield on bonds issued by Gasunie, GTS's parent company. Importantly, while the spreads on Gasunie's bond can be considered as a cross-check, they do not necessarily reflect the cost of debt applicable to its network activities on a stand-alone basis. In particular, the spread on Gasunie's bond could:

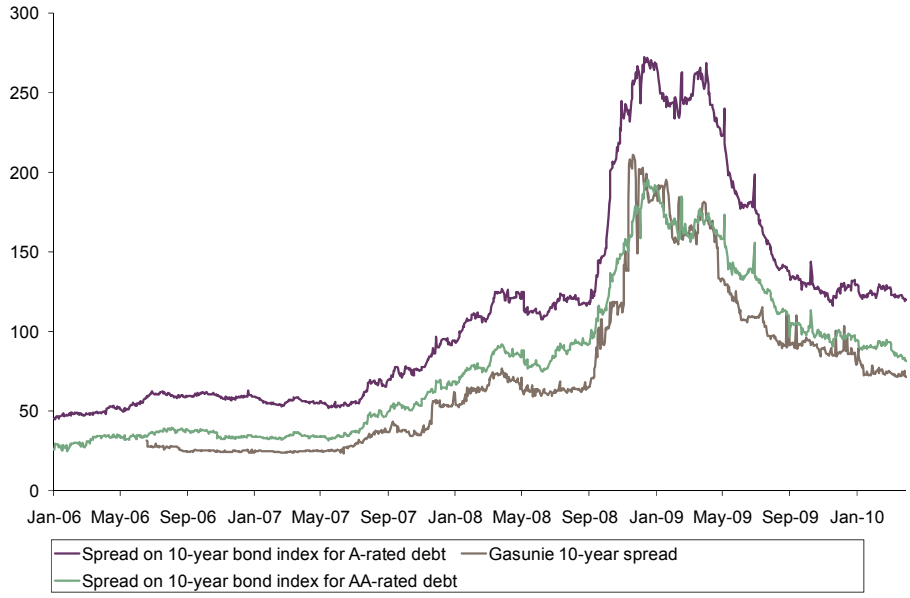
– exceed the spread on bonds issued by a stand-alone GTS if other activities—in particular, Gasunie's non-regulated business—have a higher risk profile than GTS;

– understate the cost of borrowing for the network activities given the benefits to Gasunie of diversification across its various divisions, which can lower the volatility of cash flows at the group level;

– understate the cost of borrowing for the network activities given the implicit government guarantee on Gasunie's bonds, as recognised by S&P.

On balance, the spread on bonds issued by Gasunie is likely to be lower than the cost of debt for a stand-alone regulated network. The bonds, issued in 2006, traded at an average spread of 31bp and 62bp in the two years to December 2007 and 2008 respectively (see Figure 6.3). This is below the spreads on BBB and A bonds examined in this section, largely owing to Gasunie's higher credit rating, which is partly a reflection of the government's implicit guarantee.

Figure 6.3 Spreads on Gasunie's bond and corporate bond indices (bp)



Note: Gasunie spread is the average of 2016 and 2021 maturities. Index spreads are BFV corporate bond indices over the BFV European sovereign benchmark index.
Source: Datastream, Bloomberg, and Oxera analysis.

7 Inflation

In the recent regulatory determination for energy networks and electricity transmission, EK asked Oxera to review its treatment of inflation in the estimation of the WACC. For the purpose of estimating inflation in the case of GTS, the same method has been employed across the relevant periods. For each year, Oxera has used information that was available only when the determination was, or would have been, made.

In essence, the revised methodology was anchored on the principle that the inflation adjustment in the WACC calculation should seek to capture the inflation expectations that investors had incorporated into the price of securities that were used to estimate the components of the WACC. As outlined in the Oxera (2010) methodology report, evidence from various sources, including index-linked bonds and independent inflation forecasts, should be used to inform estimates for future inflation rates. However, the Dutch government does not issue index-linked bonds. The Oxera (2010) methodology report identifies CPB as the main source which provides independent forecasts for Dutch inflation that are available consistently over time. Therefore, in order to maintain transparency and objectivity, the adopted methodology combines the CPB forecasts with realised inflation rates. It should be noted that the use of the longer-term CPB forecast for 2008–11 in place of the inflation estimates presented for those years would result in a lower real rate of return. Oxera recommends that the NMa reconsider its approach to using forecast data in the future, as new sources of evidence for inflation forecasts become available.

More specifically, in order to define the two ends of the inflation range estimate, the approach generates two averages. The first is an average of three data points: the realised inflation rates over the last two years, and the most recent forecast from the Netherlands Bureau for Economic Policy Analysis (CPB). 'Realised' inflation is the average of the year-on-year inflation figures for each month of the year, from December to November.[52] The second average uses six data points, including five years of realised inflation rather than two, and the CPB forecast.

7.1 Market evidence

Applying the existing methodology for annual estimates in 2006–11, the estimated ranges for inflation are as shown in Table 7.1.

Table 7.1 Inflation range for the assessment of the WACC, 2006–11 (%)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Realised inflation	4.0	3.4	2.2	1.3	1.6	1.3	1.5	2.5	1.3	1.2
Forecast inflation					1.0	1.3	2.3	1.5	1.0	1.5
Two-year estimate					**1.3**	**1.4**	**1.7**	**1.8**	**1.6**	**1.3**
Five-year estimate					**2.3**	**1.8**	**1.7**	**1.6**	**1.5**	**1.5**

Note: Realised inflation is as at the November cut-off date of the previous year. One-year forecasts are as at December of the previous year. For example, 2006 reflects realised inflation from November 2004 to November 2005 (ie, realised inflation values for 2005 and 2006) and forecast 2006 inflation as at December 2005. Differences from Oxera (2010) methodology paper result from the use of a different cut-off date.
Source: Statistics Netherlands, CPB, and Oxera analysis.

[52] Unlike for market parameters, November is used rather than December because estimates of inflation to December are not available at the December 31st cut-off date.

7.2 Cross-checks

The method for estimating inflation has been designed to achieve a balance between the NMa's objectives of transparency and reasonableness.[53] Nevertheless, it is important to cross-check the estimates produced by the approach, especially given its mechanistic nature. For these purposes, the following evidence has been considered.

– **Longer-term inflation forecasts** by the CPB can be used to assess the estimates based on realisations. For instance, a four-year forecast of inflation is available from CPB for the period 2008–11, of 1.75%.[54] An alternative forecast can be obtained from Consensus Economics. Ten-year forecasts for Dutch inflation are 1.8–1.9% in 2005 and 2007 and 2.1% in 2008.[55] These cross-checks are broadly consistent with the range estimates reported above.

– **Implied inflation**. Inflation expectations can be measured from market yields on real and nominal government bonds. Because the Dutch government does not issue index-linked bonds, it is not possible to observe implied inflation for the Netherlands. While inflation in France is not expected to be equal to inflation in the Netherlands, implied inflation derived from French bonds can be informative as a cross-check. Implied inflation on French government bonds ranges from 1.8% to 2.3% for the periods under consideration (see Table 7.2).

Table 7.2 Implied inflation from French index-linked bonds (%)

Year (cut-off date)	**Implied inflation**
2006 (Dec 2005)	2.3
2008 (Dec 2007)	2.1
2009 (Dec 2008)	2.1
2010 (Dec 2009)	1.8

Note: Implied inflation is calculated as the difference in the yields of French sovereign nominal and index-linked bonds, averaged over the preceding two years, subject to data availability. Values for 2006, 2008, and 2009 reflect average ten-year implied inflation. Due to insufficient 10-year data, 2010 reflects average five-year inflation. A cross-check for 2007 is not included due to insufficient data.
Source: Bloomberg, and Oxera analysis.

One would expect that the implied inflation rate calculated from nominal and index-linked bonds would be slightly higher than expected inflation. This is because, while the holder of a nominal bond is subject to the risk of inflation being different from forecast, the holder of an index-linked bond is not.[56] Therefore, in addition to compensation for expected inflation, the holder of a nominal bond would require an inflation risk premium to compensate for the risk that realised inflation differs from that expectation. Recent estimates of the inflation risk premium range from as low as 3bp in the USA to 50bp in the UK.[57] This could explain the higher implied inflation estimates reported in Table 7.2 compared with the other sources of evidence.

[53] Oxera (2010), Methodology paper.

[54] CPB (2007), 'Actualisatie Economische Verkenning 2008–11', September.

[55] NERA (2010), 'Critique of Oxera's Report for the NMa on the Cost of Capital', December, p. 7.

[56] The holder of an index-linked bond can be subject to some inflation risk, but to a much lesser extent. This risk results from a lag between the period in which inflation is calculated and the time at which the bondholder is compensated for inflation.

[57] US estimate obtained from data covering 1952–2006, UK estimate obtained from a ten-year period. See Ravenna, F. and Seppala, J. (2007), 'Monetary policy, expected inflation, and inflation risk premia', *Journal of Economic Literature*, August; and Joyce, M., Lildholdt, P. and Sorensen, S. (2009), 'Extracting inflation expectations and inflation risk premia from the term structure: a joint model of the UK nominal and real yield curves', Bank of England working paper No.360.

7.3 Summary

On the basis of this methodology, the inflation estimates for each annual estimate are:

– 1.3–2.3% for 2006;
– 1.4–1.8% for 2007;
– 1.7% for 2008;
– 1.6–1.8% for 2009;
– 1.5–1.6% for 2010;
– 1.3–1.5% for 2011;

These estimates are broadly consistent with the cross-checks presented in this section. The range for 2010 differs slightly from the equivalent range presented in the Oxera 2010 methodology paper. This results from the use of different time periods for realised inflation between the two reports.

A1 Asset beta

A1.1 Beta estimates

Tables A1.1–A1.6 present estimates of asset betas for the comparators used in each period from 2006 to 2011. As discussed in section 4, EK methodology suggests constructing a range for the asset beta based on the median of the comparator estimates.

Table A1.1 Asset beta estimates, 2006

	Country	Daily	Weekly
Australian Pipeline Trust	Australia	0.36	0.31
Emera	Canada	0.16	0.13
Terasen Inc	Canada	0.41	0.31
Snam Rete Gas	Italy	0.29	0.22
Enagas	Spain	0.56	0.34
Red Electrica	Spain	0.39	0.25
National Grid	UK	0.40	0.30
United Utilities	UK	0.33	0.27
Viridian	UK	0.41	0.29
Atlanta Gas Light	USA	0.55	0.41
Kinder Morgan	USA	0.38	0.58
Duquesne Light Holdings	USA	0.67	0.40
Exelon	USA	0.78	0.45
Northwest Natural Gas	USA	0.73	0.36
Piedmont Natural Gas	USA	0.72	0.46
TC Pipelines	USA	0.44	0.42
Mean		**0.47**	**0.34**
Median		**0.41**	**0.33**

Note: Daily betas calculated with two years of data, weekly betas with five years of data. Vasicek adjustment was applied to the equity betas using a prior expectation of 1 and variance equal to that of the cross-section of estimated betas.
Source: Bloomberg, OECD, and Oxera analysis.

Table A1.2 Asset beta estimates, 2007

	Country	Daily	Weekly
Australian Pipeline Trust	Australia	0.41	0.32
Emera	Canada	0.10	0.17
Snam Rete Gas	Italy	0.31	0.22
Terna	Italy	0.40	0.56
Enagas	Spain	0.65	0.39
Red Electrica	Spain	0.46	0.28
National Grid	UK	0.41	0.33
United Utilities	UK	0.40	0.33
Viridian	UK	0.57	0.37
Atlanta Gas Light	USA	0.56	0.47
Kinder Morgan	USA	0.35	0.33
Duquesne Light Holdings	USA	0.62	0.45
Exelon	USA	0.75	0.55
Northwest Natural Gas	USA	0.81	0.44
Piedmont Natural Gas	USA	0.74	0.49
TC Pipelines	USA	0.31	0.35
Mean		**0.49**	**0.38**
Median		**0.44**	**0.36**

Note: Daily betas calculated with two years of data, weekly betas with five years of data. Vasicek adjustment was applied to the equity betas using a prior expectation of 1 and variance equal to that of the cross-section of estimated betas.
Source: Bloomberg, OECD, and Oxera analysis.

Table A1.3 Asset beta estimates, 2008

	Country	Daily	Weekly
Australian Pipeline Trust	Australia	0.37	0.35
Emera	Canada	0.19	0.20
Snam Rete Gas	Italy	0.36	0.39
Terna	Italy	0.36	0.46
Red Electrica	Spain	0.55	0.48
Enagas	Spain	0.46	0.41
National Grid	UK	0.37	0.39
United Utilities	UK	0.50	0.48
Atlanta Gas Light	USA	0.47	0.53
Duquesne Light Holdings	USA	0.33	0.46
ITC Holdings	USA	0.57	0.69
Kinder Morgan	USA	0.30	0.33
Northwest Natural Gas	USA	0.79	0.62
Piedmont Natural Gas	USA	0.79	0.53
TC Pipelines	USA	0.16	0.42
Mean		**0.45**	**0.44**
Median		**0.37**	**0.46**

Note: Daily betas calculated with two years of data, weekly betas with five years of data. Vasicek adjustment was applied to the equity betas using a prior expectation of 1 and variance equal to that of the cross-section of estimated betas.
Source: Bloomberg, OECD, and Oxera analysis.

Table A1.4 Asset beta estimates, 2009

	Country	Daily	Weekly
Emera	Canada	0.20	0.26
Snam Rete Gas	Italy	0.18	0.31
Terna	Italy	0.31	0.36
Enagas	Spain	0.47	0.56
Red Electrica	Spain	0.46	0.51
National Grid	UK	0.41	0.50
Atlanta Gas Light	USA	0.44	0.48
Kinder Morgan	USA	0.55	0.63
ITC Holdings	USA	0.38	0.49
Northwest Natural Gas	USA	0.52	0.45
Piedmont Natural Gas	USA	0.64	0.49
TC Pipelines	USA	0.38	0.73
Mean		**0.41**	**0.48**
Median		**0.43**	**0.49**

Note: Daily betas calculated with two years of data, weekly betas with five years of data. Data for ITC Holdings and Terna is available only from July 2005 and June 2004, respectively. Vasicek adjustment was applied to the equity betas using a prior expectation of 1 and variance equal to that of the cross-section of estimated betas.
Source: Bloomberg, OECD, and Oxera analysis.

Table A1.5 Asset beta estimates, 2010

	Country	Daily	Weekly
Emera	Canada	0.18	0.25
Snam Rete Gas	Italy	0.10	0.19
Terna	Italy	0.22	0.24
REN	Portugal	0.34	0.39
Red Electrica	Spain	0.38	0.49
Enagas	Spain	0.40	0.47
National Grid	UK	0.35	0.43
Atlanta Gas Light	USA	0.39	0.47
ITC Holdings	USA	0.50	0.60
Kinder Morgan	USA	0.37	0.47
Northwest Natural Gas	USA	0.42	0.41
Piedmont Natural Gas	USA	0.54	0.49
TC Pipelines	USA	0.41	0.64
Mean		**0.35**	**0.43**
Median		**0.38**	**0.47**

Note: Daily betas calculated with two years of data, weekly betas with five years of data. Vasicek adjustment was applied to the equity betas using a prior expectation of 1 and variance equal to that of the cross-section of estimated betas.
Source: Bloomberg, OECD, and Oxera analysis.

Table A1.6 Asset beta estimates, 2011 onwards

	Country	Daily	Weekly
Emera	Canada	0.21	0.28
Snam Rete Gas	Italy	0.13	0.19
Terna	Italy	0.15	0.24
REN	Portugal	0.24	0.36
Red Electrica	Spain	0.35	0.45
Enagas	Spain	0.37	0.46
National Grid	UK	0.28	0.40
Atlanta Gas Light	USA	0.38	0.46
Kinder Morgan	USA	0.35	0.47
ITC Holdings	USA	0.43	0.58
Northwest Natural Gas	USA	0.40	0.44
Piedmont Natural Gas	USA	0.46	0.49
TC Pipelines	USA	0.39	0.60
Mean		**0.32**	**0.42**
Median		**0.35**	**0.45**

Note: Daily betas calculated with two years of data, weekly betas with five years of data. Vasicek adjustment was applied to the equity betas using a prior expectation of 1 and variance equal to that of the cross-section of estimated betas.
Source: Bloomberg, OECD, and Oxera analysis.

A1.2 Comparator selection criteria

Table A1.7 Comparator selection criteria, 2005

Company	Country	Share of energy networks (%)	Gearing (%)	Turnover (€m)[1]	Regulatory regime
Australian Pipeline Trust	Australia	94%	51%	165	Price cap
Emera	Canada	97%	48%	701	Cost of service
Terasen Inc	Canada	91%	52%	102	Cost of service
Snam Rete Gas	Italy	96%	29%	1,809	Four-year revenue cap
Enagas	Spain	92%	37%	1,295	Four-year revenue cap
Red Electrica	Spain	87%	49%	779	Four-year revenue cap
National Grid	UK	100%	47%	13,062	Five-year price cap
United Utilities	UK	87%	47%	3,035	Five-year price cap
Viridian	UK	75%	31%	1,229	Five-year price cap
Atlanta Gas Light	US	79%	42%	1,473	Cost of service + performance-based adjustments
Kinder Morgan	US	79%	34%	5,026	Cost of service + negotiated agreements
Duquesne Light Holdings	US	97%	40%	634	Cost of service
Exelon	US	71%	36%	11,668	Cost of service
Northwest Natural Gas	US	100%	41%	563	Cost of service
Piedmont Natural Gas	US	100%	35%	669	Cost of service + performance-based adjustments
TC Pipelines	US	100%	2%	265	Cost of service + negotiated agreements

Note: [1] Turnover converted from local currency at average exchange rate in 2004. 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, Northwest Natural Gas and Piedmont Natural Gas include regulated supply activities reported by these companies as part of their distribution segment.
Source: Annual reports, Bloomberg, and Oxera analysis.

Table A1.8 Comparator selection criteria, 2008

Company	Country	Share of energy networks (%)	Gearing (%)	Turnover (€m)[1]	Regulatory regime
Australian Pipeline Trust	Australia	99%	61%	326	Price cap
Emera	Canada	94%	42%	912	Cost of service
Snam Rete Gas	Italy	94%	40%	1,272	Four-year price cap
Terna	Italy	89%	31%	778	Four-year price cap
Enagas	Spain	96%	29%	778	Four-year revenue cap
Red Electrica	Spain	93%	34%	1,031	Four-year revenue cap
National Grid	UK	77%	42%	12,700	Five-year revenue cap
Atlanta Gas Light	US	73%	43%	3,643	Cost of service + performance-based adjustments
ITC Holdings	US	100%	45%	623	Cost of service
Kinder Morgan	US	70%	35%	6,724	Cost of service + negotiated agreements
Northwest Natural Gas	US	98%	35%	741	Cost of service
Piedmont Natural Gas	US	100%	34%	1,248	Cost of service + performance-based adjustments
TC Pipelines	US	100%	37%	432	Cost of service + negotiated agreements

Note: [1] Turnover converted from local currency at average exchange rate in 2007. 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, Northwest Natural Gas and Piedmont Natural Gas include regulated supply activities reported by these companies as part of their distribution segment.
Source: Annual reports, Bloomberg, and Oxera analysis.

Table A1.9 Comparator selection criteria, 2010

Company	Country	Share of energy networks (%)	Gearing (%)	Turnover (€m)	Regulatory regime
Emera	Canada	90	46	854	Cost of service regulation
Snam Rete Gas	Italy	98	43	1,902	Four-year price cap
Terna	Italy	95	37	1,336	Four-year price cap
REN	Portugal	99	52	494	Cost of service regulation
Enagas	Spain	97	34	813	Four-year revenue cap
Red Electrica	Spain	93	34	1,155	Four-year revenue cap
National Grid	UK	98	53	18,801	Five-year revenue cap
Atlanta Gas Light	US	71	47	1,913	Cost of service + performance-based adjustments
Kinder Morgan	US	70	39	8,023	Cost of service + negotiated agreements
ITC Holdings	US	100	49	422	Cost of service regulation
Northwest Natural Gas	US	95	36	709	Cost of service regulation
Piedmont Natural Gas	US	75	35	1,401	Cost of service + performance-based adjustments
TC Pipelines	US	100	35	427	Cost of service + negotiated agreements

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, Northwest Natural Gas and Piedmont Natural Gas include regulated supply activities reported by these companies as part of their distribution segment.
Source: Oxera (2010), quantitative paper.

A1.3 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, a breach of any one of these assumptions does not invalidate the estimate of the beta, but does undermine its reliability. While OLS estimates remain unbiased, the procedure no longer produces the least-variance estimator. This means 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 fourth 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 and heteroscedasticity has a minimal impact on the beta estimates in the years tested (Table A1.10). For these reasons, the range estimates for beta presented in section 4 of this report are considered sufficiently robust in statistical terms to serve as a basis for the determination of the WACC.

Table A1.10 Beta estimates tested for autocorrelation and heteroscedasticity

	2009 asset beta		2011 asset beta	
	Daily estimate	Weekly estimate	Daily estimate	Weekly estimate
Full sample	0.43	0.49	0.35	0.45
Amended sample excluding estimates affected by autocorrelation[1]	0.44	0.49	0.32	0.46
Amended sample excluding estimates affected by heteroscedasticity[2]	0.40	0.49	0.36	0.45

Note: [1] Estimates that do not fail at least one of the two autocorrelation tests. [2] Estimates that do not fail at least one of the two heteroscedasticity tests.
Sources: Bloomberg; Datastream; Oxera calculations.

A2 Debt premium

A2.1 Debt premium estimates

Tables A2.1 and A2.6 present the ranges for the debt premium in each period as estimated using the methodology described in section 6 (equivalent to Table 6.5 in the report).

Table A2.1 Spreads on a sample of corporate bonds, 2006

	S&P rating as at end of 2005	Residual maturity (years)	Two-year average spread (bp)
Alliander	A+	14	63
RWE	A+	15	84
RWE	A+	10	35
RWE	A+	7	68
Energias de Portugal	A	12	92
Essent	A	7	53
Transco	A	11	78
Transco	A	12	98
Elia System Operator	A–	13	53
National Grid	A–	13	70
Terasen Gas	A–	10	85
Terasen Gas	A–	11	88
United Utilities	A–	12	82
Western Power	BBB+	15	113
ITC Holdings	BBB–	8	144
Median		**12**	**82**
Mean		**11**	**80**
With maturity <10 years			88
With maturity >10 years			78

Note: Average spreads over the period January 1st 2004 to December 31st 2005. If the data series begins later than January 1st 2004, the average is taken from the earliest data point.
Source: Datastream, and Oxera analysis.

Table A2.2 Spreads on a sample of corporate bonds, 2007

	S&P rating as at end of 2006	Residual maturity (years)	Two-year average spread (bp)
Alliander	A+	13	66
RWE	A+	14	80
RWE	A+	9	34
RWE	A+	6	64
Energias de Portugal	A	11	85
Essent	A	6	46
Transco	A	10	75
Transco	A	11	95
Elia System Operator	A–	12	55
National Grid	A–	12	75
Terasen Gas	A–	9	80
Terasen Gas	A–	10	85
United Utilities	A–	11	75
Kinder Morgan	BBB+	8	108
Western Power	BBB+	14	104
ITC Holdings	BBB–	7	138
Median		**11**	**78**
Mean		**10**	**79**
With maturity <10 years			79
With maturity >10 years			79

Note: Average spreads over the period January 1st 2005 to December 31st 2006. If the data series begins later than January 1st 2005, the average is taken from the earliest data point.
Source: Datastream, and Oxera analysis.

Table A2.3 Spreads on a sample of corporate bonds, 2008

	S&P rating as at end of 2007	Residual maturity (years)	Two-year average spread (bp)
Alliander	A+	12	59
RWE	A+	13	87
RWE	A+	8	41
Scottish & Southern	A+	15	80
Elia system operator	A–	11	61
Energias de Portugal	A–	10	92
Transco	A–	10	102
Transco	A–	9	83
United Utilities	A–	10	81
Transco	BBB+	11	92
Western Power	BBB+	13	103
Kinder Morgan	BBB	7	124
Median		**10**	**85**
Mean		**11**	**84**
With maturity <10 years			85
With maturity >10 years			83

Note: Average spreads over the period January 1st 2006 to December 31st 2007. If the data series begins later than January 1st 2006, the average is taken from the earliest data point.
Source: Datastream, and Oxera analysis.

Table A2.4 Spreads on a sample of corporate bonds, 2009

	S&P rating as at end of 2008	Residual maturity (years)	Two-year average spread (bp)
Alliander	A+	11	80
Scottish & Southern	A	14	129
RWE	A	15	133
RWE	A	12	133
RWE	A	7	69
Elia system operator	A–	10	85
Energias de Portugal	A–	9	142
National Grid	A–	15	133
Transco	A–	8	128
United Utilities	A–	9	131
Median: A range		**11**	**130**
Mean: A range		**11**	**116**
With maturity <10 years			117
With maturity >10 years			115

Note: Average spreads over the period January 1st 2007 to December 31st 2008. If data series begins later than January 1st 2007, average is taken from the earliest data point.
Source: Datastream, Oxera calculations.

Table A2.5 Spreads on a sample of corporate bonds, 2010

	S&P rating as at end of 2009	Residual maturity (years)	Two-year average spread (bp)
Terna	A+	10	122
Alliander	A	10	139
RWE	A	11	168
RWE	A	14	176
RWE	A	6	99
Elia system operator	A–	9	124
Energias de Portugal	A–	8	198
National Grid	A–	14	185
National Grid	A–	10	194
Scottish & Southern	A–	13	165
Severn Trent	A–	8	180
Transco/National Grid	A–	15	183
Transco	A–	7	170
United Utilities	A–	8	178
Median		**10**	**173**
Mean		**10**	**163**
With maturity <10 years			151
With maturity >10 years			179

Note: Average spreads over the period January 1st 2008 to December 31st 2009. If data series begins later than January 1st 2008, average is taken from the earliest data point. Values differ slightly from those in Oxera (2010) quantitative paper as a result of the use of a different cut-off date.
Source: Datastream, and Oxera analysis.

Table A2.6 Spreads on a sample of corporate bonds, 2011 onwards

	S&P rating as at end of 2010	Residual maturity (years)	Two-year average spread (bp)
Terna	A+	9	117
Alliander	A	9	136
RWE	A	10	135
RWE	A	13	144
Elia system operator	A–	8	123
Energias de Portugal	A–	7	213
National Grid	A–	13	159
National Grid	A–	9	154
Scottish & Southern	A–	12	141
Transco	A–	6	150
Transco/National Grid	A–	14	152
Median		**9**	**144**
Mean		**10**	**148**
With maturity <10 years			149
With maturity >10 years			146

Note: Average spreads over the period January 1st 2009 to December 31st 2010. If data series begins later than January 1st 2009, average is taken from the earliest data point.
Source: Datastream, and Oxera analysis.

A2.2 Credit rating history

Table A2.7 S&P issuer rating of comparable network companies—history

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Fingrid Oyj							A+	A+	A+	A+
National Grid	A	A	A	A	A	A	A–	A–	A–	A–
Bord Gáis Eireann		A–	A–	A–	A–	A–	A–	A+	A–	BBB+
REN								A+	A+	A–
Severn Trent	A+	A+	A	A	A	A	A	A–	A–	BBB–
Elia				A–	A–	A–	A–	A–	A–	A–
United Utilities	A–	A–	A–	A–	A–	A–	A–	A–	A–	BBB–
Terna				AA–	AA–	AA–	AA–	AA–	A+	A+
CE Electric			BBB–	BBB–	BBB–	BBB–	BBB–	BBB+	BBB+	BBB+
Wessex Water	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+
Northern Gas Networks					BBB+	BBB+	BBB+	BBB+	BBB+	BBB+
Northumbrian Water		A–	BBB	BBB	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+
Scotia Gas					BBB	BBB	BBB	BBB	BBB	
Western Power			BBB–	BBB–	BBB–	BBB–	BBB–	BBB–	BBB–	BBB–
Alliander	AA–	AA–	A+	A+	A+	A+	A+	A+	A	A
Essent	A+	A+	A+	A+	A+	A+	A+	A+	A	A
Eneco		A+	A+	A+	A	A	A	A	A–	A–
Enagas		A+	A+	AA–	AA–	AA–	AA–	AA–	AA–	AA–
Snam Rete				AA	AA	AA	AA	AA–		
Red Electrica	AA–	AA–	AA–	AA–	AA–	AA–	AA–	AA–	AA–	AA–
Emera	BBB+	BBB+	BBB+	BBB+	BBB+	BBB	BBB	BBB	BBB+	BBB+
Kinder Morgan	A–	BBB+	BBB+	BBB+	BBB+	BBB+	BBB	BBB	BBB	BBB
Atlanta Gas Light	A–	A–	A–	A–	A–	A–	A–	A–	A–	A–
Piedmont Natural Gas	A	A	A	A	A	A	A	A	A	A
Northwest Natural Gas					A+	AA–	AA–	AA–	AA–	A+
ITC Holdings				BBB–	BBB	BBB+	BBB+	BBB	BBB	BBB
Envestra				BBB	BBB	BBB–	BBB–	BBB–	BBB–	BBB–
Canadian Utilities	A+	A+	A+	A	A	A	A	A	A	A
TransCanada Pipelines	A–	A–	A–	A–	A–	A–	A–	A–	A–	A–
Duquesne Light Holdings		BBB	BBB	BBB	BBB	BBB	BBB–	BBB–	BBB–	BBB–
Terasen	BBB+	BBB+	BBB	BBB	BBB	BBB	A	A	A	
Atmos	A–	A–	A–	BBB	BBB	BBB	BBB	BBB+	BBB+	BBB+
Exelon	A–	A–	A–	A–	BBB+	BBB+	BBB+	BBB	BBB	BBB

Note: Years denote each annual estimate, with these being based on market data available up to start of the year. For example, the 2006 estimates are based on data up to and including December 31st 2005.
Source: Bloomberg, S&P and Oxera analysis.

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