The WACC for Dutch Drink Water Companies

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I. INTRODUCTION AND SUMMARY

The Dutch Authority for Consumers and Markets (ACM) has commissioned *The Brattle Group* to calculate the Weighted Average Cost of Capital (WACC) for drinking water distribution companies in the Netherlands. The purpose of the WACC calculation is to estimate an allowed return in the context of future price controls.

The ACM has instructed us to calculate the WACC using a methodology that complies with the relevant decree and ministerial ruling.[1] This report therefore represents an update of our previous advice on the WACC for drinking water distribution, dated 28th June 2013.[2] In preparing our estimate of the WACC, we use data up to and including March 2015, this being the most recent data available at the time we started the work. In broad terms, the methodology we apply estimates the WACC by applying the Capital Asset Pricing Model (CAPM) to calculate the cost of equity. The risk-free rate is calculated based on the two-year and five-year average yield on 10-year Dutch government bonds. This results in a risk-free rate of 1.83%.

The Equity Risk Premium (ERP) is calculated using long-term historical data on the excess return of shares over long-term bonds, using data from European markets. Specifically, the methodology requires that the projected ERP should be based on the average of the arithmetic and geometric realised ERP. The methodology also takes note of other estimates of the ERP, from for example, dividend growth models, on deciding whether any adjustments need to be made to the final ERP.[3] Based on the available data, we conclude that 5.0% represents the best estimate of the ERP.

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[1] The '*Drinkwaterbesluit*' and the '*Drinkregeling*'.

[2] The WACC for Dutch Drink Water Companies', Dan Harris, Renato Pizzolla, The Brattle Group, 28th June 2013. Hereafter referred to as the June 2013 WACC report.

[3] Note that the methodology that we apply in this report to estimate the WACC for water distribution (the 'Water WACC methodology') is similar to the ACM's WACC methodology for electricity and gas distribution/transmission (the 'energy networks WACC methodology') the main differences being that: a) the Water WACC methodology uses only Dutch government bonds for the risk-free rate, while the energy networks WACC methodology uses an average of German and Dutch government bonds. The period over which the yields on these bonds is calculated also differs; and b) the Water WACC methodology estimates the cost of debt using yields from both specific bonds and generic bonds, while the energy networks WACC methodology uses only data from generic bonds.

The Dutch water firms for which we are estimating the WACC are not publicly traded. Therefore we have selected a 'peer group' of publicly traded water distribution firms, as well as regulated energy network firms that have similar systematic risk to a regulated water distribution firm. We use the peer groups to estimate the beta for water distribution. The methodology specifies that the equity betas are estimated using daily betas taken over three years and tested for liquidity and statistical robustness. We estimate that the asset beta for water distribution in the Netherlands is 0.39, which yields an equity beta of 0.65.

We have examined the gearing and credit ratings of network industries in the peer groups and for Dutch network firms. We conclude that a 40% gearing level is a reasonable target for a Dutch water distribution firm and is consistent with an S&P 'A' credit rating.[4]

The methodology specifies that the allowed cost of debt should be based on the average cost of debt for A-rated bonds, and the cost of debt for a group of bonds issued by firms engaged in similar activities to drinking water distribution that have a rating at or close to 'A' – so-called comparable bonds. We understand that 'similar activities' in this context means not only firms undertaking drinking water distribution but also firms engaged in activities such as the transport and/or distribution of gas and electricity. We identified a group of bonds that fit these criteria. This methodology results in a pre-tax cost of debt of 2.80%. The cost of debt includes 15 basis points for the cost of issuing debt.

Applying the methodology results in an after-tax cost of equity of 5.09% and a nominal pre-tax WACC of 4.17%. Because the Dutch drinking water firms do not corporation pay tax we apply an effective tax rate of 0%. Table 1 summarises the WACC for Dutch water distribution and of the inputs which led to the WACC.

[4] Leverage and gearing are usually used interchangeably. Both refer to the percentage of the firm value that is financed by debt, or the market value of debt divided by the sum of the market value of debt and the market value of equity.

Table 1: Summary of WACC Calculation

Gearing (D/A)	[1]	40.00%	Section III
Gearing (D/E)	[2]	66.67%	[1]/(1-[1])
Tax rate	[3]	0.00%	Effective tax rate
Risk free rate	[4]	1.83%	Section IV
Asset beta	[5]	0.39	Table 13
Equity beta	[6]	0.65	[5]x(1+(1-[3])x[2])
ERP	[7]	5.00%	Section VI.E
After-tax cost of equity	[8]	5.09%	[4]+[6]x[7]
Debt premium	[9]	0.82%	Section V
Non-interest fees	[10]	0.15%	
Pre-tax cost of debt	[11]	2.80%	[4]+[9]+[10]
Nominal after-tax WACC	[12]	4.17%	(1-[1])x[8]+[1]x(1-[3])x[11]
Nominal pre-tax WACC	[13]	4.17%	[13]/(1-[3])

II. SELECTION OF PEERS

The Dutch water distribution firms for which we are estimating the WACC are not publicly traded. Therefore we need to find publicly traded firms which derive the majority of their profits from water distribution. We call these firms 'comparables' or 'peers'. We use the peer groups for two key steps in the WACC calculation:

1. Estimating the beta;
2. Estimating the appropriate level of debt or gearing.

We first identify a group of potential peers. We then apply test to see if the firms' shares are sufficiently liquid before deciding on the final peer group.

In determining the number of peers that should be in each peer group, there is a trade-off. On the one hand, adding more peers to the group reduces the statistical error in the estimate of the beta. On the other hand, as more peers are added, there is a risk that they may have a different systematic risk than the regulated firm, which makes the beta estimate worse. In statistical terms, once we have 6-7 peers in the group the reduction in the error from adding another firm is relatively small. However, the ACM has expressed a preference for at least 10 peers to be included for the calculation of beta.

To reach the required number of peers we first attempt to include companies involved in similar business lines in the EU. If this is not sufficient we use peers from for the US. We have identified ten listed European water companies which may meet the criteria on sufficient revenue and liquidity and are therefore potential peers.[5] However, in anticipation that not all of the potential peers will meet the criteria to be an actual peer, we include two water companies from the US. For the same reason, we also include seven major European network companies as potential peers. Table 2 summarises the potential peers.

Table 2: Firms Selected as Potential Peers

Potential peers		Country
European and US Water Companies		
	Severn Trent PLC	United Kingdom
	Pennon Group PLC	United Kingdom
	Northumbrian Water Group PLC	United Kingdom
	United Utilities Group PLC	United Kingdom
	California Water Service Group	United States
	Aqua America	United States
	Athens Water Supply & Sewage	Greece
	Tallinna Vesi	Estonia
	Thessaloniki Water and Sewage Company SA	Greece
	Dee Valley Group PLC	United Kingdom
	Eaux de Royan SA	France
	Societe des Eaux de Douai SA	France
European Network Companies		
	Snam	Italy
	Terna Rete Elettrica Nazionale	Italy
	REN - Redes Energeticas Nacionais	Portugal
	Red Electrica	Spain
	Enagas	Spain
	National Grid	United Kingdom
	Elia System Operator	Belgium

II.A. Liquidity and Revenue Tests

One of the things that we use the peer group for is estimating the beta for each activity. Illiquid stocks will tend to underestimate a beta,[6] and so we apply two initial 'screens' or

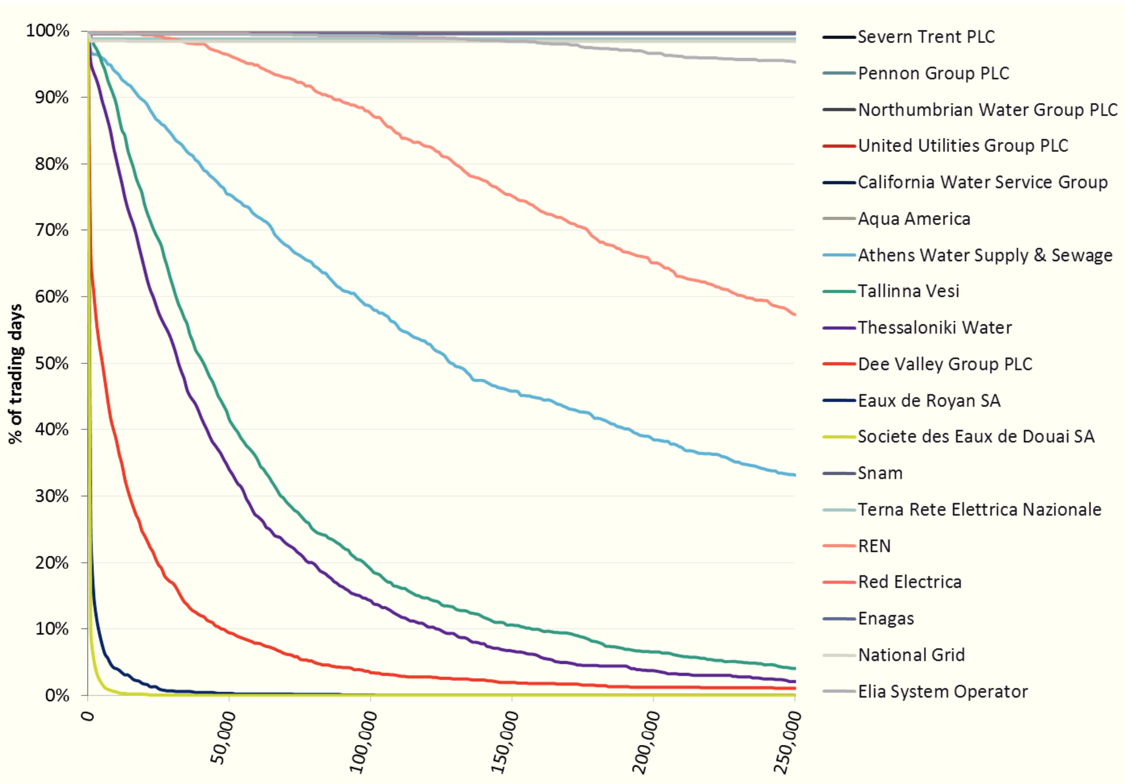
[5] Note that Northumbrian Water Group, which we used as a peer in our June 2013 report, only has share price data up to 14 October 2011. We discuss the implications of this in section VI.B.

[6] For example, suppose that the true beta of a firm was 1.0, so that every day the firm's true value moved exactly in line with the market. But the firm's shares only change price when they are traded. Suppose that the firm's shares are traded only every other day. In this case, the firm's actual share price will only react to news the day after the market reacts. This will give the impression that the firm's value is not well correlated with the market, and the beta will appear to be less than one. Using weekly returns to calculate beta mitigates this problem, since it is more likely that the firm's shares will be traded in the week. However, using weekly returns have other disadvantages, such as providing 80% less data points over any given period.

criteria to test whether a firm can be included in our sample for beta. We first test each firm to see how frequently its shares are traded, the idea being that more frequent trading will give a more reliable beta estimate. Second, we checked peer companies have annual revenues of at least €100 million for the last three years. This is a criterion which we applied in previous reports for the ACM, the idea being that companies with low revenue may also be relatively illiquid.

Figure 1 shows, for the potential beta peers, the percentage of days in which the amount of trading exceeded a given threshold from 1 April 2010 to 31 March 2015. [7] We have explored thresholds between €0 and €250,000 of shares traded per day. Clearly, when the threshold is zero, all the firms pass the threshold. Six water firms and six network firms exceed the €250,000 threshold for nearly 100% of the trading days. The Portuguese network firm – REN exceeds the €250,000 threshold by more than 55% and exceeds the €50,000 threshold by 95%. The Greek water firm – Athens Water Supply & Sewage exceeds the €250,000 threshold by 33% and exceeds the €50,000 threshold by more than 75%. The rest of the five water companies – Tallinna Vesi, Thessaloniki Water, Dee Valley, Eaux de Rayan and Eaux de Duai exceed the €250,000 threshold by less than 10% and exceeds the €50,000 threshold by less than 50%.

Figure 1: Trading Frequency



Source: Bloomberg data and Brattle calculations.

[7] No trading data for Northumbrian Water Group PLC after 14 October 2011.

We defined a share as being sufficiently frequently traded for the purposes of estimating beta using daily returns if it trades on more than 90% of days in which the market index trades. Dee Valley, Eaux de Royan and Eaux de Douai failed this test.

Table 3: Liquidity Test

	Country	Liquidity test Volume as % of share outstanding [A]	% of days company traded [B]	Average value traded (€) [C]
European and US Water Companies				
Severn Trent PLC	UK	1.62%	100.00%	15,547,344
Pennon Group PLC	UK	1.26%	100.00%	7,953,771
Northumbrian Water Group PLC	UK	1.71%	100.00%	8,006,332
United Utilities Group PLC	UK	1.74%	100.08%	19,977,836
California Water Service Group	US	2.43%	100.00%	3,313,536
Aqua America	US	2.17%	100.00%	12,144,342
Athens Water Supply & Sewage	GR	0.26%	97.04%	399,016
Tallinna Vesi	EE	0.20%	99.68%	74,023
Thessaloniki Water and Sewage Company SA	GR	0.16%	96.57%	55,172
Dee Valley Group PLC	UK	0.18%	72.59%	31,459
Eaux de Royan SA	FR	0.04%	36.37%	4,579
Societe des Eaux de Douai SA	FR	0.04%	16.04%	2,388
European Network Companies				
Snam	IT	1.44%	98.83%	38,436,976
Terna Rete Elettrica Nazionale	IT	2.24%	98.83%	29,729,071
REN - Redes Energeticas Nacionais	PT	0.31%	99.77%	822,807
Red Electrica	ES	3.94%	99.61%	47,388,257
Enagas	ES	4.48%	99.61%	39,274,444
National Grid	UK	1.09%	98.52%	65,687,822
Elia System Operator	BE	0.29%	99.69%	1,144,403

Notes and sources:
[A] to [C]:
Based on data from Bloomberg.
Average data from 01/04/2010 to 31/03/2015.
Northumbrian Water Group PLC was acquired in 2011 so no data after 14 October 2011.

Dee Valley, Eaux de Royan, Eaux de Douai, Tallinna Vesi and Thessaloniki Water all had revenues less than €100 million. We exclude these five companies from the peers. After applying our two screens, we have five European water companies, two US water companies[8] and seven European network companies for the beta estimation (see Table 5). All these firms meet the trading frequency test and the minimum revenue threshold.

[8] Note that in our June 2013 report, we used SJW Corp as one of the US water firms. In this report we instead use Aqua America. This is because SJW Corp is only active in California, whereas Aqua America is active across the US. Using two water firms that have their activities concentrated in California may bias the results, and hence we have introduced Aqua America instead of SJW Corp.

Table 4: Annual Revenues

		Annual revenue				
		2014	2013	2012	2011	2010
European and US Water Companies						
Severn Trent PLC	GBP million	1,857	1,832	1,771	1,711	1,704
Pennon Group PLC	GBP million	1,321	1,201	1,233	1,159	1,069
Northumbrian Water Group PLC	GBP million		827	790	738	705
United Utilities Group PLC	GBP million	1,705	1,636	1,565	1,513	1,573
California Water Service Group	USD million	597	584	560	502	460
Aqua America	USD million	780	762	751	687	660
Athens Water Supply & Sewage	EUR million	326	336	353	359	379
Tallinna Vesi	EUR million	53	53	53	51	50
Thessaloniki Water and Sewage Company SA	EUR million	72	74	75	71	77
Dee Valley Group PLC	GBP million	24	23	22	21	21
Eaux de Royan SA	EUR million	35	36	36	36	36
Societe des Eaux de Douai SA	EUR million	13	15	18	17	16
European Network Companies						
Snam	EUR million	3,881	3,848	3,946	3,605	3,508
Terna Rete Elettrica Nazionale	EUR million	1,996	1,845	1,733	1,631	1,586
REN - Redes Energeticas Nacionais	EUR million	756	789	811	917	977
Red Electrica	EUR million	1,847	1,758	1,769	1,647	1,413
Enagas	EUR million	1,206	1,233	1,180	1,118	982
National Grid	GBP million	14,809	14,359	13,832	14,343	14007
Elia System Operator	EUR million	786	788	1,228	1,211	1,038

Notes and sources:
Financial Times website.
Annual revenues for Northumbrian Water Group come from Bloomberg.

Table 5: Peers Considered in the Beta Estimation

Final peers	Country
European Water Companies	
Severn Trent PLC	United Kingdom
Pennon Group PLC	United Kingdom
Northumbrian Water Group PLC	United Kingdom
United Utilities Group PLC	United Kingdom
Athens Water Supply & Sewage	Greece
US Water Companies	
California Water Service Group	United States
Aqua America	United States
European Network Companies	
Snam	Italy
Terna Rete Elettrica Nazionale	Italy
REN - Redes Energeticas Nacionais	Portugal
Red Electrica	Spain
Enagas	Spain
National Grid	United Kingdom
Elia System Operator	Belgium

III. GEARING AND CREDIT RATING

The relevant decree state that the financing structure used for calculating the WACC should be that which is considered reasonable for drinking water companies given the situation on the financial markets. The explanatory notes to the decree also state that this value may deviate from the actual equity capital of the Dutch drinking water companies. Given that the cost of debt will be based on a firm with an A rating, we interpret this to mean that the assumed gearing should also be consistent with an A rating. To determine if the observed average gearing is consistent with an A rating we have investigated the relationship between gearing and credit rating for a number of network firms.

We use the gearing ratio as calculated for Q1 2015, which is the latest data available. The most recent gearing data gives the best estimate of the future gearing, because gearing is very sensitive to stock prices, and today's stock price is the best estimate of future stock prices. In contrast, taking a three year average stock price is not a good predictor of future stock prices. Using the Q1 2015 gearing also ensures that the gearing is consistent with the A credit rating, since we have checked this for Q1 2015.

Figure 2 illustrates our findings.[9] The sample demonstrates a weak trend of decreasing gearing ratios with increasing ratings. The average gearing of the A rated firms is 39% (see also Table 6), the average gearing of firms rated BBB is 44% and the gearing of BB rated firms is 64%. While this confirms that gearing is an important factor for credit ratings, another factor driving credit ratings include the sector in which the firm is active and the countries in which it operates. Four out of six BBB rating companies operated in the countries at the centre of the Eurozone sovereign debt crisis and were downgraded from rating A between late 2012 and mid-2013.[10] As of Q4 2012 the average gearing ratio is just over 50% compared to around 40% in the beginning of 2010, as a result of increasing debts. Since 2013 the gearing ratios for these companies have been falling as a result of rising share prices. However, the ratings remained unchanged at BBB. The only BB rated firm, REN (Portugal), was downgraded from rating A- to BBB in March 2011 and further downgraded to rating BB+ in February 2012. The gearing ratio in the same period increases from just below 60% to nearly 70%.[11]

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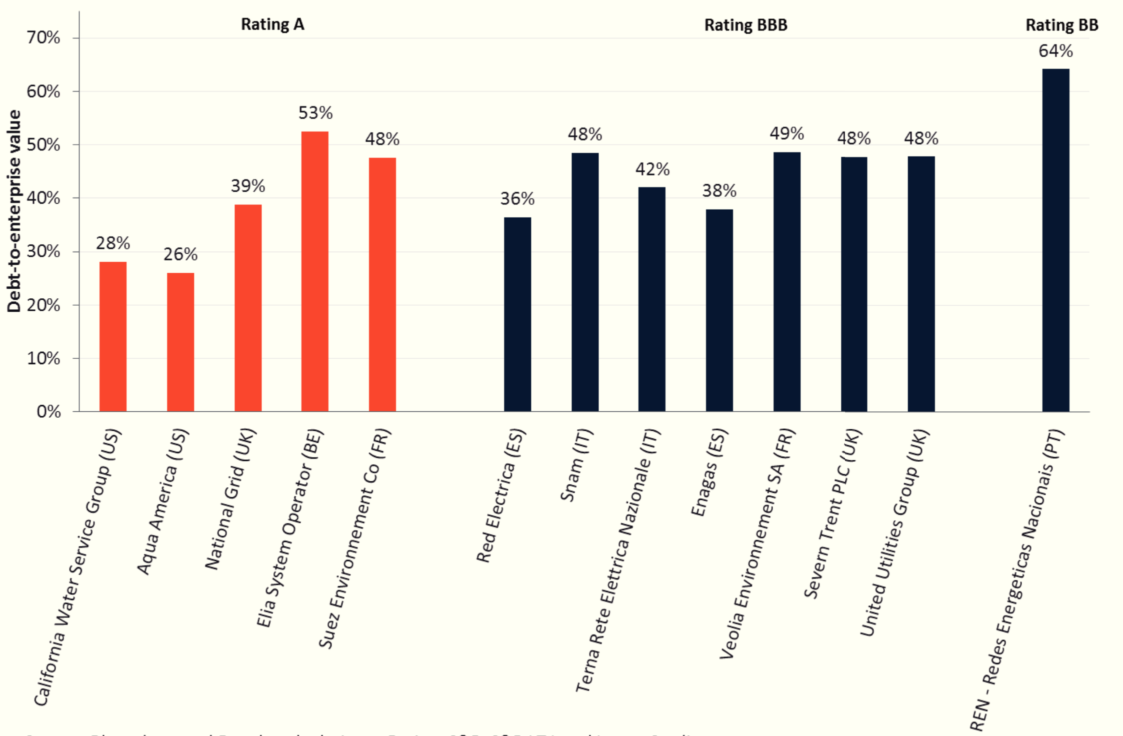
[9] In this exercise we also include two French energy/water companies with worldwide operations, Veolia Environnment and Suez Environnment. About a third of revenues of Veolia and Suez come from water-related business in Europe.

[10] Snam and Terna were downgraded from A- to BBB+ in July 2013. Red Electrica and Enagas were downgraded from A- to BBB in October 2012.

[11] Unlike the other firms, REN's gearing ratio increased as a result of reductions in its share price.

Figure 2: Gearing vs S&P Credit Rating[12]



Source: Bloomberg and Brattle calculations. Rating: S&P, S&P LT Local Issuer Credit.
Aqua America rating comes from Egan-Jones for LC senior unsecured; Suez Environnment Co rating comes from Moody's for senior unsecured debt. Convert both ratings to S&P rating scale.

Table 6: Average Gearing (D/A) of A rated Peers

Company	Country	Rating	Gearing D/A
California Water Service Group	United States	A+	28.10%
Aqua America	United States	A-	25.96%
National Grid	United Kingdom	A-	38.83%
Elia System Operator	Belgium	A-	52.53%
Suez Environnement Co	France	A-	47.58%
Average			38.60%
Maximum			52.53%
Minimum			25.96%

Notes and sources:
Bloomberg.
Rating as of 17 April 2015.
Gearing ratio calculated from Q1 2015 data.

In the past other EU regulators have allowed slightly higher gearing levels – up to around 65% – in their WACC calculations. However since 2008 firms have generally had to hold less debt to maintain an investment grade rating. Targeting an A grade rating – which is the last-but-one credit rating before debt loses its investment-grade status – seems prudent.

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12 Rating as of 17 April 2015 and gearing ratio for Q1 2015.

We also note two other factors relevant to Dutch water distribution. First, Dutch water distribution firms pay no tax. This means that one of the main attractions of debt financing – being that interest is tax deductible –has no relevance for Dutch water firms. As a result, we might expect Dutch water firms to have less debt than a comparable firm that pays tax. Second, and relatedly, we understand that there is a requirement that Dutch water distribution firms are financed by no more than 70% equity, so in other words that they have at least 30% debt.[13] This places a minimum or floor on the gearing for Dutch water distribution firms.

We note that the final WACC results are not sensitive to the choice of gearing, as long as the firms maintain an A credit rating. As gearing increases, the proportion of relatively cheap debt in the WACC formula increases. However, increased debt means more risk for equity holders, which results in a higher equity beta and a higher cost of equity. The cost of debt will also start to increase. These two effects – more relatively cheap debt versus increasing equity and eventually debt costs – largely offset one another.[14] As long as the target level of debt and the credit rating assumed are consistent with one another, and the credit rating is reasonable given that the country in which the firms operate, then the resulting WACC should be reasonable. For example, we estimate that the WACC varies by only 0.1 percentage points (10 basis points) as the gearing increases from 35% to 45%.

Given the observed gearing levels of between 26-53%, the need to maintain an A credit rating and the relative insensitivity of the WACC to the final choice of gearing (as long as it consistent with an A rating), a gearing level of 40% is consistent with an A credit rating for regulated water firms operating in the Netherlands. This level of gearing and the target credit rating are consistent with actual practice of the Dutch network firms for which credit ratings are available. It is also consistent with Moody's requirement for gearing to be between 40% and 55% to qualify for an A-rating.[15]

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[13] This applies at least for the period 2012-2015. See letter from the Ministry of Infrastructure and Environment to the Chair of the Second House of Parliament, subject '*Vermogenskostenvoet drinkwaterbedrijven*', dated 28 October 2013.

[14] The insensitivity of the WACC to the financing choices under certain assumption is known as the Modigliani–Miller theorem.

[15] Gearing is only one criterion that Moody's look at when assigning a rating. Hence a firm that scores an A rating on gearing may obtain a higher or lower rating than A depending on other rating criteria.

We note that in our 2013 report we used a gearing ratio of 50%. However, the in the 2013 report average gearing for A rated firms was actually 46%, which we rounded up to 50%. The average gearing is now 39%, which we round up to 40%.

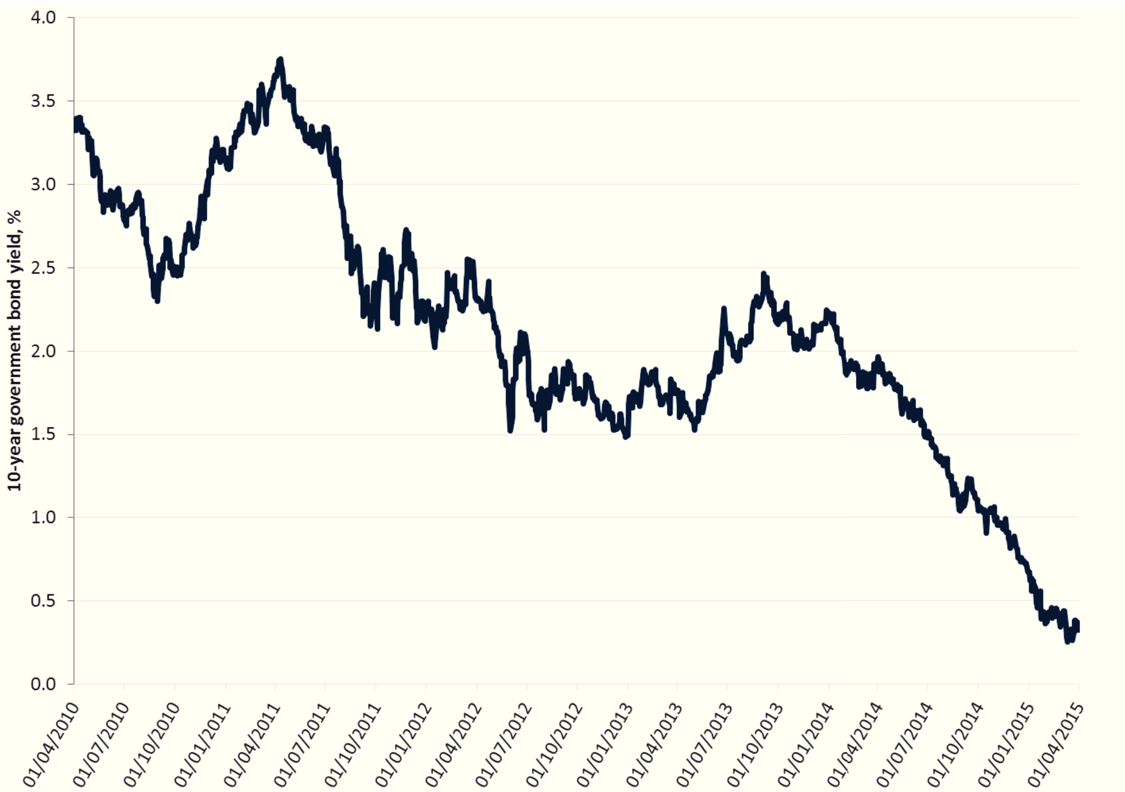
IV. RISK FREE RATE

The methodology specifies that to calculate the risk-free rate, we must calculate the average yield on 10-year Dutch government bonds over the last five years, and the average over the last two years. The risk-free rate is then the average of the two-year and five-year average.

Figure 3 below shows the movement of the yields on 10-year Dutch government bonds over the prior five years. The yields have declined substantially over the five-year period, from near 3.5% to less than 0.5% due to the sovereign crisis in the Eurozone and subsequent easing of monetary policy.

The two-year average yield is 1.54%, and the five-year average is higher at 2.12%. The average of these two numbers gives a risk-free rate of 1.83%.

Figure 3: Yield on Dutch Government 10 Year Bonds



Source: Bloomberg.

V. COST OF DEBT

The method prescribes that we must estimate the cost of debt for water distribution by looking at two different sources of debt yields and spreads:[16]

1. Yields and spreads on A-rated Euro bonds with a maturity of 10 years, where the bonds have been issued by firms active in the industry sector. We refer to these yields and spreads as 'generic industry';[17]

2. Yields and spreads on bond issued by firms that engage in activities which are comparable to that of drinking water companies and which have a rating of A, A+ or A- and a maturity of around 10-years. In our view 'activities' which are comparable to that of drinking water companies' in this context means not only firms engaged in drinking water distribution but also firms engaged in activities such as the transport and/or distribution of gas and electricity. We refer to these as the 'comparable' bonds.

In both cases, we calculate two year average and five year average of the differences between the bond yields and the relevant government bond rates. We describe the results below.

V.A. Spread on the Generic Industry Bonds

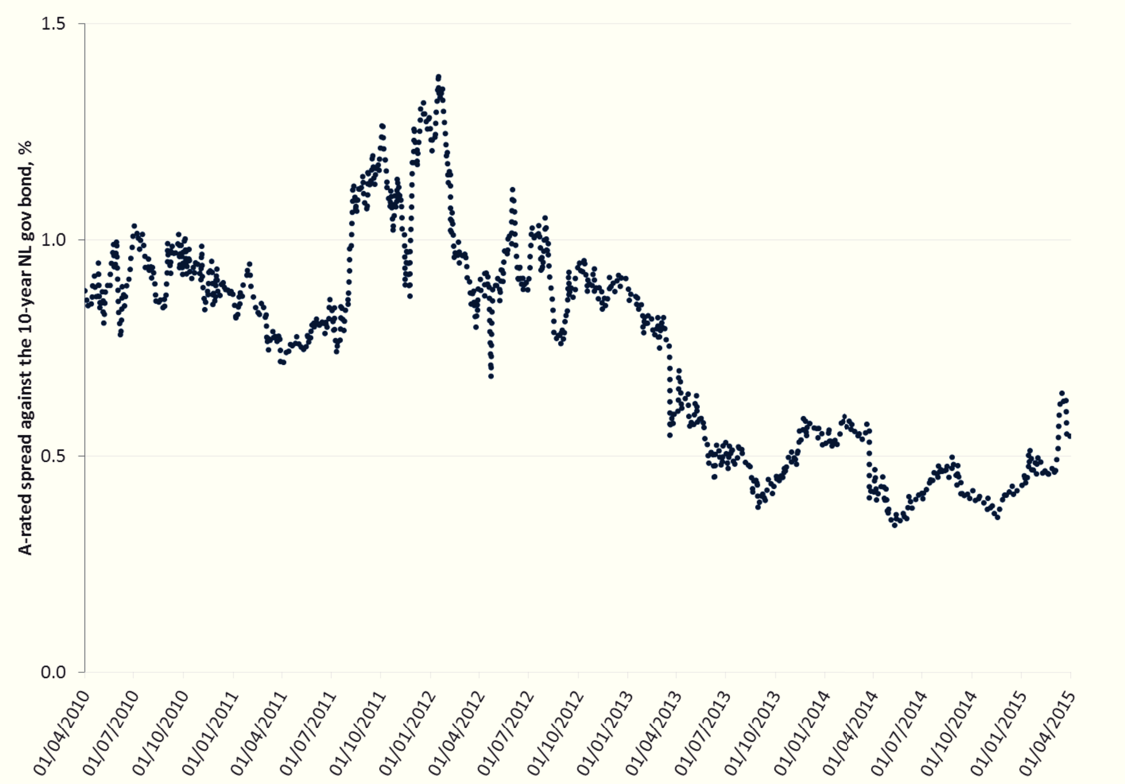
The method requires the calculation of the spread of the cost of 10-year debt over the risk-free rate. We take the risk-free rate to be the contemporaneous yield on a Dutch government 10-year bond. The spread is the difference between the yield on the generic A-rated industrial Euro-denominated debt with 10 years maturity and the contemporaneous yield on a Dutch government 10-year bond.

Figure 4 illustrates how this spread has developed over the last five years. During the Eurozone sovereign debt crisis, the spreads reached over 1%, in particular in reaction to the risk of a Greek default. The spread has since fallen to around 0.5% since 2013. The average spread over the last five years is 0.75% and the average spread over the last two years is 0.48%. The average of these two numbers gives a spread of 0.61%.

[16] By spread we mean the difference between the debt yield and the corresponding risk-free rate.

[17] By 'generic', we mean these are yields for a group of A-rated industrial firms calculated by Bloomberg, where the individual firms used in the sample have not been identified.

Figure 4: Spread of 10-year A-rated European Industrial Debt over 10-year Dutch Government bonds



Source: Bloomberg and Brattle calculations.

V.B. Spread On the Comparable Bonds

We considered two sources of 'comparable' bonds: a generic utility bond and individual bonds issued by firms engaged in similar activities to drinking water distribution.

V.B.1. Generic Utility

We took the difference between the yield on the generic A-rated utility Euro-denominated debt with 10 years maturity and the contemporaneous yield on a Dutch government 10-year bond. The average spread for the generic A-rated EUR utility bonds was 0.89% over the last five years and 0.62% over the last two years. The average of these two numbers gave a spread of 0.75%.

V.B.2. Firms engaged in similar activities to drinking water distribution

We identified a 'long-list' of 1,578 issuers whose bonds are traded and who seemed to be engaged in similar activities to drinking water distribution. This includes water distribution companies, but also network companies more generally. To increase the sample size we considered firms from around the world, and not only Europe, though we limited the currencies to GB Pounds Sterling, US Dollars, Canadian Dollars and Euros. We then screened the long-list to find debt which was rated either A, A+ or A- by Standard & Poors (S&P), and had a maturity of between 9 to 11 years during 1 April 2010 to 1 April 2015. We also eliminated so-called ‘callable bonds’,[18] ‘putable bonds’,[19] ‘convertible bonds’[20] and ‘sinkable bonds’.[21] Applying these criteria reduced the number of possible bonds to 111. From the list of 111, we then checked that the firms were really engaged in activities that could be considered similar to drinking water distribution. Specifically, we checked that most of the firms’ revenues were derived from regulated activities in energy or water. Applying this criterion reduced the number of bond issuers to 30 (9 in water and 21 network companies), and the number of bond issues to 56. Nine of these bond issuers were owned by six water companies: Anglian Water, Dwr Cymru Welsh Water, Southern Water, Thames Water, Yorkshire Water and Affinity Water. Appendix II gives details of the firms considered.

We include yields during the period when bonds still have 9 to 11 year maturity and calculate spreads against yields of relevant government bonds with 10-year maturity. We decide the relevant government bond based on the country where the business predominantly operates. For example, for a bond issued by Elia we use a Belgian government bond of the same outstanding maturity and of the same currency to calculate the spread.[22] Comparing all corporate bonds to Dutch government bonds could give misleading results.

[18] Callable bonds can be redeemed by the issuer prior to maturity and generally attract a higher yield than bonds that mature on a fixed date. Callable bonds cannot be compared on a like-for-like basis with Government bonds that have a fixed maturity, which is why we do not use them in our analysis. Callable bonds generally attract a higher yield because bonds are more valuable if interest rates fall, but in this scenario the callable bond may be re-deemed. Hence the bond holder has an asymmetric pay-off.

[19] Putable bond gives bond holders options to sell back bonds to issuers at one or several specific dates before maturity. When interest rate arises, investors could exercise such option and use the proceeds in higher-yield investments. Bond holders are generally willing to accept a lower yield to have such option.

[20] Convertible bond is a type of bond that can be converted into equity at certain dates during its life. Convertible bond usually attracts a lower yield because investors could convert it into stocks and receive a higher yield when stock price arises.

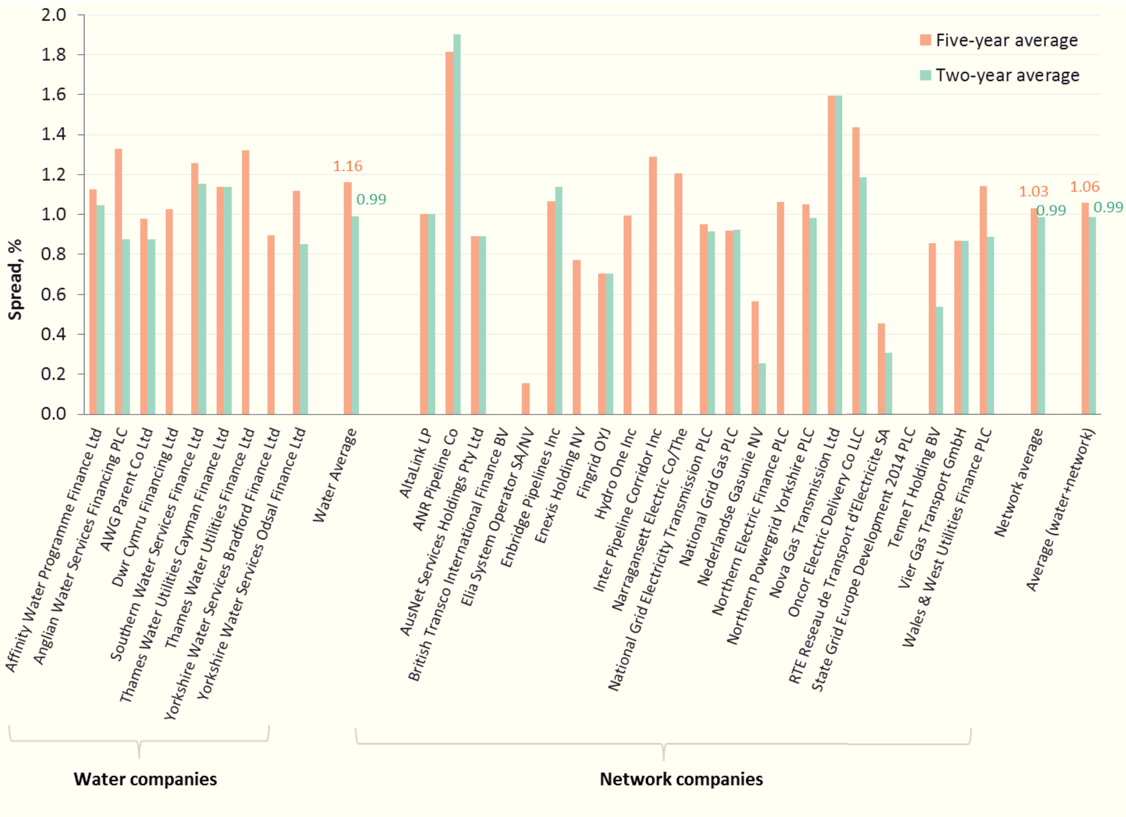
[21] Sinkable bond is a bond issue backed by sinking fund, which sets aside money on a regular basis to ensure the repayments will be made. Sinkable bond has less risk to investors and allows the issuers to offer a lower interest rate to bond holders.

[22] Most of the selected bonds are issued in local currency. There are two exceptions: a USD-denominated bond by Nova Gas Transmission (Canada) and a EUR-denominated bond by AusNet services (Australia). For simplicity we use US government bonds in USD and German government bond in EUR to calculate the spreads. Excluding these two bonds would change the average spread by less than 0.1% percentage points.

This is because the difference between, for example, the yield on Elia's bonds and the yield on Dutch government bonds is partly due to the additional risk that Elia has as a company (corporate risk), and partly due to country risk. If the country risk for Belgium was significantly higher for Belgium relative to the Netherlands, then the spread between Elia's bonds and Dutch government bonds would exaggerate the actual corporate spread, because it would include the additional Belgian country risk which is not relevant for Dutch water companies.

The average spreads for water peers are 1.16% and 0.99% respectively over the last five years and over the last two years. Both figures are slightly higher than the average spreads for network peers, 1.03% and 0.99%. However, the number of water peers is relatively small, and so the finding of a higher debt premium for that group does not statistically significant. Accordingly, we use the average spread from the larger group of all peers. Over the last five years this spread is 1.06% and over the last two years it is 0.99%. The average of these two numbers gives a spread of 1.02%.

Figure 5: Spread of A-rated Peers over Relevant Government Bonds



V.C. Conclusions on Debt Spreads

Table 7 summarises the debt spreads for the Generic Industry bonds, the Generic Utility bonds and the individual bonds of the comparable peers. Table 5 shows that the comparable peers have the highest spreads, followed by the Generic Utility bonds and then the Generic Industrial bonds.

Table 7: The average spreads on the generic industry and comparable bonds

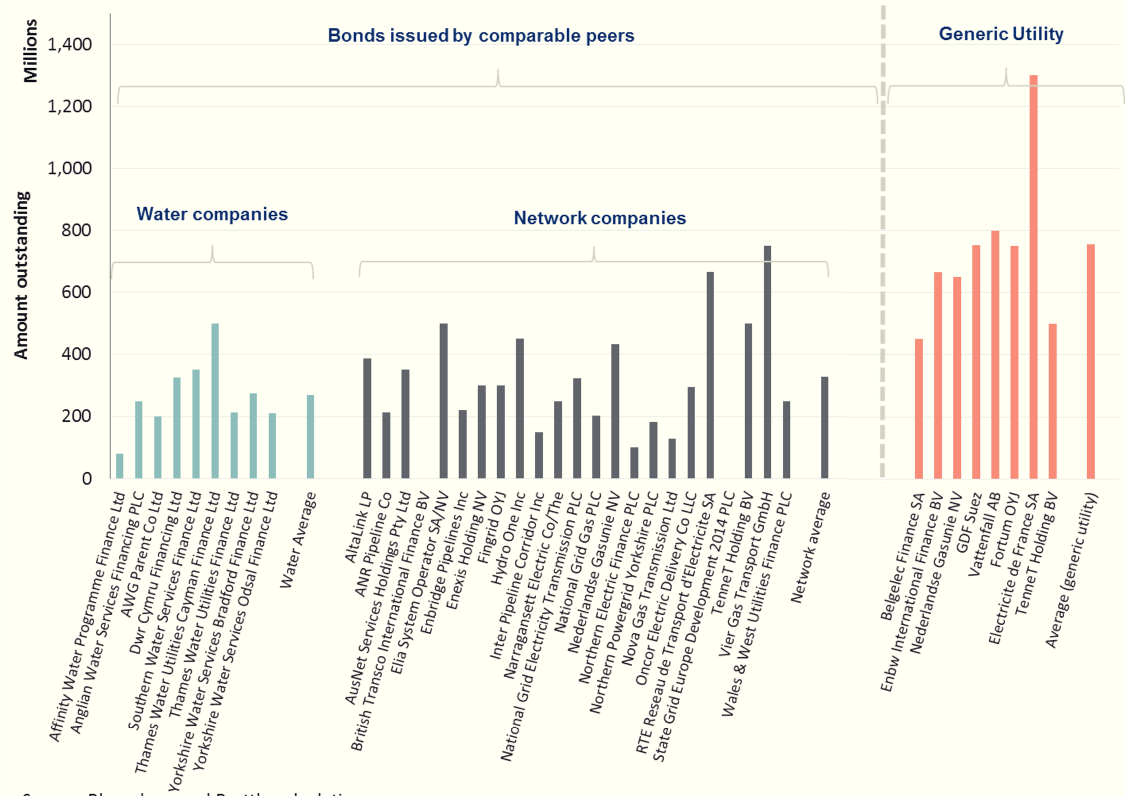
		Spreads		
			Comparables	
		Generic Industry [A]	Generic utility [B]	Individual bonds [C]
Five-year average	[1] See note	0.75%	0.89%	1.06%
Two-year average	[2] See note	0.48%	0.62%	0.99%
Average	[3] ([1]+[2])/2	0.61%	0.75%	1.02%
Average between generic industry and comparables	[4] See note		0.68%	0.82%

Notes and sources:
[1] Average spreads from 01/04/2010 to 31/03/2015.
[2] Average spreads from 01/04/2013 to 31/03/2015.
[4][B]: ([3][A]+[3][B])/2.
[4][C]: ([3][A]+[3][C])/2.
[A]: Difference between Bloomberg BFV Eurozone A-rated industry 10-year and NL sovereign 10-year.
[B]: Difference between Bloomberg BFV Eurozone A-rated utility 10-year and NL sovereign 10-year.
[C]: Difference between bond yields of selected peers and sovereign bond yields.

We suspected that an important part of the difference between the spread on the Generic Utility bonds and the spread on comparable peers was to do with liquidity. Investors will generally demand a higher return for bonds that are less frequently traded and are therefore less liquid. This is known as a liquidity premium. To confirm if the difference was indeed due to a liquidity premium, we asked Bloomberg – the data provider that compiles the Generic Utility bonds data – for the firms which make up the Generic Utility bonds series. As a proxy for liquidity, we looked at the value of the bonds outstanding, the logic being that larger bond issues will tend to be more heavily traded and hence more liquid. Figure 6 shows that the average value of the outstanding bond issues for the comparable peers is less than half of that for the bonds Bloomberg used for calculating generic utility yields.[23] We conclude it is likely that the higher debt spreads for the bonds of comparable peers is because these bonds are less liquid than the bonds that make up the Generic Utility set.

[23] The bonds selected by Bloomberg change day by day. These are bonds used as of 13 April 2015.

Figure 6: Value of outstanding bond issues for various firms



Source: Bloomberg and Brattle calculations

We also understand from the ACM that the Dutch water distribution firms are relatively small, and finance their activities using bank debt rather than by issuing bonds. If the Dutch water firms were to issue bonds, they would be at the lower end of the scale in terms of the size of the issue. The bonds would also be less liquid than average, and we would expect that they would command some sort of liquidity premium. Given this context, we think it would be appropriate to calculate the debt spread for Dutch water distribution using the simple average of the 0.61% spread for the generic industry bonds and the 1.02% spread for the comparable peers. This results in an average spread of 0.82%.

Note that in our 2013 WACC estimate calculated the cost of debt using the spread of generic utilities, rather than the spreads on individual bonds. Specifically, we took the average spread of generic industrial bonds and generic utility bonds. The latter had a spread of 1.12%. In the current report we have replaced the generic utilities by using individual bonds. In 2015, the generic utility bonds had a spread of 0.75%, while the individual bonds have a spread of 1.02%. Therefore, using the spread on individual bonds, rather than the spread on the generic utility bonds, has increased the allowed cost of debt. In more detail, the simple average of the 0.61% spread for the generic industry bonds and the 0.75% spread for the Generic Utility bonds results in an average spread of 0.68%, rather than the spread of 0.82% that we actually use.

VI. COST OF EQUITY

The methodology specifies that the cost of equity will be estimated by applying the Capital Asset Pricing Model. The CAPM expresses the cost of equity for a business activity as the sum of a risk-free rate and a risk premium. The size of the risk premium depends on the systematic risk of the underlying asset, or project, relative to the market as a whole.[24]

Because the Dutch water distribution firms are not listed on a stock exchange we cannot measure the systematic risk directly by measuring the covariance of firm value against the movement of the market as a whole. In the CAPM this covariance is referred to as beta. Accordingly, we estimate the systematic risk for Dutch water distribution using our peer group of firms which are publicly traded and derive the majority of their profits either from water distribution, or from a regulated network activity which appears to face similar systematic risk.

VI.A. MARKET INDICES

The relative risk of each peer, as summarised in its beta parameter, must be measured against an index representing the overall market. We are of the opinion that a hypothetical investor in a Dutch water firm would likely diversify their portfolio within the single currency zone so as to avoid exchange rate risk. Accordingly, to calculate betas we use a broad Eurozone index for the European companies, and a national index for the US companies and a national index for the UK companies.[25] Using indices of the currency zone or country concerned avoids exchange rates movements from depressing betas, and should result in a higher beta estimate than if we estimated betas against an index derived in a different currency.

VI.B. PEER GROUP EQUITY BETAS

The methodology specifies a three year daily sampling period for the beta. We note that of the firms we used in our June 2013 report, Northumbrian water was acquired and delisted from the London Stock Exchange as of 14 October 2011.[26] To investigate if it might still be possible to use the beta for Northumbrian Water Group calculated in the three-year period up to October 2011, we plotted the rolling three-year daily betas for Northumbrian Water Group and other EU water firms. Figure 7 shows that there is an upward trend in the peers'

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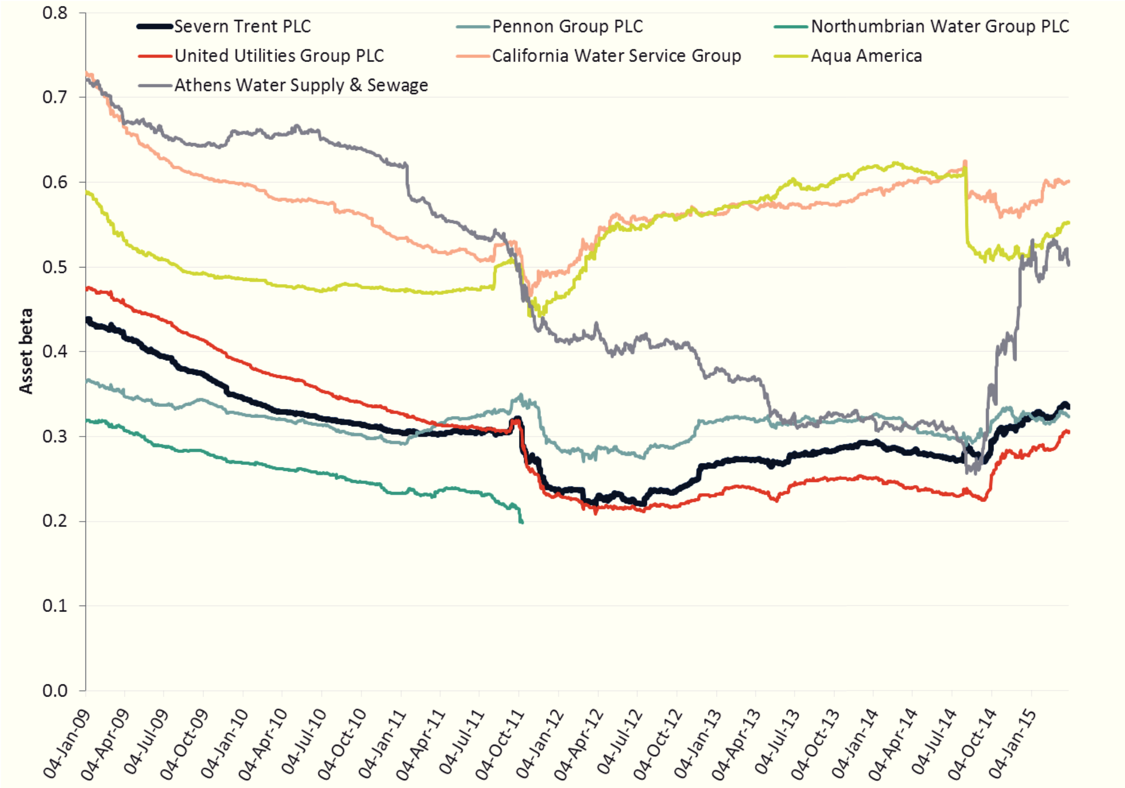
[24] Further information on assumptions and theory underlying the CAPM can be found in most financial textbooks; see Brealey, Myers, Allen, *"Principles of Corporate Finance".*

[25] Respectively Euro Stoxx, S&P 500 and FTSE All-Share index.

[26] Utility Week, 'Northumbrian Water acquisition by CKI takes effect', 14/10/2011.

betas since late 2014. Therefore, it seems likely that if we used the beta for Northumbrian Water Group calculated in the three-year period up to October 2011, it is likely that we will underestimate the true beta as of today. Accordingly, we decided to exclude the Northumbrian Water Group from the beta calculation.

Figure 7: 3-year rolling beta for water peers



Source: Bloomberg and Brattle calculations

We perform a series of standard diagnostic tests to assess if the beta estimates satisfy the standard conditions underlying ordinary least squares regression, which are detailed in Appendix I. Where a sample has either autocorrelation or heteroskedasticity problems, we perform a Prais–Winsten regression and use the resulting beta and standard error.

Table 8: Equity Betas robust to autocorrelation or heteroskedasticity

	Country	Beta	Standard error
European Water Companies			
Severn Trent PLC	United Kingdom	0.60	0.06
Pennon Group PLC	United Kingdom	0.53	0.05
United Utilities Group PLC	United Kingdom	0.59	0.06
Athens Water Supply & Sewage	Greece	0.57	0.14
US Water Companies			
California Water Service Group	United States	0.77	0.06
Aqua America	United States	0.68	0.05
European Network Companies			
Snam	Italy	0.73	0.04
Terna Rete Elettrica Nazionale	Italy	0.72	0.03
REN - Redes Energeticas Nacionais	Portugal	0.37	0.04
Red Electrica	Spain	0.74	0.05
Enagas	Spain	0.63	0.04
National Grid	United Kingdom	0.59	0.04
Elia System Operator	Belgium	0.30	0.03

VI.B.1. Dimson Adjustments

When calculating betas using daily returns, there is a risk that the response of a firm's share price may appear to react to the market index the day before or the day after. This could occur because of differences in market opening times and trading hours, or differences in the liquidity of the firm's shares vs. the average liquidity of the market. If such an effect is present, it could affect the beta estimate which is calculated using only the correlation between the return on the firm's share on day D and the return on the market index on the same day.

The Dimson adjustment deals with this effect. We start by performing a regression of the company returns against the market index returns. We include in the regression the market index returns calculated one day before and one day after the company returns.[27] The Dimson adjusted beta is the sum of the three coefficients calculated by the regression. If the market is perfectly efficient, all information should be dealt with on the same day. If the Dimson adjusted beta estimate is significantly different from the original beta estimate, this suggests that information about the true beta may be lost by considering only the simple regression.

[27] More days of leads and lags can be applied, but in this case we look at only one.

We have performed this test for the firms in our peer groups. The Dimson adjustment is significant for three firms out of the total sample, suggesting that information on systematic risk is contained within the adjacent days. Hence for these three firms we take the adjusted beta. For the remaining firms we take the unadjusted beta. Table 9 shows both the 'raw' unadjusted betas and the Dimson-adjusted betas.

Table 9: Raw and Dimson Adjusted Equity Betas

		Raw' - unadjusted		Dimson adjustments			Dimson adjusted	
		Beta	Standard error	Beta	Standard error	Significant Dimson	Beta	Standard error
European Water Companies								
Severn Trent PLC	United Kingdom	0.60	0.06	0.66	0.10	No	0.60	0.06
Pennon Group PLC	United Kingdom	0.53	0.05	0.56	0.09	No	0.53	0.05
United Utilities Group PLC	United Kingdom	0.59	0.06	0.55	0.10	No	0.59	0.06
Athens Water Supply & Sewage	Greece	0.57	0.14	1.22	0.22	Yes	1.22	0.22
US Water Companies								
California Water Service Group	United States	0.77	0.06	0.55	0.09	Yes	0.55	0.09
Aqua America	United States	0.68	0.05	0.63	0.08	No	0.68	0.05
European Network Companies								
Snam	Italy	0.73	0.04	0.63	0.06	No	0.73	0.04
Terna Rete Elettrica Nazionale	Italy	0.72	0.03	0.67	0.05	No	0.72	0.03
REN - Redes Energeticas Nacionais	Portugal	0.37	0.04	0.41	0.06	No	0.37	0.04
Red Electrica	Spain	0.74	0.05	0.92	0.09	Yes	0.92	0.09
Enagas	Spain	0.63	0.04	0.74	0.07	No	0.63	0.04
National Grid	United Kingdom	0.59	0.04	0.60	0.06	No	0.59	0.04
Elia System Operator	Belgium	0.30	0.03	0.33	0.05	No	0.30	0.03

VI.B.2. Vasicek Correction

The Vasicek adjustment is a statistical adjustment which aims to avoid extreme estimates of beta, which could be statistically unreliable, by 'pulling' beta estimates toward an estimate of beta that is thought to be more reliable – the 'prior expectation' for beta. The methodology applies the Vasicek adjustments to the observed equity betas. In this case, we have used a prior expectation of the beta of 1.0, which is the market average. We considered applying the critique of Lally,[28] which among other things argues for using a prior expectation of the beta which is specific to the activity in question. However, we could find no objective way of determining the prior expectation of beta which was different from the average of our sample. Accordingly, we have adopted the more neutral assumption of the prior expectation of a prior expectation of beta of 1.0.

The Vasicek adjustment moves the observed beta closer to 1 by a weighting based on the standard error of the beta, such that values with lower errors will be given a higher weighting. The prior expectation of the Beta given in other consultant reports is 1, which we

[28] Lally, Martin, *"An Examination of Blume and Vasicek Betas"*. Financial Review, August 1998.

apply here. For the prior expectation of the standard error we use the standard error on the overall market.[29]

Table 10 illustrates the effect of the Vasicek adjustment.

Table 10: Effect of the Vasicek adjustment

		Dimson adjusted		Market average		Weighting		Vasicek
		Beta	Standard error	Beta	Standard error	Company beta	Market beta	Beta
		[A]	[B]	[C]	[D]	[E]	[F]	[G]
European Water Companies								
Severn Trent PLC	United Kingdom	0.60	0.06	1.00	0.36	97.5%	2.5%	0.61
Pennon Group PLC	United Kingdom	0.53	0.05	1.00	0.36	98.4%	1.6%	0.54
United Utilities Group PLC	United Kingdom	0.59	0.06	1.00	0.36	97.4%	2.6%	0.60
Athens Water Supply & Sewage	Greece	1.22	0.22	1.00	0.36	73.5%	26.5%	1.16
US Water Companies								
California Water Service Group	United States	0.55	0.09	1.00	0.39	94.8%	5.2%	0.58
Aqua America	United States	0.68	0.05	1.00	0.39	98.6%	1.4%	0.69
European Network Companies								
Snam	Italy	0.73	0.04	1.00	0.36	98.9%	1.1%	0.73
Terna Rete Elettrica Nazionale	Italy	0.72	0.03	1.00	0.36	99.2%	0.8%	0.73
REN - Redes Energeticas Nacionais	Portugal	0.37	0.04	1.00	0.36	99.0%	1.0%	0.38
Red Electrica	Spain	0.92	0.09	1.00	0.36	94.5%	5.5%	0.92
Enagas	Spain	0.63	0.04	1.00	0.36	98.8%	1.2%	0.63
National Grid	United Kingdom	0.59	0.04	1.00	0.36	98.8%	1.2%	0.60
Elia System Operator	Belgium	0.30	0.03	1.00	0.36	99.3%	0.7%	0.30

Notes and sources:
[A], [B]: Table 9.
[C], [D]: Assumed.
[E]: [D]^2/([D]^2+[B]^2).
[F]: 1-[E].
[G]: [A]x[E]+[C]x[F].

VI.C. Peer Group Asset Betas

The measured equity beta measures the relative risk of each company's equity, which will reflect the financing decisions specific to each company. As debt is added to the company the equity will become riskier as more cash from profits goes towards paying debt in each year before dividends can be distributed to equity. With more debt, increases or decreases in a firm's profit will have a larger effect on the value of equity. Hence if two firms engage in exactly the same activity, but one firm has more debt, that firm will have a higher beta than the firm with less debt.

To measure the relative risk of the underlying asset on a like-for-like basis it is necessary to 'unlever' the betas, imagining that the firm is funded entirely by equity. The resulting beta is

[29] The standard error on the FTSE 100 index is used as a proxy for the European market, and is reported by the LBS. Valueline reports the standard deviation of all stocks in the US market.

As we are using the market average beta for our prior expectation, it is consistent to use the standard deviation of the distribution of the betas underlying the market population as the prior expectation of the standard error.

referred to as an asset beta or an unlevered beta. To accomplish the un-levering, the methodology specifies the use of the Modigliani and Miller formula.[30] Table 11 illustrates both the equity beta and the asset betas for each firm.

Table 11 also shows that the asset beta for Athens Water Supply & Sewerage (Athens Water) is significantly higher than the asset betas for the other three European water firms in the peer group. Figure 7 also shows that the beta for Athens Water has also been very volatile. While Athens Water meets our liquidity test, Table 3 shows that that the volume of shares traded as a percentage of the shares outstanding are an order of magnitude lower than for the other peers that we use. The large effect of the Dimson adjustment on the beta of Athens Water - shown in Table 9 – also indicates that a lot of trading takes place on the days following a move in the market. While the Dimson adjustment tries to compensate the beta estimate for this effect, it cannot do so perfectly. A more heavily traded stock should react to market events on the same day.[31] Our concern is that the high beta for Athens Water is at least partly driven by a lack of liquidity in the shares. The beta may also be affected by events specific to Greece. In particular, we expect that as the risk of a Greek default increases, the beta for Athens Water will also increase. This is because events that affect the value of the Greek market will start to affect the value of all firms in Greece to a similar extent, regardless of the industry that they are in or the fact that the business has regulated returns.[32] We conclude that the beta for Athens Water is highly unlikely to be representative for a Dutch water distribution firm, and should not be included in the final calculation. In practise, because the asset beta for Athens Water is so much above the other asset betas, and because we use the median beta, excluding the Athens Water beta only reduces the median beta of the European water companies from 0.34 to 0.33.

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[30] The specific construction of this equation was suggested by Hamada (1972) and has three underlying assumptions: A constant value of debt; a debt beta of zero; that the tax shield has the same risk as the debt.

[31] However, sometimes differences in market opening and closing times can also lead to significant Dimson adjustments. Hence, a significant Dimson adjustments does not always imply illiquidity.

[32] For further discussion of the link between betas for utilities and the Eurozone crisis, see "A Tale of Two Crises: The Betas of EU Networks", August 2013 Dan Harris and Francesco Lo Passo Published by The Brattle Group, Inc.

Table 11: Equity and Asset Betas

		Equity beta [A]	Gearing (D/E) [B]	Tax rate [C]		Asset beta [D]
European Water Companies						
Severn Trent PLC	United Kingdom	0.61	101.4%	22.4%		0.34
Pennon Group PLC	United Kingdom	0.54	80.0%	22.4%		0.33
United Utilities Group PLC	United Kingdom	0.60	114.4%	22.4%		0.32
Athens Water Supply & Sewage	Greece	1.16	15.8%	24.5%		1.04
				Median	[1]	0.34
				Median excl. Athens Water	[2]	0.33
US Water Companies						
California Water Service Group	United States	0.58	51.6%	40.0%		0.44
Aqua America	United States	0.69	39.4%	40.0%		0.55
				Median	[3]	0.50
European Network Companies						
Snam	Italy	0.73	97.3%	31.4%		0.44
Terna Rete Elettrica Nazionale	Italy	0.73	97.7%	31.4%		0.43
REN - Redes Energeticas Nacionais	Portugal	0.38	204.4%	24.2%		0.15
Red Electrica	Spain	0.92	89.4%	30.0%		0.57
Enagas	Spain	0.63	80.4%	30.0%		0.41
National Grid	United Kingdom	0.60	73.9%	22.4%		0.38
Elia System Operator	Belgium	0.30	128.4%	34.0%		0.16
				Median	[4]	0.41

Notes and sources:
[A]: Table 10.
[B]: Calculated from Bloomberg data. Average values from Q2 2012 to Q1 2015.
[C]: KPMG. Average values from Q2 2012 to Q1 2015.
[D]: [A]/(1+(1-[C])x[B]).

VI.D. Asset Beta for Dutch Water Distribution

Table 11 illustrates the median asset betas for European water companies (0.33), US water companies (0.50) and European network companies (0.41). There are several reasons to believe that the US water companies have structurally higher betas because of differences in regulation and the US water industry more generally. US firms have a price cap, rather than a revenue control. Firms with a price caps tend to have higher betas, because they face volume risk, which itself tends to be correlated to economic activity. In other words, a downturn in economic activity could cause a reduction in transported volumes, which in turn leads to reduced revenues and profits for the network. Hence the price cap increases the correlation between the firm's share price and the market index – giving a higher beta. In the US, water firms change their tariff or rates when either the water company or its customers asks for the tariffs to be changed via a 'rate case'. Since rate cases are expensive and risky – in that tariffs could change in unpredictable ways – they tend to be only brought when a large change in the market has occurred. Accordingly, there is a qualitative case that the revenues for US water firms will tend to be more highly correlated with the market, since it is more likely that for example the water firms' customers will ask for lower rates when there is a decrease in economic activity. This does not occur in Europe, where tariff reviews or price controls take place at regular fixed intervals, which are independent of macroeconomic activity. We also understand that US water firms are engaged in a historically high level of capital expenditure. This will lead to increased 'operating leverage', which will again tend to increases betas, all else being equal. Therefore, we conclude that the betas for US water firms are likely to overestimate the true beta for a Dutch water distribution firm.

European network firms have similar regulation to Dutch water distribution firms, in that they are subject to a regulated revenue control. However, they are not water firms. We expect that water demand may be less sensitive to macroeconomic conditions than demand for electricity or gas. While a regulated firm may have a revenue guarantee, a fall in revenues may only be compensated in a later period, and the present value of the compensation may not be sufficient to offset completely the earlier fall in revenues. Hence, differences in the sensitivity of demand to macroeconomic conditions could affect a regulated firm's beta. To the extent that water demand may be less sensitive to macroeconomic conditions than demand for electricity or gas, the beta for European network firms may be structurally higher than the beta for a Dutch water distribution firm.

We conclude that the asset betas we estimate for both US water companies and European network firms may overestimate the true beta for a Dutch water distribution firm. On the other hand, we prefer to rely on a sample of at least 10 firms in calculating beta. Given this, our proposal is to give more weight to the European water firms, and less weight to the US water firms and the European network firms when estimating the asset beta for Dutch water distribution. Specifically, we give the European water firms a 50% weight, and the US water firms and the European network firms a 25% weight each. Table 12 shows that this results in an asset beta of 0.39. We note that if we had adopted the same methodology as in our June 2013 report, and simply taken the median of the European and US water firm betas, we would have obtained a similar but slightly lower asset beta of 0.34. The asset beta of 0.39 is higher than the median European water firms' asset beta of 0.33, and in our view is more likely to overestimate the true asset beta for Dutch water distribution than to underestimate it.

Table 12: Estimation of the Asset Beta for Dutch Water Distribution

		Median beta	Weights
		[A]	[B]
European Water Companies*	[1]	0.33	50%
US Water Companies	[2]	0.50	25%
European Network Companies	[3]	0.41	25%
Weighted average	[4]	0.39	

Notes and sources:
[1] to [3]:
[A]: Table 11.
[B]: Assumed.
[4][A]: [1][A]x[1][B]+[2][A]x[2][B]+[3][A]x[3][B].

VI.E. Equity Beta for Water Distribution

We re-lever the asset beta derived for each activity in the previous section to the 40% gearing of the regulated asset described in Section III.

Table 13 shows that the resulting equity beta is 0.65. Note that the Dutch water distribution firms are publicly owned and do not pay corporation tax. Accordingly, we assign a zero tax rate when re-levering the beta.

Table 13: Equity beta

Asset Beta	[1]	0.39	Table 12
Gearing (D/A)	[2]	40%	Section III
Gearing (D/E)	[3]	67%	[2]/(1-[2])
Tax Rate	[4]	0%	Effective tax rate
Equity Beta	[5]	0.65	[1]x(1+(1-[4])x[3])

VI.F. The Equity Risk Premium

The methodology specifies a 'European' ERP. That is, it uses an ERP based on the excess return of stocks over bonds for the major economies of Europe, rather than the ERP based on only the excess return of shares in the Netherlands. More specifically, the ACM has determined to use the simple average of the long-term arithmetic and geometric ERP as the anchor for the forward-looking ERP estimate. The ACM will then examine other sources of information on the ERP, in particular evidence of the ERP from Dividend Growth Models, and use these results as a check on the validity of the historical data for the next regulatory period. In line with the ACM's methodology we present evidence on the long-term ERP in Europe using both the arithmetic and geometric realised ERP. We then consider adjustments to the realised ERP based on evidence on the ERP from Dividend Growth Models.

We note that the ERP derived from the historic realised ERP and from Dividend Growth Models are both estimates of the future, expected ERP. That is, they are both forward looking estimates of the ERP. The only difference is that one method takes the past as the best guide to the future, while the other (the Dividend Growth Models) derive the ERP estimate from projections of dividends and earnings.

As we noted in our November 2012 report for the ACM regarding the WACC methodology,[33] we do not consider that all sources of potential evidence on the ERP have equal weight. For example, survey data has often proved an unreliable source for ERP estimates, for various reasons. In our view, as we explained in more detail in our November 2012 report, the data from the historic, realised ERP is a more reliable basis for the ERP estimate that estimates of the ERP derived from Dividend Growth Models.[34] Accordingly, we do not simply take the average of ERP estimates derived from historical data and Dividend Growth Models, because we do not give these sources equal weight. Nevertheless, and consistent with the recommendations in the November 2012 report, we do take account of the evidence on the ERP from Dividend Growth Models.

Table 14 below illustrates the realised ERP derived from one of the most widely used sources for long-run returns, being the data published by Dimson, Marsh and Staunton (DMS) for individual European countries taken from the February 2015 DMS report.[35] This report contains ERP estimates using data up to and including 2014. Table 11 also shows the simple and weighted average ERP for the Eurozone. All the ERPs are calculated relative to long-term bonds and the weighting is based on the current market-capitalisation of each country's stock market. Hence, the ERPs of larger markets are given more weight, the idea being that a typical investor would have a larger share of their portfolio in countries with more investment opportunities.

[33] Calculating the Equity Risk Premium and the Risk-free Rate, The Brattle Group (Dan Harris, Bente Villadsen, Francesco Lo Passo), 26 November 2012.

[34] See discussion in the November 2012 report (*Ibid*) Section 4.7 p.36.

[35] Credit Suisse Global Investment Returns Sourcebook 2015, Table 10.

Table 14: Historic Equity Risk Premium Relative to Bonds: 1900 – 2014

		Risk premiums relative to bonds, 1900 - 2014				
		Geometric mean % [A]	Arithmetic mean % [B]	Average % [C]	Standard Error % [D]	2014 market cap $million [E]
Austria	[1]	2.50	21.50	12.00	14.40	100,169
Belgium	[2]	2.30	4.40	3.35	2.00	374,059
Denmark	[3]	2.00	3.60	2.80	1.70	336,052
Finland	[4]	5.10	8.70	6.90	2.80	198,544
France	[5]	3.00	5.30	4.15	2.10	1,935,091
Germany	[6]	5.00	8.40	6.70	2.70	1,837,847
Ireland	[7]	2.60	4.50	3.55	1.80	140,411
Italy	[8]	3.10	6.50	4.80	2.70	561,295
The Netherlands	[9]	3.20	5.60	4.40	2.10	398,313
Norway	[10]	2.30	5.30	3.80	2.60	241,172
Portugal	[11]	2.60	7.40	5.00	3.10	61,381
Spain	[12]	1.90	3.90	2.90	1.90	724,418
Sweden	[13]	3.00	5.30	4.15	2.00	664,775
Switzerland	[14]	2.10	3.60	2.85	1.60	1,572,441
United Kingdom	[15]	3.70	5.00	4.35	1.60	3,670,080
Europe	[16]	3.10	4.40	3.75	1.50	
World	[17]	3.20	4.50	3.85	1.40	
Average Eurozone	[18]	3.13	7.62	4.78		
Value-weighted average Eurozone	[19]	3.48	6.48	4.98		

Notes and sources:
[A], [B], [D]: Credit Suisse Global Investmentmet Returns Sourcebook 2015, Table 10.
[C]: ([A]+[B])/2.
[18]: Average [1], [2], [4], [5], [6], [7], [8], [9], [11], [12].
[19]: Weighted average [1], [2], [4], [5], [6], [7], [8], [9], [11], [12] by [E].

Table 14 shows that the simple average of the arithmetic and geometric ERP for the period 1900 to 2014 inclusive was 3.8% if all of Europe is included, and 4.8% if only Eurozone countries are included. The very low ERP in Denmark and Switzerland in particular lower the simple average ERP for all of Europe. Using the market size to weight the averages for all of Europe, the ERP for the Eurozone is 4.98%, which we round up to 5.0%. These figures reflect the very long run and notably exclude countries in former Eastern Europe. We use the ERP for the Eurozone, since a Dutch investor is more likely to be diversified over the same currency zone, rather than to incur additional currency risks by diversifying within Europe but outside of the Euro zone.

The methodology asks us to also take into account ERP data derived from Dividend Growth Models. We have obtained and constructed two ERP estimates based on Dividend Growth Models.[36,37] The Bloomberg estimate shows that the ERPs have been increasing for the past four years. The ERP forecast by Bloomberg is currently above the historically realised ERP at a little over 10%. The BOE estimates, on the other hand, have been decreasing. The final estimate available was below the historically realized ERP.

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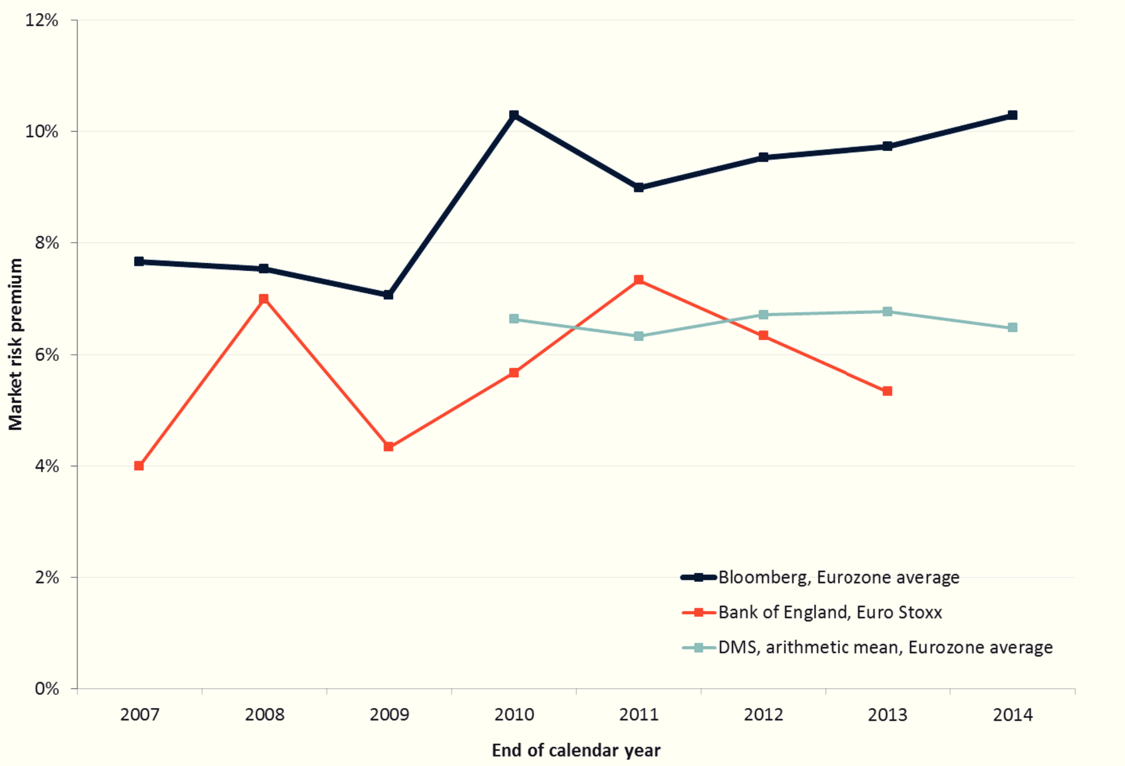
36 Bloomberg provides market premium by country relative to the ten year government bonds. We weight the premium by the market capitalization at the end of each calendar year.

37 Bank of England, "Financial Stability Report," Nomber 2013, Chart 1.6.

Figure 8: Eurozone Equity Risk Premiums by Year



Source: Bloomberg, Bank of England Nov-13 FSR, various DMS reports and Brattle calculations.

Hence, the trend and magnitude of the ERP based on DGM evidence seems to be contradictory. However, given the state of the Eurozone economies, we find it unlikely that the ERP has decreased materially since our June 2013 report. Therefore, it still seems reasonable not to make any of the downward adjustments that DMS recommend applying to the historical average ERP, to convert the historical data into an expected, forward-looking ERP. DMS in essence argue that several factors mean that the historic outturn realised ERP is likely to overestimate the future ERP, because several events occurred to increase the outturn ERP which will not happen again. These events include the favourable resolution of many risks that were present in the last century, which led to unusually high real dividend growth rates, the reduced risk of holding shares due to advances in technology which made diversification easier, real exchange rate gains which would not be expected to be repeated.[38] Correcting for these factors, DMS estimate that the expected arithmetic average ERP over bills would be 4.5-5%, rather than the observed world ERP of 5.7% over bills, a reduction of between 70 and 120 basis points.[39] If we instead take the 'raw' historical ERP estimates over

[38] Note that the adjustments to the 'raw' historic ERP which DMS recommend to account for these factors is distinct and separate from any concern that the use of the arithmetic average historic ERP may overestimate the future ERP, if returns are serially correlated over time.

[39] See Credit Suisse Global Investment Returns Sourcebook 2015 section 2.6 p.33.

long-term bonds, we obtain a Eurozone average ERP of 5.0%. Hence, by taking into account the ERP derived from Dividend Growth Models, we increase our estimate of the ERP by between 70-120 basis points, relative to what would have been the case without a consideration of the ERP derived from Dividend Growth Models.

VII. WEIGHTED AVERAGE COST OF CAPITAL

Based on the preceding calculations and discussions, Table 15 illustrates the overall calculation of the nominal WACC for drinking water distribution in the Netherlands.[40]

Table 15: WACC for drinking water distribution

Gearing (D/A)	[1]	40.00%	Section III
Gearing (D/E)	[2]	66.67%	[1]/(1-[1])
Tax rate	[3]	0.00%	Effective tax rate
Risk free rate	[4]	1.83%	Section IV
Asset beta	[5]	0.39	Table 13
Equity beta	[6]	0.65	[5]x(1+(1-[3])x[2])
ERP	[7]	5.00%	Section VI.E
After-tax cost of equity	[8]	5.09%	[4]+[6]x[7]
Debt premium	[9]	0.82%	Section V
Non-interest fees	[10]	0.15%	
Pre-tax cost of debt	[11]	2.80%	[4]+[9]+[10]
Nominal after-tax WACC	[12]	4.17%	(1-[1])x[8]+[1]x(1-[3])x[11]
Nominal pre-tax WACC	[13]	4.17%	[13]/(1-[3])

[40] The method assumes that since the water companies are publicly held and do not pay taxes, a tax rate of zero should be applied.

APPENDIX I – STATISTICAL RELIABILITY BETA

We detail the standard diagnostic tests to assess if the beta estimates satisfy the standard conditions underlying ordinary least squares regression, which are: that the error terms in the regression follow a normal distribution and that they do not suffer from heteroskedasticity[41] or auto-correlation.[42] Failure to meet these conditions would not invalidate the beta estimates, but would have the following consequences:

1. Although OLS is still an unbiased procedure in the presence of heteroskedasticity and/or autocorrelation, it is no longer the best or least variance estimator.
2. In the presence of heteroskedasticity and/or autocorrelation, the standard error calculated in the normal way may understate the true uncertainty of the beta estimate.
3. Heteroskedasticity and/or auto-correlation may indicate that the underlying regression is mis-specified (i.e. we have left out some explanatory variable).

HETEROSKEDASTICITY

We apply White's test for heteroskedasticity. Table 16 illustrates the results.

Table 16: White's test for Heteroskedasticity

		White Stat	p-value	Heteroskedascity
European Water Companies				
Severn Trent PLC	United Kingdom	0.32	0.85	No
Pennon Group PLC	United Kingdom	0.17	0.92	No
United Utilities Group PLC	United Kingdom	22.29	0.00	Yes
Athens Water Supply & Sewage	Greece	32.17	0.00	Yes
US Water Companies				
California Water Service Group	United States	4.28	0.12	No
Aqua America	United States	0.52	0.77	No
European Network Companies				
Snam	Italy	0.20	0.90	No
Terna Rete Elettrica Nazionale	Italy	1.23	0.54	No
REN - Redes Energeticas Nacionais	Portugal	0.19	0.91	No
Red Electrica	Spain	0.61	0.74	No
Enagas	Spain	0.06	0.97	No
National Grid	United Kingdom	17.83	0.00	Yes
Elia System Operator	Belgium	7.77	0.02	Yes

The results indicate the presence of some heteroskedasticity in the sample. This most likely relates to the significant increase in market volatility around the heart of the crisis at the start of the sample period, and a subsequent decrease, changing the variance of the population over the sampling period.

[41] Heteroskedasticity means that there exists sub-populations in the sample which have different variance from others.

[42] Auto-correlation means that the error terms between periods are correlated.

AUTOCORRELATION

We also apply the Durbin-Watson test for auto-correlation. Unsurprisingly, this test indicates a degree of autocorrelation in most of the regressions, also likely reflecting the development of the credit crisis and the changing extent of market volatility. The effect of this auto-correlation is that standard errors will over-estimate the precision of the regression. The results are presented in Table 17.

Table 17: Durbin–Watson Test for Auto-correlation

		DW Stat	Serial Correlation
European Water Companies			
Severn Trent PLC	United Kingdom	1.64	Yes
Pennon Group PLC	United Kingdom	1.55	Yes
United Utilities Group PLC	United Kingdom	1.66	Yes
Athens Water Supply & Sewage	Greece	1.52	Yes
US Water Companies			
California Water Service Group	United States	1.77	Indecisive
Aqua America	United States	1.63	Yes
European Network Companies			
Snam	Italy	1.76	Indecisive
Terna Rete Elettrica Nazionale	Italy	1.70	Yes
REN - Redes Energeticas Nacionais	Portugal	1.66	Yes
Red Electrica	Spain	1.60	Yes
Enagas	Spain	1.79	No
National Grid	United Kingdom	1.54	Yes
Elia System Operator	Belgium	1.72	Yes

PRAIS-WINSTEN REGRESSIONS

To account for the inclusion of auto-correlation in the sample a standard statistical technique is to apply a regression using the Prais–Winsten estimation tests. We also control for heteroskedasticity. The results are presented in Table 18. The corrections for auto-correlation and heteroskedasticity do not have a significant impact on the results.

Table 18: Prais-Winsten Regressions Results

	Country	Test for: Hetero-skedascity	Test for: Serial correlation	OLS: Beta	OLS: Standard error	GLS (Prais - Winsten): Beta	GLS (Prais - Winsten): Standard error
European Water Companies							
Severn Trent PLC	United Kingdom	No	Yes	0.60	0.05	0.60	0.06
Pennon Group PLC	United Kingdom	No	Yes	0.53	0.05	0.53	0.05
United Utilities Group PLC	United Kingdom	Yes	Yes	0.59	0.05	0.59	0.06
Athens Water Supply & Sewage	Greece	Yes	Yes	0.57	0.10	0.57	0.14
US Water Companies							
California Water Service Group	United States	No	Indecisive	0.79	0.05	0.77	0.06
Aqua America	United States	No	Yes	0.68	0.04	0.68	0.05
European Network Companies							
Snam	Italy	No	Indecisive	0.74	0.04	0.73	0.04
Terna Rete Elettrica Nazionale	Italy	No	Yes	0.73	0.03	0.72	0.03
REN - Redes Energeticas Nacionais	Portugal	No	Yes	0.37	0.03	0.37	0.04
Red Electrica	Spain	No	Yes	0.74	0.04	0.74	0.05
Enagas	Spain	No	No	0.63	0.04		
National Grid	United Kingdom	Yes	Yes	0.59	0.03	0.59	0.04
Elia System Operator	Belgium	Yes	Yes	0.30	0.03	0.30	0.03

APPENDIX II – BONDS ISSUED BY FIRMS ENGAGED IN SIMILAR ACTIVITIES TO DRINKING WATER DISTRIBUTION

Table 19: Bonds issued by firms engaged in similar activities to drinking water distribution

Company	Maturity date	Currency	Bond yield (%)		10-year sovereign (%)		Bond spread (%)		Amount outstanding
			5 yr	2 yr	5 yr	2 yr	5 yr	2 yr	
	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]
ANR Pipeline Co	1-Nov-21	USD	4.25		2.52		1.74		300,000,000
Enbridge Pipelines Inc	6-Apr-20	CAD	4.17		3.17		1.00		350,000,000
Enbridge Pipelines Inc	30-Nov-22	CAD	3.22	3.26	2.23	2.29	0.99	0.97	150,000,000
Enbridge Pipelines Inc	15-Feb-24	CAD	3.55	3.56	2.22	2.24	1.33	1.33	200,000,000
Enbridge Pipelines Inc	17-Nov-23	CAD	3.38	3.43	2.24	2.32	1.14	1.11	100,000,000
Enbridge Pipelines Inc	12-Nov-19	CAD	3.93		3.07		0.85		300,000,000
ANR Pipeline Co	15-Feb-24	USD	4.22	4.25	2.33	2.34	1.89	1.90	125,000,000
Nova Gas Transmission Ltd	1-Apr-23	USD	4.42	4.42	2.93	2.93	1.50	1.50	200,000,000
Nova Gas Transmission Ltd	16-Dec-24	CAD	3.63	3.63	2.09	2.09	1.53	1.53	100,000,000
Nova Gas Transmission Ltd	27-May-25	CAD	3.67	3.67	1.90	1.90	1.76	1.76	87,000,000
Elia System Operator SA/NV	13-May-19	EUR	3.67		3.27		0.41		500,000,000
Inter Pipeline Corridor Inc	3-Feb-20	CAD	4.46		3.17		1.29		150,000,000
Northern Powergrid Yorkshire PLC	1-Apr-25	GBP	2.64	2.64	1.65	1.65	0.98	0.98	150,000,000
State Grid Europe Development 2014 PLC	26-Jan-22	EUR							700,000,000
British Transco International Finance BV	4-Nov-21	USD							1,500,000,000
Vier Gas Transport GmbH	10-Jul-23	EUR	2.54	2.54	1.98	1.98	0.56	0.56	750,000,000
Oncor Electric Delivery Co LLC	1-Sep-22	USD	3.81	3.48	1.96	2.29	1.86	1.19	800,000,000
Hydro One Inc	13-Jan-22	CAD	2.88		1.87		1.01		600,000,000
Nederlandse Gasunie NV	13-Jul-22	EUR	2.19	2.07	1.75	1.81	0.45	0.26	500,000,000
Thames Water Utilities Cayman Finance Ltd	19-Jun-25	GBP	3.32	3.32	2.19	2.19	1.14	1.14	500,000,000
Enexis Holding NV	13-Nov-20	EUR							500,000,000
TenneT Holding BV	21-Feb-23	EUR	2.71	2.56	1.93	2.03	0.78	0.54	500,000,000
AusNet Services Holdings Pty Ltd	24-Jul-20	EUR							500,000,000
National Grid Gas PLC	3-Mar-20	GBP	4.56		3.65		0.91		278,000,000
RTE Reseau de Transport d'Electricite SA	12-Sep-23	EUR	2.35	2.35	1.83	1.83	0.52	0.52	500,000,000
TenneT Holding BV	1-Nov-20	EUR							500,000,000
RTE Reseau de Transport d'Electricite SA	3-Feb-21	EUR	3.80		2.90		0.90		750,000,000
Fingrid OYJ	3-Apr-24	EUR	2.17	2.17	1.54	1.54	0.63	0.63	300,000,000
Vier Gas Transport GmbH	12-Jun-20	EUR							750,000,000
Enexis Holding NV	26-Jan-22	EUR	2.67		1.90		0.77		300,000,000
National Grid Electricity Transmission PLC	2-Feb-24	GBP	3.47	3.47	2.52	2.55	0.95	0.92	323,920,000
RTE Reseau de Transport d'Electricite SA	20-Sep-19	EUR							600,000,000
AusNet Services Holdings Pty Ltd	13-Feb-24	EUR	1.99	1.99	1.29	1.29	0.70	0.70	350,000,000
AltaLink LP	6-Nov-23	CAD	3.35	3.35	2.35	2.35	1.00	1.00	500,000,000
Anglian Water Services Financing PLC	30-Jul-22	GBP	3.47	3.07	2.14	2.19	1.33	0.87	250,000,000
Yorkshire Water Services Bradford Finance Ltd	21-Aug-19	GBP	4.68		3.79		0.89		275,000,000
Northern Powergrid Yorkshire PLC	17-Jan-20	GBP	4.69		3.60		1.09		200,000,000
TenneT Holding BV	9-Feb-22	EUR	3.30		2.38		0.93		500,000,000
AWG Parent Co Ltd	21-Aug-23	GBP	3.44	3.56	2.46	2.69	0.98	0.87	200,000,000
Hydro One Inc	1-Jun-20	CAD	4.18		3.20		0.98		300,000,000
RTE Reseau de Transport d'Electricite SA	28-Jun-22	EUR	3.08	2.27	2.06	1.78	1.02	0.49	750,000,000
Nederlandse Gasunie NV	13-Oct-21	EUR	2.72		2.11		0.61		500,000,000
Southern Water Services Finance Ltd	31-Mar-21	GBP	4.59		3.24		1.36		350,000,000
National Grid Gas PLC	16-Dec-24	GBP	3.34	3.34	2.45	2.45	0.88	0.88	217,395,000
Southern Water Services Finance Ltd	31-Mar-26	GBP	2.82	2.82	1.66	1.66	1.16	1.16	350,000,000
Northern Powergrid Yorkshire PLC	17-Jan-20	GBP	4.67		3.60		1.07		200,000,000
Narragansett Electric Co/The	15-Mar-20	USD	4.35		3.14		1.20		250,000,000
Nederlandse Gasunie NV	20-Jun-21	EUR	3.36		2.73		0.64		300,000,000
Vier Gas Transport GmbH	12-Jun-25	EUR	1.63	1.63	0.91	0.91	0.72	0.72	750,000,000
National Grid Gas PLC	27-Jun-25	GBP	3.13	3.13	2.17	2.17	0.97	0.97	111,106,000
National Grid Electricity Transmission PLC	26-Nov-19	CAD							400,000,000
Yorkshire Water Services Odsal Finance Ltd	21-Feb-23	GBP	3.39	3.48	2.27	2.63	1.12	0.85	210,692,000
Dwr Cymru Financing Ltd	31-Mar-21	GBP	4.26		3.24		1.03		325,000,000
Thames Water Utilities Cayman Finance Ltd	18-Jul-22	EUR							113,000,000
AltaLink LP	28-Nov-22	CAD	3.44	3.44	2.44	2.44	1.00	1.00	275,000,000
Wales & West Utilities Finance PLC	13-Dec-23	GBP	3.48	3.50	2.54	2.62	0.94	0.89	250,000,000
Thames Water Utilities Finance Ltd	30-Jun-20	GBP	5.10		3.66		1.43		200,000,000
Northern Electric Finance PLC	16-Oct-20	GBP	4.58		3.51		1.06		100,000,000
Narragansett Electric Co/The	15-Mar-20	USD	4.35		3.14		1.20		250,000,000
Affinity Water Programme Finance Ltd	30-Sep-22	GBP	3.48	3.48	2.36	2.43	1.13	1.05	80,000,000
Thames Water Utilities Finance Ltd	20-Apr-21	GBP	4.40		3.19		1.21		225,000,000
Oncor Electric Delivery Co LLC	30-Sep-20	USD	3.87		2.58		1.29		126,278,000
Wales & West Utilities Finance PLC	30-Nov-21	GBP	4.01		2.66		1.34		250,000,000
Oncor Electric Delivery Co LLC	30-Sep-20	USD	4.29		2.99		1.30		126,278,000
AltaLink LP	17-Sep-20	CAD							125,000,000
Oncor Electric Delivery Co LLC	30-Sep-20	USD	4.29		3.00		1.30		126,278,000

Notes and sources:
Mid yields to maturity reported by Bloomberg. Government bond yields from Bank of Canada, Bank of England, Federal Reserve and De Nederlandsche Bank.
[C]: Average yields from 01/04/2010 until 31/3/2015 (included) if the yields are in the date range of 9 to 11 years from the maturity date.
For example, if a bond matures on the 18/07/2022, only yields reported between 18/07/2011 and 18/07/2013 are considered in the average.
[D]: Average yields from 01/04/2013 until 31/3/2015 (included) if the yields are in the date range of 9 to 11 years from the maturity date.
[E], [F]: Average 10 year government bond yields in the same period as that of the bond yields included. Government bond yields are assigned based on the currency.
[G]: [C]-[E]. [H]: [D]-[F].