The Brattle Group

Calculating the Equity Risk Premium and the Risk-free Rate

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1 INTRODUCTION

At present, the NMa is responsible for establishing the Weighted Average Cost of Capital (WACC) for the Transmission System Operators (TSOs) and Distribution System Operators (DSOs) in the Netherlands. The NMa also determines the WACC for the Dutch Pilotage Organisation, and advises the Ministry of Infrastructure and the Environment on the WACC for drinking water.

As of the 1st of January 2013, the NMa will merge with the Independent Post and Telecommunications Authority of the Netherlands (OPTA) and the Consumer Authority (CA) to form the new Authority Consumers & Markets (ACM). OPTA is the mandated authority for setting, among others, the WACC for the Dutch incumbent telecoms company, KPN. As a consequence of the formation of this new combined body, OPTA and NMa have set out to harmonise, where feasible and necessary, their methods used for determining the WACC.

The NMa and OPTA have already harmonized many of the elements of the WACC calculation. The two remaining elements to be harmonized are the risk-free rate and the equity risk premium (ERP). Accordingly, the NMa has commissioned *The Brattle Group* to investigate the strengths and weaknesses of the NMa's and OPTA's current methods for calculating the risk free rate and the ERP, and to explain if there are any economic reasons to use different methods.[1] In a second, later report we will use the ACM's final WACC methodology to estimate the WACC.

[1] Note that an evaluation of the merits of using the geometric mean ERP vs. the arithmetic mean ERP is outside of the scope of work. The reference period for the risk-free rate, that is the historical period over which the average risk-free rate should be calculated, was also not part of the research.

2 CHOICE OF MARKET

We begin with a discussion of the geographic choice of market. That is, when considering the risk-free rate and the ERP, should one look only at the Netherlands, or at a wider market? We put this section first in the report because the considerations apply both the risk-free rate and the ERP.

One might consider only Dutch government bonds and a Dutch ERP if one believed that investors in Dutch regulated firms only invested in the Netherlands, and/or there were barriers to Dutch investors putting their money in the assets of other countries. In fact, capital markets have become are increasingly global in nature.

With respect to the ERP, even if some unique feature of the Dutch market explained its historical returns in the past, it is no longer realistic to view the Dutch market in isolation looking forward. The Dutch economy has long been a member of the Euro-zone and is increasingly international. There are free capital flows into and out of the Netherlands. Finance experts agree that the global nature of capital markets would counsel against examining only one country's historical returns in isolation.

> "The use of historical averages as estimates of current required returns implies that France has a very high equity risk premium, while Denmark's risk premium is very low (see Table 25 in the previous chapter). While there may, of course, be differences in risk between markets, this is unlikely to account for cross-sectional differences in historical premia. Indeed, much of the cross-country variation in historical equity risk premia is attributable to country-specific historical events that will not recur. *When making future projections, there is therefore a strong case, particularly given the increasingly global nature of capital markets, for taking a global, rather than a country-by-country, approach to determining the cost of capital*."[2]

The NERA report also, in our view correctly, points out that the choice of reference market should reflect the opportunities available to investors in regulated Dutch firms. While the arguments above indicate that the set of opportunities is wider than the Netherlands alone, the NERA report makes the point that the average investor in a Dutch regulated company does not have a globally diversified portfolio, and there is a significant bias in investments to the Netherlands and Europe. This is because of factors such as political risk and information asymmetry, which inhibit full market integration. For example, one might be reluctant to invest in a country where one does not speak the language and hence it is difficult to understand what is really going on. Figure 2.1 of the NERA report shows compelling evidence of the bias toward European stocks for Dutch investors.

Given the ability to diversify across Europe, and possibly beyond, it makes sense to estimate the ERP and the risk-free rate from a European perspective. Historical stock returns in the Netherlands have shown considerable variance, demonstrating that random factors are largely involved in determining stock returns in any one year. The historical arithmetic mean for the Netherlands alone is therefore unlikely to measure the expected *future* equity risk premium with any degree of accuracy. The variance looking at a much broader range of markets is much less, because random events in different countries tend to cancel one another out. For example, the arithmetic average ERP for the Netherlands is 5.6%, with a standard error of 2.1%, so that the 95% confidence interval is relatively

[2] Dimson, E., P. Marsh and M. Staunton, 2002, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, New Jersey., p. 143, emphasis added.

wide at ±4.1%. In contrast, the ERP based on all European stocks included in the Dimson, Marsh and Staunton (DMS) study[3] of the ERP is 5.0%, with a lower standard deviation of 1.5% for a narrower 95% confidence interval of ±3.1%. Using a broader data set, which is justified in theory, results in a more accurate estimate of the ERP. Similarly, it is not credible that investors in the Netherlands would be unable to buy for example German government bonds, and so adopting a Europe-wide perspective for the risk-free rate also makes sense.[4]

For the reasons given above, it makes sense to estimate the cost of capital based on a European data set. In particular, this means:

- Considering a European risk-free rate,
- Estimating the expected ERP for an investor in a portfolio of European stocks;
- Estimating the beta of regulated firm *i* by looking at the co-variance of the share price of firm *i* and a European stock index.

3 THE RISK-FREE RATE

In this section we address the following main methodological questions for determining the risk-free rate (RFR):

1. *Which maturity or maturities of bonds should the ACM use for calculating the risk-free rate and why? For example, should the ACM use a bond duration that matches the regulatory period, or a 10-year bond?*
2. *Which origin of bonds should the ACM use to determine the risk-free rate? For example, should the ACM use Dutch government bonds, German government bonds, or some other bond or group of bonds?*
3. *Should the ACM use some average of past yields, current yields or a forecast of future yields?*

Clearly in the current financial environment the estimation of the risk-free rate poses a number of challenges. Before the financial crisis, regulators in the Euro zone routinely used their government's bonds as the risk-free rate. Now, many of these bonds are clearly not risk-free – some euro-zone bonds command a yield higher than the return on most stocks.

On the one hand, using a government bond in the WACC that is not risk-free risks over-estimates the cost of capital. The ERP (discussed later) has been measured against bonds that were largely risk-free. Adding a non-risk-free rate to the ERP measured in this way could exaggerate the cost of equity. On the other hand, the WACC needs to recognise that current financial conditions have raised the risk for equity. Combining a truly risk-free rate with the historical ERP may not provide a sufficient return. This is the dilemma facing many regulators today.

[3] E. Dimson, P. Marsh, and M. Staunton, *Credit Suisse Global Investment Returns Sourcebook 2012* (DMS), Table 10.

[4] According to a recent study, Dutch pension funds have reduced their home bias but a non-trivial home bias remains present. Specifically, the study estimates the home bias has been reduced from approximately 37% in 1992 to 13% in 2006. See, G. Rubbaniy, IPP van Lelyveld, and WFC Verschoor, "Home Bias and Dutch Pension Funds' Investment Behavior,"Erasmus School of Economics, July 2010.

We begin with a summary of the NMa and OPTA's current methods, before going on to address the questions above.

3.1 Overview of the NMa's and OPTA's Current Methods

NMa method

The NMa calculates a risk-free rate using the nominal yield on Dutch Government 10-year bonds. The NMa's reason to use 10-year bonds is that the yields on shorter-term bonds are too volatile, and that yields on longer-term bonds less volatile. The NMa also believes that trading in 10-year bonds is more liquid, and that the use of 10-year bonds is a common benchmark in the financial world. NMa uses Dutch Government bonds, rather than the bonds of, for example, Germany, because it believes that Dutch bonds are the best fit to the capital market conditions of the regulated Dutch companies. More specifically, the NMa calculates the average yield over the last two to five years. According to the NMa using the average over this period gives the right balance between stability and representativeness. Another argument for using the average of the past five years is that it replicates the gradual refinancing of the company over time.

More detailed reasoning on some of these issues is given in the appendix of the NMa's method decisions for the gas TSO, electricity TSO, gas DSOs and electricity DSOs.[5] A report prepared for the NMa by Oxera, hereafter referred to as 'the Oxera report', also provides some research in which underpins the method decisions.[6]

OPTA method

In contrast to the NMa, OPTA uses an average of nominal Dutch Government bond yields and German Government bond yields, with remaining maturities as close as possible to the next regulatory period. The idea beyond choosing this maturity is that the investment horizon of the investor is equal to the regulatory period. In common with NMa, OPTA also takes an average of historic bond yields, but over a three year period. The argument for using a three year period is that this is consistent with the regulatory period.

More detailed reasoning on some of these issues is given in a report prepared for OPTA by NERA, hereafter referred to as 'the NERA report'.[7] We address some of the arguments made in the NERA report in more detail in the following sections.

[5] The method decisions can be downloaded from the following links:
http://www.nma.nl/images/Bijlage_2_Methode_tot_vaststelling_van_de_WACC_transport22-155485.pdf (WACC decision for TenneT)
http://www.nma.nl/images/Bijlage%202%20WACC%20bij%20Methodebesluit%20Transport%20GTS%202010-2013%20(2)22-193277.pdf (WACC decision for GTS)
http://www.nma.nl/images/103221_Bijlage_222-149357.pdf (WACC decision for electricity DSOs)
http://www.nma.nl/images/103222_Bijlage_222-149395.pdf (WACC decision for gas DSOs)
[6] Oxera, Cost of capital for GTS: annual estimates from 2006 onwards, May 2011.
[7] NERA, The Cost of Capital for KPN's Wholesale Activities, A Final Report for OPTA, 9 July 2012.

3.2 CHOICE OF BOND DURATION

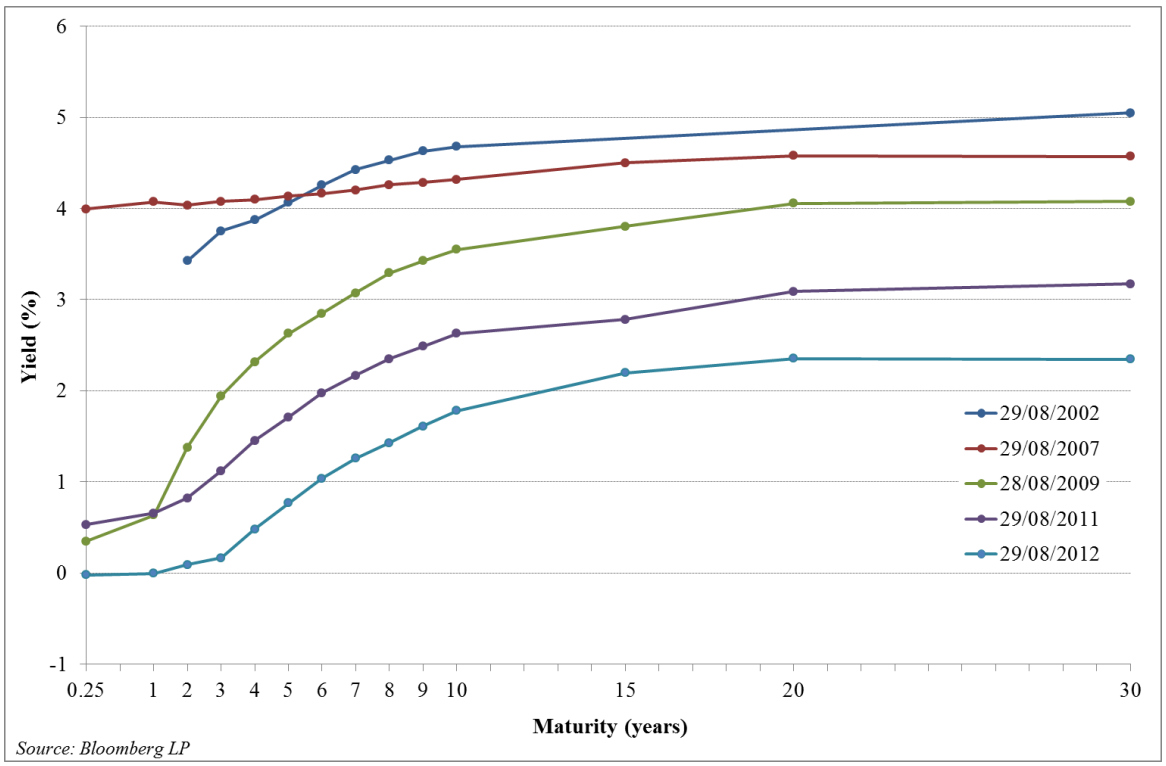
The yield curve

The first question to answer is, as a practical matter, how much difference does the choice of bond duration make in practical terms, by constructing a yield curve.

Figure 1 and Figure 2 illustrate the yield curves for Dutch and German Government bonds respectively, for several years between 2002 and 2012. Most obviously, bond yields and interest rates have declined over time, and in particular since the onset of the financial crisis. The second, more subtle point is that the post-crisis yield curve is relatively steep, compared to the pre-crisis yield curve, especially in the interval between 5-10 year bonds. For example, in August 2012 the average yield on a Dutch five year bond was 0.72%, while the yield on a 10-year bond was 1.75% – a difference of about 100 basis points. In January 2007, pre-crisis, the 5-year yield was 3.97% and the 10-year was 4.05 – a difference of only 8 basis points. The reason for the current steep yield curve is that interest rates are at a historic low, and investors expect them to increase after five years once Europe's economies recover and start to grow again.

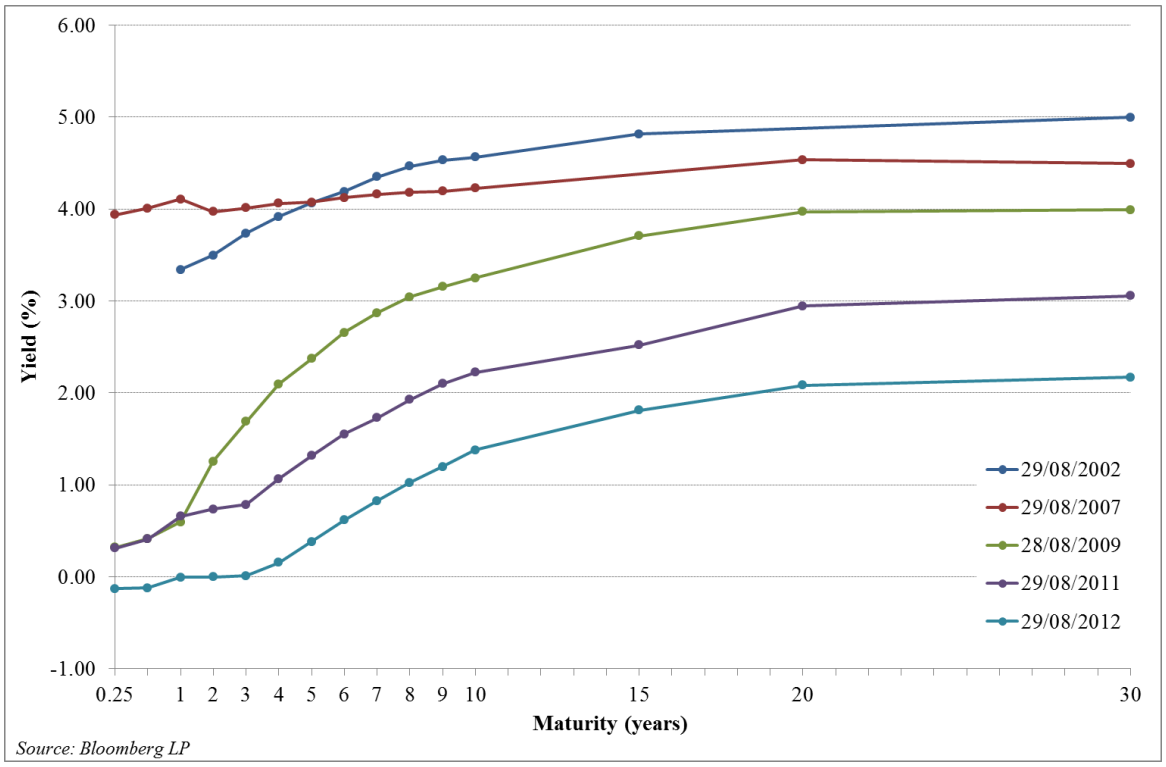
The steepening of the yield curve means that, pre-crisis, the difference between choosing for example a 5-year and a 10-year bond for the risk free rate was less important than it is now. In 2012 choosing a 10-year bond instead of a 5-year bond will add about 83 percentage points to the cost of equity (if the average yield over the past 5 years is used).

Figure 1: Yield curves for Dutch Government bonds, 2002 to 2012



Source: Bloomberg LP

Figure 2: Yield curves for German Government bonds, 2002 to 2012



Source: Bloomberg LP

Consistency between the ERP and the risk-free rate

One basic issue in the choice of the bond duration is the need for consistency between the choice of ERP and the risk-free rate. The ERP is a premium over some bond – usually either a long-term or a short-term bond.[8] As we see from the yield-curves, yields on long-term bonds tend to be higher. Accordingly, subtracting a higher number from the historical return on equity gives a lower ERP than if the same calculation were done using the average return on short-term bonds. For example, the latest estimate of the Dutch ERP measured relative to bonds is 0.8 percentage points higher than the ERP measured over bills.[9]

The risk-free rate chosen should be consistent with the ERP used, otherwise the cost of equity will be mis-calculated. This consideration means that the ERP could be calculated with respect to either long-term or short-term bonds, as long as there is consistency. As a practical matter, DMS, which is the most commonly used source of the historical, outturn ERP, has measured the ERP with respect to either short-term (so roughly 6 months) bills, or long-term bonds, so roughly 20-years. Considering the need for consistency, this means that if we choose to estimate the ERP based on the historical DMS data , then we need to use either a short-term bill, or a relatively long-term bond. The yield curve is relatively flat from 10-year bonds onward, so that a 10-year bond is a relatively good approximation of a long-term bond. Accordingly, consistency with the available ERP estimates means that we should either use a forecast of the short-term, 3-6 month rate, or a 10-year bond.

Arguments for and against using the short-term rate

Short-term bonds are the best approximation of a truly risk-free rate assumed by the CAPM. An investor who really wanted to minimise risk would buy a series of three-month government bonds for example. In contrast, long-term government bonds are not risk-free, even if held to maturity. Imagine an investor in 2012 who wants to invest for 10 years (until 2022). If he buys a 10-year government bond, he will receive €1,000 for certain in 2022. However, the purchasing power of that €1,000 in 2020 is unknown ahead of time. If inflation over the 10-year period is higher than anticipated in 2012, the €1,000 will buy less than anticipated. Interest rate changes in the meantime also add risk.

The ERP calculated with respect to short-term bonds will normally be higher than the ERP relative to long-term bonds, since investors require an additional premium to incur the risk of holding long-term bonds.[10] Using the smaller premium over *long-term* bonds could either over or under estimate the cost of capital according to the CAPM, depending on beta.

To see this, suppose, for example, that the true equity premium over the risk-free rate was 7% compared with a premium over long-term bonds of 6%. Suppose also that the expected return on the

[8] In the context of historical ERP calculations, a short-term bond typically refers to something alike a 6-month bond, sometimes also called a T-bill in the US. A long-term bond would typically be a 20-30 year bond. In practise the exact length of long term and short-term bonds will vary between countries.

[9] E. Dimson, P. Marsh, and M. Staunton, *Credit Suisse Global Investment Returns Yearbook 2012*, Tables 9 and 10. For Germany, the difference between the ERP over bonds and over bills is higher at approximately 1.1%.

[10] In unusual circumstances such as the current debt crisis in, for example, Greece, the yield on Greek short-term bonds is higher than the yield on Greek long-term bonds.

market was 10%: the true 7% premium over the risk-free rate plus a 3% risk-free rate, or alternatively the 6% premium over long-term bonds plus a 4% long-term rate. While the overall expected market return obviously remains unaffected by our choice of true premium over risk-free or the premium over long-term bonds, our choice affects the cost of capital for individual assets within the market portfolio. Figure 3 illustrates how the choice of risk premium would affect the cost of capital for two projects, one with a beta of 0.5, and another with a beta of 1.5.

Figure 3: Cost of capital for two hypothetical assets

	Beta = 0.5	Beta = 1.5	Average
Premium over long-term bonds			
Risk-premium over long-term	6.0%	6.0%	
Long-term rate	4.0%	4.0%	
Cost of capital	7.0%	13.0%	10.0%
Premium over short-term bonds			
Risk-premium over short-term	7.0%	7.0%	
Short-term rate	3.0%	3.0%	
Cost of capital	6.5%	13.5%	10.0%
Difference	-0.5%	0.5%	0.0%

In the example in Figure 3, use of the equity premium over long-term bonds would *overestimate* the cost of capital for a project with beta of 0.5, but *underestimate* the cost of capital for a project with beta of 1.5. Indeed, the use of long-term bonds *overestimates* the cost of capital for the project with beta of 0.5 by exactly the same amount that it *underestimates* the cost of capital for the project with beta of 1.5, thereby leaving the overall cost of capital across both projects unaffected.

Regulators could use a short-term risk-free rate, and combine this with the ERP over bills. However, what is actually required for setting the WACC is the forecast of the short-term risk-free rate over the regulatory period. One way to do this is simply take a longer-term rate which extends over the regulatory period, and then deduct the expected difference between long-term and short-term bonds, known as the term premium. Historically, the term premium has been about 1%. However, the NERA report also notes that regulations requiring certain kind of investors to buy low-risk/high rated bonds, combined with a shrinking pool of such assets as various firms and countries have been downgraded, have increased the price of AAA rated bonds and depressed yields. The NERA report cites a Bank of England study that yields may have been depressed by as much as 100 basis points or 1 percentage point. This means that actual observed yields could be under-estimating the true risk-free rate. If we added back the estimated effect of this 'flight to quality', it cancels out the term premium reduction that was made to estimate the short-term rate. That is, we would end up using the long-term rate as a proxy for the expected short-term rate over the regulatory period.

We also note that utilities often have betas close to or less than 1.0. Therefore using the combination of long-term rates and the ERP over long-term bonds may slightly over estimate the cost

of capital, if the standard CAPM accurately captures the empirical relationship between the individual stock and the market. However, there are models that indicate that (i) the standard CAPM's slope is too steep relative to empirical observations and / or that (ii) factors other than the market are needed to explain an individual stock's return.

Early papers by Black, Jensen and Scholes (1972) and Fama and MacBeth (1972) were among the first to look at whether the empirically observed relationship between company-specific returns and the market was as steep as indicated by the CAPM.[11] Although the realized market returns demonstrated a remarkable linearity in the CAPM beta, as predicted by CAPM, the empirical version of the CAPM was 'pivoted' around a value of beta equal to one. That is, if we imagine chart with beta plotted on the x-axis and realized market returns on the y-axis, then the actual straight line we see would have an intercept higher and a slope less steep than predicted by theory.

Several subsequent studies confirmed the robustness of this result and proposed explanations revolving around market frictions, such as different borrowing and lending rates, and the role of taxes. Nevertheless, the empirical evidence suggested significant movement in the relationship between individual stock returns and the market (the Security Market Line), often flattening, to the point that Fama and French (1992) found a zero slope in the empirical Security Market Line.[12] Fama and French suggested that factors other than the risk relative to the market, such as book-to-market value ratios (among others) were significant in explaining the SML. A string of papers followed the initial work that has culminated into the model now known as the Fama-French model, which explains stock market returns by adding explanatory risk factors to the CAPM model. Fama & French (1997) found that in addition to the (1) excess return on the market, (2) the return on small-firm stocks less the return on large-firm stocks and (3) the return on high book-to-market-ratio stocks less the return on low book-to-market-ratio stocks helped explain empirical regularities.[13] These models are alternatives to the CAPM and indicate that (i) the standard CAPM may result in too steep a Security Market Line or (ii) there are missing factors in the standard CAPM. In either case, there is evidence that the standard CAPM may underestimate the cost of capital for companies with a beta less than 1.0. This effect could partially or offset any overestimate of the cost of equity which results from using a long-term bond rate in the CAPM. Given these uncertainties, we do not see the use of long-term bonds as a significant problem for the accuracy of the CAPM.

Financing considerations

One point of view is that one should use a bond for the risk-free rate with a maturity which roughly matches the regulatory period, since this will give the best prediction of the rate over the regulatory period. This was the approach adopted by the NERA report and which OPTA has adopted.

One practical reason to deviate from using a bond with duration equal to the regulatory period could be the way in which regulated firms finance their investment. In theory, a firm could finance

[11] F. Black, M.C. Jensen, and M. Scholes, "The Capital Asset Pricing Model: Some Empirical Tests," *Studies in the Theory of Capital Markets*, Praeger Publishers, 1972, pp. 79-121 and E.F. Fama and J.D. MacBeth, "Risk, Returns and Equilibrium: Empirical Tests," *Journal of Political Economy* 81 (3), 1972, pp. 607-636.
[12] E.F. Fama and K.R. French, "The Cross-Section of Expected Returns," *Journal of Finance* 47, 1992, pp. 427-465.
[13] E.F. Fama and K.R. French, "Industry Costs of Equity," *Journal of Financial Economics* 43, 1997, pp. 153-193.

itself at the beginning of the regulatory period, using bonds equal to the duration of the regulatory period. In this way the regulated firm could 'lock in' the return allowed by the regulator. The firm would then to re-finance or 'roll over' all of its debt at the start of the next regulatory period. This would leave the firm with little or no exposure to changes in the cost of debt over the regulatory period or beyond it.

In practise we see that regulated firms tend to finance their long-term assets using long-term debt and equity, which in principle has an infinite horizon. For example, TenneT and Gasunie[14] have issued 10, 15 and 20-year bonds; KPN has a number of 30 year bonds. One reason firms do this is because it would be extremely risky and difficult to re-finance all of their debt in one go, at the end of the regulatory period. If they attempted it, bond holders would become nervous about their ability to achieve re-financing and yields wold likely increase above the level that results from issuing some longer term bonds. Accordingly, it seems prudent for firms to issue some longer dated debt. Because of the yield curve, the generic cost of longer term debt is higher than the generic cost of shorter term debt that matches the regulatory period. However, reliance on shorter term debt is not necessarily cheaper or available to an individual regulated firm.

The above discussion concerns the cost of debt, rather than the risk-free rate used to assess the cost of equity. However, if the cost of debt is determined as the risk-free rate plus a premium, it may make sense to use a longer term risk-free rate to avoid having to consider both a maturity and risk premium. We also discuss this issue in 3.5. Further, one could take the view that the risk-free opportunity cost of capital for equity holders should take a similar perspective – that it is not practical to look only at the regulatory period, but at a longer period. This consideration would be less important for firms for whom the regulated revenues are only a relatively small fraction of the total revenues, since re-financing at the intervals of the regulatory period would be more feasible.

Volatility and liquidity considerations

Using a term longer than the regulatory period could be defendable if the liquidity of longer term bonds is higher, their volatility is lower, or their ability to forecast yields better, so that the yield data they give is more reliable.

We have searched for data on the volumes of Dutch and German government bonds traded by maturity, but neither Bloomberg nor other official sources provide this data. However, it is possible to see data on the aggregated volume of 5 and 10-year bonds. From this data it is clear that both the Netherlands and Germany issue a relatively large number of both 5-year and 10-year bonds that are sold, but issue few 3, 6, 7, 8 year bonds.[15] We would expect the liquidity of the bonds to be proportional to the volume of bonds issued. Therefore, we can conclude that 5 and 10-year bonds relatively liquid and likely more liquid than a three-year bond. Unfortunately the data available cannot provide guidance as to whether 5 or 10-year bonds might be better.

[14] Gasunie is not regulated, but Gasunie but derives most of its revenues from the regulated business of Gas Transport Services.

[15] The Dutch Ministry of Finance appears to have issued a relatively large number of bonds with a maturity of approximately 3 years in 2012, but for 2008-2011 the relative issuance of 3 year bonds was much lower than both 5 year and 10 year bonds.

According to a 2010 study from the Federal Republic of Germany Finance Agency, 10-year German bonds constitute approximately 50% of the trading volume of German Government securities whereas 5-year bonds constitute only about 20%.[16] Table 1 below summarized information from the Dutch Ministry of Finance's issuance results over the past five years. It indicates the approximately 30% are 10-year bonds while approximately 20% are 5-year bonds.[17]

Table 1: Dutch State Treasury Agency – Ministry of Finance Issuance Results of DSLs

	Less than 5 Years	About 5 Years	More than 5, Less than 10 Years	About 10 Years	More than 10 Years
	€ billion	€ billion	€ billion	€ billion	€ billion
2012	18.6	16.7	-	13.1	11.3
2011	20.4	8.2	4.2	15.5	4.7
2010	16.7	7.0	3.3	15.1	9.8
2009	18.0	10.8	5.1	6.5	7.8
2008	12.4	2.1	0.7	10.7	-
Total	86.1	44.8	13.2	60.8	33.7

Source: Dutch State Treasury Ministry of Finance Issuance Results
http://www.dsta.ne/english/News/Issuance_results

Because the absolute magnitude of bond issuances is relatively large for 10-year bonds, we believe the market for these bonds is relatively liquid.

We have also computed the price volatility of both Dutch and German government bonds for different maturities. Figure 4 and Figure 5, which illustrate the results of these calculations, show that in the Netherlands, bonds with a maturity of 10 years have significantly less volatility than 5-year bonds. For Germany longer term bonds are also less volatile, although the differentiation between 5 and 10 year bonds is less stark than for Dutch government bonds. It also appears that the volatility of the shorter term bonds increases more during times of financial uncertainty than do the volatility of longer term bonds.

That shorter term bonds are more volatile makes sense, because there is more shorter-term market news available that affects yields on these bonds. In contrast, there is relatively little news concerning events 10-20 years away.

[16] Federal Republic of Germany Finance Agency, *Investor Forum: German Government Securities*, June 2010.
[17] Ministry of Finance, *Issuance Results*; spreadsheet at http://www.dsta.nl/english/News/Issuance_results.

Figure 4: Volatility of Dutch Government bonds of different terms

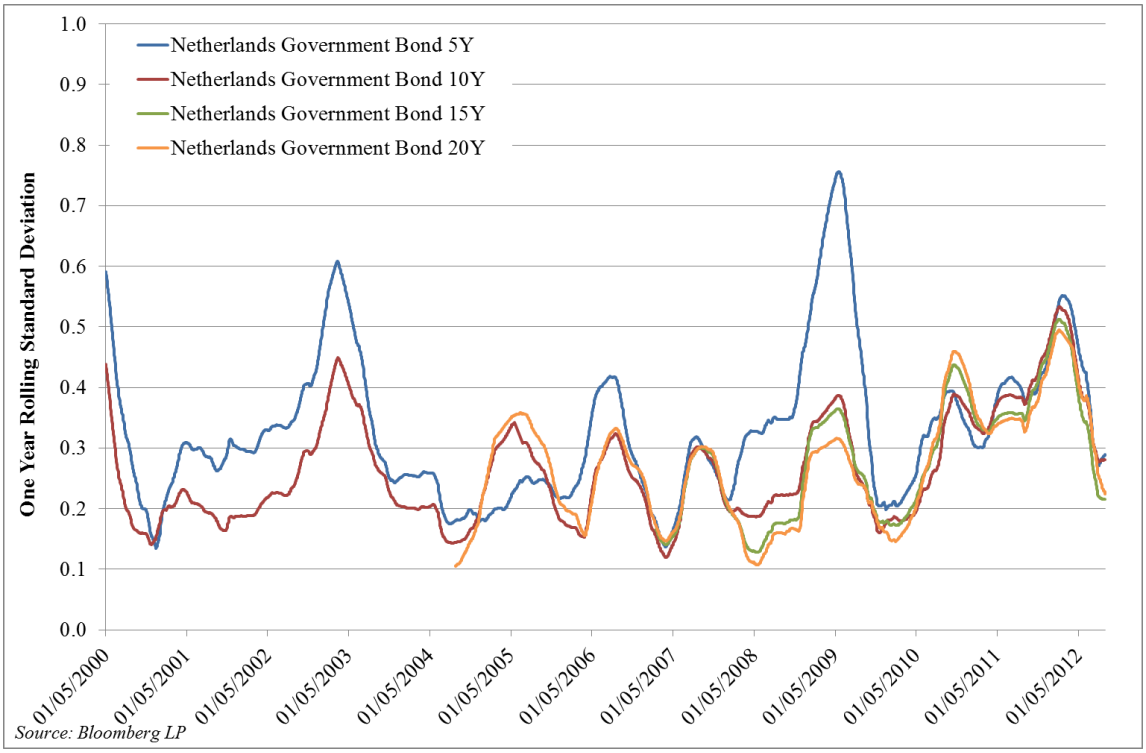
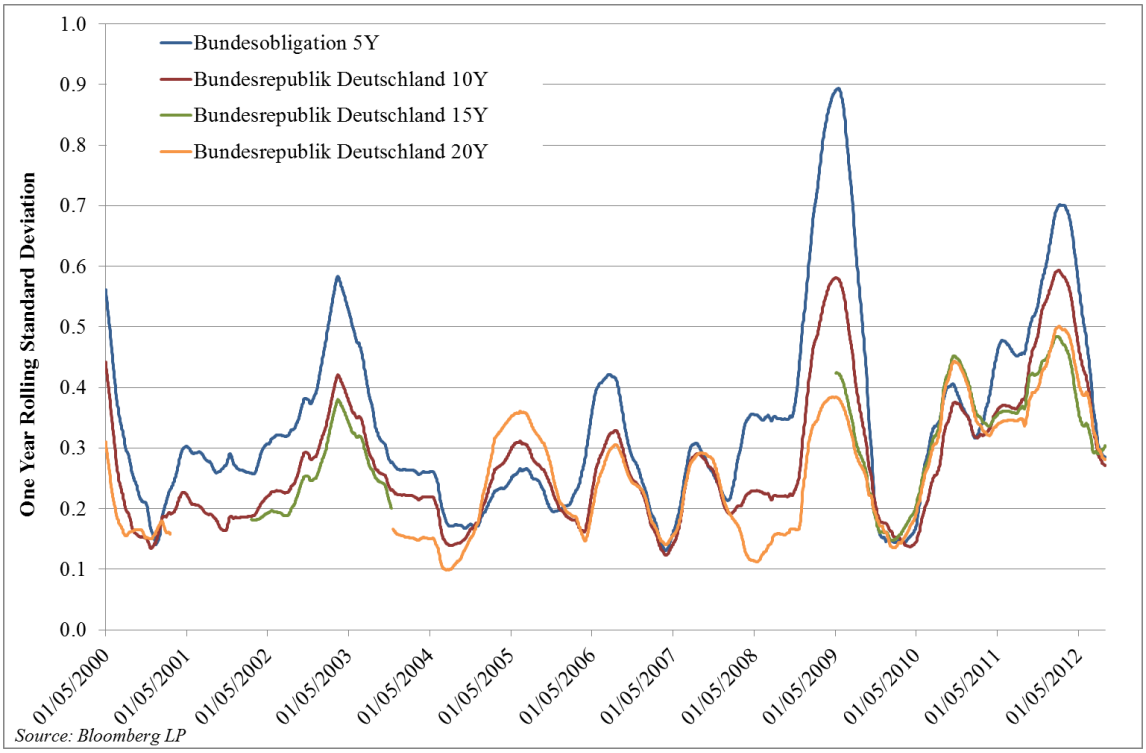
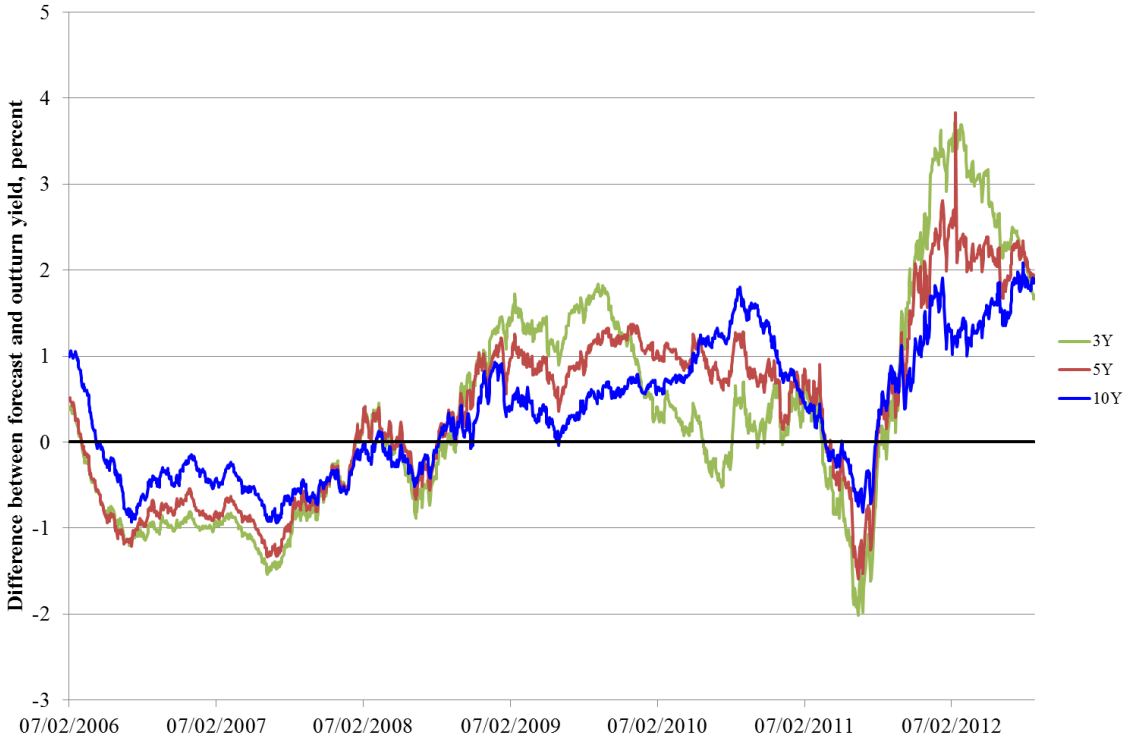


Figure 5: Volatility of German Government bonds of different terms



Using longer term bonds with less volatile yields would be an advantage in regulatory decision making, because the results of the cost of capital decision will be more stable over time. To test this hypothesis, we used the historical yield on 3, 5, and 10-year bonds to forecast current yields on bonds of the same maturity. Specifically, we estimated the linear relationship between bond yields at time t and bond yields at time (t-3 years) to determine the ability of the bonds to provide a reasonable estimate on bond yields 3 years out. Having estimated this relationship, we calculated the difference between the forecasted yield and the actual yield over time, so that a positive figure indicates an over estimation of the yield, whereas a negative figure indicates an under estimation. The results for the Dutch 3, 5 and 10-year bonds are depicted in Figure 6 below.

Figure 6: Forecast Error Using 3, 5, and 10-Year Dutch Bonds



Source: Bloomberg
Forecasts are 3 years out.

Figure 6 shows that all the bonds failed to anticipate the lower bond yields resulting from the financial crisis, and so forecasts have overshot for the period 2009-2010. Figure 6 also shows that the historical yield on longer bonds currently provides a better forecast on the current yield. While all bond yields currently are low compared to historical standards, the 10-year bond yield is more in line with its historical value than are 3 or 5 year bond yields.

3.3 ORIGIN OF THE BONDS

In section 2, we concluded that adopting a Europe-wide perspective was appropriate for the risk-free rate. However, this could still mean that a regulator chooses to use their own government bonds as the risk-free rate. Historically, this has indeed been the default choice.

Before the financial crisis in the Euro zone, the choice of which government bond to use did not matter much, as all Euro zone government yields were fairly similar. Post crisis, the choice of bond has become important. Figure 7and Figure 8illustrate that until the beginning of 2008, Dutch and German bond yields were very close. However, in the period October 2008 through September 2009, Dutch 5-year bonds yielded on average an additional 36 basis points over German bonds. 10 year bonds also yielded an additional 49 basis points over the same period. The spread then declined to below 20 and 30 basis points for 5-year and 10-year bonds, respectively, but has recently risen to 35-40 basis points for both 5 and 10-year bonds. Therefore, since 2008, the origin of the bonds has become more important, because it results in differences in the WACC of around 35-40 basis points.

Figure 7: Dutch 5-year bond yield vs. German 5 year bond yield

Figure 8: Dutch 10-year bond yield vs. German 10 year bond yield

Source: Bloomberg LP

As we discuss in section 3.1, the NMa currently uses Dutch bonds, whereas OPTA uses the average of Dutch and German bonds. Economists commonly define the difference between the yield of a bond of country X and the rate of the country with the lowest risk as the 'country risk premium'. For the Eurozone, country risk is measured by reference to German bonds, since these bonds have the lowest yields. Accordingly, both the NMa and OPTA are allowing some 'country risk' in the WACC, by using Dutch government bonds.

In considering whether this might be justified or not, it is worth remembering that the Capital Asset Pricing Model (CAPM) only compensates investors for non-diversifiable risk. That is, risk that cannot be eliminated by holding a broad market portfolio of stocks. According to the CAPM, we should take a pure risk-free rate. Any risk specific to the Netherlands should, according to the strict theory, not be included in the cost of equity. This is because, again in theory, investors could diversify their investment, so that the risk of adverse events in the Netherlands is offset by holding investment in other countries.

In practise, when looking at a specific investment in a given country, investors require compensation for other types of risk. Clearly, an investor would want a higher return for investing in a gas distribution network in Argentina than for an investment in the Netherlands. Some leading

finance textbooks acknowledge this, but argue that investors should not add country risk into the discount rate or weighted cost of capital. Instead, investors should adjust the expected cash flows from the project to account for the additional risks they see in that particular country. For example, if the investor foresees a 10% risk of the asset being appropriated without compensation, they could reduce the expected cash flows by 10%.

In their seminal textbook Professors Brealey and Myers note that they "suspect that managers mark up the required return for foreign investment to cover the risk of expropriation, foreign exchange restrictions, or unfavourable tax changes. A fudge factor is added to the discount rate to cover these costs. We think that managers [valuing firms] should leave the discount rate alone and reduce expected cash flows instead.… [A]djusting cash-flows brings management's assumptions about "political risks" out in the open for scrutiny and sensitivity analysis."[18]

Regulators should typically set tariffs so that the stream of allowed revenues, when discounted at the WACC, equals the cost of the investment.[19] But investors then discount the stream of revenues to account for country and other specific risks, the present value of the revenues will be less than the amount of the investment. In this case, not rational person would put invest in the network company. To account for the specific risk, the regulator could apply an 'uplift' to the allowed revenues or price cap to compensate for specific risks. This would conform with the strict view of the CAPM model – the regulator would apply a pure risk-free rate – so use the German bond rate – and then adjust expected cash-flows to account for specific risks faced by the investors.

In practise, we know of no regulator which does this. The main reason is probably because, from a practical point of view, it is very hard for the regulator to know what level of uplift to apply. This is not least because one of the most important risks as far as investors are concerned is regulatory risk. For obvious reasons, investors and the regulator are likely to take different views on the magnitude of regulatory risk.

For this reason, all regulators that we are aware of do increase the WACC to allow for specific risks, even though the pure CAPM allows only for non-specific or systematic risks. Moreover, most regulators increase the WACC by applying the bond rate of their country, rather than the true risk-free rate.

The question is then: is the country spread the appropriate amount to be adding to the WACC to compensate for specific risks? One answer is that, if the difference between bond yields of the country's government and the corporate bonds of that country remain stable over time, then the 'country risk' premium is giving useful information about the general business risk in the country. If, on the other hand, government bond yields increase *more* than corporate yields, this means that

[18] R.A. Brealey & S.C. Myers, *Principles of Corporate Finance*, Fifth International Edition, p. 972. Professor Myers is a Principal of *The Brattle Group*.

[19] For example, the allowed future stream of revenues from a network investment of €10 million, should, when discounted at the WACC, equal €10 million. If the allowed revenues are less than this, no one would want to invest. If they are more, the investors are earning return in excess of the risk taken. We call this criteria for setting tariffs 'the NPV test', and we introduced the concept in our 2000 report for the European Commission on setting of tariffs for gas networks. See Methodologies for Establishing National and Cross-Border Systems of Pricing of Access to the Gas System in Europe, 17 February 2000, p.52.

investors are more worried about the specific risk of Government default. In this case it would not be appropriate to use the government bond rate as the 'risk-free' rate for the country, because the yields include a high premium for the specific risk of government default.

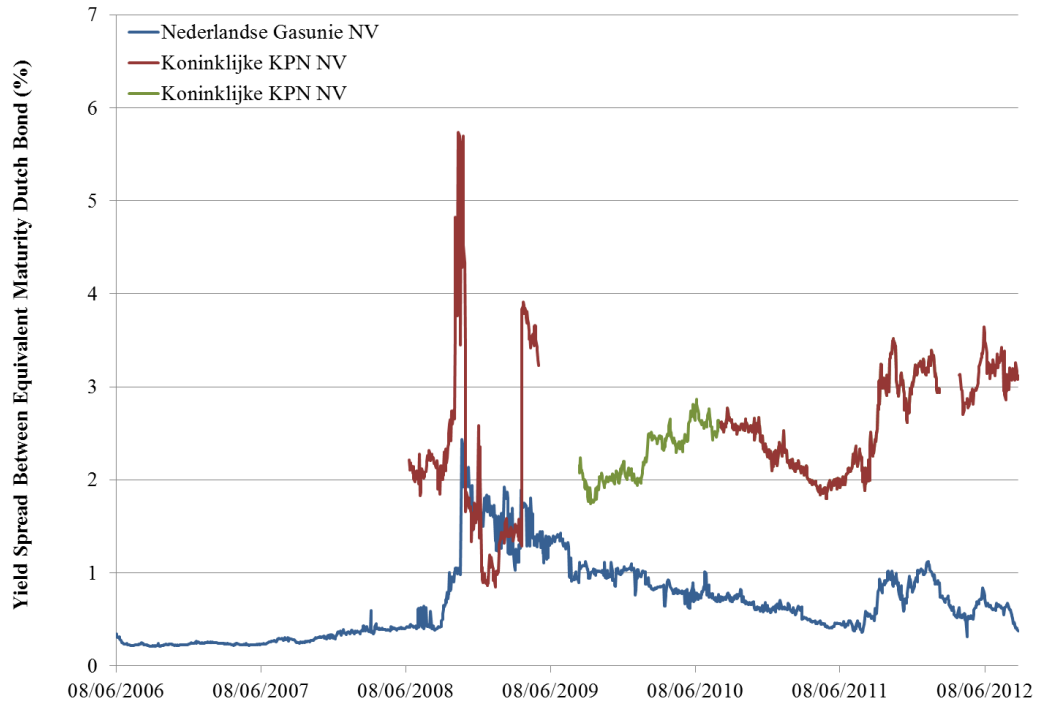
To apply this test in the Netherlands, we have compared Dutch government bond yields to the yields of regulated firms. TenneT, Gasunie, Alliander[20] and KPN all have traded bonds, but only KPN and Gasunie have bonds that are suitable for this exercise.[21] Figure 9 illustrates the results.

We find that the spread between corporate or utility bond and government bond yields increased dramatically during the financial crisis of 2008-09. While spreads have fallen post crisis, they remain above pre-crisis levels. For example, prior to the financial crisis of 2008-09, Gasunie's 15-year bond had a spread of 0.25% to 0.30% to Dutch government bonds of the same maturity, but this spread increased to over 2.4% in October 2008. During 2012, this same spread to government bonds of the same maturity has ranged from 0.45% to almost 1%. Other corporate bonds, such as those of KPN, have exhibited substantially higher variability in the spread over government bonds.

[20] Alliander has a regulated network business, but also sells gas and power in the liberalised market.

[21] Since we would like to examine changes in corporate or utility bonds and government bond yields for the pre and post crisis period, which means roughly 2006 to 2012, we need a bond issued before 2006. We need to compare the corporate bonds to government bonds with a similar maturity date. However all the government bond yield data we have is for bonds with a constant maturity. As we 'roll forward' in time, the time to maturity for the corporate bonds is decreasing, while the time to maturity for the government bonds is constant. This means that the two yields are not directly comparable. To mimimise this problem, we choose long-term corporate bonds, so that the change in maturity date between 2006 and 2012 is relatively small. For example we have used a KPN bond with maturity in 2030. Hence the time to maturity decreases from 24 years in 2006 to 18 years in 2012. However, since the yield curve is very flat between 18 and 24 years, this change in the maturity date will have little effect on the yields.

Figure 9: Dutch Government bonds vs. Utility Corporate bonds



Note that after 8/10/2010, the two Koninklijke KPN NV Corporate bonds have identical yield spreads. *Source: Bloomberg LP*

While the results are relatively noisy, it does seem that since the crisis, the spread of yields on the bonds of Dutch regulated firms over government bond yields has remained relatively stable, and if anything seems to have increased. This indicates that using Dutch government bonds will likely not overcompensate regulated Dutch firms, since the Dutch yields reflects the general risks that the regulated firms are facing.

However, we should also caution that a recent paper by the European Central bank has found that at least some of the increase in spreads between German and French government bonds reflects the greater liquidity of the German bond market, rather than differences in credit quality.[22] If the same results apply to the Netherlands, then some of the additional return that would be granted to Dutch firms is not to do with country risk, but actually has to do with the fact the Dutch government bonds are less liquid than German bonds. This is clearly not something that regulated Dutch firms should be compensated for. However, the effect is likely to be relatively small, compared to other possible errors and biases in the CAPM discussed below, and so we do not see this issue as a significant factor against using Dutch government bonds in the risk-free rate.

To the extent that the spreads might be increasing, we note that one academic paper has concluded that an increase in the corporate-government bond spread is indicative of an increase in the ERP.[23] Hence using the slightly higher yield on Dutch government bonds – relative to German

[22] European Central Bank Working Paper Series No 1440 / June 2012, 'Liquidity And Credit Risk Premia In Government Bond Yields', by Jacob Ejsing, Magdalena Grothe and Oliver Grothe.

[23] 'Explaining the Rate Spread on Corporate Bonds', Edwin J. Elton, Martin J. Gruber, Deepak Agrawal, and Christopher Mann, *Journal of Finance*, Vol. LVI, No.1 February 2001.

government bonds – could help reflect this increase in the ERP, albeit through application in the risk-free rate.

To summarize the above debate on the origin of the bonds:

- German bonds are the true risk-free rate for the Eurozone which is consistent with the CAPM;
- A rigorous CAPM approach would not support adjusting the WACC to deal with risks specific to the Netherlands; instead the regulated firms cash-flows should be adjusted by adding an uplift which account for risk;
- In practice, determining the level of such an uplift would be extremely difficult and contentious for a regulator to determine;
- Using the bonds of the country in which the regulated firm operates as a proxy for the risk-free rate is a reasonable short-cut for dealing with country-specific risk, as long as the corporate yields and government yields for that country have a stable relationship. We have confirmed that this is indeed the case for the Netherlands;
- However, some of the spread between Dutch and German government bonds is probably due to liquidity differences. Hence adding 100% of the spread may overcompensate the regulated firms for country risk. Therefore, using an average of Dutch and German bonds could be a pragmatic approach to dealing with country risk.

3.4 RISK-FREE RATE METHODOLOGY OF OTHER REGULATORS

In assessing the strengths and weaknesses of the NMa and OPTA approaches, we have investigated how a sample of other regulators approach the risk-free rate in their regulatory decision making. Table 2 summarizes the results.

UK regulators calculate real rates over return, and so have used index-linked bonds. Ofgem, Ofwat (the water regulator), Ofcom (the telecoms regulator) and the Competition Commission have all used the average of the yields on 5 and 10-year UK index-linked government bonds. The CREG, the Belgian energy regulator, uses the average yield on 10-year Belgian government bonds.

Since the decisions described in the Table below, Ofgem has also introduced a variable cost of debt in response to the crisis as part of its review of network regulation. Ofgem's review led to the introduction of the 'RIIO' model, which stands for Revenue = Incentives+Innovation+Outputs. However, Ofgem will not update the cost of equity during the price control, even though the price control period has been extended to eight years.[24]

In the US, California also looks at the changes in the yield on utility bonds and the change in the spread between utility and government bonds every six months. If the changes are larger than a benchmark figure, the cost of capital is updated based on the change. Some Canadian regulators use a similar approach. For example, the province of Ontario updates the allowed return on equity

[24] For more details see: www.ofgem.gov.uk/Networks/rpix20/ConsultDocs/Documents1/RIIO%20handbook.pdf

annually using changes in 10-year government bond yields and utility bond yields assigning 50% weight to each change.[25]

The Portuguese energy regulator, the ERSE, is unusual in that it is one of the few regulators to have used German bonds in its rate setting. However, this seems to be a pragmatic decision based on the result that, in 2006, Portuguese government bonds were giving a negative real rate in Portugal, because of high inflation in Portugal. It is not clear why negative real rates were a problem, given that the WACC would presumably have been re-inflated each year using Portuguese inflation rates, but nevertheless the ERSE decided to use German bonds because they gave a positive real rate of return. The ERSE switched back to using Portuguese government bonds in its 2010 decision, as German bond yields had fallen while Portuguese rates had remained stable.

The Irish energy regulator, the CER, is another Eurozone country which has used bonds from other countries. In its 2005 decision it took the average of the real risk free rate on a variety of Irish, French and German government bond rates across a range of maturities. CER chose to look at the yields on other Eurozone member State government bonds, before and after the 2007 financial crisis. The Irish regulator chose to focus on current rates rather than backward looking estimates to reflect the current cost of borrowing faced by ESB (the regulated electricity transmission firm), and included maturities in addition to 10 year bond to reflect ESB's expected debt portfolio. The range of returns considered include both nominal and index-linked bonds, as CER preferred to use the latter but recognized that the index-linked bond market is less liquid and prices might be set more efficiently in nominal markets. Accordingly, CER considers the spot, 3-year, and 5-year rates for 5 and 10-year bonds.

[25] Ontario Energy Board, EB-2009-0084: Report of the Board on the Cost of Capital for Ontario's Regulated Utilities," Issued December 11, 2009.

Table 2: Survey of risk-free rate decisions by EU regulators

Regulators	Date	level	Country	Description
Ofgem: Transmission (TPCR 2007-2012)	4 December 2006	2.50%	**UK**	Ofgem followed the recommendations of a consultant's report in setting its real risk free interest rate. The report chose to deflate nominal yields on medium term, 7-10 years, UK Government bonds to establish the real risk-free interest rate.
Ofgem: Transmission (TPCR4)	8 February 2011	1%-2%	**UK**	Ofgem didn't believe that recent negative values for 5 years bonds could properly be taken as indicative that risk free rates were negative in 2011. Moreover, the authority stated that ten years government bonds were likely to be downward biased by around 100 basis points by quantitative easing and it was also likely that there was an element of inflation risk hedging in 5 years index linked gilt yields. Therefore, Ofgem found out that focusing on the 10 years benchmark, a 100 basis points adjustment would have suggested a spot rate of arounfd 1.5%, in line with the five years averages for 10 years index linked bonds.
Ofgem: Distribution (DPCR5)	7 December 2009	n.a	**UK**	Yields on five- and ten-year UK government-issued index-linked
Ofcom	3 February 2012	1.4%	**UK**	5 years averages of 10 years and 5 years indexed linked gilts.
Ofwat	23 July 2009	2.00%	**UK**	The authority said that the RFR that has been chosen is consistent with the 10 years and 5 years long run historic UK index-linked gilts of 5 and 10 years maturuty and consistent with recent regulatory determination.
Competition Commission (Heathrow and Gatwick)	3 october 2007	2.50%	**UK**	The CC stated that it is not possible to derive the RFR in a mechanic way from historical data on five and ten years UK ILG. Therefore, the authority considered it was necessary to make an overall judgement based on range of evidence that was available. This judgment reflected their view that the five and ten year benchmark and forward rates are currently a more reliable indicator of the RFR than longer dated benchmarks; the significant step down in gilt yields in 1997/98 was unlikely to be reversed in the period to the end of Q5, making data from before this time much less useful than data of the last ten years; the very low rates observed, on the Bank of England yield curve real spot rates 5, 10 and 20 year maturities, for periods of time between 2003 and 2006 were considered unusual.
Competition Commission (Stansted)	4 November 2008	2.00%	**UK**	The CC tested the reliability of ILGs in the estimation of the RFR. First of all it considered the forward rates. The forward curve constructed by the Bank of England showed that ILG yields in September 2008 priced in a return of less than 0.5% after 15 years, justifying the view that long run maturity ILGS did not provide reliable risk free rate estimates. This view was then confirmed, to some extent, by the gap between yields on nominal and index linked gilts. Therefore, the CC decided to place less weight on the ten year ILG benchmark in its 2008 review decision. Thirdly, the authority analyzed the movement in yields on three, five and ten years ILGs during the last ten years.The values found are lower then the RFR fixed in the Heathrow and Gatwick decision in 2007 (2.5%). Finally, the CC underlined the lack of a mechanistic way of interpreting the data and, hence, it decided to exercise a certain amount of judgement on the basis of the data available.

Regulators	Date	level	Country	Description
CREG	24 November 2011	n.a	**Belgium**	Arithmetic average yield 10 years government bonds.
ERSE (Electricity Price Control)	December 2008	4.55%	**Portugal**	
ERSE (Gas Transportation Price Control)	June 2010	4.55%	**Portugal**	In its 2010 decision, the ERSE defines the real risk free rate as the average return on 10 year Portuguese Government bills between March 2009 and February 2010. In a previous (2006) regulatory decision, the German Bund was used because Portuguese real rates were often negative, due to high inflation in Portugal but nominal returns that were determined by the broader Euro zone market. The change back to using Portuguese Government bills was made in response to the financial crisis, which led to falling German bond rates but relatively stable Portuguese rates.
ERSE (Electricity Distribution)	December 2011	3.40%	**Portugal**	
AEEG	12 January 2007	4.65%	**Italy**	Arithmetic average yield 10 years government bonds. The average was calculated over the period that goes from July 2008 to June 2009.
CER	9 september 2005	2.38%	**Ireland**	The CER based its estimate of the real risk free rate on a variety of Irish, French and German government bond rates across a range of maturities. CER chose to look at the yields on other Eurozone member State government bonds, before and after the 2007 financial crisis. The Irish regulator chose to focus on current rates rather than backward looking estimates to reflect the current cost of borrowing faced by ESB (the regulated electricity transmission firm), and included maturities in addition to 10 year bond to reflect ESB's expected debt portfolio. The range of returns considered include both nominal and index-linked bonds, as CER preferred to use the latter but recognized that the index-linked bond market is less liquid and prices might be set more efficiently in nominal markets. Accordingly, CER considers the spot, 3-year, and 5-year rates for 5 and 10-year bonds.
CER	19 November 2010	2.00%	**Ireland**	n.a

3.5 THE RISK-FREE RATE AND THE COST OF DEBT

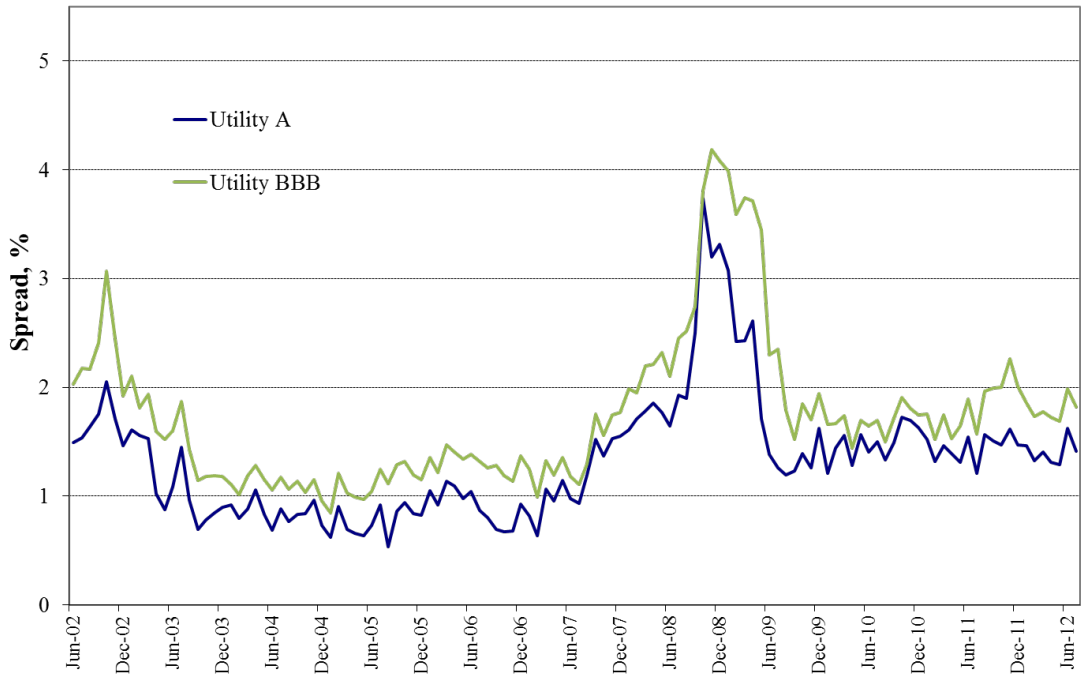
We understand that the NMa calculates the allowed cost of debt by estimating an average debt premium for a mixture of specific bonds and bond indices, and then adding this to the risk-free rate. We have been asked to comment on this issue.

In our view, adding a spread to the risk-free rate is of course the same as using an absolute cost of debt. Hence the real issue is the way in which the spread is calculated. As we noted in section 3.3 and illustrated inFigure 9, spreads of corporate debt over government debt have been volatile over the period of the financial crisis. An exact picture is difficult to obtain given the limited number of Dutch utility bonds with the correct characteristics. However, in US markets more bonds are available, and so it is easier to produce a longer time series of spreads of utility bonds over government bonds with the same maturity. Figure 10illustrates the results. We see that spreads were relatively high in 2002, following the tail-end of the dot-com bubble bursting. They then stabilized and then increased dramatically following the start of the financial crisis, peaking at the fall of Lehman brothers in September 2008. Spreads then fell again, but remained above pre-crisis levels.

We expect a similar picture would emerge in the Netherlands, since the latter half of the figure is similar in pattern to Figure 9, although the trend is clearer inFigure 10 because of better data continuity. The one important different is the Eurozone sovereign debt crisis, which may be responsible for declining corporate spreads we see in the 2010/2011 period. However, more recently the corporate spread seems to have reverted upward, as perhaps investors become more concerned about the effects of a sovereign debt default on the wider economy.

The conclusion that we can draw from this is that corporate spreads over government bonds are clearly not constant. Using averages of corporate spreads which includes the peak of the crisis in 2008 will likely overestimate the forward looking cost of debt. Similarly including the relative low spreads of 2010 and 2011 from the Eurozone could also underestimate the forward-looking cost of debt. We conclude that the cost of debt should be estimated using relatively recent estimates of corporate debt spreads, perhaps over the last 6-12 months.

Figure 10: Twenty-Year Utility Bond Spread Over Twenty-Year Treasury Note



3.6 CONCLUSIONS ON THE RISK-FREE RATE

We have summarised the arguments for and against using 10-year bonds, and also for using either Dutch or German bonds, in Table 3 below. We have rated each argument either strong, medium or weak depending on how much weight we think should be assigned to it.

Table 3: Conclusions on the risk-free rate

Arguments for 10-year bonds	Importance
10-year bonds are less volatile than 5-year bonds, especially for the Netherlands. This is an advantage because a yield chosen at any point in time for a 10-year bond will be more stable than that of a 5-year bond.	Medium
The volume of 10-year and 5 year bonds issued is higher than for bonds with duration of less than five years, which means trading in 10-year and 5-year bonds is more likely to be more liquid and therefore give more reliable yield data relative to 3-year bonds.	Medium
Using a 10-year bond is more compatible with the historical estimates of the ERP which are available. The ERP is either measured against long-term – meaning 20/30-year bonds – or short term (6 month) bills. In practice, as the yield curves show, the difference in the yield on a 10 and 20 year bond is much less than the difference between a 20 and a 5-year bond. Accordingly, using a 10-year bond will be more consistent with available ex post ERP estimates, which we discuss in the next section. Using a five year bond will tend to underestimate the cost of capital, if combined with an ERP over long-term bonds.	Strong
In the current environment, the historical yield on 10-year bonds are better predictors of the current yield on 10-year bonds than historical yields on 5-year bonds are of the current yield on 5-year bonds.	Medium
Regulated entities commonly rely on a mix of short-term and longer-term financing with the majority of long-lived assets being financed with long-term debt and equity. This could suggest choosing a risk-free rate that is also based on a longer term rate, if one takes the view that equity investment is also long-term. This approach could also facilitate the calculation of the cost of debt as a premium over the risk-free rate.	Weak

Arguments against 10-year bonds	Importance
Using a 10-year Dutch government bond results in a yield about 1.5 percentage points higher than a 3-year bond, and that this yield is connected to events that are expected to occur after the end of the regulatory period.	Strong

Arguments against using Dutch bonds	Importance
The German rate is the true 'risk-free' rate – the Dutch yield is 45 basis points higher than the German yield on 10-year bonds in the period January to August 2012 inclusive. Using German bonds will give a result which is closer to the true risk-free rate.	Medium

Some of the spread between Dutch and German bonds might be due to liquidity and should therefore not be reflected in the rate of return for regulated Dutch firms.	Medium

Arguments for using Dutch bonds	Importance
The higher Dutch yield could be reasonable given country risk considerations. Data from Dutch corporate bonds indicates that Dutch government bonds have not risen by more than corporate bonds.	Strong
Using the bonds of the country in which the regulated firm operates is standard practice, although this practice evolved during a period where bond yields for different Member States within the Eurozone were very close, and so the choice of using 'own country' bonds or German bonds made little difference.	Medium
Dutch government bonds are less volatile than German bonds, and hence give more stable predictions.	Weak

4 THE EQUITY RISK PREMIUM

The ERP is an estimate of the additional return that investors expect – or demand – for holding relatively risky stocks as compared to holding a safe 'risk-free' asset. The questions we address with respect to the ERP in this section of the report are:

1. Which method should be used to make ex-ante estimates on the ERP? There are broadly three ways to estimate the ERP:
    a. Using historical data on the excess return of stocks over bonds
    b. Using a dividend growth model
    c. Survey data
2. To what extent should international data (for example Eurozone data) be used?
3. Are there structural factors which justify a modification of the measured ex-post market risk premium?

We begin by giving an overview of the NMa's and OPTA's current approaches to estimating the ERP.

4.1 OVERVIEW OF THE NMA'S AND OPTA'S CURRENT METHODS OF ESTIMATING THE ERP

NMa method

The NMa use a mixture of the historically realized (ex post) and, to lesser extent, future (ex ante) data. The historically realized market risk premium is based on the long-term geometric and arithmetic averages of the results of Dimson, Marsh and Staunton (DMS). The NMa relies on data from the Dutch market which is updated as recently as possible. The ex ante estimate of the ERP is based on academic studies and surveys of academics and businesses. We understand that the NMa has expressed the intention to do research on structural factors that lead to better diversification of risk that could lead to the use of a broader data set than only the Netherlands.

OPTA method

OPTA also estimates the ERP using a mix of historical ex post data and future data, with each method counting for 50 per cent to the final estimate. The historical realized market risk premium is based on long-term arithmetic average of the results of DMS, and the data set used is the long-term average for the last three years using Eurozone Data. The future market risk premium is based on the Dividend Growth Model, using data from Bloomberg, and is based on the average of the last three years' of long-term Dutch data.

4.2 Overview of Methods Used to Determine the ERP

There are multiple methods that are commonly relied upon to determine the ERP. However, the methods can broadly be characterized as falling in the following categories based on the data they rely on.

- Historical data
- Forward-looking estimates
- Survey results

For each category, there are multiple manners in which the ERP estimate can be obtained. For example, historical data can be for a variety of different periods, locations, and based on simple averages or models. Forward-looking estimates typically rely on forecasted growth rates to assess future stock returns. Survey results are obtained from surveys about individuals' perception of the current or forward looking ERP.

4.3 Historical data

Historical data are often used in their raw form, so that averages of the historical ERP are used as an estimate of the forecast ERP. Other uses make adjustments for historical phenomena that are found to be unlikely to occur going forward and some incorporate key economic factors to assess the impact of current or forecasted economic conditions. The latter are referred to as conditional estimates of the ERP.

Raw Historical Data

Using historical data to estimate the ERP implicitly assumes that the past is the best guide to the future. The standard data source for ERP estimates based on historical data is the work of Dimson, Marsh and Staunton (DMS). The DMS data set calculates the average excess return of stocks over bonds over more than 100 years, for a large group of world markets. Both OPTA and NMa already use this data source. When using the raw historical data the key issue becomes what time period to use data for, whether to use a long-term or a short-term ERP measure and exactly how to measure the ERP.

Modifying Historical Data

There is of course no guarantee that long-run historical averages exactly match the expected *future* ERP that investors demand now. In their work, DMS note a number of unexpected and positive factors that might have led the realized ERP to be higher than the ERP that investors would have demanded or expected. They suggest several downward adjustments to the historical ERP, to account for events which happened in the past but, in the view of DMS, are unlikely to occur in the future.

For example, DMS argue that advances in technology have made investment diversification cheaper and easier than it was 100 years ago. A more diversified investor has lower risk and so should be content with a lower expected ERP than if the past. If risk premiums have declined, say over the last 50 years, the decline would have reduced investors' required rates of return and generated higher stock prices, other things equal. According to this line of argument, historical-average ERPs could therefore be upward-biased forecasts of future MRPs.

Symptoms of a declining ERP could include an upward trend in stock prices relative to dividends or earnings. Price-dividend ratios have indeed increased over the last 50 years, and DMS argue that this upward trend is unlikely to continue. They therefore adjust average MRPs downward to remove the return contributed by the increasing price-dividend ratios we have seen in the past. .

Adjusting the historical averages for trends in price-dividend ratios may seem plausible, but DMS ignore other reasons why price-dividend ratios have increased. Corporations' cash payout has shifted from dividends to other channels, including share repurchases and payments to selling shareholders in takeovers. Repurchases are now "the dominant form of payout" in the U.S.[26] These changes have generated higher price-dividend ratios (other things equal) simply because dividends now account for a much smaller fraction of total payout. Therefore the trend of increasing price-dividend ratios does not necessarily imply that the expected ERP is lower than historical averages. Looking only at dividends understates the total payout to investors. Moreover, when overall payout decreases, reinvestment and growth should increase. DMS make no adjustment for additional growth from increased reinvestment.

Looking at international diversification, the world ERP (based on DMS data) is 5.8% against bills whereas the Dutch and German ERP against bills are 6.4% and 9.6%, respectively. So the increase in diversification has provided room for a reduction in the raw ERP of about 60 basis points for the Dutch investor, being the difference between the Dutch ERP and the world ERP. However, two factors make this figure upward biased. First, the ERP is estimated over 112 years, and part of the diversification benefits have already been realised. Second, the figure has to be viewed in the light of the exchange rate risk, which historically about 0.18% for the world (0.31% and 0.27% for the Netherlands and Germany, respectively).[27] Thus, the absolute upper limit on any adjustment for diversification is 0.42%, but even that figure is over estimated as some benefits are incorporated in the ERP already.

[26] D. J. Skinner, "The evolving relation between earnings, dividends, and stock repurchases," *Journal of Financial Economics* 87 (2008), p. 584.
[27] DMS Table 11.

The supply-side estimate of the MRP is based upon the observation that the "supply" of market returns is generated by the productivity of businesses in the real economy. Investors should not expect to have returns much higher or much lower than those produced by businesses in the real economy. A paper by Professors Ibbotson and Chen (2003) adopts a supply-side approach to estimate the forward looking long-term sustainable equity returns and equity risk premium based upon economic fundamentals. The primary difference between the supply-side estimates and historical realized estimates of the MRP is that the supply-side model notes that the increase in the average price-earnings ratio for stocks cannot continue. Therefore, the growth in the average price earnings ratio is subtracted from the other factors that generate returns in the market. Ibbotson and Chen's supply-side estimate of the U.S. equity risk premium over the long-term risk-free rate is updated annually and reported in the Morningstar Ibbotson SBBI 2012 Valuation Yearbook. The estimate for the U.S. is currently 4.10% in geometric terms and 6.16% on an arithmetic basis.[28]

On the other hand the NERA report points out that recent low levels of stock returns have depressed the historical ERP, but this "produces the counterintuitive result that large falls in the stock market lead to reductions in the expected return."[29] The OXERA report also notes the relationship between market volatility and the expected ERP, concluding that the ERP is below the levels during the financial crisis but above pre-crisis levels. They also make the intuitive argument that as volatility and risk-rises, the rate of return demanded should increase. In contrast, the ERP estimated by DMS in 2009 actually fell, because of the poor performance of shares. Therefore the crisis likely justifies an upward adjustment to the ERP as estimated by the historical data. This leads us to the conditional MRP estimates.

Conditional ERP Estimates

The notion that market volatility increases the ERP is consistent with the academic literature which finds a positive relationship between the ERP and volatility. For example, Kim, Morley and Nelson (2004) find a positive relationship between stock market volatility and the equity premium[30] while Bansal and Yaron (2004) demonstrate that economic uncertainty plays an important role in explaining the MRP.[31] In their model, higher uncertainty (measured in their paper by volatility of consumption) leads to higher conditional MRP.

There are also a number of papers that argue that the MRP is variable and depends on a broad set of economic circumstances. For example, Mayfield (2004) estimates the MRP in a model that explicitly accounts for investment opportunities. He models the process that governs market volatility and finds that the MRP varies with investment opportunities which are linked to market volatility. Thus, the MRP varies with investment opportunities and about half of the measured MRP

[28] Morningstar *Ibbotson SBBI 2012 Valuation Yearbook*, p. 66.

[29] NERA report, section 4.2 p.17.

[30] C-J. Kim, J.C. Morely and C.R. Nelson (2004), "Is There a Positive Relationship Between Stock Market Volatility and the Equity Premium," *Journal of Money, Credit and Banking*, vol. 36.

[31] Bansal, R., and A. Yaron (2004), "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles", *Journal of Finance*, Vol. 59 (4): 1481-1509.

is related to the risk of future changes in investment opportunities. Based on this approach, Mayfield estimates the U.S. MRP to be 5.6 percent measured since 1940.[32] However, the problem with such an approach is determining when the MRP has changed and by how much. Another version of the conditional MRP is found in French, Schwert, and Stambaugh (1987),[33] for example, who find a positive relationship between the expected MRP and volatility of stock returns. Put differently, the conditional MRP varies with the volatility in the stock market.

4.4 FORWARD LOOKING ESTIMATES

Some practitioners forecast the expected MRP. To do so, a DCF model is commonly used to estimate the expected return on the market (e.g., the S&P/TSX companies) and subtracting the forecast government bond (or bill) yield to obtain a forward looking estimate of the expected premium that stocks command over bonds. This forecasted MRP can then be used with a forecasted risk-free rate to estimate the forward-looking CAPM estimate of the cost of equity. This method is also a version of the Conditional MRP as the forecast depends on the economic circumstances at the time of the forecast.

Dividend Growth Models

Other prospective MRP estimates are based on dividend-discount models, which forecast dividends and dividend growth and back out the rate of return consistent with observed stock prices. Dividend-discount models typically give MRP estimates higher than historical averages. For example, the latest MRP forecasts from Bloomberg's dividend discount model are between 7.74% and 9.58% for developed economies.[34] The Bank of England also produces ERP forecast based on dividend-discount models, and forecasts the U.K. FTSE and Euro Stoxx MRP at a little over 7%.[35]

The NERA report seems to justify the use of a DGM on the basis that, in their view, it has a more solid theoretical grounding. The implication is that because the ERP is a forward-looking estimate, the DGM will give a better answer than using 'backward looking' historical data.

However, we do not think it is correct to characterize the use of historical data as 'backward looking'. Rather, as we note above, the premise is that the past is the best guide to the future. Moreover, the ERP estimate will only be *based* on the historical data. As we discuss above, economists have recognized that there are a number of events that have taken place in the past that may affect the historical ERP that some of these events may not be repeated, and so the historical data should be revised to account for these events and make a better forward-looking ERP estimate. We discuss some of the potential changes to the historical ERP in section above. Accordingly, dismissing the historical data altogether, rather than simply trying to make some adjustments, seems unfounded.

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[32] E. S. Mayfield, "Estimating the market risk premium," *Journal of Financial Economics* 73, 2004, pp. 465-496.

[33] K. French, W. Schwert and R. Stambaugh, "Expected Stock Returns and Volatility," *Journal of Financial Economics* 19, 1987.

[34] Bloomberg uses a three-stage dividend-discount model, which allows a high near-term growth rate of dividends and earnings, but requires convergence to a relatively low, sustainable long-term growth rate.

[35] Bank of England, "Financial Stability Report," June 2012, Issue 31, Chart 1.11 p. 10.

In our view dividend-discount models give interesting support to the historical data. But the results are volatile and rather subjective, based as they are on the views of analysts, forecasts from dividend-discount models suffer from some of the same flaws as survey data. As one recent paper noted:

> "consensus long-term earnings growth estimates routinely exceed sustainable GDP growth. The current consensus growth rate for earnings on the S&P 500, according to the Zacks Investment Research survey, is 10 percent, which, if we assume a consensus inflation expectation of 2–3 percent, corresponds to 7–8 percent real growth. Real earnings growth of 8 percent is six times the real earnings growth of the past century, however, and three times the consensus long-term GDP growth rate. This growth is not possible."[36]

Stability, predictability and a lack of volatility are desirable in a regulatory context. The historical ERP provides a good 'anchor' for estimates and prevents large changes in the ERP from one regulatory period to the next. However, the higher estimates resulting from dividend-discount models indicates that choosing a point from the higher end of the historical data is probably justified. Figure 11 and Figure 12 below compares the ERP as forecast using Bloomberg's dividend discount model and the historical ERP from DMS. While the figures show that the historical ERP is less volatile than the forecasted ERP it is worth keeping in mind that both the historical ERP and the forecasted ERP are estimated with a substantial standard error.

[36] Robert D. Arnott, Equity Risk Premium Myths, published in 'Rethinking the Equity Risk Premium', *Research Foundation of CFA Institute*.

Figure 11: Comparison of Bloomberg Forecasted MRP and DMS Historical MRP for the Netherlands

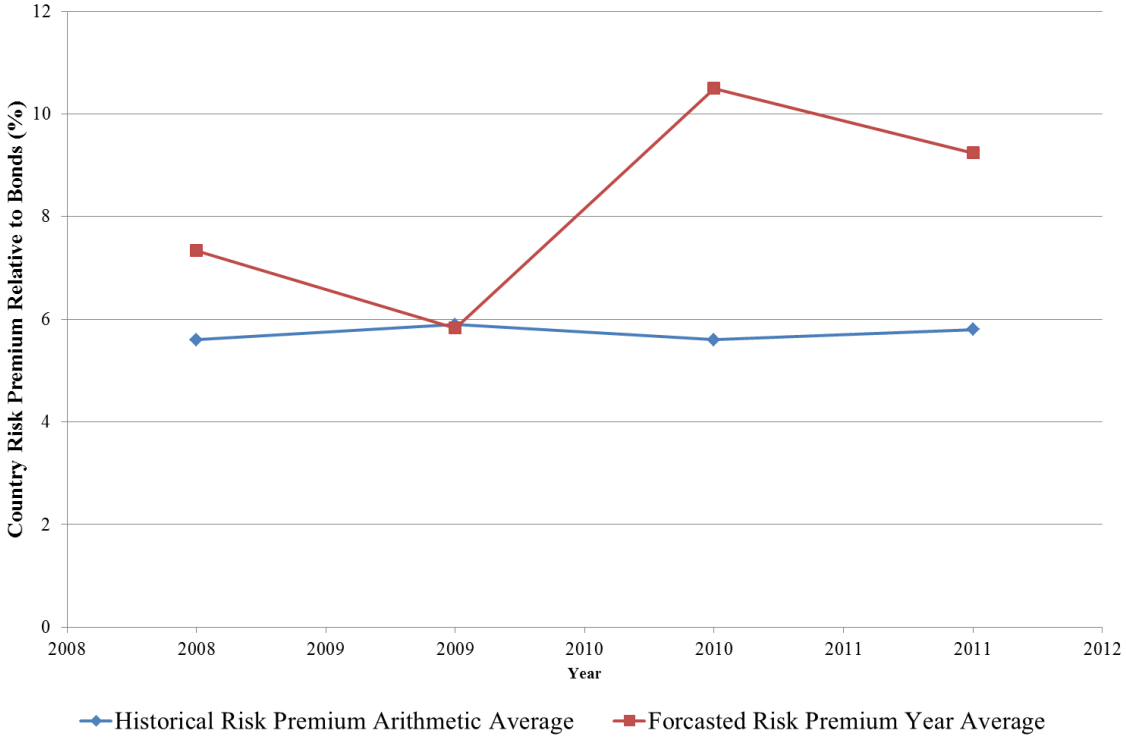
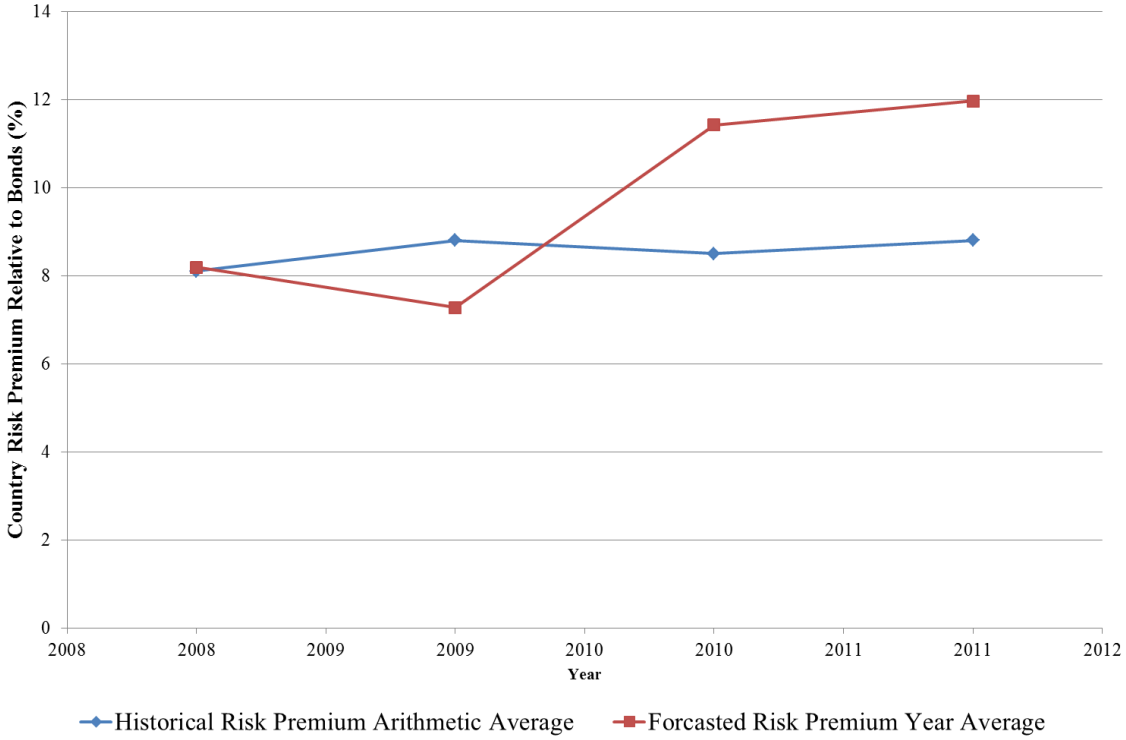


Figure 12: Comparison of Bloomberg Forecasted MRP and DMS Historical MRP for Germany



4.5 SURVEY DATA

In theory, since the ERP is a forward-looking estimate, simply asking people what they expect the ERP will be in the form of a survey seems like an appealing idea. In practice, the use of survey results to estimate the ERP is problematic. As one recent paper noted:

> "The consensus [i.e. survey] method might appear to be a very good approach; when using this method, one attempts to obtain the estimates from the market participants themselves (i.e., the very investors who are setting the market prices). But there are a number of problems with this approach. Most of these investors have no clear opinion about the long-run outlook. Many of them have only very short-term horizons. Individual investors often exhibit extreme optimism or pessimism and make procyclical forecasts, and so following a boom, they can have ERP estimates that exceed 20 percent or 30 percent. Following a recession or a decline in stock market prices, their estimates of the ERP might even be negative. Academics and institutional investors may be more thoughtful, but any survey of their opinions would have to be very carefully designed. I have seen surveys, however, that do not seem to even clarify whether the questionnaire refers to arithmetic mean returns or geometric mean returns. Many surveys also do not make clear whether the ERP to which they refer is the excess return of stocks over government bonds or Treasury bills or some other type of bond. This lack of clarity makes the surveys very difficult to interpret."[37]

For example, a recent survey of the ERP in 56 countries included estimates for the ERP in the Netherlands. Based on 48 responses, the survey came up with a low estimate of about 2% and the highest estimate was over 12%. Most of the answers fell in a range between 4-8% – still a large range.[38]

The variability of survey results is not new. In a 2000 paper concerning the ERP, Professor Brealey of the London Business School[39] cites widely varying results from four surveys as evidence of their unreliability.[40] From the surveys he considered, estimates for the ERP varied between 16% and 3% over short-term US Treasury bills. The highest estimates occurred in a 1997 Montgomery Asset Management survey in which US mutual fund managers desired as high as 16% over short-term Treasury bills. An August 1997 poll by Paine Webber indicated a premium of only 9% over Treasury bills.

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[37] The Equity Risk Premium, Roger G. Ibbotson Professor in Practice, Yale School of Management Chairman, Zebra Capital Management p.20, published in 'Rethinking the Equity Risk Premium', *Research Foundation of CFA Institute*.

[38] Based on Figure 1 of Fernández, Pablo, Javier Aguirreamalloa, and Luis Corres. 2011. "Market Risk Premium Used in 56 Countries in 2011: A Survey with 6,014 Answers." Working Paper WP-920, IESE Business School May 2011.

[39] Professor Brealey also consults exclusively with *The Brattle Group*. With Professor Stewart Myers of the Massachusetts Institute of Technology (who is a partner of *The Brattle Group*), Professor Brealey has written *Principles of Corporate Finance,* which for the past twenty years has been the world's best-selling textbook in corporate finance.

[40] Brealey RA, "The New Economy and the Cost of Capital", London Business School, September 2000.

As noted above, survey results are also subject to changing market sentiment. Professor Ivo Welch has produced two interesting surveys of financial economists concerning the ERP. His surveys would seem to command more weight than surveys of fund managers, who might be more prone to influence by prevailing market sentiment. However, it appears that financial economists are also influenced by market sentiment. Professor Welch's 1998 survey of financial economists estimated the equity risk premium at just over 7%. A following survey in September 2001, in contrast, came at a time of greater pessimism. The audience estimated the equity risk premium at only 5%.[41] If the audience had analysed recent stock performance objectively, one would have expected them to raise their estimates of the equity risk premium rather than lower them. The poor performance of stocks since March 2000 indicated significant market risk, which is associated with a higher equity risk premium. If the audience provides high estimates of the equity risk premium at times of rising stock prices, and low estimates at troubled times, it seems that the survey does little more than reflect short-term optimism or pessimism. For these reasons we do not recommend the use of survey data in estimating the ERP.

4.6 ERP METHODOLOGY OF OTHER REGULATORS

All of the regulators surveyed base their ERP decisions on the historical DMS data in one form or another. The exception was the Belgian energy regulator, the CREG, which did not specify how it had arrived at its the ERP estimate. Moreover, almost all of the regulators surveyed relied only on the DMS data. Within the sample, we see some regulators relying on the arithmetic average, others on the geometric average, and others on a mixture of both. In terms of geography, the UK regulators seem to have relied on DMS data for the UK only, rather than looking at an average European return. Similarly the CER in Ireland has based its 2010 estimate on data for the relatively small Irish market. Portugal considered a wider geographic area, but only because data of a sufficient period of time was not available for Portugal. We infer than if such data had been available for Portugal, then the ERSE would have used it – so that the decision to rely on a wider geographic data set was pragmatic rather than being based on a point of principle.

The CER in Ireland is one of the few regulators that has also used some forward looking estimates. In its 2005 ERP decision, the CER used survey data and estimates from dividend growth models. However, in its 2010 decision the CER seems to have abandoned this approach and reverted to the standard method of using historical data.

Several regulators have noted the effect of the financial crisis in their decisions since 2008, and adjusted the ERP to account for the crisis, though none have been explicit about the size of the effect. In its 2009 decision Ofgem noted the increase in uncertainty in the ERP relative to the previous price control. Also in 2009 Ofwat justified choosing a value for the ERP at the high end of the historical estimate because of the effects of the financial crisis, as did the CER in its 2010 decision.

Table 4 below summarizes the various decisions and methodologies applied.

[41] Welch I, "The Equity Premium Consensus Forecast Revisited", 8th September 2001.

Table 4: ERP Methodology of other regulators

Regulators	Date	Level	Country	Description
Ofgem: Transmission (TPCR 2007-2012)	4 December 2006	4.5%-6.25%	**UK**	In its 2006 price control Ofgem did not set an MRP explicitly. It estimated the total market return based on a consultant's report which calculated the total market return as an arithmetic average based on world data from 1900-2000, from DMS dataset.
Ofgem: Transmission (TPCR4)	8 February 2011	4.50%	**UK**	The TPCR4 determination does not explicitly favour any equity risk premium (ERP). However, given a risk-free rate of 2.5 and the apparent favouring of an equity beta of 1.0, the choice of 7.0 per cent for the cost of equity implies an equity risk premium of 4.5 per cent. Moreover, Ofgem considered the DMS and the total market return. More precisely, the authority highlighted Smithers' standard argument that the arithmetic mean is the correct concept, but that the arithmetic mean of an assumed normal distribution will tend to over-state returns relative to the arithmetic mean of a lognormal distribution. Ofgem added that if there had been a downwarding on equity returns, it would have been, therefore, reasonable to fix an ERP between 4.5% and 5%.
Ofgem: Distribution (DPCR5)	7 December 2009		**UK**	Ofgem considered third party evidence such as the Dimson, Marsh and Staunton dataset and also the views of other regulatory bodies (the Competition Commission and Ofwat). Ofgem included an additional premium in the ERP to reflect the fact that there is perhaps greater uncertainty in the cost of equity for DPCR5 than at The Gas Distribution Price Control Review (GDPCR).
Ofcom	3 February 2012	5%	**UK**	Ofcom estimated the ERP by reference to the DMS model. In particular, they considered the latest historical ERP evidence reported by DMS which shows that the historic premium of equities over bonds for the UK remains at 5.2%. Moreover, the 2011 DMS report suggested a long-run arithmetic mean premium for the world index of around 4.5-5%.
Ofwat	23 July 2009	5.40%	**UK**	Ofwat stated that the ERP value is at the high end of the range proposed by Europe Economics (itself based on DMS model). By adopting this EREP level, Ofwat wanted to reflect the riskier economic conditions within which the cost of capital is set.

Regulators	Date	Level	Country	Description
Competition Commission (Heathrow, Gatwick and Stansted)	3 october 2007 and 4 November 2008	2.5%-4.5%	**UK**	The Competition Commission concluded that the appropriate range for the ERP is 2.5% to 4.5%. More precisely, the lower end of the range is consistent with the ex-ante estimates by Dimson et al (2002, 2007) and Gregory (2007) which are based on historical data and the upper end of this range is consistent with the ex post estimates by Dimson et al (2007) of long-run historical returns.
CREG	24 November 2011	3.50%	**Belgium**	It is unclear hoew the CREG derived its MRP estimates. The MRP estimates remain unchanged since 2003.
ERSE (Electricity Price Control)	December 2008	5%-6.5%	**Portugal**	The ERSE considered the 50-90th percentile range of Dimson, Marsh, and Staunton's geometric average of international market returns, as well as the global weighted mean of each country's return, and fixes the nominal market risk premium at 5-6.5%.
ERSE (Gas Transportation Price Control)	June 2010	3.75% -4%	**Portugal**	ERSE noted that the time-series data spanning more than 30 years, that is required to estimate the MRP, do not exist for Portuguese financial markets. They cite the international popularity of Dimson, Marsh, and Staunton (2002), and support focusing on the geometric mean. ERSE ultimately chose to use the 50-75th percentile range of the MRPs resulting from global historical geometric means as their risk premium.
ERSE (Electricity Distribution)	December 2011	6.50%	**Portugal**	n.a
AEEG	12 January 2007	4.00%	**Italy**	The Authority has calculated the ERP by applying different methodologies. It has been found that the ERP is equaled to 7.7%, by applying the arithmetic average method, 4.4% if it is calculated as a geometric average or 1.8% if the ERP is computed by applying the dividend growth model. The authority seems to have adopted the second methodology since it has stated that the ERP is equaled to 4%.
CER	9 september 2005	5.25%	**Ireland**	The CER estimated the MRP by reference to historical returns based on the Dimson, Marsh, and Staunton data set. They also included a wide variety of forward-looking estimates from academic sources, which used surveys, dividend growth models (DGM), historical estimates of forward-looking rates, and other methodology. CER also considered regulatory precedent. . These three methods combined to provide a range of possible MRPs. CER selected a value near the high end of the range.
CER	19 November 2010	5.20%	**Ireland**	It is not clear how CER determined the ERP. However, CER considered Europe Economics approach which based its range estimate of the ERP on Irish data rather than on international data, and chose a point figure towards the top end of the range to reflect the potential for the ERP to be temporaly elevated during period of recession.

4.7 CONCLUSIONS ON THE ERP

We have summarised the arguments for different ways of estimating the ERP in Table 5 below. We have rated each argument either strong, medium or weak depending on how much weight we think should be assigned to it.

Table 5: Summary of ERP arguments and their importance

ERP Arguments	Importance
There is good evidence that investors in Dutch regulated firms can and do diversify their investments Europe-wide. Moreover, relying only on Dutch historical returns will increase the statistical error in the ERP. Therefore estimating the ERP based only on Dutch historical returns is a weaker approach than relying on European returns.	Strong
Survey results have in the past tended to be unreliable estimators of the ERP, and the results vary strongly according to the precise questions asked and the people that are asked the question.	Strong
The use of historical returns, and in particular the DMS data series, is the most common way to estimate the ERP used by regulators.	Medium
The historical ERP is 'backward looking' and therefore not a good forecast of the future, expected ERP.	Weak
The DGM is a better forward looking estimate that using historical data.	Weak

Both NMa and OPTA rely on historical returns to help estimate the ERP. We strongly support this approach, and specifically the use of the DMS data. The NMa also relies on survey data. This seems a potentially weaker approach. Survey results have in the past tended to be unreliable estimators of the ERP, and the results vary strongly according to the precise questions asked and the people that are asked the question.

OPTA uses ex ante information based on the dividend growth model. We sympathize with the desire to include an explicitly forward-looking estimate of the ERP. If the regulators want to include a forward looking estimate, then estimates from dividend growth models will be more reliable than survey evidence. However, in our view it would be better to use the ERP evidence from dividend growth models to support justify adjustments to the ex post ERP estimates based on the historical evidence rather than use the estimates from the dividend growth models directly in the ERP estimate. ERP estimates from dividend growth models tend to be more volatile than estimates from the historical data series. This is because it is hard for one additional year to change the average of over 100 years' worth of data. In contrast, dividend forecasts can be changed radically from one-year to the next. This could of course mean that ERP estimates based on dividend growth models are likely to be more accurate as they respond to events more quickly. But in a regulatory setting, we think that a premium should be placed on predictability and stability, which suggests putting more weight on the historical averages. However, it is also clear that there is no academic consensus as to whether the historical data or estimates based on dividend growth models are superior, and so we cannot characterize the current OPTA approach as a significant weakness.

5 CONSISTENCY IN THE WACC PARAMETERS

In this final section we briefly highlight some consistency issues in the CAPM and the Weighted Average Cost of capital more generally.

In section 3.2 we already discussed the need for consistency between the ERP estimation and the choice of risk-free rate. In sum, historical ERPs are measured over short-term bills or long-term bonds. Accordingly, when using an ERP measured over long-term bonds, the risk-free rate should also be based on long-term bonds.

We have also given our support to the idea of estimating the ERP based on the ex post ERP measured in Europe as a whole, rather than only the Netherlands. This results in a less volatile estimate of the ERP with smaller error and better reflects the perspective of Dutch investors. The implication of this is that beta should also be measured against a European-wide investment portfolio. That is, beta for stock *i* should be calculated as the co-variance of the return on stock *i* and the return on a Europe-wide market index.

Given that we are measuring an ERP based on Europe-wide data – that is the excess return of European stocks vs. the return on European bonds – is it inconsistent to use a Dutch or German risk-free rate, rather than some European average risk-free rate? The answer is no – we are simply using Europe-wide data to generate an estimate of the ERP demanded by a Dutch investor. In practise there is only one risk-free rate – which is the German bond rate, although as we discuss in section 3.3 using Dutch government bonds for the risk-free rate seems reasonable.

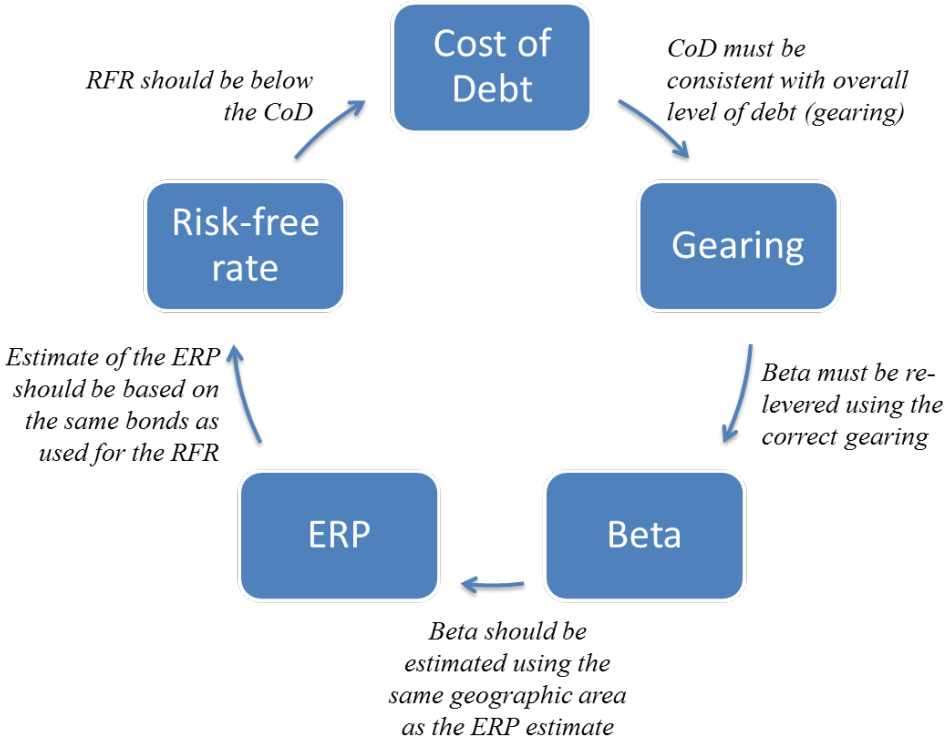
Some practioners have noted the negative correlation between the ERP and the risk-free rate – in other words bond yields. For example, following the crisis bond yields, and hence the risk-free rate fell as the authorities attempted to support economies in the EU. At the same time, most people believe that the ERP has risen due to increased risk-aversion following the crisis.

As an empirical matter, the ERP usually changes by less than the change in bond yields. Specifically, studies of the relationship between a forecast ERP (commonly using the dividend growth model) and the yield on long-term government bonds indicate that the ERP goes up by approximately 0.5% when government bond yields decrease by 1%.[42] Thus, a decline in the government bond yield is likely to lead to an under estimation of the cost of equity using the CAPM, if no change is made to the ERP. This is consistent with our views in section 4, where we conclude that the ERP should be adjusted upward at times of market stress and volatility, based on the results of for example dividend growth models.

An alternative approach would be to simple maintain the old ERP and use a higher risk-free rate, perhaps by taking a pre-crisis risk-free rate. However, we do not recommend this approach, as it essentially combines two measures that are incorrect – an inflated risk-free rate and a depressed ERP – so as to try and estimate a correct cost of equity. In our view it is better to use the correct risk-free rate and make an adjustment to the ERP so that this is also correct.

[42] R.A. Morin, *New Regulatory Finance*, Public Utilities Report, Inc., 2006, pp. 128-129.

Figure 13: Summary of the relationship between parameters of the WACC calculation



Another important element of the WACC calculation which needs to be consistent in the assumed level of gearing, or debt to equity ratio, and the beta. The more heavily indebted or leveraged a firm, the higher its beta will be. To correct for this it is standard practice to convert the observed, levered betas to 'asset' betas – that is, the beta for a firm which had no debt. There are several alternative ways to perform the re-levering. One can then calculate an average asset beta, before re-levering the beta to match the debt, or target debt, of the regulated firm. Sometimes we have seen regulators apply an asset beta when they should be using a levered beta, or else they re-lever the beta assuming a level of debt that is not consistent with the firm's actual or target debt level. This is an error.

Similarly, it is important the assumed cost of debt, or corporate debt spread, is consistent with the level of debt assumed. For example it is unlikely that a firm financed 80% through debt would be able to obtain a AAA credit rating. Accordingly, it would not be correct to mix a AAA spread with 80% leverage. Finally, the cost of debt should clearly be above the risk-free rate chosen – that is, there should be a positive debt premium. Figure 13summarizes the relationships above in a stylized form.

Appendix I: Sources for Regulatory Decisions

Table 6: Sources for risk-free rate decisions

Regulators	Date	link
Ofgem: Transmission (TPCR 2007-2012)	4 December 2006	Transmission Price Control Review: Final Proposals, p.53, parag. 8.10.
Ofgem: Transmission (TPCR4)	8 February 2011	Updating the Cost of Capital for the Transmission Price Control Rollover, Ofgem- Phase 2 Final Report, p. 3, parag. 2.5.
Ofgem: Distribution (DPCR5)	7 December 2009	Electricity Distribution Price Control review Final Proposals- Allowed Revenies and Financial Issues, p. 11, parag. 1.36
Ofcom	3 February 2012	Charge Control review for LLU and WLR services Annexes, p. 136, parag. A8. 5.
Ofwat	23 July 2009	Future water and Sewerage Charges (2010-2015), p. 128, parg. 5.4.3
Competition Commission (Heathrow and Gatwick)		Heathrow airport price regulation (2007), Appendix F, p. 11
Competition Commission (Stansted)		Stansted airport price regulation (2008), Appendix L, p. L11.
CREG	24 November 2011	Commission de regulation de l'électricité et du gaz, ARRÊTÉ (Z)111124-CDC-1109/1, p. 24, Art 16
ERSE (Electricity Price Control)	December 2008	Parametros de Regulaçao e Custo de Capital, p. 10, parag. 3.2.
ERSE (Gas Transportation Price Control)	June 2010	Proveitos Permitidos Do Ano Gas 2010-2011 Das Empresas Reguladas Do Sector Do Gas Natural, p. 25, parag. 5.3.
ERSE (Electricity Distribution)	December 2011	Parametros de Regulaçao Para o Periodo 2012 a 2014, p. 9, parag. 2.3.1.
AEEG	12 January 2007	Criteri per la determinazione delle tariffe per l'attività di trasporto e di dispacciamento del gas naturale per il terzo periodo di regolazione, p. 23.
CER	9 september 2005	Decision on TSO and TAO Transmission Revenue for 2006 to 2010, p. 6-12, parag. 6.2.3.a.
CER	19 November 2010	Decision on TSO and TAO Transmission Revenue for 2011 to 2015, p. 52, parag. 5.3.

Table 7: Sources for ERP decisions

Regulators	Date	Country	link
Ofgem: Transmission (TPCR 2007-2012)	4 December 2006	**UK**	Transmission Price Control Review: Final Proposals, p.54, parag. 8.14.
Ofem: Transmission (TPCR4)	8 February 2011	**UK**	Updating the Cost of Capital for the Transmission Price Control Rollover, Ofgem- Phase 2 Final Report, p. 9-10, parag. 2.27 and 2.29
Ofgem: Distribution (DPCR5)	7 December 2009	**UK**	Electricity Distribution Price Control Review Final Proposals- Allowed Revenies and Financial Issues, p. 12, parag. 1.37.
Ofcom	3 February 2012	**UK**	Charge Control Review for LLU and WLR Services Annexes, p. 134, parag. A8.18.
Ofwat	23 July 2009	**UK**	Future Water and Sewerage Charges (2010-2015), p. 128, parg. 5.4.3.
Competition Commission (Heathrow, Gatwick and Stansted)	3 october 2007 and 4 November 2008	**UK**	Heathrow Airport Price Regulation (2007), Appendix F, p. 15 and Stansted Airport Price Regulation (2008), Appendix L, p. L17.
CREG	24 November 2011	**Belgium**	Commission De Regulation De l'Electricité et Du Gaz, ARRÊTÉ (Z)111124-CDC-1109/1, p. 24, Art 16.
ERSE (electricity price control)	December 2008	**Portugal**	Parametros de Regulaçao e Custo de Capital, p. 18, parag. 3.3.
ERSE (Gas Transportation Price Control)	June 2010	**Portugal**	Proveitos Permitidos Do Ano Gas 2010-2011 Das Empresas Reguladas Do Sector Do Gas Natural, p. 22, parag. 5.2.1.
ERSE (Electricity Distribution)	December 2011	**Portugal**	Parametros de Regulaçao Para o Periodo 2012 a 2014, p. 41
AEEG	12 January 2007	**Italy**	Criteri Per La Determinazione Delle Tariffe Per l'Attività Di Trasporto e Di Dispacciamento Del Gas Naturale Per il Terzo Periodo Di Regolazione, p.
CER	9 september 2005	**Ireland**	Decision on TSO and TAO Transmission Revenue for 2006 to 2010, p. 6-15, parag. 6.2.3.b.
CER	19 November 2010	**Ireland**	Decision on TSO and TAO Transmission Revenue for 2011 to 2015, p. 52, parag. 5.3.