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A review of PwC's approach to setting cost of equity in a "lower for longer" era

A report for Heathrow Airport

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Executive Summary

Heathrow Airport Limited (HAL) commissioned NERA Economic Consulting (NERA) to review a report by PwC on aspects of the cost of capital for regulated utilities, commissioned by Ofwat to inform its approach to finance issues at the forthcoming water price control (PR19). Specifically, PwC's report considers the implications for the cost of equity for water companies for PR19 (2020-25) where interest rates are low, in a so-called "*lower for longer era*".

In summary, PwC argues that a low risk-free rate environment, which PwC expects to be the case over the PR19 (or similarly H7) period, implies a reduction in the total market return (TMR), as supported by evidence on reductions in recent *realised* returns for the UK equity market. Based on this assertion, PwC concludes that long-term historical data is inappropriate for estimating the TMR in the current market environment, because it is too slow to react to short-term dynamics. Instead, PwC recommends to estimate the TMR drawing on "current" approaches, such as the application of the dividend discount model (DDM) or market-to-asset ratios (MAR). Based on its application of the "current" approaches, PwC estimates a real TMR between 5.1 and 5.5 per cent, substantially below estimates based on historical data of around 7 per cent.

In this report, we demonstrate that PwC's analysis and conclusions are flawed and that there is no evidence that the TMR has declined in the current market environment.

There is uncertainty over UK interest rates, and markets generally expect global interest rates to normalise over PR19/H7

PwC assumes that interest rates will remain low throughout the early 2020s, and correspondingly expected market returns will be lower. However, the prospects for UK rate changes have changed substantively since PwC's publication, with the Bank of England signalling earlier than anticipated increases in interest rates, highlighting the risk of PwC (or UK regulators) drawing such firm conclusions for interest rates over forthcoming regulatory periods. Moreover, it is global interest rates, and particularly US rates, that are relevant to globally diversified investors, and US interest rates are currently expected to increase to around 3 per cent (nominal) by the start of PR19/H7.

PwC provides no meaningful evidence that the cost of equity is low when interest rates are low

PwC presents evidence seemingly showing a decline in *realised* equity or total market return over recent periods for the UK, which it considers demonstrates that investors' *expected* returns are lower in periods of low interest rates. We show that both PwC (and Ofwat's) evidence is weak and selective, and that only slight changes to its approach, e.g. the period selected, can substantially change the results of the analysis.

For example: in Appendix 13 of its consultation, Ofwat shows a supposed decline in UK equity returns over the period since 1966 drawing on PwC's analysis. However, the analysis is based on an arbitrary choice of time period (i.e. 1966-2016), and divided again arbitrarily into 10 year sub-periods within this time period. Ofwat and PwC's conclusions of a decline in market returns do not hold if we adopt alternative periods. For example, if we start with a

time period in 1962, the decadal returns show no discernible trend over time, and indeed the final period shows a return of 8.5 per cent, above the long-run historical average of around 7 per cent.

Furthermore, and much more importantly, we show that realised equity returns for other major markets, namely the US and Germany, have clearly increased in recent periods with the decline in global interest rates, directly contradicting PwC's thesis that investors' expected returns are lower when interest rates are lower. PwC and Ofwat completely ignore this broader evidence on global trends in equity returns which is surprising since it is so well documented that there is substantial correlation between global equity markets.

More generally, it is not reasonable to place reliance on short-run *realised* returns as a measure of the *expected* cost of equity, given the volatility in stock market returns and high standard errors. DMS make the same point: "*To understand risk and return in capital markets […] we must examine periods much longer than 20 years because stocks are volatile, with major variation in year-to-year returns. We need long time series to support inferences about stock returns.*" [1]

The weight of academic evidence supports the notion of a constant TMR over time

PwC acknowledges that the ERP and RFR co-vary, and overall it agrees that the TMR should be estimated directly. However, it provides a single regression equation based on the 2000-2016 period to conclude that the TMR declines in periods of low interest rates. In doing so, PwC rejects the substantive body of academic evidence that supports the constancy of the TMR over time. For example, Smithers & Co, who have reviewed the academic literature on the constancy of the TMR on a number of occasions for UK regulators, concluded most recently in 2015 that there was a "*a remarkable degree of stability of the long-term real return*", notably drawing on studies examining more than 200 years of stock market data.

The constancy of the TMR is also supported by financial institutions, notably the Bank of England's own DDM shows a broadly constant TMR over the most recent period. PwC's analysis is at odds with the Bank of England's DDM results and other recent published evidence on the TMR from sources such as Bloomberg. It is also at odds with the wider body of finance literature which supports the constancy of the TMR over time.

PwC's DDM estimates are far lower than estimates by the Bank of England and Bloomberg

Given PwC's hypothesis that there has been a decline in expected returns in the recent low interest rate environment, PwC concludes that regulators should not draw on long run historical returns to determine the cost of equity but should use techniques that draw on current financial market expectations, such as the dividend discount model and market-to-asset ratios. Drawing on these techniques, PwC and Ofwat estimate a TMR of between 5.1 per cent and 5.5 per cent.

[1] Credit Suisse Research Institute (February 2017) Credit Suisse Global Investment Returns Yearbook, p. 12.

We show that PwC's DDM estimates of the TMR are fundamentally biased due to errors that it makes in its assumptions on short-term and long-term dividend growth. Specifically, PwC assumes that FTSE dividends grow in line with short term and long-term nominal growth in UK GDP, but provides no basis for its assumption that UK GDP forecast growth rates are a good proxy for investors' assumptions on dividend growth rates. There are a number of reasons why this is likely to be a flawed assumption, not least because FTSE companies derive over 70 per cent of their earnings from outside of the UK, which have higher forecast GDP growth than the UK. We also note that UK GDP forecast growth rates in the short term are somewhat depressed (due to factors like Brexit etc.) and are substantially lower than independent analyst forecasts of dividend growth rates for FTSE stocks, which are used by the Bank of England to forecast short-term dividend growth in its DDM.

Independent DDM estimates of the TMR by the Bank of England and Bloomberg are between 7.1 per cent and 8.2 per cent, far higher than PwC's TMR range, and consistent with (or above) long-run historical averages of around 7 per cent.

Independent analyst estimates of outperformance and other factors fully explain PwC's supposed MAR premiums

In calculating MARs for listed UK water companies, PwC fails to adjust for important drivers of water companies' valuations, including value of non-regulated activities, value of regulated activities unrelated to wholesale, value of pension deficit/surplus, as well as full extent of expected outperformance. The value of these adjustments is subject to a large degree of uncertainty, but evidence from independent analyst reports suggests that the RCV premium calculated by PwC is fully explained by these factors, and there is no evidence that the *adjusted MAR* for listed water companies is substantially different from 1.

In addition, PwC's calculations of the implied cost of equity and TMR from its "adjusted" MAR include two methodological errors, confusing real and nominal terms, and ignoring real growth in the RCV. Both of these errors lead to PwC substantially understating the (implied) TMR based on MARs for listed water companies, even under PwC's own assumptions on the "adjusted" MAR.

Market evidence does not support a reduction in TMR relative to CMA NIE determination

We have updated the different approaches employed by the CMA in determining the TMR for NIE in 2014 to calculate latest estimates of the TMR using the CMA's methodology.

Table 1
Updating methods used by CMA at NIE 2014 does not support a reduction in TMR

	CMA NIE 2014 evidence	Latest evidence
DMS long run *(historical ex post)*	6 – 7 %	6.4 – 7.3%
DMS decomposition *(historical ex ante)*	5.5 – 6 %	5.5 – 6 %
Fama-French *(historial ex ante)*	5.25 – 6.25 %	5.27 – 6.27 %
Bank of England DDM *(forward looking)*	5 – 6%	7.1 – 8.2 %

Sources: NERA analysis of CMA (March 2014) Northern Ireland Electricity price determination. section 13; DMS (February 2017),Credit Suisse Global Investment Returns Yearbook 2017; Barclay's (March 2016), Equity Gilt Study 2016; Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2(4) and Bank of England yield curves.

As can be seen in Table 1, latest evidence on the TMR based on the different methods considered by the CMA in the 2014 NIE determination do not support a reduction in the TMR. These results are clearly at odds PwC's assertion that equity returns are lower in recent periods, and demonstrate that the factors that influence required equity returns are complex and varied.

1. Introduction

Heathrow Airport Limited (HAL) commissioned NERA Economic Consulting (NERA) to review a report by PwC on aspects of the cost of capital for regulated utilities. The PwC report was commissioned by Ofwat to inform its approach to finance issues at the forthcoming water price control (PR19).[2] In particular, we review PwC's analysis for the cost of equity in a so-called "*lower for longer era*", as well as Ofwat's comments on this issue.[3]

The rest of this report is structured as follows:

- Section 2 reviews PwC's comments on the implication for the cost of equity in a lower for longer era;
- Section 3 reviews PwC's estimates of the total market return (TMR) based dividend discount models (DDM), and PwC's interpretation of market-to-asset ratio (MAR) data for the cost of capital; and
- Section 4 provides updated evidence for the total market return (TMR), using the approaches used by the Competition and Markets Authority (CMA) at previous appeals.

[2] PwC (June 2017) Refining the balance of incentives for PR19.

[3] In particular, we review: PwC (June 2017) op. cit., Appendix B – The cost of equity in a "lower for longer" era; and, Ofwat (July 2017) Delivering Water 2020: Consulting on our methodology for the 2019 price review, Appendix 13: aligning risk and return.

2. Implications of low RFR on required equity returns

2.1. PwC considers market returns are lower in a low interest rate environment

PwC states that current market expectations indicate that the cost of equity for PR19 will likely be set in a prolonged period of low interest rates (referred to as "lower for longer"). PwC argues that a low risk-free rate environment implies a reduction in market returns, as supported by evidence on reductions in recent realised returns for the UK market. PwC concludes that long-term historical data is inappropriate for estimating the total market return in the current market environment, as historical data is too slow to react to short-term dynamics and fails to include a comparable period of ultra-low interest rates. Instead, PwC recommends to estimate the TMR drawing on "current" approaches, such as the application of dividend discount model (DDM) or market-to-asset ratios (MAR).[4]

In the following sections, we show that evidence that interest rates will remain low over the PR19 (or similarly the H7) period is not conclusive. We also demonstrate that there is no evidence that recent *realised* returns for the UK or especially for global equity markets have declined as a consequence of low risk free rates. Moreover, we demonstrate that PwC's assertion that the TMR declines in periods of low interest rates rejects the substantive body of academic evidence which supports the constancy of the TMR over time. (We address PwC's evidence on DDM and MARs in section 3.)

2.2. Evidence on current low RFR persisting over PR14/H7 is not conclusive

PwC's "lower for longer" conjecture is based on the premise that both short-term interest rates and long-term bond yields will remain low due to ultra-loose monetary policies in the major economies.[5] PwC supports such premise by showing the forecasts by the UK Office for Budget Responsibility (OBR) and a historical time series of UK gilt yields, and concludes that the "*current low long-term interest rates are likely to persist for the foreseeable future*."[6,7]

We show that the market's views on the prospects for rate changes have already changed since PwC's publication, highlighting the risk of PwC/ Ofwat drawing such firm conclusions for interest rates over forthcoming review periods. US rates are also expected to normalise

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4 PwC (June 2017), Refining the balance of incentives for PR19, Appendix B, p.70-80.

5 PwC (June 2017), Refining the balance of incentives for PR19, Appendix B, p.70.

6 PwC presents evidence from the OBR which it concludes shows that rates are expected to remain below 1 per cent through to Q1 2022 "*representing a very significant softening of the rate outlook since December 2013*." PwC (June 2017) Refining the balance of incentives for PR19, Appendix B, p. 70.

7 We do not address PwC's potential reasons for ultra-low interest rates, although note that PwC concludes that many of its cited reasons are unlikely to support its notion that interest rates will be lower for longer. For example, of the arguments set out for lower real interest rates, PwC concludes that "expectations of future growth", "an aging population", and, "a lower propensity to invest" are unlikely to explain lower real interest rates, leaving "quantitative easing", "a higher propensity to save", and "shifts in the demand for safe assets and supply of safe assets", as potential explanations. PwC (June 2017), Refining the balance of incentives for PR19, Appendix B, p. 73-74.

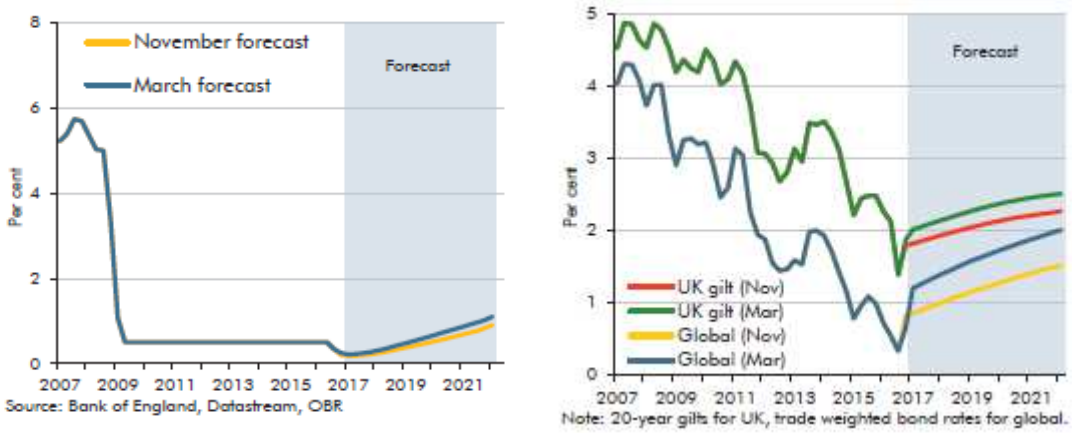
over PR19/H7, and it is global (and principally US) rates that are relevant to globally diversified investors.

2.2.1. Recent evidence calls into question PwC's assumption of "lower for longer" short-term interest rate

PwC shows the OBR's base rate forecasts published in December 2013 and November 2016, and concludes that the outlook of the base rate has been softened significantly since 2013, and the UK base rate is expected to remain below 1 per cent through to early 2022. However, recent market movements in the past few months since PwC's report highlight the risk of drawing firm conclusions on interest rates, particularly over such a long period (e.g. over H7).

In fact forecasts for interest rates over H7 have been rising over the past year. In March 2017 OBR revised the forecast of interest rates upwards (from its November 2016 forecast) on the basis of new market evidence.[8] In this March forecast the OBR projects the base rate to be 1.1 per cent by the end of our forecast period, as shown in the Figure 2.1. In addition, OBR also updated its expectation of future UK Gilt rate and global bond yields, which are both higher than at the time of their November forecast.

Figure 2.1
OBR has revised upwards the forecast of base rate



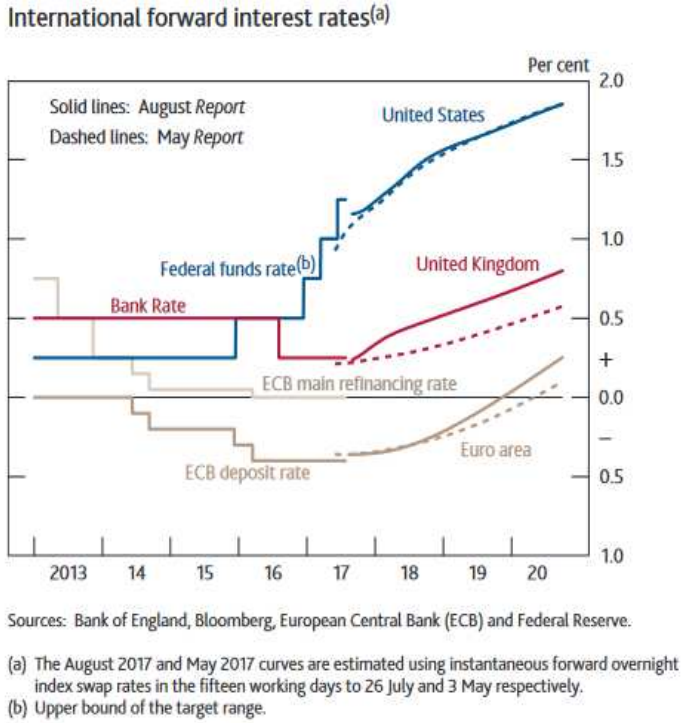
Source: OBR

Likewise, the Bank of England (BoE) has recently stated that the market expectation for short-term rates has risen in the UK and euro area has increased over the past year.[9] The market implied path for the UK official Bank rate has increased around 20 basis points since May 2017, and the market expects the rate to rise by 25 basis points in late 2018, as shown in Figure 2.2.

[8] Office for Budget Responsibility (March 2017), Economic and fiscal outlook, p.40.

[9] Bank of England, (August 2017), Inflation Report, p.5.

Figure 2.2
Bank of England data shows that short-term rate expectation has risen since May 2017



Source: Bank of England

In addition during the summer of 2017, the BoE's Monetary Policy Committee (MPC) has also signalled an increasing probability of an interest rate rise in the short-term: *"[…] if the economy follows a path broadly consistent with the August central projection, then monetary policy could need to be tightened by a somewhat greater extent over the forecast period than the path implied by the yield curve underlying the August projections.*"[10'11]

The emerging expectation of an interest rate rise is also taking place in the United States. In June 2017, the Federal Open Market Committee (FOMC) raised the target range for the federal funds rate to between 1 and 1.25 per cent.[12] On 20 September 2017, the US Federal Reserve further announced a timeline for unwinding the Quantitative Easing measures and reducing its balance sheet by October, although the interest rates were kept unchanged.[13] As shown in Figure 2.3, the median of the FOMC members' interest rate projection, a forecast

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10 Bank of England, (August 2017), Inflation Report, p.ii.

11 The Chief Economist of BoE Andrew Haldane also signals that "*Certainly, I think such a tightening is likely to be needed well ahead of current market expectations*.", and "*Provided the data are still on track, I do think that beginning the process of withdrawing some of the incremental stimulus provided last August would be prudent moving into the second half of the year.*" Source: Andrew Haldane, (20 June 2017), Speech: Work, Wages and Monetary Policy, p.15-16.

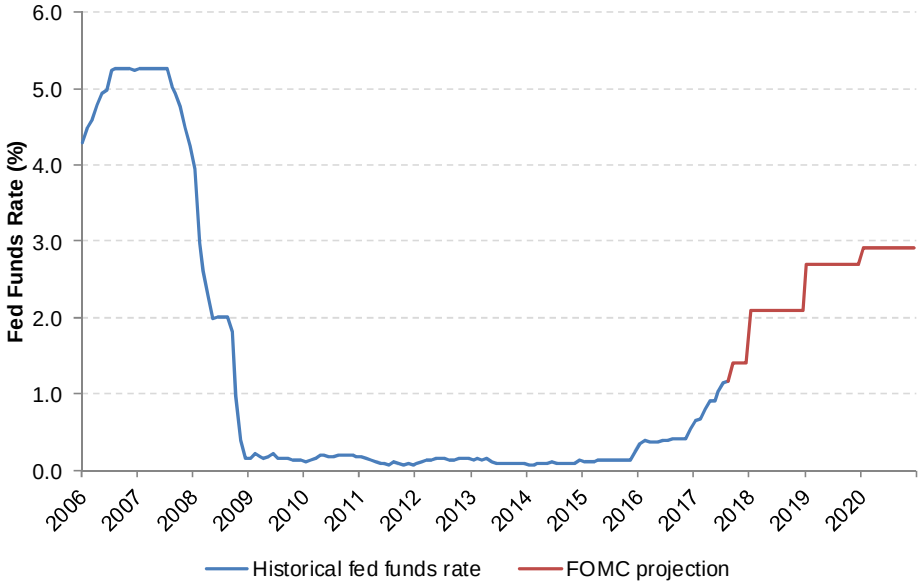
12 Federal Reserve (14 June 2017): Press Release, Decisions Regarding Monetary Policy Implementation.

13 Federal Reserve (20 September 2017): Press Release, Decisions Regarding Monetary Policy Implementation.

that is widely used by the market to understand the central bank's policies and the long-term neutral rate, is to raise federal funds rate to almost 3 per cent by the end of 2019.

In conclusion, the recent market movements in the UK highlight the risk of drawing firm conclusions on the path for interest rates over H7. Moreover, the expected increases in rates in the US presage the end of the low interest rate of environment globally. It is global and particularly US interest rates, given the dominance of the US capital markets by value, that are relevant for globally diversified investors.

Figure 2.3
The FOMC forecasts the US federal funds rate to rise to near 3 per cent by 2020



Source: Federal Reserve Bank of St. Louis, U.S. Federal Open Market Committee

2.3. No evidence that required market returns are lower in low interest rate environment

PwC provides evidence of declining market returns as a consequence of "*low equity returns in recent history*" [14] PwC argues long term historical averages are slow to react to short-term dynamics, and fail to capture structural breaks.[15] As a consequence, it concludes that historical approaches to estimating the TMR are not appropriate because they do not "*contain a comparable period of ultra-low interest rates*".

Ofwat also provides evidence of declining realised returns to equity in the recent period drawing on PwC's analysis.[16]

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[14] PwC (June 2017), op. cit., Appendix B, Figure 24, p.80.

[15] PwC (June 2017), op. cit., Appendix B, p.79.

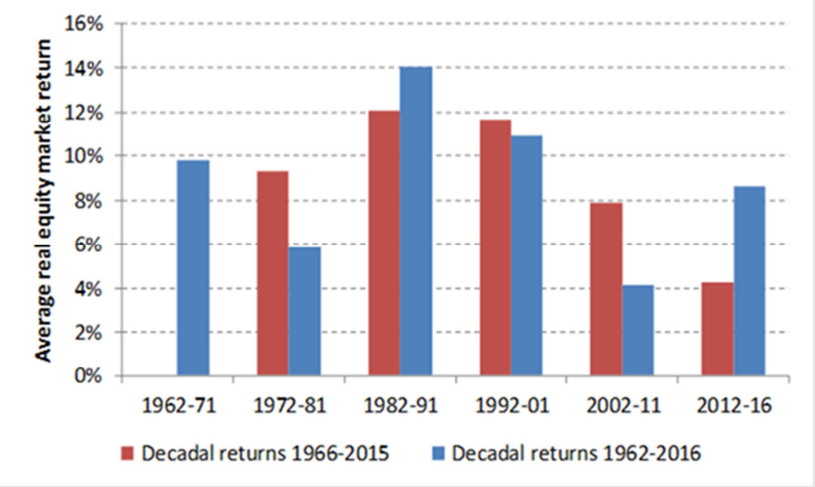
[16] Ofwat (July 2017), op. cit., Appendix 13: Aligning risk and return, p.10.

In contrast, we show that there is no evidence that recent realised returns to UK *or especially global* equities have declined, or that there has been a "structural break" in TMR as a consequence of low risk free rates. We also show that regulators should not draw firm conclusions from short periods, e.g. decadal returns, given the high standard errors. Finally, we show that evidence from other markets show an increasing TMR associated with a declining RfR, the exact opposite of PwC's assertion.

2.3.1.1. There is no evidence of a decline in UK equity returns over recent period

In Appendix 13 of its consultation, Ofwat shows a supposed decline in UK equity returns over the period since 1966. However, the analysis is based on an arbitrary choice of time period (i.e. 1966-2016), and divided again arbitrarily into 10 year sub-periods within this time period. PwC's conclusions of a decline in market returns do not hold if we adopt alternative periods. For example, if we start with a time period in 1962, the decadal returns show no discernible trend over time, and indeed the final period shows a return of 8.5 per cent, above the long-run historical average of around 7 per cent.

Figure 2.4
Ofwat's purported fall in decadal returns over period 1966-2016 is sensitive to the period chosen: Starting with the date 1962, we show there is no decline



Notes: The red bars in the chart show Ofwat's calculation of decadal returns starting from 1966. The blue bars show decadal returns calculated by NERA using DMS data adopting a start date of 1962, with the last period corresponding to a 5-year window (2012-16). The x-axis in the chart shows the periods associated with NERA's calculation of decadal returns.

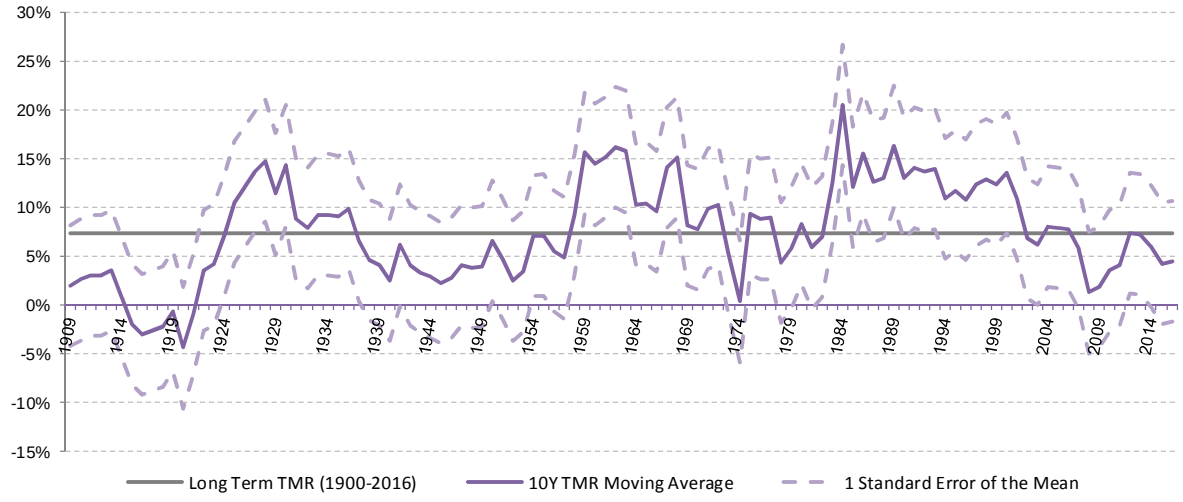
PwC also claims to show a decline in the TMR based on a 10, 20 and 30 year moving average for the period 1980-2015.[17] However, again, we can show that its conclusion is dependent on the time period chosen. For example, drawing on the full period for which DMS data are available from 1900 to 2016, the time-series shows that 10Y moving average realised returns are volatile over the extended period as expected. Although there is a decline in the 10Y moving average return for the most recent period, reflecting the sharp fall in equity markets

[17] PwC (June 2017), op. cit., Appendix B, p.80.

during the financial crisis, 10Y moving returns demonstrate volatility over time, and the peaks and troughs bear no relationship with the RfR as PwC considers.

More to the point, it requires a leap-of-faith to draw conclusions from 10Y periods given the underlying volatility in returns and the statistical uncertainty around the mean estimate. As we show in Figure 2.5, the 10Y moving average TMR over recent periods is not statistically different from the long run mean of 7 per cent. DMS make the same point: *"To understand risk and return in capital markets […] we must examine periods much longer than 20 years because stocks are volatile, with major variation in year-to-year returns. We need long time series to support inferences about stock returns."*[18]

Figure 2.5
Over a longer time horizon, there is no trend decline in the 10Y moving average. The most recent 10Y moving average is not statistically different from the LR average of around 7 per cent



Source: NERA analysis of DMS (February 2017),Credit Suisse Global Investment Returns Yearbook 2017

2.3.1.2. Other major equity markets demonstrate increases in the TMR over the recent period

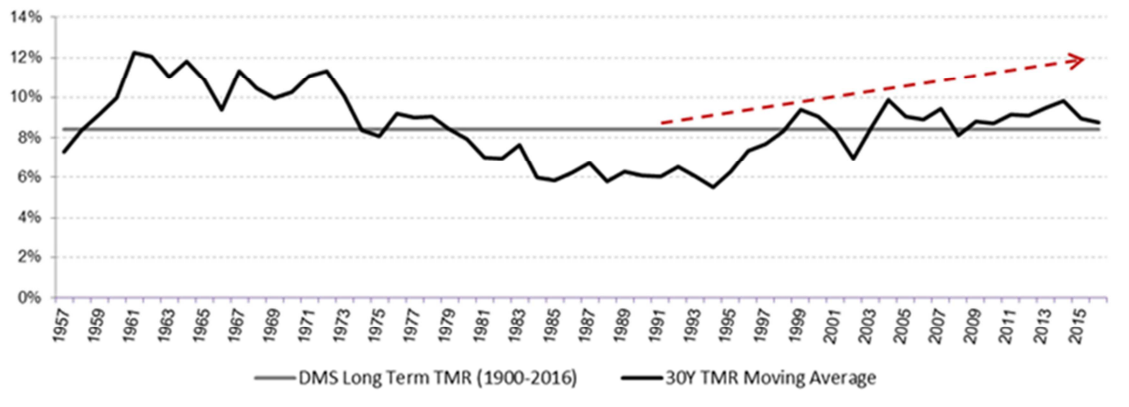
If PwC was correct that equity returns are lower in periods of low interest rates, we would expect to observe a decline in realised equity returns in other major markets, which, like the UK, have enjoyed a prolonged period of low interest rates. In fact, we observe an increase in averages of realised equity returns for both US and Germany, two of the top four global

[18] Credit Suisse Research Institute (February 2017) Credit Suisse Global Investment Returns Yearbook, p.12.

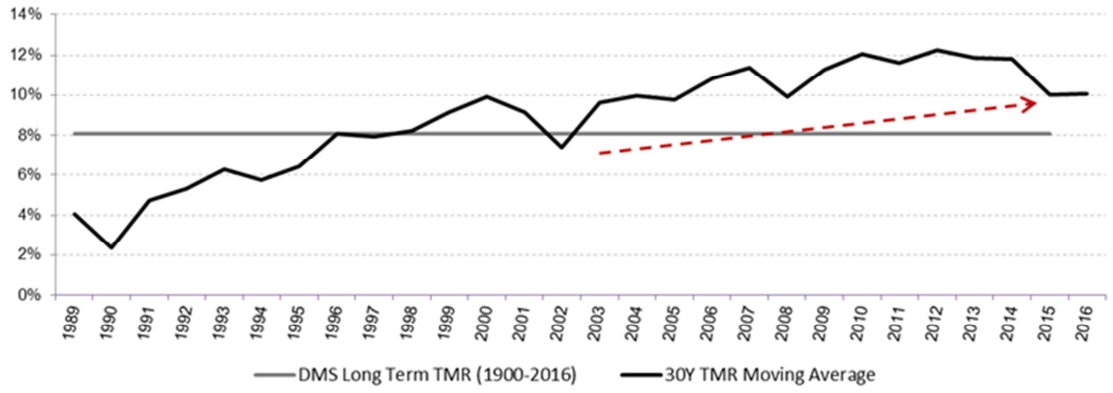
equity markets,[19] undermining PwC's assertion that TMR has declined with a declining RfR.[20]

Figure 2.6
Other major markets (including US and Germany) show an increase in 30Y moving average returns, contrary to PwC's thesis

(a) US equity market returns



(b) German equity market returns



Source: NERA analysis of DMS (February 2017),Credit Suisse Global Investment Returns Yearbook 2017

In conclusion, PwC/ Ofwat evidence on a decline in UK equity returns over recent periods is selective: the choice of alternative data periods provides contrasting results. Moreover, evidence from other markets shows an increase in realised TMR during the recent period of low interest rates, in direct contrast to PwC's assertion that expected returns should decline.

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[19] Credit Suisse Research Institute (February 2017) Global Investment Returns Yearbook 2017 – Slide Deck, slide 3.

[20] In addition, we observe a similar increase in the average of realised equity returns for France, albeit based on 20Y moving average returns (given 30y moving average series not available for a sufficiently long period of time due to data limitations).

2.4. Financial literature supports constant TMR over time

2.4.1. PwC empirical evidence on relationship between RfR and ERP does not support its premise that market returns have fallen

PwC acknowledges that the ERP and RFR co-vary, and overall it agrees that the TMR should be estimated directly. It notes: "*[...] we find that direct estimates of the TMR are more stable than the sum of the RFR and a fixed EMPR [...]. We therefore prefer direct estimation of the TMR on the basis of its relative stability*".[21]

However, PwC then claims that the "*reductions in the risk-free rate are not perfectly offset by increase in the equity risk premium (and therefore the TMR is not constant). […] In this regard we disagree with the earlier Smithers study (2003) which envisaged a broadly constant figure for the TMR.*" [22]

PwC's rejection of a constant TMR over time is based on short-run data for the period 2000-2016. By contrast, the Smithers 2003 report considered the vast body of finance literature on this issue which includes studies of 200 years of data (as we describe in section 2.4.2 below). It is not reasonable for PwC and Ofwat to refute such a body of evidence with a single regression equation based on 16 years of data.

Moreover, PwC identifies a regression coefficient between the equity risk premium (ERP) and RFR of between negative 0.76 and 0.88 for the period 2000-2016.[23] Replicating PwC's analysis, but drawing on the ERP from the Bank of England DDM and the long run risk free rate given by UK gilts, we estimate a regression coefficient of negative 0.97 (which is statistically not different from negative 1 at all conventional significance levels), which actually shows that reductions in the risk free rate were offset by an increase in the ERP over this time period when we use the independent Bank of England source for the ERP rather than PwC's own (in house) estimates. The relationship between the ERP and the RfR over this period is shown diagrammatically in Figure 2.7.

This finding shows that the PwC evidence cannot be relied upon. More importantly, as we describe in the following section, PwC ignores the wider body of finance literature which supports the constancy of the TMR over time.

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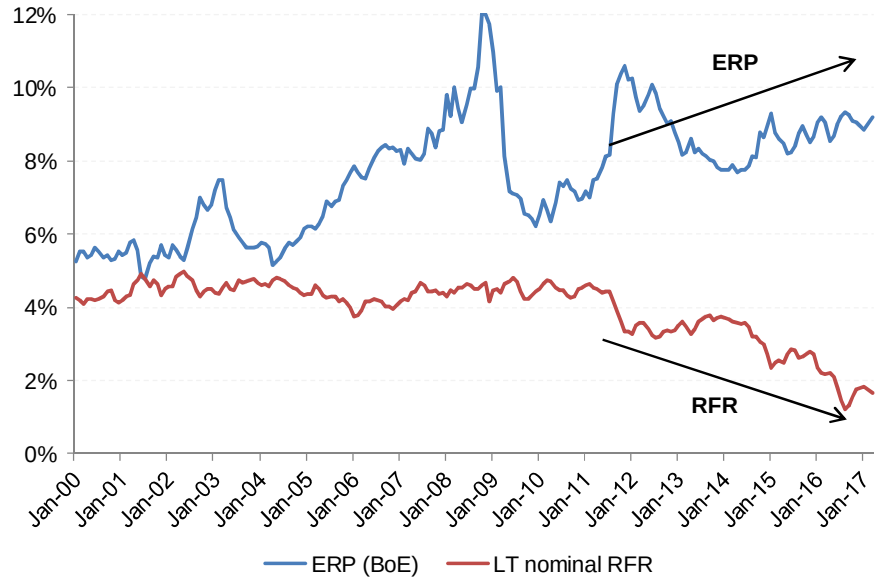
[21] PwC (June 2017), op. cit., Appendix B, p.78.

[22] PwC (June 2017), op. cit., Appendix B, p.79.

[23] PwC reports a negative regression coefficient of negative 0.76 for the period 2000-16, and negative 0.88 for the more recent period from 2010-16. PwC (June 2017), op. cit., Appendix B, p.78.

Figure 2.7
Data from Bank of England DDM support theory that reduction in RFR offset by increases in ERP over recent period



Source: NERA analysis of Bank of England data

2.4.2. Finance literature supports a constant TMR over time

2.4.2.1. Academics and financial institutions support constancy of TMR

Financial literature explains that the negative correlation between RfR and ERP is associated with the increase of risk aversion and associated "flight-to-safety" during periods of economic and financial crisis. [24] In times of heightened market volatility investors dispose of risky assets such as equity, which increases the required return for holding stocks and hence the ERP, and use the proceeds to buy risk-free assets such as government bonds, which reduces the yield of risk free assets ("flight to quality").

Empirically, a number of studies find a positive relationship between volatility and expected returns and a negative relationship between RFR and ERP while the TMR exhibits a stable mean over time, implying that over long timeframes the ERP and RfR have moved point-by-point in opposite directions.[25] As an example, some of the most compelling evidence is

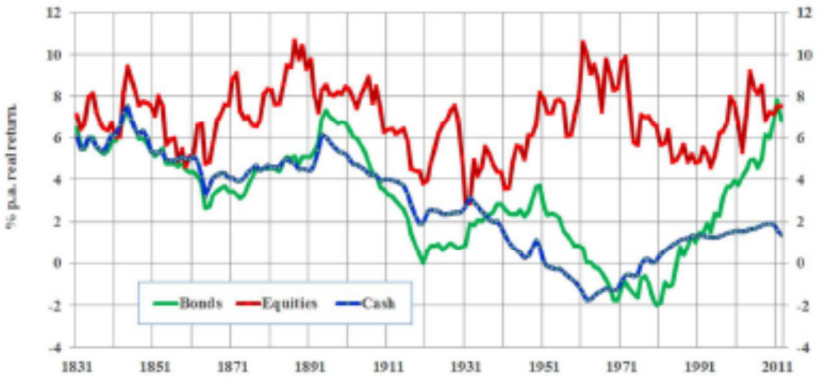
[24] See for example: (1) Campbell and Cochrane (1999), By force of habit: A consumption-based explanation of aggregate of stock market behaviour, Journal of Political Economy, 107, 205-51; (2) Wright, S. et al. (September 2006), Report on the Cost of Capital – provided to Ofgem, Smithers & Co Ltd; (3) Harris, Robert, and Marston, Felicia (1999) , The Market Risk Premium: Expectational Estimates Using Analysts' Forecasts, Darden Business School Working Paper No 99-08; (4) Maddox, F., D. Pippert and R. Sullivan (1995), An Empirical Study of ex ante Risk Premiums for the electric Utility Industry," Financial Management, 89-95.

[25] See for example: (1) Graham and Harvey (2010), The equity risk premium in 2010. (2) Cochrane and Piazzesi (2008), Decomposing the yield curve, Graduate School of Business, University of Chicago. Working Paper; (3) Wright, Mason, Miles (2003), A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK, Smithers & Company Limited.; (4) Scruggs (1998), Resolving the puzzling intertemporal relation between the market risk premium

provided by Siegel (1998), who analysed 200 years of US stock market data, which shows a remarkable degree of stability in equity returns over time, in contrast to other asset classes (such as the risk-free rate):[26]

*"the growth of purchasing power in equities not only dominates all other assets but **is remarkable for its long-term stability**. […] This remarkable stability of long-term real returns is a **characteristic of mean reversion**, a property of a variable to offset its short-term fluctuations so as to produce far more stable long-term returns. […]As stable as the long-term real returns have been for equities, the **same cannot be said of fixed-income assets**."*

Figure 2.8
US stock market returns show "a remarkable degree of stability" over time
(30 year rolling averages for period 1801 -2011)



Source: Siegel (1998) for the period 1801 to 1899 then updated by DMS. See: Wright and Smithers (2014) The cost of equity capital for regulated companies: a review for Ofgem.

In addition, leading economic institutions, such as the Bank of England, have recognised that the low interest rates and economic uncertainty have led to increased ERPs: *"There remains, however, substantial uncertainty about the nature of the UK's future trading arrangement and the implications for competitiveness. This may have increased the risk premium required by investors to hold sterling-denominated assets."*[27]

Empirically, the Bank of England's own time-series DDM shows a constant TMR both prior to, and following the period of low interest rates (as shown in Figure 2.9).

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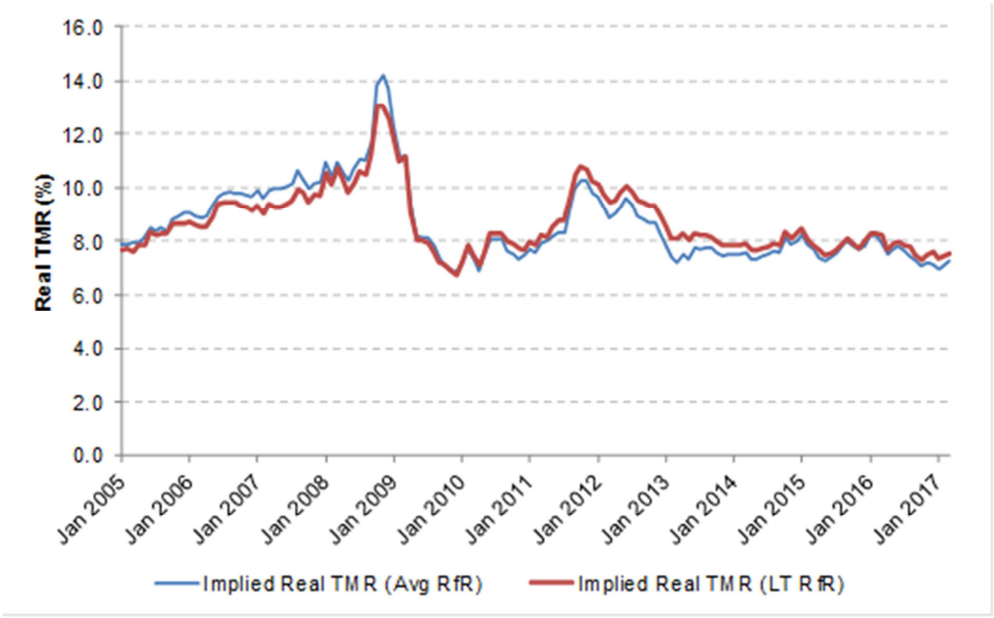
and conditional market variance: A two‐factor approach. The Journal of Finance, 53(2), 575-603.; (5) Siegel W(1998), Stocks for the Long Run McGraw Hill, Second Edition.

[26] Siegel (1998), Stocks for the Long Run. McGraw-Hill, second edition, p.11, 13.

[27] Bank of England, (August 2017), Inflation Report, p.1; Bank of England, (August 2016), Inflation Report.

Figure 2.9
The Bank of England DDM supports constancy of TMR over recent time period



Source: NERA analysis of Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2(4) and Bank of England yield curves

The German Bundesbank has also noted in its monthly reports that there is a strong negative correlation between ERP and risk free rates: *"[…] the correlation between returns from stocks and long-term government bonds is a suitable measure of risk aversion... In times of heightened risk aversion, it is therefore often possible to observe that investors demand higher equity risk premiums or undertake shifts from stocks into secure government bonds (safe haven flows). The resulting contrasting price developments of stocks and government securities are accompanied by a negative correlation."*[28]

2.4.2.2. UK Regulators and Smithers reports also support constancy of TMR

The CMA as well as other GB economic regulators have acknowledged the negative correlation between the ERP and RfR as a principal reason for estimating the TMR directly.[29] The CMA and GB regulators have made extensive reference to the analysis of Mason, Miles and Wright in their study of the cost of capital, commissioned by a consortium of GB

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[28] Deutsche Bundesbank, (Nov 2007), Monthly Report.

[29] The CMA explained that its reason for adopting such an approach is that it provides more stable estimates: "*Our preferred approach is to deduct our estimate of the RFR from our estimate of the equity market return* [TMR] *to derive the ERP. There are two principal reasons for preferring to calculate the ERP in this manner: first ERP estimates can vary depending on the class of risk-free instruments used in the calculation; second the market return has tended to be less volatile than the ERP […], and there is some evidence of the ERP being negatively correlated with Treasury bill rates over the short term.*" Competition and Markets Authority (then Competition Commission) (26 March 2014) NIE Limited price determination, p. 13-16, para. 13.82. The later Bristol Water (2015) decision used the TMR approach as per NIE 2015 citing "NIE (2014) represented an appropriate comparison for estimating the equity market return, as well as being published within the last 18 months, and hence was relatively up to date." See CMA (2015), Bristol Water plc, A reference under section 12 (3) (a) of the Water Industry Act 1991, para 10.185.

regulators ("Smithers report"). Drawing on a wide body of research, Smithers & Co noted that there was strong evidence that the realised aggregate stock market return, and by implication the expected market return, has been remarkably stable both over long historical samples and in a wide range of markets. The authors confirm that given the body of evidence on the stability of the TMR, the best approach for estimating future TMR is to draw on realised long term historical averages.[30]

As part of Ofgem's review of the cost of equity in 2014, Ofgem asked Smithers & Co to review their earlier methodology for estimating the TMR.[31] The authors argued, as they had in 2003, that realised returns are made up of expected returns and a "surprise factor", and over a long enough period, the surprises should cancel out, to give the average expected return.

The report recognised that long run averages should be updated for the latest market evidence (which was up to 2000 for its 2003 report), and for certain changes to the ONS calculation relevant at that time. However, the authors did not consider any further downward adjustment was required for current market evidence, e.g. lower risk-free rates: [32]

"*We conclude that there is no plausible case for any further downward adjustment in the assumed market cost of equity based on recent movements in risk-free rates (or indeed any other "recent market evidence").*"

In light of the Smithers review, Ofgem concluded that: [33]

"*[Smithers and Co] view is that the long-run history of achieved returns remains the best approach to assessing the equity market return. Their report updated long-term analysis of equity market returns in the Smithers & Co report to include additional years of data. Based on this updated analysis, they suggest that a downward adjustment of 40 basis points in the long-term equity market return is the most that can be more warranted in the light of more recent data.*"

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30 The conclusions of the 2003 Smithers report have been reinforced by further reviews of the original authors, Stephen Wright, as part of price controls in 2012 by the Australian Energy Regulator (AER). In 2012, he concluded "*My view, in line with UK regulators, is that the regulators should work on the assumption that the real market cost of equity is constant. This approach is supported by quite strong evidence.*" Wright, Stephen (October 2012), Review of risk free rate and cost of equity estimates: A comparison of UK approaches with the AER, p.2

31 Wright and Smithers (2014) The cost of equity capital for regulated companies: a review for Ofgem. Link: https://www.ofgem.gov.uk/ofgem-publications/86100/wrightsmithersequitymarketreturnpdf

32 Wright and Smithers (2014) op. cit., p.2

33 Ofgem (2014) Decision on our methodology for assessing the equity market return for the purpose of setting RIIO-ED1 price controls. Link: https://www.ofgem.gov.uk/ofgem-publications/86366/decisiononequitymarketreturnmethodology.pdf

3. Empirical estimates of TMR based on current approaches

3.1. Summary of PwC DDM and MAR evidence

Given PwC's hypothesis that there has been a decline in expected returns in the recent low interest rate environment, PwC concludes that regulators should use techniques that draw on current financial market expectations, such as the dividend discount model (DDM) and market-to-asset ratios (MAR) to estimate the TMR. Applying these techniques, PwC estimates a real TMR under "current" market conditions between 5.1 and 5.5 per cent:[34]

- *DDM evidence*: PwC constructs its own DDM for the FTSE all share index, assuming short-term and long-term dividend growth equal to the forecast nominal growth rate in UK GDP. Based on this, PwC calculates a nominal TMR of 8.3% to 8.8% (or 5.4% to 5.8% real).
- *MAR evidence*: PwC calculates market-to-asset ratios for listed UK water companies, adjusts them downwards to reflect expected outperformance, and uses the residual observed RCV "premium" to back-solve for implied investor expectations of the cost of equity for the water sector (6.7% to 6.8% nominal, 3.8% to 3.9% real RPI) and the TMR (7.6% to 8.1% nominal, 4.7% to 5.2% real).

In the following sections, we show that PwC's empirical calculations of the DDM and MARs include a number of errors, which result in a substantial understatement of PwC's estimates of the TMR. Correcting for these errors, we show that "current" estimates of the TMR are consistent with long-run historical averages, which supports our conclusion from section 2 that there is no evidence that investors' required returns have reduced in a low interest rate environment.

3.2. PwC's DDM estimate of TMR is flawed and substantially biased downwards

The dividend discount model (DDM) solves for a discount rate which equates the present value of future expected dividends to the current stock price.[35] If the DDM is applied to the entire market index (e.g. FTSE all share), the discount rate implied by the DDM reflects the expected return for the whole market (i.e. the TMR).

To estimate the TMR using the DDM, PwC applies a two stage DDM model to the FTSE all share index, with a separate growth rate assumption to derive short run expected dividends up to five years ahead and a long-run dividend growth assumption thereafter. PwC's short term and long-term dividend growth assumptions are based on short-term and long-term nominal GDP growth rate forecasts for the UK economy.[36] Based on this, PwC derives a nominal

[34] PwC (June 2017), Refining the balance of incentives for PR19, p.81-87.

[35] Including buy-backs.

[36] PwC (June 2017), Refining the balance of incentives for PR19, Appendix D.

TMR range of 8.3% to 8.8% (or 5.4% to 5.8% real assuming 2.8% RPI inflation in line with PwC).[37]

There are a number of issues with PwC's application of the DDM which we believe lead to a substantial understatement of the TMR by PwC.

First, PwC estimates a TMR for the UK stock market (FTSE all share index), which requires taking into account the characteristics of this market. PwC uses a long-run UK GDP growth rate to derive long-run growth in dividends for the FTSE all share index, which ignores the fact that more than 70 per cent of revenues generated by the FTSE all share companies comes from outside of the UK.[38] A more appropriate assumption for long-run dividend growth is therefore to use a weighted average of GDP growth rates for the different regions from which the FTSE all share companies derive their earnings. Indeed, this is the approach adopted by the Bank of England in its application of the DDM.[39] Based on data from Bank of England, the weighted average GDP growth rate for the different regions in the FTSE all share index is greater than UK GDP growth assumed by PwC. For example, the weighted average GDP growth rate for the different regions in October 2016 is 5.9% (nominal), while the UK GDP growth rate assumed by PwC is only 4.0% (nominal).[40] PwC's use of the lower UK GDP growth rate therefore leads to an understatement in long-term dividend growth.

Second, PwC uses a short-term GDP growth rate to derive short-run growth in dividends, which, even if applied correctly as the weighted average of the GDP growth for the different regions represented in the FTSE, fails to take into account equity analyst forecasts of expected short term dividends. Indeed, analysts' forecasts are used to estimate short-term dividend projections by the Bank of England in its application of the DDM. Based on data from the Bank of England, short-term dividend growth based on analyst forecasts is greater than PwC's assumed short-term GDP growth, resulting in an understatement of short-term dividend growth by PwC.[41]

As a result of understating dividend forecasts for both the short-term and the long-term, PwC's application of the DDM results in an understatement of the TMR.[42]

PwC's understatement of the TMR is apparent by comparing PwC's DDM derived real (RPI) TMR of 5.4% to 5.8% with independent estimates of the TMR published by the Bank of England and Bloomberg based on their application of the DDM (as shown below in Figure 3.1. and Table 3.1).

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37 PwC (June 2017), Refining the balance of incentives for PR19, p.82, 87.

38 Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.91.

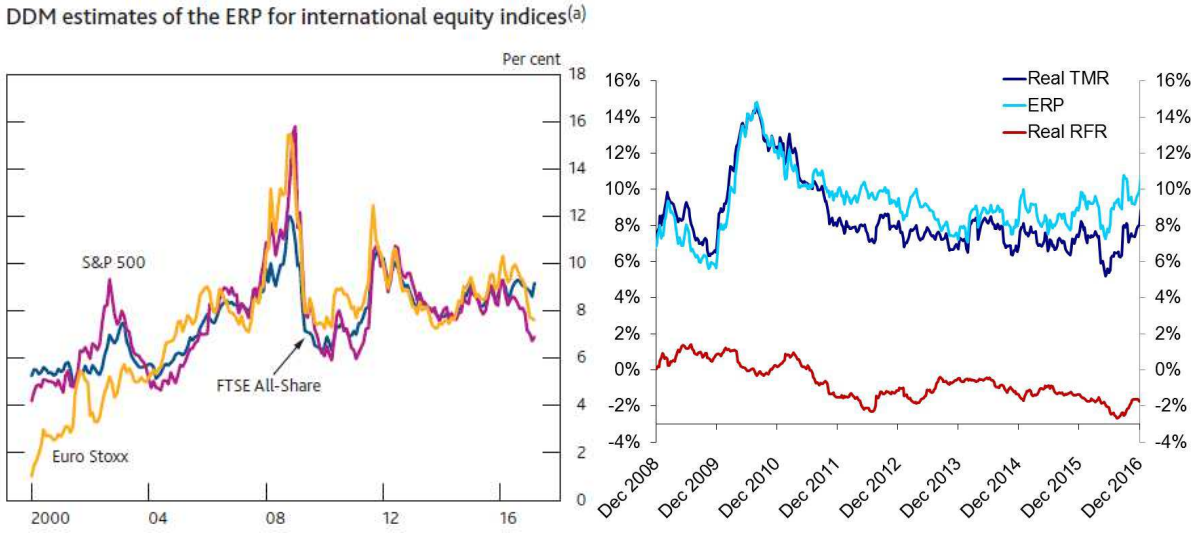
39 Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.91.

40 See Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.91, Chart 7 and PwC (June 2017), Refining the balance of incentives for PR19, Appendix D, Table 24, p 102.

41 See Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.90, Chart 3 and PwC (June 2017), Refining the balance of incentives for PR19, Appendix D, Table 24, p.102.

42 The DDM estimates a discount rate which equates the forecast dividends to the current value of the FTSE all share index, which is observable. If dividend forecasts are understated, the DDM will "compensate" for this by producing a lower discount rate (i.e. TMR) to equate the lower dividend forecasts to the same observed value of the market index.

Figure 3.1
PwC's DDM TMR is understated compared to independent estimates by Bank of England and Bloomberg



Source: Source: Bloomberg, Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.94. Note: The Bank of England figure shows an estimate of the ERP. For the estimate of the TMR, see Table 3.1.

Table 3.1
TMR (real RPI) estimates from Bank of England and Bloomberg DDM support a "current" TMR in line with historical averages

	Index	5 year average to Dec 2016	Dec 2016 (spot)
PwC	FTSE All-Share	5.8%	5.4%
Bank of England (average RfR)*	FTSE All-Share	7.9%	7.1%
Bank of England (LT RfR)*	FTSE All-Share	8.2%	7.4%
Bloomberg	FTSE 100	7.4%	7.8%

Source: Source: Bloomberg, Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.94. Note: The Bank of England estimates the DDM using a time varying risk-free rate for all maturities (where available) and a long-run risk-free rate assumption. We calculate a TMR as the sum of the Bank of England's reported ERP and an i) average of the real risk-free rate for all available maturities and 2) the real risk-free rate at the longest maturity available.*

As can be seen from Table 3.1, PwC's estimates of the TMR are substantially below estimates of the TMR from established independent financial institutions such as the Bank of England and Bloomberg. The Bank of England and Bloomberg estimates of the TMR support a current real (RPI) range of between 7.1 per cent and 8.2 per cent (estimated over the same period as PwC), which is actually slightly above long-run historical averages (see section 4 for historical long-run average TMR evidence).

3.3. PwC's MAR analysis fails to adjust for key drivers of water companies' valuations which may fully explain the observed RCV premium

Market-to asset ratios (MARs) measure the ratio of the market value (MV) of the regulated business to the value of the regulated asset base (RAB):

$$MAR = \frac{Market\ value\ of\ regulated\ businesses\ (debt + equity)}{RAB}$$

Under certain conditions, the MAR expression can be re-written to show a simple relationship between the regulatory allowed rate of return (ARoR) and investors' view of the cost of capital (WACC). The market value of the regulated business is equal to the net present value of future cash-flows, discounted at the cost of capital. Assuming investors expect constant cash flows equal to the ARoR applied to the RAB (i.e. assuming no outperformance of regulatory assumptions and no growth in the RAB), the market value of the regulated business and the MAR can be re-written as follows:

$$MV = \frac{AROR * RAB}{WACC} \leftrightarrow MAR = \frac{AROR}{WACC}$$

The MAR equation shows that assuming the allowed rate of return is equal to investors' views of the cost of capital, and assuming that investors expect the company to perform exactly in line with regulatory assumptions underlying the price controls until perpetuity, then the market value of the company should be equal to the RAB and the MAR should be equal to 1.

PwC's estimates MARs for listed UK water stocks (Severn Trent and United Utilities) to infer investor views of the cost of equity for the water sector. Specifically, PwC estimates a MAR of 1.24 and 1.27 for United Utilities (UU) and Severn Trent (SVT) respectively. PwC then adjusts the estimated MAR downwards by 0.14 and 0.15 for UU and SVT respectively, to remove the impact of expected outperformance on the companies' market valuations. It then assumes that the residual premium to the regulated capital value (RCV) of 10 and 12 per cent reflects cost of equity "outperformance" (i.e. that the allowed return on equity is set above investors' expected cost of equity) and uses this to derive an "implied" nominal cost of equity of 6.7 per cent to 6.8 per cent (3.8 per cent to 3.9 per cent real[43]) for the water sector and an implied nominal TMR of 7.6 per cent to 8.1 per cent (4.7 per cent to 5.2 per cent real[44]).[45]

[43] Assuming 2.8% RPI inflation in line with PwC.

[44] Assuming 2.8% RPI inflation in line with PwC.

[45] PwC (June 2017), Refining the balance of incentives for PR19, Table 15, p.86.

3.3.1. PwC's MAR analysis fails to properly take into account important drivers of water companies' valuations such as outperformance and non-regulated activities which fully explain the observed RCV premium

PwC's MAR analysis fails to take into account important drivers of water companies' valuations which may fully explain the observed RCV premium. Specifically, the "raw" MAR calculated by PwC of 1.24 and 1.27 for UU and SVT based on stock market data needs to be adjusted to reflect only the value of the wholesale regulated businesses (to correspond to the wholesale RCV in the denominator of the MAR equation) and to remove the effect of wholesale outperformance. The adjustment should include the following factors:

- **Non-regulated activities:** Water companies' market valuations derived from stock market data reflect the companies' entire business operations, including their non-regulated activities. The value of these non-regulated activities has to be removed from the market valuation to derive a market value for the wholesale regulated business only.
- **Non-wholesale regulated activities**: In PR14, Ofwat introduced separate wholesale and retail controls, with the RCV going forward only relating to the wholesale controls. As a result, the value of all other non-wholesale regulated activities[46] needs to be removed to arrive at a market value for the wholesale regulated business only, which is relevant for making comparisons to the wholesale RCV.
- **Pension deficit**: Another important factor affecting water companies' market valuations is the value of any pension deficit/surplus. Ofwat allows companies to recover 50 per cent of the assumed pension deficit in 2009 over a 10-15 year period, with the remaining pension deficit costs borne by shareholders.[47] The value of any residual deficit/surplus represents an additional loss/revenue for shareholders which is unrelated to the cost of capital and should therefore be removed from the valuation of the wholesale regulated business.
- **Outperformance**: As recognised by PwC in its analysis, outperformance of regulatory assumptions (e.g. costs, incentives, cost of debt) represents an additional source of shareholder return, which is unrelated to the cost of equity and should therefore be removed from the valuation of the wholesale regulated business.

Failure to adjust for the above factors will result in an incorrect market valuation for the wholesale regulated business after all sources of outperformance are taken into account, which is the relevant measure which should be compared to the wholesale RCV in calculating the MAR for the purpose of gauging investor perceptions of the cost of equity.

However, the value of the above adjustments is inherently uncertain, which represents one of the key practical difficulties with estimating MARs for the purpose of gauging investor expectations of the cost of capital/equity. Nevertheless, to assess the likely value impact of the above adjustments on water company valuations, we collected estimates for each of the

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[46] Most notably household retail, as non-household retail is typically classified by analysts as a "non-regulated" activity following recent market opening.

[47] Ofwat (October 2013), IN13/17: Treatment of companies' pension deficit repair costs at the 2014 price review.

factors from equity analyst reports since the start of 2015 as summarised in Table 3.2 below.[48]

Table 3.2
Analyst adjustments more than explain observed RCV premium calculated by PwC
(Analyst estimates of MAR adjustments as a % of wholesale RCV)

Analyst estimates for:	SVT	UU
Non-regulated activities	2.3% - 6.6%	0.8% - 2.9%
Regulated non-wholesale activities	5.7% - 6.9%	1.1% - 3.3%
Pension surplus/(deficit)	-7.4% - 0%	0.4% - 3.5%
Wholesale outperformance	20.9% - 23.5%	16.1% - 21.3%
Total analyst estimates	**21.4% - 37%**	**18.4% - 30.9%**
PwC MAR premium	**27%**	**24%**

Source: Equity analyst reports, see Appendix A for detail. Note: Range based on min and max of all analyst estimates.

As can be seen from Table 3.2, analyst estimates of the value of the adjustments are subject to a large degree of uncertainty. Nevertheless the sum of all the adjustments appears to be able to explain the observed RCV premium calculated by PwC of 24 and 27 per cent for UU and SVT respectively. For example, for SVT, the adjustments made by analysts for the factors shown in Table 3.2 would mean that SVT's MARs would expect to be trading at a 21.4 to 37 per cent premium before any account taken of possible differences between the allowed return on equity and the expected cost of equity.

By contrast, PwC's analysis only makes a single adjustment to the observed RCV premium to account for wholesale outperformance of 14 and 15 per cent for UU and SVT respectively. PwC fails to take into account the other adjustments for non-regulated activities, non-wholesale regulated activities as well as pensions which explain part of PwC's residual RCV premium. In addition, PwC also fails to take into account the substantial uncertainty around its estimate of the value of future expected outperformance, which also appears understated compared to analysts' estimates (as shown in Table 3.2).

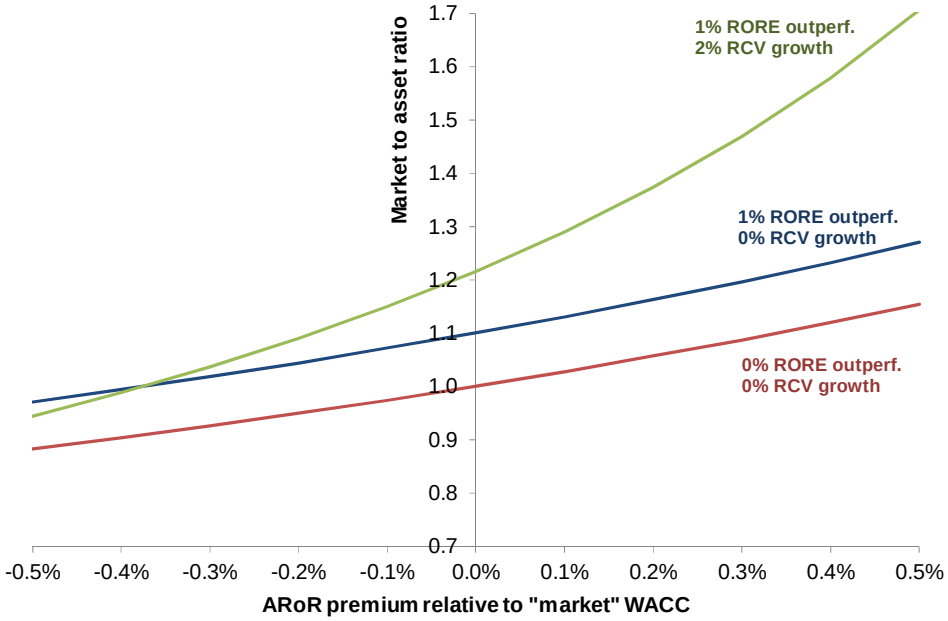
3.3.2. SVT and UU strong outperformance consistent with analyst estimates

Given investors' expectations regarding future outperformance can drive a substantial RCV premium, we have also reviewed available evidence on prospective outperformance for UU and SVT over PR14.

Outperformance can have a substantial impact on the observed RCV premium. Figure 3.2 shows the relationship between investors' assumptions on RORE outperformance and the MAR, factoring in alternative assumptions on real RCV growth.

[48] We use analyst valuations for each of the factors reported in £m terms and convert them into a percentage measure by dividing the £m amount by the wholesale RCV reported by each analyst.

Figure 3.2
Relationship between RORE outperformance and MAR



Source: NERA illustration assuming AROR=3.74% and 62.5% gearing. [49]

As shown in Figure 3.2, RORE outperformance of 1 per cent assumed in perpetuity can explain around 10 per cent of an RCV premium (assuming 0 per cent real growth in the RCV) or around 20 per cent of an RCV premium (assuming 2 per cent real growth in the RCV). Outperformance therefore represents a key driver of water company valuations.

Based on data from latest annual performance reports, both SVT and UU are expecting strong RORE outperformance over PR14:

- SVT reports outperformance of 2.6 per cent of RORE since the start of PR14, due to strong incentive and totex outperformance.[50]
- UU reports outperformance of 1.2 per cent of RORE since the start of PR14, largely due to strong outperformance on the cost of debt.[51]

In summary, UU and notably SVT's expected outperformance over PR14 suggests that the analyst valuations of outperformance of around 20 per cent of the RCV we have presented (see Table 3.2), equivalent to 1 per cent RORE outperformance in perpetuity (assuming 2 per

[49] Derived from the following formula for the MAR which takes into accounts account RORE outperformance (RORE): and real RCV growth (g):

$$MAR = \frac{AROR_R + RORE * (1 - gearing) - g}{WACC_R - g}$$

[50] Severn Trent (2017), Annual Performance Report year ended 31 March 2017, p.94.

[51] United Utilities (2017), United Utilities 2016/17 Annual Performance Report, p.130.

cent real growth in the RCV, in line with historical data[52]), appear plausible and potentially conservative compared to cost, incentive, and debt outperformance reported by the two companies over the current regulatory price control.

3.4. PwC's calculations from "adjusted" MAR are incorrect and lead to an understatement of "implied" cost of equity/TMR

As discussed in the previous section, we consider that there is no evidence to conclude that the "adjusted" MAR for water stocks is greater than 1 and therefore that the allowed return on equity differs from the investors' expected cost of equity.

Notwithstanding this conclusion, we also note that PwC made two errors in calculating the "implied" cost of equity and TMR from its "adjusted" MAR of around 1.1 for the two listed UK water companies. PwC's errors result in a substantial understatement of the "implied" cost of equity and TMR, as we explain below.

3.4.1. MAR is a ratio of real AROR to real WACC

PwC's calculations assume that the MAR for water companies measures the ratio of the allowed rate of return (ARoR) and investors' expected cost of capital (WACC) in nominal terms.[53] This is incorrect, the MAR reflects a ratio of ARoR and WACC in real terms, as we explain in Appendix B.

Correcting PwC's error, Table 3.3 shows that PwC's incorrect application of the MAR formula leads to an understatement of the "implied" cost of equity by 70-80bps and the "implied" TMR by 80-100bps (but otherwise calculated using PwC's assumed MARs, as well as equity beta and risk-free rate).

[52] See Table 3.4 below.

[53] This is not explicitly stated, but our replication of PwC's calculations suggests this is the case.

Table 3.3
PwC's incorrect application of the MAR formula understates "implied" cost of equity by 70-80 bps and "implied" TMR by 80-100bps

PwC (nominal calculations)				
	SVT		**UU**	
MAR	1.12		1.1	
Assumed AROR (nominal)	6.6%			
Implied WACC (nominal)	5.9%		6.0%	
Assumed COD (nominal)	5.5%			
Assumed gearing	62.5%			
Implied COE (nominal)	**6.7%**		**7.0%**	
Assumed equity beta	0.80			
Assumed RFR (nominal)	1.5%	3.0%	1.5%	3.0%
Implied TMR (nominal)	**8.0%**	**7.6%**	**8.4%**	**8.0%**
PwC (nominal results converted to real)				
Implied COE (real)	3.8%		4.1%	
Implied TMR (real)	5.1%	4.7%	5.4%	5.1%
Correct approach (real calculations)				
	SVT		**UU**	
MAR	1.12		1.1	
Assumed AROR (real)	3.7%			
Implied WACC (real)	3.3%		3.4%	
Assumed COD (real)	2.6%			
Assumed Gearing	62.5%			
Implied COE (real)	**4.6%**		**4.7%**	
Assumed equity beta	0.80			
Assumed RFR (real)	-1.3%	0.2%	-1.3%	0.2%
Implied TMR (real)	**6.0%**	**5.7%**	**6.2%**	**5.9%**
PwC understatement				
Real COE understatement	**0.8%**		**0.7%**	
Real TMR understatement	**1.0%**	**1.0%**	**0.8%**	**0.8%**

Source: NERA calculations.

Note: Assuming AROR=PR14 allowed WACC (as per PwC). For illustrating the impact of the corrections, we use the PR14 AROR of 3.74% (real, vanilla) calculated by Ofwat for the appointed business, to allow for comparisons of the calculated cost of equity with PR14 assumptions. We note a more relevant comparison should be to the AROR for the wholesale business of 3.6%, but Ofwat did not publish a decomposition of the wholesale AROR into its constituent elements and hence comparisons to PR14 would be difficult.

3.4.2. MAR formula needs to be adjusted to account for real growth of the RCV

PwC's calculations fail to take into account the impact of real growth in the RCV on the MAR for UK water companies, implicitly assuming zero real growth in backing out the "implied" cost of equity and TMR.

In reality, water companies' RCVs have historically exhibited growth in real terms over successive price reviews of around 2 per cent per annum (as shown in Table 3.4 below).

Table 3.4
Average growth in real allowed RCV was around 2% per annum over successive price reviews

	PR99 (2000-2004)	**PR04** (2005-2009)	**PR09** (2010-2014)	**PR14** (2015-2019)	**Whole period** (2000-2019)
Industry	2.9%	2.7%	2.4%	1.4%	**2.4%**
Severn Trent	2.3%	2.1%	0.7%	1.9%	**1.8%**
United Utilities	2.7%	2.1%	2.7%	0.5%	**2.0%**

Source: Ofwat (September 2005), Financial performance and expenditure of the water companies in England and Wales 2004-05 report, Table 9, p.31; Ofwat (2010), Financial performance and expenditure of the water companies in England and Wales 2099-10, Table 9, p.19; Regulatory capital value update 2009-10 and 2014-15 available at http://www.ofwat.gov.uk/publications/regulatory-capital-value-updates/

Allowing for real growth in the RCV, the MAR formula becomes:

$$MAR = \frac{AROR_R - g}{WACC_R - g}$$

Table 3.5 below shows the impact of assuming 2 per cent growth in the RCV (in line with historical data over the last four price reviews) on PwC's calculation of "implied" cost of equity and TMR.

Table 3.5
Assuming 2 per cent real growth in the RCV increases PwC's "implied" cost of equity by 50-60 bps and "implied" TMR by 60-70bps

Calculations assuming 0% real RCV growth				
	SVT		**UU**	
MAR	1.12		1.1	
Assumed AROR (real)	3.7%			
Assumed real RCV growth	**0.0%**			
Implied WACC (real)	3.3%		3.4%	
Assumed COD (real)	**2.6%**			
Assumed Gearing	62.5%			
Implied COE (real)	4.6%		4.7%	
Assumed equity beta	0.80			
Assumed RFR (real)	-1.3%	0.2%	-1.3%	0.2%
Implied TMR (real)	**6.0%**	**5.7%**	**6.2%**	**5.9%**
Calculations assuming 2% real RCV growth				
	SVT		**UU**	
MAR	1.12		1.1	
Assumed AROR (real)	3.7%			
Assumed real RCV growth	**2.0%**			
Implied WACC (real)	3.6%		3.6%	
Assumed COD (real)	2.6%			
Assumed Gearing	62.5%			
Implied COE (real)	**5.2%**		**5.2%**	
Assumed equity beta	0.80			
Assumed RFR (real)	-1.3%	0.2%	-1.3%	0.2%
Implied TMR (real)	**6.8%**	**6.4%**	**6.9%**	**6.5%**
PwC understatement				
Real COE understatement	**0.6%**		**0.5%**	
Real TMR understatement	**0.7%**	**0.7%**	**0.6%**	**0.6%**

Source: NERA calculations

As can be seen from Table 3.5, PwC's assuming 2 per cent real RCV growth as opposed to the 0 per cent growth assumed by PwC results in a further increase in the "implied" cost of

equity by 50-60bps and the "implied" TMR by 60-70bps (calculated using PwC's assumed equity beta and risk-free rate), with an implied TMR of between 6.5 and 6.9 per cent.[54]

In total, PwC's errors result in an understatement of the implied real cost of equity by 110 to 130 bps and the TMR by 140 to 170 bps, assuming PwC's "adjusted" MAR of around 1.1 for the two listed UK water companies as well as PwC's assumed equity beta and risk-free rate (as shown in Table 3.6)

Table 3.6
Summary of impact of PwC calculation errors

	Real Cost of Equity	Real TMR
PwC estimate	3.8% to 4.1%	4.7% to 5.4%
Correcting real vs nominal error	+ 0.8% to 0.7%	+ 1.0% to 0.8%
Correcting RCV growth error	+0.6% to 0.5%	+ 0.7% to 0.6%
Corrected PwC estimate	**5.2%**	**6.4% to 6.9%**

Source: NERA calculations

3.5. No weight should be attached to PwC's MAR analysis

As set out above, we do not consider that PwC's MAR analysis for UU and SVT provides robust evidence that the allowed rate of return is greater than the cost of capital for the water sector. We show that for UU and SVT, analyst estimates of adjustments for outperformance, value of non-regulated activities, value of regulated activities unrelated to wholesale (for which the RCV is measured) and value of pension deficit/surplus more than explain their respective observed MARs.

The water sector MARs have especially no relevance for the CAA's estimates of the WACC for HAL, which is a completely different sector with a very different risks and regulatory regime.

More generally, the CAA should not attach weight to MAR evidence in determining the allowed rate of return at H7. As demonstrated above, the value of the required adjustments to arrive at a MAR for the wholesale regulated business only is uncertain, with a wide range of estimates from analyst valuations for both UU and SVT (and we would expect other listed network comparators). In addition, there is a well-known conceptual problem with interpreting MAR evidence: in backing out the implied cost of equity for a MAR, it is necessary to make assumptions on investors' views on the allowed rate of return over

[54] As can be seen in Table 3.5, despite the calculated "implied" cost of equity of 5.2 per cent which is lower than the PR14 allowed cost of equity of 5.65 per cent, the "implied" TMR calculated using PwC's assumptions is 6.4 per cent to 6.9 per cent, with the top end lying above the PR14 allowed TMR of 6.75%, which appears counterintuitive. The reason for this result is that PwC assumes a lower RFR compared to the PR14 allowance of 1.25% real. Given PwC's assumed equity beta of 0.8 is below 1, a lower RFR requires a disproportionate increase in the ERP (and therefore the TMR) to compensate for this reduction in the RFR. Had PwC used an RFR of 1.25% real consistent with PR14, its implied cost of equity of 5.2% would have resulted in a TMR of 6.1% to 6.2%.

successive reviews. In the above analysis, we have assumed the allowed rate of return is as per PR14, but in reality this key assumption is unobservable.

4. Updated evidence on TMR

As explained in section 2 and 3, PwC's evidence that the TMR has fallen as a result of the low risk-free rate environment is not robust. In this section, we consider the different methods for estimating the TMR applied by the CMA in its 2014 determination for Northern Ireland Electricity (NIE)[55] and provide updated estimates based on latest data. We conclude that the latest estimates for the TMR obtained using the different methods considered by the CMA in the 2014 NIE determination do not support a reduction in the TMR.

4.1. Updating evidence from CMA NIE 2014

In its NIE 2014 price control determination, the CMA considered three types of evidence for estimating the expected market return or TMR: [56]

- studies that assume that historical realised returns are equal to investors' expectations (so-called "historical ex post" approaches);
- studies that fit models of stock returns to historical data to separate out ex-ante expectations from ex-post good or bad fortune (so-called "historical ex ante approaches");
- studies that use current market prices and surveys of market participants to derive current forward-looking expectations (so-called "forward-looking approaches").

The CMA notes that it uses historical approaches (both ex ante and ex post) as its primary sources for estimating the equity market return, with forward-looking approaches being used as a cross-check.

Historical ex-post approaches

The CMA used the DMS and Barclays capital databases as the basis for its long-run historical estimate. Drawing on a number of different measures differentiated by holding period and averaging technique (as replicated in Table 4.1 below), the CMA concluded a TMR of around 6 to 7 per cent for UK and world markets in 2014.[57]

Our analysis shows that the long run historical averages have increased relative to the estimates at the time of the 2014 NIE decision, with the majority of estimates in a range between 6.4 and 7.3 per cent, indicative of relatively strong stock market performance over recent years.

[55] CMA (March 2014) Northern Ireland Electricity price determination. Link: https://assets.publishing.service.gov.uk/media/535a5768ed915d0fdb000003/NIE_Final_determination.pdf

[56] CMA (March 2014) op. cit. p.13-26

[57] CMA (March 2014) op. cit. p.13-27, para 13.141

Table 4.1
DMS Long-run historical returns have increased slightly since NIE

NIE (2014)	Simple	Overlapping	Blume	JKM
1-year holding period	7.1	7.1	7.1	7.0
2-year holding period	7.5	7.0	7.1	7.0
5-year holding period	6.7	6.8	7.0	6.8
10-year holding period	6.4	6.8	6.9	6.6
20-year holding period	6.7	6.9	6.8	6.1
Latest data (2017)	**Simple**	**Overlapping**	**Blume**	**JKM**
1-year holding period	7.3%	7.3%	7.3%	7.3%
2-year holding period	7.7%	7.2%	7.3%	7.3%
5-year holding period	7.4%	7.0%	7.2%	7.1%
10-year holding period	6.9%	6.9%	7.2%	6.9%
20-year holding period	7.9%	7.0%	7.0%	6.4%

Source: NERA calculations using DMS (February 2017),Credit Suisse Global Investment Returns Yearbook 2017, CMA (2014), Northern Ireland Electricity price determination, Final Determination, Appendix 13.2.[58]*, and CC (2010), Bristol Water Final Determination, Appendix N22.*
**The JKM adjustment is intended to average between the arithmetic and geometric mean. It is slightly higher than the arithmetic mean in this calculation because it uses an approximation for the Arithmetic Mean = ½ * variance of return + Geometric mean.*

Historical ex-post approaches

The CMA noted that an alternative approach to estimating expected returns from historical data can be made under the assumption that the dividend-price ratio is stationary, referred to as the Fama and French underlying return.[59] Under this assumption, the expected return can be estimated as the sum of the average dividend yield and the average annual dividend growth rate. Drawing on Barclay's data set up to 2009, the CMA estimated an expected

[58] The simple approach calculates the arithmetic mean for successive time periods (and therefore there are few observations for long holding periods), and the overlapping approach is identical other than it allows for overlapping time periods. For holding periods greater than 1 year, this approach first calculates the average nth period return (e.g. in the simple (non-overlapping) approach, for a 5-year holding period, it calculates the average 5-year compound return earned in the consecutive periods 1-5, 6-10, 10-15 etc., and then backs out the geometric average annual return implied by the average 5-period compound return. The overlapping approach allows e.g. that the average compound 5-year return is calculated for periods 1-5, 2-6 etc. The Blume adjustment takes a weighted average of the arithmetic and geometric returns, and the JKM is a statistical approach that provides efficient estimates for small samples, but this adjustment also effectively produces unbiased estimates of the nth period return as a weighted average of the geometric and arithmetic averages over the observation period.

[59] Estimated based on the approach developed in Fama and French (April 2002), The Equity Premium, the Journal of Finance, Vol. 57, No. 2, p. 637-659.

market return of 4.5 to 5.5 per cent. The top end of the range was based on the CMA's application of the Fama French estimate to the historical data from Barclay's, while the bottom end of the range reflected a downward adjustment to the historical data to account for the fact that current dividend yields were about 1 per cent below historical averages.[60] The CMA also acknowledged that the application of the Fama French approach may lead to an understatement of the expected market return due to dividend growth being less volatile than equity price index growth, with the understatement being equal to half the variance of the two growth rates (as suggested by Fama and French).[61] Applying the CMA's estimate of this understatement of around 75 bps results in a market return estimate between 5.25 and 6.25 per cent.

We have updated the CMA's calculations of the Fama French underlying return for the UK market based on the updated Barclay's data set up to 2015 and found that the estimate remains broadly unchanged relative to NIE 2014.[62]

The CMA also cited the DMS estimate of the expected market return for the world index. The DMS decomposes the historical returns into four elements: dividend yield (the dominant effect), dividend growth rate, the annual expansion in the price/dividend ratio, and real exchange rate changes. The DMS then determines an expected market return based on consideration of which elements correspond to investor expectations, and elements of non-repeatable good or bad luck. Drawing on DMS forecasts, the CMA cited a value of 5.5 to 6 per cent for the world index.[63] Our review of the most recent DMS forecast indicates that the forecast has not changed relative to NIE 2014.[64]

Forward-looking approaches

Finally, the CMA considered evidence from the Bank of England DDM which it concluded supported a market return of between 5 and 6 per cent.[65] As we set out in section 3.2, current estimates of the market return from the Bank of England's DDM are between 7.1 and 8.2 per cent (with the range based on a spot and 5 year average of monthly estimates ending December 2016).[66]

Table 4.2 summarises the CMA's estimates of the total market return for the different approaches considered in the NIE decision, and our updated estimates drawing on latest evidence, as discussed above.

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60 CMA (March 2014) op. cit. p.13-27, para 13.143-13.144

61 CMA (March 2014) op. cit., p. A13(2)3

62 Based on Barclay's (March 2016), Equity Gilt Study 2016, we calculate an updated estimate of the Fama French underlying return of 6.27 per cent, using data up to 2015 (based on 4.5 per cent dividend yield, 1.1 per cent dividend growth and 70bbps volatility adjustment).

63 CMA (March 2014) op. cit. p.13-29, para 13.145

64 DMS (2017), op. cit., p. 37; DMS cites an arithmetic risk premium of 4.5-5 per cent relative to bills, and an historical bill return of around 0.8 per cent.

65 CMA (March 2014) op. cit., p.13-31, para 13.155.

66 We note that the Bank of England changed its methodology in applying the DDM in 2017, compared to the approach used in the 2013 study cited by the CMA in the NIE (2014) decision.

Table 4.2
Updating studies used by CMA at NIE 2014 does not support a reduction in the TMR

	CMA NIE 2014 evidence	Latest evidence
DMS long run *(historical ex post)*	6 – 7 %	6.4 – 7.3%
DMS decomposition *(historical ex ante)*	5.5 – 6 %	5.5 – 6 %
Fama-French *(historial ex ante)*	5.25 – 6.25 %	5.27 – 6.27 %
Bank of England DDM *(forward looking)*	5 – 6%	7.1 – 8.2 %

Sources: NERA analysis of CMA (March 2014) Northern Ireland Electricity price determination. section 13; DMS (February 2017),Credit Suisse Global Investment Returns Yearbook 2017; Barclay's (March 2016), Equity Gilt Study 2016; Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2(4) and Bank of England yield curves.

As can be seen from Table 4.2, the latest evidence on the TMR based on the different methods considered by the CMA in the 2014 NIE determination do not support a reduction in the TMR. These results are clearly at odds PwC's assertion that expected equity returns are lower in recent periods.

Appendix A. Analyst Estimates of Drivers of Water Company Valuations

In this appendix, we summarise data we have collected on analysts' estimates of the key drivers of water companies' valuations. These include: valuation of companies' non-regulated activities (Table A.1), valuation of companies' non-wholesale regulated activities (Table A.2), valuation of companies' pension deficit/surplus (Table A.3) and valuation of expected wholesale outperformance (Table A.4).

Table A.1
Analyst estimates of value of non-regulated activities

Analyst	Report date	SVT	UU
Societe Generale	29-Mar-16	3.1%	0.8%
RBC	05-Oct-16	4.1%	1.9%
Societe Generale	13-Oct-16	6.6%	2.9%
RBC	30-Jan-17	n/a	1.9%
JPMorgan	23 & 25 May 2017	2.3%	1.1%
RBC	31-Jul-17	5.0%	1.7%
Range of estimates		**2.3% - 6.6%**	**0.8% - 2.9%**

Source: Societe Generale (March 2016), United Utilities, p.6; Societe Generale (March 2016), Severn Trent, p.2; RBC (October 2016), UK Water: RORE and valuations, p.12; Societe Generale (October 2016), United Utilities, p.11; RBC (January 2017), United Utilities Group, PLC, p.3; JPMorgan (May 2017), Severn Trent, p.2; JP Morgan (May 2017), United Utilities, p.2; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4.

Table A.2
Analyst estimates of value of non-wholesale regulated activities

Analyst	Report date	SVT	UU
RBC	05-Oct-16	5.7%	1.1%
RBC	30-Jan-17	n/a	1.1%
RBC	31-Jul-17	6.9%	3.3%
Range of estimates		**5.7% - 6.9%**	**1.1% - 3.3%**

Source: RBC (October 2016), UK Water: RORE and valuations, p.12; RBC (January 2017), United Utilities Group, PLC, p.3; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4

Table A.3
Analyst estimates of value of pension deficit/surplus

Analyst	Report date	SVT	UU
Societe Generale	29-Mar-16	-1.7%	0.8%
RBC	05-Oct-16	-3.8%	2.6%
Societe Generale	13-Oct-16	0.0%	2.7%
RBC	30-Jan-17	n/a	2.6%
JPMorgan	23 & 25 May 2017	-3.6%	0.4%
RBC	31-Jul-17	-7.4%	3.5%
Range of estimates		**-7.4% - 0%**	**0.4% - 3.5%**

Source: Societe Generale (March 2016), United Utilities, p.6; Societe Generale (March 2016), Severn Trent, p.2; RBC (October 2016), UK Water: RORE and valuations, p.12, Societe Generale (October 2016), United Utilities, p.11, RBC (January 2017), United Utilities Group, PLC, p.3; JPMorgan (May 2017), Severn Trent, p.2; JP Morgan (May 2017), United Utilities, p.2; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4

Table A.4
Analyst estimates of value of wholesale outperformance

Analyst	Report date	SVT	UU
Investec	29-Jan-15	n/a	16.6%
RBC	05-Oct-16	20.9%	21.3%
RBC	30-Jan-17	n/a	21.3%
RBC	31-Jul-17	23.5%	16.1%
Range of estimates		**20.9% - 23.5%**	**16.1% - 21.3%**

Source: Investec (January 2015), United Utilities Group, p.3; RBC (October 2016), UK Water: RORE and valuations, p.12; RBC (January 2017), United Utilities Group, PLC, p.3; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4

Appendix B. MAR reflects the ratio of ARoR and WACC in real terms for UK water companies

The MAR formula is derived by expressing market value (MV) of the water company as the sum of future expected cash-flows, discounted at the investors' expected cost of capital. Assuming no outperformance of regulatory assumptions and no real growth in the RCV, the future cash-flows earned by investors in nominal terms are represented by the real allowed rate of return ($AROR_R$) applied to the RCV at time zero (RCV_0) indexed over time with inflation (π). These nominal cash-flows are then discounted by investors' expected cost of capital in nominal terms ($WACC_N$) as follows:

$$MV_0 = \sum_{k=1}^{\infty} \frac{AROR_R * RCV_0 * (1+\pi)^k}{(1+WACC_N)^k}$$

Recognising that the expression for 1 plus the nominal WACC in the denominator can be de-composed into the real WACC ($WACC_R$) and inflation components as $(1+WACC_R)*(1+\pi)$, the inflation term $(1+\pi)^k$ can then be cancelled out from the numerator and denominator and the market value formula is simplified as:

$$MV_0 = \sum_{k=1}^{\infty} \frac{AROR_R * RCV_0{}^k}{(1+WACC_R)^k}$$

Applying the formula for a sum of an infinite geometric progression, the market value and MAR can be then derived as follows:

$$MV_0 = \frac{AROR_R * RCV_o}{WACC_R} \leftrightarrow MAR = \frac{AROR_R}{WACC_R}$$

The formula above shows that the MAR represents a ratio of the AROR and investors' expected WACC in real terms.[67]

In contrast, PwC's calculations appear to have assumed that the MAR reflects a ratio of AROR and WACC in nominal terms (this is not explicitly stated, but our replication of PwC's calculations suggests this is the case). This assumption is incorrect and leads to an understatement of the "implied" cost of equity and TMR calculated by PwC, as shown in Table 3.3.

[67] Assuming no outperformance and zero real growth in the RCV, as explained above.

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