NERA
ECONOMIC CONSULTING

Deriving ALFs from Lump-Sum Valuations – A Response to Ofcom's Second Consultation

Telefónica UK

17 September 2014

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Executive Summary

Telefónica UK has asked NERA to review Ofcom's revised proposals to re-calculate annual licence fees (ALF) for the 900 MHz and 1800 MHz spectrum bands incorporating new information from UK 4G spectrum auction prices. This report focuses on Ofcom's discount rate used for converting lump sum payments into annuities (ALFs); we do not comment on whether the lump-sum value correctly reflects the market value of licences.

Ofcom seeks to convert its estimate of the lump-sum spectrum value into annuities using its discount rate estimate while taking account of inflation and tax effects. Following the first consultation, Ofcom proposes the following revisions:

- the use of an estimate of mobile operators' cost of debt rather than the WACC as the relevant discount factor for annuitisation;

- the adoption of CPI instead of RPI to index the real annuity; and

- changes to the tax adjustment factor in response to the above changes in its annuitisation method.

In our view, Ofcom's revised proposal to use the cost of debt as the relevant discount rate contains a number of errors, which we set out below.

Ofcom's use of a "long-run average" in setting the discount factor is incorrect

Ofcom proposes to apply the same approach for calculating the discount factor as for setting the cost of debt for the WACC. Ofcom's approach of using long-run averages for setting the cost of debt has economic merit: the cost of debt set at the beginning of each regulatory period needs to remunerate the expected cost of new and embedded debt raised over the regulatory period. Under this approach, long-run estimates are better indicators than spot rates. This is, however, conceptually different from the determination of a "one-off" ALF contract today.

Ofcom is therefore incorrect to argue that the long-term nature of the contract also requires a long-term *observation period* for deriving yields: Ex-ante the government should be indifferent between receiving the lump sum now or the ALF payment over a 20 year period. This is because it is akin to the government providing a lease in the size of the lump sum to the MNO and receiving the ALF payments over 20 years. The financing costs of this lease, however, would be determined by *current* financing conditions and not by historical long-run averages. Hence using the *current* yield is the appropriate approach for determining the ALF payments.

In light of the above, an unbiased discount rate for the ALF should be based on *current* data for long-run debt instruments. We find yields on long-term debt issued by MNO parent companies to lie in a range from 4.4% to 4.7% (nominal, pre-tax), significantly below Ofcom's long-run estimate of 5.8% (nominal, pre-tax).

Ofcom's approach overestimates the cash flows risk to government

Ofcom's approach of using the cost of debt based on corporate bonds leads to an overestimate of "*the risk of the cash flows coming from MNOs to the Government through the*

ALF" (Ofcom, 4.12). The bias arises from the following which have an impact on the size of the debt premium:

- *Liquidity risk*: MNO bond spreads contain a significant liquidity risk premium which reflects the transactions costs of converting the bond to cash at the fair market value. This is however irrelevant to the UK government as there is no (realistic) option for the government to sell/trade the ALF. Hence there is no compensation necessary for this type of risk. Our review of the academic literature, which has also informed previous UK Competition Commission decisions, suggests that the liquidity risk included in Ofcom's discount rate lies in range of 32 to 45 basis points.

- *The benefits of securitisation*: These benefits are not contained in Ofcom's risk premium, which is based on unsecured debt. Our empirical analysis of the rating benefits that Moody's accords to securitisation suggest that securitisation can account for 10 to 12 basis points.

- *Inflation risk*: Under Ofcom's approach, the real ALF payment for year one is calculated with respect to forecast inflation; the government will receive the real payment over the course of the 20 year period independent of outturn inflation. Thus, the ALF structure provides the government with a safeguard against unexpected changes in inflation. The reference bonds used by Ofcom do not contain such protection but instead pay higher yields. Our analysis shows that this protection provided by the MNO is worth 10 to 20bps. Ofcom would need to reduce the real discount factor by this premium.

When accounting for these factors, we obtain a discount factor in a range of 0.9% to 1.3% (real, post-tax) instead of the 2.6% Ofcom currently uses. Considering that the mobile operator faces less adverse consequences from defaulting on its ALF obligation than on a corporate bond, we retain 1.3% (real, post-tax) as a conservative point estimate for the discount rate.

Correcting for errors in the cost of debt calculation significantly reduces annuities

Based on our discount factor estimate of 1.3% (real, post-tax) and Ofcom's lump-sum value of spectrum (which is not part of our analysis and used here purely for illustrative purposes), we calculate that annuities for the 900 MHz and 1800 MHz bands reduce to £1.38m per MHz of 900 MHz spectrum and £0.84 per MHz of 1800 MHz spectrum, respectively. Table 1.1 shows our results alongside Ofcom's ALF estimates based on a discount rate of 2.6%. .

Table 1.1
Ofcom and Corrected ALF Values (£m/MHz)

Spectrum	Ofcom	ALF using corrected discount rate
900 MHz	£1.57	£1.38
1800 MHz	£0.96	£0.84

Source: NERA analysis based on Ofcom data

1. Introduction

Telefónica UK has asked NERA to review Ofcom's revised proposals to re-calculate the value of the annual licence fee (ALF) rates paid for both the 900 MHz and 1800 MHz spectrum bands. This report reviews Ofcom's discount rate used for converting lump sum payments into annuities (ALFs); we do not comment on whether the lump-sum value correctly reflects the market value of licences for 900 MHz and 1800 MHz frequencies. This report is written for Telefónica UK to include in its response to the Ofcom ALF consultation.

Ofcom is reviewing the level of ALF paid by the mobile operators for the 900 MHz and 1800 MHz spectrum bands using new information on the market value of spectrum inferred from the 2013 UK 4G spectrum auction. As part of its review process, Ofcom is consulting stakeholders on a revised proposal following a first consultation in 2013. Initially, Ofcom proposed to calculate the new ALF rate as a 20 year annuity associated with the upfront lump-sum payment derived from the values bid in the UK 4G auction. Ofcom proposed to set the ALF constant in real terms and index it each year with outturn RPI inflation using its estimate of the WACC for a mobile network operator (MNO) as the discount rate for annuity calculation.

In the further consultation, Ofcom revised some features of its initial methodology. First, it now uses the cost of debt rather than the WACC as the relevant discount rate for transposing the lump-sum spectrum value into annual ALF payments. This methodological change takes into account the specific ALF payment structure, which bears considerable similarity to a debt obligation. Second, Ofcom now uses the CPI for inflation indexation of the ALF payments, with the objective of keeping annual payments constant in real terms.

In this report, we show that the proposals still contain a number of conceptual errors, which we analyse in the following sections:

- Section 2 sets out Ofcom's revised proposals for converting the lump-sum value into an ALF annuity;

- Section 3 discusses Ofcom's errors in using long-run averages to calculate the discount rate;

- Section 4 sets out further biases in Ofcom's discount rate calculation;

- Section 5 points out remaining flaws in Ofcom's calculation of the tax adjustment factor (TAF); and

- Section 6 summarises the results and concludes on the corresponding ALF values.

2. Ofcom's Revised Proposals for Calculating the ALF

Ofcom seeks to revise the ALF amounts paid for the existing 900 MHz and 1800MHz frequencies based on new information about the value of spectrum informed by the amounts paid in the UK 4G auction.

Ofcom proposes to calculate the new ALF rate as a 20 year annuity spreading a lump sum value derived from the values bid in the UK 4G auction. Initially, Ofcom used a discount rate equal to the WACC of a hypothetical UK mobile-only operator of 4.2 per cent (real, post-tax), which was based on Ofcom's 2011 MCT determination. Ofcom further proposed to set the ALF constant in real terms and to index it each year with outturn RPI inflation. Ofcom also calculated a tax adjustment factor (TAF) to correct for differential tax effects that arise from using an annuity rather than an upfront lump-sum payment.

In the further consultation, Ofcom revised a number of elements of its approach, in particular: (a) its estimate of the discount rate for the annuitisation of licence fees; and (b) the index used to adjust constant real ALF payments to inflation. In Section 4 of its second draft for consultation, Ofcom sets out its revised proposal to translate the lump-sum values derived from the amounts bid in the UK 4G auction into an annual license fee (ALF) rate for each of the 900 MHz and 1800 MHz spectrum bands.

Ofcom now uses its estimate for a UK mobile operator's cost of debt rather than the WACC as the relevant discount rate for annuitisation, which translates into a post-tax real (post-CPI) discount rate of 2.6% compared to 4.2% (post-RPI) before. Ofcom's cost of debt estimate of 2.6% is based on the use of long-run average estimates for the risk-free rate and an estimate of the debt premium for long-dated debt issuance by the parent companies of the UK MNOs.

Ofcom also considers an alternative approach that relies on current bond yields to maturity for UK MNO parent companies and possible adjustments for securitisation and inflation risk but concludes that no further adjustments are required.

As another revision to its initial methodology, Ofcom now uses CPI rather than RPI inflation to index the constant real annual payments. As there is no market information on expected CPI (as there are no CPI-linked bonds), Ofcom assumes CPI inflation of 2%, in line with the Bank of England's inflation target.

We acknowledge that the changes between the first and second consultation are generally positive from an economic point of view and are therefore to be welcomed. However, we note that a number of errors remain, which we discuss below.

3. The Use of a Long-run Cost of Debt is Incorrect for the Purposes of ALF Setting

In its revised proposal, Ofcom uses the cost of debt rather than the WACC as its discount rate to calculate ALFs from its estimate of the spectrum lump-sum value. We agree with Ofcom that this method conceptually better reflects the debt-like payment structure of the ALF annuities. However, we take issue with Ofcom's cost of debt calculation based on long-run *average* estimates as we set out below.

3.1. Ofcom's Revised Approach

In its revised proposal, Ofcom uses the MNOs' cost of debt to determine the ALFs. Ofcom sets out two different methods to determine the cost of debt:

- **Aggregation approach:** The first method consists of estimating the risk-free rate and the debt premium separately and subsequently aggregating them to yield the total cost of debt. This aggregation approach provides some latitude to specify the parameters for the risk-free rate and the debt premium independently. For example, in implementing its approach Ofcom uses different averaging periods and maturities for the risk-free rate and the debt premium, as discussed below.

- **YTM approach:** The second method seeks to infer the relevant cost of debt directly from the yield to maturity (YTM) currently observed for corresponding corporate bonds issued by UK MNO parent companies. This approach does not estimate the risk-free rate and debt premium separately and therefore inevitably uses consistent time periods for both elements. In implementing the approach Ofcom relies on (relatively) short-term data for YTMs.

We note that the key theoretical difference between the two approaches is that the former affords Ofcom an extra degree of discretion in allowing it to select different observation periods for the risk-free rate and debt premium while the latter does not. In practice the key difference in how Ofcom decides to implement the approaches is that Ofcom uses a long-run average observation period for the first approach while using a consistently short-run observation period for the latter.

Aggregation approach ("Option A" in Ofcom's proposal)

Using the first (aggregation) approach, Ofcom calculates a total cost of debt of 5.8% (nominal, pre-tax), which includes a nominal risk-free rate of 4.6% and a debt premium of 1.2%. Ofcom's nominal risk-free rate is based on its May 2014 Fixed Access Market Review, where the real risk-free rate estimate of 1.3% is informed by short- and long-term averages of index-linked gilts interpreted with discretion, increasing forward rates and the 2014 NIE Determination of the Competition Commission (the CC retained an estimated range of 1.0-1.5%). Ofcom adds an RPI inflation estimate of 3.3% as in its June 2014 MCT Consultation, which itself is an aggregation of the Bank of England's CPI inflation target of 2% and estimated CPI-RPI wedge of 1.3%.

As for the debt premium, Ofcom considers spreads of five bonds taken out by the MNO parent companies (MCPs) – Deutsche Telekom, Vodafone, France Telekom and Telefónica – with an average maturity of slightly more than 20 years. Observed spreads range from 1.0%

to 1.7% over a 12-month period; attributing particular weight on Vodafone, Ofcom retains a point estimate of 1.2%. The total cost of debt of 5.8% pre-tax corresponds to 4.7% nominal, post-tax and 2.6% real, post-tax (deflated with 2% CPI).

YTM approach ("Option B" in Ofcom's proposal)

Ofcom also estimates the cost of debt directly from observed yields to maturity. Considering the same MCP bonds as for the debt premium estimation over the 12 months until 15 July 2014, Ofcom estimates the relevant range at 4.2 to 5.4%. Again placing more weight on Vodafone, Ofcom retains a point estimate of 4.6%. This corresponds to 3.7% nominal, post-tax and 1.7% real, post-tax. The risk-free rate implicitly included in this approach is the 12-month average of yields on UK gilts with a c. 20-year maturity.

Considering estimates from both approaches, Ofcom decides to retain the value derived from the aggregation method (Option A), based on the following arguments:

- The long-run cost of debt estimate corresponds to the long-term nature of the ALF obligation.
- Ofcom usually takes the long-run approach for its WACC calculation and notes the benefits of regulatory consistency.
- The Competition Commission used a risk-free rate of 1-1.5% in its NIE determination.

We will address these arguments in turn, pointing out the conceptual flaws underlying Ofcom's reasoning.

3.2. Incorrect Use of Long-run Averages

For the cost of debt to be an unbiased estimate of the discount factor, it has to be estimated correctly both in relation to the:

- maturity of the underlying debt instrument; and
- observation period representative of conditions at the time of financing.

The appropriate *maturity* is based on a 20-year financing instrument to match the duration of the ALF, which is set for a 20-year period. This is witnessed by Ofcom's statement that:

> "it is **important to consider the long term nature of the ALF obligation**. *We need to set a value of ALF that will apply in the near future and that will remain in force until changed, as explained in Section 6. The (starting) level of ALF is derived from a calculation which assumes that it **remains unchanged in real terms over 20 years**." (A10.27)*

The above does provide a strong rationale for using a long maturity bond. However, Ofcom's arguments for also using a long observation period over which to average financing costs are incorrect. Ofcom states that:

> "We are therefore setting these fees, including the discount rate, for an extended period of time. This makes potential short-term distortions more serious, since there

*are fewer prospects for these being removed in further reviews than in the case of
setting WACC for periodic market reviews." (A10.29)*

However, Ofcom's argument above overlooks a fundamental conceptual difference between
setting a "one-off" ALF contract today and regulatory rate setting. The determination of ALF
payments is different from setting the cost of debt for the WACC. UK regulators generally
do not trace the cost of each individual debt instrument (the cost of which is based on the
current yield at the time of issue) but take a holistic approach by setting an average, or in the
case of Ofgem, a rolling ten year average, cost of debt at the beginning of each regulatory
period that remunerates the expected cost of new and embedded debt. Under this approach,
long-run estimates are a better indicator than spot rates.

As part of the regulatory revenue cap determination in its 2014 Fixed Access Market Reviews
(FAMR) that also informs the 2014 Mobile Call Termination (MCT) market review, Ofcom
sets out the reasoning behind the use of long-term averages:

> *"Our WACC estimate needs to be relevant for the three year period of the charge
> control and in particular for the final year of the charge control (2016/17), which is
> the year in which we estimate BT's costs for the purposes of setting a glide path. Our
> approach is to estimate a WACC that is based on historic and current data, but which
> should be relevant for the period covered by the control." (FAMR 2014, A14.27-
> A14.28)*

This is however conceptually different from the determination of a "one-off" ALF contract
today. Determining ALF is akin to arranging a *one-off* 20-year lease between the government
and the mobile operators *today*. The financing costs would be determined by *current*
financing conditions and not by historical long-run averages. Hence using the *current* yield
is the appropriate approach for determining the ALF payments.[1]

In light of the above Ofcom's appeal to regulatory consistency appears misplaced:

> *"[this] is also the approach we generally take in calculating the cost of debt for the
> WACC for a similar reason of consistency through time, and so there is also a
> potential benefit from regulatory consistency to consider." (A10.30)*

We further note that Ofcom itself does not use an entirely consistent method between the
MCT 2014 Consultation where it uses bonds with an average maturity of around 10 years for
the debt spread calculation and the ALF setting where it uses 20-year bonds.[2]

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[1]   The use of current yields continues to hold true even when taking into account that Ofcom may decide to re-open the
ALF calculation at some point in time to recalculate ALFs based on new information. In this case Ofcom should use
the remaining years to maturity as the maturity for debt instrument to set the ALF as the terms of the lease are fixed for
a shorter period of time; but Ofcom should continue to rely on current estimates at each ALF re-setting of financing
costs as the key difference relative to regulatory rate setting is that any new "lease" (ALF settlement) struck will be able
to draw on latest data on financing conditions at the time.

[2]   Given that debt spreads are relatively insensitive to tenor (which should net out from a theoretical point of view) this
inconsistency does not have significant bearing on the final result as, in both cases, Ofcom retains a 1.2% point estimate
for the debt premium).

In light of the above, the conceptually correct approach for estimating the discount rate for ALF setting is to use *current* data on 20-year maturity debt instruments for both the risk-free rate and the debt spread.

This approach is reflected in Ofcom's second method (the YTM approach) where it estimates the cost of debt directly from current yields to maturity observed on financial markets. While the maturity is in line with the long-term nature of the ALF financing, this method ensures that current conditions on financial markets are "locked in" as would typically be the case for a loan taken out on the debt market today.

3.3. Evidence on Actual Cost of Debt

Given the conceptual background supporting the use of a current cost of debt estimate rather than estimates based on long-run averaging, it is relevant to identify the corresponding empirical cost of debt estimates.

In line with Ofcom's approach in the second consultation, we calculate yields on bonds issued by the parent companies of UK mobile operators. We focus on bonds with maturities close to 20 years, in line with the period over which the lump sum payment is spread to calculate the ALF annuity. We cross check the evidence on the cost of debt of UK mobile operators with wider evidence from UK corporate bond indices of comparable rating.

Figure 3.1 shows the nominal yield to maturity over the last year for selected bonds issued by UK mobile operators' parent companies. We included bonds based on Ofcom's criteria in the second ALF consultation:

- issued in GBP currency; and

- maturity not before 2029 (i.e. with maturity in excess of 15 years).

We have identified five bonds which satisfy these criteria.

Figure 3.1
Nominal Yields on Selected UK Mobile Operators' Bonds
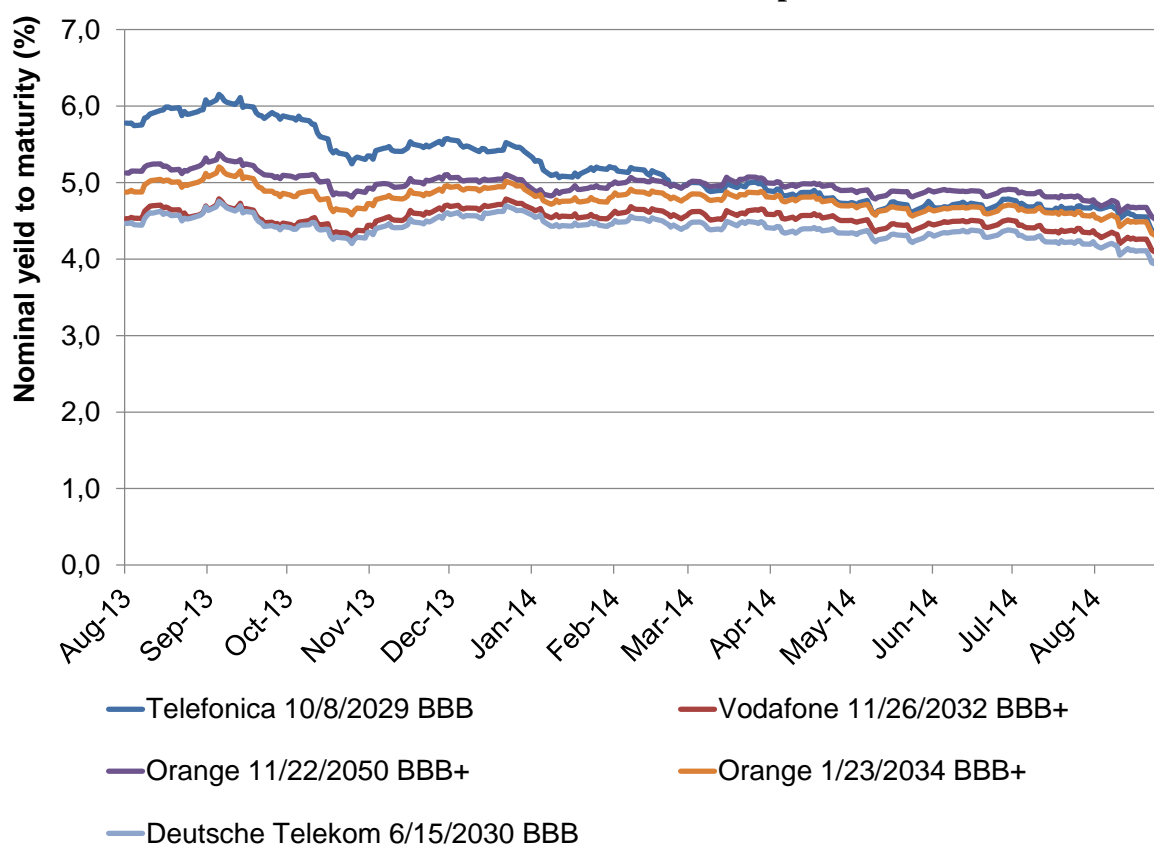
Source: NERA analysis of Bloomberg data

Nominal yields on selected bonds were between 3.9% and 6.3% over the last year, with relatively small variation in yields for individual bonds. Table 3.1 shows average yields calculated over 1 month, 3 months, 6 months and 1 year periods.

Table 3.1
Nominal Yields on Selected UK Mobile Operators' Bonds

	Maturity (Y)	1M avg	3M avg	6M avg	1Y avg
Telefonica 10/8/2029 BBB	15.1	4.6	4.7	4.7	5.1
Vodafone 11/26/2032 BBB+	18.2	4.3	4.4	4.5	4.5
Orange 11/22/2050 BBB+	36.2	4.7	4.8	4.9	5.0
Orange 1/23/2034 BBB+	19.4	4.5	4.6	4.7	4.8
Deutsche Telekom 6/15/2030 BBB	15.8	4.1	4.2	4.3	4.4
Average	**21.0**	**4.4**	**4.5**	**4.6**	**4.7**

Source: NERA analysis of Bloomberg data; cut-off date is 1 September 2014

The selected bonds have an average maturity of 21 years, with an average yield between 4.4% and 4.7% nominal, when averaged over short run periods of up to 1 year.

There is no particular reason to prefer a specific short-run averaging time horizon over another when calculating the "current" cost of debt. As shown in Figure 3.1, the yields have gradually fallen over the last year. We consider that estimate range of 4.4% to 4.7% nominal represents a reasonable estimate of the current cost of debt of UK mobile operators.

We perform a cross-check of the evidence on cost of debt of UK mobile operators with evidence on yields from UK corporate bond indices with comparable rating. The bonds of MPCs are now all rated BBB+/BBB. We therefore consider benchmark yields for broad A and BBB rated indices, which will allow us to interpolate the BBB+ yields. We use a benchmark index with maturity as close to 20 years as possible.

We use the iBoxx corporate non-financial series as the benchmark bond index. The iBoxx series is currently used by Ofgem for cost of debt indexation for setting allowed cost of debt for regulated companies as part of Ofgem's latest RIIO price controls.[3] Specifically, we use:

- the iBoxx corporate non financials index with A rating and 10+Y maturity, whose average maturity over the last year was 22.5 years; and

- the iBoxx corporate non financials index with BBB rating and 15+Y maturity, whose average maturity over the last year was 21.5 years.[4]

Figure 3.2 shows the nominal yield to maturity for the iBoxx corporate non financials series with A rating and a 10+Y maturity as well as the iBoxx corporate non financials series with BBB rating and a 15+Y maturity.

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[3] For details on the iBoxx index, see Ofgem's consultation on cost of debt indexation. Ofgem (March, 2011): Decision on the strategy for the next transmission and gas distribution price controls – RIIO T1 and GD1 Financial issues ,p. 21-24. Available at: https://www.ofgem.gov.uk/ofgem-publications/53838/t1decisionfinance.pdf.

[4] We also considered using the iBoxx BBB 10Y+ index but found that the 15Y+ index more closely matches a 20Y maturity.

Figure 3.2
Nominal Yields on iBoxx A 10+ and iBoxx BBB 15+ Indices
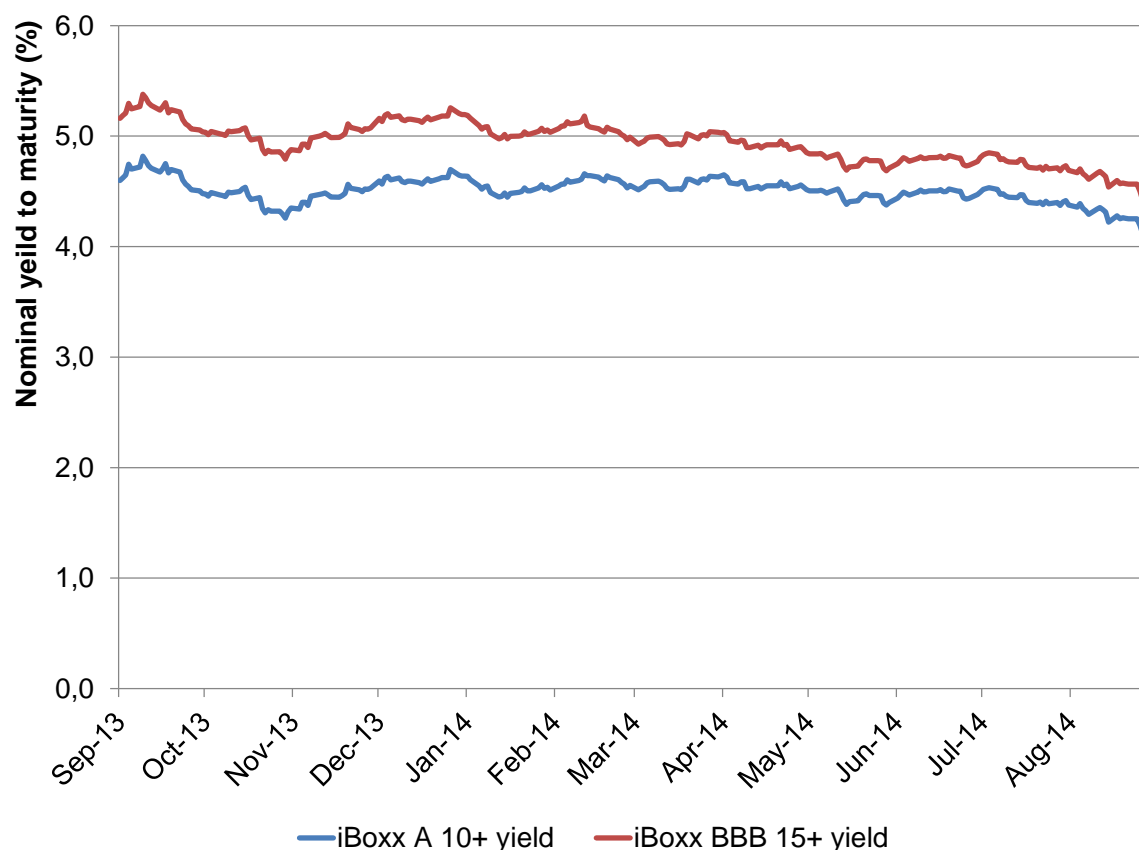
Source: NERA analysis of Datastream data

The yields varied between 4.1% and 4.8% nominal over the last year for the A-rated iBoxx index and between 4.4% and 5.4% nominal for the BBB-rated iBoxx index. Table 3.2 shows average yields of the iBoxx indices calculated over periods of 1 month, 3 months, 6 months and 1 year.

Table 3.2
Average Yields on iBoxx Indices

	1M avg	3M avg	6M avg	1Y avg
iBoxx £ corp non-fin A 10+Y	4.3	4.4	4.5	4.5
iBoxx £ corp non-fin BBB 15+Y	4.6	4.7	4.8	4.9
Average	**4.4**	**4.6**	**4.6**	**4.7**

Source: NERA analysis of Datastream data; cut-off date is the 29 August 2013

Average yields of the A and BBB indices over a period from one month of up to one year coincide with the above evidence on corporate debt issued by parent companies of UK mobile operators, leading us to conclude that a range of 4.4% to 4.7% is a reasonable estimate of the current cost of debt for a notional UK mobile-only operator. This is

consistent with a real post-tax cost of debt of about 1.5% to 1.7%, when using a long-run CPI inflation assumption of 2% (Table 3.3).[5]

Table 3.3
Current Cost of Debt of a UK Mobile-Only Operator

	Low	High
Cost of Debt nominal, pre-tax	4.4%	4.7%
CPI inflation	2.0%	2.0%
Cost of Debt real, pre-tax	2.4%	2.6%
Cost of Debt real, post-tax	**1.5%**	**1.7%**

Source: NERA analysis; real cost of debt is calculated from nominal using the Fisher formula and a CPI inflation assumption of 2 per cent. Corporate tax rate is 20%.

Our estimate of the cost of debt of 1.5-1.7% (real, post-tax) is based on the actual cost of debt of UK only mobile operators with rating between broad A and broad BBB.

3.4.   Conclusion

Ofcom's long-run approach to estimating the cost of debt is incorrect and does not stand up to critical assessment.

Ex-ante the government should be indifferent between receiving the lump sum now or the ALF payment over a 20 year period. This is because it is akin to the government providing a lease in the size of the lump sum to the MNO and receiving the ALF payments over 20 years. The financing costs of this lease, however, would be determined by *current* financing conditions and not by historical long-run averages. Hence using the *current* yield is the appropriate approach for determining the ALF payments.

Based on short-term averages of yields on debt issued by mobile operator parent companies and in light of consistent evidence from UK non-financial corporate debt with similar credit rating, we estimate the cost of debt in a range of 4.4-4.7% (nominal, pre-tax). This implies a reduction of 110 to 140 basis points from Ofcom's cost of debt estimate (5.8%) used for the calculation of annuities.

We set out below why the bias in Ofcom's discount rate is even larger than 110 to140 basis points and that an unbiased estimate for the discount rate is still significantly lower than 4.4-4.7% (nominal, pre-tax) or 1.5-1.7% (real, post-tax).

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[5]   We use the Fisher formula to convert the nominal cost of debt into real cost of debt.

4. Ofcom's Approach does not Correctly Reflect the Risk of the Cash Flows to Government

In addition to overstating the discount rate by applying an averaging period that is not suitable for the problem at hand, Ofcom's approach also contains a number of other elements that overstate the discount rate. Specifically, Ofcom argues that:

> *"the discount rate used to annualise the lump-sum value should reflect **the risk of the cash flows coming from MNOs to the Government through the ALF**" (4.12).*

Ofcom's approach overstates the risk of the cash flows for a number of reasons, namely:

- inclusion of a liquidity risk premium;
- failure to recognise the benefits of securitisation; and
- inclusion of inflation risk (at least in option B).

We discuss these points in turn.

4.1. Liquidity Risk

Without further adjustment, the cost of debt of MNOs does not correctly reflect the risk that the government bears by collecting annuities rather than an upfront lump-sum payment. The spread of corporate bond yields over the risk-free rate reflects a number of different components. In addition to idiosyncratic default risk, creditors face systemic (market) risk and liquidity risk. Liquidity risk refers to the difficulties that a creditor may encounter when trying to sell a bond on the secondary market at market value. As illiquidity restricts the possibility to mitigate risk exposure, creditors require a premium for bearing liquidity risk.

However, such illiquidity risk is not relevant to the UK government when setting ALFs as there is no (realistic) option for the government to sell the ALF contract with the MNO to a third party.[6] Instead the government will hold the contract to maturity unless the MNO "defaults", which means default risk is the only risk that is relevant to the government. This implies that liquidity risk, a typical feature of corporate bonds and reflected in Ofcom's cost of debt estimate, does not apply to the case of spectrum licence fees; that is, concerns of an illiquid market are not relevant where the sale of the ALF revenue stream by the government is not a realistic option.

Research into the drivers of corporate bond spreads suggests that default risk accounts for a significant proportion of the premium that corporate debt holders demand over sovereign debt yields. Figure 4.1, taken from a study by Bank of England economists L. Webber and R. Churm (2007), shows that a substantial share of investment grade corporate debt spreads

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[6] Ofcom actually argues that constraints on the government's ability to monetise the spectrum asset expose the government to additional risk. While this might be true for a private investor concerned with a situation where he needs to monetise assets, the same cannot be said of the government, which has other options (fiscal policy) at its disposal for overcoming liquidity crises and will therefore not be interested in monetising the asset.

cannot be explained by either idiosyncratic or systematic default risk. They postulate that liquidity risk remains the primary explanatory factor for the observed residual.[7]

Figure 4.1
Decomposition of Sterling-Denominated Investment-Grade Corporate Bond Spreads
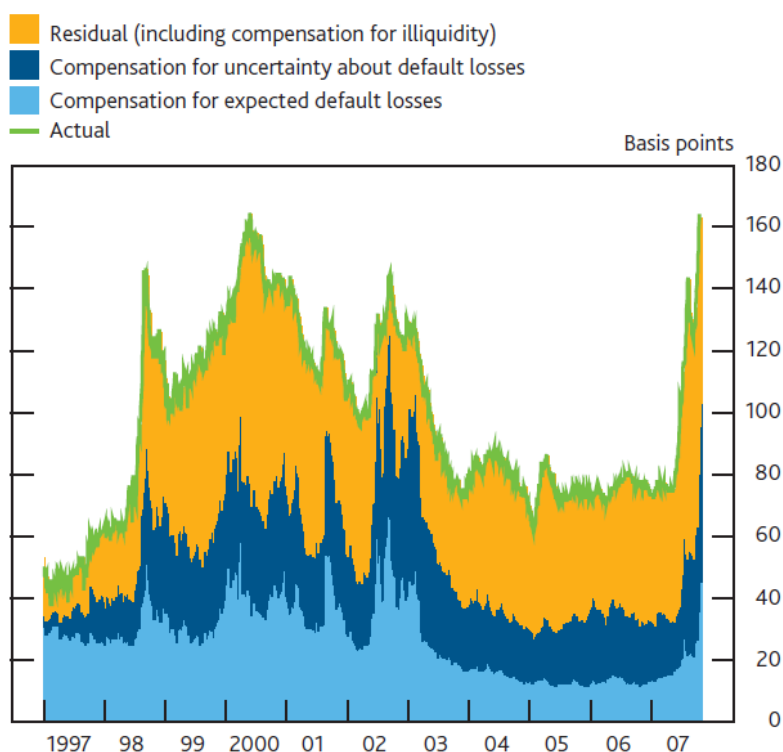
Source: Bank of England Quarterly Bulletin Vol. 47 (2007).

Regulatory precedent also recognises the significance of the liquidity premium as a driver of corporate debt spreads. In its 2007 BAA Ltd decision, the CC explicitly estimated liquidity components of the debt premium for BBB-rated corporate debt (investment grade credit quality, the relevant benchmark for BAA Ltd) and retained a range of 27.0-37.3% based on its analysis of academic studies on the matter.[8]

The CC's estimate is informed by the studies listed in Table 4.1, but it considers Huang and Huang (2003) to be an outlier. Based on an estimate of BAA's total debt premium of 110 basis points, the CC assumes a liquidity premium in a range from 30 to 41 basis points.

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[7] Webber, L. and R. Churm (2007): Decomposing corporate bond spreads, Bank of England Quarterly Bulletin, Vol. 47, No. 4, pages 533-541, 2007

[8] Competition Commission (2007): A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd), presented to the Civil Aviation Authority 28 September 2007; for the relevant discussion, see Appendix p. F25.

Table 4.1
Studies Used by the CC for Estimating the Share of Liquidity Components

Author	Year	Estimate
Longstaff, Mithal and Neis	2005	29%
Almeida and Philippon	2006	27%
Cremer et al	2005	37.3%
Chen et al 2005	2005	29.8%
Huang and Huang	2003	66%

Source: Competition Commission on BAA Ltd (2007)

Given that the relevant base year for Ofcom's cost of debt estimate is 2011, we have reviewed the estimates from the studies referenced by the CC in light of more recent evidence. Table 4.2 lists estimates of the liquidity premium from more recent studies.

Table 4.2
Recent Studies on the Share of Liquidity Components

Author	Year	Estimate
Bongaerts, De Jong and Driessen	2011	53% [9]
Chen et al.	2013	18-57% [10]
Gaspar and Pereira	2010	40% [11]

Source: NERA analysis based on listed studies

Ofcom uses the credit ratings of the MNO parent companies Deutsche Telekom, Vodafone, Telefónica and France Telekom, which were all rated investment grade at the time of assessment. Thus, we consider investment grade corporate bonds as the relevant benchmark when estimating the relative size of liquidity risk premium in the overall debt premium.

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[9]   The authors note that "*across all portfolios, the average expected excess bond return equals about 1.9% per year, of which about 1% is due to expected liquidity, while equity market liquidity risk, equity market risk and volatility risk each contribute about 0.3% to the expected excess return.*" The results do not, however, appear to be substantially different if only investment grade corporate bonds are considered.

[10] The share varies according to the specific rating within the investment grade bond class and tends to be larger for higher-rated bonds, see Chen, Hui , Rui Cui, Zhiguo He and Konstantin Milbradt (2013): "Quantifying Liquidity and Default Risks of Corporate Bonds over the Business Cycle", Working paper, University of Chicago Booth School of Business, April 2013.

[11] Gaspar, Raquel M., and Patrícia Pereira (2010): "Liquidity Risk Premia: An Empirical Analysis of European Corporate Bond Yields." Available at SSRN 1744184.

Bongaerts et al (2011) find evidence that the liquidity premium continues to be a significant determinant of corporate bond spreads, noting that:

> *"incorporating liquidity effects goes a long way in explaining the high returns on high-rated corporate bonds."*[12]

Recent research, such as Dick-Nielsen et al. (2012), emphasises that with the onset of the financial crisis, liquidity premiums increased significantly. The authors note that

> *"the subprime crisis dramatically increased corporate bond spreads and it is widely believed that deteriorating liquidity contributed to the widening of spreads."*[13]

However, considering the temporary nature of the credit constraints following the subprime crisis, we are minded to attribute more weight to estimates obtained prior to 2007, i.e. namely the studies cited by the CC. We consider that more recent estimates primarily provide evidence that earlier studies are not unduly inflated and that we can retain the CC's estimate for the purposes of our analysis, i.e. a liquidity premium of 27.0% to 37.3%.

On the basis of the total debt premium of 120 basis points[14], a liquidity premium of 27.0% to 37.3% relative to the total debt premium corresponds to a premium in the range of 32 to 45 basis points.

4.2. Securitisation

The MCP bonds used for the debt premium estimate are senior unsecured debt instruments. We note that secured debt would benefit from a lower risk premium:

> *"It is likely that a secured debt would attract a lower rate than an unsecured debt due to the greater probability of the creditor recovering a greater proportion of their investment in the event of a default."* (A10.33)

Indeed, the ALF can be viewed as a debt obligation secured against the value of the spectrum licence. This argument suggests that debt premiums inferred from unsecured corporate bonds overstate the risk that a holder of such secured debt is actually exposed to. Ofcom cites several factors that it takes as evidence against the application of a securitisation discount for the debt premium. As we show below there is considerable uncertainty around the exact magnitude of the discount but it seems very unlikely based on the evidence presented by Ofcom that there should be *no* discount at all.

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[12]   Bongaerts, D., F. De Jong, and J. Driessen (2012): An asset pricing approach to liquidity effects in corporate bond markets, working paper, Tilburg University.

[13]   Dick-Nielsen, J., P. Feldhuetter and D. Lando (2012): Corporate bond liquidity before and after the onset of the subprime crisis, Journal of Financial Economics 103 (2012) 471–492; citation from p. 485. Note that these authors measure relative effects within a certain bond class (average vs. most liquid bond in a given bond class) and their liquidity estimates can therefore not be directly compared with estimates from other studies.

[14]   We note that Ofcom's estimate of the debt premium (120 basis points) is based on short-term market evidence, in line with our short-term averages of the cost of debt of MNO parent companies. We therefore consider that Ofcom's debt premium estimate is a consistent estimate of the debt premium implicit in current MNO parent company bond yields.

First, Ofcom argues that a low spread between AAA and A rated bonds suggests that securitisation does not lead to a substantial difference in yields. However, Figure 4.2 (taken from Ofcom's revised proposal) reveals a non-negligible difference of 50 bps in yields of AAA and A rated, EUR-denominated bonds with a maturity of 10 years. In relative terms, this corresponds to a 30% premium for A rated bonds; while for shorter maturities, the relative difference is even larger. Hence, our analysis does not support Ofcom's claim that there is no benefit from features leading to a higher credit rating such as securitisation.

Figure 4.2
Comparison of AAA- and A-Rated, EUR-Denominated Bonds
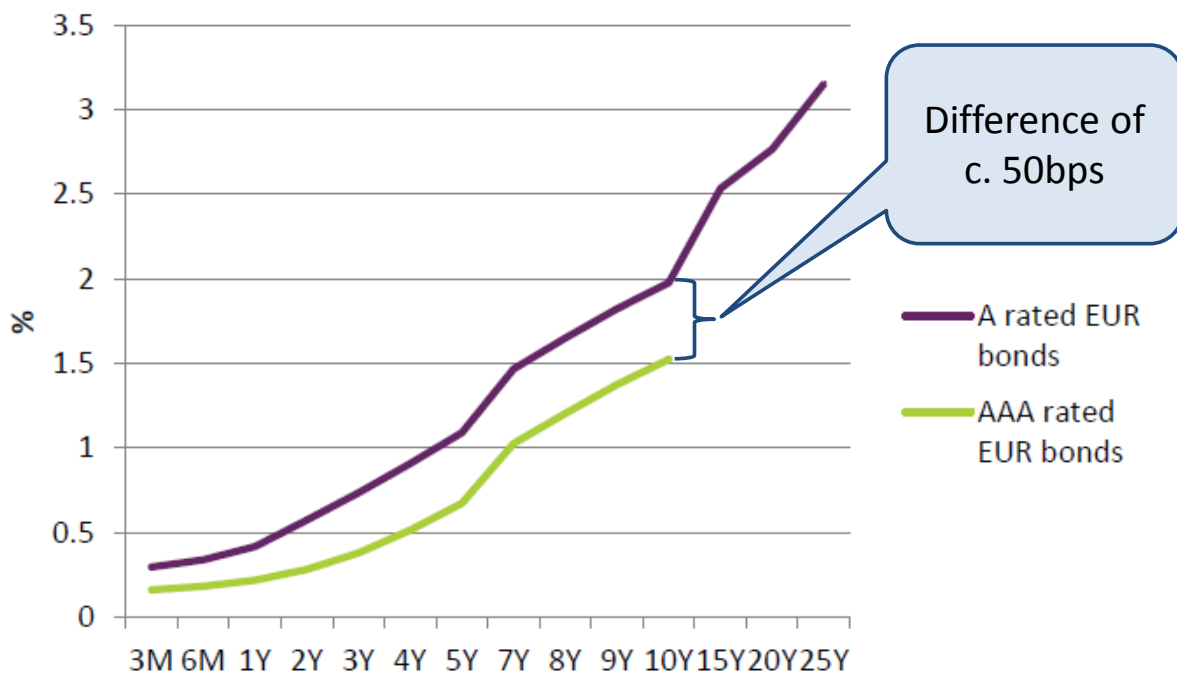
Source: Ofcom consultation proposal, A10.34

Second, Ofcom notes that "*ALF is not 'secured' on a general purpose 'asset' but rather on a specific asset (the spectrum licence)*" (A10.35) and infers that the specific nature of the security provided does not justify a lower debt premium. This conclusion does not account for rating agency practice on other securitisations in the regulated sector. E.g. many utilities securitise their debt against specific infrastructure assets. Nonetheless rating agency Moody's sets out in its "Rating Methodology for Regulated Electric and Gas Networks" (2009) that:

>   "*structural enhancements can deliver **up to three notches of uplift** from a fundamental rating if they are very comprehensive and effective.*" (Moody's rating methodology, p.22)

As a typical example of such structural enhancements, Moody's cites securitisation provisions, which in the case of utilities generally relate to special purpose assets as the value of general purpose assets in such businesses is significantly below the value of total debt. A difference of three notches in the credit rating can have a non-negligible impact on the yield

that investors require. Table 3.2 where we compared yields of A and BBB rated corporate bond indices (i.e. a difference of three notches at the relevant level of credit quality) with roughly similar average maturities shows that 1-year average yields differ by approximately 40 basis points, or nearly 10% in relative terms.

We note that the value of the spectrum band licences used for securitisation is negatively correlated with the probability of the MNO defaulting on its ALF contract: The mobile operator is more likely to suspend ALF payments and return the licence to the government when the economic value of the licence is low. This obviously reduces the value of securitisation. Considering both this observation on security value and the above evidence of benefits from securitisation (special purpose assets included), we conclude that a reasonable estimate of the benefit from securitisation corresponds to a one-notch rating uplift (compared with a maximum of three notches that Moody's applies), or about 10-12 basis points (roughly one third of the c.40 basis points estimated above for a three notch difference).

Based on the evidence above, it seems highly unlikely that the security provided by securitisation of the spectrum asset would leave creditors entirely indifferent. The evidence presented above suggests that secured debt earns lower yields, even if the security is provided against special purpose assets. We consider that a discount of 10 to 12 basis points is a reasonable estimate of the securitisation benefit in the ALF setting.

4.3. Inflation Risk

4.3.1. Evidence for a Positive Inflation Risk Premium

Ofcom uses real yields to calculate the ALF payment and indexes the real payment with inflation. Under option B, Ofcom uses *forecast* inflation to calculate the real yield (for the determination of the real ALF payment) and proposes *actual* inflation for the indexation over the course of the 20 year period.

Under Ofcom's approach, the real ALF payment for year one is calculated with respect to forecast inflation; the government will receive the real payment over the course of the 20 year period independent of outturn inflation. Thus, the ALF structure provides the government with a safeguard against unexpected changes in inflation. Note the reference bonds used by Ofcom do not contain such protection but instead pay higher yields.

For such a protection, a market participant (here the government) would need pay a fee, i.e. an inflation risk premium. Our analysis shows that under the alternative approach (option B), Ofcom would need to deduct up to 20bps (in addition to the forecast CPI inflation) from the nominal yield in order to account for the protection of inflation risk provided by the MNO.

Ofcom's preferred approach (option A) calculates the cost of debt based on real yields. Arguably, with respect to the inflation risk, this approach would be unbiased. However, as we have shown in section 3.2, the use of current yields (option B) is clearly preferable. Under this approach, Ofcom's method is biased as explained above. We therefore discuss the issue of inflation risk in more detail below.

Economic theory provides no straightforward answer as to whether investors would require an inflation risk premium; the CAPM model tells us that much depends on the systematic risk

component, i.e. on the correlation of inflation risk and market risk. A negative correlation can indeed justify a negative inflation premium, even for risk averse investors. However, empirical research generally supports a *positive* inflation risk premium. The authors of a recent study on inflation risk summarise their conclusion from a literature review as follows:

> "*Most studies, including very recent ones that actually use inflation-linked bonds and information in surveys to gauge inflation expectations, **find the inflation risk premium to be sizeable and to substantially vary through time**.*"[15]

Considerable variation in empirical estimates of inflation premiums calls for a differentiated approach to the analysis. As part of a wider regulatory study conducted in 2009, NERA also investigated the case for an inflation risk premium on financial markets and found that empirical evidence suggests a positive, albeit limited, inflation risk premium.[16]

Market evidence on breakeven inflation implied by yields on index-linked gilts (ILGs) suggests that there may be an inflation risk premium of c.20 basis points relative to Ofcom's baseline RPI inflation of 3.3% for 20 year bonds, the relevant maturity for the purpose of ALF setting.[17] Figure 4.3 shows the difference between inflation expectations implied by 20 year ILGs and Ofcom's RPI estimate of 3.3% over the last year (cut-off date is 29 August 2014). The spread between Ofcom's RPI estimate and inflation expectations implicit in 20 year ILGs varied in a range of 2 and 34 basis points over the last 12 months, with an average value of 22 basis points. Based on this market evidence, we consider that a range of 10 to 20 basis points represents a reasonable estimate of the inflation risk premium.

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[15] Geert Bekaert and Xiaozheng Wang (2010): Inflation Risk, Economic Policy, Oct. 2010.

[16] NERA Economic Consulting: Cost of Capital for PR09 - A Final Report for Water UK, January 2009.

[17] Note that we only consider price data since mid-2013 to avoid potential distortions related to the ONS' review process of potential modifications to the RPI.

Figure 4.3
Difference Between 20Y ILG Breakeven Inflation and Ofcom RPI Estimate (3.3%)
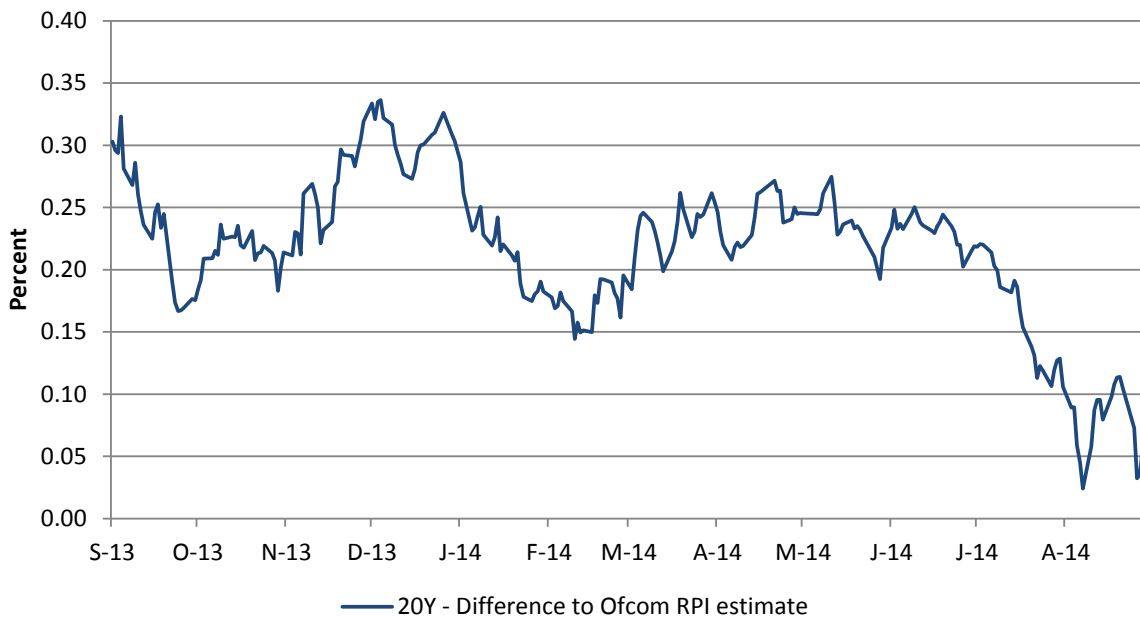
Source: NERA analysis based on Bank of England data; cut-off date is 29 August 2014

4.3.2. CPI Forecasts

Although the analysis of implied RPI inflation assumptions provides helpful insights, we are eventually most interested in CPI inflation given that Ofcom moved to using CPI rather than RPI. Unfortunately, there exists no market equivalent to ILGs that would allow us to infer investor expectations of CPI inflation for the UK from financial market data.

We can, however, refer to commonly used CPI inflation forecasts to assess the plausibility of Ofcom's 2% baseline estimate, which is mainly informed by the Bank of England's explicit inflation target. We note that Consensus Economics, which aggregates inflation estimates of a large number of market participants, calculates average inflation forecasts over a 10Y horizon to lie in range from 2.5% to 2.9% indicating the potential for CPI to lie significantly above the BoE target for extended periods. We do note, however, that the annual Consensus forecast is now relatively dated.[18] In a more recent review of forecasts for UK CPI inflation, HM Treasury finds that average CPI forecasts over the 2014-18 period vary between 1.8% and 2.1%, broadly in line with Ofcom's estimate.[19]

Overall, our analysis of inflation risk suggests that investors tend to demand a premium for exposure to inflation risk. Market evidence on breakeven inflation suggests that there may be an inflation risk premium of 10 to 20bps relative to Ofcom's baseline RPI inflation of 3.3% for 20 year bonds.

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[18]   Consensus Economics (2013): Forecasts for the UK economy: a comparison of independent forecasts, Oct. 2013.

[19]   HM Treasury (2014): Forecasts for the UK economy: a comparison of independent forecasts, No. 328, Aug. 2014.

4.4.   Conclusion

Using the cost of debt instead of the WACC for annuitisation represents a significant improvement in Ofcom's revised consultation proposal. However, Ofcom's estimate of the cost of debt differs from its stated target of providing an estimate of *the risk of the cash flows coming from MNOs to the Government through the ALF* for a number of reasons. Distortions arise from three notable elements impacting the size of the debt premium:

- liquidity risk contained in observed MNO bond yields but irrelevant to the UK government, which we estimate to account for 32 to 45 basis points of the total debt premium of 120 basis points;

- rating benefits from securitisation not incorporated in the observed bond yields for unsecured bonds, which we estimate to account for 10 to 12 basis points of the total debt premium; and

- inflation risk contained in nominal yields but not applicable for the case of ALF setting leads to upward bias in the current cost of debt estimate of 10 to 20bps.

Omitting these factors leads to an overestimation of the debt premium and yields an inaccurate reflection of the risk that the government is actually exposed to through the ALFs. Taken together, a correction of the current bias would imply a significant reduction of Ofcom's debt premium: In light of the uncertainty surrounding the estimation of the individual components, we estimate a relatively wide aggregate range of 52 to 77 basis points.

Table 4.3
Correction for Irrelevant Components of Debt Premium

	Max (bps)	Min (bps)
Correction Liquidity Risk Premium	45	32
Securitisation	12	10
Inflation Risk Premium	20	10
Total Correction	**77**	**52**

Source: NERA analysis

5. Review of Ofcom's Tax Adjustment Factor (TAF)

Ofcom uses a tax-adjustment factor to take account of different tax implications resulting from the application of an ALF regime relative to a lump-sum payment for spectrum fees. This approach is somewhat inconsistent: minor differences may arise due to the fact that the annuity is constant in real terms (the annuity is indexed to CPI), whereas the sum of financing costs and amortisation of the lump sum is not indexed to inflation. In practice, however, Ofcom's approach does not materially bias the ALF value.

In our view, the conceptually correct approach is to take into account interest deductibility of debt financing of the lump sum, and to use a pre-tax cost of debt to calculate the annuity. The riskiness of the ALF cash-flows is akin to debt and therefore the tax benefit of the ALF and lump-sum are identical (as debt financing costs are fully tax deductible). Consequently, there is no need for a TAF adjustment term when the correct discount rate (i.e. pre-tax cost of debt) is used.

6. NERA Estimate of Discount Factor and ALF Value

This section brings together the results derived above in order to obtain an aggregate estimate of the discount rate, based on which we can determine the value of the ALF payments. The discount rate to be used for annuitisation is the MNO cost of debt, corrected for a number of items that follow from the specific ALF setting and that have to be deducted from the debt premium: liquidity premium, securitisation and inflation risk.

6.1. Discount Rate

We set out above that nominal bond yields for the purpose of setting the ALF payments need to be corrected by a total of 52 to 77 basis points (Table 4.3). We use this range to correct our cost of debt estimate, which is based on observed MPC bond yields. This calculation is shown in Table 6.1.

Table 6.1
Aggregate Cost of Debt Calculation

	Low (%)	High (%)
Cost of Debt of MNO Parent Companies (nom., pre-tax)	4.40	4.70
Correction for irrelevant components	0.77	0.52
Cost of Debt (nom., pre-tax)	3.63	4.18
Cost of Debt (nom., post-tax)	2.90	3.34
Cost of Debt (real, post-tax)	**0.9**	**1.3**

Source: NERA analysis

When accounting for the impact from liquidity risk, securitisation and inflation risk, we obtain a discount factor in a range of 0.9% to 1.3% (real, post-tax) instead of the 2.6% Ofcom currently uses. [20] Considering that the mobile operator faces less adverse consequences from defaulting on its ALF obligation than on a corporate bond, we decide to retain 1.3% (real, post-tax) as a conservative point estimate for the discount rate.

6.2. Calculation of ALF

For a given lump-sum of the spectrum value we can use the discount factor of 1.3% (real, post-tax) to derive the ALF for the 900 MHz and 1800 MHz bands, respectively. Table 6.2 compares Ofcom's estimation with the value we obtain by applying the corrected discount factor to Ofcom's lump-sum estimation. We note that this report only concerns the methodology used to convert the lump-sum value into an ALF annuity. It does not address the question of whether the lump-sum value correctly reflects the market value of licences for

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[20] Note that we should use pre-tax cost of debt to derive annuities, as set out in section 5. However, to allow for comparability with Ofcom's cost of debt estimate, we decide to present the post-tax cost of debt figure as discount factor.

900 MHz and 1800 MHz frequencies. Using Ofcom lump sum data for illustrative purposes, we calculate that annuities for the 900 MHz and 1800 MHz bands amount to £1.38m and £0.84m per MHz, respectively, as illustrated in Table 6.2.

Table 6.2
Ofcom and Corrected ALFs (£m/MHz)

Spectrum	Ofcom	ALF using corrected discount rate
900 MHz	£1.57	£1.38
1800 MHz	£0.96	£0.84

Source: NERA analysis based on Ofcom data

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