
Three response to Ofcom mobile call termination market review 2015-18 consultation.

Non-confidential

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Executive Summary.

Hutchison 3G UK Ltd (Three) welcomes the opportunity to respond to Ofcom's mobile call termination (MCT) market review 2015-18 consultation¹.

Overall, Three strongly supports Ofcom's proposed approach.

Three's response includes responses to Ofcom's specific consultation questions, plus relevant supporting evidence.

¹ Mobile call termination market review 2015-18 consultation, Ofcom, 4 June 2014.

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Response to Ofcom consultation questions.

Question 3.1: Do you agree with Ofcom's view of the relevant market? If not, please explain why.

Yes.

Ofcom's 2011 MCT market review identified 32 separate markets for termination services provided by named mobile communications providers (MCPs), to another communications provider, for the termination of voice calls to UK mobile numbers for which that MCP is able to set the termination rate.

Ofcom's current consultation proposes the same market definition, but now applies to 82 separate wholesale markets, corresponding to one for each MCP that currently provides MCT or which Ofcom expects to do so during the market review period.

Three strongly agrees with Ofcom's proposed market definition, as there remain no close substitutes for voice calls to mobile numbers nor are such likely to emerge during the review period.

This is chiefly because:

- consumers (and non-consumers) place a high value on being able to contact anyone they might wish to on their mobile phone;
- MCPs control MCT to customers on their network; and
- MCT enjoys greater quality of service (QoS) and universality of access than potentially competing over-the-top (OTT) or alternative mobile communications services.

Accordingly, Three also agrees with the consultation's conclusion that, for each of the relevant markets, the respective MCP operating in that market has significant market power (SMP).

Question 5.1: Do stakeholders agree with our assessment of the harm that would result from a lack of effective competition in MCT markets?

Yes.

The consultation finds that, without regulation, MCPs may have the incentive and ability to refuse to supply MCT, charge excessively high mobile termination rates (MTRs), supply MCT in discriminatory ways or not provide clarity in relation to MTRs.

Three agrees with Ofcom's assessment.

Ofcom notes however from its 2011 MCT statement that it found that if all MCPs have similar market shares, the distortion of existing competition through high MTRs in retail mobile markets would be limited (5.20).

Three strongly disagrees with this conclusion. This conclusion also appears inconsistent with Ofcom's conclusions elsewhere in the consultation.

In particular, even if all MCPs had identical market shares, high MTRs would still distort, limit and/or restrict competition, through creating the same barriers to expansion and thereby to competition as faced by smaller MCPs.

Namely, irrespective of market structure, high MTRs will act as a price floor on off-net calls, thereby dampening incentives on MCPs to reduce call prices and creating a barrier for MCPs to compete for each other's customers and market shares. Indeed, Ofcom appears to reach the same conclusion elsewhere, which Ofcom refers to as the "market-wide effect" (consultation, 6.58).

Accordingly, irrespective of market structure, high MTRs are likely to lead to higher retail prices, lower quality, innovation and investment, and less choice, among other things.

Question 5.2: Do you agree with our assessment that ex-post competition law would not be sufficient to address the competition problems we have identified, and that therefore deregulation is not a regulatory option?

Yes.

Question 5.3: Do you agree with our proposal to impose an obligation to provide network access on reasonable request on all MCPs with SMP? If not, please explain why.

Yes.

Ofcom's 2011 MCT market review imposed a network access obligation and price transparency obligation all MCPs with SMP, and no undue discrimination obligation and charge control on the four largest MCPs.

Three agrees that Ofcom should continue to impose a network access obligation on all MCPs with SMP.

Question 5.4: Do you agree with our proposal to impose a price transparency obligation on all MCPs with SMP? If not, please explain why.

Yes.

Question 5.5: Do you agree with our proposal to impose a non-discrimination obligation on the four largest MCPs, but not on smaller MCPs? If not, please explain why.

Yes.

Question 5.6: Do you agree that our proposal to impose a charge control on the four largest MCPs is appropriate? If not, please explain why.

Yes.

Question 5.7: Do you agree that our proposal to impose a charge control on all other MCPs with SMP is also appropriate? If not, please explain why.

Yes.

Question 6.1: Do you agree that the above framework is the appropriate one? If not, please explain why.

Yes.

Ofcom's analytical framework for assessing the appropriate cost standard for setting MTRs consists of the following criteria:

- economic efficiency;
- competitive effects;
- distributional effects; and
- commercial and regulatory consequences.

Three agrees with this framework.

Question 6.2: Do you agree with our analysis and views on allocative efficiency? If not, please explain why.

Not entirely.

The consultation concludes that allocative efficiency considerations do not provide any strong reason to prefer the long-run incremental cost (LRIC) or LRIC+ cost standard (6.44).

Three disagrees. On the contrary, Three considers that allocative efficiency provides strong grounds to prefer the LRIC cost standard.

First, the consultation notes that allocative efficiency is generally improved, and consumers are better off, when prices are lowered towards marginal (or incremental) cost, and usage is correspondingly higher – but that common costs need to be recovered, and setting prices for one service at LRIC means that common costs need to be recovered elsewhere (6.35).

Second, the consultation states that Ofcom does not favour a Ramsey pricing approach (6.28), as Ramsey pricing is rarely applied in practice (6.29) and because MCPs offer both wholesale and retail services (6.30).

Nevertheless, allocative efficiency is generally maximised by setting Ramsey prices – namely, setting retail price margins reflecting customer's willingness to pay – as this represents the least-distorting way to recover firms' common costs. Moreover, absent SMP (and/or externalities) at the retail level, profit-maximising firms are likely to have strong incentives to set Ramsey prices at the retail level (albeit imperfectly), thereby also promoting allocative efficiency.

Accordingly, in the presence of downstream SMP and/or externalities, regulators should aim to set retail prices (and/or price baskets) to approximate and/or incentivise retail Ramsey pricing.

Correspondingly, at the upstream wholesale level, in order to maximise allocative efficiency, wholesale prices should be set to incentivise Ramsey prices at the downstream retail level. This means setting wholesale prices at marginal (or incremental) cost, i.e. LRIC, to mimic the internal wholesale costs faced by equivalent vertically-integrated firms.

Likewise, absent SMP and/or externalities, profit-maximising upstream firms are likely to have strong incentives to set wholesale prices at marginal cost, if necessary by implementing two-part wholesale pricing. This is to avoid double-marginalisation, which can lead to retail prices

that are neither allocatively-efficient nor profit-maximising (and may exceed vertically-integrated monopoly prices).

Hence, in the presence of (upstream) SMP and/or externalities, and in order to maximise allocative efficiency, regulators should set wholesale prices at marginal cost, namely LRIC.

This is especially the case for vertically-integrated firms, such as MCPs, which are present both in wholesale MCT and corresponding retail call origination and related services, as such firms easily have the opportunity to recover fixed costs through price margins on retail services².

Question 6.3: Do you agree with our analysis and views on dynamic efficiency? If not, please explain why.

Mostly.

Ofcom notes that increasing competition generally acts to increase dynamic efficiency by encourages firms to invest and innovate in order to maximise profits (6.46).

Three strongly agrees with this view. The exception, however – when increasing competition does not act to increase dynamic efficiency – is when the intensity of competition becomes so great that firms are unable to make an economic profit on their past investments, thereby discouraging future investment and innovation. Namely, when the current state of competition becomes unsustainable, one or more firms may have a reduced incentive for future investment and innovation (or incentive to stop investment and innovation altogether).

Three notes that, on average, the UK mobile network operators are currently unable to make an economic profit on their cumulative past investments³. Some of this may in part be due to the lower revenues and greater intensity of competition associated with LRIC MTRs as opposed to LRIC+.

Accordingly, to the extent that current industry economic profit is an indicator of prospective economic profit, this may indicate an unsustainable level of competition and therefore reduced incentive for

² For firms with SMP that are only present in upstream wholesale services, in order to promote allocative efficiency, regulators should aim to set two-part (or multi-part) wholesale pricing with relevant marginal units of output close to marginal cost.

³ Based on average (unadjusted) return on capital employed (ROCE) relative to the industry weighted-average cost of capital (WACC).

one or more firms to make future investment and innovation, some of which may be due to lower MTRs⁴.

However, even if LRIC MTRs were likely to lead to an unsustainable level of competition, relative to LRIC+, that might put at risk future investment and innovation, then regulators should use other less-competition distorting and more-allocatively efficient measures to ensure sustainable competition than retain LRIC+ MCT.

Question 6.4: Do you agree with our analysis and views on competition impacts? If not, please explain why.

Mostly.

The consultation identifies three broad ways in which MTRs can affect competition between MCPs:

- 1 high MTRs dampen the incentives for MTRs to reduce call prices, as MTRs act as a retail price floor for off-net calls, in particular for smaller MCPs, which face a greater proportion of off-net calls (6.58);
- 2 high MTRs create distortions between different customer segments, for example, smaller MCPs will be a disadvantage in competing for customers which tend to be net makers of calls, which often tend to be high-value customers (6.59-6.62);
- 3 high MTRs encourage on-net/off-net price differentials, which distorts competition against smaller MCPs (6.67).

Three strongly agrees with the existence of these effects and that they imply stronger competition under LRIC rather than LRIC+.

First, Three considers that the increase in Three's market share between 2010 and 2013 is strongly linked to the reduction in MTRs from LRIC+ to LRIC. Moreover, reduction in MTRs from LRIC+ to LRIC in 2011 allowed Three to launch its market-leading "One Plan" tariff, which included much larger bundles of off-net voice minutes than previous tariffs.

Three considers that the One Plan tariff was the main driver of Three's increased market share during the period 2010 to 2013. It has been progressively copied by all the other major MCPs. Indeed, Three considers that the One Plan contributed greatly to an overall increase in competition and lower prices in the UK mobile market, as documented

⁴ Continuing, or rising, capital investment levels does not in itself show that firms do not have adequate incentives for future investment or innovation. Firms in capital-intensive industries, such as mobile network operators, need to continue investing just to stay in business and remain competitive. Accordingly, total investment levels do not easily identify such non-discretionary investment from discretionary investment in otherwise socially valuable activities.

extensively in the consultation (especially A9.18-A9.35) and other Ofcom research.

Three's One Plan tariff also echoed the tariffs that Three entered the UK mobile market with in 2003, namely tariffs focusing on market-leading large bundles of voice minutes. This was the most significant factor in enabling Three to grow market share rapidly at launch. Such tariffs were commercially viable for Three, as Three's MCT was initially unregulated, then subsequently regulated at an asymmetrically higher rate than the larger MCPs. This allowed Three to offset high net outbound call volumes with relatively higher inbound MTRs.

However, as Ofcom progressively reduced Three's MTR in line with the larger MCPs to LRIC+, especially during the period 2007-2011, Three became increasingly limited in its ability to offer such market-leading tariffs (i.e. to compete) and this was a major contributor to the stalling of Three's market share growth during this period.

Second, lower MTRs since 2011 have greatly enabled Three to compete for higher-value customers, for example, customers wanting an iPhone plus large (or unlimited) bundles of minutes, data and texts. Being able to compete in this segment is essential to being a credible and viable vertically-integrated MCP/mobile network operator.

Third, on-net/off-net pricing differentials have now largely disappeared from the UK mobile market, with all MCPs tending to offer large bundles of any-network voice minutes as standard. This is clearly evident in the significant growth in outgoing off-net mobile-to-mobile calls and decline in on-net mobile-to-mobile calls (see consultation Figures A9.10, A9.11). Three considers this chiefly reflects the competitive impact of lower MTRs.

Overall, Three remains of the view that the competitive impacts is the most important factor in the choice of MCT cost standard.

Question 6.5: Do you agree with our analysis and views on the impact on vulnerable consumers? If not, please explain why.

Yes.

Question 6.6: Do you agree with our analysis and views on regulatory and commercial impacts? If not, please explain why.

Yes.

Question 6.7: Do you agree with our proposal that LRIC should continue to be the appropriate cost standard? If not, please explain why.

Yes.

Question 7.1: Do you agree with our proposed modelling approach as discussed in this section, the supporting annexes and the 2014 MCT model? If not, please discuss the specific proposals that you disagree with.

Broadly.

The 2014 MCT model uses a bottom-up approach to calculate the costs of an average efficient national MCP, allowing Ofcom to calculate the forward-looking economic costs for MCT independent of any particular network operator's business model or choice of technology.

Ofcom proposes to calculate LRIC (and LRIC+) in the same way as calculated in Ofcom's 2011 MCT review, with the exception of:

- various updates to reflect the passage of time, such as updates to network operators' weighted average cost of capital (WACC);
- modifications to the MCT 2011 model's functionality; and
- additions of new functionality to the model.

Three agrees strongly with Ofcom's overall cost modelling approach.

Three is nevertheless concerned about apparent modelling errors in Ofcom's MCT 2014 model. Please refer to Annex A below for report by Adam Mantzos (independent cost modelling expert) for further details.

Three is also concerned about Ofcom's proposed WACC estimate, in particular, Ofcom's approach to making the real WACC estimate consistent with the use of the Consumer Price Index (CPI) as the inflation index in the 2014 MCT model.

In particular, Three is concerned about Ofcom's reliance on the Bank of England's target CPI inflation of 2%, rather than on independent estimates of future CPI inflation and relativity to the Retail Price Index (RPI) inflation forecasts (A11.65, A14.15). Three has already responded extensively on this matter in relation to Ofcom's ongoing review of annual licence fees for 900MHz and 1800MHz spectrum and Ofcom's specific

consultation on methodology to derive a discount rate consistent with CPI inflation⁵. Three commissioned an independent expert report on this by Economic Insight. Please refer to Annex B.

Question 8.1: Do you agree with our proposed approach to implementing the MCT charge control? If not, please discuss the specific proposals that you disagree with.

Yes.

⁵ Annual licence fees for 900 MHz and 1800 MHz: methodology to derive a discount rate consistent with CPI inflation, Ofcom, 17 April 2014.

Annex A Adam Mantzos report: Apparent modelling errors.

2015 MTR charge control: Ofcom June 2014 proposals apparent modelling errors

Introduction

1. This paper details five apparent errors in Ofcom's June 2014 MTR model:
 - a) a cell reference error which prevents the Economic Depreciation (ED) calculations from working as intended;
 - b) a cell reference error which affects the modelling of S-RAN costs;
 - c) some unintended and perverse consequences of how S-RAN assets are modelled, which result in the addition of the voice termination increment leading to a reduction in total costs for some network elements;
 - d) an incorrect treatment of the long run consequences of the RAN sharing adjustment in the ED calculations; and
 - e) an inconsistency in the modelling of sites and carrier channels in the 4G network build.

Year 1 MEA capital cost in ED

2. The ED calculations rely on a number of inputs from the rest of the model to function as intended. One of those inputs is the Modern Equivalent Asset (MEA) unit capital cost for each network element in the first year of deployment ("Year 1 MEA capital cost"). That input drives the profile of the capex element of ED over the lifetime of the network¹.
3. The Economic module which houses the ED calculations sources the Year 1 MEA capital cost from the Cost module. However, the reference used for that sourcing appears to be incorrect. Instead of picking up the Year 1 MEA capital cost of all network elements, it omits some network elements – mainly those relating to 4G². The omissions would appear to be unintentional.
4. The omissions have a fundamental effect on the ED calculations of a significant number of network elements, because those calculations proceed on the assumption that the Year 1 MEA capital cost is zero.

¹ See, for example, E2, Economic. The Year 1 MEA capital cost at cell E18 is applied to the cost trend at row 19, in order to generate the MEA unit capital cost in each year, including the final year, at row 20. The final year cost drives the investment calculation at row 42, which feeds into one of the main elements of ED at row 47; the cost in each year drives the "relative value" calculation at row 82, which feeds into another element of ED at row 99.

² More precisely, the name range "MEA_capex_1990_91" is defined as cells D4388:D4537 in the sheet Unit Investment, Cost. However, the logic of the model, the text at F4538, and the definition of the parallel name range "MEA_opex_1990_91", all suggest that the correct definition is cells F4388:F4537.

5. This is immediately apparent from an examination of the ED calculations for some of the key 4G network elements. For example, sheet E101 in the Economic module shows the ED calculations for 4G Macro eNodeBs. Rows 18 to 20 clearly show MEA unit capital costs as zero in the first and in every year of the lifetime of the network. The result would appear to be that ED is not calculated as intended for this and other affected network elements.

S-RAN unit cost profiling adjustment

6. The model assumes the deployment of combined RAN equipment that provides 2G, 3G and 4G functionality (single-RAN or S-RAN). In modelling terms, this assumption is implemented by continuing to model separate RAN equipment for 2G, 3G and 4G technologies, but adjusting the unit cost profile over time of that equipment to reflect each technology's effective share of the unit cost of S-RAN equipment, as determined by each technology's share of radio traffic³.

3G share of radio traffic

7. The S-RAN unit cost profiling adjustment assumes a share of radio traffic for 3G which is in fact based only on 3G HSPA traffic, not on all 3G traffic. There is no explanation for this in the consultation documentation, and the labelling of the relevant cells in the model suggest that this is an unintentional referencing error⁴.

Impact of profiling adjustment on LRIC

8. The S-RAN unit cost profiling adjustment would appear to have some unintended and perverse consequences for the LRICs of the different technologies.
9. These are perhaps most clearly illustrated by considering the impact of the profiling adjustment on the LRIC of 4G RAN equipment, which is subject to the adjustment from initial deployment.
10. The profiling adjustment has the effect of making the assumed unit cost of 4G RAN equipment dependent upon 4G's share of total radio traffic. However, 4G's share of total radio traffic is lower in the "with incoming" scenario, than in the "no incoming scenario". As a result, 4G RAN unit costs are lower in the "with incoming" scenario. In other words, 4G RAN unit costs are assumed to fall as a result of the addition of the voice termination increment. In fact, the percentage fall in unit costs as a result of voice termination, is greater than the percentage increase in the quantity of 4G RAN equipment as a result of termination. The outcome is that total 4G RAN costs fall as the voice termination increment gets added.
11. This can be seen for example in sheet E101 in the Economic module (4G Macro eNodeBs). Once the two errors identified above have been corrected for, when run in LRIC mode, the model implies that the addition of termination services would result in both an increase in the number of eNodeBs in every year, and a reduction in capex on eNodeBs in every year. As a result, this network element generates a negative ED charge in every single deployed year⁵.
12. This is a perverse consequence of the S-RAN profiling adjustment. It cannot be correct to assume that adding more 4G capacity saves 4G costs.

³ Paragraphs A11.198 to A11.214, and Section 4.1, Annex 12 (Analysys Mason report), Ofcom consultation

⁴ Specifically, rows 1706:1716, Unit investment, Cost, are sourced from rows 995:1005, Cost drivers, Network. Although these rows are labelled "3G radio traffic as proportion of total", they in fact take account only of 3G HSPA traffic (rows 871:881), not of all 3G traffic (rows 777:787). This would appear to be an error. Note, the error does not prevent the total share of radio traffic across technologies adding up to 100%, because the model calculates 2G's share of radio traffic as a balancing item given the calculated 3G and 4G shares, rather than independently on a bottom up basis (rows 982:992).

⁵ It should be stressed that this is not due to any feature of the ED calculation. Any approach to setting the pattern of unit cost recovery will result in a negative charge for this and similarly affected network elements.

13. It could be argued that the change in assumed 4G unit costs should not be considered in the context of the 4G network alone. However, such an argument is not consistent with the fact that the ED calculations reflect the impact of that change on 4G voice termination alone.
14. The fundamental cause of the problem is that:
 - a) one part of the model, that determining unit costs, assumes that RAN equipment is shared across technologies; and
 - b) another part of the model, that which runs the “with incoming” and “no incoming” scenarios in order to generate LRIC, assumes that each technology uses RAN equipment that is not shared across technologies.
15. These are inconsistent assumptions, and it is not clear that a satisfactory solution can be found while this logical inconsistency remains.
16. One solution would be to create new asset categories for S-RAN equipment, and treat it like other modelled assets that are shared across technologies (e.g. backhaul). Ofcom explains in the consultation that this has been considered but not adopted due to the significant effort involved⁶. However, it is not clear from Ofcom’s explanation what account has been taken of the perverse consequences of the existing approach, and whether those might justify a reconsideration.
17. Pending resolution of the problem, another option is to de-activate the assumed deployment of S-RAN sharing, and avoid the problem altogether.

Treatment of RAN sharing impact on unit costs in ED

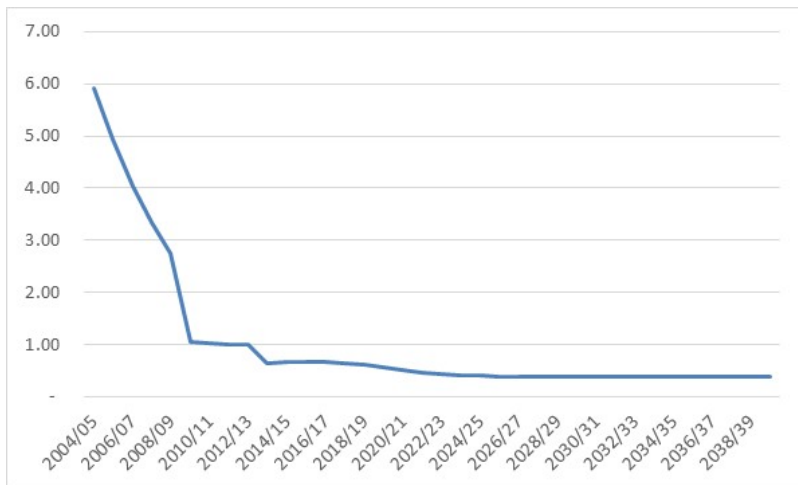
18. The model assumes the sharing of RAN and backhaul between operators. In modelling terms, this assumption is implemented by adjusting the unit cost profile over time of affected equipment to reflect the lower effective cost of such equipment for the hypothetical modelled operator⁷.
19. The adjustment has the effect of lowering the effective unit cost of shared equipment. However, the effect is not constant across geotypes: it is assumed that equipment is shared in the less dense Suburban 2 and Rural geotypes, but not shared in the denser Urban and Suburban 1 geotypes⁸. As a result, the degree to which RAN sharing lowers modelled unit costs depends on the distribution of sites across geotypes.
20. Since the additional sites required by the voice termination increment are primarily in the denser geotypes, the distribution of sites across geotypes is denser in the “with incoming” scenario than in the “no incoming” scenario. This means that average unit costs for all assets, not just incremental assets, are higher in the “with incoming” scenario than in the “no incoming” scenario.
21. This is not necessarily inappropriate from a LRIC perspective. However, the implications of this effect do not seem to have been properly reflected in the ED calculations.

⁶ Paragraphs A11.209 to A11.212, Ofcom consultation

⁷ Paragraphs A11.215 to A11.228, and Section 4.2, Annex 12 (Analysys Mason report), Ofcom consultation. Note, Ofcom explains that the model also takes account of the additional traffic served by such shared assets.

⁸ Section B12.2, Annex 12 (Analysys Mason report), Ofcom consultation

22. For example, this effect contributes to the long run steady state difference in costs associated with the voice termination increment. Under ED principles, this contribution should be reflected in the long run level of ED, and should not affect the “Stage 3” glide path component which is intended to reflect input costs being higher than long run levels in the short to medium term⁹. But it appears that the Stage 3 component is indeed affected, because the ED calculations have not been adapted to reflect this source of a long run steady state difference in costs. As a result, the long run level of ED appears to be understated, and the short to medium run level overstated.
23. For example, in sheet E42 in the Economic module (3G Macrocell equipment) with the errors identified above corrected for and S-RAN deployment de-activated:
- there is a long run steady state increase of 285 assets attributable to the termination increment, each of which has an assumed long run steady state unit opex of £4,066¹⁰, suggesting a long run steady state difference in opex of £1.2m;
 - these figures are used as the basis of the long run ED charge for opex of £0.38 per output unit¹¹; and
 - the remaining unrecovered opex attributable to termination is recovered by a Stage 3 ED component between 2004/05 and 2025/26¹².
24. The result is a steep profile for the path of cost recovery over time:



25. However, much of this steepness is driven by the assumption that the long run difference in opex is £1.2m. In fact, as shown on the same sheet, it is much higher than that, at £1.9m¹³. The profile of cost recovery over time is therefore significantly distorted by the incorrect treatment of long run costs as short to medium run costs.
26. It would again appear that the impact of an adjustment to the unit cost profile as a relatively simple solution to reflecting the impact of one feature of the network, in this case RAN sharing, has unintended consequences that need further consideration.

⁹ Paragraphs A11.244 to A11.239, Ofcom consultation

¹⁰ Rows 16 and 24, E42, Economic

¹¹ Rows 148 and 171, E42, Economic

¹² Rows 148 and 171, E42, Economic

¹³ Row 14, E42, Economic

27. Pending resolution of the problem, one option is to de-activate the assumed deployment of RAN sharing between operators, and avoid the problem altogether.

4G eNodeB and carrier build

28. The model estimates the number of 4G eNodeBs required by comparing traffic levels with an average effective capacity per eNodeB¹⁴. Capacity per eNodeB is calculated as capacity for each carrier channel, multiplied by an assumed number of carrier channels per eNodeB¹⁵.
29. For example, in the long run, a total of 6 carrier channels is assumed for macro eNodeBs in the Suburban 1 geotype¹⁶. Given assumed traffic levels and carrier channel capacities, the model estimates that in addition to the 368 macro eNodeBs required for coverage¹⁷, a further 12,593 macro eNodeBs will be deployed to service traffic levels¹⁸: a total of 12,961 eNodeBs.
30. The model then adopts the total number of eNodeBs as an assumption, and calculates total traffic per eNodeB¹⁹. It then performs an independent calculation of the number of carrier channels required for each eNodeB, based on an assumed capacity per carrier channel²⁰.
31. It is not clear why the model seeks an independent calculation of the number of carrier channels required per eNodeB, if the number of eNodeBs has already been established on the basis of an assumed number of carrier channels per eNodeB. In principle, such a calculation ought simply to result in confirmation of the original assumption. In practice however, it does not.
32. Returning to the example of macro eNodeBs in the Suburban 1 geotype, the independent calculation indicates that a total of 29,448 carrier channels are deployed in the long run²¹. That equates to an average of 2.3 carrier channels for each of the 12,961 eNodeBs deployed. However:
- a) it is inconsistent to assume, in calculating the number of eNodeBs in one part of the model, that each eNodeB has 6 carrier channels, and to conclude in another part of the model that each eNodeB has an average of 2.3 carrier channels; and
 - b) it is unclear how an efficient operator would ever deploy as many as 12,593 traffic driven sites, if existing sites were not operating at capacity, because only 2.3 out of 6 available carrier channels had been deployed.
33. As noted above, the inconsistency should not in any case arise. In principle, the independent calculation of the number of carrier channels required should simply result in confirmation of the original assumption. The fact that it does not indicates that some of the assumptions in that independent calculation are inconsistent with some of the assumptions in the eNodeB calculation.

¹⁴ Rows 342 to 376, Nw-4g, Network

¹⁵ Rows 324 to 340, Nw-4g, Network

¹⁶ Rows 270 to 322, Nw-4g, Network

¹⁷ Rows 84 to 101, Nw-4g, Network

¹⁸ Rows 342 to 358, Nw-4g, Network

¹⁹ Rows 434 to 451, Nw-4g, Network

²⁰ Rows 453 to 903, Nw-4g, Network

²¹ Rows 885 to 903, Nw-4g, Network

34. One such inconsistency appears to relate to utilisation assumptions:
- a) When calculating the number of macro eNodeBs, the model assumes an average achievable utilisation of 5%, resulting from the product of three separate components:
 - i) a carrier utilisation of 50%;
 - ii) a cell utilisation of 38%; and
 - iii) an average to peak ratio of 26%²².
 - b) However, when estimating the number of carrier channels in the independent calculation, the model assumes an average achievable utilisation of 13%, based on the product of (i) and (iii) above, and excluding (ii)²³.
 - c) It is not clear how the number of eNodeBs can be based on an assumption that carrier channels have a 5% achievable utilisation, and the number of carrier channels on an assumption that the same assets have a 13% achievable utilisation.
35. A related anomaly, but smaller in scale, appears to affect the modelling of 3G NodeBs²⁴. For example, in the Suburban 1 geotype, the model assumes that in the long run:
- a) 727 NodeBs are required for coverage²⁵;
 - b) a further 721 NodeBs are deployed to service traffic, bringing the total to 1,448 NodeBs²⁶; and
 - c) a total of 3,321 carrier channels are deployed²⁷, equating to an average of 2.3 carrier channels per NodeB, even though the hypothetical operator is assumed to have 3 carrier channels available.

²² Rows 215 to 268, Nw-4G, Network

²³ Rows 434 to 451, Nw-4G, Network

²⁴ We have been unable to determine, in the time available, whether a similar anomaly affects the modelling of 2G BSCs.

²⁵ Rows 59 to 69, Nw-3G, Network

²⁶ Rows 1464 to 1474, Nw-3G, Network

²⁷ Rows 1357 to 1367, Nw-3G, Network. Note that this shows a total of 9,964 carrier channels. Unlike the 4G part of the model, the 3G part assumes that one carrier deployed over three sectors equates to three carrier channels, so the figure of 9,964 has been divided by three to allow consistent terminology with the preceding discussion.

Annex B Economic Insight report: Deriving a discount rate consistent with CPI.



Deriving a discount rate consistent with CPI

A short report for Three on the key methodological issues and evidence

This note sets out our analysis and conclusions regarding Ofcom's proposed methodology for deriving a discount rate for setting annual license fees for 900MHz and 1800MHz spectrum using CPI. Ofcom's proposed approach is to inflate the real discount rate at the time of the March 2011 MCT decision by a higher level of RPI than was assumed at the time, and to then deflate the implied (higher) nominal discount rate by CPI. We have two concerns regarding this. First, that it implies Ofcom is ex post changing its view as to the wedge between RPI and CPI without committing to updating other discount rate parameters. Secondly, that based on our detailed evidence any revised wedge between RPI and CPI should be lower than Ofcom suggests, at around 0.9 percentage points.

Introduction

Ofcom has published a consultation regarding its proposed *methodology* for setting an annual license fee (ALF) with respect to 900 and 1800 MHz spectrum using a CPI measure of inflation within its assumed discount rate.¹ This follows a broader consultation, in which Ofcom sought stakeholder views regarding its approach to setting the ALF more widely.² In the current consultation, Ofcom has made it clear that it has not yet determined which inflation measure it will adopt – and nor has it determined any of the other fundamental methodological aspects of its approach to setting the ALF. Rather, the consultation seeks views on two specific questions:

- » “Question 1: Do you agree with this methodology for deriving a real discount rate consistent with the CPI measure of inflation?”
- » Question 2: Do you agree with our approach to deriving estimates of long-run RPI and CPI?”

In the above context, Hutchison 3G UK Ltd (Three) asked Economic Insight to set out our views on the issues outlined in Ofcom’s consultation and, where appropriate, to provide relevant analysis and evidence to support those views. This short report therefore addresses these matters – and is structured as follows:

- we firstly provide a summary of Ofcom’s proposed approach to applying CPI to derive the discount rate for deriving the ALF;
- we then set out our views regarding Ofcom’s suggested methodology; and
- finally, we set out a range of evidence regarding the ‘wedge’ between RPI and CPI that Ofcom is proposing within its consultation, which includes: (i) historical data regarding the actual size of the wedge; (ii) the future wedge implied by independent RPI and CPI forecasts; (iii) various third party evidence regarding the potential future size of the wedge; and (iv) our own bottom-up analysis of the possible future size of the wedge, based on an assessment of how its key drivers might vary over time.

Summary of Ofcom’s approach

In the following we briefly summarise the main elements of Ofcom’s proposed *methodology* for deriving a discount rate based on CPI, and the evidence Ofcom has drawn on with respect to its proposed *levels* of inflation.

Context

Ofcom has stated that the scope of its consultation is limited only to a consideration of its proposed approach for applying CPI to determine a discount rate for setting the ALF. Ofcom has further explicitly stated that the consultation does not, therefore, address:

- » The issue of *which* inflation measure it should use for setting the ALF (i.e. whether ultimately Ofcom will apply CPI or RPI).
- » The appropriate discount rate to be used for calculating the ALF from Ofcom’s estimated lump sum values of the spectrum (i.e. in the responses to Ofcom’s first consultation, relating to the appropriate methodology for determining the ALF, various parties put forward arguments in favour of both the risk free rate and the cost of debt, rather than the WACC).
- » Whether and how Ofcom should update the other discount rate parameters (aside from the updates that relate specifically to inflation and the rate of corporation tax). For example, in our

¹ ‘Annual licence fees for 900 MHz and 1800 MHz: methodology to derive a discount rate consistent with CPI inflation.’ Ofcom (2014).

² ‘Annual licence fees for 900 MHz and 1800 MHz spectrum.’ Ofcom (2013).

report for Three,³ which was included in its response to Ofcom, we suggested that, were Ofcom to use a WACC - rather than, say, the risk free rate - it would be appropriate to use the latest available market evidence.

In its previous consultation, Ofcom indicated that it believed that the WACC parameters estimated in its March 2011 MCT determination represented the most appropriate proxy for the discount rate it should use to derive the ALF from the lump sum values. Ofcom's rationale for this was based on a number of factors, but importantly included: (i) the fact that the WACC used by bidders at the time of the 4G auction represented an important reference point; and (ii) that Ofcom had taken a long term view of the available data at the time of the MCT decision, and that therefore, it didn't think it would take a materially different view with respect to separately estimating a WACC for the ALF.⁴ Therefore, for the purpose of deriving the ALF, Ofcom's proposed approach (as stated in the prior consultation) was to retain the MCT WACC parameters, save only for the rate of corporation tax, which Ofcom proposed to reduce from 24% to 20%, to reflect actual future tax rates. The 2011 MCT WACC included an assumed rate of inflation of 2.5%, which was based on RPI.

Ofcom's proposed inflation levels and evidence

In the current consultation, Ofcom has stated that – were it to adopt a CPI measure of inflation to derive the discount rate for setting the ALF - it would:

- assume CPI inflation of 2.0% (which Ofcom states reflects expected long-run CPI⁵); and
- base its view of the corresponding level of RPI on an assumed forward-looking 'wedge' between the two indices of 1.3 percentage points, which implies an RPI of 3.3%.

CPI based on Bank of England target

Ofcom has based its CPI assumption on the Bank of England's long-run CPI target of 2.0%, which has existed since 2003 (when the government first changed the remit of the Monetary Policy Committee to use CPI, rather than RPI). Ofcom noted that the target is symmetrical, and so inflation being below target motivates action as much as inflation above target. Whilst Ofcom accepted that the existence of the target does not mean that actual CPI inflation will be 2.0%, the fact that price stability is the primary objective of the MPC means that it is likely to be: *"the best estimate available to us as to what CPI inflation will be in the long-run."*⁶

RPI based on an assumed 'wedge' over CPI – reflecting the Bank of England's long-term view

Ofcom's assessment of assumed RPI is not based on any specific forecast of the index; but, rather, an assumed 'wedge' as to what RPI might be over and above CPI. The specific 'wedge' of 1.3 percentage points proposed by Ofcom (which implies RPI of 3.3%) reflects the Bank of England's long-run assessment, as set out in its February 2014 inflation report.⁷ Ofcom notes that this is higher than the historic wedge (which it quotes as being 0.5% from 2005 to 2013), and attributes this to three factors:

- » The formula effect, which is due to there being different statistical techniques in the aggregation of data for the prices of individual items within each index. Ofcom states that the contribution of

³ See *'A note on Ofcom's proposed WACC parameters for setting the ALF.'* Economic Insight (2013). We note that Three's position is that the risk free rate is the appropriate discount rate – and the scope of our earlier report was limited to an assessment of what the WACC parameters should be were Ofcom to apply a WACC and did not, therefore, address the question of what discount rate should be used.

⁴ Ofcom stated: "It is not clear that in estimating a WACC appropriate for a longer period, we would take into account different evidence or would arrive at a different WACC than that estimated for the MCT." See paragraph 5.71 of *'Annual licence fees for 900 MHz and 1800 MHz spectrum.'* Ofcom (2013).

⁵ Although we note that, significantly, Ofcom does not specify at what point in time it is seeking to capture forward-looking expectations regarding CPI or inflation more generally.

⁶ *'Annual licence fees for 900 MHz and 1800 MHz: methodology to derive a discount rate consistent with CPI inflation.'* Ofcom (2014). Page 7.

⁷ *'Inflation Report: February 2014.'* Bank of England (2014).

the formula effect to the wedge has increased since 2010, due to changes in how the ONS collects clothing price data.

- » Mortgage interest payments and other housing costs are included in RPI but not CPI (the implication of this contributing to an *increase* in the future wedge would seem to be that that the Bank of England expects housing costs to increase more quickly than the RPI index overall).
- » Various other differences in weights and coverage e.g. the weights used in the two indices are based on different sources and capture different consumer groups. Ofcom stated that, since 2005, the effect of these differences reflects (amongst other things) increases in energy and import prices, which have a smaller weight in RPI than in CPI, and so boosted RPI inflation by less than CPI inflation. Ofcom states that, in the long run, these items are expected to grow at rates consistent with CPI inflation at the 2% target, and the contribution from other differences to the wedge is expected to fall.

Finally, Ofcom notes that its assumed wedge of 1.3% is similar to that forecast by the Office of Budget Responsibility (OBR), which estimates a range of 1.3% to 1.5%. However, Ofcom also notes that “*discussions with market participants suggest that the long-run wedge priced into inflation breakevens is a little lower than the Bank staff estimate, at around 0.9 to 1 percentage points on average.*”⁸ We address this point subsequently in our review of third party evidence.

Ofcom’s approach to deriving a discount rate using CPI

With an assumed CPI of 2.0% and a corresponding RPI of 3.3%, Ofcom’s proposed approach to applying CPI in order to derive a discount rate for setting the ALF is set out below. For illustrative purposes, we focus on the example Ofcom provides with respect to using the WACC as the start point. However, we note that Ofcom has not determined whether it is the WACC (or some other discount rate) that is appropriate.

- » Firstly, and as noted in our description of the relevant context, in its previous consultation, Ofcom indicated that – were it to use the WACC – it was minded to use that from the March 2011 MCT determination, updated only to reflect a lower rate of corporation tax of 20%.
- » Secondly, in the current CPI consultation Ofcom is proposing to take the ‘real’ MCT 2011 WACC (or other measure of discount rate it might use), and apply a higher rate of RPI inflation (3.3%, as opposed to the 2.5%) than was originally set in that determination.
- » The above, of course, has the effect of increasing the implied *nominal* post-tax 2011 MCT WACC (Ofcom’s worked example shows that the nominal MCT WACC increases from 6.8% to 7.6%).⁹
- » Thirdly, starting from the revised (higher) *nominal* WACC of 7.6%, Ofcom then deflates by CPI (at assumed CPI of 2.0%), which translates to a real post-tax WACC of 5.5%.
- » The net result of Ofcom’s methodology is that the real WACC being proposed to derive the ALF has actually *increased* from 4.1% to 5.5%.¹⁰

⁸ ‘Annual licence fees for 900 MHz and 1800 MHz: methodology to derive a discount rate consistent with CPI inflation.’ Ofcom (2014). Page 8.

⁹ See Table 1 of: ‘Annual licence fees for 900 MHz and 1800 MHz: methodology to derive a discount rate consistent with CPI inflation.’ Ofcom (2014). Page 9.

¹⁰ ‘Annual licence fees for 900 MHz and 1800 MHz: methodology to derive a discount rate consistent with CPI inflation.’ Ofcom (2014). Page 10.

Our assessment of the appropriate methodology

The role that inflation plays in the cost of capital

In considering what the appropriate approach should be to applying CPI, it is helpful to address the role that inflation plays in discount rates (or here for illustrative purposes, the cost of capital) more generally. In particular, as investors typically think about returns in real terms (i.e. because they do not want the value of their investments to be eroded by inflation) we would suggest that their perspective would tend to be to ask: “*given my desired real rate of return, and my expectations of inflation, what nominal return do I need to achieve?*”

Given the above, *if* all WACC parameters could be accurately measured in real terms in the first instance, the appropriate methodology for deriving the nominal WACC would simply be to ‘add’ inflation to the real post-tax WACC. In this world, the effect of moving from an inflation assumption of 2.5% (RPI) to 2.0% (CPI) would be to leave Ofcom’s proposed real WACC unchanged at 4.2%, although the nominal WACC would be lower.

In practice, however, the complication with the above perspective is that, whilst most WACC parameters are observable in nominal terms, the risk free rate can be observed in real terms, and on an RPI basis. This raises the question as to how ‘accurately’ the real parameters have been estimated in the first place, and therefore whether they can be used as the start point. We consider this issue further in our proposed alternative approach.

Our review of Ofcom’s approach

In summary, we observe that Ofcom’s proposed approach results in both the real and nominal post-tax WACC being higher than was set in the March 2011 MCT determination, which is not what one would expect if the only change in approach was one of RPI being replaced with CPI. Rather, it implies that Ofcom’s view of the relativities between RPI and CPI has changed. Relatedly, we have a number of observations regarding the methodology Ofcom has set out relating to applying CPI in order to derive a discount rate for determining the ALF. These are as follows:

Revising expectations ‘after the event’ and potentially artificially increasing the real WACC

As set out above, Ofcom’s approach is to re-calculate the *nominal* discount rate (in this case the 2011 MCT WACC) by applying a higher RPI of 3.3% rather than the 2.5% assumed in the original determination – and then deflating the revised (higher) nominal WACC by CPI inflation of 2.0%. At a high level, therefore, by starting from a historical WACC and then revising certain assumptions, Ofcom is effectively adjusting investor expectations *after the event*. We think it is important to consider Ofcom’s calculation steps from the perspective of an investor – as at present, Ofcom’s approach appears to have the potential to artificially increase the real WACC.

- » Investor’s originally expected a real (post tax) return of 4.2% (the post-tax real WACC of the MCT decision) which, in nominal terms (with assumed or expected inflation of 2.5%) meant they expected returns of 6.8% (or, indeed, vice versa).
- » By re-calculating the nominal 2011 MCT WACC through the imposition of a higher rate of RPI inflation of 3.3%, Ofcom is effectively implying: (i) that investor’s expectations in *real terms* at the time of the MCT decision represent the appropriate start point; and (ii) that it is appropriate to (ex-post) adjust investor’s nominal expectations to reflect a *higher* expected rate of inflation of 3.3%. Put simply, Ofcom’s approach now assumes that investors actually expected inflation of 3.3%.
- » Ofcom’s final step is to deflate the adjusted nominal WACC down by CPI of 2.0%. This, we suggest, may be somewhat at odds with Ofcom’s second step, as it implies that, in fact – now starting from a nominal position, investors expected the relevant rate of inflation to be 2.0%, not 3.3%. We suggest that this may not be internally consistent.

An alternative way of characterising the above might be to say that Ofcom is ex-post adjusting its view of the ‘wedge’ between RPI and CPI, from 0.5% implied at the time of the March 2011 MCT

decision (RPI of 2.5% less CPI of 2.0%, which as set out subsequently, is broadly consistent with the current observed wedge and, indeed, Ofcom's own stated assessment of the historical long-term wedge) to 1.3% as proposed in its current consultation. Regarding this, we note that the OBR's medium term forecast of CPI as of March 2011 stood at 2.0%¹¹ and Ofcom's view of RPI at the time was – as stated in the March 2011 MCT determination – 2.5%.

The need to reflect latest market data

In our view, and as set out in our previous report to Three on this matter, we think it is appropriate that (irrespective of the *measure* of discount rate Ofcom uses) Ofcom should base its decision on the latest available market data to reflect current investor expectations (or at a minimum, expectations at the time of the UK 4G auction). Consequently, if Ofcom were to use a WACC, it is important not to update only certain parameters selectively (such as the tax rate and rate of inflation) and in isolation of other WACC parameters. At present, therefore, there appears to be the potential for some inconsistency in Ofcom's approach in this regard.

Consistent with the above, it seems to us that any ex-post amendments to the implied 'wedge' are not conceptually valid unless Ofcom is also committed to updating all other relevant discount rate parameters. However, as Ofcom has separated the current consultation from the wider question as to what discount rate it should apply, we do not know whether this will be the case in practice.

Our alternative proposed methodology

To reflect the complication that the risk free rate can be observed in real terms (because government bonds are index linked to RPI) whereas other parameters are observed in nominal terms, we think a further alternative appropriate approach is to:

- » Re-state the real risk free rate based on CPI inflation of 2.0%. For internal consistency the CPI used should correspond to the point at time at which the risk free rate was estimated. As stated in our previous report for Three, our view is that it is appropriate to update *all* relevant WACC parameters to reflect current market expectations. Here, however, for illustrative purposes, we are using the risk free rate as stated in the March 2011 MCT determination and assuming that CPI inflation of 2.0% was consistent with that.
- » Then to re-calculate the real WACC reflecting an overall inflation rate of 2.0% rather than 2.5% leaving all other parameters unchanged.

We do not, therefore, consider that Ofcom's intermediate step of inflating the real MCT WACC by a higher rate of RPI to be appropriate. The following table sets out the detail of our proposed approach and compares it to that put forward by Ofcom.

¹¹ *'Economic and fiscal outlook.'* OBR (March 2011). Here we note that – at the time – the OBR expected a wedge of 1.2% points – but what is of relevance here is the implied view that Ofcom itself took regarding expectations at the time of the MCT decision and the difference under its proposals set out in the current consultation.

Table 1 Illustrating our approach to applying CPI

WACC parameter	Ofcom's proposed ALF values in first consultation (MCT with 20% tax rate)	Ofcom's proposed approach with 3.3% RPI inflation	Our alternative approach
Real risk-free rate	1.5%	1.5%	2.0% ¹²
Inflation	2.5%	3.3%	2.0%
Nominal risk free rate	4.0%	4.8%	4.0%
Gearing	30%	30%	30%
Equity risk premium	5.0%	5.0%	5.0%
Asset beta	0.56	0.56	0.56
Cost of equity (post tax)	7.8%	8.6%	7.8%
Debt premium	1.5%	1.5%	1.5%
Overall nominal post-tax cost of debt	4.4%	5.1%	4.4%
Corporation tax rate	20.0%	20%	20%
Post tax nominal WACC	6.8%	7.6%	6.8%
Real post-tax WACC	4.2%	4.1%	4.7%
Real post-tax WACC after deflating adjusted nominal WACC for CPI	NA	5.5%	NA

Source: Economic Insight

Ultimately we see that, by first inflating the 2011 WACC by a higher level of RPI (3.3%), and then deflating by CPI (2.0%) Ofcom arrives at a real post-tax WACC of 5.5%, as set out in its consultation document. In contrast, our proposed approach, which is to re-state the real risk free rate on a CPI basis, and then change the overall rate of inflation used in the calculations to 2.0%, results in lower real post-tax WACC of 4.7%, which could then be used to derive the ALF.

We also think that Ofcom's proposed approach raises wider questions. For example, it would appear to call into question whether it now considers the WACC it set in the March 2011 MCT determination to be appropriate – particularly if it now believes that the appropriate inflation expectation at the time was 3.3%.

Finally, in reviewing the above, it should be noted that under our proposed approach we have left all other WACC parameters unchanged. This is for illustrative purposes and in no way affects: (i) Three's position that, in fact, it is the risk free rate, and not the WACC that should be used to determine the ALF; or (ii) our view that, were a WACC to be used, all parameters should be updated

¹² Adjusted so that the risk free rate is expressed in real terms based on CPI of 2.0%, rather than RPI of 2.5%. Put simply, we are not changing the RPI deflated level of the risk free rate, but merely are translating that into CPI terms so that the implied wedge between RPI and CPI at the time of the March 2001 MCT determination of 0.5 percentage points is unchanged.

to reflect the latest market evidence (and that therefore, the appropriate real WACC would be lower than is indicated in the above table).

Ofcom's approach links expected RPI and CPI measures

Notwithstanding the above, from a practical perspective Ofcom's approach raises a further challenge. Namely, that under Ofcom's methodology, it is important that the assumed rates of RPI and CPI are internally consistent and, in particular, reflect investor expectations of the two indices. As set out in the next section, we do not think that this is the case and that market data indicates a lower expected wedge than the one Ofcom is proposing. The risk is that Ofcom's approach is artificially increasing the real post-tax WACC – and therefore, ultimately, the ALF.

Evidence on the size of the wedge

Notwithstanding the issues we identified above regarding Ofcom's overall approach, we separately consider that a range of evidence suggests that (were Ofcom to retain its proposed methodology) it would be appropriate for Ofcom to assume a somewhat *lower* wedge than the 1.3 percentage points it has set out. In particular, we think that Ofcom may not have given sufficient consideration to the high level of uncertainty regarding the likely size of the wedge, and the wider available evidence relating to this. In this section we therefore set out a range of analyses to inform this issue, which includes:

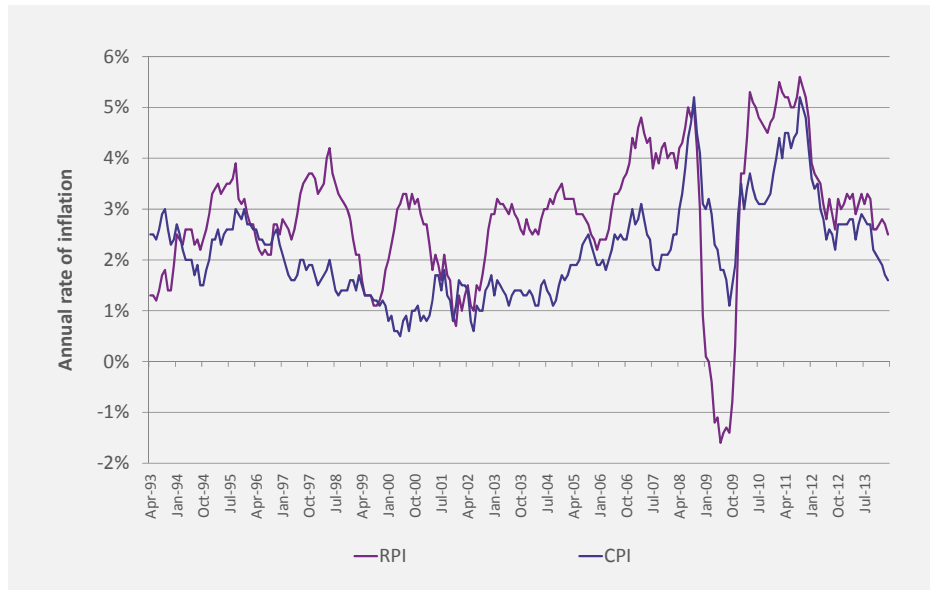
- historical evidence relating to the actual wedge between RPI and CPI;
- the future wedge between RPI and CPI that is implied by a range of independent forecasts of the two indices;
- third party evidence as to the likely future size of the wedge (which includes other regulatory determinations);
- the RPI-CPI wedge implied by current market breakeven rates; and
- our own 'bottom up' analysis of the potential future size of the wedge, based on data regarding forecasts for key inputs into the indices.

Historical evidence

As Ofcom notes in its consultation, there are some reasons as to why the historical 'wedge' between RPI and CPI may not be an accurate predictor of the future wedge. In particular, the formula effect and the fact that components within one index may follow a different trend than components in the other. Nonetheless, we consider that historical data is relevant – and so in the following we set out a range of evidence relating to this.

Firstly, when one examines the indices over a very long period, it is clear that the CPI measure of inflation is typically lower than the RPI measure – although CPI has actually been higher on a number of occasions. The chart below shows both indices over the period April 1993 – March 2014 inclusive (21 years).

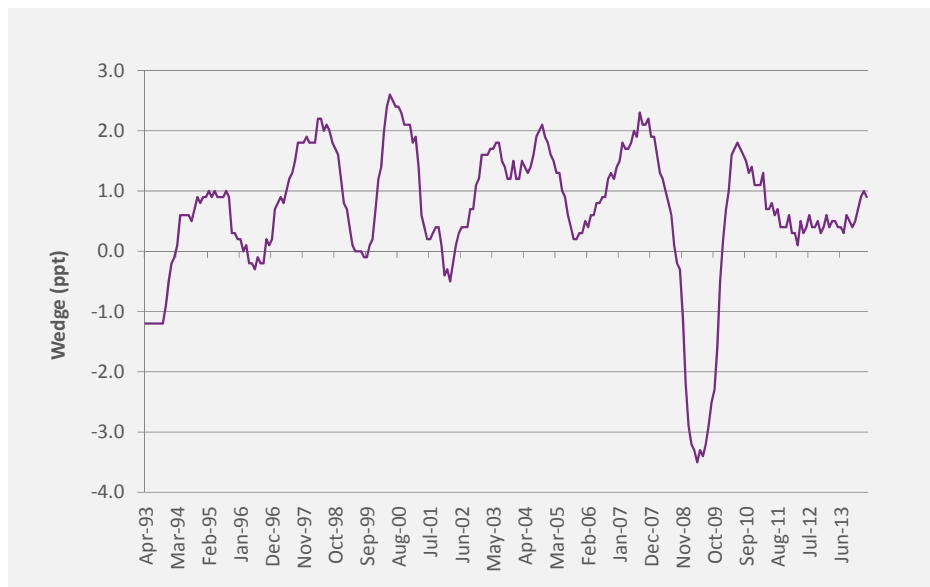
Figure 1 Long-term CPI and RPI data



Source: ONS

Consistent with the above, the wedge (i.e. RPI less CPI) has also varied considerably over the long-term – and, in fact, is highly seasonal. Over the whole 21 year time period shown to March 2014, the average wedge has been 0.7 percentage points, which is substantially lower than the 1.3 percentage points proposed by Ofcom.

Figure 2 Historic wedge over the long-term



Source: ONS

Whilst the long-term historical wedge has been well below that proposed by Ofcom, it is important to take into consideration the relatively recent (in 2010) methodological changes to how the ONS collects clothing pricing data (which in part matter because clothing has a higher weight in CPI than in RPI). Regarding this, the Bank of England states: “During 2010, the ONS changed how it collects clothing prices, leading to a considerable increase in their contribution to the formula effect... That

change led Bank staff to revise up their estimate of the contribution of the formula effect to the long-run wedge to 0.9 percentage points.”¹³

According to the ONS, the improvements to its collection of clothing related price data were implemented in January 2010.¹⁴ Consequently, to the extent that this is considered to be the main driver of the formula effect’s contribution to an increase in the long-term wedge, we think it important to focus on the historical data pre and post 2010. The following table therefore shows the wedge in the four years up to March 2010 (inclusive) and the four years from April 2010 to March 2014 (inclusive).¹⁵

Table 2 RPI-CPI percentage point ‘wedge’ pre and post 2010 ONS methodological changes

	2006 / 07	2007 / 08	2008 / 09	2009 / 10	Av	2010 / 11	2011 / 12	2012 / 13	2013 / 14	Av
RPI-CPI wedge	1.2	1.9	-0.8	-1.8	0.1	1.4	0.5	0.4	0.6	0.7

Source: ONS

The data shown in the above table indicates that, consistent with the Bank of England and OBR’s analysis, the RPI-CPI wedge has widened (on average) somewhat since 2010, reflecting the increased impact of the formula effect. Indeed, we find that, on average, the wedge was 0.1 percentage points in the four years up to 2010, and then rose to 0.7 percentage points on average for the four years from 2010 to date. However, and significantly, the key point is that even when we focus on the period of time *after* which the increased impact of the formula effect *should* have fed through, the wedge remains below that proposed by Ofcom – and actually, is consistent with the 21 year long-term average presented earlier. Furthermore, it is not the case that the wedge has persistently widened post-2010. In fact, it is now lower than it was in 2011. This, in our view, seems to somewhat call into question an assumed wider future ‘wedge’ where, at least in part, the rationale for that rests on an increased impact arising from the formula effect.

In summary, the historical data shows that:

- over the long-term the RPI-CPI wedge has been 0.7 percentage points;
- in the period since the ONS’ methodological changes that have increased the formula effect (i.e. post 2010) the wedge has also been 0.7 percentage points – consistent with the long-term data; and
- in the most recently available data (i.e. for March 2014); the wedge is 0.9 percentage points.

We think that the most reasonable interpretation of the historical data – regarding its potential relevance to setting inflation within the discount rate used to derive the ALF – is to focus on the post-2010 period. As such, the historical evidence is most consistent with an RPI-CPI inflation wedge of 0.7 percentage points.

The wedge implied by independent forecasts of RPI and CPI

Notwithstanding our views that historical data is a valuable source of information regarding the likely long-run wedge between RPI and CPI, it is helpful to also consider forward looking evidence. In this regard, one obvious source is to compile RPI and CPI inflation forecasts and calculate the ‘wedge’ implied by these.

¹³ ‘Inflation Report: February 2014.’ Bank of England (2014). Page 34.

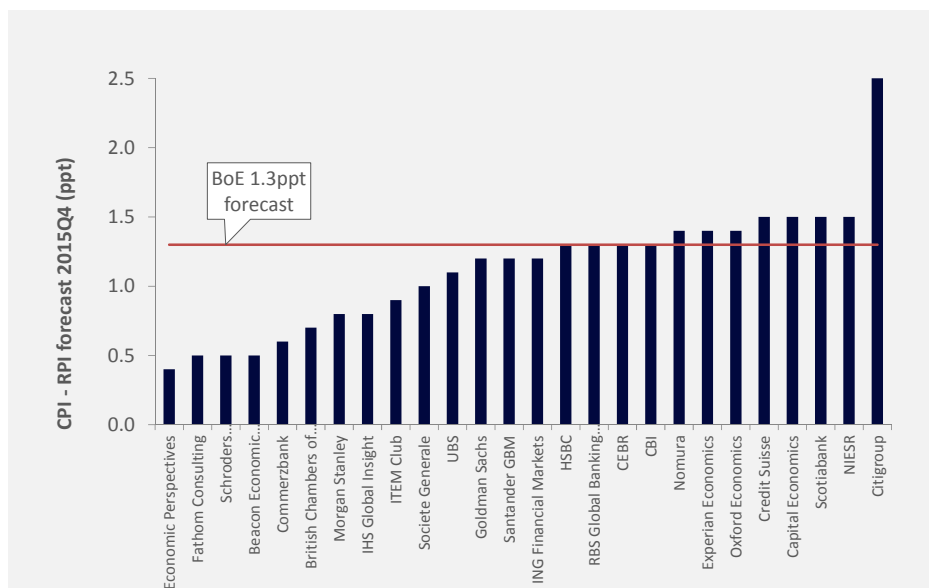
¹⁴ ‘CPI and RPI: increased impact of the formula effect in 2010: ONS Information note.’ (2011).

¹⁵ We have examined data up to March as this is the most recent month for which it is available for 2014.

Short-term forecasts

Each month HM Treasury publishes a comparison of independent forecasts of macroeconomic variables. Banks, consultancies and research institutions contribute their forecasts. The majority of contributors forecast both CPI and RPI for Q4 of the next full year. The chart below, therefore, shows the most recent implied forecasted wedge, for 2015 Q4.

Figure 3 Implied 2015 Q4 ‘wedge’ based on independent inflation forecasts



Source: HM Treasury comparison of independent forecasts April 2014

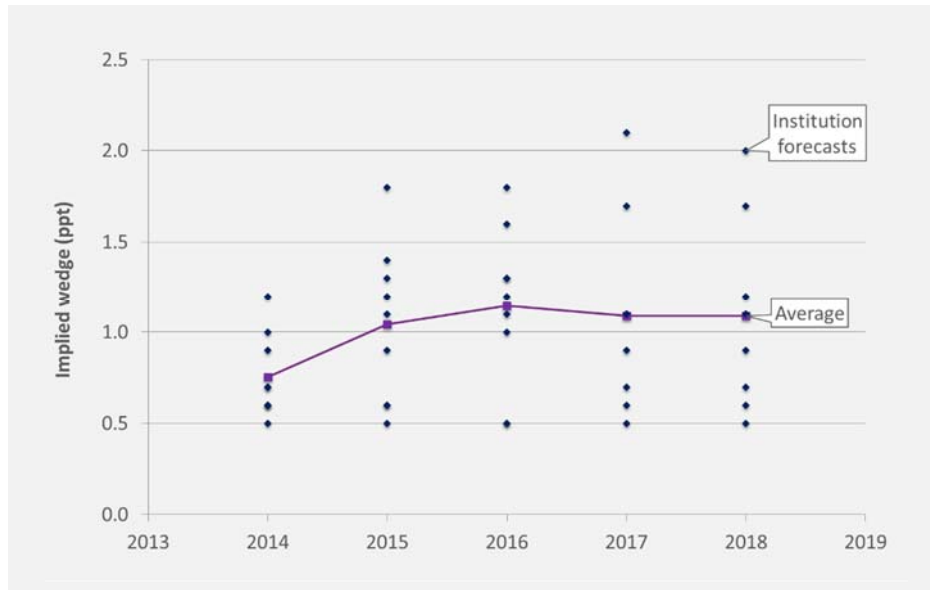
As can be seen, the majority of institution's forecasts for 2015 Q4 is that the wedge will be below the Bank of England's long-term prediction of 1.3 percentage points. Indeed, across the various forecasts compiled by HM Treasury, the 2015 Q4 expected wedge is 1.1 percentage points on average. For comparison, the OBR expects the wedge to be 1.5 percentage points in 2015 Q4.

Long-term forecasts

At less frequent intervals HM Treasury also publishes more long term independent inflation forecasts. The most recent, in February 2014, contains predictions of both CPI and RPI (although only a subset of institutions still predict RPI). The following chart shows the implied RPI-CPI wedge based on these forecasts. The data reveals a wide variation in the implied wedge across forecasters. Focusing on 2018 (as we are particularly interested in the long-run wedge) we note that:

- only two institutions (Experian and Oxford Economics) expect a wedge of greater than 1.3 percentage points; and
- that the average wedge in 2018 across all institutions is 1.1 percentage points – again, below the wedge proposed by Ofcom and predicted by the Bank of England.

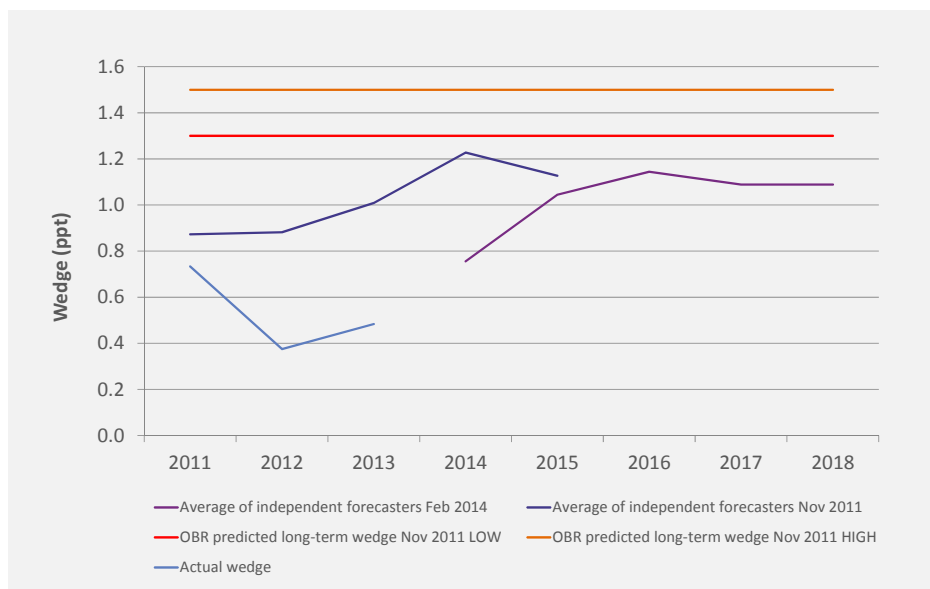
Figure 4 Implied 'wedge' based on longer-term inflation forecasts



Source: Economic Insight analysis of HM Treasury consensus forecasts – Feb 2014

Similar independent forecasts were also made in November 2011, the same time the OBR published its working paper on the long-run difference between RPI and CPI. As noted previously, at that time the OBR expected the wedge to be between 1.3 and 1.5 percentage points. The next chart provides a summary of: the independent forecasts from February 2014; November 2011; the OBR’s expected range; and the actual wedge (for calendar years ending in December).¹⁶

Figure 5 Implied 'wedge' based on longer-term inflation forecasts



Source: various

As can be seen, independent forecasts are consistently *below* the long-term prediction made by the OBR in 2011, and have been revised downwards recently. The actual wedge between RPI and CPI has been well below all forecasts, although is currently standing at 0.9 (March 2014) – which is broadly in line with independent long-term forecasts.

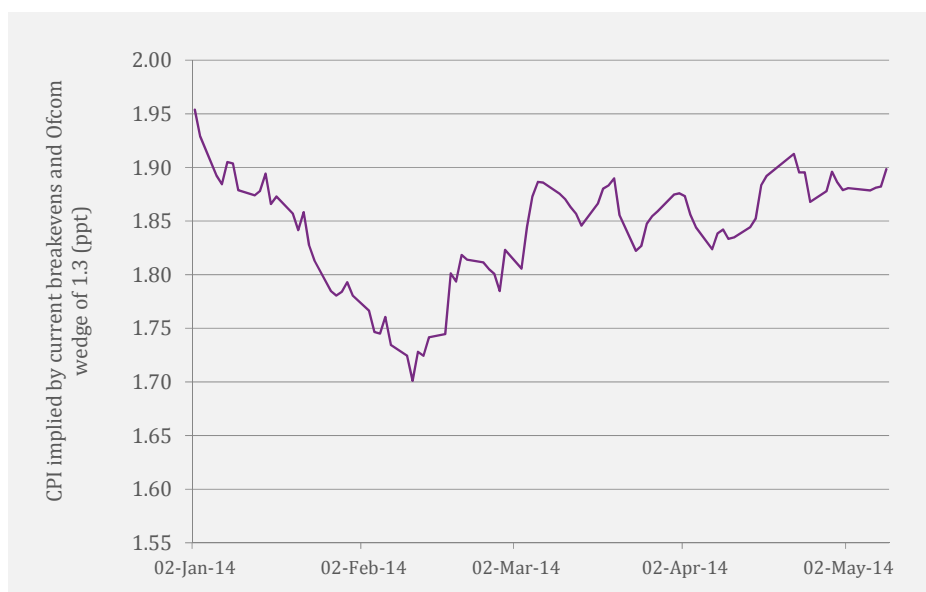
¹⁶ Note the data shown previously relating to the actual wedge was for years ending in March so as to make use of the latest available data.

Breakeven yields

The difference between nominal and (RPI) index-linked UK government bonds provides a measure of the 'breakeven' rate of inflation for investors. By deducting Ofcom's proposed RPI-CPI wedge we can infer market expectations for CPI – and conversely, by deducting an assumed market expectation of CPI, we can infer market expectation for the wedge on a forward-looking basis.

To examine this we calculated the latest implied 'breakeven' RPI inflation for 10 year UK index-linked bonds. From these we then calculated the implied 'expected' CPI inflation by deducting Ofcom's proposed 1.3 percentage point wedge. The chart below shows the results of our analysis.

Figure 6 Implied market expected CPI given current breakevens and Ofcom's proposed wedge



Source: Economic Insight analysis of Bank of England data

The above data shows that, at current breakevens, Ofcom's proposed RPI-CPI wedge of 1.3 percentage points would imply that markets currently expect CPI inflation materially below the 2.0% assumed by Ofcom (and targeted by the Bank of England). In fact, on average over 2014, the implied market expectation of CPI from the above would be 1.6%.

Given that it is reasonable to suppose that markets price inflation efficiently, our view is that the implied level of expected CPI of 1.6% is too low to be plausible – the inference being that the proposed wedge of 1.3 percentage points is too high.

Using the same data, if we instead assume that markets expect CPI inflation of 2.0% in the long-run and deduct this from the breakeven rate, we calculate an implied market expectation of the RPI-CPI wedge to be 0.9 percentage points (which is also consistent with Ofcom's assessment of the wedge implied by breakeven rates). This estimate of the wedge is much more in line with long-run historical data and the various independent forecasts described previously.

Third party evidence as to the size of the wedge

In addition to the historical and forecast wedge data set out previously, there is also a range of third party evidence that either explicitly or implicitly sets out a view as to the likely future RPI / CPI wedge. This evidence: (i) highlights the uncertainty regarding the future size of the wedge; and (ii) indicates that the appropriate assumed wedge should be lower than the 1.3 percentage points proposed by Ofcom. In this section we provide a summary of this third party evidence.

Morgan Stanley UK Economics and Strategy Report (2012)

In 2012 Morgan Stanley published its own analysis of the likely future wedge between RPI and CPI. Morgan Stanley's assessment is that the wedge is likely to be materially below the 1.3% that Ofcom is proposing to apply. In particular, Morgan Stanley concluded: "Over the next 12 months, we expect the RPI-CPI wedge to remain somewhere in the 0.5 – 1ppt range... in the medium/long term, we don't see the wedge rising to the range estimated by the OBR."¹⁷

Further to the above Morgan Stanley expects the long run wedge to be less than 1 percentage point: "Thinking in terms of the medium/long term, while plausible, we would be very surprised to see the wedge rising close to the 1.3-1.5pp range as is currently envisaged by the OBR." The report continues: "The likelihood is that the wedge will continue to be close to its historical norm [which Morgan Stanley quotes as being 0.9% points] in the long-run."¹⁸ Morgan Stanley set out a number of reasons as to why it holds this view:

- » First, it believes that the ONS' analysis of clothing price measurement will reduce the formula effect back to more historical norms.
- » Second (at the time of writing in 2012) it was expected that a number of components included within RPI would be introduced into CPI. This included vehicle excise duty, trade union subscriptions and TV license fees. The increased standardisation of components included in the indices (all else equal) should narrow the wedge. We have checked and, consistent with Morgan Stanley's expectations at the time, found that vehicle excise duty and trade union subscription costs were incorporated into CPI in February 2012. This increases the validity of Morgan Stanley's analysis.
- » Finally, and critically, Morgan Stanley state that: "If the difference between RPI-CPI is expected to stay wider indefinitely, then (assuming the market prices RPI swaps using an expectation of CPI plus a wedge) we could see a re-pricing of breakevens as RPI expectations adjust."¹⁹ Put simply, assuming markets price rationally, a persistent wider wedge should be reflected in breakevens – but Morgan Stanley noted, this did not appear to be the case (as of 2012).

Regarding the above, we note the following. Firstly, that Ofcom itself has acknowledged that breakevens currently do not reflect a wedge as large as that suggested by the Bank of England or the OBR; but, rather, are more consistent with a future wedge of 0.9 to 1.0 percentage points. Consequently, assuming markets are pricing inflation efficiently, a lower wedge than 1.3 percentage points is appropriate. Secondly, the Morgan Stanley analysis suggested that, whilst the formula effect might have widened the wedge post 2010, it was not anticipating it to widen further (for the reasons set out above). The historical data we summarised previously is consistent with this in that it showed that – although on average the wedge post 2010 was somewhat higher than the four year wedge prior to 2010: (i) the wedge has not persistently widened since 2010; and (ii) the average post-2010 wedge is in line with the long-run historical wedge.

Ofwat / PwC analysis for the PR14 water price control (2013)

As part of the PR14 price review process in the water industry, Ofwat (the water regulator) set out a number of core economic assumptions that it wanted the companies to apply consistently for the purpose of undertaking risk modelling and analysis. To this end, Ofwat commissioned PwC to provide advice as to what those assumptions should be, and the evidence on which they should be based. In July 2013 PwC published its report setting out these economic assumption in full.²⁰

PwC's recommended inflation assumptions, which Ofwat required the water and sewerage companies to apply for PR14 risk modelling purposes, imply an RPI-CPI wedge of 0.8 percentage points. PwC specifically stated: "Consensus Economics is also the source for the base case RPI

¹⁷ 'UK Economics and Strategy: A New RPI-CPI Wedge?' Morgan Stanley (2012). Page 1.

¹⁸ 'UK Economics and Strategy: A New RPI-CPI Wedge?' Morgan Stanley (2012). Page 4.

¹⁹ 'UK Economics and Strategy: A New RPI-CPI Wedge?' Morgan Stanley (2012). Page 2.

²⁰ 'Economic Assumptions for PR14 Risk Analysis.' PwC (July 2013).

inflation numbers... Consistent with the base case projection of stable GDP growth, it is assumed that the RPI rate of inflation will also remain fairly stable at around 3% during the forecast period. Assuming a wedge of around a 0.8% difference between RPI and CPI... ”²¹

PwC cost of capital report for CAA (2013)

In its Cost of Capital report for the CAA to support the Q6 price control for Heathrow, Gatwick and Stansted, PwC also assumed a forward-looking RPI-CPI wedge of 0.8 percentage points: *“When converting from nominal to real returns, we use an inflation estimate of 2.8%. We consider this estimate to be appropriate over Q6. This is based on a review of historical and forward looking expectations of trends in inflation based on the RPI, the CPI and the GDP deflator. Our proposed approach for calculating inflation adds the long-term RPI-CPI wedge of 0.8% to the Government’s target rate of CPI inflation of 2.0%. The estimate is the same as the figure used by CAA in Q5 and consistent with broader market evidence from various sources.”²²*

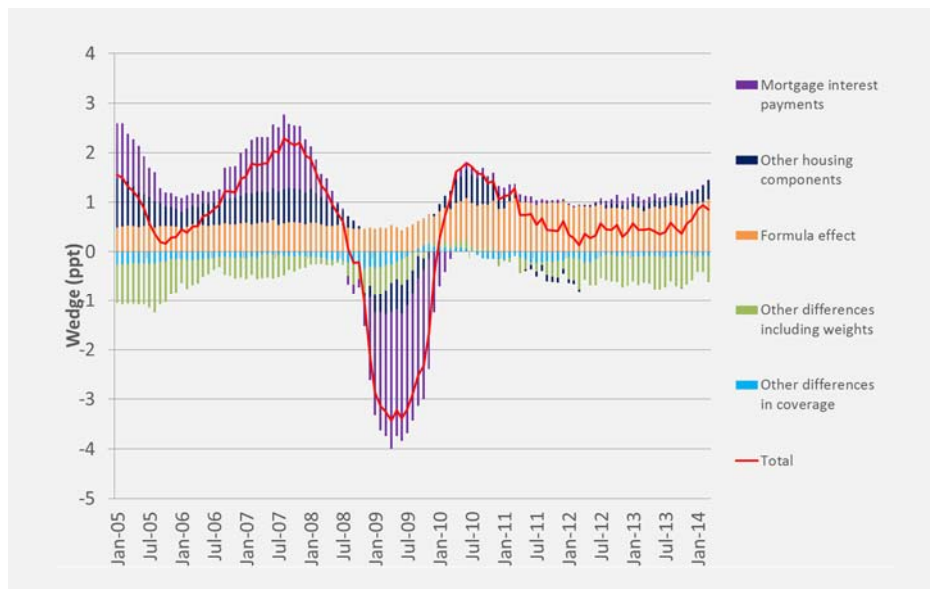
CEPA cost of capital report for ORR (2013)

In its report to the ORR regarding the appropriate cost of capital for Network Rail, CEPA set out evidence regarding the appropriate real risk free rate. In doing so, CEPA assumed a wedge between RPI and CPI of 0.7 percentage points.²³

Our ‘bottom-up’ analysis of the wedge based on forecasts for key input parameters

To predict the long term wedge the Bank of England has analysed the contribution of different factors over time. The chart below shows the effect different components have had on the overall wedge. As can be seen, mortgage interest payments have had a significant impact on the wedge historically, and more recently the formula effect has been the main driver.

Figure 7 Implied wedge based on bottom up component analysis



Source: Economic Insight analysis of Bank of England data

The Bank of England’s central long-run estimate of the wedge is comprised of the following elements:

²¹ *‘Economic Assumptions for PR14 Risk Analysis.’ PwC (July 2013). Page 7.*
²² *‘Estimating the cost of capital in Q6 for Heathrow, Gatwick and Stansted.’ PWC (2013). Page 1.*
²³ *‘Advice on Estimating Network Rail’s Cost of Capital.’ CEPA (2013). See footnote 14 on page 14.*

Table 3 Component contributions to wedge

Component	Contribution to the RPI-CPI wedge
Formula effect	0.9
Mortgage interest payments and other housing components	0.6
Other differences	-0.2
Total	1.3

Source: Bank of England data

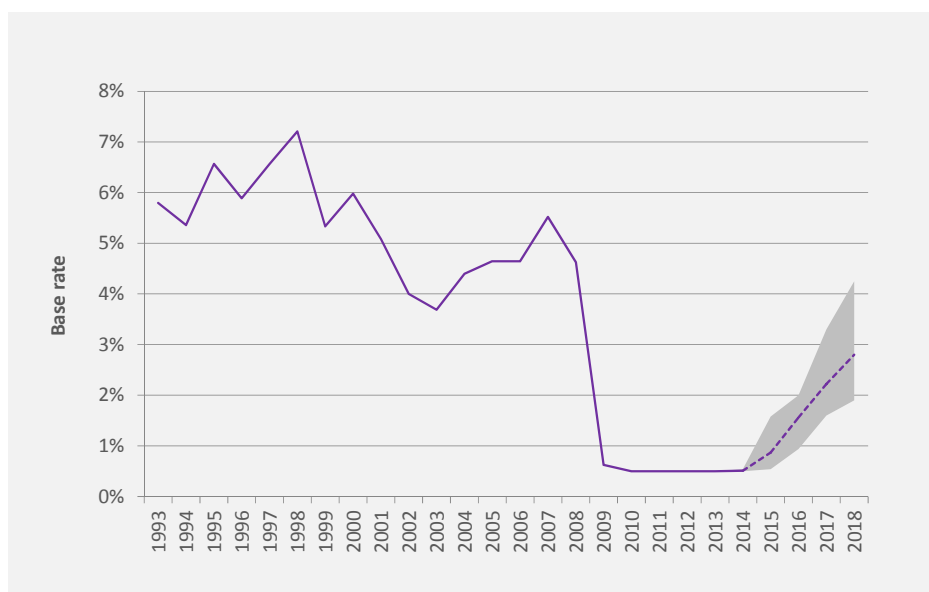
Assuming that the Bank has accurately estimated the formula effect and impact of other differences, we have investigated the robustness of their estimate of the impact of housing costs. They assume that in the long-run interest rates will be broadly stable, so that the contribution of mortgage interest payments will depend on house prices – which also determines housing depreciation. We have therefore built a simple econometric model that relates the housing costs element of the wedge to interest rates and house prices.²⁴

Higher house price inflation will result in higher mortgage interest payments and higher depreciation charges. Higher interest rates will further increase mortgage interest payments – with certain assumptions on elasticities. Our simple OLS model relates the Bank of England base rate and house price inflation (as measured by Nationwide) to the housing cost wedge, and finds the two positive relationships. From this model we have used two different sets of forecasts to determine the likely contribution that housing costs will make to the future wedge.

The following figure (overleaf) shows the spread of interest rate consensus forecasts as reported by HM Treasury. Our model uses the average in order to predict the implied contribution of housing costs to the RPI-CPI wedge.

²⁴ The model is based on monthly data from January 2005 to March 2014. Both parameters, interest rate and house price inflation, are highly significant with t-statistics of 7.56 and 9.66 respectively. The model has an R2 of 0.65.

Figure 8 Consensus interest rate forecasts



Source: HM Treasury consensus forecasts

The table below shows our two predictions of the housing cost wedge, which are both 0.3. The consensus forecasts provided by HM Treasury give predictions for both the Bank of England base rate and house price inflation for 2014 to 2018. Using these figures with our estimated parameters gives an average housing cost wedge over the period of 0.3. In their own forecasts, the Bank of England has assumed that house prices will grow at about 4.5% (average historical wage growth), which is on the cautious side compared with consensus forecasts. Using the Bank of England's assumption of house prices gives our second prediction of the housing cost wedge, which is also 0.3 percentage points. The results of our bottom up analysis are shown in the table below and indicate that, assuming the Bank of England's other parameters are unchanged, the expected future wedge is likely to be 1.0 percentage points. Again we note that this is consistent with the wider evidence set out elsewhere in this report.

Table 4 Economic Insight 'bottom up' estimates of housing cost contribution and impact on wedge

Component	Bank of England prediction	Prediction based on consensus forecasts	Prediction based on Bank of England assumption and consensus forecasts
Formula effect	0.9	0.9	0.9
Mortgage interest payments and other housing components	0.6	0.3	0.3
Other differences	-0.2	-0.2	-0.2
Total	1.3	1.0	1.0

Source: Economic Insight analysis and Bank of England data

Conclusions and recommendations

Reflecting the evidence and analysis set out here, our view is – firstly – that it is not appropriate to retrospectively adjust the MCT nominal WACC upwards to reflect a higher level of RPI than was originally assumed. This is because, by doing so, Ofcom is – in essence – effectively revising investor expectations from those that would have prevailed at the time of the MCT decision. Instead, we think Ofcom should strongly consider retaining its estimated real post-tax WACC of 4.2%. Alternatively, it could re-state the March 2011 MCT WACC for CPI inflation of 2.0%, which results in a post-tax real WACC of 4.7%, compared to that implied by Ofcom’s approach of 5.5% (noting that, as per our separate report for Three on WACC parameters, our view is that were Ofcom to use a WACC to derive the ALF all parameters should be updated; and that, therefore, the WACC would in fact be lower than the 4.7% reported here).

Notwithstanding the above, were Ofcom to retain its proposed approach, a range of evidence suggests that it should apply a smaller RPI – CPI wedge than the 1.3 percentage points it is proposing. In particular, we consider that a more appropriate figure would be between 0.7 and 1.1 percentage points (with a mid-point of 0.9) as this reflects the fact that:

- » Post 2010, the RPI-CPI wedge has averaged 0.7 percentage points (which includes the period post the increase in the formula effect).
- » Independent long-run forecasts imply a wedge of 1.1 percentage points.
- » Current market breakeven rates imply an expected wedge of 0.9 percentage points.
- » Third party evidence is consistent with a wedge 0.7-0.9 percentage points.
- » Our own ‘bottom-up’ analysis implies a wedge of 1.0 percentage points.

Further information

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