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OFCOM'S REVIEW OF ANNUAL LICENCE FEES

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Contents

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1 Executive summary

1 Ofcom imposes annual licence fees (ALFs) for spectrum that has never been auctioned, or where spectrum has been auctioned but the initial term of the licence has expired.[1] Ofcom is consulting on revised ALFs for 900 MHz, 1800 MHz and 2100 MHz spectrum (the "Consultation").[2] Vodafone has commissioned Frontier Economics to assess Ofcom's proposals.

ALFs should reflect a conservative view of the market value of spectrum

2 Ofcom sets ALFs to reflect the market value of spectrum. When setting ALFs, Ofcom has a duty to ensure spectrum is used efficiently.[3] The possibility of spectrum trading means there is little risk of spectrum inefficiency from underestimating the market value of spectrum for ALFs, however there is a greater risk of spectrum inefficiency if Ofcom overestimates the market value of spectrum, resulting in a fallow period. Therefore, Ofcom has historically taken a conservative approach to valuing spectrum when setting ALFs.[4]

3 Ofcom is also required to have regard to the desirability of promoting economic growth, and encourage investment and innovation.[5] Investment and innovation in mobile networks is dependent on the availability of mobile spectrum and the predictability of the terms associated with that spectrum. Ofcom has set ALFs without a fixed review date, which provides a degree of regulatory certainty. However, the indefinite term of ALFs further emphasises the need to be conservative, as otherwise there is a risk that the value of spectrum will fall over time, below the market value used to set the ALF, before a review is triggered.

Ofcom is proposing to update the level of ALFs to reflect changes in the market value of spectrum

4 There is strong evidence that the current level of ALFs is materially misaligned with the market value of the relevant spectrum as the development of technology and changes in the market for mobile services means that both the absolute and relative values of different spectrum bands have changed over time. In order to

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1 See: Ofcom (2015) Statement: Annual licence fees for 900 MHz and 1800 MHz spectrum (herein "the 2015 Statement"); Ofcom (2018) Statement: Annual licence fees for 900 MHz and 1800 MHz spectrum (herein "the 2018 Statement"); and Ofcom (2021) Statement: Annual licence fees for 2100 MHz spectrum (herein "the 2021 Statement").

2 Ofcom (2024) Review of Annual Licence Fees Consultation.

3 Wireless Telegraphy Act 2006 (the "Wireless Telegraphy Act"), Section 3, paragraph 2(a).

4 See for example, 2018 Statement, paragraph 3.11

5 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 6.6 and A8.12.

ensure ALFs remain conservative Ofcom should update the ALFs based on more recent evidence on the valuation of spectrum.

5 Ofcom has recognised that bands with similar physical characteristics (e.g. sub 1 GHz bands) are increasingly equivalent from a technical and commercial perspective and that ALFs should be set based on the most recent auction evidence. Ofcom proposes updating the 900 MHz ALF, to align the lump-sum value (LSV) of this spectrum with the 700 MHz auction price in the relatively recent UK auction. For 1800 MHz and 2100 MHz LSVs, there is not a recent UK auction of directly comparable spectrum in the UK and Ofcom proposes using auction data reflective of mobile network operator (MNO) spectrum valuations in the '5G era' from the UK and Europe. Ofcom's updated approaches imply lower LSVs relative to those used to set the existing ALFs.

6 Ofcom is also consulting on an updated annualisation rate for converting LSVs into a stream of annual payments, and its indexation of ALFs to the Consumer Price Index (CPI). The proposed annualisation rate is significantly higher than in previous ALF decisions (6.38% vs 5.34/5.75%). Overall, Ofcom's proposals imply:

(a) For 900 MHz spectrum, a 21% reduction in the ALF to £1.097m/MHz;
(b) For 1800 MHz spectrum, a 21% reduction in the ALF to £0.810m/MHz; and
(c) For 2100 MHz spectrum, a 12% increase in the ALF to £0.766m/MHz.

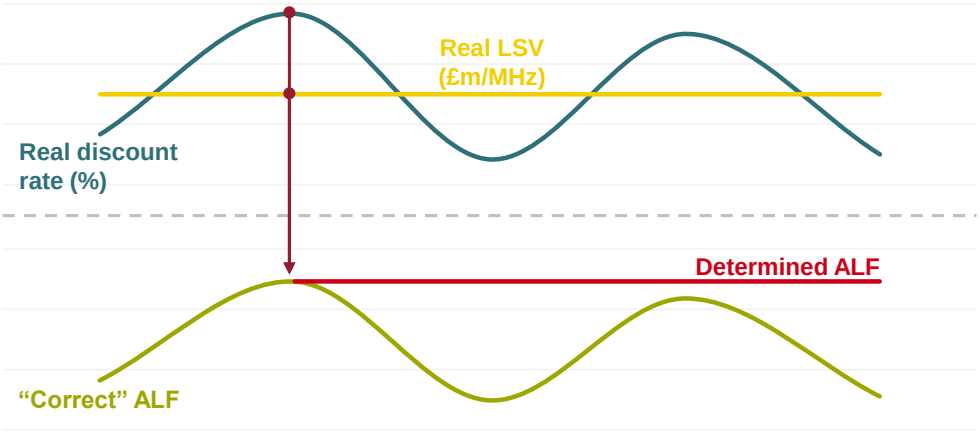
The proposed annualisation rate risks setting ALFs too high

7 Once set, ALFs have only been revised when substantial new information becomes available. As such ALFs should be set conservatively to reflect any likely changes in the parameters that feed into valuations to avoid ALFs being set too high in the future.

8 In particular, the annualisation rate should reflect a forward-looking view of the real discount rates of MNOs and Government. If the annualisation rate is based on interest rates above the long-run average, as interest rates converge to the long-term mean then ALFs will be set too high, assuming the value of spectrum is broadly stable in real terms.[6]

[6] Conversely, if the assumption is that cash flows are stable over time, with lump-sum valuations varying to reflect changes in the cost of capital then Ofcom's approach which combines UK LSVs from periods when interest rates were at a low level with an annualisation rate based on current historically-high interest rates will lead to an overestimate of ALFs even in the short term.

Figure 1 Determining ALFs when the real discount rate is high will result in ALFs being set too high over the following period



Source: Frontier Economics illustration

9 Ofcom's proposed increase in the annualisation rate is mostly driven by its updated estimate of the cost of debt of UK MNOs, which is based on average bond yields over the past year. Bond yields have been high and volatile over this period, reflecting increases in the Bank of England (BoE) base rate aimed at controlling inflationary pressures primarily caused by the War in Ukraine. The cycle of monetary tightening has concluded, with the base rate beginning to decline. Therefore, Ofcom's proposed annualisation rate is unlikely to accurately reflect the likely long-run real discount rates over the period before ALFs are reviewed again.

10 Ofcom's conversion of nominal discount rates into real terms is based on the BoE's target for inflation. The monetary tightening has occurred precisely because CPI is currently above the BoE target and is expected to remain above target for a number of years. Using the BoE target rather than the actual market expectations of inflation leads to Ofcom overestimating the real discount rate and therefore the annualisation rate.

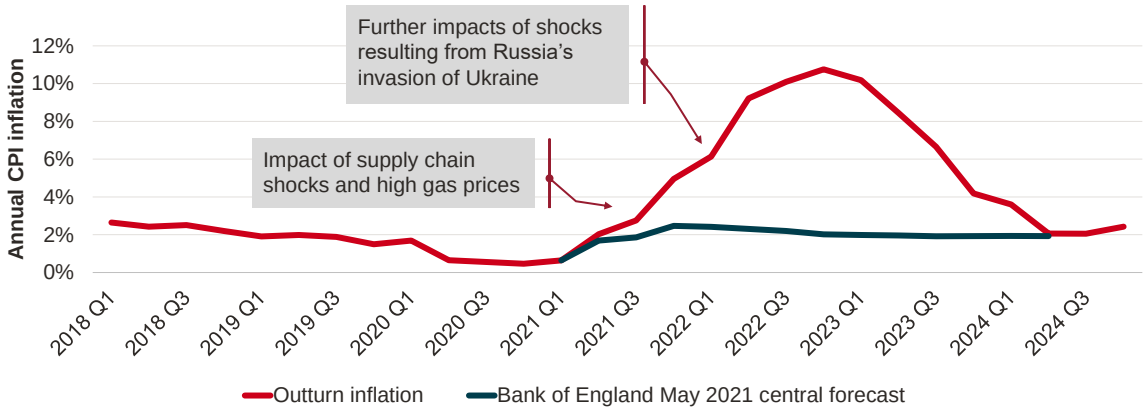
11 In addition the bond index Ofcom uses to derive its cost of debt estimate includes financial firms. The debt premia for financial firms indicate they are considered riskier than non-financial firms including UK MNOs, meaning this index is likely to overestimate the current real discount rate for MNOs.

12 Ofcom should set the annualisation rate based on a longer-term (e.g. 10-year) average of the cost of debt, using an appropriate bond index that excludes financial firms, and a realistic forecast of inflation reflecting independent forecasters' views. Otherwise, Ofcom will set ALFs above the optimal level appropriate for the period until ALFs are reviewed again.

Ofcom's proposals overlook evidence that the nominal value of spectrum has not increased in line with recent extraordinary inflation

13 Ofcom's decision that ALFs should rise with CPI inflation was made in an era where the overall rate of inflation was subdued, with annual rates of inflation close to the BoE target rate of 2%. In this context it was reasonable to assume asset values and cash flows increased in line with the general reduction in the purchasing power of money as measured by CPI inflation. However, recent high levels of CPI have turned out much higher than assumed by Ofcom, with this level of CPI due to external shocks, such as the War in Ukraine.

Figure 2 Impact of external shocks on outturn inflation, relative to forecast



Source: *Frontier Economics analysis of ONS and Bank of England data*

Note: *We note that the Bank of England's May 2021 Monetary Policy Report was the latest such report at the time that Ofcom first proposed the level of ALFs for paired 2100MHz spectrum in its July 2021 Consultation.*

14 The real value (deflated by CPI) of spectrum licences is likely to have fallen as the economic shocks that have driven up CPI inflation will not translate into increases in the nominal value of spectrum. In normal times, there is likely to be high correlation between changes in the purchasing power of money, as measured by general inflation, and the value of assets. However, the high rates of inflation that the UK (and global) economy is currently experiencing are not due to monetary effects but are mainly being driven by supply-side shocks, such as disrupted supply chains due to Covid-19, tight labour markets and the War in Ukraine. There are no obvious reasons why increases in CPI driven by these external factors, for example increases in the market price of fossil fuels, should be correlated with the value of spectrum. Therefore, it is likely that the increase in CPI has outpaced growth in the market value of spectrum (i.e. the real value of spectrum deflated by CPI has fallen).

15 There is clear evidence that the real value of spectrum has fallen since the most recent UK auction. Sector revenues have fallen in real terms, MNOs face increasing cost pressures, and the supply of spectrum has been constant since

2021. As a result, there has been a real-terms reduction in sector profitability, as shown by Ofcom's own EBITDA analysis. Evidence also suggests MNOs' real asset values (including spectrum) have fallen.

16 To mitigate the risk of CPI outpacing growth in spectrum values due to future economic shocks, Ofcom could consider committing to automatically review ALFs if inflation falls outside a reasonable range (e.g. the BoE target +/- 2%).

The updated lump-sum values proposed by Ofcom also risk overstating the value of spectrum

17 Ofcom's proposed updates to the LSVs of ALF-band spectrum capture some of the past decline in values across the different spectrum bands, which were causing a material misalignment of existing ALFs with the current market value of these bands. However, Ofcom's methodology still risks overestimating the LSVs of the spectrum. Specifically:

(a) By continuing to adjust past auction results for inflation, Ofcom would bake extraordinary recent inflation into LSVs, despite the clear evidence that real spectrum values have fallen during this period – this is most pronounced for the proposed LSV of 900 MHz, which is 23% higher in nominal terms than the amount MNOs paid for 700 MHz at auction only four years ago;

(b) Ofcom continues to use the 'distance method' to determine LSVs for 1800 MHz and 2100 MHz despite:

  (i) No real assessment that the methodology is robust, with the evidence from other jurisdictions suggesting that the implicit assumptions underlying the method are not valid;

  (ii) The analysis inferring UK valuations from a very small sample of overseas auctions in particular, Ofcom effectively uses a benchmarking sample of two countries for the 1800 LSV, meaning there is a significant risk of overestimating the UK market value of spectrum; and

(c) When determining the LSV for 1800 MHz Ofcom dismisses a benchmark implying a lower lower-bound for the LSV on the basis that the benchmark is *"overly conservative"*, and uses unreliable evidence to justify aiming above the bottom of the range – this contrasts with Ofcom's stated aim to take a conservative view of the market value of spectrum.

(d) A more conservative approach would be to: align the 900 MHz LSV with the 700 MHz auction price, uplifted by a notional 2% estimate of general inflation, and set the LSVs for both 1800 MHz and 2100 MHz around the bottom of the range of Ofcom's benchmarks for both bands (e.g. around £10.0m/MHz), reflecting that 1800 MHz and 2100 MHz are functionally equivalent.

18 In light of the above, we consider that Ofcom's proposals risk setting ALFs too high. Ofcom should consider taking a more conservative approach, given the

asymmetric risk of over/underestimating the market value of spectrum. This would ensure spectrum efficiency is maintained, and avoid introducing regulatory uncertainty that dampens investment incentives to the detriment of consumers in the long run.

2 Introduction

19 Radio spectrum is a finite public resource used by MNOs to provide mobile services to consumers and businesses. Ofcom now generally issues perpetual licences (with a minimum 20-year term, and five-year notice of termination thereafter) for operators to use the spectrum via an auction process.[7] Prior to 2000, spectrum was issued directly to MNOs.

20 Ofcom has the power to impose fees for the use of radio spectrum, including the spectrum used by MNOs.[8] That includes the power to set fees above Ofcom's administrative costs incurred in executing its radio spectrum functions.[9] Ofcom does not impose ALFs during the initial term after an auction, but does impose ALFs for spectrum that has never been auctioned, or where spectrum has been auctioned but the initial term of the licence has expired. Ofcom currently charges ALFs for three mobile spectrum bands (900 MHz, 1800 MHz and 2100 MHz), with ALFs for 1400 MHz to be set once evidence of market value has been obtained from a forthcoming auction.[10]

21 In March 2024, BT/EE requested that Ofcom review the ALFs charged for use of 1800 MHz spectrum. In that request, BT/EE set out its view that there is *"strong evidence that the level of fees charged for the 1800 MHz spectrum is materially misaligned with the current market value of this spectrum given:*

- *material inconsistencies in relative spectrum fees for different bands today, with 1800 MHz fees 49% higher than 2.1 GHz;*
- *significant changes in supply and demand conditions since fees were set;*
- *the risks to efficient spectrum use, and consumer benefits, from misaligned fees; and*
- *if left unaddressed, today's distortions are likely to be exacerbated over time."*[11]

22 In light of this, Ofcom announced a review of the ALFs for 900 MHz, 1800 MHz and 2100 MHz spectrum in July 2024, noting the commonalities in the formula used

7 The upcoming mmWave award will be an exception.

8 Under section 12 of the Wireless Telegraphy Act, Ofcom has the power to require licensees to pay fees to Ofcom on the grant of a licence and subsequently.

9 Section 13 of the Wireless Telegraphy Act provides for Ofcom to set fees at an amount that is higher than the cost to Ofcom of carrying out our radio spectrum functions.

10 Ofcom also set ALFs for C-band spectrum used for fixed wireless access by UK Broadband, which was acquired by Hutchison 3G UK in 2017. We understand that Hutchison 3G subsequently paid a fee to align the ALF dates for this spectrum with that of spectrum acquired via auction,

11 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 2.7.

to set ALFs for each of these bands.[12] Following initial stakeholder engagement, Ofcom is now consulting on its proposed amendments to the relevant ALFs.[13] Vodafone UK has asked Frontier Economics to assess Ofcom's consultation proposals.

23 Below, we provide an overview of Ofcom's objectives in setting ALFs, the current level of ALFs and Ofcom's consultation proposals. In following sections, we then assess Ofcom's proposals for the key determinants of ALFs:

(a) The annualisation rate (Section 3);
(b) The treatment of inflation (Section 4); and
(c) The lump-sum value of spectrum (Section 5).

2.1 Ofcom's objectives in setting ALFs

24 Ofcom has set out its general policy position for setting spectrum fees in its Strategic Review of Spectrum Pricing (SRSP),[14] which it uses as a guide when setting ALFs.[15] From 2010, a Government Direction ("the Direction") required Ofcom to set ALFs to reflect the full market value of the relevant spectrum frequencies.[16]

25 Ofcom has always asserted that ALFs increase spectrum efficiency, in line with its statutory objectives. Specifically, Ofcom set out in the SRSP that it considered ALFs reflecting opportunity cost (and therefore market value)[17] would promote efficient use of spectrum:

26 *"If the value of spectrum to a particular user is less than* [the] *opportunity cost, then the spectrum is, by definition, valued more by someone else. If spectrum were reassigned to that alternative use or user then we would expect that user to generate greater benefits to consumers and therefore increase the efficiency of the spectrum use".*[18]

12 Ofcom (2024) "Ofcom launches review of spectrum licence fees" <https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/ofcom-launches-review-of-spectrum-licence-fees/>

13 Ofcom (2024) "Consultation: Review of Annual Licence Fees" <https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/consultation-review-of-annual-licence-fees/>

14 SRSP: The revised Framework for Spectrum Pricing. Ofcom, 2010.

15 In the SRSP, spectrum fees set above administrative cost are referred to as Administered Incentive Pricing (AIP). In practice, Ofcom has used the terms ALF and AIP interchangeably – see paragraph 3.2 of the 2018 Statement.

16 <https://www.legislation.gov.uk/uksi/2010/3024/article/6/made>

17 Ofcom considers that setting ALFs based on opportunity cost results in fees reflecting market value of spectrum. See for example: Statement: Annual licence fees for 2100 MHz spectrum, Ofcom 2021, paragraph 2.6.

18 SRSP, paragraph 4.30

27 In the UK, spectrum is generally tradeable which means that, in theory, if another user has a higher valuation of spectrum, then the existing holder would be willing to transfer the spectrum to the higher-value user at a price acceptable to both parties. As such, under spectrum trading, we would expect an efficient outcome in terms of spectrum use independently of ALFs being levied on the spectrum. However, Ofcom considers that setting ALFs to reflect market value provides a further incentive, i.e. that it incentivises the existing users to relinquish their spectrum if there are other users who value that spectrum more highly.[19,20]

28 Given that MNOs already have an incentive to trade spectrum where it is not allocated efficiently (regardless of whether ALFs are imposed), the risk resulting from ALFs being set below market value is limited. On the other hand, Ofcom has recognised the potential for spectrum inefficiency from ALFs that are inadvertently set above market value and result in a fallow period.[21] As such, there is an asymmetry in the risk of spectrum inefficiency from inadvertently setting ALFs above or below market value. Ofcom has therefore taken a conservative approach to setting ALFs.[22]

2.2 The current level of ALFs

29 In determining the level of ALFs, Ofcom assesses the market value of the spectrum concerned, and converts the resulting lump-sum market value estimate into an equivalent annual payment over a 20-year period, with the resulting ALFs indexed to inflation (CPI), on the implicit assumption the LSVs are stable in real terms – see Figure 3.

Figure 3 Ofcom's formula for setting ALFs in a given year

$$ALF_t = LSV * TAF * \underbrace{\left[\frac{r}{1-(1+r)^{-t*}}\right] * \left[\frac{1}{(1+r)}\right]}_{\text{Annualisation rate}} * \left[\frac{CPI_t}{CPI_{t0}}\right]$$

Source: Ofcom

19 SRSP, paragraphs 4.189-4.191

20 Ofcom has considered in particular that ALFs may improve spectrum efficiency where there are high transaction costs, lack of price information and co-ordination problems, and that MNOs may be more responsive to a direct cost via ALFs than to forgone revenue (i.e. an opportunity cost) that they might achieve through trading spectrum. See: SRSP, paragraphs 4.201-4.204

21 2015 Statement, paragraph 1.38(a)

22 See for example, 2018 Statement, paragraph 3.11

Note: LSV = Lump-sum value; TAF = Tax adjustment factor; r = Discount rate; t = time period; CPI = Consumer pricing index (CPI_t usually refers to the latest CPI index as of January each year, while CPI_{t0} refers to the index as of April 2018 in the case of the 2018 Statement, and April 2021 in the 2021 Statement).*

30 To determine the LSV of spectrum, Ofcom has historically relied on an international benchmarking approach, due to a lack of recent UK auction price data for the relevant spectrum bands. In practice, this has meant interpolating or extrapolating from UK auctions for other bands to the ALF bands using data from overseas auctions (the 'ratio method' and 'distance method').

31 Estimating LSVs of spectrum using the ratio and distance methods is uncertain and requires significant judgment. In setting out its view on the LSV of 2100 MHz spectrum in its 2021 Statement, Ofcom described how the process *"involved considerable exercise of* [regulatory] *judgement, reflecting the fact that trying to determine a forward-looking estimate of market value for a specific spectrum band is not a precise science"*.[23] In particular, regulatory judgement was required when disaggregating prices paid for bands in combinatorial auctions, determining whether auction prices reflect true market value, and choosing point estimates from small and variable samples of international benchmarks.

32 Ofcom uses a real discount rate to annualise the LSV over the 20-year period (represented as "r" in the formula above). The discount rate is set such that the present value of the payment stream of ALFs equals the LSV if it had indeed been paid as a lump sum. The significance of the discount rate is that it reflects the uncertainty associated with the future level of ALFs – particularly changes in the market value of spectrum over time.[24] The real discount rate is set between an adjusted post-tax real cost of debt (CoD) estimate, and a real post-tax weighted average cost of capital (WACC) estimate – referred to as the lower and upper polar case for the real discount rate, respectively.

33 Table 1 below summarises the ALFs currently paid by MNOs, and the main constituent parameters that determine the current level of ALFs.

23 2021 Statement, paragraph 4.68

24 Specifically, paragraphs 4.77-4.78 of the 2018 Statement explain that: *"The discount rate depends on, among other things, the uncertainty associated with this future ALF payment stream. One significant uncertainty relates to changes in the market value of the spectrum over time. The discount rate which will leave licensees indifferent between paying ALFs and paying a lump-sum depends on the extent to which they (rather than the Government) are exposed to the effect of such changes in market value of spectrum over time and, therefore, it is an important consideration in determining the appropriate discount rate."*

Table 1 Summary of ALFs currently paid by MNOs

Parameter	900 MHz	1800 MHz	2100 MHz
LSV	£19.00m/MHz (£ April 2018)	£14.00m/MHz (£ April 2018)	£10.50m/MHz (£ April 2021)
TAF	1.05	1.05	1.06
Lower polar real discount rate	-0.10%	-0.10%	-1.00%
Upper polar real discount rate	4.20%	4.20%	3.60%
Risk sharing factor	25.00%	25.00%	25.00%
Real discount rate for ALFs (r)	1.00%	1.00%	0.10%
Annualisation rate	5.75%	5.75%	5.34%
Latest CPI adjustment	1.27	1.27	1.23
Latest ALF	**£1.09m/MHz**	**£0.81m/MHz**	**£0.69m/MHz**
Cost to industry	**£96.93m**	**£146.88m**	**£81.99m**

Source: *Ofcom*

Note: *The latest ALFs and resulting cost to industry are based on the ALFs for 900 MHz and 1800 MHz applicable from 31 October 2024, and the ALFs for 2100 MHz applicable from 4 January 2025, and are reported in nominal terms.*

2.3 Overview of Ofcom's proposals

34 Ofcom is proposing to revise the current level of ALFs. Specifically, Ofcom proposes to:

(a) Set the LSV for 900 MHz equal (in real terms) to that implied by the 2021 auction prices for 700 MHz;

(b) Update the LSVs for 1800 MHz and 2100 MHz based on a reapplication of the 'distance method', drawing on post-2015 auction data from the UK and Europe;[25] and

(c) Update the annualisation rate, using a recalculated real discount rate.

35 Table 2 below summarises the implications of Ofcom's proposals. Ofcom's proposals imply a reduction in the LSV for each of the ALF bands, and an increased annualisation rate relative to previous ALFs decisions. Effectively, this would result in lower ALFs for 900 MHz and 1800 MHz bands, and a higher ALF

[25] Ofcom assumes post-2015 auctions reflect spectrum valuations in the 5G era. While Ofcom focuses on post-2015 auction data, its proposals are set with some regard to pre-2015 auction data.

for 2100 MHz. We discuss Ofcom's proposals and their underlying assumptions in more detail in Sections 3, 4 and 5.

Table 2 Ofcom's proposed revisions to ALFs

Proposals	900 MHz	1800 MHz	2100 MHz
LSV	£17.20m/MHz (28.90% reduction)	£12.70m/MHz (28.75% reduction)	£12.00m/MHz (6.24% reduction)
Annualisation rate	6.38% (63 bps increase)	6.38% (63 bps increase)	6.38% (104 bps increase)
Revised ALF	£1.10m/MHz (21.11% reduction)	£0.81m/MHz (20.95% reduction)	£0.77m/MHz (12.02% increase)

Source: *Ofcom*

Note: *Monetary terms are expressed in September 2024 prices. The revised ALFs and difference relative to existing ALFs are calculated based on updating LSVs to September 2024 prices and applying the relevant annualisation rates (i.e. these figures do not refer directly to the applicable level of ALFs under existing spectrum licences). Bps stands for basis points (1bps = 0.01 percentage points).*

36 Ofcom's review also considered how to treat inflation in setting ALFs. Under the current regime, ALFs are indexed to CPI inflation on the assumption that the underlying value of spectrum is stable in real terms. Ofcom has proposed to retain this approach. Ofcom has proposed not to remove the effect of recent external shocks to inflation from the revised level of ALFs.

3 Annualisation rate

37 In this Section, we set out that:

(a) The annualisation rate should reflect a forward-looking view of the input parameters;
(b) Ofcom proposes to raise the annualisation rate significantly; and
(c) Ofcom's approach will overstate the real discount rate over the period until ALFs are next reviewed.

3.1 The annualisation rate should reflect a forward-looking view of the input parameters

38 The annualisation rate is designed to provide equivalences between LSVs and ALFs. Over time the relationships between the inter-related variables will vary:

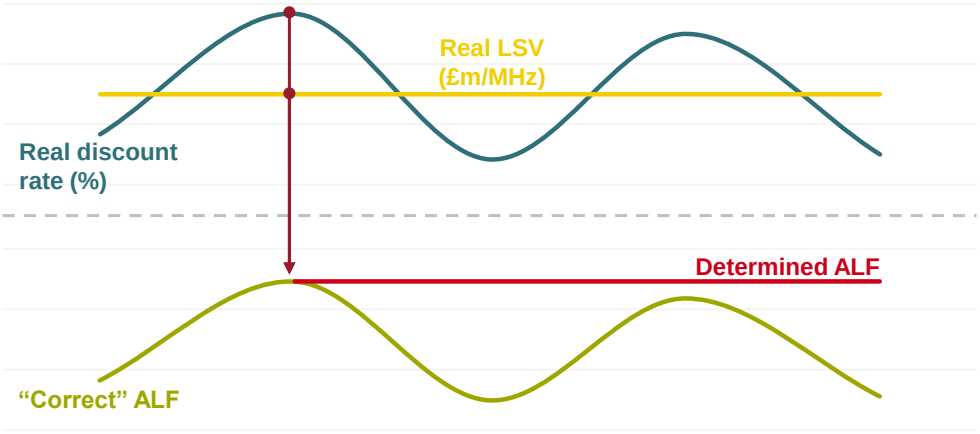
(a) Cash flows attributable to spectrum will vary with macroeconomic cycles;
(b) The discount rate used calculate the net present value of future cash flows will depend on interest rates and the perceived risk profile the future cash flows; and
(c) The lump-sum valuation of spectrum will vary reflecting the factors above.

39 As set out in the Consultation, ALFs are only reviewed when new data provides *"sufficient evidence that there is a material misalignment between ALFs and the underlying market value* [of spectrum]*"*.[26] This contrasts with other regulatory decisions such as charge controls, where there is a defined cycle. ALFs are also designed to be conservative, whereas with regulated prices Ofcom can set prices based on a best central estimate, relying on the fair bet principle to deal with any uncertainty.

40 The open-ended nature of ALF determination, coupled with the need to be conservative, needs to be taken into account when setting ALFs. Ofcom's implicit assumption is that LSVs remain stable (in real terms), but if this condition holds then the appropriate level of ALFs will vary over time as the discount rate changes. If ALFs are set using an elevated annualisation rate, for example due to exceptionally high interest rates, this will result in ALFs in the future being set at a level above the appropriate level – see Figure 4.

[26] Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 1.4.

Figure 4 Determining ALFs when the real discount rate is high will result in ALFs being set too high over the following period



Source: Frontier Economics illustration

41 Alternatively if the assumption is that the cash flows generated by spectrum are relatively stable but the LSV varies as the discount rate varies, Ofcom's approach of using LSVs estimated in a time of past low interest rates (e.g. the 700 MHz valuation in 2019), but applying an annualisation rate based on high current interest rates will again over-estimate the appropriate levels of ALF.

3.2 Ofcom proposes to raise the annualisation rate significantly

42 Ofcom proposes a revised annualisation rate of 6.38%, which is significantly higher (by 63-104 bps) than the annualisation rates used when it has set ALFs in the past. While Ofcom is proposing changes to several inputs to the annualisation rate, the overall increase is primarily driven by an increase in its pre-tax nominal cost of debt estimate.

43 Table 3 shows that Ofcom's latest estimate of the pre-tax nominal cost of debt is 215-325 basis points higher than in previous ALF decisions. This increase is slightly offset by a higher assumed inflation risk premium and corporate tax rate. However, it still results in a significant (130-220 basis points) increase in Ofcom's lower polar case for the real discount rate.

Table 3 Inputs to Ofcom's lower polar case estimates for the real discount rate across publications

Parameter	900 and 1800 MHz (2018 Statement)	2100 MHz (2021 Statement)	ALFs review Consultation
A: Pre-tax nominal CoD	**2.80%**	**1.70%**	**4.95%**
B: Inflation risk premium	0.10%	0.10%	0.40%
C: Liquidity risk premium	0.30%	0.30%	0.30%
D: Adjusted pre-tax nominal CoD (A-B-C)	2.30%	1.30%	4.25%
E: Corporate tax rate	17.10%	24.90%	25.00%
F: Post tax nominal CoD (D*(1-E))	1.90%	1.00%	3.20%
G: CPI Inflation forecast	2.00%	2.00%	2.00%
Adjusted post-tax real CoD ((1+F)/(1+G)-1)	**-0.10%**	**-1.00%**	**1.20%**

Source: Ofcom Consultation, Table A5.1; Annual Licence Fees for 900 MHz and 1800 MHz frequency bands Annex 5; Annual licence fees for 2100 MHz spectrum Annex 4.

44 The pre-tax nominal cost of debt estimate also affects the upper polar case for the real discount rate – see Table 4. However, the overall change in the upper polar estimate of the real discount rate is less stark. This reflects that Ofcom also uses a higher gearing assumption than previously, which puts significantly less weight on MNOs' cost of equity (CoE) relative to the cost of debt than in previous ALFs decisions (reducing the upper polar case estimate of the real discount rate). Since the increase in the lower polar case is greater than the reduction in the upper polar case, Ofcom's proposed real discount rate is higher than in previous ALFs decisions, and this in turn drives up the annualisation rate.

Table 4 Inputs to Ofcom's upper polar case estimates for the real discount rate across publications

Parameter	900 and 1800 MHz (2018 Statement)	2100 MHz (2021 Statement)	ALFs review Consultation
A: Pre-tax nominal CoD	**2.80%**	**1.70%**	**4.95%**
B: Debt premium	1.30%	1.10%	0.90%
C: Nominal RFR (A-B)	1.50%	0.60%	4.05%

Parameter	900 and 1800 MHz (2018 Statement)	2100 MHz (2021 Statement)	ALFs review Consultation
D: Nominal EMR	8.80%	8.80%	8.80%
E: Nominal ERP (D-C)	7.30%	8.20%	4.70%
F: Equity beta	1.02	1.05	0.90-1.00
G: Pre-tax nominal CoE (C+F*E)/(1-J)	10.80%	12.30%	11.10%-11.80%
H: Gearing	10%	45%	60%-75%
I: Pre-tax nominal WACC (H*A+(1-H)*G)	7.60%	7.50%	6.50%-7.70%
J: Corporate tax rate	17.10%	24.90%	25.00%
K: Post-tax nominal WACC (G*(1-J))	6.30%	5.60%	4.90%-5.80%
L: CPI inflation	2.00%	2.00%	2.00%
Post-tax real WACC ((1+K)/(1+L)-1)	**4.20%**	**3.60%**	**3.30%**

Source: *Ofcom Consultation, Table A5.3; Annual Licence Fees for 900 MHz and 1800 MHz frequency bands Annex 5; Annual licence fees for 2100 MHz spectrum Annex 4.*

Note: *RFR stands for Risk Free Rate; EMR stands for Expected Market Return; ERP stands for the Expected Risk Premium.*

45 The pre-tax nominal cost of debt assumption that Ofcom proposes is based on an average of yields on BBB-rated 10-year corporate bonds, over the 12 months to 31st October 2024.[27] Ofcom says this approach reflects that:

(a) The discount rate in the lower polar case should reflect the credit risk of a UK MNO; and

(b) It is appropriate for the cost of debt in the lower polar case to reflect the relevant cost of debt today, given the objective to leave MNOs indifferent between paying a LSV or ALFs.[28]

46 Ofcom intends to update its annualisation rate estimates, including its estimate of the pre-tax nominal cost of debt, upon its final decision.

27 Ofcom uses S&P Capital IQ's GBP All Corporates index for 10-year BBB bonds.

28 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs A5.13-A5.17.

3.3 Ofcom's approach will overstate the real discount rate over the period until ALFs are next reviewed

3.3.1 Cost of debt should be estimated over a longer horizon

47 The level and volatility of the cost of debt has increased markedly since Ofcom's previous ALF decisions. This largely reflects external shocks to the global economy. Persistent increases in interest rates – notably the BoE base rate, which is currently 4.5% compared to 0.1% in 2021 – in response to extraordinary recent rates of inflation (see Section 4.2), will have made interest on existing bonds less competitive, reducing the prices of bonds and therefore increasing average yields. Indeed, the BoE's February 2025 Monetary Policy Report notes that long-term government bond yields in the UK and US are around their highs reached during the global financial crisis, and recent moves in long-term UK rates have been mainly driven by spillovers from global shocks.[29] UK-specific shocks such as the UK government's 'mini budget' announcement in September 2022 have also caused periods of high volatility in UK bond yields.[30]

48 By using a pre-tax nominal cost of debt estimate based on only the last 12 months of data, Ofcom's proposed annualisation rate will internalise the effect of current high interest rates (driven by exceptional inflation). In other words, Ofcom overestimates the long-run average real discount rate. Current high interest rates also will not have been reflected in MNOs' valuations of spectrum in the auctions that determine the LSV for ALF bands and will not be reflective of interest rates for the full period until ALFs are next reviewed. As we explained in Section 3.1 above, combining an annualisation rate which bakes in high interest rates with LSVs reflecting spectrum valuations at times when interest rates were low will result in ALFs which, on a forward-looking basis, are above the optimal level.

49 There are two potential approaches to mitigate this:

(a) Use long-run, forward-looking views of the parameters within the annualisation calculation, rather than short-run market values; or

(b) Adjust the LSVs to take account of the current discount rate compared to when the auction took place.

50 We consider the first approach is likely to be more robust and simple to implement. The principle change would be to use a pre-tax nominal cost of debt which is based

29 Bank of England (2025) Monetary Policy Report - February 2025; Charts 2.7 and 2.8.

30 Ethan Ilzetzki (2022) UK Financial Crisis of 2022: Retrospective Diagnosis and Policy Recommendations. Available at: <https://www.lse.ac.uk/CFM/assets/pdf/CFM-Discussion-Papers-2024/CFMDP2024-08-Paper.pdf>

on long-run averages rather than the current cost of debt, which is at a historic high. This will reflect a degree of mean convergence in the cost of debt.

3.3.2 An index which excludes financials should be used

51 Ofcom aims to estimate the cost of debt for UK MNOs. There is not a pure-play UK MNO which issues debt on a stand-alone basis and the maturity of bonds issued by the parent groups of the UK MNOs may not match closely with the 10-year maturity used to populate the annualisation formula. Therefore, Ofcom proxies the cost of debt for UK MNOs using cost of debt data for firms with a credit rating that Ofcom considers is broadly comparable to UK MNOs.[31]

52 However, the set of firms included in Ofcom's cost of debt analysis will not be a reliable proxy for estimating UK MNOs' cost of debt. Importantly, Ofcom has used an *"All Corporates"* index,[32,33] which includes financial institutions which typically exhibit a higher debt premium than equivalent non-financial firms due to the highly leveraged nature of most financial institutions. This biases upwards the estimated cost of debt – see Table 5 below. Ofcom should instead use an index which excludes financial institutions. This would be consistent with the approaches of other UK regulators – for example, Ofwat and Ofgem use bond indices that exclude financial institutions when assessing the cost of debt in determining their respective network price controls.[34,35]

Table 5 Premium of Corporates over Non-financials index bond yields

Index	**Average yield over the 10 years to 31st October 2024**
GBP Corporates BBB (average of 7-10 and 10-15 year maturity indices)	3.77%
GBP Non-financials BBB (average of 7-10 and 10-15 year maturity indices)	3.54%

Source: *Frontier Economics analysis of iBoxx data.*

Note: *iBoxx data does not provide a specific Corporates or Non-financials index (GBP BBB) relating to bonds with a 10-year maturity. Therefore, we average the available indices for 7-10 year and 10-15 year maturities to estimate the average yields of 10-year maturity bonds.*

31 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs A5.11-A5.13.

32 Ofcom (2024) Review of Annual Licence Fees Consultation; Figure A5.1.

33 Capital IQ's All Corporates indices include financials – see: S&P Global Market Intelligence (2019) Corporate Yield Curve Methodology. Available at: <https://assets.marketplace.spglobal.com/_assets/documents/marketplace/dataset-docs/corporate-cyc.pdf>

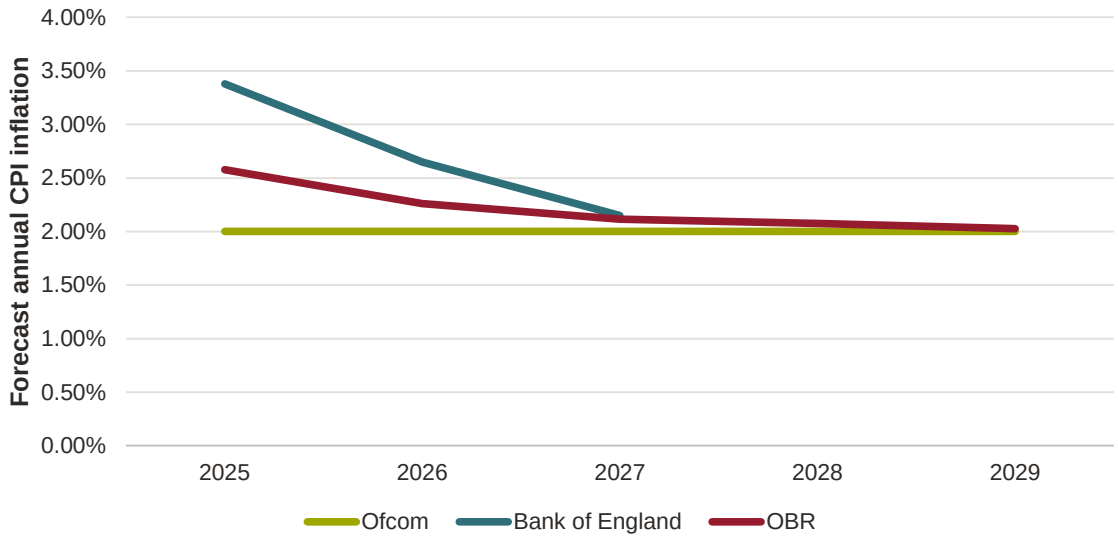
34 Ofwat (2024) PR24 final determinations. Aligning risk and return – allowed return appendix; page 94.

35 Ofgem (2024) RIIO-3 Sector Specific Methodology Decision – Finance Annex; page 27.

3.3.3 Assuming a forecast of 2% inflation over the licence period does not reflect evidence

53 Ofcom bases the annualisation factor on a real discount rate, taking nominal rates and adjusting for a forecast of CPI inflation. For the forecast of inflation, Ofcom uses the BoE target rate of 2%. However, current forecasts of CPI inflation are that it will remain above 2% for the foreseeable future and such forecasts will be implicitly embedded in current market data such as the cost of debt.

Figure 5 Independent forecasts of inflation vs Ofcom's assumption



Source: *Frontier Economics analysis of ONS, OBR and BoE data*

Note: *The BoE forecast comes from BoE's February 2025 Monetary Policy Report; the OBR forecast comes from the OBR's October 2024 Economic and Fiscal Outlook report. BoE forecasts inflation on a quarterly basis, so annual figures reflect inflation in the average of CPI each year, implied by BoE's forecasts. BoE forecasts only extend to 2028 Q1, therefore BoE data is only available on an annual basis until 2027.*

54 In particular, while there may be a long-run expectation that inflation will return to around 2%, there is not an expectation that current rates of above-target inflation will be offset by sub-2% inflation in future. Indeed, the BoE's February 2025 Monetary Policy Report summarised that:

55 *"CPI inflation was 2.5% in 2024 Q4.* ***Domestic inflationary pressures are moderating, but they remain somewhat elevated, and some indicators have eased more slowly than expected****. Higher global energy costs and regulated price changes are expected to push up headline CPI inflation to 3.7% in 2025 Q3, even as underlying domestic inflationary pressures are expected to wane further. While* ***CPI inflation is expected to fall back to around the 2% target thereafter****, the*

Committee will pay close attention to any consequent signs of more lasting inflationary pressures"[36] *(emphasis added).*

56 Ofcom should therefore use information on actual forecasts of CPI inflation rather than defaulting to the notional target when adjusting from nominal to real rates. This would better reflect the actual real discount rate, and avoid setting an ALFs profile that is effectively more expensive to MNOs than paying the LSV upfront. Table 6 shows that a long-term inflation assumption based on actual forecasts would lead to a 15-37 basis point change in the annualisation rate, whereas assuming a reversion to 2% inflation over the rest of a 20-year licence period would also imply a change of 7-11 basis points.

Table 6 Impact on annualisation rate of alternative CPI inflation inputs

Long-run CPI assumption	Assumed inflation rate	Implied real discount rate	Implied annualisation rate
BoE target (Ofcom's assumption)	2.00%	1.68%	6.38%
BoE forecast (Q1 2025-Q1 2028)	2.66%	1.02%	6.01%
BoE forecast (Q1 2025-Q1 2028), with reversion to 2% thereafter	2.10%	1.58%	6.32%
OBR forecast (2025-2029)	2.27%	1.42%	6.23%
OBR forecast (2025-2029), with reversion to 2% thereafter	2.07%	1.61%	6.33%

Source: *Frontier Economics analysis*

Note: *Where we assume reversion to 2% inflation after the independent forecaster's forecast horizon, we set the assumed inflation rate based on a simple average of the implied annual inflation over a 20-year period, including the relevant forecaster's horizon.*

36 Bank of England (2025) Monetary Policy Report - February 2025; page 4.

4 Treatment of inflation

57 In this Section we set out that:

(a) Ofcom assumes the value of spectrum is generally stable in real terms;
(b) Recent rates of inflation were extraordinary;
(c) There is clear evidence that the real value of spectrum has fallen; and
(d) ALFs should not reflect extraordinary levels of inflation.

4.1 Ofcom assumes the value of spectrum is generally stable in real terms

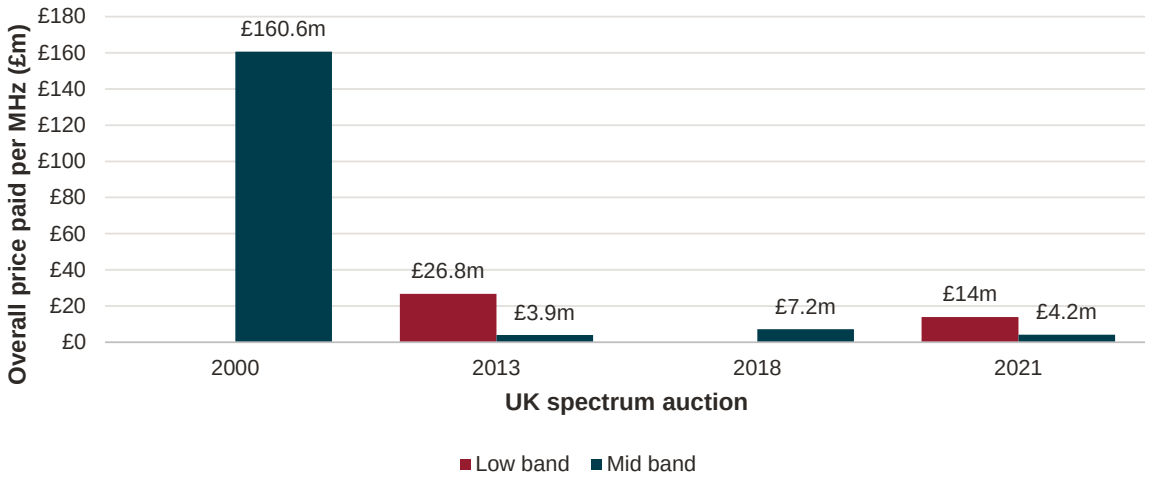
58 Ofcom has historically assumed that the value of spectrum is generally stable in real terms. As a result, Ofcom has used outturn inflation to:

(a) Adjust past auction results for inflation (i.e. uplift LSVs to current prices); and
(b) Index ALFs to outturn CPI, going forwards.

Background on Ofcom's assumption that spectrum values are stable in real terms

59 From 2000 onwards there was a clear downward trend in the value of low- and mid-band spectrum over time as more spectrum became available while the overall revenues remained broadly flat in the mobile sector.

Figure 6 Time series since 2000 of UK spectrum prices per MHz



Source: *Frontier Economics analysis of Ofcom and Telegeography data*

Note: *Nominal prices paid taken from Ofcom notices on auction results; conversion to £/MHz using data on purchased MHz from Telegeography. Low band means sub-1GHz and mid band means 1-6GHz. 2013 prices divided between low and mid band based on table 2.2 of the 2015 Statement. EE's payment of for low-band centre-gap*

frequencies and in-band position in 2021 is excluded. 2021 figures for mid-band are aligned with Ofcom's assessment of £/MHz paid for C-band in Table 4.1 of the 2021 Statement).

60 It is reasonable to assume that the value of spectrum assets has now stabilised, with limited additional low- and mid-band spectrum being released and revenues remaining broadly stable. In other words, it may be appropriate to assume that the value of spectrum will increase in line with the general reduction in the pounds purchasing power implicit in the BoE's 2% inflation target, as measured by the CPI.

61 Indeed, Ofcom made its implicit assumption that the market value of spectrum is stable in real terms at a time where the overall rate of inflation was subdued, with annual rates of inflation close to the BoE's target rate of 2%. Ofcom's decision to index ALFs to CPI reflected that it did not foresee inflation greatly exceeding the BoE's 2% target.

62 > *"**We consider that 2% is a reasonable expectation as to long-term CPI inflation**. Figure A10.6 shows CPI inflation between June 1998 and June 2014. This shows that while CPI inflation more recently has been above 2%, it has not been consistently above this level over this period, having been below 2% prior to 2005. More recently, inflation has fallen to around 2% again, standing at 1.9% in the year to June 2014. The annual average CPI inflation between 1998 and 2013 was 2.2%. **While CPI inflation is unlikely to be constantly at 2%, we are not convinced that there is evidence that inflation will be consistently and significantly greater than 2% such that we should prefer a different inflation assumption**"*[37] *(emphasis added).*

Ofcom's Consultation proposals

63 MNOs have said that Ofcom should not continue to adjust past auction results for inflation using CPI.[38] In the Consultation, Ofcom recognises that the relatively high levels of inflation over the past couple of years (see Section 4.2 below) mean that adjusting past auction results for inflation materially affects its LSV estimates. In particular, Ofcom highlights that adjusting for inflation implies a LSV for 700 MHz spectrum that is significantly higher (by 23%) than the amount MNOs paid at auction in 2021, only four years ago.[39] However, Ofcom has said that there is no compelling evidence to suggest spectrum values have not remained stable in real terms, arguing that total sector EBITDA has been stable in real terms since 2018, and therefore proposes to continue to adjust past auction results using CPI.[40]

37 Ofcom Consultation: Annual licence fees for 900 MHz and 1800 MHz spectrum Further consultation, 1 August 2014, Annex 9, paragraph A10.53.

38 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.18.

39 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.48.

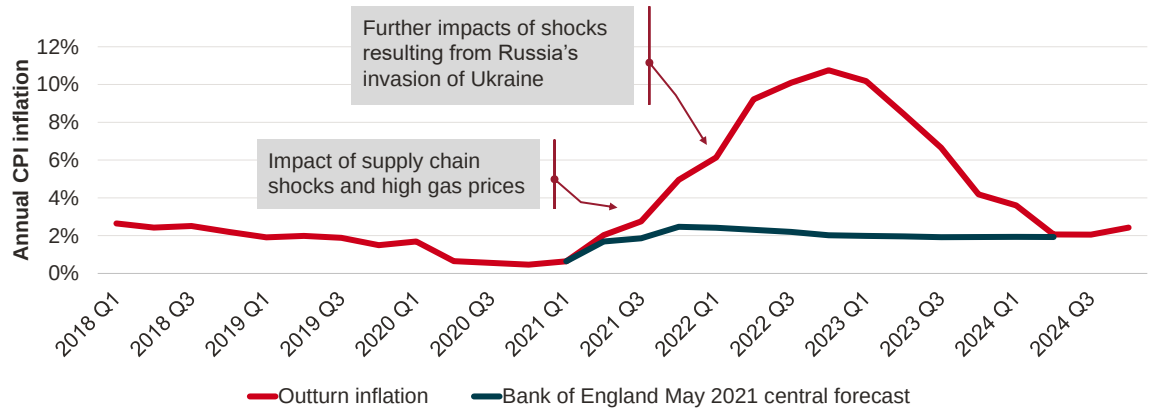
40 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 3.52-3.55.

64 Ofcom has also received submissions from MNOs about alternative ways of indexing ALFs to inflation going forwards. MNOs suggested that indexation of ALFs to reflect inflation should involve a fixed assumption, cap or adjustment to outturn inflation, as to avoid exceptional levels of inflation being automatically reflected in ALFs.[41] Ofcom's provisional view is that it remains appropriate to increase the level of ALFs in line with inflation year on year.[42] However, Ofcom has said it is open to considering arguments for a move to adjusting in line with the BoE's target rate of inflation, noting that adopting this approach would involve removing the inflation risk premium adjustment from the calculation of the annualisation rate.[43]

4.2 Recent rates of inflation were extraordinary

65 Inflation has turned out much higher than expected, including Ofcom's assumptions in previous ALF decisions, due to external shocks, including the War in Ukraine.[44] Since inflation has only fallen back towards the 2% target, not to a very low or negative rate of inflation, recent increases in ALFs will not be offset in the future. Therefore, ALFs would likely end up being significantly higher, in nominal terms, than Ofcom had anticipated.[45]

Figure 7 Impact of external shocks on outturn inflation, relative to forecast



Source: Frontier Economics analysis of ONS and Bank of England data

41 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 7.2.

42 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 7.3.

43 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 7.7.

44 The Bank of England set out in 2022 that "[g]*lobal inflationary pressures have intensified sharply following Russia's invasion of Ukraine. This has led to a material deterioration in the outlook for world and UK growth. These developments have exacerbated greatly the combination of adverse supply shocks that the United Kingdom and other countries continue to face."* See: Monetary Policy Committee Monetary Policy Report May 2022. Bank of England, 2022, page 4.

45 All spectrum subject to ALFs is still in the early stages of 20-year licences, which are subject to extensions in any case.

Note: Bank of England CPI inflation projections based on market interest rate expectations, other policy measures as announced. We note that the Bank of England's May 2021 Monetary Policy Report was the latest such report at the time that Ofcom first proposed the level of ALFs for paired 2100MHz spectrum in its July 2021 Consultation.

66 In contrast to Ofcom's assumption that spectrum values have remained stable in real terms, the economic literature suggests that the real value of assets (or the real return on assets, which is what theory suggests economic agents use to form a view of real asset values)[46] is typically impaired by inflation driven by external shocks (like the recent high inflation experienced in the UK).

67 Notably, Danthine and Donaldson (1986)[47] explained why real rates of return on assets tend to fall in light of rising inflation.[48] They provided the specific insight that, not only is the relationship between real asset returns (and hence real asset values) and inflation negative, but this is particularly true in the case of non-monetary shocks – i.e. the types of shock that have led to recent levels of inflation in the UK.

68 *"Thus it may be said that in this world stocks provide a perfect hedge against a purely monetary inflation.* ***They are no hedge at all, however, against temporary episodes of inflation of nonmonetary origin.***

69 […] *Stocks, which represent ownership to real income streams generated by real assets, offer those who own them protection against purely nominal changes in the value of those underlying assets. They are, of course, no protection against changes in their real values"*[49] *(emphasis added).*

70 While this result was derived almost 30 years ago, it still applies today. More recently, a review of the theory of inflation, its sources and effects on asset prices in 2011 summarised that supply shocks reduce real rates of return on assets, and that this is reflected by the strong negative correlation between inflation and real and nominal stock prices.[50] It was also highlighted in this review that expected policy reactions to high rates of inflation can reduce economic activity, which would amplify the impairment of real asset values.

71 Similarly, a 2023 review of theoretical and empirical evidence of how inflation and investors' expectations of future inflation affect financial markets found that the body of evidence suggests that persistent, long-lived, shocks that increase inflation

46 Inflation, Inflation Risks and Asset Returns. Corkish, J; and Miles, D. Bank of England Working Paper No. 27 (November, 1994).

47 Inflation and Asset Prices in an Exchange Economy. Danthine, JP; and Donaldson JB. Econometrica , May, 1986, Vol. 54, No. 3 (May, 1986), pp. 585-605.

48 See for example: The Relation Between Stock Prices and Inflationary Expectations: The International Evidence. Solnik, B. Journal of Finance, 38 (1983), 35-65.

49 Inflation and Asset Prices in an Exchange Economy. Danthine, JP; and Donaldson JB. Econometrica , May, 1986, Vol. 54, No. 3 (May, 1986), pp. 585-605.

50 Inflation and asset prices. Tatum, J. Munich Personal RePEc Archive Paper No. 34606 (Nov, 2011).

and stunt economic growth are costly.[51] Specifically, the authors pointed out that asset values fall when supply shocks drive up inflation.

72 Academic research from the BoE also found the immediate impact of unexpected inflation on real returns of all assets is negative.[52] And even when high inflation has become sufficiently persistent to be considered 'anticipated', it continues to erode the real returns on the majority of assets.

73 As such, while real assets may provide a hedge against general inflation, the academic literature emphasises that asset prices tend to fall as a result of external shocks as such shocks impact the willingness of consumers to pay for other services, so for example the 57% increase in the price of energy will have squeezed consumers' and businesses' disposable incomes, reducing mobile revenues.[53]

74 This general result means that Ofcom should carefully examine the assumption that spectrum values have remained stable in real terms during the recent period of high inflation, even if the assumption may be reasonable in the absence of external shocks.

4.3 There is clear evidence that the real value of spectrum has fallen

75 The value of additional spectrum to an MNO derives from the fact that it allows capacity and quality to be delivered at a lower cost (excluding the cost of the spectrum itself) than if the spectrum is not available. Operators with additional spectrum will, at least in part, be likely to use this lower cost base to enhance the network to capture a greater share of demand compared to the counterfactual, as well as reducing the network cost of delivering the counterfactual level of demand.

76 Even if the network cost of equipment has moved in line with CPI inflation the overall nominal value of spectrum is unlikely to have risen in line with inflation in recent years as the negative impact of external inflationary shocks on consumers' and businesses' purchasing power will have reduced the value in real terms of additional customers that could be captured by improving capacity or quality in the last three years.[54]

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51 Inflation And Asset Returns. Cieslak, A; and Pflueger, C. National Bureau of Economic Research Working Paper 30982 (March, 2023).

52 Inflation, Inflation Risks and Asset Returns. Corkish, J; and Miles, D. Bank of England Working Paper No. 27 (November, 1994).

53 Based on change in ONS's CPI index for Electricity, gas & misc. energy (G) (2015=100) between April 2021 and January 2025.

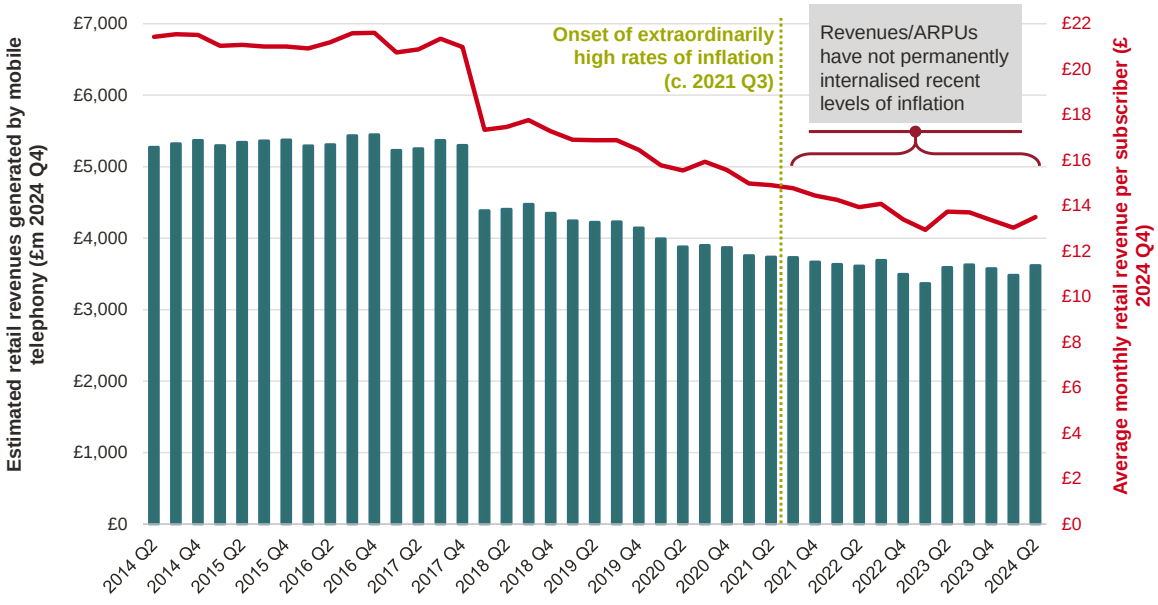
54 The effects of inflation on network costs may have been mitigated by the long-term supply agreements typically used.

77 This effect is evident in mobile sector revenues and profitability and confirmed by overall asset values.

Revenues

78 Figure 8 below shows the evolution of retail revenues and average revenue per user (ARPU) for the UK mobile sector, adjusted for inflation. There has been a consistent real-terms decline in revenues since 2018/2019. Slow growth in subscriber numbers means that ARPUs have also been sluggish and have fallen in recent years. Importantly, the downward trend in revenues has persisted following the onset of inflationary shocks highlighted in Figure 7 above, suggesting the effects have not been internalised by mobile sector prices and revenues in the same way as they have in the general price level across the economy (given that the CPI remains elevated).

Figure 8 Real retail revenues and ARPUs over time



Source: Frontier Economics analysis of Ofcom Telecommunications Market Data Update Q2 2024 data
Note: The sharp drop between 2017 and 2018 was caused at least partly by accounting changes.

79 In the face of declining revenues, the market valuation of spectrum can be expected to fall, as lower revenues imply a weaker return on investment in spectrum (all else the same). Put another way, as MNOs would forego less revenues by not acquiring an additional unit of spectrum, their private valuation of spectrum is likely to have fallen.

80 While data volumes have increased significantly in recent years,[55] this would not necessarily increase MNOs' demand (and thus willingness to pay) for spectrum. Increasing data traffic has coincided with the significant increases in the supply and efficiency spectrum, meaning the increase in data volumes (which itself is a function of deployable spectrum and spectral efficiency) is unlikely to have led to an additional constraint on MNOs' capacity.

Profitability

81 Declining revenues have not been accompanied/driven by significantly lower costs. In fact, several recent market developments have put upward pressure on MNOs' costs, specifically:

(a) The removal of Huawei equipment following a government direction,[56] reportedly cost BT alone £500m;[57]

(b) The implementation of the provisions of the Telecoms Security Regulations will have led to incremental costs to MNOs;[58]

(c) MNOs have committed to collectively invest over £530 million in the Shared Rural Network (SRN);[59]

(d) In recent years in particular, MNOs have also faced similar cost pressures as other industries, driven by rising supply chain and energy costs – for example, energy costs have risen by about 79% and electrical equipment costs by 23% since April 2021;[60] and

(e) Going forwards, densifying networks to enable new 5G use-cases is also likely to increase MNOs' costs – for example, as of 2022, the investment required to roll out full 5G ranged from about £12bn to £34bn, depending on the scale of roll-out, whereas the investment likely to be committed by MNOs was about £9bn[61] – acquiring additional spectrum would not materially reduce such costs, meaning these increases in network costs would not imply a higher valuation of spectrum for MNOs.

82 As a result, profitability has also fallen in real terms since 2021, as demonstrated by Ofcom's own analysis of sector EBITDA – see Figure 9. Again, this suggests

55 Ofcom Telecommunications Market Data Update Q1 2024 data suggests sector data traffic increased from 2,451 PB in 2018 to 9,405PB in 2023.

56 https://www.gov.uk/government/news/huawei-legal-notices-issued

57 https://www.rcrwireless.com/20230925/5g/uk-telco-bt-says-huawei-ban-cost-firm-612-million-report

58 https://www.legislation.gov.uk/uksi/2022/933/contents/made

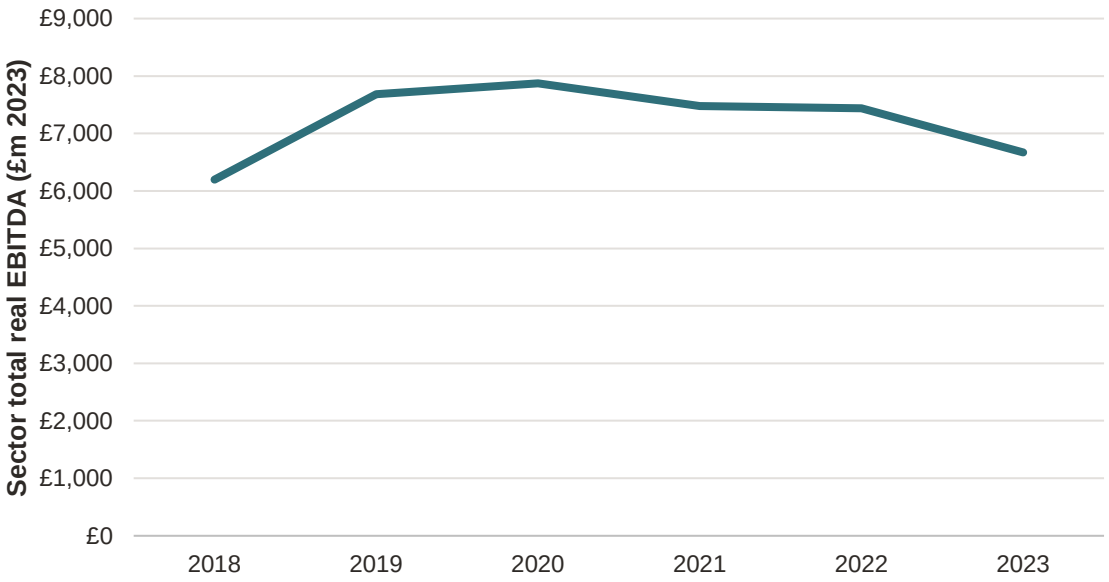
59 https://www.gov.uk/government/consultations/shared-rural-network-consultation/shared-rural-network-srn-consultation-document

60 Increase in Producer Price Indices (output domestic) for Electricity, including Climate Change Levy, and Electrical equipment from April 2021 to January 2025.

61 https://www.connectivityuk.org/wp-content/uploads/2022/09/The-Investment-Gap-to-Full-5G-Rollout.pdf

that the market value of spectrum in turn is falling in real terms, since the value MNOs place on spectrum will stem from the returns that spectrum could generate for investors. Ofcom also refers to MNOs' EBITDA margins being broadly stable over time,[62] however unlike profit levels, profit margins are not a useful indicator of the real value of spectrum as they do not reflect the level of returns that a given level of spectrum holdings can generate for MNOs.

Figure 9 Mobile sector total real EBITDA over time



Source: *Frontier Economics replication of Figure 3.1 of the Consultation*

Note: *Ofcom's calculations are based on UK company financial statements (Vodafone Limited, O2 Holdings Limited – 2018-2021, Telefonica UK Limited – 2022-2023, Hutchison 3G UK Limited and EE Limited). 2023 data either refer to the financial year ended 31 December 2023 or 31 March 2024.*

83 Therefore, while MNOs will have somewhat mitigated the effect of inflationary shocks through indexation of prices within contract, this has been more than offset by the reduction in initial and re-contract prices, driven by customers' decreased purchasing power. This can be seen as neither ARPUs nor EBITDA increased in line with CPI.

Asset values

84 Consistent with profitability declining, the overall the market value of assets held by MNOs, including spectrum, will have fallen. This can be seen in the collapse in enterprise values of MNOs' parent companies in recent years – Figure 10 shows that nominal share prices have declined since 2021, implying an even greater reduction in real share prices.

62 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.53.

Figure 10 Evolution of MNOs' parent share prices in nominal terms over the last five years

Source: *Google Finance*

Note: *Share prices taken at the group level of MNOs meaning that they will also reflect investor confidence in the other relevant parts of MNOs' businesses, such as fixed broadband. Data accessed 19th February 2025.*

85 Ofcom recognises the decrease in MNOs' parent share prices in the Consultation, but considers this does not indicate a decline in real spectrum values. Instead, Ofcom argues that:

(a) Falling share prices indicate a decline in the expected future cashflows of MNOs, potentially reflecting technological or commercial developments that will decrease profitability; and

(b) These expectations would also have been reflected in MNOs' bidding in spectrum auctions.[63]

86 However, Ofcom's first point is inconsistent with its view expressed in the same section of the Consultation that *"the value of incremental spectrum to an MNO* […] *is likely to depend on the additional profits the MNO could generate* [using] *the additional spectrum"*.[64] In particular, if falling share prices imply an MNO will be

63 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.54(c).

64 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.49.

less able to generate profits going forwards, and the value of spectrum reflects an MNO's view of how much profit it can generate using that spectrum, then a real decline in share prices at a given level of spectrum holdings would imply a real decline in spectrum values.

87 Ofcom's second point ignores that share prices have fallen since previous spectrum auctions, and the decline in nominal MNO parent share prices implies an even greater decline in real share prices. For example, Figure 10 implies that current share prices are at best slightly above their levels at the time of the 2021 spectrum auction, before taking into account significant inflation. This means MNOs' expected future profitability has fallen relative to when MNOs bid for spectrum in past auctions. In other words, to the extent that falling share prices reflect expectations of technological or commercial developments that will decrease MNOs' profitability, this will not have been reflected in MNOs' bidding in spectrum auctions. Therefore, adjusting past auction results for inflation will result in LSVs that overestimate MNOs' current valuations of spectrum.

4.4 ALFs should not reflect extraordinary levels of inflation

4.4.1 Updating spectrum values in line with outturn CPI inflation since 2021 will overstate real spectrum values

88 Our analysis in Section 4.3 shows that there is clear evidence that extraordinary recent levels of inflation, driven primarily by rising energy prices due to the War in Ukraine, are uncorrelated with spectrum values, implying the real value of spectrum has fallen. Most notably, Ofcom has not provided evidence that MNOs would be willing to pay 23% more for 700 MHz spectrum than they were when this spectrum was auctioned in 2021, despite evidence of a real decline in revenues, profits and asset values since 2021.

89 As set out in Section 2.1, there is a risk that setting ALFs above the market value of spectrum will lead to spectrum inefficiency, meaning Ofcom should aim to take a conservative approach to setting ALFs. In light of the evidence above, updating spectrum values in line with outturn CPI inflation since 2021 will overstate real spectrum values, increasing the risk of spectrum inefficiency. Instead, Ofcom could use a notional estimate of general inflation of 2% per year over this period.

4.4.2 Ofcom should automatically review ALF indexation in times of exceptional outturn inflation going forwards

90 There is no theoretical reason why, as a rule, the value of spectrum would be correlated with external shocks to the macroeconomy that lead to exceptional levels of inflation, such as the energy price shocks caused by the War in Ukraine. Therefore, there is a risk that Ofcom's proposal to continue to index ALFs to outturn

CPI could lead to further misalignment between ALFs and the real value of spectrum if similar shocks occur in the future.

91 However, developing an alternative approach to CPI indexation would be complex. Indeed, MNOs' submissions highlighted that there are several alternatives to pure indexation, whereas Ofcom additionally noted that a departure from pure CPI indexation would require a recalibration of the annualisation rate to account for the transfer of inflation risk from MNOs to Government.

92 Therefore, one practical option would be for Ofcom to include a trigger clause in the regulations such that the level of ALFs is automatically reviewed when CPI inflation deviates significantly (e.g. by +/- 2%) from the long-run BoE target of 2%.

5 Lump-sum value of spectrum

93 In this Section we set out that:

(a) Ofcom has updated LSVs based on the latest evidence on auction prices; and
(b) Ofcom must be conservative when determining spectrum values.

5.1 Ofcom has updated LSVs based on the latest evidence on auction prices

94 Ofcom is consulting on revised ALFs in light of a letter from BT/EE and subsequent stakeholder engagement highlighting strong evidence that ALFs are materially misaligned with the current market value of spectrum – see Section 2. Below, we discuss Ofcom's proposed changes to the LSVs on which ALFs are based.

5.1.1 Ofcom aligned the value of sub-1GHz bands

95 For 900 MHz Ofcom proposes to focus on the relevant auction evidence for sub-1 GHz mobile spectrum bands.[65] Ofcom has agreed with submissions by MNOs that there has been a convergence in the values of the sub-1 GHz spectrum bands over time. Therefore, Ofcom expects the value of 900 MHz to be broadly convergent with the 2021 UK auction price of 700 MHz (although Ofcom uplifts the auction price to take account of inflation, as we discussed in Section 4 above).[66]

5.1.2 Ofcom continues to estimate 1800 MHz and 2100 MHz values using the distance method

96 For 1800 MHz and 2100 MHz, Ofcom proposes to take the relevant evidence from UK auctions of low- and high-frequency mobile spectrum as a starting point for the bounds within which the values of 1800 MHz and 2100 MHz are likely to lie. In addition, it proposes to draw on evidence from European auctions using the 'distance method' approach, described in Section 2.2 above.[67]

97 Ofcom has agreed with submissions by MNOs that technological and commercial developments over time can have an impact on forward-looking market values, meaning auction prices from 3G- and 4G-era spectrum awards are less relevant than more recent evidence on spectrum values. As such, Ofcom puts greater weight on post-2015 evidence.[68] In practice, Ofcom estimates the LSVs for 1800

65 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.31.

66 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 4.11.

67 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.32.

68 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 3.36-3.40.

MHz and 2100 MHz by defining a range based on post-2015 benchmarks, before using pre-2015 evidence when 'aiming' within the range.[69]

5.2 Ofcom must be conservative when determining spectrum values

98 In Section 2.1 we set out that there is an asymmetric risk of setting ALFs above/below the market value of spectrum, and therefore Ofcom has aimed to take a conservative approach when determining ALFs in the past. However, we also set out in Section 2.2 that Ofcom's historical approach to setting LSVs using the distance and ratio methods involved significant uncertainty, requiring Ofcom to exercise a high degree of regulatory judgement. Below, we set out that:

(a) Ofcom's approach to valuation has evolved but is still based on assumptions which are not supported by the evidence;

(b) Using a small sample of benchmarks to set values for 1800 MHz and 2100 MHz risks overestimating LSVs for these bands; and

(c) Ofcom's approach to valuing 1800 MHz spectrum dismisses relevant evidence suggesting a lower LSV.

5.2.1 Ofcom's approach to valuation has evolved but is still based on assumptions which are not supported by the evidence

Ofcom has accepted that bands with similar physical properties will have similar values

99 Ofcom has recognised that, on a forward-looking basis, bands with similar physical characteristics are largely fungible and hence have similar values.[70] As a result, it has set the LSV of 900 MHz at the same level as the price of 700 MHz spectrum determined via auction.

100 However, despite the uncertainties underlying the distance method (as explained below) Ofcom is not proposing to align the value of 1800 and 2100 MHz bands,[71] although the values are not materially different.

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69 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 4.48 and 4.65.

70 MNOs now have more flexibility in how they use different spectrum bands to serve different mobile technologies on a forward looking basis (i.e. 5G, and legacy 4G technologies). This increased fungibility of spectrum is likely to have relaxed spectrum-related constraints for MNOs, as there will no longer be technology premia for certain bands. For sub-1 GHz, whereas there was likely a premium for 800 MHz relative to 900 MHz when only 800 MHz could be used to launch 4G (900 MHz was still required for 2G), this is no longer the case.

71 We note that 2100 MHz and 1800 MHz are close substitutes. In 2021 Ofcom stated an expectation for *"the value of the paired 2100 MHz spectrum to be relatively close to the value of the 1800 MHz spectrum given both bands are mainstream coverage bands with similar propagation characteristics and established equipment ecosystem"* (2021 Statement, paragraph 4.22).

The evidence suggests that the assumptions underlying the distance method no longer hold

101 Underlying Ofcom's use of the distance method are a number of assumptions:

(a) That spectrum valuation declines monotonically as frequency increases;
(b) That the relationship between valuations in different markets is similar and stable over time; and
(c) That auction data from other countries captures relative values in that market.

102 Ofcom has not tested these hypotheses. The empirical data that Ofcom uses to populate the distance method suggest that these assumptions no longer hold, in particular:

(a) In Germany and Slovenia, 700 MHz spectrum sold for less than 1800 MHz and/or 2100 MHz spectrum; and
(b) In Sweden, 2100 MHz spectrum sold for less than higher bands. [72]

103 Rather than assessing what this evidence suggests about the robustness of the distance method, Ofcom simply underweights the evidence which shows that the hypotheses that lie behind the distance method are not supported. An objective analysis would conclude that the results of the distance method are very uncertain and as such Ofcom should be extremely conservative when using the results from the distance method when estimating UK LSVs, for example by generally aiming down from a central estimate.

104 It is clear from recent developments (e.g. the advent and proliferation of multiple input multiple output (MIMO), massive MIMO, and Dynamic Spectrum Sharing) that technological changes can shift the absolute and relative values of different spectrum bands in unforeseen ways, in a relatively short timeframe. This further underlines the need for Ofcom to take a conservative view of LSVs implied by benchmarks based on historical data.

5.2.2 Using a small sample of benchmarks to set values for 1800 MHz and 2100 MHz risks overestimating LSVs for these bands

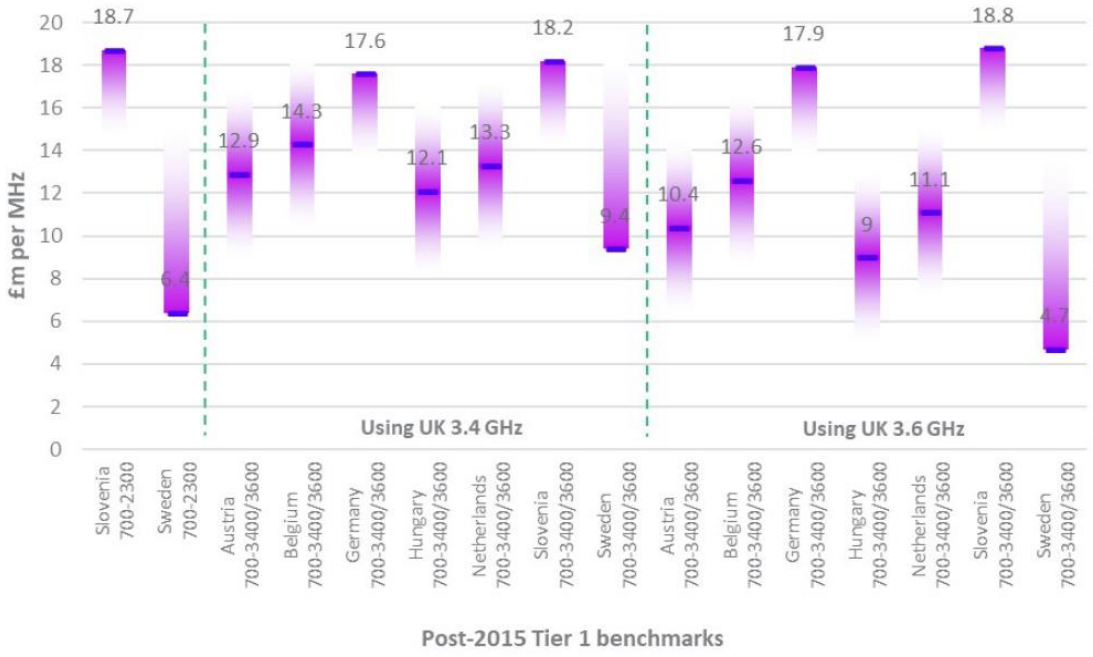
105 Even if Ofcom thought the distance method was robust, it effectively determines what it considers to be the credible range for LSVs for both the 1800 MHz and 2100 MHz bands based on evidence from two countries (Belgium and Hungary),

[72] Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 4.38 and 4.59.

which co-incidentally give similar results. For 1800 MHz, Ofcom considers all other 'Tier 1' benchmark values to be outliers.[73]

106 The full set of 'Tier 1' benchmarks considered when deriving its proposed 2100 MHz LSV shows that the results of the distance method analysis with a wider sample of countries have significant variability. Ofcom ultimately excluded estimates from three countries (Sweden, Germany and Slovenia) where 2100 MHz sold for more than 700 MHz or less than higher bands. Among the remaining four countries (Belgium, Hungary, Austria and the Netherlands), LSV estimates ranged from £9.0m/MHz to £14.3m/MHz – i.e. Ofcom's upper bound is still more than 50% greater than its lower bound, even after excluding outliers.

Figure 11 Post-2015 2100 MHz Tier 1 benchmarks considered by Ofcom



Source: Figure 4.4 of the Consultation

107 This highlights the uncertainty involved in using the distance method that stems from the limited availability of useful data points. There can be little statistical confidence in any point estimate derived from such a small sample. Notably, if two observations (e.g. Belgium and Hungary) are drawn from a population, *a priori* the probability of a third observation (e.g. the UK) being lower than the two previous observations is 1/3. Put another way, there is a reasonable likelihood that auction data from both Belgium and Hungary imply an LSV for 1800 MHz that is above the 'true' LSV that UK MNOs would be willing to pay at auction today.

73 'Tier 1' benchmarks are those from auctions where Ofcom considers prices were most informative. See: Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 3.43.

108 Therefore, for Ofcom to be conservative in setting ALFs, it should aim around the bottom of the overall range implied by its distance analysis for 1800 MHz and 2100 MHz spectrum – i.e. the LSV for 1800 MHz and 2100 MHz should be set at around £10.0m/MHz. This would reflect that these bands are functionally equivalent.

5.2.3 Ofcom's approach to valuing 1800 MHz spectrum dismisses relevant evidence suggesting a lower LSV

109 On top of the inherent risk of overestimating the LSV for 1800 MHz from using the distance method, we note that Ofcom's approach to valuing 1800 MHz spectrum involves several steps that are not consistent with Ofcom's aim to be conservative when setting ALFs.

110 First, when aiming within its range of LSVs for 1800 MHz spectrum, Ofcom refers to data it explicitly considers as unreliable for defining the range.[74] Specifically, Ofcom states that part of its rationale for the proposed LSV is that post-2015 German benchmarks would support a value towards the top end of that range, as would pre-2015 benchmarks. However, Ofcom also acknowledges that the German 1800 MHz spectrum sold for more than its 700 MHz, potentially due to the future value of 700 MHz as a 5G band being less clear to operators in 2015 (the time of the auction), noting this *"raises a question as to how meaningful the resulting value is"* for these benchmarks. Ofcom also explicitly states that pre-2015 auction data do not reflect 5G-era spectrum valuations (although some analysts consider 2017 as the start date for 5G era awards),[75] which implies that pre-2015 data is no longer meaningful.

111 Second, Ofcom excludes one of its own benchmarks for the 1800 MHz LSV, with its only justification being that it considers *"that a value below £12.5m per MHz would be an overly conservative interpretation of the evidence as it would mean we were setting the LSV at a level below five of the six benchmarks"*.[76] This is clearly inconsistent with taking a conservative approach to setting ALFs.[77] The excluded benchmark is Ofcom's estimate of £10.3m/MHz of 1800 MHz spectrum based on Hungarian auction prices for 700 MHz, 1800 MHz and 3600 MHz bands. All else equal,[78] including this estimate in Ofcom's determination of the LSV for

74 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 4.48(b) and 4.38, and footnote 35.

75 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraphs 3.36-3.40.

76 Ofcom (2024) Review of Annual Licence Fees Consultation; paragraph 4.39.

77 While Ofcom also dismisses another, higher benchmark on the basis that including it would be inconsistent with its conservative approach, this also does not justify dismissing the lower benchmark without further explanation.

78 Assuming Ofcom would continue to consider the mid-point between the lower bound and upper bound of the range – i.e. leaving aside our comments on Ofcom's approach to aiming.

1800 MHz would imply a revised LSV of £11.6m/MHz, 9% lower than Ofcom's proposed LSV of £12.7m/MHz.

112 In light of the above, Ofcom's approach to valuing 1800 MHz spectrum may continue to overestimate the market value of the spectrum. Therefore, Ofcom should consider re-evaluating its estimate of the LSV for 1800 MHz.