Update on Annual licence fees for 900 MHz and 1800 MHz spectrum: German 2015 auction

A RESPONSE TO OFCOM'S CONSULTATION DOCUMENT

Executive summary

In July 2015, Ofcom published an update document[1] as part of the consultation process to set Annual Licence Fees (ALF). The document considers the information available from the recent spectrum auction in Germany. Ofcom's initial view is that the bids in the German auction should be treated as highly relevant evidence (Tier 1) for the purposes of deriving 900 MHz and 1800 MHz ALFs values in the UK.

We agree with Ofcom's view that the results of the auction in Germany should be treated as Tier 1 evidence. However, we disagree with Ofcom's interpretation of the evidence with regards to the risk of market value over-/under-statement in relation to 900 MHz relative spectrum.

As discussed below, we believe that there is strong evidence that the results of the German auction are reflective of market value of spectrum in Germany. The evidence does not suggest that the results of the auction have been unduly distorted by the specifics of auction design or any form of strategic bidding. Germany is also the first auction in a jurisdiction where 900 MHz and 1800 MHz spectrum is being auctioned after the rollout of LTE networks in that jurisdiction. This potentially provides new information following a structural change in the market. Hence the evidence should be given relatively high weight when determining the forward looking value of spectrum following the roll out of LTE networks in the UK.

While we recognise that there are market specific factors that may affect the relative valuations of different spectrum bands in the German auction, there are a number of effects, some of which are potentially offsetting. In particular, the 2015 auction did not include any bands included in the 2013 UK auction (i.e. 800 MHz and 2.6 GHz). In order to produce benchmarks of relative prices between bands, Ofcom has to compare results from the 2010 German auction with the 2015 German auction, while in order to set ALFs on a forward looking basis it

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1 "Update on Annual licence fees for 900 MHz and 1800 MHz spectrum: German 2015 auction", 9 July 2015, "Ofcom's July 2015 consultation" hereinafter

proposes to apply differentials to the 2013 UK auction. Only to the extent that values of 800 MHz[2] in Germany changed between 2010 and 2013 would the use of the differentials between 800 MHz in 2010 and 900MHz and 1800 MHz in 2015 lead to a bias.[3] No evidence has been provided that there was a structural change in the value of 800 MHz between 2010 and 2013. In any event, the types of errors potentially introduced are not substantially different from errors introduced by using data from other jurisdictions where spectrum in the relevant bands was auctioned simultaneously.

As such, there is no evidence that the results would lead to a bias in the estimate of the true market value of 900 MHz spectrum and 1800 MHz spectrum in the UK.

On balance, we therefore consider ratios based on the 2010 and 2015 auctions in Germany as Tier 1 evidence for both 900 MHz and 1800 MHz spectrum.

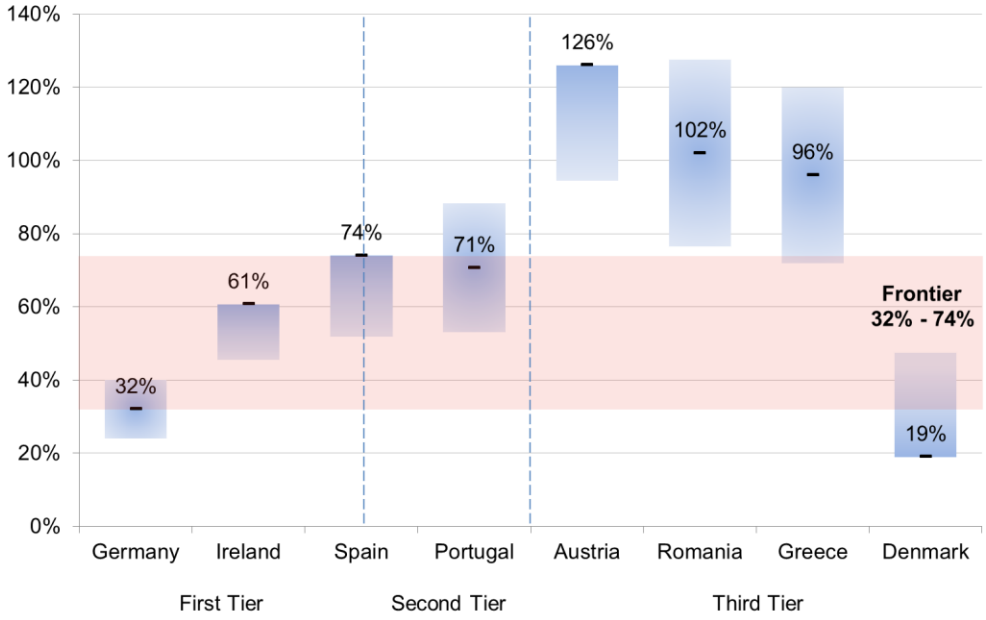
900 MHz results

Our updated results for 900 MHz benchmarks show that the appropriate range for the relative value of 900 MHz spectrum in the UK is between Germany (32%) and Spain (74%) see **Figure 1** below.

2 Under Ofcom's 'distance' methodology, values relative to the 2.6 GHz band are also used.

3 Any changes in relative valuations in bands after the UK auction are relevant evidence and should be taken into account when setting forward looking ALFs

Figure 1. The appropriate estimate of 900 MHz relative value



Source: Frontier Economics

Note: all 900/800 MHz ratios applicable to UK 800 MHz value net of co-existence costs and without coverage obligation

Consistent with our previous submissions, we believe that the true market value of 900 MHz spectrum is likely to lie toward the lower end of this range, between Tier 1 benchmarking evidence from Germany (32%) and Ireland (61%), as Spain is considered to be borderline Tier 1/Tier 2 evidence in our analysis. This suggests that Ofcom's previously proposed 77%[4] ratio could lead to the overestimation of the true market value of 900 MHz spectrum.

We therefore support Ofcom's preliminary view that there could be a case for a "*material downward adjustment*" of the proposed 900 ALF value, based on the new evidence available.[5] This would be in line with Ofcom's previous position that ALF estimates should be derived conservatively taking into account the asymmetric risk of setting ALFs above true market value.[6] In the previous

4 In order to derive a consistent comparator with our recommended ratio of 61%, Ofcom's proposed 900 MHz value of £23m per MHz has been divided by Ofcom's estimate of UK 800 MHz value net of co-existence costs and without coverage obligation, i.e. £30m.

5 Ofcom's July 2015 consultation, para. 69

6 Ofcom's August 2014 consultation, para. 1.34

consultation[7] Ofcom estimates its proposed 900 MHz market value to be the mid-point between the lowest Tier 1 value and the average of the Tier 1 values. If we were to apply Ofcom's methodology using the updated range of 900 MHz values, the point estimate for the relative value of 900 MHz would be 44%.[8] This value would be within the range of sensitivities, as presented below. Again, this value would be significantly below Ofcom's current proposal of 77% and would therefore support the downward adjustment of the proposed 900 ALF value.

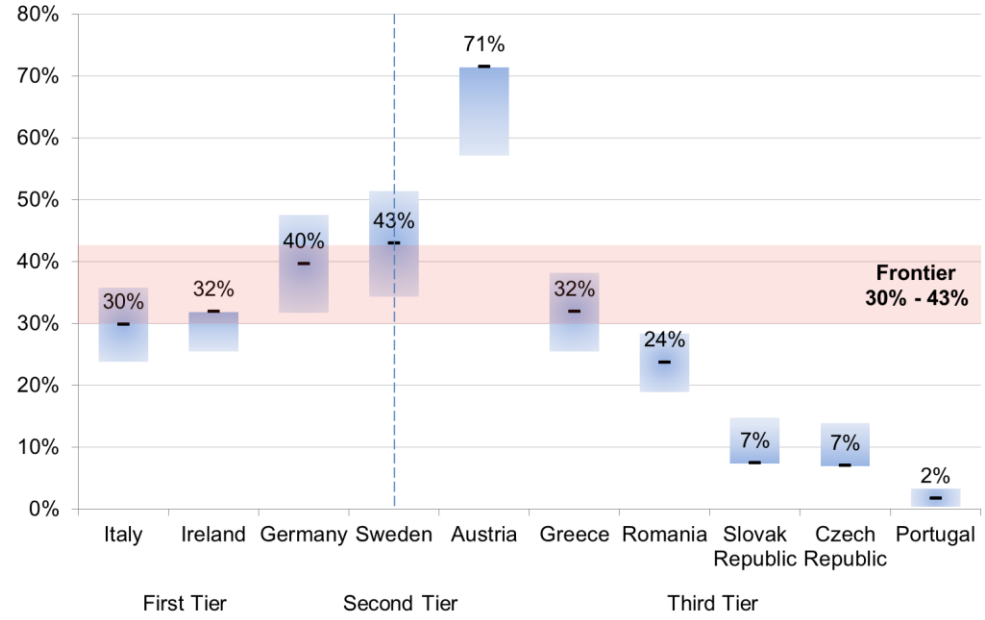
1800 MHz spectrum

Our updated results for 1800 MHz benchmarks show that the appropriate range for the relative value of 1800 MHz spectrum in the UK still lies between Italy (30%) and Sweden (43%), with Germany (40%) falling within this range - see **Figure 2** below.

7 Ofcom's February 2015 consultation, para. 3.56 to 3.59

8 Treating Spain as Tier 1 evidence, thus being conservative.

Figure 2. The appropriate estimate of 1800 MHz relative value



Source: Frontier Economics

Note: all distance ratios based on UK 800 MHz value net of co-existence costs and without coverage obligation

Ofcom's current proposal of a distance ratio of 31%[9] is towards the lower end of this range. Given the need to set ALFs conservatively, Ofcom's current proposal appears reasonable. Therefore, our analysis supports Ofcom's view that it is not necessary to make an adjustment to its previous 1800 ALF estimate.

This appears to be in line with the sensitivities presented below, as well as with Ofcom's methodology for deriving a conservative point estimate. Ofcom estimates of the relative value of 1800 MHz spectrum to be between the midpoint of the lowest Tier 1 value and the average of the Tier 1 values.[10] If we were to apply this methodology to the updated range of 1800 MHz Tier 1 values, the point estimate for the relative value of 1800 MHz would be around 33% (including Sweden as Tier 1 evidence). This implies that Ofcom's current proposal of 31% is highly conservative, which is in contrast with the 900MHz proposal.

9 In order to derive a consistent comparator with our the distance ratios we present, we have adjusted Ofcom's estimate to use the UK value of 800 MHz value net of co-existence costs and without coverage obligation, i.e. £30m.

10 Ofcom's February 2015 consultation, para. 3.68 to 3.72

Assessing the German auction as benchmarking evidence

Below, we evaluate the available evidence from the German 2015 auction and take a view on the relevance of 900 and 1800 benchmarks for the purposes of deriving ALFs in the UK.

We briefly describe the key features and outcomes of the German auction. We then consider whether these outcomes are reflective of true market value in Germany, focusing in particular on the two factors that Ofcom identified as potentially distorting auction outcomes. We argue that there is no convincing evidence that auction outcomes may have been distorted by the auction design or country specific factors. We then focus on how reflective the relative prices from the German auction are of the true market value of spectrum in the UK. On balance, we conclude that relative prices from Germany are a good proxy for deriving UK market values.

Auction outcomes

From May to June 2015 the German regulator Bundesnetzagentur (BNetzA) held a multi-band spectrum auction for frequencies in the 700, 900, 1500 and 1800 MHz bands. All three operators (Telefonica, Vodafone and Deutsche Telekom) participated in the auction.[11]

The chosen mechanism was a simultaneous multi-round ascending auction (SMRA) in which bidders could make bids for individual 5 MHz lots in each round. The minimum bid in the next round was set 5% above the current highest bid, rounded down to the nearest 1000 Euro. At the end of each round, the highest bid (and bidder) was announced for each lot. In the case of ties, the quickest bidder was awarded the highest bid. We summarise the auction design in **Table 1**, and show an overview of the auction results in **Table 2**.

11 We understand that there were more interested parties who did not fulfil the minimum requirements for participation set by the regulator.

Table 1. Summary of German auction design

Band	MHz	Reserve price per lot	Spectrum cap	Coverage obligation
700	2 x 30	€75m	-	98% of households, 50 Mbit/s after 3 years
900	2 x 35	€75m	2 x 15	-
1500	1 x 40	€17.75m	-	-
1800	2 x 50	€37.5m	-	-

Source: Frontier Economics based on BNetzA

Note: All spectrum licenses have durations of 18 years. However, the 700 MHz band is currently used by digital television and will gradually be freed up starting in 2017 on a regional basis. It is expected to be available for mobile telecommunication services by 2019.

Table 2. Summary of German auction results

Band	DT	Vodafone	Telefonica	Average clearing price per lot
700	2 x 10	2 x 10	2 x 10	€167m
900	2 x 15	2 x 10	2 x 10	€192m
1500	1 x 20	1 x 20	0	€41m
1800	2 x 15	2 x 25	2 x 10	€241m

Source: Frontier Economics based on BNetzA

Do auction outcomes reflect true market value?

There appears to be strong evidence that auction outcomes are reflective of true market value in Germany:

- spectrum caps allowed for excess demand in both 900 and 1800 bands;
- there was competitive bidding across different bands; and
- the auction cleared significantly above reserve price in all bands.

There is no convincing evidence that auction outcomes may have been distorted by the auction design or country specific factors.

In particular, in relation to 900 MHz spectrum[12], Ofcom is concerned that:

- the 900 MHz cap and the need for GSM provision may have led to the underestimation of the 'true' forward looking market value of 900 MHz spectrum; and
- a degree of strategic demand reduction may have occurred in the 900 MHz band, with final results underestimating the true market value of 900 MHz spectrum.

Ofcom's initial view is that the 900 MHz German benchmark is at risk of understating the true market value of 900 MHz spectrum, although it cannot be sure of the likelihood or scale of this risk.

Our view is that the evidence available suggests that the risk of understating the 900 MHz value is negligible and should not affect Ofcom's treatment of the 900 MHz benchmark, as discussed in more detail below.

No evidence of the impact of the 900 MHz cap leading to lower valuations of 900 MHz spectrum

Ofcom's view appears to be that the appropriate market value of 900 MHz spectrum for the purposes of setting the ALF is driven by the forward looking usage of this band (LTE). Ofcom hypothesises that MNOs in the German auction were not able to fully express their intrinsic valuation of larger blocks of 900 MHz spectrum (e.g. 2x10 MHz) due to a combination of the continuing need to serve their legacy GSM 900 networks and the spectrum caps. For instance, if an MNO required 2x10 MHz to serve its GSM traffic in the medium term, it would not be able to bid for additional 2x10 MHz that would be used for LTE 900, due to spectrum caps of 2x15 MHz.

This hypothesis does not appear to be supported by the evidence.

Firstly, the current market value of 900 MHz in Germany is likely to be driven by the legacy use (GSM) more than the potential future use (LTE), i.e. continued GSM use with later re-farming to LTE is likely to have a higher value than use for LTE alone. Therefore, marginal values related to short or medium term 2G usage are likely to have been much more significant for auction bidders and to have set the auction prices for 900 MHz spectrum.[13] In particular:

- the German regulator expects the provision of legacy 2G services to continue until 2025, which increases demand for GSM 900;

12 Ofcom has not identified a reason for the auction price of 1800 MHz spectrum to be an understatement of the market value of 1800 MHz spectrum in Germany (para 59)

13 See Vodafone's response to the July 2015 consultation for more detail.

- the LTE 900 ecosystem is still in the early stages of development and its prospects in the EU are unclear; and
- there are substantial LTE holdings in other bands which can be used to deliver coverage and capacity until the 900 MHz spectrum is re-farmed to LTE.

These factors are not significantly different in the UK and as such would not in themselves be expected to introduce any bias when using the results of the German auction for assessing 900 MHz spectrum in the UK.

Secondly, even if we assume that the marginal value of 900 MHz spectrum was set on the basis of future LTE 900 usage, there is no evidence that spectrum caps prevented bidders from adequately expressing their demands for 900 MHz spectrum.[14]

- Vodafone expects that, in the medium to long term, all bidders would be able to reduce the amount of spectrum used to provide GSM services on 900 MHz to at most 2x5 MHz of spectrum;
- this would therefore allow all bidders to fully express their long term valuations for 2x10 MHz of LTE 900; and
- all bidders bid for three blocks of 900 MHz spectrum at various stages of the auction, implying that this demand was indeed expressed in the auction.

As such, there is little evidence that the combination of the spectrum caps applied and a continued need to maintain GSM networks artificially depressed the value of 900 MHz spectrum.[15]

No evidence of strategic demand reduction leading to lower valuations of 900 MHz spectrum

Ofcom hypothesises that the open SMRA format of the auction in combination with 900 MHz spectrum caps may have led to strategic demand reduction or collusive outcomes in the 900 MHz band.[16]

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14 See Vodafone's response to the July 2015 consultation for more detail.

15 While spectrum caps applied in any auction can theoretically depress demand, spectrum caps have been applied generally in the auctions used as benchmarks by Ofcom. The critical question is whether the caps used are so tight that operators are not able to fully express demand for marginal spectrum, Conversely, if spectrum caps are too weak, this may artificially inflate the value of spectrum, as arguably occurred in Austria.

16 Ofcom's July 2015 consultation, para. 35 to 42

However, we understand that this hypothesis does not appear to be consistent with the evidence available:[17]

- the lot structure (seven lots available) and the 900 distribution pre-auction (2x12.4 MHz, 2x12.4 MHz and 2x10 MHz) made it difficult to tacitly coordinate on a clear 'focal outcome' (e.g. 3-3-1 or 3-2-2);
- there was a strong pattern of competitive bidding throughout the auction, particularly considering 900 MHz and 1800 MHz bids together; and
- the spectrum in both bands cleared significantly above reserve price as shown in **Table 2**.

The fact that 1800 sold relatively higher above its reserve price than 900 is readily explained by a higher than expected[18] intrinsic demand for 1800 MHz spectrum, rather than the lack of competition for 900 MHz spectrum, as Ofcom appears to be suggesting.

Therefore, we conclude that there is no evidence of strategic demand reduction leading to lower valuations of 900 MHz spectrum in the German auction.

Are these outcomes reflective of market value in the UK?

Below, we consider how reflective the relative prices from the German auction are of the market value in the UK.

First, we consider that the timing of the auction, with Germany being the first auction in which 900 MHz and 1800 MHz spectrum is being auctioned in a jurisdiction where LTE networks have been rolled out. We believe this makes the relative prices from Germany informative of forward looking value of spectrum in the UK.

Second, we consider the potential impact of changes in the market value of 800 MHz spectrum since the 2010 auction in Germany on the calculated differentials. While we recognise that there may be a risk that the 900 and 1800 relative ratios may be affected by this effect, we believe that direction of this risk is unclear and the magnitude of the effect is unlikely to be sufficient to invalidate the use of the ratios as Tier 1 evidence.

17 See Annex 1 to Vodafone's response to the July 2015 consultation for more detail.

18 Such that the relative reserve prices between bands did not reflect the final market prices as revealed in the auction.

The timing of the German auction makes it the most relevant observation in Ofcom's benchmarking sample

We believe that Germany should be treated with special attention when it comes to deriving forward looking UK market values of 900 and 1800 MHz spectrum. This is primarily because Germany 2015 is the first jurisdiction where 900 and 1800 MHz spectrum has been auctioned after an initial 4G/LTE rollout.

As explained in more detail in Vodafone's response to the July 2015 consultation, spectrum value is changing over time, reflecting new information on supply side factors (e.g. type of spectrum available and the availability and performance of technology) and demand (e.g. volume and type of usage applications). The results of the German auction are consistent with the following trends in the valuation of spectrum:

- a decrease in the average value of spectrum, since the 4G auction in 2010 (i.e. the value of 900 and 1800 spectrum significantly below the 800 MHz value, which may reflect an increase in the total amount of spectrum available in the short term in the market);
- a potential increase in the relative value of high frequency spectrum, reflecting rapidly increasing data usage and the need for MNOs to increase their network capacity in congested areas for which higher frequencies are more suitable; and
- similarly, a potential shift in value towards 'LTE ready' spectrum (e.g. 1800), compared to spectrum for which the LTE ecosystem is only being developed or is still in early stages (e.g. 700, 900 or 1500).

The UK is a market where there is increased certainty on the availability of future spectrum since the 2013 auction, in particular the future availability of additional low frequency (700 MHz) spectrum. In addition, all operators have deployed LTE networks and there is a rapidly increasing demand for data services. As such these factors are likely to influence the forward looking value of ALF spectrum.

Therefore, the results of the German auction should be given correspondingly high weight when deriving the market value of ALF spectrum on a forward looking basis.

Potential changes in the market value of 800 MHz spectrum may have affected the relative ratios, but the impact on ALFs in unclear

When deriving the 900/800 ratio, Ofcom recognizes that the 800 MHz band was auctioned five years earlier than the 900 MHz band and that there is a risk that the value of this band has changed since 2010, although it is not clear in which

direction. Therefore, Ofcom considers that this creates a risk of understatement or overstatement of the 900 MHz benchmark, although it cannot be sure of the likelihood or scale of this risk.[19]

However, it is important to consider the use that the differential will be put to. The differential will be used to convert a 2013 market value for 800 MHz, as determined from the UK auction, to derive a forward looking value of ALF for 900 MHz and 1800 MHz from 2015 onwards. Ideally the basis for calculating this ratio would be the benchmarks from other jurisdictions of the market value of 800 MHz in 2013 and 900 and 1800 MHz at the latest available date. However, in no case do we have information on market values with this exact timing:

- for most auctions we have simultaneous data from the same auction on 800 and 900/1800 MHz market valuations, in the period 2010-2014; and
- for Germany, we have an 800 MHz valuation for 2010 and recent (2015) 900/1800 MHz data.

For Germany, the issue is whether the value of the 800 MHz spectrum changed between the 2010 German auction and the 2013 UK auction. For the other jurisdictions, the issue is whether there was:

- a change in the value of 800 MHz spectrum between the relevant auction and the 2013 UK auction; and/or
- a change in the value of 900 MHz/1800 MHz spectrum between the relevant auction and currently (i.e. 2015).

As such, all of the evidence suffers to some extent from 'timing' errors. Given the length of time between the 2010 German auction and the 2013 UK auction (which will influence the magnitude of the timing error from Germany) is similar to the length of time between the UK auction and the present day (which will influence the magnitude of the timing error for other benchmark jurisdictions), there is no reason to reduce the weight given to Germany for this reason alone.

We also agree with Ofcom's view that the direction of the potential change in 800 MHz value between 2010 and 2013 is unclear and it is not clear whether relative ratios derived using 800 MHz value from 2010 are under- or overestimating the appropriate ratios for the UK.

19 Ofcom's July 2015 consultation, para. 52

Conclusion

On balance, we believe relative values from the German auction are a good proxy for UK market values of 900 and 1800 MHz spectrum. As with other evidence, we recognise that there are potential risks of the relative ratio over- or under-estimating forward looking market values in the UK, but the direction or scale of this potential bias is unclear.

Updating the international benchmarking results

Below, we present our updated benchmarking results for both 900 MHz and 1800 MHz spectrum, together with different sensitivity analyses.

900 MHz

Tiering of evidence

As explained above, we consider Germany to be clear Tier 1 evidence, together with Ireland. This is consistent with Ofcom's own views. As explained in our previous submission[20] we do not consider Austria to be fulfilling the relevant criteria for being treated as Tier 1 evidence, contrary to Ofcom's views. In particular, as explained before:

- The LRP decomposition of the package prices from the CCA auction in Austria does not provide market clearing prices for individual blocks of spectrum[21] and there is a lack of transparency in the application of the LRP methodology;
- There is a significant risk that the auction results have been distorted by strategic bidding. In fact, there is evidence that strategic valuations paid a key role in the Austrian auction; and
- A combination of strategic bidding and high private values for existing spectrum could therefore have led to the price of 900 and 1800 MHz

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20 Ofcom's updated international benchmarking analysis Frontier Economics, September 2014. Available at http://stakeholders.ofcom.org.uk/binaries/consultations/annual-licence-fees-900-MHz-1800-MHz/responses/Vodafone_Annex_2.pdf

21 Frontier's analysis of the UK auction (Annexe 2 to Vodafone's response to Ofcom's original consultation on Annual Licence Fees for 900 MHz and 1800 MHz spectrum dated January 2014), hereinafter 'UK auction analysis', shows that the LRP method does not give band specific market clearing prices.

spectrum being bid up above a market clearing level, thus further distorting relative valuations and any sensible comparison with the UK:

- prices paid in the auction may be influenced by the potential value of foreclosing or weakening an existing operator, and the value of a third operator trying to maintain its existence (and relative competitiveness); and
- spectrum suitable for delivery of mobile data services, and in particular 900 and 2100 MHz spectrum used for delivery of 3G services, is likely to be more valuable in Austria than in the UK.

This is in strong contrast to Germany 2015, where the evidence for treating it as a Tier 1 observation is much stronger. As explained above:

- prices in the auction were set by a competitive and transparent SMRA process, cleared well above reserve price and are observable; and
- the spectrum caps prevented strategic investment and so relative prices are likely to be reflective of operators' intrinsic valuations for spectrum and the risk of prices in Germany being distorted by strategic bidding is low.

This is summarised in **Table 3** below.

Table 3. Comparing quality of evidence from Germany and Austria

	Austria	Germany 2015
Observable prices set by a competitive process	NO	YES
Prices reflective of intrinsic value / not distorted by strategic bidding	NO	YES

Source: Frontier Economics

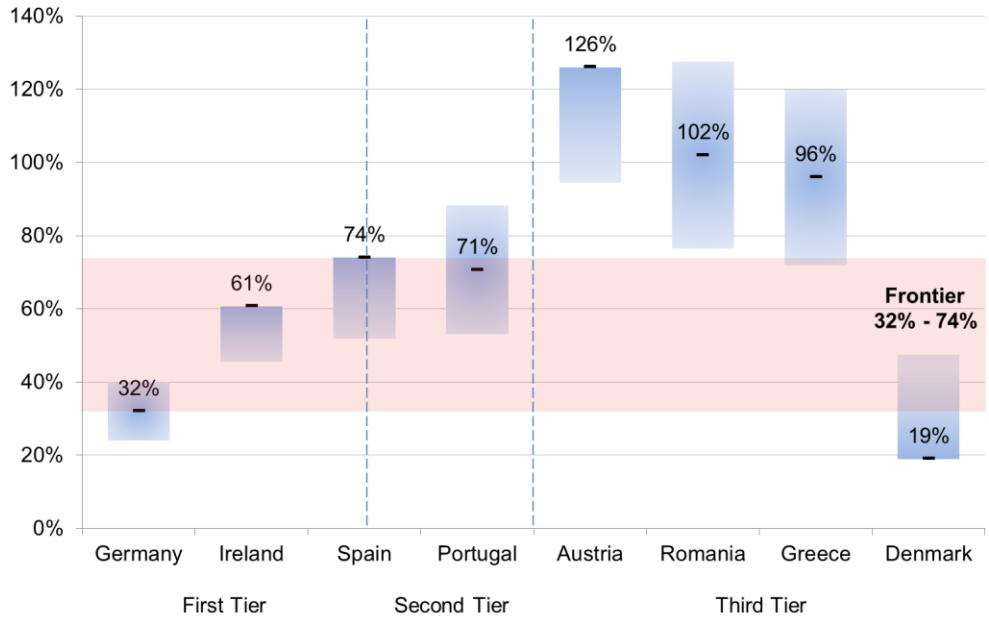
In addition, we continue to consider Spain as a borderline case between Tier 1 and Tier 2 benchmarks when deriving the appropriate range of relative 900 MHz values. For our main estimate, we treat Spain as a Tier 1 benchmark. As part of our sensitivity analyses, we also show the impact of treating Spain as Tier 2 evidence, in line with Ofcom's classification.

Our main results and sensitivities are presented below.

Main results

Our updated results for 900 MHz benchmarks show that the appropriate range for the relative value of 900 MHz spectrum in the UK is between Germany (32%) and Spain (74%) see **Figure 3** below.

Figure 3. The appropriate estimate of 900 MHz relative value



Source: Frontier Economics

Note: all 900/800 MHz ratios applicable to UK 800 MHz value net of co-existence costs and without coverage obligation

Consistent with our previous submissions, we believe that the true market value of 900 MHz spectrum is likely to lie toward the lower end of this range, between Tier 1 benchmarking evidence from Germany (32%) and Ireland (61%)[22], as Spain is considered to be a borderline Tier 1/Tier 2 evidence in our analysis. This suggests that Ofcom's previously proposed 77%[23] ratio could lead to the overestimation of the true market value of 900 MHz spectrum. We therefore

22 As discussed in more detail below, even if we assume that 900/800 ratio based on a combination of the 2010 and 2015 auctions may be underestimating appropriate differential and we adjust for the potential decline in the value of 800 MHz spectrum, the resulting ratio is still significantly below Ofcom's current proposal of 77%.

23 In order to derive a consistent comparator with our recommended ratio of 61%, Ofcom's proposed 900 MHz value of £23m per MHz has been divided by Ofcom's estimate of UK 800 MHz value net of co-existence costs and without coverage obligation, i.e. £30m.

support Ofcom's preliminary view that there could be a case for a "*material downward adjustment*" of the proposed 900 ALF value, based on the new evidence available.[24]

This would be in line with Ofcom's previous position that ALF estimates should be derived conservatively taking into account the asymmetric risk of setting ALFs above true market value.[25] In the previous consultation[26] Ofcom estimates its proposed 900 MHz market value to be the mid-point between the lowest Tier 1 value and the average of the Tier 1 values. If we were to apply Ofcom's methodology using the updated range of 900 MHz values, the point estimate for the relative value of 900 MHz would be 44% (including Spain as Tier 1 evidence). This value would be within the range of sensitivities, as presented below. Again, this value would be significantly below Ofcom's current proposal of 77% and would therefore support the downward adjustment of the proposed 900 ALF value.

Sensitivities

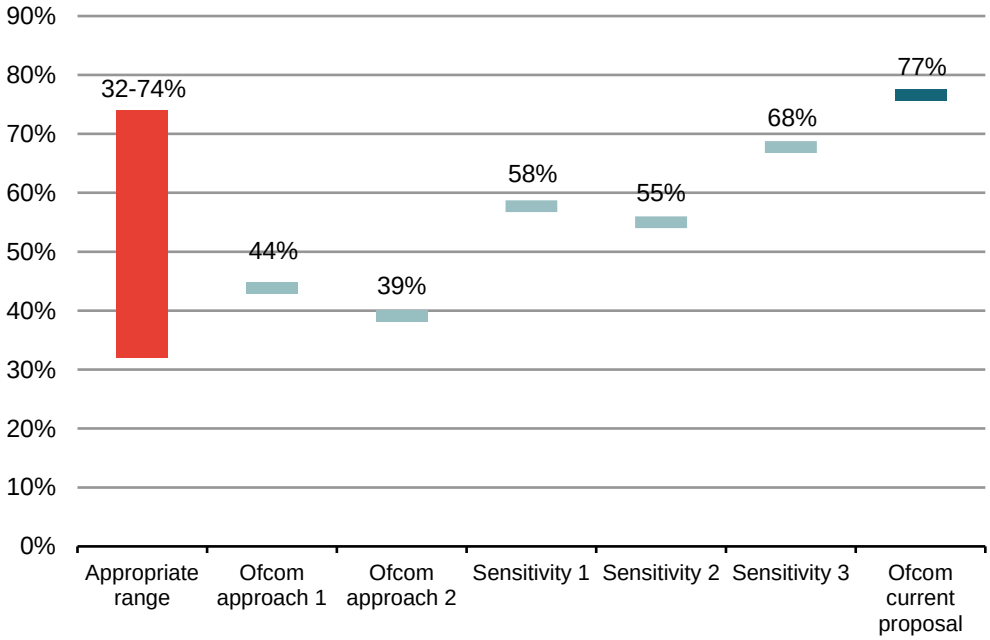
In line with our previous submission, we have undertaken multiple sensitivities to test the robustness of our findings in relation to the proposed 900/800 ratio, see **Figure 4** below.

24 Ofcom's July 2015 consultation, para. 69

25 Ofcom's August 2014 consultation, para. 1.34

26 Ofcom's February 2015 consultation, para. 3.56 to 3.59

Figure 4. Sensitivity analysis of 900 MHz relative values



Source: Frontier Economics

We calculate several reference points based on the available benchmarking data and compare this with Ofcom's current estimate of the 900/800 ratio. In particular, we consider the following reference points:

- **Appropriate range** – the range of values based on Tier 1 evidence;
- **Ofcom approach 1** – calculating mid-point between the average and the lowest Tier 1 evidence: (treating Spain as Tier 1);
- **Ofcom approach 2** – calculating mid-point between the average and the low Tier 1 evidence (treating Spain as Tier 2)
- **Sensitivity 1-3** – calculating a weighted average across the benchmarking sample, with different weights as per **Table 4** below, as per the approach used in our previous submission[27].

27 "Ofcom's updated international benchmarking analysis: a report prepared for Vodafone". August 2014

Table 4. Sensitivity of 900 MHz range to weighting of benchmarking evidence

Country	900/800 MHz ratio	Weights for sensitivity 1	Weights for sensitivity 2	Weights for sensitivity 3
Ireland	61%	100%	100%	100%
Austria	127%	0%	0%	50%
Portugal	71%	50%	50%	75%
Spain	74%	100%	50%	75%
Denmark	19%	0%	0%	50%
Greece	96%	0%	0%	50%
Germany	32%	100%	100%	100%
Romania	102%	0%	0%	50%
Weighted average 900/800 MHz ratio		58%	55%	68%

Source: Frontier Economics

Note: In Sensitivity 1, we classify Spain as a Tier 1 benchmark. Then, we derive two ranges for the 900 MHz spectrum value which take into account, respectively:

- Tier 1 and 2 benchmarks in Sensitivity 2; and
- Tier 1, and 3 benchmarks in Sensitivity 3.

In Sensitivities 2 and 3 we use Ofcom's classification of Spain as a Tier 2 benchmark.

We believe that these sensitivities should be treated as complementary evidence to inform Ofcom whether its proposed ALF ratios can be treated as reasonable and conservative. As shown in **Figure 4** above, Ofcom's current proposal of 77% is above all sensitivity estimates and there is a significant risk that it could lead to overestimating the true market value of 900 MHz spectrum. This is in contrast with Ofcom's proposal for 1800 MHz distance ratio of 31%, which is towards the lower end of the appropriate range of values and below the main sensitivity estimates (see **Figure 6**), where Ofcom appears to have followed a more conservative approach when setting ALF values.

1800 MHz

Tiering of evidence

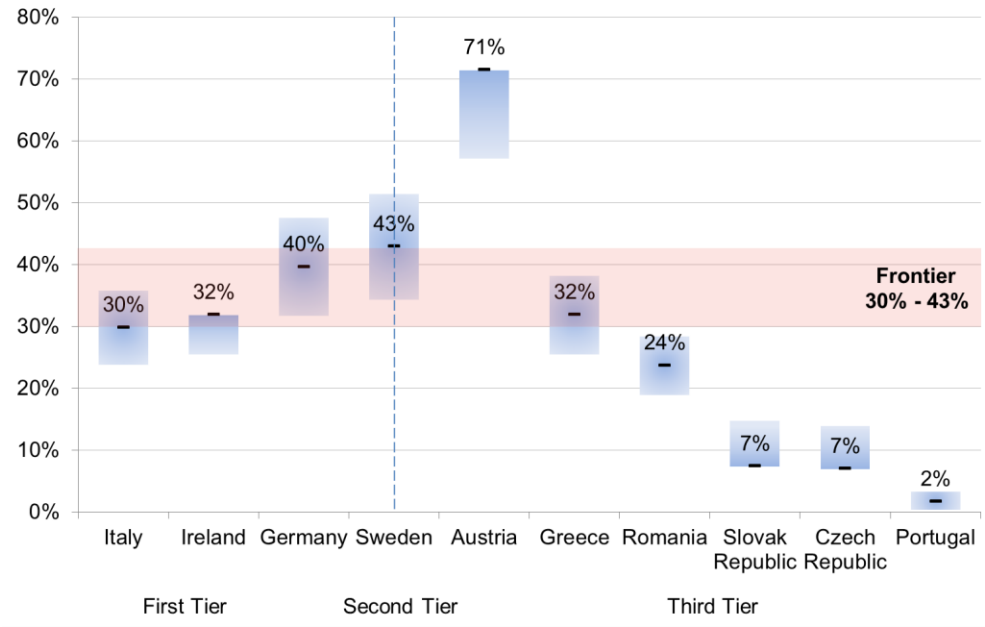
As explained above, we consider Germany to be clear Tier 1 evidence, together with Ireland and Italy. This is consistent with Ofcom's own views. As explained in our previous submission, auction outcomes from Sweden could be considered as Tier 1 evidence, but we recognise Ofcom's concerns and we consider Sweden as a borderline case between Tier 1 and Tier 2 benchmarks, for the purposes of this analysis.[28] For the reasons outlined above and in our previous submission, we consider Austria to be Tier 3 evidence and only consider it in our sensitivity analysis. We also accept Ofcom's categorisation of Greece, Romania, Slovak Republic and the Czech Republic as Tier 3 benchmarks.

Main results

Our updated results for 1800 MHz benchmarks show that the appropriate range for the relative value of 1800 MHz spectrum in the UK still lies between Italy (30%) and Sweden (43%), with Germany (40%) falling within this range - see **Figure 2** below.

28 In order to derive the appropriate range for relative 1800 MHz values, we treat it as Tier 1 evidence. As part of our sensitivity analyses, we show the impact of treating it as Tier 2 evidence, in line with Ofcom's classification.

Figure 5. The appropriate estimate of 1800 MHz relative value



Source: Frontier Economics

Note: all distance ratios based on UK 800 MHz value net of co-existence costs and without coverage obligation

Ofcom's current proposal of a distance ratio of 31%[29] is towards the lower end of this range.

This appears to be in line with the sensitivities presented below, as well as with Ofcom's methodology for deriving a conservative point estimate. Ofcom estimates of the relative value of 1800 MHz spectrum to be between the midpoint of the lowest Tier 1 value and the average of the Tier 1 values.[30] If we were to apply this methodology to the updated range of 1800 MHz Tier 1 values, the point estimate for the relative value of 1800 MHz would be around 33% (including Sweden as Tier 1 evidence). This is broadly in line with Ofcom's current proposal of 31%.

29 In order to derive a consistent comparator with our the distance ratios we present, we have adjusted Ofcom's estimate to use the UK value of 800 MHz value net of co-existence costs and without coverage obligation, i.e. £30m.

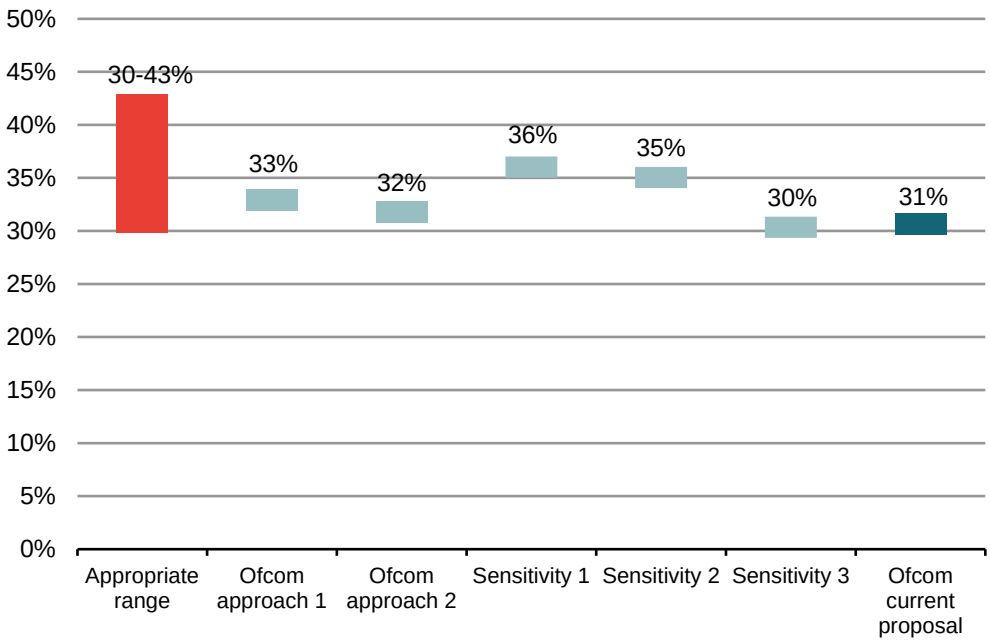
30 Ofcom's February 2015 consultation, para. 3.68 to 3.72

Given the need to set ALFs conservatively, Ofcom's current proposal appears reasonable. Therefore, our analysis supports Ofcom's view that it is not necessary to make an adjustment to its previous 1800 ALF estimate.[31]

Sensitivities

In line with our previous submission, we have undertaken multiple sensitivities to test the robustness of our findings in relation to the proposed 1800 MHz distance ratio, see **Figure 6** below.

Figure 6. Sensitivity analysis of 1800 MHz relative values



Source: Frontier Economics

As with 900 MHz, we calculate several reference points based on the available benchmarking data and compare this with Ofcom's current estimate of the 1800 MHz distance ratio. In particular, we consider the following reference points:

- **Appropriate range** – the range of values based on Tier 1 evidence;
- **Ofcom approach 1** – calculating mid-point between the average and the lowest Tier 1 evidence: (treating Sweden as Tier 1);
- **Ofcom approach 2** – calculating mid-point between the average and the low Tier 1 evidence (treating Sweden as Tier 2)

- **Sensitivity 1-3** – calculating a weighted average across the benchmarking sample, with different weights as per **Table 5** below, and in line with the approach used in our previous submission[32].

Table 5. Sensitivity of 1800 MHz range to weighting of benchmarking evidence

Country	Distance ratio	Weights for sensitivity 1	Weights for sensitivity 2	Weights for sensitivity 3
Austria	71%	0%	0%	50%
Czech Republic	7%	0%	0%	50%
Greece	32%	0%	0%	50%
Germany	40%	100%	100%	100%
Ireland	32%	100%	100%	100%
Italy	30%	100%	100%	100%
Portugal	2%	0%	0%	50%
Romania	24%	0%	0%	50%
Slovak Republic	7%	0%	0%	50%
Sweden	43%	100%	50%	75%
Weighted average 1800 MHz distance ratio		36%	35%	30%

Source: Frontier Economics

Note: we derive two ranges for the 1800 MHz spectrum value which take into account, respectively:

- Tier 1 and Tier 2 benchmarks in Sensitivity 1; and
- Tier 1, 2 and 3 benchmarks in Sensitivity 2.

In Sensitivities 2 and 3 we use Ofcom's classification of Sweden as a Tier 2 benchmark

As described above for 900 MHz spectrum, we believe that these sensitivities should be treated as complementary evidence to inform Ofcom whether its proposed ALF ratios can be treated as reasonable and conservative. As shown in

32 "Ofcom's updated international benchmarking analysis: a report prepared for Vodafone". August 2014

Figure 6 above, Ofcom's current proposal of 31% appears to be reasonable, as it is towards the lower end of the appropriate range of values and below the main sensitivity estimates.