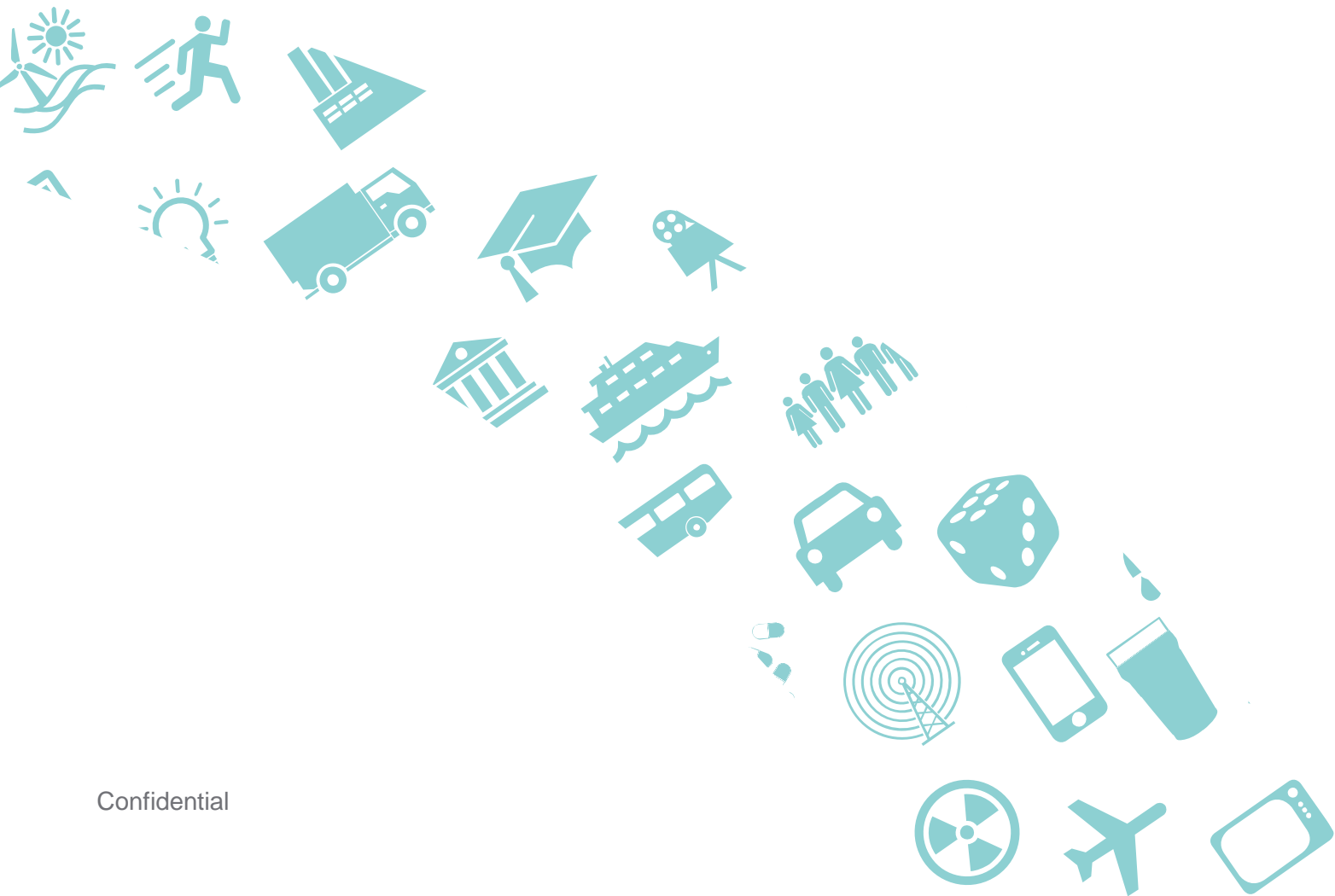


MOBILE PRICING IN THE UK

A report prepared for Three

January 2017



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EXECUTIVE SUMMARY

Context

Ofcom is currently consulting on rules, including the use of spectrum caps, for the forthcoming auction of spectrum in the 2.3GHz and 3.4GHz bands. Existing spectrum holdings in the UK are highly asymmetric, with BT/EE holding significantly more spectrum – 45% of the total - than the other operators, and Three holding significantly less. This asymmetry is even more acute if existing spectrum holdings are compared to existing data volumes (which is one measure of an operator's capacity to accommodate further traffic growth), ✂¹.

Ofcom recognises that operators' spectrum holdings may impact the marginal costs they will face in accommodating further traffic growth. This will, in turn, influence how aggressively they can compete for new customers or cut prices for existing customers². Changes in the capacity of some operators to compete are likely to be reflected in the prices that are observed in the market. Ofcom has analysed price trends in recent years, both in aggregate and as between different operators, and has found:

- using the approach it employed prior to 2016, which assessed the **minimum prices for mobile contracts including handsets** across a range of baskets, aggregate prices **increased by 12%** between 2014 and 2015,
- that using the approach it adopted in the latest International Communications Market Report to consider only **SIM-only prices**, that these prices **fell by 38%** between 2015 and 2016,
- ✂
- ✂

Three has asked Frontier Economics to assess how mobile prices have been changing in the UK over recent years. This report presents our analysis and conclusions.

We have used individual tariff level pricing data to replicate Ofcom's basket approach, but have expanded the analysis by:

- considering **both tariffs for contracts with handsets and SIM-only tariffs**; this is important as, despite the increasing share of post-pay subscriptions accounted for by SIM-only tariffs, a significant majority of post-pay subscribers still purchase contracts with handsets,
- considering the basket analysis based on **average of prices and price changes throughout the year**, rather than relying on one particular week in the year,
- using econometric analysis **to consider every price offered by operators** (over 160,000 over the past 3 years) rather than just the lowest price for a particular basket at a particular point in time, which underlies Ofcom's basket approach. We have used econometrics to assess changes in both overall

¹ Ofcom (November 2016) PSSR spectrum release consultation Figure 3.4(b)

² Ofcom (November 2016) PSSR spectrum release consultation paragraph 4.27.

prices and in Three's relative price position in relation to contracts with handsets, and

- **removing handset cost changes from the analysis**, to ensure that the results in relation to price changes in tariffs with handsets are not influenced by changes in handset prices (which should not be expected to be affected by spectrum holdings). We have done this in both our basket and econometric analysis.

Findings

Our main findings are:

- **overall prices for post-pay services covering both contracts with handsets and SIM-only increased by 7.8-9.4%** between 2014 and 2016.³
- **an increase of 13% (when using the basket approach) and 15% (when using the econometrics approach) in prices for contracts with handsets** between 2014 and 2016, excluding the impact of changes in handset prices.
- **a decrease in SIM-only prices of 16%** between 2014 and 2016.⁴



Our results reveal that, overall, post-pay prices have continued to rise in both 2015 and 2016, despite the reductions in SIM-only tariffs in 2016, found in both Ofcom's and our analysis. ✂

³ Calculated using the weighted average price increase for SIM-only and contracts with handsets.

⁴ Our analysis suggests a smaller price decrease for SIM-only tariffs, when considering average rather than minimum tariffs - hence the reported result is likely to be the maximum price decrease that a SIM-only mobile subscriber would face. For reasons explained in section 3.2.2 of the report we have not included basket 8 in our analysis. Doing the same for the Ofcom analysis would also reduce their estimate of -38% to -12%.

1 INTRODUCTION

Ofcom is currently consulting on the appropriate format for an auction of PSSR⁵ spectrum (2.3GHz and 3.4GHz). One of the key questions that Ofcom is consulting on relates to the potential use of spectrum caps in this auction.

Existing spectrum holdings in the UK are highly asymmetric, with BT/EE holding significantly more spectrum – 45% of the total – than the other operators, and O2 and Three holding significantly less. This asymmetry is even more acute if existing spectrum holdings are compared to existing data volumes (which is one measure of an operator’s capacity to accommodate further traffic growth), \propto . In the light of this, Three has asked Frontier Economics to assess how mobile prices have been changing in the UK over recent years.

1.1 Three’s share of spectrum and data usage

Ofcom has stated that rising data usage means that operators will need to add capacity to their networks in a variety of ways:

“Although projections of future growth are uncertain, there is a broad consensus that mobile data consumption will increase by 1-2 orders of magnitude over the next decade. There are three main ways in which mobile operators can meet this increased demand; they can increase the amount of spectrum which they use to provide mobile services; they can increase the efficiency with which they use existing spectrum; or they can increase the number of sites from which they provide mobile services. Our view is that they will need to do all three in order to meet increasing demand.”⁶

Ofcom has provided evidence that the ratio between the share of data usage and the share of spectrum varies significantly across UK MNOs (see column D in the figure below).

Figure 1 Ofcom’s analysis of shares of spectrum, data and subscribers

Figure 3.4b: Shares of spectrum, data and subscribers, and related ratios – Analysys Mason data

	A	B	C	D	E	F
	Share of spectrum (excl 1400)	Share of mobile data traffic	Share of network subscribers	Data share/spectrum share ratio	Subscriber share/spectrum share ratio	Data share/subscriber share ratio
BT/EE	45%	33%	33%	1.5	1.0	1.9
O2	15%	17%	33%	2.4	2.9	1.0
Vodafone	28%	13%	23%	1.0	1.1	1.1
H3G	12%	37%	11%	6.3	1.2	6.8

Sources: The shares of mobile data traffic are taken from Enders Analysis' *UK mobile market Q2 2016 – Future uncertain*, 5 September 2016 (slide 11). The shares of network subscribers are from Analysys Mason data and include the subscribers of hosted MVNOs, and are for Q4 2015. Note: 1400 MHz is excluded from the spectrum shares shown above because it is not currently in user devices.

⁵ Public Sector Spectrum Release

⁶ Page 4, Ofcom (November 2016) PSSR spectrum release consultation https://www.ofcom.org.uk/_data/assets/pdf_file/0026/93545/award-of-the-spectrum-bands-consultation.pdf

Source: Ofcom (November 2016) PSSR spectrum release consultation

Based on the above table, Ofcom has stated that:

“Turning our attention to H3G, it is striking that it carries a very high share of data traffic, at 37%, with only 12% of the currently useable spectrum that has already been allocated (i.e. excluding 1400 MHz which is not yet useable).”

1. Ofcom has recognised that operators with low spectrum shares may be forced to put up its prices in future to moderate demand:

*“We are concerned that a further concentration of immediately useable spectrum would mean that competition would be weaker than it would otherwise be for the reasons discussed above. The adverse effect of any such weakening in competition may be significant. In particular, it may lead operators with small spectrum shares to compete less strongly, especially for specific customer segments, such as those high value consumers who demand consistently high data speeds. **This could result in increased prices for those customers to moderate the increase in data traffic of such operators.**” [Emphasis added]*

2. Ofcom has stated that Three’s share of traffic has already started to fall, which could be consistent with it having to slow the growth of traffic on its network due to its low share of spectrum:

*“The share of data carried by the networks of the four MNO is very different to their subscriber shares. As shown in Figure A7.13, **H3G carries the most data (37% of total data), though its share has declined recently as its rate of growth has moderated.**” [Emphasis added]*

3. In light of the above, we examine in this report, in addition to overall mobile price changes in the UK, how the relative competitive position of Three has evolved, using detailed pricing data at the tariff-level.

1.2 Structure of this report

The remainder of this report is structured as follows:

- In section 2, we consider the range of different ways of measuring prices in the mobile market, given the complexity of mobile pricing;
- In section 3, we explain the approach that we have used to analyse prices;
- In section 4, we summarise our analysis of overall price changes;
- In section 5, we explore Three’s pricing compared to other operators;
- In section 6, we conclude; and
- In Annex A, we include more details of sensitivities and results from the econometric analysis.

2 THERE ARE A RANGE OF DIFFERENT WAYS OF MEASURING PRICE CHANGES IN THE MOBILE MARKET

In this section, we discuss different ways of measuring mobile prices. In general, there is no perfect approach. But the most appropriate approach is likely to vary depending on the precise context. It is also important to consider a number of different approaches to test the robustness of any results, where this is feasible.

2.1 Measuring prices in the mobile market

Due to the way consumers purchase mobile services, it is important to take account of a variety of factors when measuring prices in the mobile market. The majority of consumers in the UK buy post-paid mobile services (65% of all mobile subscribers are post-pay⁷) which typically involve a monthly payment for a bundle allowance of minutes, SMS and data. These contracts typically also include the cost of a mobile handset, which is usually covered through a combination of an upfront fee and monthly payments, with contract lengths typically being between 12 to 24 months.

Due to the wide range of handsets, potential usage and contract lengths, there are a large variety of different mobile tariffs. These tariffs change over time due to changes in consumption patterns, and new handsets coming onto the market. For post-paid tariffs, there are also out of bundle charges (structured in the same way as charges for users on pre-paid contracts). Most consumers tend to stay within their bundle allowance. Some consumers also use SIM-only tariffs, which do not come with handsets. However, contracts with handsets represent a larger proportion of the post-pay market than SIM-only (Ofcom estimated that SIM-only made up 13% of the post-pay market in 2014⁸). In addition, there are also pre-paid tariffs where users load credit onto their phone, which they then spend on minutes, messages and data.

Promotions and handset launches play a significant role in the mobile market, so prices can differ significantly for consumers depending on the point at which they renew contracts.

2.2 Ofcom's tariff-based approach

Ofcom has been monitoring pricing developments in the UK market for a number of years, using a methodology based on consumption baskets.

2.3 2015 ICMR report

In the 2015 ICMR report (before the PSSR consultation), prices were compared in July 2014 to July 2015 using a basket-based approach. The key features of this approach are:

⁷ Ofcom Annexe A7.1.

⁸ https://www.ofcom.org.uk/_data/assets/pdf_file/0019/63523/tce14_research_report.pdf figure 106

- Different baskets are defined.** Ofcom/Teligen define eight baskets termed “connections”, which specify different minimum requirements for minutes, SMS, data and quality of handset. Ofcom describes the classification of handsets at a high level in a 2016 research document on the effects of disruptive firms on mobile pricing.⁹ Teligen classifies handsets into Premium, Intermediate and Basic categories using Teligen data on phone characteristics, age and price. Ofcom includes both contracts with handsets, as well as handsets bought alongside SIM-only in its analysis. The following table summarises the different baskets used by Ofcom.¹⁰

Figure 2 Baskets for Tariff Categorisation in Ofcom’s ICMR 2015

Basket	Minutes	Texts	Data (GB)	Device/Handset	Source
1	50	0	0	Basic	OFCOM
2	50	25	0.1	Basic	OFCOM
3	150	200	0.3	Intermediate	OFCOM
4	250	100	0.4	Intermediate	OFCOM
5	200	50	0.5	Premium	OFCOM
6	100	250	2	Intermediate	OFCOM
7	300	150	1	Premium	OFCOM
8	500	200	5	Premium	OFCOM

Source: Ofcom 2015 International Communications Market Report

- Prices for each tariff are calculated based on the upfront and monthly cost.** Monthly prices for each bundle are calculated as the sum of the monthly charge and the upfront handset cost which is equally spread over 36 months¹¹.
- The minimum price for each basket for each operator is identified.** In each basket, Ofcom selects the minimum monthly price offered by each of the MNOs for a mobile bundle that meets the minimum requirements for data, minutes and SMS allowance and handset quality. This approach therefore assumes that consumers will act rationally.
- A weighted average price is calculated for each basket.** Ofcom then creates a weighted average of the MNOs’ lowest monthly prices in each basket. The weighted average price is calculated by weighting the minimum qualifying price for each MNO in each basket by the MNO’s market share of customers.
- Ofcom does not weight the different baskets.** Ofcom sums up the prices of the 8 different baskets, so that it can compare overall prices between July 2014 and July 2015.

Using the above methodology Ofcom found a 12% increase in mobile prices between 2014 and 2015.

Ofcom’s approach in its 2015 ICMR report raises a number of issues:

⁹ Page 11 Ofcom (March 2016) A cross-country econometric analysis of the effect of disruptive firms on mobile pricing https://www.ofcom.org.uk/data/assets/pdf_file/0019/74107/research_document.pdf

¹⁰ One thing to note is that baskets are not mutually exclusive as, for example, the tariffs in Basket 2 could be a subset of Basket 1.

¹¹ Mathematically, it is $monthly\ charge + (Upfront\ cost)/36$

- The approach provides estimates of the price trends for the prices that ‘minimise’ what a mobile subscriber would spend, for a given basket of consumption. Therefore, the approach ignores the wide range of other mobile tariffs on offer. Such an approach may therefore only be accurate if consumers tend to shop around a lot to find the cheapest prices and/or the prices of other tariffs tend to move in line with the prices of the cheapest tariffs. There are however reasons to expect that prices may have different trends for different parts of the market. For example, MNOs may compete strongly on the lowest cost tariffs for certain bundles, in order to attract subscribers from other networks. But such tariffs may be less popular amongst MNOs’ upgrading subscribers.
- The Ofcom approach does not apply weights to the price changes of different baskets. For example, it treats a £1 price increase in each basket with the same weight irrespective of the number of subscribers actually purchasing those bundles. This means that the approach fails to capture the fact that data usage is increasing over time (whereas the number of messages is falling).
- The consumption baskets are kept constant over time, even though actual usage patterns may vary e.g. due to increasing data usage, falling SMS usage.
- We find that Ofcom’s approach is likely to be sensitive to the exact points in time that are used for the comparison, as promotions and handset launches are important for contracts with handsets, and tariffs are often introduced and withdrawn. Ofcom itself states that¹²:

“Figure A7.18 shows the packages offered in mid-September 2016. We recognise that offers change frequently, and that some of the tariffs included in this table were time-limited promotional offers. Figure A7.18 therefore only provides a snap shot of tariffs available at a particular point in time, and is not necessarily representative of what operators offer at other times.”

2.4 2016 ICMR report

Ofcom has also produced a 2016 ICMR report, which showed price changes between 2015 and 2016. This contained a number of important changes compared to its previous ICMR reports:

- It focussed on SIM-only rather than tariffs with handsets; and
- It has changed the minimum requirements for each of the baskets, such that the data usage required is now higher for some baskets (it also made some changes to the number of minutes and texts required).

This analysis reported a significant reduction in SIM only tariffs between 2015 and 2016 (38%).

Figure 3 Baskets for Tariff Categorisation in Ofcom’s ICMR 2016

¹² Ofcom makes this statement in the context of a different piece of pricing analysis. However, the point will also apply to its pricing analysis of different baskets.

Basket	Minutes	Texts	Data (GB)	Source
1	50	0	0	OFCOM
2	50	25	0.1	OFCOM
3	150	100	0.5	OFCOM
4	250	50	1	OFCOM
5	200	200	2	OFCOM
6	300	150	3	OFCOM
7	100	250	5	OFCOM
8	1,000	300	15	OFCOM

Source: *Ofcom 2016 International Communications Market Report*

2.5 Statistical analysis

An alternative to the approach used by Ofcom is to look at *all tariffs* using statistical/econometric methods such as regression analysis. This approach has a number of benefits compared to Ofcom's basket approach:

- It uses information on all tariffs available, rather than just focussing on the minimum prices of baskets (which only represent less than 1% of all tariffs with contracts). This means that it does not necessarily require the assumption that all consumers behave consistently and continuously in a cost minimising way.
- Regression analysis offers the ability to control for changes in the size of the bundle allowance. This approach can therefore isolate pure price changes from changes that relate to differences in the size of bundle allowances over time.

3 OUR APPROACH

As discussed in the introduction to this report, we aim to assess prices in the UK mobile market by considering the following:

- Changes in Three's relative prices compared to other MNOs; and
- Changes in overall mobile prices.

In light of this objective, and to ensure comparability with the analysis undertaken by Ofcom, we have analysed prices in the UK mobile market using tariff-level data, and using both Ofcom's basket based methodology and an econometric analysis. This should enable the assessment of the trends in both overall mobile prices and Three's relative position with a greater degree of certainty than if we relied solely on one or the other methodology.

The approaches that we use are summarised in the following table.

Figure 4 Approaches used

Type of pricing analysis	Approach used
Overall price trends	Ofcom's tariff-based basket approach (both contracts with handsets and SIM-only) Econometrics
Three's prices compared to other operators	Detailed basket analysis Econometrics

Source: Frontier

In the rest of this section, we explain:

- The market segments covered by our analysis;
- Our basket approach; and
- Our econometric approach.

3.1 Market segments

We focus the analysis on UK MNOs' (EE, Three, O2, Vodafone) prices sold through both direct channels and Carphone Warehouse¹³. We focus on the post-paid segment as this represents the majority of subscribers in the UK (65% according to Ofcom¹⁴) and pre-pay users will tend to have lower data usage.

The majority of our analysis focusses on contracts with handsets. However, given that Ofcom looked at SIM-only tariffs in its most recent ICMR, we have also considered the impact of including SIM-only tariffs in our analysis.

¹³ In some of our analysis, to be consistent with Ofcom, we exclude tariffs offered through Carphone Warehouse.

¹⁴ Annexe 7

3.1.1 Contracts with handsets

We use Pure Pricing for the UK from the beginning of 2013 to November 2016. For each mobile plan, the Pure Pricing dataset includes information such as the monthly charge, the upfront cost and the device model, as well as the included monthly minutes, data and text allowances.



3.1.2 SIM-only tariffs

In its 2016 ICMR report, Ofcom has changed its approach, such that it now covers SIM-only tariffs rather than tariffs with handsets. However, Ofcom has previously indicated that the handset component is an important factor:

“Many other studies of this nature exclude handset data because of a concern that a preference for handsets is being estimated rather than mobile tariffs. However, we believe handset pricing to be a key factor in an MNO’s pricing decision. As set out above, many MNOs subsidise handsets to make plans more attractive to consumers. This is an important element of their pricing decision and it could be that disruptive firms are more likely to aggressively pursue this strategy to expand their customer base. Given what we see as the inextricable link between handsets and tariff pricing, it seems important to us to include this effect in our analysis.”¹⁵ [Emphasis added]

Ofcom estimated that SIM-only made up 13% of the post-pay market in 2014¹⁶. Nonetheless, as this is a growing share of the UK post-pay segment, we consider the impact of including SIM-only tariffs in our analysis.

3.2 Basket approach

We have largely tried to mimic Ofcom’s approach. We mainly rely on Ofcom’s basket definitions from its 2016 ICMR report, except we have excluded basket 8 (we explain why in Section 3.2.2). The following table summarises our approach compared to Ofcom’s approach in its ICMR reports based on our understanding of its analysis.

¹⁵ Page 11, Ofcom (March 2016) A cross-country econometric analysis of the effect of disruptive firms on mobile pricing https://www.ofcom.org.uk/_data/assets/pdf_file/0019/74107/research_document.pdf

¹⁶ https://www.ofcom.org.uk/_data/assets/pdf_file/0019/63523/tce14_research_report.pdf figure 106

Figure 5 Similarities to Ofcom's approaches

	Ofcom (2016)	Ofcom (2015)	Frontier
Input data	Monthly data on SIM-only tariffs	Monthly data on post-paid tariffs including handsets, as well as SIM-only tariffs combined with handset purchases.	Weekly data from Pure Pricing on post-paid tariffs including handsets sold and weekly data on SIM-only tariffs Monthly data on the wholesale cost of handsets
Baskets	8 baskets (larger data allowances than in its 2015 ICMR report)	8 baskets	Use the same baskets 1-7 that Ofcom uses in its 2016 ICMR report. For the analysis of contracts with handsets, we also include a required level of handset quality (even though we exclude the wholesale handset cost).
Distinguish between 3G/4G	Yes	Yes	No (due to lack of data)
Handset classification	No handset included	Based on Teligen information about handsets (further info not available)	Based on distribution of the wholesale cost of handsets in each year. No handset classification needed for our SIM-only analysis.
Treatment of upfront costs	Not necessary	Spread over 36 months	Spread over 36 months
Average weighting	Based on overall market shares	Based on market shares (unclear exactly which shares are used)	Based on post-paid market shares
Periods for comparison	July	July	Annual (calculated as average across all weeks) for analysis of contracts with handsets Average across four quarters for SIM-only analysis.

	Ofcom (2016)	Ofcom (2015)	Frontier
Treatment of Carphone Warehouse	Excluded	Excluded	Excluded for the calculation of overall price changes to be consistent with Ofcom. Included in our analysis of relative pricing given that operators tend to offer cheaper deals through Carphone Warehouse.

The following sections provide further details on our approach for the basket analysis.

3.2.1 Averaging

For the basket approach, we use Ofcom's approach as a starting point. However, for our analysis of contracts with handsets, given that prices in mobile markets can be quite volatile due to the impact of promotions and handset launches, we improve on Ofcom's approach by taking an average of the weekly prices throughout the whole year rather than using two particular points in time for the pricing comparison.

We note that price changes can occur at different points in the year due to promotions or introductions of new handsets. This is also true to some extent in relation to price changes over a longer time period in reaction to changes in costs for example, as operators are aware that due to the length of contracts, it may take some time for customers to migrate onto new tariffs. For this reason, although by averaging we have aimed to improve the estimated price changes identified, it is still necessary to be cautious about interpreting the specific year-on-year price changes.

3.2.2 Baskets used

We focus on baskets 1-7 that Ofcom defined in its 2016 ICMR document, as this allows us to compare prices over a number of years. As noted, we exclude basket 8 as this is unlikely to produce sensible results when going back a number of years. The following table summarises the baskets used in our analysis.

Figure 6 Baskets used for contracts with handsets and SIM-only

Basket	Minutes	Texts	Data (GB)	Handset quality (only relevant for our analysis of contracts with handsets)
1	50	0	0	Basic
2	50	25	0.1	Basic
3	150	100	0.5	Intermediate
4	250	50	1	Intermediate
5	200	200	2	Premium
6	300	150	3	Intermediate
7	100	250	5	Premium

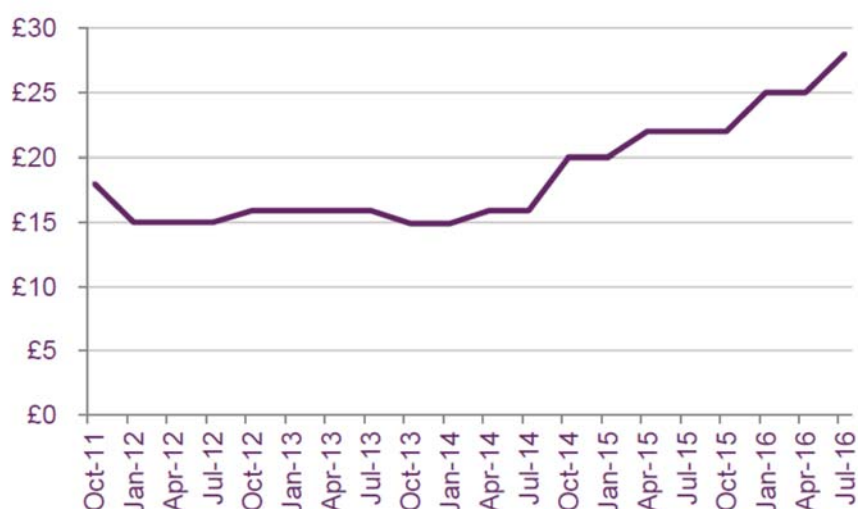
Source: *Frontier*

Reasons for excluding basket 8

We have excluded Ofcom's basket 8 for a number of reasons. Ofcom's analysis suggests that the SIM-only prices for basket 8 have fallen from £113 per month to £40 per month between July 2015 and July 2016. Given that the lowest price that Ofcom found for basket 8 was £43 per month in July 2015, this means that some operators must have been pricing above £113 per month. It seems implausible that many consumers were purchasing SIM-only deals for more than £113 per month in July 2015, given that:

- Although it may generally be true that not many consumers shop around, it seems unlikely that many consumers would pay more than £113 per month when Ofcom itself shows that there is at least one tariff that satisfied the requirements of basket 8 that cost £43 per month. Consumers' willingness to shop around is likely to depend on the potential savings from doing so, and in this case the potential savings appear to be large.
- We have analysed the Pure Pricing data set (which includes handsets) and there were no tariffs that satisfied the requirements of basket 8 that cost as much as £113 in 2015.

We also note that in Ofcom's PSSR consultation, Ofcom showed that Three had increased its prices for its SIM-only deal with unlimited data and 600 minutes. And the SIM-only prices shown in Ofcom's figure were nowhere near £113 per month (they appear to be just over £20 per month for July 2015). This tariff almost qualified for basket 8, except it has 600 minutes rather than 1000 minutes. This shows that Ofcom's results may be quite sensitive to the exact basket definitions, particularly for basket 8.

Figure 7 H3G's SIM-only unlimited data, 600 minutes, 12 month contract

Source: Pure pricing

Source: Ofcom consultation report Annex 7

3.2.3 Technology

Unlike Ofcom's data, the Pure Pricing data does not identify the technology generation (i.e. 3G/4G) for specific tariffs. This distinction is unlikely to be important for recent tariffs, as the majority of handsets are now 4G enabled and tariffs reflect this. However, around the introduction of 4G in the UK, some operators offered different tariffs depending on whether they included 4G or relied only on 3G and older generations.



3.2.4 Handset classification

Ofcom's 2015 ICMR report used Teligen data on phone characteristics, age and price when classifying handsets into Premium, Intermediate and Basic categories. Details of specific handset classification's using this methodology are not available and the Pure Pricing dataset does not provide sufficient details on handsets to allow us to attempt to replicate this approach. Instead, we have classified handsets based on the wholesale cost of handsets in a given year as follows:

- We have defined handsets whose wholesale cost is in the bottom tercile (33%) as basic;
- We have defined handsets whose wholesale cost lies in between the middle tercile as intermediate; and
- We have defined handsets whose wholesale cost lies in the top tercile as premium.

3.2.5 Calculation of prices

Consistent with Ofcom's approach, monthly prices for each bundle are calculated as the sum of the monthly charge and the share of upfront handset cost (which is spread over 36 months¹⁷). We adjust the prices to remove the effect of changes in handset costs.¹⁸ To estimate monthly phone prices across MNOs, we calculate minimum prices for each MNO-Basket combination, where the lowest priced tariff is selected subject to the requirements for the basket.¹⁹

In line with Ofcom's approach, we present a weighted average price for each basket. Our weighted average price is calculated by weighting the minimum qualifying price for each MNO in each basket by the MNO's post-paid market share of customers. Ofcom does not specify the precise market shares used in its weighting in its 2015 ICMR, although its 2016 ICMR report uses overall market shares.

As with Ofcom's 2015 ICMR approach, our analysis does not include the impact of any out-of-bundle charges. We note however that there have been some reports of operators increasing some out-of-bundle charges²⁰.

3.3 Econometric analysis

We also carry out an econometric analysis of all post-paid tariffs including a handset (over 160,000 tariffs), as this helps deal with some of the drawbacks of a basket approach i.e. it includes data on all tariffs and it controls for changes in the size of bundle allowances. In all of our econometrics, we have used Ordinary Least Squares (OLS) and robust standard errors²¹.

We have not carried out econometric analysis on SIM-only tariffs for two main reasons. Firstly the frequency of the data is monthly and the number of SIM-only tariffs offered by each operator is relatively small (compared to handset tariffs) particularly in the early period of our analysis. We also observe that Three significantly increased the number of SIM-only tariffs available in 2016 meaning any results in this year would be significantly driven by Three relative to the other operators. These factors suggest that this could potentially result in estimates that may not reflect accurately the 'average' price changes faced by consumers.

¹⁷ Mathematically, it is $monthly\ charge + (Upfront\ Cost)/36$

¹⁸ Mathematically, we deduct $wholesale\ Device\ cost/36$ from the calculation of monthly price

¹⁹ In cases where there are no tariffs for a particular basket, for example BT/EE not supplying any basic devices in 2012, the monthly price is coded as missing. All non-missing minimum prices are rounded to the nearest hundredth.

²⁰ <http://www.moneysavingexpert.com/news/phones/2016/08/ee-to-hike-out-of-bundle-mobile-charges-by-up-to-60->

<http://www.moneysavingexpert.com/news/phones/2016/06/vodafone-to-increase-out-of-allowance-costs-next-month---but-you-may-be-able-to-dodge-the-hikes>

²¹ The EC in its decision on the proposed Three-O2 merger suggested that the use of continuous variables rather than using dummy variables for unlimited estimates was likely to be preferable. Therefore, we have converted minutes, SMS and data to continuous variables by assigning values to any "Unlimited" categories (the results are not sensitive to the precise assumptions used for this).

4 TRENDS IN OVERALL PRICES

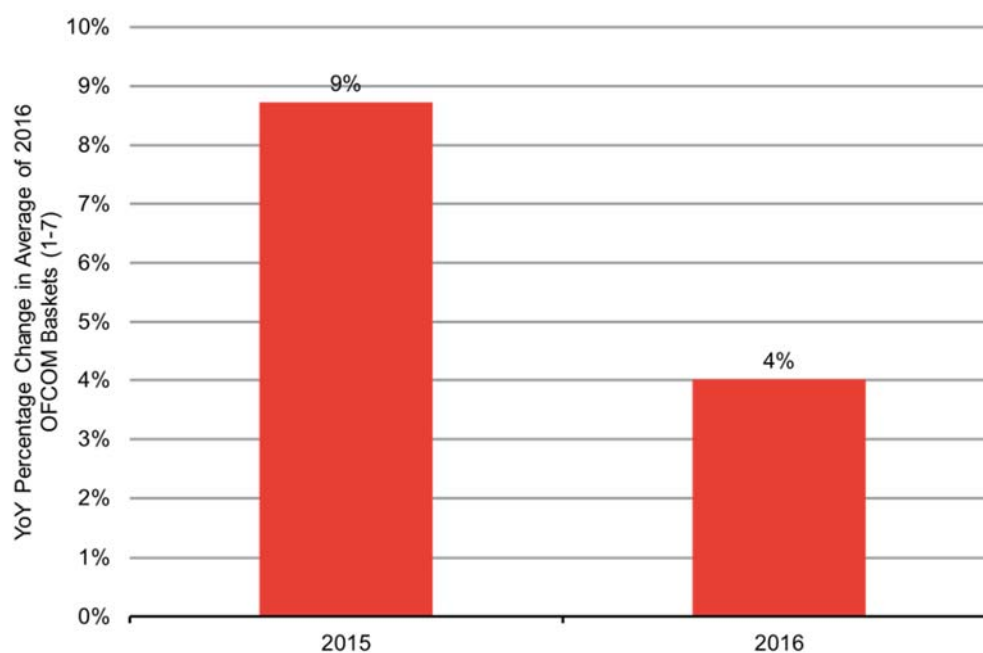
In this section, we consider how overall prices (based on tariff data) in the mobile market have changed using both the basket approach and econometrics. Under both approaches, we find evidence of overall price increases in 2015 and 2016. We primarily focus on contracts with handsets as they represent a significant proportion of the market, although we also consider how SIM-only prices have changed. We discuss the more detailed findings in the remainder of this section.

4.1 Results using Ofcom's basket approach

4.1.1 Contracts with handsets

Our results from building on Ofcom's mobile pricing analysis are presented below. In line with Ofcom's approach we consider the percentage change using the sum of the weighted average prices from each bundle. Our results show that prices increased by 9% from 2014 to 2015 and by 4% from 2015 to 2016. This means that prices increased by 13% between 2014 and 2016.

Figure 8 Year on Year overall percentage changes under a basket approach



Source: Frontier

It is important to note that the above results exclude the wholesale cost of handsets from the calculation of the price increases for contracts with handsets. When including the handset costs, we find that prices increased by 18%. This suggests that handsets have generally got more expensive, but this does not explain fully the increase in prices.

4.1.2 Weighted average for contracts with handsets and SIM-only

Given that Ofcom has focussed on SIM-only prices in its latest ICMR report, we have also done an analysis of SIM-only prices. Ofcom found price falls of 38% between July 2015 and July 2016. However, this result was largely driven by falls for the largest basket which included 15GB of data. For the reasons explained in Section 3.2.2, we have excluded basket 8 from our analysis and instead focus on baskets 1-7 (which is consistent with our approach to the analysis of contracts with handsets).

Our analysis indicates that SIM-only prices have fallen by 16% since 2014. However, contracts with handsets represent a *much larger* proportion of the post-pay market than SIM-only. Ofcom estimated that SIM-only made up 13% of the post-pay market in 2014²². As the share of SIM-only has been increasing since 2014, we have estimated the price increase based on the average of the 2014 Ofcom estimate, and an estimate of the 2016 share of SIM-only from YouGov²³, which suggests that SIM-only makes up 23% of smartphones on post-pay. When using this average of 18%, we find that *overall post-pay prices have increased by 7.8% between 2014 and 2016*.

As indicated earlier, the basket based approach reflects changes in the minimum tariffs for the selected baskets. The econometric approach reflects changes in all tariffs, and under this approach, the estimated price increase between 2014 and 2016 is 15% (see below). When using this estimate for the increase in the tariffs of contracts with handsets, we find that *overall post-pay prices have increased by 9.4% between 2014 and 2016*.

Figure 9 Weighted average price change, 2014 to 2016

	Price change for contracts with handsets	Price change for SIM only	Share of SIM-only	Weighted average price increase
Using Ofcom basket approach – minimum cost tariffs	13%	-16%	18%	7.8%
Using econometrics – all tariffs	15%			9.4%

Source: Frontier

There are a number of reasons that may help to explain why prices for contracts with handsets and SIM-only prices are moving in different directions:

- Consumers who choose SIM-only tariffs may generally be more price sensitive, which suggests that there may be a greater pressure to reduce prices for this segment of the market.

²² https://www.ofcom.org.uk/data/assets/pdf_file/0019/63523/tce14_research_report.pdf figure 106

²³ <https://yougov.co.uk/news/2016/09/02/rise-sim-only-contract-killers-or-start-quadplay-t/>

- Operators may use SIM-only as an important way of acquiring and retaining subscribers. Subscribers are increasingly keeping their handsets for longer as the incremental functionality of new handsets is generally reducing over time. This means that subscribers may have gaps between their contracts expiring and them upgrading to a new handset. SIM-only tariffs may be one way of operators trying to ensure that they do not lose subscribers in this interim period.
- MVNOs reportedly focussing on the SIM-only segment, with MVNOs often competing based on prices.

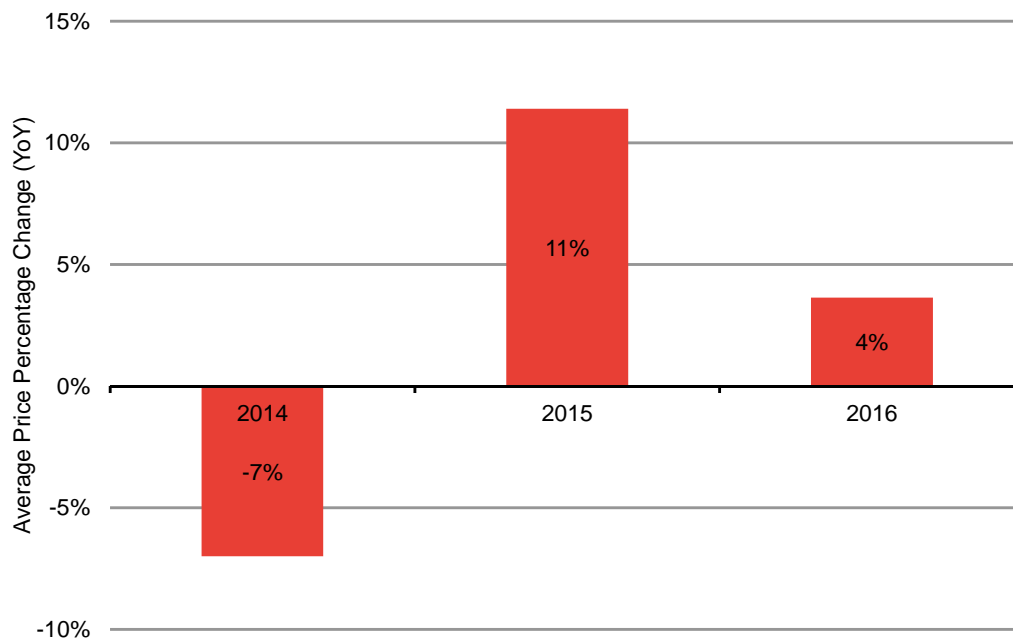
Since we do not undertake econometrics for SIM-only tariffs, we recognise that this approach focuses on the lowest price tariffs only and may not be representative of average trends in the SIM-only segment. As a sensitivity, we also performed the basket analysis for SIM-only, looking at average (rather than minimum cost) price changes for each basket. This analysis indicates that SIM-only prices have fallen by 7% since 2014 when considering average rather than minimum tariffs. Therefore the weighted average result presented above is likely to under-estimate the actual price increase, since SIM-only tariffs have not fallen in price on average as much as the minimum tariffs.

4.2 Results using econometric analysis

The regression results (see annex) for contracts with handsets suggest that, after controlling for potential increases in bundle allowances, prices have increased since 2014²⁴ (see below). This result confirms that the trends we observe from the basket approach are not just picking up changes in the ‘minimum’ prices offered for the chosen baskets, but reflect changes across all tariffs. As shown below, the estimated price increase between 2014 and 2016 when using econometric analysis is 15%: this suggests that prices for all tariffs for contracts with handsets have increased by more than the tariffs of the cheapest tariffs.

²⁴ The differences between the yearly dummies are statistically significant when using a Wald test.

Figure 10 Percentage change in overall price based on econometric analysis



Source: Frontier

We have conducted a number of sensitivity tests, which show that we still find price increases for 2015 and 2016 when:

- Using a 24 month amortisation period rather than 36 month;
- Using a different value for all-you-can-eat allowances;
- Excluding Carphone Warehouse;
- Excluding outliers; and
- Using quarterly dummies instead of annual dummies.

5 THREE'S PRICING COMPARED TO OTHER OPERATORS



6 CONCLUSIONS FROM OUR PRICING ANALYSIS

Our main conclusions are that:

- Overall price changes. Our results reveal that, overall, post-pay prices have continued to rise in both 2015 and 2016, despite the significant reductions in SIM-only tariffs in 2016, found in both Ofcom's and our analysis. Our analysis has found evidence of price increases in the mobile market for contracts handsets of 13%-15% between 2014 and 2016. When including SIM-only deals in our analysis, we find a weighted average price increase of 7.8%-9.4% (across contracts with handsets and SIM-only).



