ESMT Competition Analysis

ESMT CA SUPPLEMENTARY REPORT

Empirical analysis of BT's automatically renewable contracts

Supplementary report prepared for Ofcom
by Professor Gregory S. Crawford
and ESMT Competition Analysis

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"This Report was commissioned by Ofcom and has been prepared by Gregory S. Crawford, Professor of Economics at the University of Warwick, and ESMT Competition Analysis ("ESMT CA") to empirically analyse the effect on BT customers' switching behaviour of automatically renewable contracts. The conclusions are the results of the exercise of Professor Crawford's and ESMT CA's best professional judgment. However, any use which Ofcom or a third party makes of this document is their responsibility. ESMT CA accepts no duty of care or liability for damages suffered by Ofcom or any third party as a result of decisions made or actions taken based on this document."

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Executive summary

In August 2010, we produced a report for Ofcom analyzing the impact of automatically renewing ("rollover") contracts introduced by British Telecom ('BT') into the fixed-voice telephony market ("Rollover Report").[1] In the Rollover Report, we found that households on BT's rollover contracts switch after their first minimum contract period (MCP) 34.8% less than comparable customers on standard contracts. Based on this finding, we concluded that BT's rollover contracts significantly increase switching and/or entry costs in fixed voice telephony markets.

BT responded to the Rollover Report by raising a number of technical concerns, primary of which was that the estimated effect of price discounts embodied in the econometric analysis underlying the report inappropriately relied on certain types of price variation. Of particular concern was the reduction in the discount associated with the end of the promotional period within fixed term contracts. BT argued that because customers expected this price change, they would not switch in response to it. They further argued that the analysis in the Rollover Report was therefore likely to underestimate the impact of price discounts on switching and, as a consequence, overestimate the causal effect of the rollover clause.

In this Supplementary Report, we address the most salient technical concerns raised by BT in their communications with Ofcom discussing the results of the Rollover Report. In summary:

- We explore in detail the sources of price and percentage price difference variation in the estimation dataset for the Rollover Report.[2] We find that there are four primary sources of variation:
    - Variation over time in the undiscounted (standard) price of BT's three main calling plans: the Unlimited Anytime Plan (UAP), the Unlimited Evenings and Weekends Plan (UEWP), and the Unlimited Weekends Plan (UWP).
    - Variation over time in the difference between BT's undiscounted prices and the lowest offered market price for comparable plans offered by rival Communications Providers (CPs) TalkTalk and Virgin.
    - Variation in the level of discount from the standard price of BT's plans across various "special offers" marketed to and accepted by BT customers choosing to enroll in either fixed-term or rollover contracts.

[1] "Empirical analysis of BT's automatically renewable contracts," Gregory S. Crawford and ESMT Competition Analysis, August 2010.

[2] The price measure used in the Rollover Report was the difference between the price households pay for their chosen plan (including any discounts) and the lowest price in the market for that same plan at rival providers TalkTalk and/or Virgin, measured as a percentage of the price of the household's chosen service. It was defined as 100*(price – min_rivals_price)/price.

- Variation over time on an offer in the level of discount from the standard price afforded by a fixed-term special offer within the MCP. This was the source of price variation emphasized in the identification section (Section 4.1.3) of the Rollover Report.

- We explore the relative importance of these sources of price variation with simple regressions of price and percentage price difference on dummy variables for time (month), special offers, and both. We find that variation across time and variation across special offers are of roughly equal importance for variation in prices, but variation across special offers is much more important for variation in percentage price differences.

- We assess the relative importance of these alternative sources of price variation on our conclusions in the Rollover Report by estimating flexible percentage price difference effects across a wide variety of specifications. We draw several conclusions from this exercise:

  - We find that BT's concerns about relying on price variation due to changes over time in the discounted price provided with fixed-term special offers are legitimate: while the pooled point estimate of percentage price differences on switching is positive and statistically significant, the estimate when relying only on variation within fixed-term contracts is often negative and always statistically insignificant.

  - We find that the source of percentage price variation that consistently yields statistically significant effects is that associated with differences in discounts across special offers within rollover contracts. For example, there are two BT special offers (Offer H and Offer K) that, for the UEWP plan, appear to be identical except that the former has a price discount and the latter does not.[3] Consumer switching is higher for the plan without the discount (Offer K).

  - We find that relying primarily on price variation across special offers within rollover contracts yields larger estimated effects of percentage price differences compared to the pooled results in the Rollover Report. Despite this, there are relatively modest consequences on the estimated causal effect of rollover contracts.

  - Across all specifications we considered, we found a significant, egative effect of rollover contracts after the first MCP ranging from -0.26 to -0.34 percentage points.

  - In our preferred specification (the minimal specification that simultaneously relies on the most compelling price variation in the data and permits estimating the effects of rollover contracts on switching), we estimate rollover contracts reduce switching by 0.31 percentage points, or 32.6% of the 0.95% predicted switching rate for the average observation in the data. This is

[3] Offers H and K come with a 12-month automatically renewable contract and provide the "Friends & Family Mobile" service for free. In addition, with Offer H the UEWP plan is charged at the price of a standard UWP.

only slightly less than the estimate of -0.33 percentage points (or -34.8%) arrived at in the Rollover Report.

- In a letter to Ofcom commenting on the Rollover Report, BT argues that "in order to control for the impact of the price discount, ideally one would [...] compare ARC contracts with and without price discounts and see whether switching rates are materially different." The further investigation into price variation that this report made possible shows that such variation is indeed present and is the primary source of variation that identifies the price effects in the econometric model.

- Based on these findings, we are confident that the price effects estimated in our econometric model are reliable and that the implied causal effect of rollover contracts, while slightly lower than that estimated in the Rollover Report, is still sufficiently large to conclude that rollover contracts significantly increase switching costs in fixed-voice telephony markets.

1 Introduction

In November 2009, Ofcom commissioned a report by Professor Gregory S. Crawford and ESMT Competition Analysis analyzing the impact of automatically renewing ("rollover") contracts introduced by British Telecom ('BT') into the fixed-voice telephony market.[4] These rollover contracts were similar to existing, "fixed-term," contracts offered by BT in the market as they included an initial 12-month Minimum Contract Period (MCP), but differed from such contracts by automatically renewing the MCP for an additional 12 months unless a household elected to opt out within the first MCP.

In the first half of 2010, Professor Crawford and ESMT CA worked with Ofcom and BT to collect a detailed customer-level dataset under the powers provided to Ofcom by Section 135 of the Communications Act. Professor Crawford and ESMT CA then conducted a detailed econometric analysis whose purpose was to estimate the causal effect of BT's rollover contracts on its customers' decisions to switch to another provider after their initial MCP. Professor Crawford and ESMT CA delivered the report, titled "Empirical Analysis of BT's automatically renewable contracts," in August 2010 ("Rollover Report").

In the Rollover Report, we found that households on BT's rollover contracts switch after their first MCP 34.8% less than comparable customers on standard contracts. Based on this finding, we concluded that BT's rollover contracts significantly increase switching and/or entry costs in fixed voice telephony markets.

The results of this report were shared with BT and a number of concerns were raised by BT in a PowerPoint presentation that it shared with Ofcom.[5] Professor Crawford replied to these issues in an October letter, prompting a reply letter rebutting some of the arguments raised in the Crawford letter and further emphasizing their concerns.[6]

The most important concern highlighted by BT was that "one of the key sources of price variation in the analysis relates to prices increases happening at the end of the promotional periods within fixed term contracts." (Cheek Letter on page 2) BT argued that because such price increases were known in advance by BT customers, they were unlikely to respond to them. If so, then the price effects estimated in the report were likely to be underestimated. Since rollover contracts generally included a discount relative to a standard BT contract (i.e. one without a MCP), any underestimation of the price effect would attribute a reduction in switching to the presence of the rollover terms in the contract. They also raised other issues relating to risk and loss aversion, the magnitudes of price discounts in the data, and the specification of the rollover (self-selection) equation.

[4] "Empirical analysis of BT's automatically renewable contracts," Gregory S. Crawford and ESMT Competition Analysis, August 2010 ("Rollover Report").

[5] "Empirical Analysis of BT's automatically renewable contracts: a critique of Professor Crawford's report for Ofcom," Felipe Florez Duncan, Senior Regulatory Economist, BT Group, 22 September 2010 ("Duncan Presentation")

[6] Letter to Andrea Coscelli from Professor Crawford, dated 8 October 2010 ("Crawford Letter"). Letter to Dr. Andrea Coscelli from Dee Cheek, Manager, Regulatory Strategy and Programmes, BT Retail ("Cheek Letter").

In this Supplement to our Rollover Report ("Supplementary Report"), we address the concerns about price variation and possible bias in the estimated effects of rollover contracts raised by BT in the Duncan Presentation and Cheek Letter.

We find that BT's concerns about relying on price variation due to changes over the time on the offer in the discounted price provided by a fixed-term special offer are legitimate: such variation yields an estimated price effect statistically insignificantly different from zero. We further find that the source of price variation that consistently yields significant price effects is that associated with differences in discounts across special offers within rollover contracts.

In a reply to the Rollover Report, BT argues that "in order to control for the impact of the price discount, ideally one would […] compare ARC contracts with and without price discounts and see whether switching rates are materially different." The further investigation into price variation allowed in this Supplementary Report shows that such variation is indeed present and is the primary source of variation that identifies the price effects in the econometric model.

Indeed, we find that relying primarily on price variation across special offers within rollover contracts in the minimal specification that can estimate the effect of rollover contracts yields larger estimated effects of percentage differences (0.92 in the Rollover Report versus 1.29 in this Supplementary Report) and lower estimated effects of rollover contracts.

We find, however, that the economic consequences of relying on the most compelling price variation are small. Across all specifications we considered, we found a significant, negative effect of rollover contracts after the first MCP ranging from -0.26 to -0.34 percentage points.

In our preferred specification (the minimal specification that simultaneously relies on the most compelling price variation in the data and permits estimating the effects of rollover contracts on switching),rollover contracts are estimated to reduce switching by 0.31 percentage points, 32.6% of the 0.95% predicted switching rate for the average observation in the data. This is only slightly less than the estimate of -0.33 percentage points (-34.8%) arrived at in the Rollover Report. We therefore maintain our conclusion that BT's rollover contracts significantly increase switching and/or entry costs in fixed voice telephony markets.

The rest of this Supplementary Report is structured as follows. Section 2 documents the price variation in the estimation dataset underlying the Rollover Report and provides summary measures of the relative importance of alternative sources of price variation. Section 3 describes the econometric specifications we adopt to explore the relative importance of alternative sources of price variation and discusses identification. Section 4 presents the results of our supplementary analyses and Section 5 concludes.

2 Price variation in the dataset

The focus of this report is on the sources of price variation in the BT data, the impact that such variation has on the estimated impact of price discounts on household switching behaviour, and the knock-on effect that it has for the estimated causal effect of rollover contracts. In this section, we document the extent of price variation in the BT data.

We explore two measures of price variation in this section. The first is variation in the actual price paid by households for their chosen fixed-voice telephone service. The second is variation in the difference between the price households pay for their chosen plan (including any discounts) and the lowest price in the market for that same plan at rival providers TalkTalk and/or Virgin, measured as a percentage of the price of the household's chosen service.[7] Throughout this report, we call the former variable "price" and the latter "percentage price difference". When talking of both variables, we will call them "price measures".

There are three important elements that determine these price measures:

1. The monthly undiscounted price of BT's three main calling plans: the Unlimited Anytime Plan (UAP), the Unlimited Evenings and Weekends Plan (UEWP), and the Unlimited Weekends Plan (UWP);

2. The monthly undiscounted price of comparable plans offered by rival Communications Providers (CPs), TalkTalk and Virgin;

3. The price discount (and its duration) associated with specific "special offers" marketed to and accepted by BT customers choosing to enroll in either fixed-term or rollover contracts.[8]

We describe the variation in each across households and time in what follows.

2.1 Variation over time in BT's and rival CPs' prices for standard plans

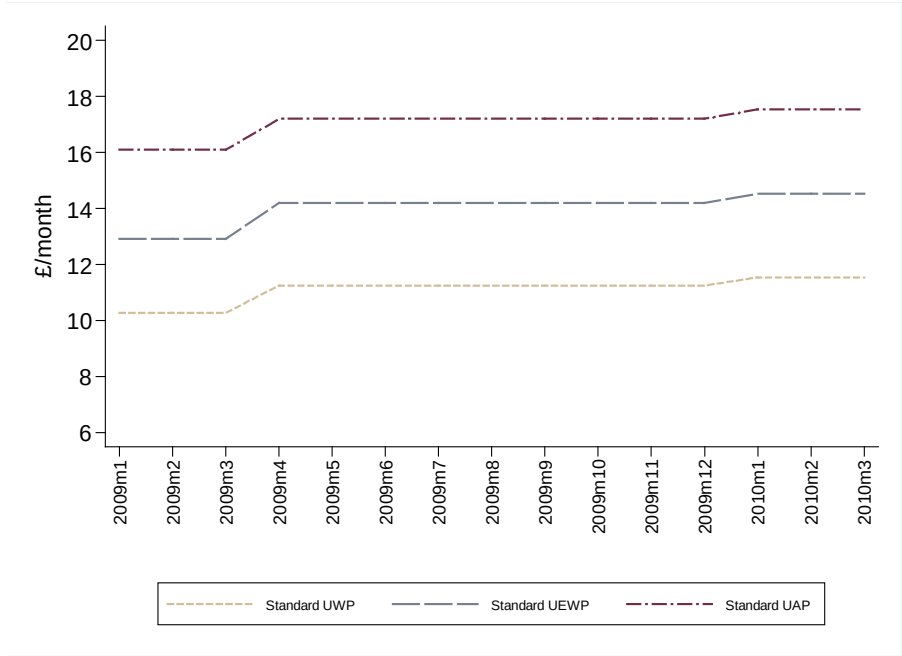
The undiscounted price of both BT's and rival CPs' calling plans do not vary across households; they only vary across time. Figures 1-3 report the limited extent of this across-time variation. Figure 1 reports the undiscounted standard-plan price for each of BT's three main calling plans. It is evident that prices changed twice within the sample, in April 2009 and January 2010. Figure 2

[7] It is defined as 100*(price – min_rivals_price)/price.

[8] Section 2.1.2 (p12) in the Rollover Report defines a BT *promotion* as a particular combination of plan (e.g. Unlimited Evenings and Weekends), contract (e.g. rollover), price discount (if any), and additional phone services (if any) to which a customer subscribes at a point in time. Internally, BT identifies promotions that feature (fixed-term or rollover) contracts as *special offers*. Promotions that do not have any contracts are called standard plans (or standard contracts).

reports the same information for BT's rivals, TalkTalk and Virgin.[9] Prices change for one or the other provider just four times within the sample. Figure 3 reports the price difference between BT's UAP and UEWP plans and the minimum price of comparable plans for TalkTalk and Virgin.[10] This is the numerator in our "percentage price difference" price measure. As for the other figures, these change rarely across time.

Figure 1: BT's prices for standard plans over time



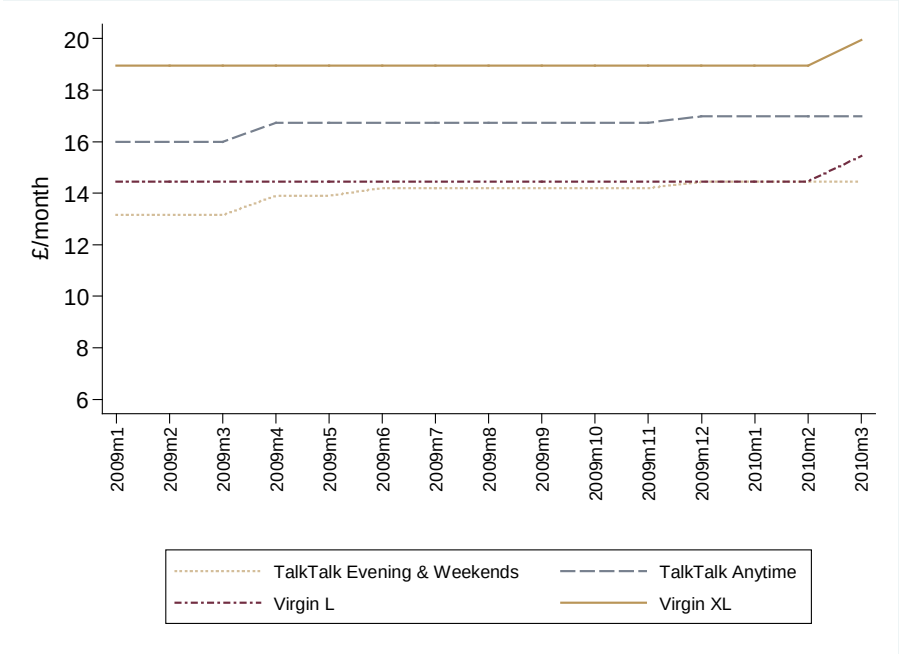
Source: Own calculations based on BT data.

Note: Prices are for paper-free billing and direct-debit payment, and include VAT.

[9] TalkTalk's Evening& Weekends and Virgin's L are comparable to BT's UEWP plan. TalkTalk's Anytime and Virgin's XL are comparable to BT's UAP plan. According to PurePricing, plans comparable to BT's UWP were discontinued by TalkTalk (TalkTalk 1) in December 2008 and by Virgin (Virgin M) in August 2008.

[10] Because our observation period starts in January 2009, we make a comparison between BT's and its rivals' prices only for the UEWP and the UAP plans.

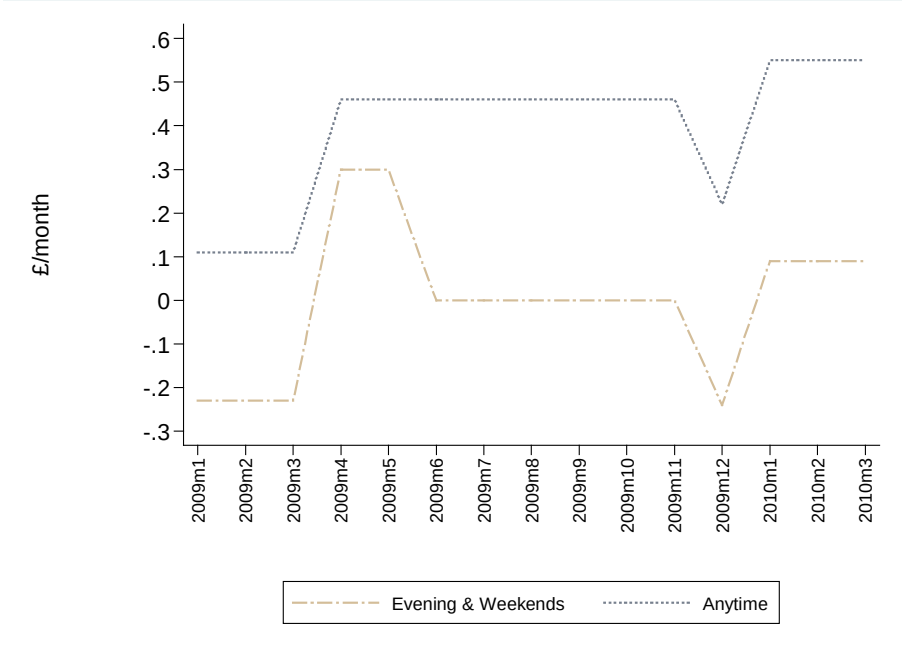
Figure 2: Rivals' prices for standard plans over time



Source: Own calculations based on PurePricing data.

Note: Prices include VAT.

Figure 3: Absolute differences between BT and its cheapest rival in the price for standard plans



Source: Own calculation based on BT and PurePricing data.

Note: Prices include VAT.

2.2 Variation in BT's prices due to special offers

Prices paid for plans associated with BT's special offers vary both across households and within households across time (for fixed-term special offers). In the Rollover Report, we calculated household-specific prices for the largest special offers chosen by households.[11] In this Supplementary Report, we do so for all special offers.

Tables 1 and 2 document the special offers chosen by the largest number of households in the estimation dataset. Table 1 reports the largest special offers chosen by customers selecting fixed-term contracts and Table 2 reports all the special offers chosen by customers on rollover contracts.[12]

The fields in each table are similar. Reported is a name identifying a special offer (which replaces the name of the special offer used internally by BT), the plan(s) to which it applied, the Minimum Contract Period associated with the offer, the price discount (if any), the duration of the price discount, and any additional services. The final column in each table reports the number of customer-month observations there are associated with each offer in the estimation.

[11] Of all the special offers that feature a price discount, in the Rollover Report we accounted for over 90% of fixed-term special offers and over 99% of rollover special offers, as weighted by the number of customer-month observations in the dataset.

[12] Table 6 in the Appendix reports in a single table all of the fixed-term special offers.

Table 1: Top fixed-term special offers

Offer name	Plan	MCP	Price discount	Duration of price discount	Additional services	Customer-month observations
Offer D	UAP	12 months	UAP for UWP (£5.99 discount)	3 months	-	✂
Offer A	UEWP	18 months	UEWP for UWP (£2.99 discount)	12 months	-	✂
Offer B	UEWP	12 months	UEWP for £1.45 (£1.54 discount)	12 months	-	✂
Offer J	UAP	12 months	-	-	-	✂
Offer C	UWP, UEWP, UAP	18 months	-	-	-	✂
Offer L	UEWP	18 months	UEWP for UWP (£2.99 discount)	18 months	-	✂
Offer M	UAP	12 months	UAP for UWP (£5.99 discount)	3 months	-	✂
Offer E	UAP	18 months	UAP for UWP (£5.99 discount)	3 months	-	✂
...	...	...	...	...	...	...

Source: Own calculations based on BT data. A complete list of fixed-term special offers is included in the Appendix.

Table 2: All rollover special offers

Offer name	Plan	MCP	Price discount	Additional services	Customer-month observations
Offer F	UEWP	12 months	UEWP for UWP (£2.99 discount)	-	✂
Offer G	UAP	12 months	£1 discount	-	✂
Offer H	UEWP	12 months	UEWP for UWP (£2.99 discount)	Friends& Family Mobile	✂
Offer K	UWP, UEWP, UAP	12 months	-	Friends& Family Mobile	✂
Offer I	UWP, UEWP, UAP	12 months	-	Friends& Family International	✂
Offer N	UEWP	12 months	UEWP for £1 less than UWP (£3.99 discount)	-	✂
Offer O	UAP	12 months	£1 discount	-	✂

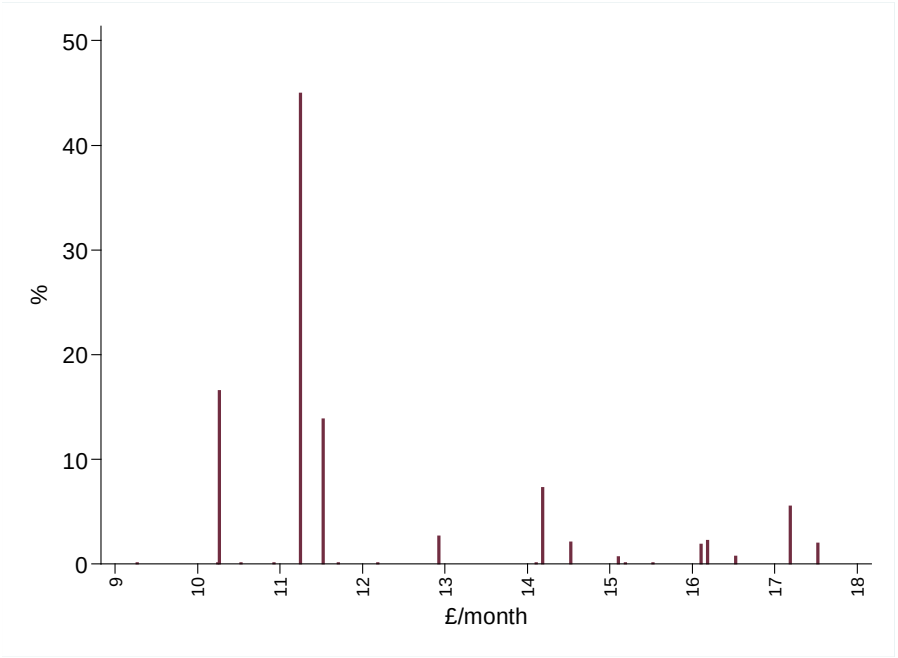
Source: Own calculations based on BT data.

2.3 Overall price variation in the dataset

Figures 4 and 5 present the the full distribution of prices and percentage price differences in the estimation dataset. Figure 4, displaying the distribution of prices, demonstrates that the majority of observations are clustered at the standard plan prices. This is no surprise, as Tables 1 and 2 show that it was common for BT to discount a more expensive plan down to the price of a less expensive plan. Figure 5, displaying the distribution of percentage price differences, demonstrates that the typical size of such discounts was usually on the order of 20-30% (of the discounted price).

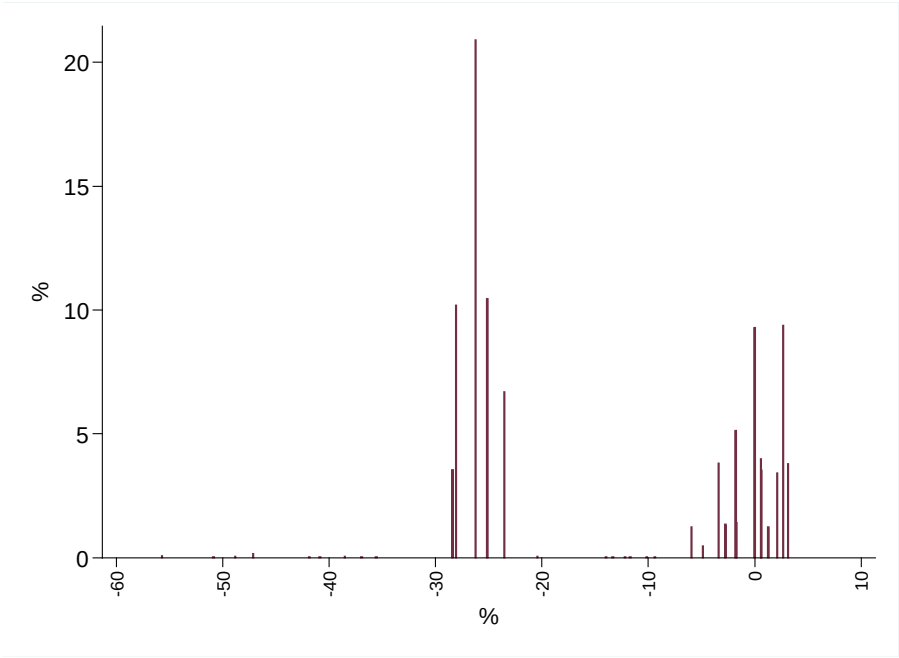
Tables 6 – 9 in the Appendix show several alternative cuts of the full price variation in the data. In particular, reported there is the distribution of prices and percentage price differences paid by households (1) by plan (UAP, UEWP, and UWP), and (2) by contract (standard, fixed-term, and rollover).

Figure 4: Distribution of BT prices in the full dataset



Source: Own calculations based on BT data.

Figure 5: Distribution of percentage price differences in the full dataset



Source: Own calculations based on BT and PurePricing data.

Note: We drop from the figure the UWP plan (representing 51.59% of customer-month observations in the dataset), for which the percentage price difference is zero.

2.3.1 Summarizing the importance of alternative sources of price variation

In this subsection, we try to summarize the relative importance of alternative sources of price variation. We do so by taking the full estimation dataset and running four regressions with each of our price measures as the dependent variable. In each regression we rely on the R^2 to provide a summary statistic for how much of the variation in each price measure can be explained by different sets of explanatory variables.[13] The explanatory variables used are plan and contract dummies, time dummies, and special offer dummies. The regressions are (1) plan and contract dummies alone, (2) plan, contract, and time dummies, (3) plan, contract, and special offer dummies, and (4) all dummies.

The goal for these regressions is to summarize the important dimensions on which our price measures vary. Different plans and contracts charge different prices and so these are clearly important baseline factors. We account for this with our first specification including just plan (UWP, UEWP, and UAP) and contract (standard, fixed-term, and rollover) dummies. The second and third specifications are the most important ones. They are meant to capture the extent to which variation across time (January 2009,…, March 2010) or variation across special offers (Offers D, A, F, G,…) is relatively more important for explaining overall price variation for each price measure. A comparison of the R^2 from these regressions to either the first or fourth provide an indication of each one's incremental contribution to overall price variation.

[13] R^2 (or "R-squared") is a measure of goodness-of-fit in regression analysis. It reports the fraction of sample variation in a dependent variable that is explained by the explanatory variables.

The following table summarizes our results. Because R^2 can vary with the functional form of the dependent variable, only values *within columns* should be compared.

Table 3: Extent of price variation by price measure

	Outcome variable	
Explanatory variables	**Price**	**Percentage price difference**
Plan and contract dummies	0.906	0.8784
Plan, contract, and time dummies	0.9575	0.8813
Plan, contract, and special offer dummies	0.944	0.9837
Plan, contract, special offer, and time dummies	0.9958	0.9867

Source: Own calculations based on BT and PurePricing data.

For both prices and the percentage price differences, we see that plan and contract dummies can explain the majority of the variation in the raw data (0.9060 for prices; 0.8784 for percentage price differences). As we have analogous dummies in the econometric estimation, it is therefore the remaining variation that will identify the price coefficients of interest.

For our first price measure, actual prices, we see that both changes over time and discounts associated with special offers are roughly of equal importance for overall price variation. Relative to the baseline R^2 of 0.9060, each contributes roughly half of the remaining price variation in the data.[14]

For our second price measure, the percentage price difference from rivals, we see instead that it is variation across special offers that is the driving source of variation. Time dummies add very little to the overall R^2 for percentage price differences (increasing it from 0.8784 to 0.8813 or 0.9837 to 0.9867), whereas special offer dummies provide considerable explanatory power (increasing the R^2 from 0.8784 to 0.9837 or 0.8813 to 0.9867).

For consistency with the Rollover Report, in the additional econometric specifications we consider below we continue to use the percentage price difference (with rivals) as our price measure important for switching behaviour. We introduce these additional specifications in what follows.

[14] Note that including all of plan, contract, special offer, and time dummies does not explain all of the price variation in the data as there is a small amount of variation across time within contracts as discounts associated with some fixed-term special offers change over time.

3 Econometric specifications and identification

In this section, we assess the importance of alternative sources of price variation for our estimates of the effect of percentage price differences on consumer switching behaviour and (ultimately) on our estimates of the causal effect of rollover contracts on switching behaviour.

The effect of percentage price differences and the effect of rollover contracts are closely related as, all else equal, the more consumer switching depends on price differences, the more they will value the discount included in (almost all) rollover special offers and the less the lower switching rates exhibited by rollover customers will be attributed to the other (non-price) elements of these contracts.

Our general approach to this problem is to begin with our baseline results from the Rollover Report (contained in its Table 2) and explore the consequences of estimating separate parameters associated with different types of price variation. This has the effect of relaxing the assumption implicit in the Rollover Report that all variation in percentage price differences, whatever their source, has the same effect on switching behaviour.

3.1 Specification in the Rollover Report

For convenience, we repeat here the variables included in the baseline results from the Rollover Report:[15]

1. A constant;

2. Unemployment rate, varying by time and region;

3. Calendar time indicators (February 2009 through March 2010, with January 2009 omitted);

4. "Broadband" and "BT vision" – indicators for "bundling" as of December 2008;

5. "F&F mobile" and "F&F international" – indicators for additional services included in the special offers (fixed-term and rollover contracts);

6. Tenure variables – the logarithm of tenure at BT, the logarithm of tenure on a particular promotion, and an indicator for the first promotion at BT;

7. "UEWP" and "UAP" – plan indicators (with the UWP plan omitted);

[15] For more information, please see Sections 2.1 (Disaggregate BT Customer Data) and 4.2 (Results) of the Rollover Report.

8. Three indicators for the 18-month fixed-term contracts (during, at the end of, and after the MCP);

9. Twelve indicators for the month in the MCP, capturing the effect of ETCs (for 12-month fixed-term contracts and rollover contracts);

10. An indicator for the 12-month fixed-term contracts after the MCP (there is only one, initial, MCP, with the fixed-term contracts);

11. The percentage price difference between the price a customer is paying BT for its fixed voice telephone service (depending on the chosen plan, contract, calendar time, and – in the case of fixed-term contracts – the month on promotion) and the price it would pay its cheapest rival (depending on plan and calendar time, in theory TalkTalk or Virgin, but in practice always TalkTalk) for the same (standard) plan.

3.2 Identification of the price parameter

In this section, we discuss the sources of price variation in the data that have the potential for providing identification of the price parameter(s). In the results section below, we describe which of these sources of variation appear in practice to be most important for our final estimates.

To build our understanding, we begin by temporarily ignoring contracts.

- Note that while we have plan dummies (UEWP and UAP) as well as time dummies (for individual months), the model is not fully saturated (i.e. it does not have time x month dummies).[16] If our price measure were simply the BT price, then the price parameter would be identified by variation over time in the price *difference* between standard plans. For example, the difference in price between the UAP and UEWP plan is equal to £3.18 (£16.1 - £12.92 = £3.18) until April 2009, at which point it becomes £3.00 (£17.2 - £14.2 = £3.00).

- In practice, our price measure is the percentage price difference between a household's price and the minimum rival price in the market. By analogous reasoning, the price parameter is identified by variation over time in the difference in this percentage discount between plans. For example, the difference in the percentage price discount between the UAP and the UEWP plans ranges over time between 0.56 (in April and June 2009, a 2.67% discount on the UAP plan less a 2.11% discount on the UEWP plan is equal to a 0.56 percentage-point difference) and 2.97 percentage points (in December 2009, a 1.28% discount on the UAP plan less a -1.69% discount on the UEWP plan is equal to a 2.97 percentage-point difference).

When we introduce fixed-term and rollover contract variables (points 8 – 10 in the variable list above), the price parameter is further identified by three additional sources of variation:

[16] If it did (and continuing to ignore contracts), then these dummies would pick up the effects of all the changes in prices across plans and time and we could not estimate any price coefficient.

- The difference in the percentage price discount for a plan in the (initial) MCP between 12-month fixed-term and rollover contracts. For example, the 12-month fixed-term special Offer D offers a UAP plan at the price of a UWP plan during the first three months of the offer (a discount of £5.99 over the standard price of a UAP plan). By contrast, the 12-month rollover Offer G offers a UAP plan for just £1 less than the standard price. For the first three months of Offer D, the difference in percentage price discount implied by these different discounts identifies the price parameter.

- The difference in the percentage price discount for a plan on a particular 12-month fixed-term promotion depending on the month in promotion within the MCP. Recall from Table 1 that many fixed-term special offers offer price discounts for periods less than the length of the MCP. For example, under the most popular fixed-term special offer introduced above, Offer D, the £5.99 discount over the standard price of a UAP plan expires at the end of the first three months of the offer.[17] It is this source of variation that was emphasized in the original Rollover Report and caused the greatest concern to BT.[18]

- The difference in the price paid for a plan between particular promotions *within* fixed-term and (especially) rollover promotions. A close examination of the special offers in Tables 1 and 2 demonstrates that, when applied to certain plans, several are identical *except for the size of the price discount*. For example, among rollover contract special offers applying to the UEWP, Offer H and Offer K differ only in whether or not a discount is offered. Both plans offer Friends & Family Mobile, but Offer H also offers UEWP for the price of UWP (a discount of £2.99), while Offer K offers no discount. Similarly, Offer N is identical to Offer F except that the former offers a UEWP for £1 less than UWP (a £3.99 discount) while the latter offers it at the price of UWP (a £2.99 discount). Furthermore, to the extent that differences in switching between plan types are constant across special offers and captured by the plan dummies, all observations on Offer K (that is, not only the Offer K observations associated with a UEWP plan) contribute to identifying the effect of the price discount.

The variation in price discounts (and additional services) within rollover contracts described in the last bullet point plays an important role in the results described in the next section. As such, we wish to briefly discuss it in further detail.

To the extent that there aren't unobservable elements influencing which types of households were presented with/accepted different special offers, the variation of the price discount on otherwise identical special offers is ideal for identifying the price parameter in the econometric estimation.[19] Indeed, as BT itself noted, "in order to control for the impact of the price discount,

[17] While it is true that as time on the offer elapses confounding factors vary (in addition to tenure on promotion itself, the value of early termination charges), we assume in our specification that these factors have the same effect on customers on fixed-term contracts as they have on customers on rollover contracts – for whom the price discount never expires.

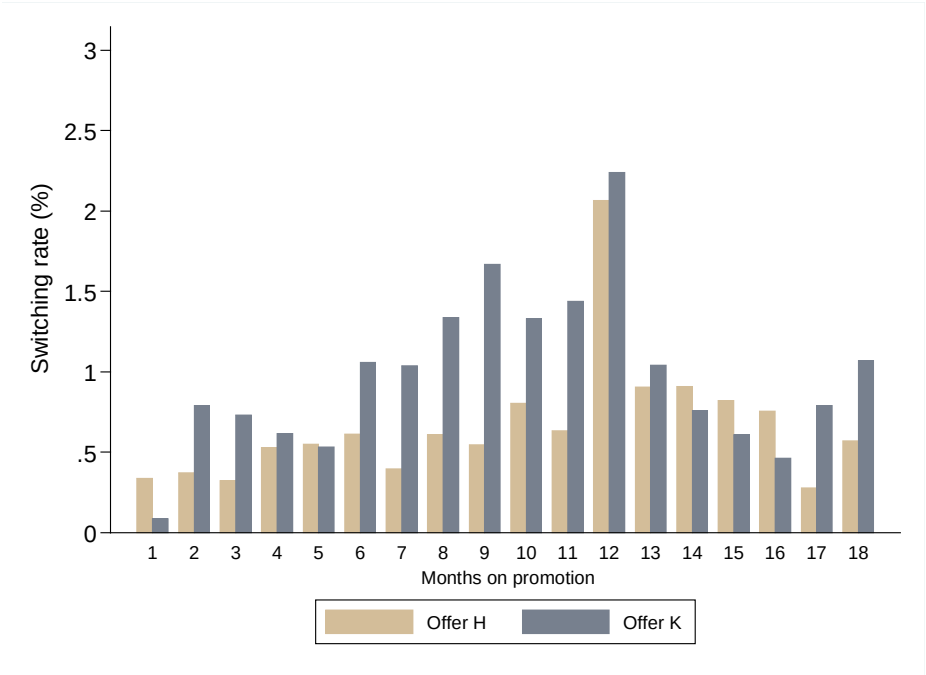
[18] The variation in price discounts at the *end* of the MCP could also contribute slightly towards estimating price effects. The effect of the *average* reduction in percentage price discount will be picked up by a dummy variable indicating the end of the MCP, but subtle variation across plans or offers in the magnitude of the discount reduction relative to this average (and any associated variation in switching) could also contribute to identifying price effects.

[19] Based on the detailed material provided by BT regarding their special offers, we could not, for example, distinguish any difference between Offer H and K other than the different price discount. Despite the fact that Offer H offered a discount and Offer K did not, there were some households that chose Offer K. To rationalize this behaviour, we assume such households were simply unaware of the existence of Offer H when they made their choice. There are ✂ household-month observations in our dataset which are associated with Offer K, ✂ of which on a UWP plan, ✂ on a UEWP plan, and ✂ on a

ideally one would […] compare ARC contracts with and without price discounts and see whether switching rates are materially different." (Cheek Letter on page 1) Having rollover contracts that differ only in the size of their price discounts provides just that experiment.

Figures 6 demonstrates the value of this variation. It reports the average switching rate by month in their MCP for customers on Offer H and Offer K. Switching is almost always lower for households on Offer H (with the discount) than on Offer K (without it). On average across all affected households and months, the average switching rate for Offer H is 0.56% and for Offer K is 0.99%.

Figure 6: Switching rates for rollover Offers H and K



Source: Own calculations based on BT data.

Note: Switching is defined as the event of switching away from BT. See Appendix 4 of the Rollover Report for a detailed description of the construction of the dataset. It is assumed that switches occurring up to 370 days after the promotion start date occurred within the twelfth month on the promotion.

3.3 Additional specifications

To explore these alternative sources of price variation, we construct additional variables. Recall from Section 3.1 that the price variable we used in the Rollover Report is constructed as the percentage price difference between the price a customer is paying BT for its fixed voice telephone service (including any discounts due to the plan and contract chosen) and the price it would pay its cheapest rival for the same (standard) plan. First, we decompose this variable into:

UAP plan. In terms of households, there are ✂ unique households in our dataset who chose Offer K, of whom 173 were on a UEWP plan.

- The percentage price difference from rivals on standard plans, that is the difference in the price of a standard plan between BT and its cheapest rival;

- The percentage price difference on contracts, that is the discount on the price of a plan offered by fixed-term and rollover contracts.

Second, we interact the Rollover Report's price variable with indicators for contract type, creating three additional variables: Percentage price difference from rivals x Standard contract, Percentage price difference from rivals x Rollover contract, and Percentage price difference from rivals x Fixed-term contract. Lastly, we interact the indicator for the standard contract with indicators for the UEWP and the UAP plans. We explain the rationale for these interactions in Section 4.1.3 below.

4 Results

We considered a large number of alternative specifications. The ones we report here are as follows (with the corresponding columns in Table 5 given in squared brackets):

1. Without prices and with a common percentage price difference effect (Columns 1-2)

2. Separating the percentage price difference into that due to (1) discounts off the standard (no-contract) BT price for that plan and (2) differences in the undiscounted price between BT and its rivals (Column 3)

3. Allowing different effects of percentage price differences by contract type (standard, fixed-term, and rollover), without and with standard-contract plan dummies (Columns 4-5)

4. Allowing different effects of percentage price differences by contract type, but for UEWP households only (Column 6).

4.1 Price effects

For convenience, we only report results for models that control for self-selection as described in the Rollover Report's Sections 3.2 and 4.1.2.[20] We describe each of the specifications introduced above in turn. In this sub-section we focus on price effects. In the next subsection, we discuss the implications of the various estimates of price effects on the estimated effect of rollover contracts.

[20] As in the Rollover Report, we find that correcting for self-selection had a negligible effect on the estimated effects of rollover contracts after the first MCP. Table 11 in the Appendix reports the results from univariate probit specifications that do not control for self-selection.

4.1.1 Models without prices and with a common percentage price difference (Columns 1 and 2)

Our first specifications are comparable to those reported in Table 2 in the Rollover Report. We include them here to facilitate comparisons with our earlier results.

Column 1 reports the marginal effects evaluated at the mean of the independent variables of the set of covariates included in the Rollover Report *excluding* the percentage price difference from rivals. Column 2 reports marginal effects including the percentage price difference, but requiring its effect to be the same for all households. For both columns, the results are very similar, but not identical, to the first and second columns in Table 2 of the Rollover Report.[21] For column 2, the point estimate of 0.92 means that a 10 percentage-point decrease in the price discount (e.g., from a discount of 25% to a discount of 15% in Figure 5) is associated with a 0.092 percentage-point increase in the probability of switching (e.g., from a probability of 0.95% to a probability of 1.042%).[22] This is 9.7% of the 0.95 percent estimated switching probability at the mean of the data.

4.1.2 Separating the effect of discounts from BT prices from differences in rivals' prices (Column 3)

Column 3 reports the effect of splitting the definition of the percentage price discount into two effects: the percentage price discount received by the household relative to the undiscounted (standard contract) BT price for their chosen plan and the percentage price difference between the undiscounted BT price and the minimum rivals' price for a comparable service plan. The purpose of this specification is to explore whether variation in the price a household pays relative to BT's undiscounted price for their chosen plan or variation between BT's and its rivals' undiscounted prices for that plan is more important for estimating the effect of percentage price differences on switching.

The results show that price differences relative to rivals matter little: the point estimate for the percentage price difference relative to the undiscounted BT price is positive, significant, and identical to the pooled effect (Marginal Effect (ME) of 0.92). By contrast, the point estimate for the difference between undiscounted BT's and rivals' prices is negative and statistically insignificantly different from zero (ME of -0.84). This is perhaps not surprising: Figure 3 demonstrates that there is very little variation in the absolute price difference between undiscounted prices for BT and its rivals and that what little there is will necessarily be picked up by the month dummies. There just isn't much if any information in price differences between CPs. Moreover, the multiplicity of retail offers available and the presence of switching costs further reduce the impact of these price differences on switching behaviour.

[21] The differences are two. First, in this Supplement, we infer household-specific prices and additional services (F&F mobile and international) for all the special offers in the estimation dataset; in the Rollover Report, we did so just for the largest and most important special offers (accounting for more than 90% of fixed-term offers and for more than 99% of rollover offers. Second, Column 1, Table 5 in the Supplement includes a self-selection correction while Column 1, Table 2 in the Rollover Report did not (yet) correct for self-selection.

[22] For ease of interpretation, in comparison with the Rollover Report we rescale the price variable downwards by a factor of 100. This implies that a marginal effect of 0.92 corresponds to a marginal effect of 0.0092 in the Rollover Report.

4.1.3 Separating price effects by contract type (Columns 4 and 5)

Columns 4 and 5 report the effects of allowing for different price effects within standard, fixed-term, and rollover contracts. We find three interesting effects, each for a different reason. For reasons that will become clear, we discuss the standard contract effects last.

First, we find that there is a large, positive, and very significant effect of percentage price differences on switching within rollover contracts (ME of 1.13). In absolute magnitude, this effect is slightly larger than the pooled effect (0.92) recovered in Column 2 (and in the Rollover Report). We discuss the implications of the significant effect of price variation within rollover contracts in detail in the section below.

Second, we find that there is a small, negative, and insignificant effect of percentage price differences on switching within fixed-term contracts (ME of -0.12). As this was the source of price variation that most concerned BT, these results validate its concerns. It does indeed appear that consumers do not respond to the price variation induced by expected changes in their percentage price difference due to the expiration of discounts within their MCP (and/or other price variation within fixed-term contracts). The larger estimated effect of price variation within rollover contracts further validates BT's contention that this kind of price variation is likely to reduce the estimated effect of percentage price differences on consumer switching behaviour based on pooling (as in Column 2 and in the Rollover Report). We discuss the implications of these conclusions for the estimated effect of rollover contracts below.

Finally, we find that there is a very large, positive, and significant effect of percentage price differences due to standard contracts (ME of 2.97). The statistical significance of this result is surprising given the lack of discounts on standard plan prices. As described in the second bullet in the identification section, this effect must be driven by subtle differences in the variation over time in switching rates relative to the difference in the percentage price discount between plans.

To assess the robustness of the last effect, we included additional dummy variables for plan types within standard contracts. Interacting plan dummies with a standard-contract dummy relaxes the assumption that the purchase of certain plans has a common effect on switching across contracts. It had an important effect here, reducing the absolute magnitude of the price effect for standard plans (to 1.35) and also making it statistically insignificantly different from zero. We note that this also had a statistically significant effect on the estimated impact of percentage price differences on rollover contracts, increasing its estimated marginal effect on switching even further (from 1.13 to 1.57).

Based on the results in Column 5, we can see the importance of accounting for different sources of price variation in the econometric estimation. Variation in prices across time (as for standard-contract price variation and fixed-term contracts with discounts that end before the end of their MCP) appears not to be sufficiently strong to accurately identify the effect of price variation on switching. By contrast, variation across households in the discount received across special offers within rollover contracts appears to be the driving source of price variation generating our estimates of percentage price differences on switching.

4.1.4 Estimating price effects within UEWP plans only (Column 6)

To further try to isolate the most credible price variation in the data, our last regression estimates the effect of price variation within UEWP households *only*. We chose this specification as it was

the minimal specification that allowed both (1) relying exclusively on price variation due to rollover special offers that were identical other than the price discount (e.g., Offer H/Offer K and Offer F/Offer N, all of which – with the exception of Offer K - are only applicable to the UEWP plan) and (2) estimating the effect of rollover contracts themselves (as this requires including households on fixed-term and standard contracts for a comparison group). As a result, this specification was estimated on approximately ✂ of our 2,000,000 observations.

The results within this specification are broadly consistent with the effects of the whole sample. The point estimate of the effect of percentage price difference (ME of 1.29) is of comparable magnitude and statistical significance as the earlier results. This confirms our belief that it is the variation in prices associated with special offers within rollover contracts that are the driving source of identification of price effects in the entire dataset.

4.2 Rollover effects

The reason to be concerned about the accurate estimation of price effects is that they can influence the estimated effect of rollover contracts: the more consumer switching depends on price differences, the more they will value the discount included in (almost all) rollover special offers and the less the lower switching rates exhibited by rollover customers will be attributed to the other (non-price) elements of these contracts.

The last, highlighted, row in Table 5 reports the influence our alternative specifications had on the estimated effect of rollover contracts after the first Minimum Contract Period. Across all specifications, we find there are relatively modest consequences on the estimated causal effects of rollover contracts.

The first two columns confirm the argument outlined above: estimating the determinants of household switching ignoring (Column 1) and including (Column 2) the price discount has a significant effect on the estimated effect of rollover contracts (reducing the effect from -0.48 to -0.34 percentage points). As intended, these results are essentially identical to those in Table 2 in the Rollover Report.[23]

The remaining columns show differences in rollover effects in line with their relationship with price effects. Splitting the effect of discounts from BT prices from differences in rivals' prices (Column 3) has no effect on the price coefficient and thus none on the estimated rollover effect (-0.34). Separating price effects by contract type (Columns 4 and 5) increased the estimated effect of percentage price differences (for those coefficients that were statistically significant) and correspondingly reduced the estimated effect of rollover contracts (to -0.30 and -0.26 percentage points, respectively). Column 6, relying on the minimal specification required to estimate rollover effects while relying on variation within rollover contracts, yields an estimated effect of rollover contracts of -0.31 percentage points.

[23] See footnote 16 for the reasons for their slight difference.

Which set of results should one prefer? In our opinion, it is the results in Column 6 that are the most reliable. As described above, this is the minimal specification that simultaneously relies on the most compelling price variation in the data and permits estimation of the effect of rollover contracts. For this specification, rollover contracts are estimated to reduce switching by 0.31 percentage points, 32.6% of the 0.95% predicted switching rate for the average observation in the data. This is only slightly less than the preferred estimate of -0.33 percentage points (-34.8%) arrived at in the Rollover Report.

Table 4: Main marginal effects in models that control for self-selection

Variable	[1]	[2]	[3]	[4]	[5]	[6]
Price difference (%) from rivals	-	0.92***	-	-	-	-
Price difference (%) on contracts	-	-	0.92***	-	-	-
Price difference (%) from rivals on standard plans	-	-	-0.84	-	-	-
Price difference (%) from rivals x Standard	-	-	-	2.97*	1.35	-
Price difference (%) from rivals x Rollover	-	-	-	1.13***	1.57***	1.29*
Price difference (%) from rivals x Fixed-term	-	-	-	-0.12	0.091	-1.01
UEWP x Standard	-	-	-	-	-0.086	-
UAP x Standard	-	-	-	-	0.11	-
Log(Tenure at BT)	-0.59***	-0.59***	-0.59***	-0.59***	-0.59***	-0.55***
Log(Tenure on promotion)	-0.17***	-0.17***	-0.17***	-0.17***	-0.17***	-0.31***
Broadband	-0.49***	-0.50***	-0.50***	-0.50***	-0.50***	-0.48***
BT vision	0.091*	0.09	0.09	0.090*	0.091*	0.072
F&F mobile	-0.078	-0.12**	-0.12**	-0.13**	-0.15***	-0.19***
F&F international	0.87	0.77	0.77	0.73	0.69	0.58
UEWP	0.047*	0.081***	0.081***	0.083***	0.16	-
UAP	-0.25***	-0.30***	-0.30***	-0.33***	-0.37***	-
Initial MCP month 1	-0.83***	-0.80***	-0.80***	-0.79***	-0.78***	-0.88***
Initial MCP month 2	-0.83***	-0.79***	-0.79***	-0.78***	-0.77***	-0.86***
...	...	...	...	...	...	...
Initial MCP month 11	-0.44***	-0.32***	-0.32***	-0.28***	-0.25***	-0.25*
Initial MCP month 12	0.67***	0.98***	0.98***	1.08***	1.16***	1.18***
12-month fixed-term after end of MCP	0.39***	0.41***	0.41***	0.46***	0.44***	0.63***
Rollover in subsequent MCP(s)	-0.48***	-0.34***	-0.34***	-0.30***	-0.26***	-0.31**
Rho (corr. Coeff.)	-0.064	-0.061	-0.061	-0.058	-0.060	-0.042
Average predicted switching	0.95%	0.95%	0.95%	0.95%	0.95%	1.00%
Predicted switching for the average observation	1.24%	1.24%	1.24%	1.24%	1.24%	1.33%
Obs. num.			✂			✂

Source: Own calculations based on BT data.

Note: One, two, and three stars (*, **, and ***) denote statistical significance at the 5%, 1%, and 0.1% level, respectively.

5 Conclusions

In our Rollover Report, we found that households on BT's rollover contracts switch after their first MCP by 0.33 percentage points (34.8%) less than comparable customers on standard contracts. Based on this finding, we concluded that BT's rollover contracts significantly increase switching and/or entry costs in fixed-voice telephony markets.

BT responded to the report by raising a number of concerns, primary of which was that the estimated effect of price discounts embodied in the econometric analysis underlying the Rollover Report inappropriately relied on certain types of price variation. Of particular concern was the reduction in the discount associated with the end of the promotional period within fixed term contracts.

In this Supplementary Report, we have addressed the concerns raised by BT regarding the sources of price variation identifying our estimated price effects. We have documented the sources of price variation in the estimation dataset for the Rollover Report, explored the relative importance of alternative sources of price variation, and estimated different price effects across a wide variety of econometric specifications.

We find that BT's concerns about relying on price variation due to changes over time–on-promotion in the discounted price provided within fixed-term special offers are legitimate: such variation yields an estimated price effect statistically insignificantly different from zero. We further find that the source of price variation that consistently yields significant effects is that associated with differences in discounts across special offers within rollover contracts.

In a reply to the Rollover Report, BT argues that "in order to control for the impact of the price discount, ideally one would […] compare ARC contracts with and without price discounts and see whether switching rates are materially different." The further investigation into price variation allowed in this Supplementary Report shows that such variation is indeed present and is the primary source of variation that identifies the price effects in the econometric model.

Indeed, we find that relying primarily on price variation across special offers within rollover contracts in the minimal specification that can estimate the effect of rollover contracts yields larger estimated effects of percentage differences (0.92 in the Rollover Report versus 1.29 in this Supplementary Report) and lower estimated effects of rollover contracts.

We find, however, that the economic consequences of relying on the most compelling price variation are small. Across all specifications we considered, we found a significant, negative effect of rollover contracts after the first MCP ranging from -0.26 to -0.34 percentage points.

In our preferred specification (the minimal specification that simultaneously relies on the most compelling price variation in the data and permits estimating the effects of rollover contracts on switching), rollover contracts are estimated to reduce switching by 0.31 percentage points, 32.6%

of the 0.95% predicted switching rate for the average observation in the data. This is only slightly less than the preferred estimate of -0.33 percentage points (-34.8%) arrived at in the Rollover Report. We therefore maintain our conclusion that BT's rollover contracts significantly increase switching and/or entry costs in fixed voice telephony markets.

Appendix

Fixed-term special offers

Table 5: All fixed-term special offers

Offer name	Plan	MCP	Price discount	Duration of price discount	Additional services	Customer-month observations
Offer D	UAP	12 months	UAP for UWP (£5.99 discount)	3 months	-	✂
Offer A	UEWP	18 months	UEWP for UWP (£2.99 discount)	12 months	-	✂
Offer B	UEWP	12 months	UEWP for £1.45 (£1.54 discount)	12 months	-	✂
Offer J	UAP	12 months	-	-	-	✂
Offer C	UWP, UEWP, UAP	18 months	-	-	-	✂
Offer L	UEWP	18 months	UEWP for UWP (£2.99 discount)	18 months	-	✂
Offer M	UAP	12 months	UAP for UWP (£5.99 discount)	3 months	-	✂
Offer E	UAP	18 months	UAP for UWP (£5.99 discount)	3 months	-	✂
Offer N	UAP	18 months	£1 discount	18 months	-	✂
Offer Q	UWP, UEWP, UAP	18 months	-	-	-	✂
Offer R	UEWP, UAP	12 months	£2 discount	12 months	-	✂
Offer S	UAP	18 months	£2 discount	12 months	-	✂
Offer T	UEWP	12 months	£2 discount	12 months	-	✂
Offer U	UWP, UEWP, UAP	18 months	-	-	-	✂
Offer V	UEWP, UAP	18 months	£2 discount	12 months	-	✂
Offer W	UWP, UEWP, UAP	12 months	-	-	Friends and Family International	✂
Offer Y	UAP	12 months	UAP for UWP (£5.99 discount)	3 months	-	✂
Offer Z	UWP, UEWP, UAP	18 months	-	-	-	✂
Offer AA	UWP, UEWP	18 months	-	-	-	✂
Offer AB	UEWP	18 months	UEWP for £1.45(£1.54	12 months	-	✂

Offer name	Plan	MCP	Price discount	Duration of price discount	Additional services	Customer-month observations
			discount)			
Offer AC	UAP	12 months	UAP for UWP (£5.99 discount)	1 month	-	2

Source: Own calculations based on BT data.

Distribution of prices

Table 6: Distribution of monthly prices, by plan type

UWP			UEWP			UAP		
Price	Frequency	Fraction (%)	Price	Frequency	Fraction (%)	Price	Frequency	Fraction (%)
10.27	✂	23.18	9.27	✂	0	10.27	✂	0.23
11.25	✂	59.57	10.25	✂	0.06	11.25	✂	0.12
11.54	✂	17.25	10.27	✂	13.56	11.54	✂	0.61
-	-	-	10.54	✂	0.04	14.1	✂	0.02
-	-	-	10.92	✂	0.05	15.1	✂	4.95
-	-	-	11.25	✂	41.46	15.2	✂	0.01
-	-	-	11.54	✂	13.93	15.53	✂	0
-	-	-	11.72	✂	0.03	16.1	✂	14.08
-	-	-	12.2	✂	0	16.2	✂	17.1
-	-	-	12.92	✂	6.83	16.53	✂	5.33
-	-	-	14.2	✂	18.76	17.2	✂	42.39
-	-	-	14.53	✂	5.29	17.53	✂	15.15

Source: Own calculations based on BT and PurePricing data.

Note: Prices are for paper-free billing and direct-debit payment, and include VAT.

Table 7: Distribution of monthly prices, by contract type

Standard			Fixed-term			Rollover		
Price	Frequency	Fraction (%)	Price	Frequency	Fraction (%)	Price	Frequency	Fraction (%)
10.27	✂	16.94	10.27	✂	2.69	9.27	✂	0
11.25	✂	43.48	10.92	✂	0.53	10.25	✂	0.07
11.54	✂	12.57	11.25	✂	5.08	10.27	✂	17.22
12.92	✂	3.54	11.54	✂	3.58	10.54	✂	0.04
14.2	✂	10.04	11.72	✂	0.3	11.25	✂	52.58
14.53	✂	2.84	12.2	✂	0	11.54	✂	17.65
16.1	✂	2.04	12.92	✂	8.68	12.92	✂	0.06
17.2	✂	6.52	14.1	✂	0.08	14.2	✂	0.22
17.53	✂	2.05	14.2	✂	17.97	14.53	✂	0.09
-	-	-	14.53	✂	4.56	15.1	✂	2.01
-	-	-	15.1	✂	0.26	16.1	✂	0.03
-	-	-	15.2	✂	0.04	16.2	✂	6.97
-	-	-	15.53	✂	0	16.53	✂	2.19
-	-	-	16.1	✂	12.98	17.2	✂	0.42
-	-	-	16.2	✂	0.7	17.53	✂	0.44
-	-	-	16.53	✂	0.06	-	-	-
-	-	-	17.2	✂	29.43	-	-	-
-	-	-	17.53	✂	13.04	-	-	-

Source: Own calculations based on BT and PurePricing data.

Note: Prices are for paper-free billing and direct-debit payment, and include VAT.

Distribution of percentage price differences

Table 8: Distribution of price differences, by plan type

UEWP			UAP		
Price diff. (%)	**Freq.**	**Fract. (%)**	**Price diff. (%)**	**Freq.**	**Fract. (%)**
-41.86	✂	0.00	-55.70	✂	0.23
-40.88	✂	0.01	-50.93	✂	0.00
-38.54	✂	0.04	-48.80	✂	0.11
-37.00	✂	0.04	-47.14	✂	0.61
-35.61	✂	0.00	-13.40	✂	0.02
-28.36	✂	4.72	-11.71	✂	0.00
-28.04	✂	13.56	-10.13	✂	0.01
-26.22	✂	27.84	-9.34	✂	0.00
-25.13	✂	13.93	-5.89	✂	4.95
-23.56	✂	8.91	-4.81	✂	1.85
-20.42	✂	0.05	-3.33	✂	15.24
-13.93	✂	0.00	-2.72	✂	5.33
-12.20	✂	0.03	0.68	✂	14.08
-1.78	✂	6.83	1.28	✂	4.90
-1.69	✂	1.87	2.67	✂	37.49
0.00	✂	12.36	3.14	✂	15.15
0.62	✂	5.29	-	-	-
2.11	✂	4.53	-	-	-

Source: Own calculations based on BT and PurePricing data.

Notes: Percentage price difference are constructed as 100*(price – min_rivals_price)/price, where prices are for paper-free billing and direct-debit payment, and include VAT.

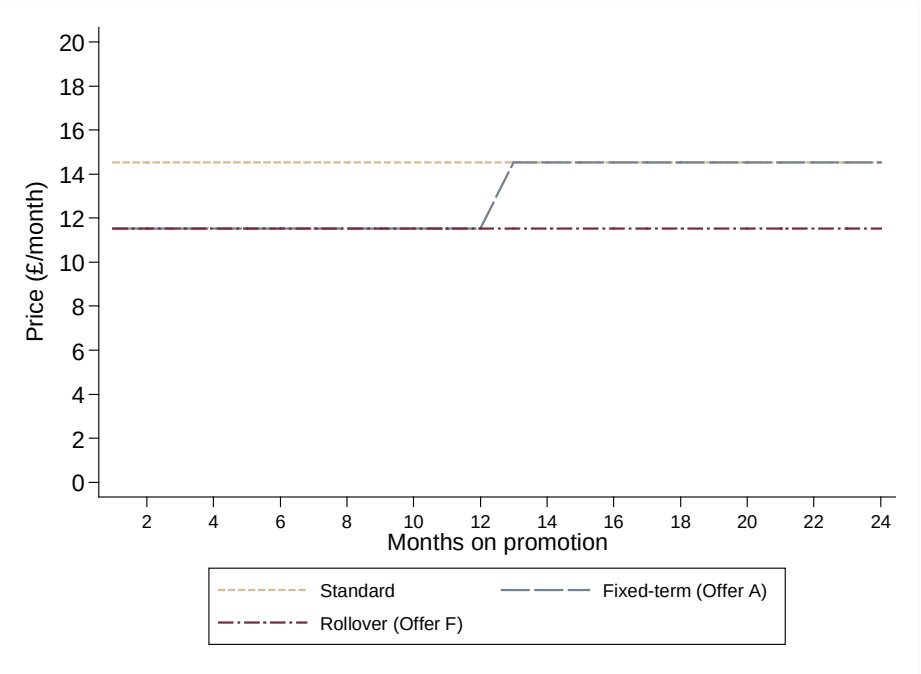
Table 9: Distribution of price differences, by contract type

Standard			Fixed-term			Rollover		
Price diff. (%)	Freq.	Fract. (%)	Price diff. (%)	Freq.	Fract. (%)	Price diff. (%)	Freq.	Fract. (%)
-1.78	✂	3.54	-55.70	✂	0.75	-55.70	✂	0.01
-1.69	✂	1.00	-48.80	✂	0.27	-50.93	✂	0.00
0.00	✂	79.62	-47.14	✂	2.10	-48.80	✂	0.01
0.62	✂	2.84	-28.36	✂	0.15	-47.14	✂	0.00
0.68	✂	2.04	-28.04	✂	0.63	-41.86	✂	0.00
1.28	✂	0.70	-26.22	✂	0.92	-40.88	✂	0.01
2.11	✂	2.39	-25.13	✂	0.42	-38.54	✂	0.05
2.67	✂	5.82	-23.56	✂	0.29	-37.00	✂	0.04
3.14	✂	2.05	-20.42	✂	0.53	-35.61	✂	0.01
-	-	-	-13.93	✂	0.00	-28.36	✂	5.83
-	-	-	-13.40	✂	0.08	-28.04	✂	16.72
-	-	-	-12.20	✂	0.30	-26.22	✂	34.37
-	-	-	-11.71	✂	0.00	-25.13	✂	17.20
-	-	-	-10.13	✂	0.04	-23.56	✂	11.00
-	-	-	-9.34	✂	0.00	-5.89	✂	2.01
-	-	-	-5.89	✂	0.26	-4.81	✂	0.76
-	-	-	-4.81	✂	0.05	-3.33	✂	6.21
-	-	-	-3.33	✂	0.65	-2.72	✂	2.19
-	-	-	-2.72	✂	0.06	-1.78	✂	0.06
-	-	-	-1.78	✂	8.68	-1.69	✂	0.03
-	-	-	-1.69	✂	1.62	0.00	✂	2.46
-	-	-	0.00	✂	17.12	0.62	✂	0.09
-	-	-	0.62	✂	4.56	0.68	✂	0.03
-	-	-	0.68	✂	12.98	1.28	✂	0.11
-	-	-	1.28	✂	3.83	2.11	✂	0.04
-	-	-	2.11	✂	5.05	2.67	✂	0.31
-	-	-	2.67	✂	25.60	3.14	✂	0.44
-	-	-	3.14	✂	13.04	-	-	-

Source: Own calculations based on BT and PurePricing data.

Notes: Price difference are constructed as 100*(price – min_rivals_price)/price, where prices are for paper-free billing and direct-debit payment, and include VAT.

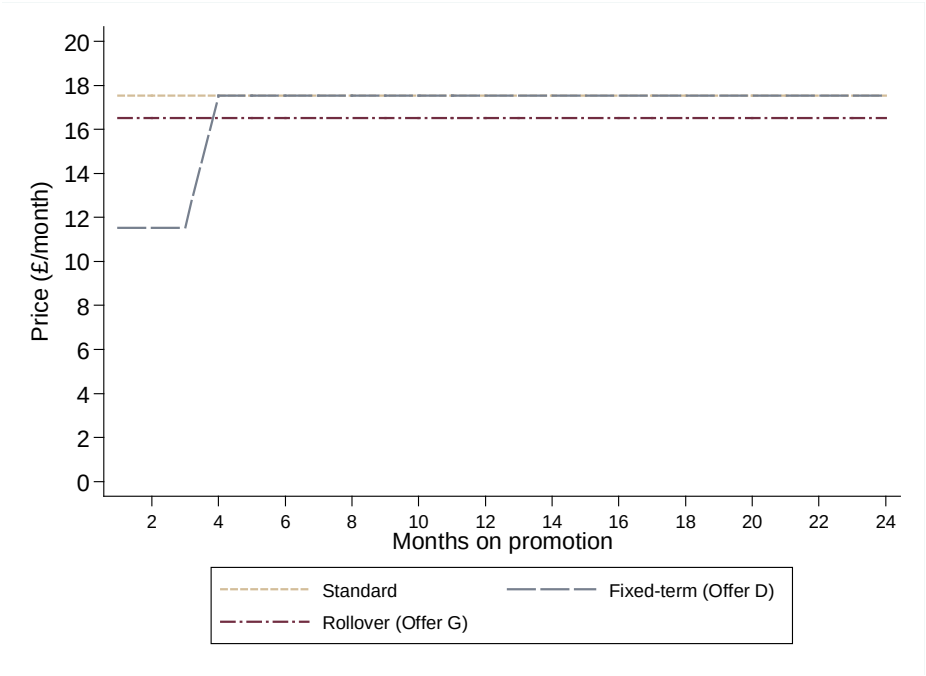
Figure 7: UEWP prices for different contracts



Source: Own calculations based on BT data.

Note: Prices are for paper-free billing and direct-debit payment, and include VAT.

Figure 8: UAP prices for different contracts



Source: Own calculations based on BT data.

Note: Prices are for paper-free billing and direct-debit payment, and include VAT.

Results from models that do not control for self-selection

Table 10: Main marginal effects in models that do not control for self-selection

Variable	[1]	[2]	[3]	[4]	[5]	[6]
Price difference (%) from rivals	-	0.95***	-	-	-	-
Price difference (%) on contracts	-	-	0.95***	-	-	-
Price difference (%) from rivals on standard plans	-	-	-0.85	-	-	-
Price difference (%) from rivals x Standard	-	-	-	2.90*	1.36	-
Price difference (%) from rivals x Rollover	-	-	-	1.15***	1.57***	1.30**
Price difference (%) from rivals x Fixed-term	-	-	-	-0.22	-0.016	-0.99
UEWP x Standard	-	-	-	-	-0.08	-
UAP x Standard	-	-	-	-	0.11	-

Variable	[1]	[2]	[3]	[4]	[5]	[6]
Log(Tenure at BT)	-0.59***	-0.59***	-0.59***	-0.59***	-0.59***	-0.55***
Log(Tenure on promotion)	-0.18***	-0.18***	-0.18***	-0.17***	-0.17***	-0.32***
Broadband	-0.49***	-0.50***	-0.50***	-0.50***	-0.50***	-0.48***
BT vision	0.091*	0.09	0.09	0.090*	0.091*	0.072
F&F mobile	-0.083*	-0.12**	-0.12**	-0.13***	-0.15***	-0.19***
F&F international	0.87	0.77	0.77	0.73	0.69	0.58
UEWP	0.050*	0.085***	0.085***	0.086***	0.16	-
UAP	-0.25***	-0.31***	-0.30***	-0.34***	-0.37***	-
Initial MCP month 1	-0.89***	-0.86***	-0.86***	-0.86***	-0.85***	-0.93***
Initial MCP month 2	-0.84***	-0.80***	-0.80***	-0.79***	-0.77***	-0.87***
…	…	…	…	…	…	…
Initial MCP month 11	-0.45***	-0.32***	-0.32***	-0.29***	-0.26***	-0.27*
Initial MCP month 12	0.64***	0.96***	0.96***	1.05***	1.13***	1.13***
12-month fixed-term after end of MCP	0.38***	0.40***	0.40***	0.45***	0.43***	0.60***
Rollover in subsequent MCP(s)	-0.49***	-0.35***	-0.35***	-0.31***	-0.28***	-0.33**
Average predicted switching	1.25%	0.95%	0.95%	0.95%	0.95%	1.00%
Predicted switching for the average observation	0.95%	1.25%	1.25%	1.25%	1.25%	1.34%
Obs. num.			✂			✂

Source: Own calculations based on BT data.

Note: One, two, and three stars (*, **, and ***) denote statistical significance at the 5%, 1%, and 0.1% level, respectively.

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