ESMT Competition Analysis

ESMT CA FINAL REPORT

Empirical analysis of BT's automatically renewable contracts

A 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

This report presents the results of an econometric study analysing the impact of BT's automatically renewing ("rollover") contracts on its customers' decisions to switch to another supplier of fixed voice telephony service in the UK. The goal of the report is to contribute to Ofcom's understanding of the likely effects of such contracts on household switching costs and, by extension, on the nature of competition and consumer welfare in this market.

Many telecommunications firms offer "fixed-term contracts" (or just "term contracts") that require customers to maintain service for a minimum contract period (MCP) in return for a price discount relative to that charged on a flexible contract that can be cancelled with short notice. In February 2008, BT introduced "rollover contracts" that include such a 12-month MCP, but also automatically renew the MCP for an additional 12 months unless the household elects to opt out during the course of the original MCP. In exchange, households receive a promotional benefit (that also "rolls over"), most commonly free evening and weekend calls at the price of the baseline free weekend calling plan, a £2.99 discount.

There are mixed views about the impact of fixed-term contracts on the functioning of economic markets. Service providers claim that they allow them to spread any fixed costs of providing service over the length of the MCP, reducing up-front costs to consumers and enhancing take-up. MCPs also include early termination charges (ETCs), however, increasing the costs of switching providers. Such switching costs can reduce social welfare, particularly if consumers are myopic or they influence the costs of product or market entry by making it harder to attract customers to new service offerings. Rollover contracts would appear to increase market-wide switching costs by increasing the share of a company's customers that are under MCPs at a given point of time.

The purpose of this study is to estimate the causal effect of BT's rollover contracts on its customers' decisions to switch to another provider of fixed voice telephone service. Accurately measuring such causal effects is challenging for a number of reasons. First, it requires detailed disaggregate data on the switching behaviour of individual households. These data are not typically available to external analysts. Second, it requires accurately accounting for determinants of household switching behaviour *other than* that due to the rollover contracts themselves. The most important of these are likely to be tenure (i.e., how long a customer has been with BT), whether the customer purchases other services from BT (e.g. broadband access), the effect of any price discounts, and "self-selection" (or just "selection"), unobserved differences in households' likelihood of switching that might be correlated with their decision to select a rollover contract.

The data collected and econometric model estimated in this study attempt to address each of these concerns. First, working with Ofcom staff, we obtained detailed customer-level billing data from BT for a random sample of almost 180,000 of its fixed-line voice customers as of 31 December 2008. This data includes detailed information about each household's history with BT as well as their voice plan, contract, price paid (including any discounts), and minimum contract period(s) on the sampling date and for 15 subsequent months (through 31 March 2010). We

augmented this with aggregate market-wide information measuring macroeconomic trends and prices offered by rival providers for similar services. The result was a comprehensive dataset that provides the best information available to analyse switching behaviour at the level of the individual household.

The econometric model was similarly designed to attempt to address the measurement challenges above. The large sample size gave us sufficient data to effectively estimate the impact of rollover contracts on switching behaviour while controlling for a host of other factors that might influence switching, including tenure. To measure the impact of price, we were able to exploit both differences in relative price changes across plans and time within BT as well as differences in relative price changes across providers of similar plans. Finally, to account for selection, we specified a model of households' decision to enrol in a rollover contract and allow unobservable determinants of that decision to be correlated with the decision to later switch away from BT.

The following are our key findings in the study.

We first estimate the difference in switching behaviour of households on rollover contracts without regard to disaggregating the effect into price differences, selection, and/or the causal effects of the contracts themselves. We find BT customers on rollover contracts switch after their first MCP 51.7% less than comparable customers on standard contracts and by 65.8% less than comparable customers on fixed-term contracts that do not automatically roll over.

We further find that this qualitative finding is robust to the inclusion of controls for tenure, whether or not the household purchases other services from BT, the price discount offered by rollover contracts, as well as accommodating self-selection by households into such contracts. We find that tenure, price effects, and the purchase of broadband service are all economically important (doubling a household's tenure with BT, offering a 21% discount like that offered on the most popular rollover contract, and purchasing broadband service from BT reduces switching by an estimated 62.3%, 21.9%, and 52.8%, respectively) and that there is statistically significant evidence of self-selection. However, even after controlling for the effects of tenure, price discounts, broadband purchase, and self-selection, we find that households on BT's rollover contracts switch after their first MCP 34.8% less than comparable customers on standard contracts and by 54.8% less than comparable customers on BT's fixed-term contracts.

In an Appendix, we extend this analysis to account for the reduction in ETCs recently agreed between Ofcom and BT.[1] To do so, we separate the effect of BT's rollover contracts on switching into an effect of the ETCs induced by subsequent MCPs under rollover contracts and the effect of rollover contracts themselves. We find, after controlling for the effects of tenure, price discounts, broadband purchase, and self-selection, that households on BT's rollover contracts switch after their first MCP by 26.0% less than comparable customers on standard contracts and that this would fall to 18.8% under the now-lower ETCs agreed between Ofcom and BT.

This evidence is consistent with the view that BT's rollover contracts significantly increase switching and/or entry costs in fixed voice telephony markets. The existing economic literature

[1] See Ofcom press release at http://www.ofcom.org.uk/consumer/2010/06/cheaper-charges-for-uk-consumers-to-end-phone-contracts, accessed 3 July 2010.

has raised concerns about the influence such costs may have on competition and welfare that suggests rollover contracts may therefore be cause for concern, particularly in light of BT's continuing (if diminished) role as the largest firm in the market. While we exclusively analyse switching in voice markets, these concerns would also arise in broadband markets to the extent rollover contracts for such services similarly reduce household switching.

An important qualification to these findings is that they rely on our adequately controlling for the self-selection of households into rollover contracts. Our model of selection exploits the sequential nature of decisions in the market: customers in month t-1 continuing with BT in month t make a choice of plan and contract they wish to have in month t. We therefore can use these time t-1 factors to instrument for the choice of time t rollover contracts when predicting the impact of such contracts on switching from BT at the end of period t. This is an attractive modelling strategy as long as these lagged factors do not unintentionally capture the effects of unmodelled, persistent unobserved heterogeneity that might be driving self-selection. We are sensitive to this concern, test for this possibility, and can reject that it is driving our results. Further analysis of likely sources of self-selection suggests it is unlikely based on significant differences in switching rates between customers on rollover versus standard contracts among long-time BT customers. Based on both these results, we are confident our self-selection correction is adequate.

Ofcom expressed interest in a number of other aspects of rollover contracts that we were not able to analyse in this study. For example, rollover contracts increase the burden of cancelling an additional MCP by making it an "opt-out" instead of "opt-in" contracting environment. This presents BT with the opportunity to make "bespoke retention offers" when customers call to opt out. This, in turn, may permit BT to keep prices relatively high and only provide discounts to those customers who have expressed an interest in leaving. We explored the possibility of obtaining the necessary data to analyse the incidence and effects of such offers when designing this study, but BT's call centre records were not linked to its customer billing data, making the effort too costly for both BT and us.[2]

Consumers might also respond differently to rollover contracts due to so-called "behavioural" effects. For example, an opt-out contracting environment changes the default option for rollover customers, possibly leading to "default bias" and more customers on MCPs than might otherwise occur. Furthermore, opting out must be done in a timely manner (i.e. before an additional MCP begins). BT prompts customers that this is necessary with a letter in the 11th month of the MCP, but myopia, forgetfulness, and/or the pressing demands of modern life may cause customers to miss the deadline, again leading to more customers on MCPs than otherwise. Investigating such "behavioural effects" is challenging with only observational data and was therefore not explored here.

[2] We similarly attempted to obtain information about the marketing channel used by customers to sign up for rollover contracts to try to assess the impact of differences in offer transparency on household behaviour, but BT does not retain this information in its customer records.

1 Introduction

1.1 Factual background

On 1 February 2008, BT inaugurated a new tariff according to which residential customers who agreed to a 12-month automatically renewable contract would pay a monthly price of £11.54 for its fixed-voice Unlimited Evening & Weekend plan, instead of the price of £14.53 available without a contract[3]—a price discount of 21%. If the customer wished to terminate the contract during the initial or any subsequent 12-month Minimum Contract Periods (MCPs), she would have to pay Early Termination Charges (ETCs) of £7.50—65% of the contract price—for each month left to the end of the current MCP.[4]

Automatically renewable contracts are now offered by BT on all of its plans (Unlimited Weekend, Unlimited Evening & Weekend, and Unlimited Anytime), sharing the same characteristics as the inaugural contract: [5]

- A price discount or additional service (e.g. Friends & Family Mobile) on the plan;
- ETCs in the amount of £7.50 per month if termination takes place before the end of the current 12-month-long MCP;[6]
- Automatic renewal of the contract at the end of the current MCP.

In addition, while these automatically renewable (henceforth, rollover) contracts can be cancelled (effective at the end of the current MCP) at any time during the MCP, BT sends a single reminder notice to its customers approximately one month before the MCP expires. Cancellation requires customers to call BT, who may use that opportunity to the customers intending to cancel the contract to make a "bespoke" offer in order to retain them.

Figure 1 shows the penetration of rollover contracts among BT's customer base over time. After a quick initial run-up, the rate of increase falls after January 2009, in some part due to a shift in

[3] These prices, as all prices quoted in this report, refer to Direct Debit, paper-free billing, prices.

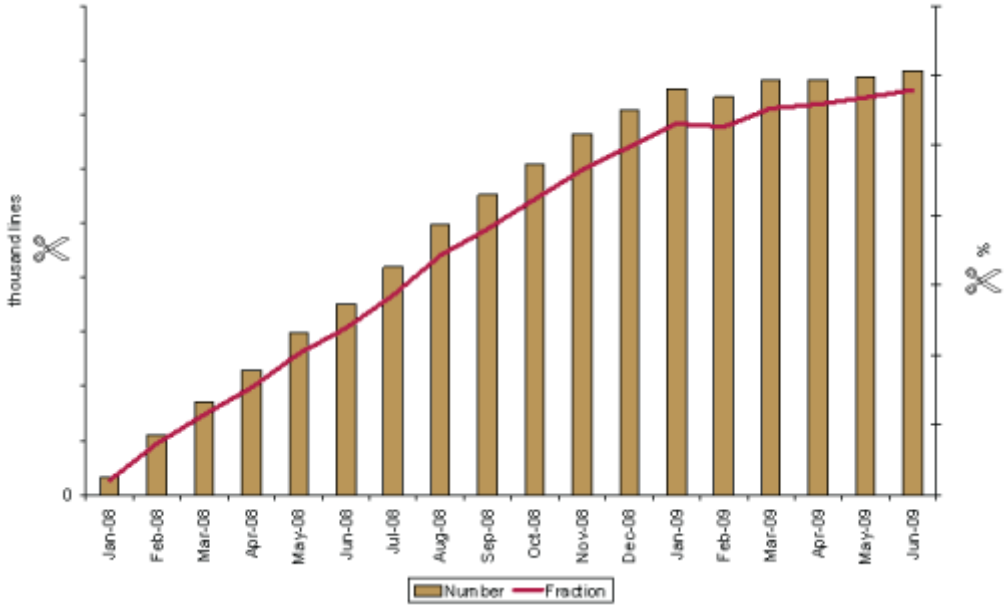
[4] See BT Price List, Notices 2008, Section 55, Part 2, Subpart 3.

[5] See BT Terms and Conditions: Currently available Offers/Deals (effective from 1 April 2010).

[6] BT, as well as TalkTalk and Virgin Media, agreed with Ofcom to change the amounts of their ETCs during the writing of this report. The new ETCs will become effective in October 2010. See Ofcom's press release dated 17 June 2010, available at http://consumers.ofcom.org.uk/2010/06/cheaper-charges-for-uk-consumers-to-end-phone-contracts and accessed on 3 July 2010. In Appendix 2, we evaluate the likely effects of these changes.

BT customer marketing away from auto-renewable contracts.[7] By June 2009, slightly less than 30% of BT customers were on an automatically renewable contract.[8]

Figure 1: Number and proportion of BT customers on automatically renewable contracts through June 2009



Source: BT's response to Ofcom's S135 on the narrowband market review.

BT has offered rollover contracts to fixed-voice business customers for quite some time[9] and has since February 2009 started to offer them also to residential broadband customers.[10] Thus far, except for small Communication Providers (CPs) AdEPT and Axis, BT is the only major CP to offer rollover contracts to fixed-voice residential customers.[11]

These rollover contracts coexist with simpler, non-renewable, term contracts that have only an initial MCP—with associated price discounts and ETCs.[12] For example, BT currently[13] offers on its Unlimited Evening & Weekend plan a non-renewable contract for the duration of 18 months, and the price discount associated with this longer (18 month) non-renewable contract is equal to the price discount associated with a shorter (12 month) renewable contract on the same plan. By agreeing to either contract, customers pay (during the MCP) for the Unlimited Evening & Weekend Plan what they would pay for the Unlimited Weekend plan without any contract. Households may also select non-contracted plans, but must pay higher prices.

[7] Conversations with BT between November and December 2009.

[8] In March 2010, [≫]% of the customers remaining in our (roughly 1%) random sample of BT customers were on rollover contracts.

[9] Ofcom (2009a), p.3.

[10] Ofcom (2009a), p.84.

[11] Ofcom (2009a), p. 85.

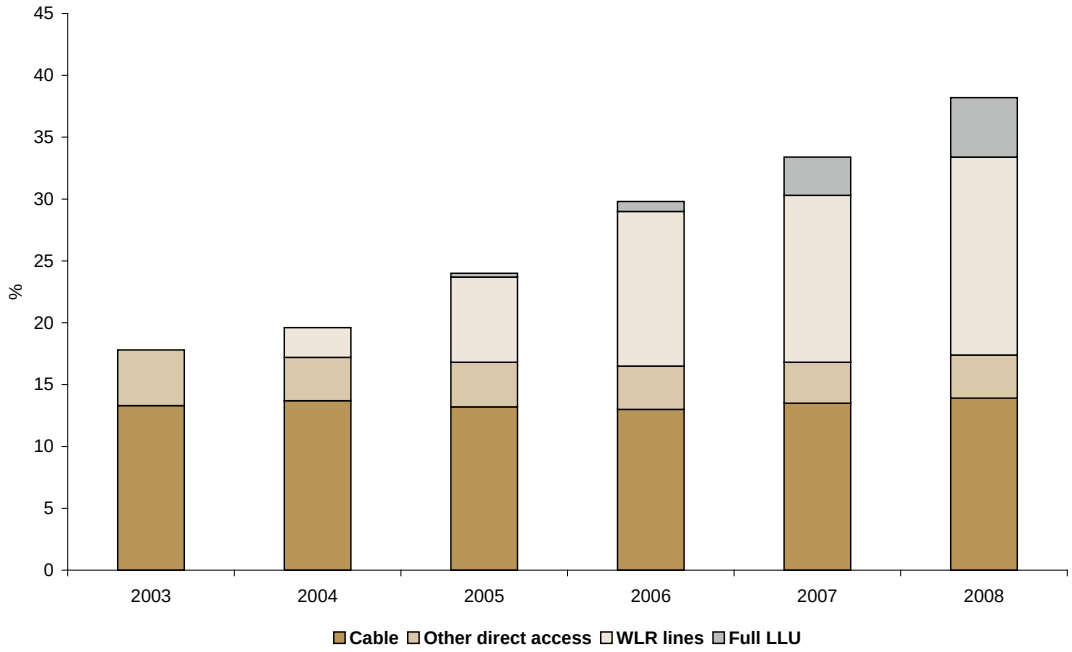
[12] ETCs are associated not only to fixed-term and rollover contracts, but also to the first 12 months of any new BT account.

[13] See BT Terms and Conditions: Currently available Offers/Deals (effective from 1 April 2010).

BT's introduction of rollover contracts occurred at a time of increased competition for fixed-voice telephony markets, either on a stand-alone basis or from providers offering cheap bundles of broadband, telephony and (sometimes) pay-television. Figure 2 illustrates that the introduction first of Wholesale Line Rental (WLR) and then of Local Loop Unbundling (LLU) have significantly increased the share of services provided by rivals to BT.[14] Figure 3 shows a comparable decrease in BT's share of lines. In September, 2009, Ofcom concluded in their Retail Fixed Narrowband Market Review that BT no longer has significant market power (SMP) in the UK market (excluding Hull). It seems likely that BT's recent loss of lines (and associated losses of call volumes and revenue) motivated their introduction of rollover contracts.

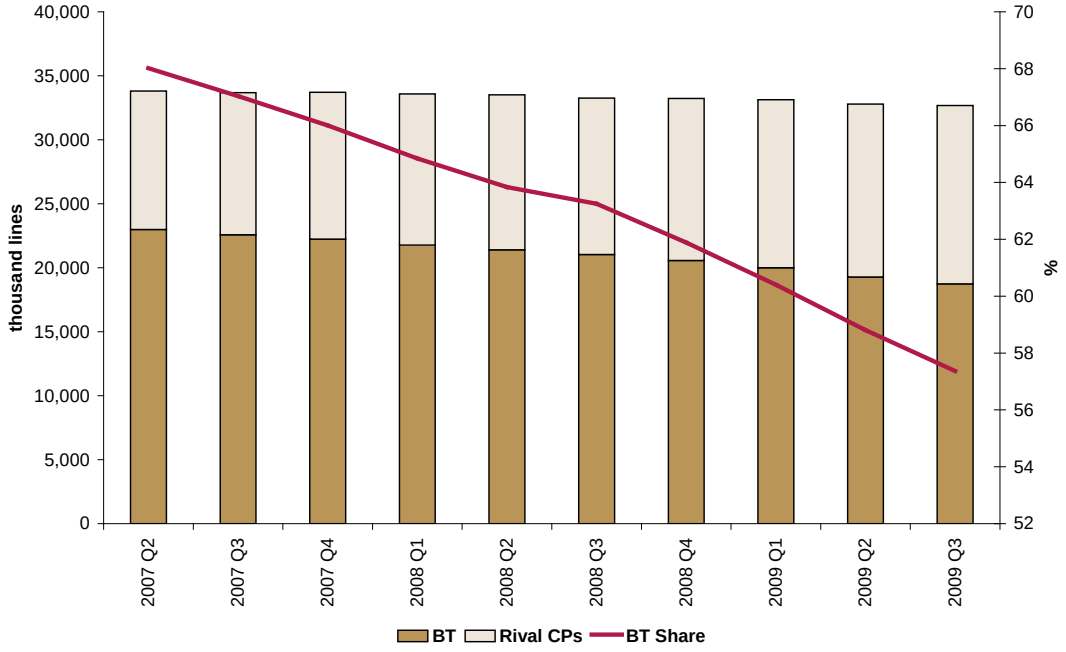
[14] Ofcom (2009b).

Figure 2: Proportion of phone lines taking non-BT voice services



Source: Ofcom (2009b), p.228.

Figure 3: Number of lines by CP



Source: Ofcom's Telecommunications Market Data Tables Q2 2008 and Q3 2009, Table 2 on page 5.

Notes: We construct the number of lines for rival CPs as the sum of number of lines for Virgin Media and for Other.

1.1.1 Possible effects of rollover contracts

Fully informed and rational households who decide whether to sign fixed-term contracts (with or without rollover terms) trade off lower prices on the one hand against the potential costs of triggering an ETC or forgoing a better offer in order to avoid triggering an ETC. Households on contracts that at a future point in time (not coinciding with the end of an MCP) would like to switch would have to face either *monetary* switching costs (in the form of ETCs) or the cost of delaying switching to a preferred plan. Postponing the switching time may also entail foregoing better offers by rival CPs altogether or at least foregoing some cost savings by accepting them with delay.

While it is possible that households are informed and forward-looking enough to make privately optimal choices with respect to whether or not to sign 12 month non-renewable contracts, concerns exist as to whether households are adequately aware of the switching costs entailed by infinitely-lived rollover contracts. Because of this, households may agree to rollover contracts and remain locked into them, becoming irresponsive to the offers made by rival CPs and thus harming the competitive process and consumer welfare.

Since MCPs are staggered over time (not all MCPs end at the same time of the year) and rival CPs do not know the month in which the MCP expires for individual BT customers, the marketing efforts of BT's competitors necessarily become less effective in the presence of large numbers of customers on contract—in particular contracts that are rolled over multiple MCPs. Superficially, this reduces the effectiveness of the marketing of rivals from trying to attract these customers and raise the cost of entry and growth. The relatively homogenous products, mature competitors, and, in the case of BT, large installed base characterizing fixed-line telephone services suggest such increases may also yield higher prices to consumers (Klemperer, 1995). The latter point may not appear concerning in the (mature) fixed voice telephone market, but becomes more worrisome if rollover contracts become more prevalent in the (still evolving) market for broadband data services and/or in supply of double- or triple-play bundles of video, voice, and data services.

1.2 Theoretical background

There are several views in the economics literature on firms' incentives to provide term contracts and their consequences in the marketplace. One view often expounded by service providers is that term contracts allow companies to spread any fixed costs of providing the service (e.g., access costs to a network or a mobile phone) over the length of the term and therefore reduce the up-front costs to consumers from purchasing the service. It also reduces uncertainty to both consumers and firms, simplifying decision-making and strategic planning.

The presence of term contracts can have important consequences on the functioning of the market, however. At a superficial level, such contracts (specifically the early termination charges associated with them) increase the "switching costs" of consumers with such contracts.[15]

[15] In the canonical survey of the literature, Farrell and Klemperer (2007, p.1972) say "A product has classic switching costs if a buyer will purchase it repeatedly and will find it costly to switch from one seller to another [during that series]."

Switching costs, in general, tend to introduce a "bargains-then-rip-offs" element into pricing, replacing competition period-by-period with competition for a buyer's "lifecycle requirements". This need not imply social welfare losses, but can, for example due to consumer mistakes, lead to ex post rents if households are myopic, or discourage efficient entry.[16]

The impact of switching costs in oligopoly depend on the relative strength of the incentives facing firms to charge high prices to their existing, "locked-in," consumers or charge low prices to attract new customers. While different theoretical models yield different specific predictions, Farrell and Klemperer conclude, "On balance, switching costs seem more likely to increase prices."[17] The *sources* of any switching costs are also important for welfare, with contractual switching costs causing both too little switching (Farrell and Klemperer, 2007) and inhibiting large-scale entry by limiting the ability of a potential entrant to attract new consumers (Aghion and Bolton, 1987).

There is little direct empirical evidence on the effects of term contracts. The small, but growing, literature measuring the effects of switching costs more generally (often in media and telecommunications markets) is suggestive, however. The majority of this literature looks at the demand side and tries to measure the welfare consequences of switching costs; recent papers have begun to tackle competitive (supply-side) effects as well. On the demand-side, Crawford and Shum (2005) estimate the effects of uncertainty, learning, and risk aversion (the combination of which induce switching costs) in the market for anti-ulcer drugs, finding eliminating uncertainty reduces market concentration and increases welfare by 8%. Shcherbakov (2007) estimates switching costs in U.S. pay television markets and finds them to be between $100-200, roughly 3-6 times the monthly cost of the average service. On the supply side, Viard (2007) finds that reduced switching costs make markets more competitive in U.S. long-distance telephone service while Dube, Hitsch and Rossi (2009) find the opposite: increasing switching costs in the (differentiated) markets for orange juice and margarine make markets more competitive. The nature of the products being sold, consumer purchase habits, and market structure all appear to be important factors driving the variation in these results, suggesting accurate modelling of the specific market under study is necessary for obtaining reliable inferences about the magnitudes and effects of switching costs.

1.3 Issues and roadmap

We are in principle interested in the effects of BT's rollover contracts on a number of economic outcomes in the fixed voice telephony market. These include their impact on household's decision to switch providers (and thus switching costs), consumer welfare, competition between existing providers, and entry and innovation incentives for new and existing firms. We are also interested in separating out the effects of ancillary aspects of the rollover contracts, including measuring possible behavioural effects (e.g. "default bias") among households, bespoke retention offers (should a household call to cancel BT service), and the transparency of the contracts.

[16] Ibid., pp.1973-4.
[17] Ibid., p.1974.

Unfortunately, the academic literature reveals that even measuring switching costs is a challenging empirical problem. BT's rollover contracts (and term contracts more generally) require households to make choices today based on their expectations of their (and providers') behaviour at some point in the future. This is an inherently dynamic decision and therefore requires a dynamic model of household choice to understand all aspects of it. Dynamic models, however, are significantly more difficult to implement than static models due to greater data and analyst time requirements. Indeed, the accurate specification, identification, and estimation of dynamic models of household choices are active areas at the frontiers of academic economic research.

In this study, we limit our attention to measuring the causal effect of BT's rollover contracts on household switching behaviour in fixed voice telephony markets. This is a critical first step in understanding the extent to which rollover contracts influence switching costs, with knock-on effects for the competitive process and consumer welfare. We discuss the possible consequences of unmodelled dynamic effects after introducing our model.

The rest of this report is structured as follows. In Section 2, we describe the detailed customer-level data we collected from BT to measure the impact of rollover contracts on the propensity of their customers to switch to another provider. We make a point of demonstrating the raw patterns in the data that will subsequently identify our causal effects of interest. In Section 3, we introduce the econometric models used to estimate the effect of rollover contracts on switching. We highlight how we control for determinants of switching behaviour other than rollover contracts and further introduce a model designed to control for the self-selection of households into rollover contracts based on unobserved differences in their willingness to switch. Section 4 presents our results and Section 5 concludes.

2 Data

As part of this project, we worked closely with Ofcom staff and BT to ensure we had the detailed data necessary to accurately estimate the impact of rollover contracts on household switching.

The primary dataset used in the study is detailed customer information provided to us by BT from their internal billing database. Most of the discussion in this section describes patterns in this micro-level customer data. Two additional aggregate datasets also play a role in the analysis. First, BT's and other CPs' price data by month was provided by PurePricing, a third-party data provider. Second, aggregate macroeconomic variables (i.e. the unemployment rate) by month and region were provided by the UK's Office for National Statistics.

2.1 Disaggregate BT customer data

Our primary dataset contains detailed customer-level data provided by BT. It was collected in collaboration with Ofcom and BT under the powers provided Ofcom by Section 135 of the Communications Act 2003 ("S135 Data Request"). We summarize the main elements of this data request here; the formal document is included as Appendix 3 at the end of this report.

2.1.1 Sampling plan

An important aspect of the data collection was the design of the sampling plan. We requested BT to provide customer-level information on a subset of 180,000 customers randomly drawn from the population of individuals that were BT customers on 31 December 2008.[18] We call this date the *sampling date*. We further asked BT to report the product choices of these customers from 1 January 2007 (or when they joined BT, if later) until the end of the observation period, on 31 March 2010 (or when they left BT, if earlier).

This type of sampling is called *stock sampling* as it consists of sampling from the stock of customers at a given point of time.[19] It is common in the economic analysis of duration (or survival) data (Wooldridge, 2002, and Jenkins, 2004). We adopt stock sampling because this scheme is simpler to implement than flow sampling and because many BT customers are long-term customers, the effects on whom we might miss if we were to use flow sampling.

The sampling date was chosen to strike a balance between observing long histories (from the sampling date until the end of the observation period) and having a significant fraction of the population on automatically renewable contracts (which were introduced in February 2008). The

[18] A BT customer is an individual who both rents a telephone line and purchases calls from BT. This definition does not include individuals that only rent the line from BT and purchase calls from a rival CP.

[19] The primary alternative to stock sampling is *flow sampling* which would sample from customers as they enter the BT customer database over a specified period of time.

sample size was chosen to be large enough to allow us to precisely estimate the effects of interest.

2.1.2 Variables

Before describing the variables collected, we define some relevant terms and concepts:

- The *sampling date* is the date on which BT sampled from their database to provide the data used in this study. It is 31 December 2008;
- The *observation period*[20] *is* the time period for which we obtained BT customer data (1 January 2009 to 31 March 2010);
- A customer's *BT start date* is the month in which the individual became a BT customer (e.g., July 2008);
- If a customer leaves BT, her *BT switching date* is the date on which she leaves BT. A customer leaves BT when he or she ceases to rent the line from BT;
- If a customer does not leave BT, her *censoring date* is the latest date for which her customer information is available (e.g., March 2010);
- A BT *promotion* is a particular combination of plan (e.g. Evenings and Weekends), contract (e.g. rollover), price discounts (if any), and additional phone services (if any) to which a customer subscribes at a point in time. [21] Internally, BT identifies promotions that feature (fixed-term or rollover) contracts—also known as *special offers*—by special offer names (Offer D, Offer A, Offer F, Offer H)[22]
- Promotions that are not subject to any contractual terms are called *standard plans* (or, with a slight abuse of language, *standard contracts*).
- We refer to the set of promotions featuring a fixed-term or a rollover contract as fixed-term or rollover contracts, respectively;
- We refer to customers on promotions featuring a fixed-term or a rollover contract as fixed-term or rollover customers, respectively;
- The *sampling-date promotion* is the promotion which the customer was on at the sampling date;

[20] Given the longitudinal nature (i.e., the same set of customers are followed over time) of the dataset, we concluded that "observation period" was more appropriate language than "sampling period", which is the language we used in the S135 data request: we sample customers only once (on 31 December 2008) and not repeatedly between 31 December 2008 and 31 March 2010.

[21] The use of the word "promotion" suggests limited duration and it is indeed the case that (a) the set of promotions available to new and existing BT customers varies over time; and (b) certain characteristics of a promotion (for example, a discount on the price of a plan) may not be permanent. However, once a customer starts a BT promotion, that customer remains on the same promotion until she moves to a different promotion or she switches away from BT. Promotions that do not have any contracts are called *standard plans* (or *standard contracts*).

[22] Please see Appendix 5 for a description of these offers.

- *Previous promotions* and *subsequent promotions* are promotions (if any) that the customer was on previous to and/or following their sampling-date promotion.

We collected three main categories of information from BT: information on dates, information on "promotions", and other (aggregate) information.

Date Information:

- BT start date;
- Start date for the sampling-date promotion;
    - A customer was identified as being on their first promotion if these dates were within 15 days of each other;
- Switching or censoring date, as appropriate.

Plan information for the sampling-date, previous, and subsequent promotions:

- Plan identifier (UWP, UEWP, UAP);[23]
- Contract identifier (Standard plan/None, Fixed-term, Rollover);
- Information on prices and ETCs;
- MCP information (None, 12-month fixed-term, 18-month fixed-term, 12-month rollover).

Other Information:

- Subscription to other BT services (i.e., broadband and BT Vision) at the sampling date;
- Customer postcode at the sampling date.

2.1.3 The estimation sample

The raw dataset provided to us by BT had 519,168 observations on 179,957 customers. An observation was a customer-promotion, i.e. the specific BT promotion under which that customer was being provided service for every promotion held by the customer between 1 January 2007 and 31 March 2010. BT also provided a data dictionary that permitted matching the promotion for each customer to a set of characteristics of that promotion, notably plan type, contract type, and any price discounts or additional services included in the promotion.

The matching process was imperfect. Some customers had promotion codes that were not in the data dictionary, some promotion codes in the data dictionary were not associated with any customers, and other promotions were associated with more than one code. Furthermore, as

[23] The three most common plans were Unlimited Weekend Plan (UWP), Unlimited Evenings and Weekend Plan (UEWP), and Unlimited Anytime Plan (UAP)

some customers have been with BT since the 1930s, there were many old and/or redundant promotion codes.

In constructing the estimation dataset, we balanced the goals of including as many BT customers as possible in the analysis against the costs of including erroneous and/or tracking down mismatched data. We first excluded customers that were on old, "grandfathered", promotion codes (related to BT Together Local, BT Working Together, etc.) for which it was relatively costly to obtain the associated plan, contract, and price-discount information. This eliminated 18,341, or 10.2%, of the original sample. Further customers were lost due to their dropping BT for calls but keeping it for line rental (10,352, or 5.8%) and due to their having holes or overlaps in their choice history (5,964, or 3.3%). Overall, the estimation sample contains 144,861 customers, or 80.5% of the original BT sample. Appendix 4 describes the data-cleaning process, and its consequences for the estimation sample, in more detail.

2.1.4 Descriptive statistics

While the data report decisions made by customers regarding plan choices at a daily level, BT presents plan prices and ETCs to its customers as a monthly charge.[24] Furthermore, discrete time lends itself more easily to the incorporation of time-varying covariates, like the plan/contract a BT customer is on and the price they pay. As such, we aggregate the data to the level of the month and analyse switching behaviour on a monthly basis. Such aggregation (called "grouping") is common in the analysis of duration data.

We then construct a panel dataset in which an observation corresponds to an individual (a BT customer) in a time period (a month). For every individual in every time period, a binary outcome variable (which we will call $Switch_{it}$) indicates whether an individual has decided to continue with BT into the next month ($Switch_{it} = 0$) or to leave BT by the end of this month ($Switch_{it} = 1$). If a customer remains with BT for all 15 months in our sample period, then $Switch_{it}$ will simply be a sequence of 15 zeros. In this case, we say the data are censored and define $censored_{it} = 1$ for all 15 t's for that i. If a customer switching from BT during the sample period, then $Switch_{it}$ will be a sequence of zeros followed by a 1 in the month that they switched. In this case, $censored_{it} = 0$ for as many time periods as i is in the data. This data structure allows us to apply discrete-choice panel data methods to analyse switching, as described in the next section. This dataset includes 1,984,406 monthly observations on 144,861 customers. Excluding a small number of observations regarding customers on 18-month rollover contracts reduces the dataset to 1,984,270 monthly observations on 144,849 customers: this is our estimation sample.

Table 1 below reports descriptive statistics for the key disaggregate variables used in our analysis. Unless otherwise noted, sample means and standard deviations are measured in percentages ranging from 0 to 100.

[24] Email communication with BT on 20 May 2010. For example, phone bills are generated and paid on a monthly basis.

Table 1: Descriptive statistics for the estimation sample

	All observations			Obs. In the first time period		
Variable	**Obs.**	**Mean**	**St. Dev.**	**Obs.**	**Mean**	**St. Dev.**
Switch	1,984,270	1.2%	11.1%	144,849	1.2%	10.8%
Time period (1-15)	1,984,270	7.8	4.3			
Censored				144,849	82.9%	37.6%
Tenure at BT (in years)	1,984,270	10.9	10.6	144,849	9.9	10.5
Tenure on promotion (in years)	1,984,270	3.4	4.6	144,849	3.1	4.4
First promotion	1,984,270	34.1%	47.4%	144,849	38.1%	48.6%
Months to end of MCP	1,984,270	1.9	3.3	144,849	1.7	3.1
UWP plan	1,984,270	48.4%	50.0%	144,849	52.5%	49.9%
UEWP plan	1,984,270	38.7%	48.7%	144,849	36.4%	48.1%
UAP plan	1,984,270	12.9%	33.5%	144,849	11.2%	31.5%
Standard contract	1,984,270	65.0%	47.7%	144,849	68.1%	46.6%
Fixed-term contract	1,984,270	3.7%	18.9%	144,849	4.6%	21.0%
Rollover contract	1,984,270	31.2%	46.3%	144,849	27.3%	44.5%
F&F mobile				144,849	1.6%	12.4%
F&F International				144,849	0.1%	3.2%
Broadband				144,849	24.5%	43.0%
BT Vision				144,849	2.6%	15.8%

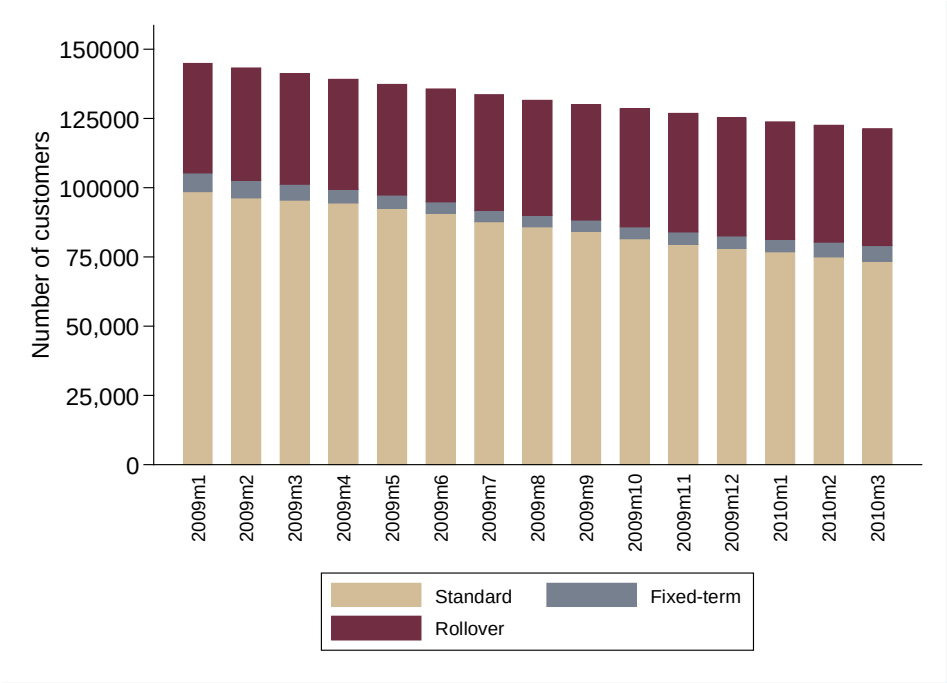
Source: Own calculations based on BT data.

Notes: This table contains descriptive statistics for the sample of data used in our analysis. An observation is a customer-month, i.e. information about a given BT customer in a given month. There are 144,849 customers and as many as 15 months per customer (January 2009 to March 2010). The first group of columns ("All observations") reports descriptive statistics across all customers and months. The second group of columns ("Obs. In the first time period") reports descriptive statistics across customers in the first month (January 2009). "Switch" indicates the event of switching away from BT. "Censored" indicates whether a household in the sample is still a BT customer at the end of the observation period. A promotion is defined as a combination of plan, contract, price, and additional phone services (if any). MCP stands for Minimum Contract Period. UWP, UEWP, and UAP are BT calling plans. F&F mobile/ F&F International /Broadband/BT Vision are other BT services that customers may be purchasing in addition to fixed voice telephone service. We only observe this at the time of the first month.

The first set of columns in the table reports descriptive statistics across customer-months.[25] The second set of columns reports descriptive statistics across customers in the first month of the observation period (January 2009).

We see that, on average, [✂]% of BT customers switch away in a given month. This corresponds to an annual switching rate of [✂]%.[26] As a result, 82.9% of customers are censored (i.e. still a BT customer at the end of the observation period). Figure 4 below demonstrates the attrition occurring in the sample as customers switch away from BT and also shows the share of the customers that remain that subscribe to a standard, fixed-term, or rollover contract.

Figure 4: Number of customers by contract type and month in the observation period



Source: Own calculations based on BT data.

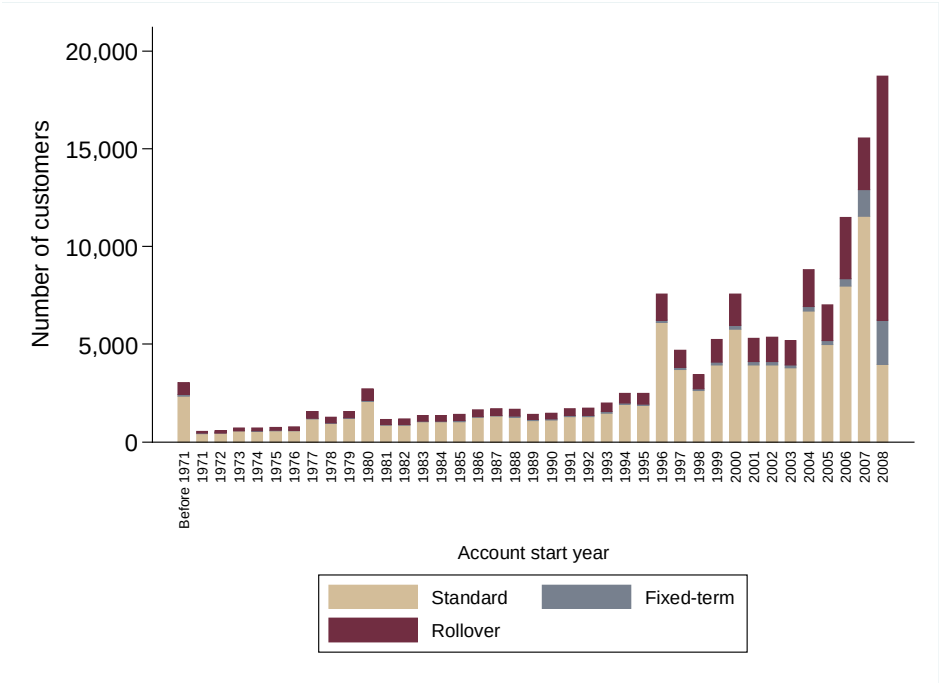
At the beginning of the sample period, the average customer in the data has been with BT for almost 10 years and has been on their sampling-date promotion (i.e. plan, contract, and price) for just over 3 years. Figure 5 reports other patterns in the data relating to tenure. First, it shows the tenure with BT during the first observation month (Jan 2009) for all the customers in the data. While most customers have been with BT for less than a decade, there are some customers in the database that have been with BT for over 75 years![27] The figure also splits out the contract type for each of these customers. As might be expected, rollover and fixed-term contracts are relatively more common among customers new to BT. That being said, some even very long-standing BT customers have adopted them. This is consistent with BT's having promoted rollover contracts to both new customers and their existing installed base.

[25] An observation in the full dataset provides information about a given customer in a given month. We therefore call any such observations a customer-month.

[26] Calculated as 1-[(1-Switch)^12] and expressed as a percentage.

[27] These are very few of course. Only ¼ of 1% of households in the sample have been with BT for more than 50 years.

Figure 5: Number of customers by contract type and account start year



Source: Own calculations based on BT data.

Notes: The number of customers and their distribution over start years by contract types is as of the first observation month (January 2009).

Continuing along the rows of Table 1, we see that the majority of BT customers (52.5%) are on the baseline, Unlimited Weekend minutes (UWP), plan at the beginning of the sample period, with 36.4% on the Unlimited Evening and Weekend minutes (UEWP) and 11.1% on the Unlimited Anytime minutes (UAP) plan. Figure 6 demonstrates these shares are remarkably consistent across time

Figure 6: Distribution of customers over plan types by month in the observation period

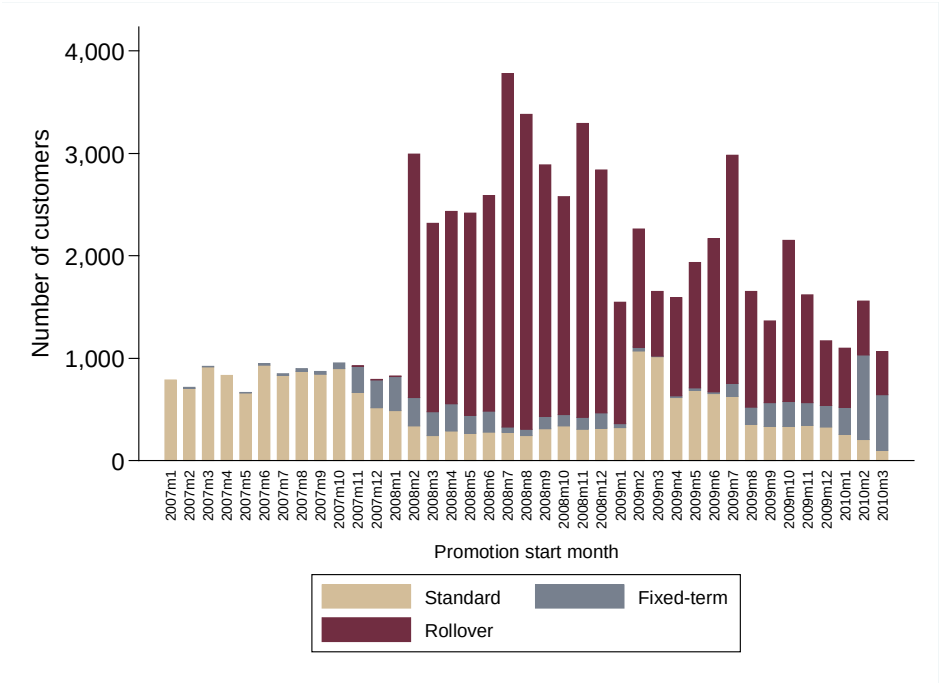
✂

Source: Own calculations based on BT data.

The majority of BT customers (68.1%) are on a standard (flexible) contract at the beginning of the observation period, with 27.3% on rollover contracts and 4.6% on fixed-term contracts. Comparing to the full sample (and Figure 4), we see that rollover contracts become more prevalent over the sample period. Figure 7 develops this idea more fully. It reports the number of customers on contracts of various types by the first month of their current "promotion" (i.e. plan, contract, and price).[28] The figure shows that fixed-term contracts were first introduced in October 2007 and rollover contracts soon followed in February 2008. The high share of rollover customers from that date also shows BT's emphasis on promoting rollover contracts once they were introduced. Recall our sampling date is December 31, 2008, so the customer numbers drop slightly from January 2009 as all new promotion starts from that date are existing BT customers migrating to new contracts.

[28] We build Figure 7 using the contract held by the household in the final month they are observed in our data.

Figure 7: Number of customers by contract type and promotion start month

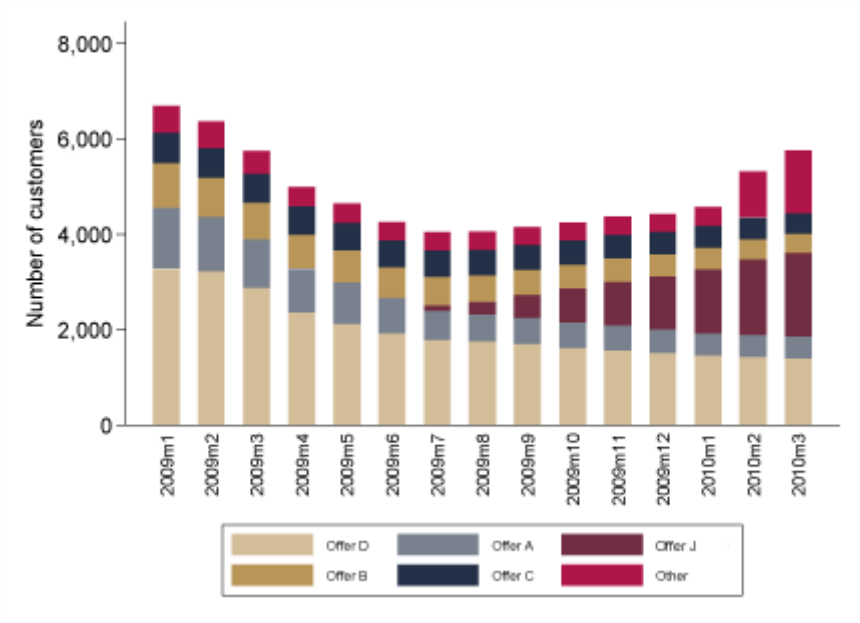


Source: Own calculations based on BT data.

Notes: The number of customers and their distribution over promotion start month by contract types is as of the last observation month (March 2010). Customers whose promotion started before January 2007 are dropped. A promotion is defined as a combination of plan, contract, price, and additional phone services (if any).

While BT offers 3 general types of contracts (standard/none, fixed-term, and rollover), many different promotions (i.e. plan, contract, and price) were offered to households in the data that contained the same type of contract. This is important for the analysis because different promotions had different discounts (and/or discounts that lasted for differing numbers of months within a MCP). This variation provides valuable information to identify the effects of price discounts on switching behaviour.

Figure 8: Number of customers by fixed term-contract promotion and month in the observation period



Source: Own calculations based on BT data.

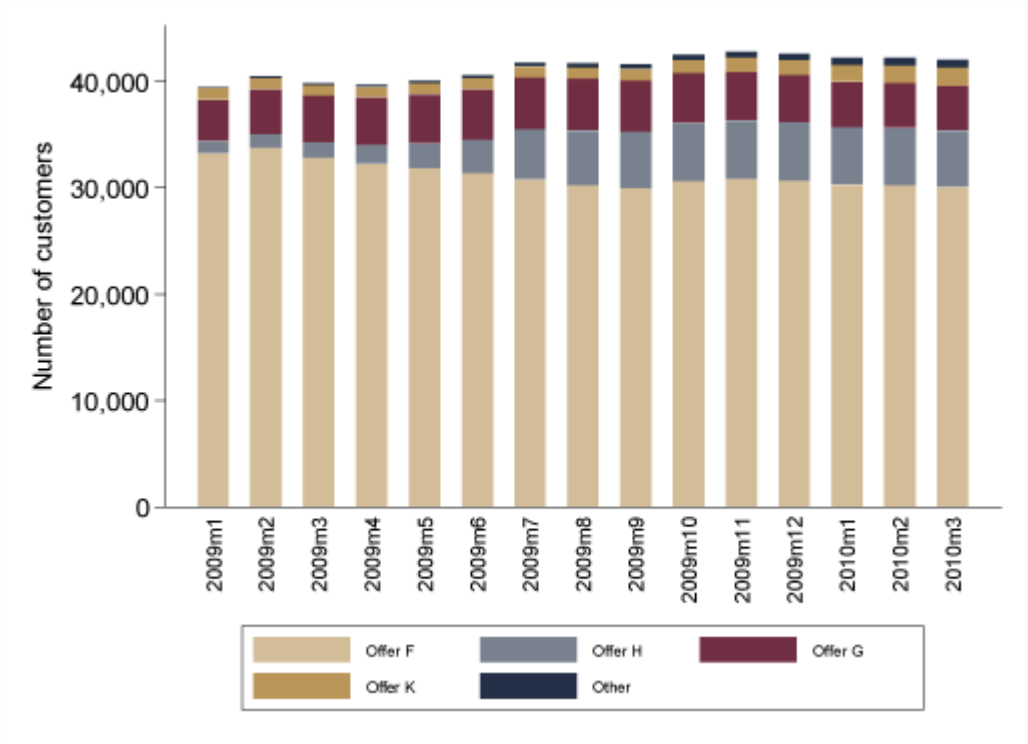
Notes: A promotion is defined as a combination of plan, contract, price, and additional phone services (if any). In this graph we focus on promotions featuring a fixed-term contract. "Offer B" and "Offer A" are promotions on a UEWP plan. "Offer D" and "Anytime plan" are promotions on a UAP plan. "Offer C" is available on all plan types. See text for details of specific promotions.[29]

Figure 8 and Figure 9 describe the types of promotions BT offered on fixed-term (Figure 8) and rollover (Figure 9) contracts. For example, Figure 8 shows that, at the beginning of the observation period, the most prevalent fixed-term promotion was "Offer D", which is a promotion with a UAP plan, a 12-month MCP, and a price discount on the corresponding standard plan during the first 3 months. "Offer A", the second most popular fixed-term promotion at the beginning of the observation period, is a promotion with a UEWP plan, an 18-month MCP, and a price discount on the corresponding standard plan during the first 12 months. Figure 8 also shows that "Offer J", which was introduced in July 2009, has rapidly gained ground.[30]

[29] Please see Appendix 5 for a description of these offers.

[30] The "Anytime Plan" as reported in the material provided to us by BT does not show a specific discount or additional service. "Offer B" is a UWEP plan promotion offering a £1.25 discount for the first 12 months on an 18-month MCP. Offer C, available on all plans, waives BT's connection fee in return for an 18-month MCP.

Figure 9: Number of customers by rollover-contract promotion and month in the observation period



Source: Own calculations based on BT data.

Notes: A promotion is defined as a combination of plan, contract, price, and additional phone services (if any). In this graph we focus on promotions featuring a rollover contract. "Offer H" and "Offer F" are promotions on a UEWP plan. "Offer G" is a promotion on a UAP plan. "Offer K" is available on all plan types.

Figure 9 shows that the distribution of customers over rollover promotions is much more concentrated than for fixed-term promotions. By far the most popular rollover promotion is "Offer F",[31] which consists of a UEWP plan at the price of a standard UWP plan (a £2.99 discount) and a 12-month automatically renewable contract.[32]

2.1.5 Switching patterns in the BT data

The extent to which customers on rollover contracts are more or less likely to switch away from BT will be critical to our analysis in this report. As such, we now present the raw patterns in the data that we will later refine, analyse, and interpret with our econometric analysis.

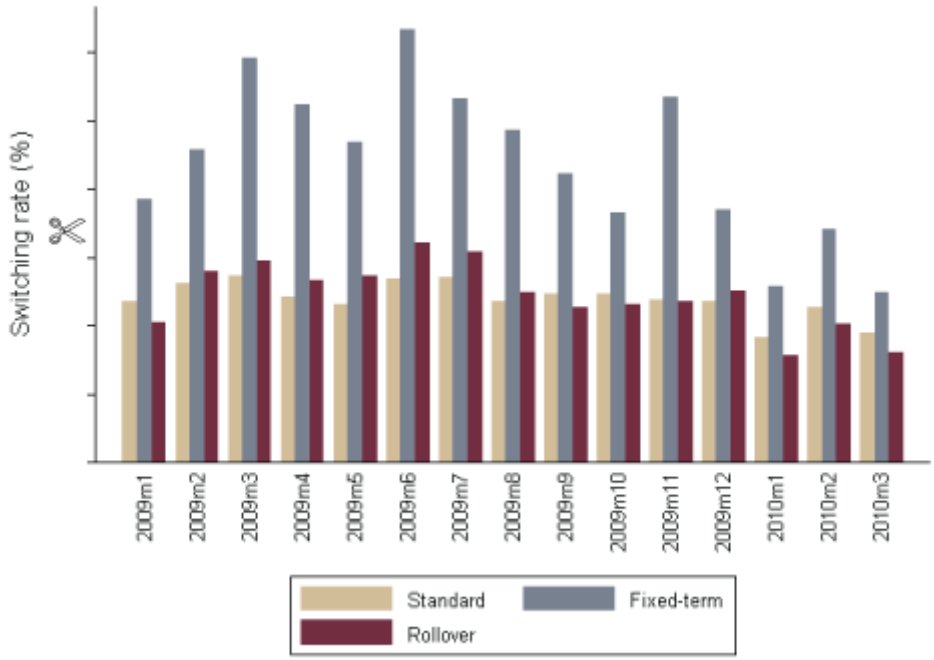
[31] Please see Annex 5 for a description of each offer.

[32] "Offer H" is the same as "Offer F" but adds the Friends & Family mobile calling service. Offer K offers a "Mobile Saver" feature to an existing UWP or UEWP plan at no additional cost (but no price discount on those plans). Offer G , lowers the cost of the UAP plan by £1 for the duration of the 12-month (rolling) MCP.

We begin by defining the *timing* of switching. In both the figures and analysis to follow, we define switching in month *t* to mean that month *t* will be a customer's *last* month of service with BT, i.e. they have decided to switch away from BT at the *end* of month *t*.[33]

Figure 10 presents the differences in switching rates by contract type over our observation period. In the raw data, customers on fixed-term contracts switch away from BT significantly more frequently than those on standard or rollover contracts. This is somewhat deceptive, however, as it does not account for the impact Minimum Contract Periods (and associated early termination charges) have on switching rates.

Figure 10: Switching rates by contract type and month in the observation period



Source: Own calculations based on BT data.

Notes: Switching is defined as the event of switching away from BT.

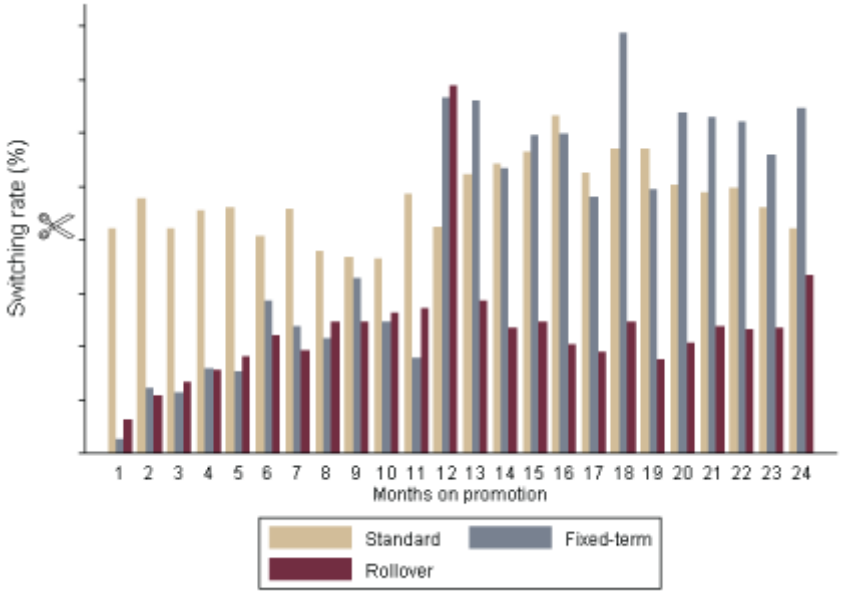
Figure 11 presents the differences in switching rates by contract types depending on the month someone is in their existing contract. The vast majority of customers (96.5%) on either fixed-term or rollover contracts have a 12-month MCP during which they must pay ETCs in order to switch away from BT.[34] Furthermore, the magnitude of the ETC depends on the number of months remaining in their MCP. These effects are evident in the data with reduced (but increasing) switching rates for fixed-term and rollover contract customers relative to standard-contract customers in the first 11 months of their MCP. In the 12th month (i.e. at the end of the 12th month), switching rates for both fixed-term and rollover customers jump as they no longer have to pay an ETC in order to switch. After month 12, fixed-term customer contracts are

[33] Throughout this report, we refer to switching as switching away from BT, not switching between different promotions (i.e. plans, contracts, and/or prices) within BT. Less than 1.5% of customer-months involved the latter kind of switching.

[34] The remaining customers have an 18-month MCP.

identical to standard customer contracts: customers pay the undiscounted rate for whatever plan they are on and can leave in any month without paying an ETC. By contrast, rollover contract customers enter a new MCP beginning in month 13 and must again pay ETCs in order to switch. These patterns show up in post-month-13 switching rates: they are broadly similar for standard and fixed-term customers and lower for rollover customers.[35] There is a similar, but smaller, spike in switching for rollover customers ending their second MCP in month 24.

Figure 11: Switching rates by contract type and tenure on promotion



Source: Own calculations based on BT data.

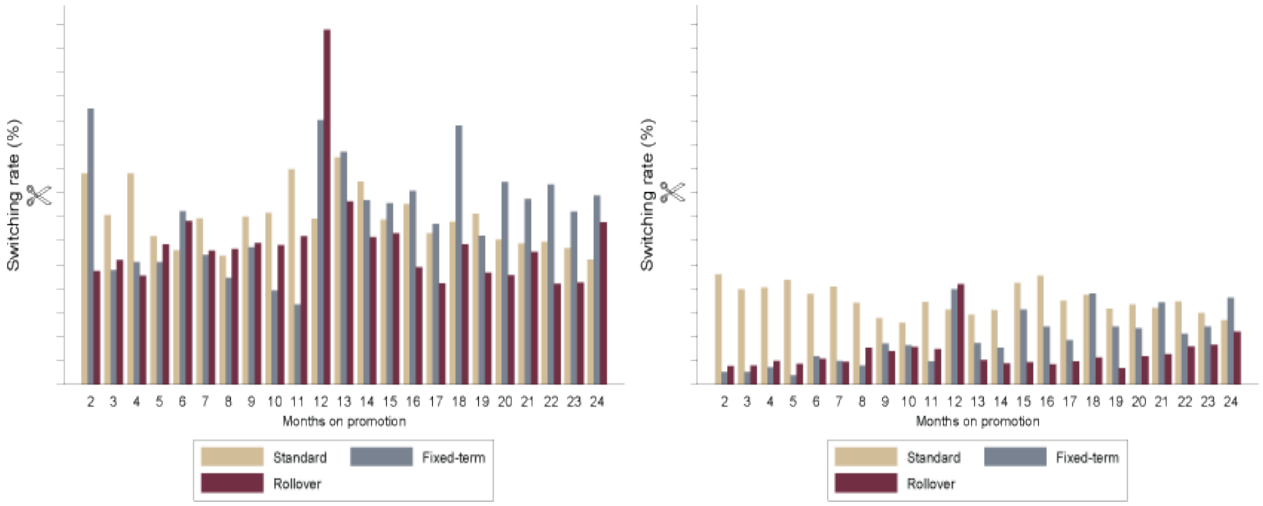
Notes: Switching is defined as the event of switching away from BT. A promotion is defined as a combination of plan, contract, price, and additional phone services (if any). See Appendix 4 for a detailed description of the construction of the dataset. It is assumed that switches occurring up to 370 days after the promotion start date occurred within the twelfth month on the promotion.

Figure 12 presents the same figure as that above, but split between old and new customers.[36] It demonstrates that while the overall level of switching is much higher for new compared to old customers, the impact of rollover contracts is similar: both types of customers switch less when on rollover contracts. Similar patterns obtain across all tenures in the data.

[35] While post-month-13 switching rates are lower for customers on rollover compared to fixed-term and standard contracts, they are not as low as for customers on rollover contracts in their first MCP. We hypothesize that this may be due to greater leniency offered by BT on ETCs in MCPs after the first. We further explore this idea in Appendix 2.

[36] A new customer is defined as one whose BT start date is no more than 15 days earlier than her promotion start date.

Figure 12: Switching rates by contract type and tenure on promotion, for existing and new customers



Source: Own calculations based on BT data.

Notes: The left hand-side graph refers to existing customers, the right hand-side graph to new customers. Switching is defined as the event of switching away from BT. A promotion is defined as a combination of plan, contract, price, and additional phone services (if any). New customers are defined as customers whose account start date is no more than 15 days earlier than their promotion start date. It is assumed that switches occurring up to 370 days after the promotion start date occurred within the twelfth month on the promotion.

2.2 Other (aggregate) data

We augmented the disaggregate BT customer-level data with aggregate data on several other factors thought to influence switching. We describe those here.

The most important of the additional aggregate information were the prices charged by rival CPs for comparable fixed-line products. There are four primary competitors in this market: BT, Virgin Media, TalkTalk (Carphone Warehouse), and Sky.[37] There are two standardized products offered by all major CPs for fixed-line telephony services: Free Evening and Weekend Calls and Free Anytime (UK) Calls. TalkTalk and Virgin used to also offer a Free Weekend Calls product, but Virgin and TalkTalk withdrew this product from the market in August and December 2008, respectively. BT continues to offer an Unlimited Weekend Plan.

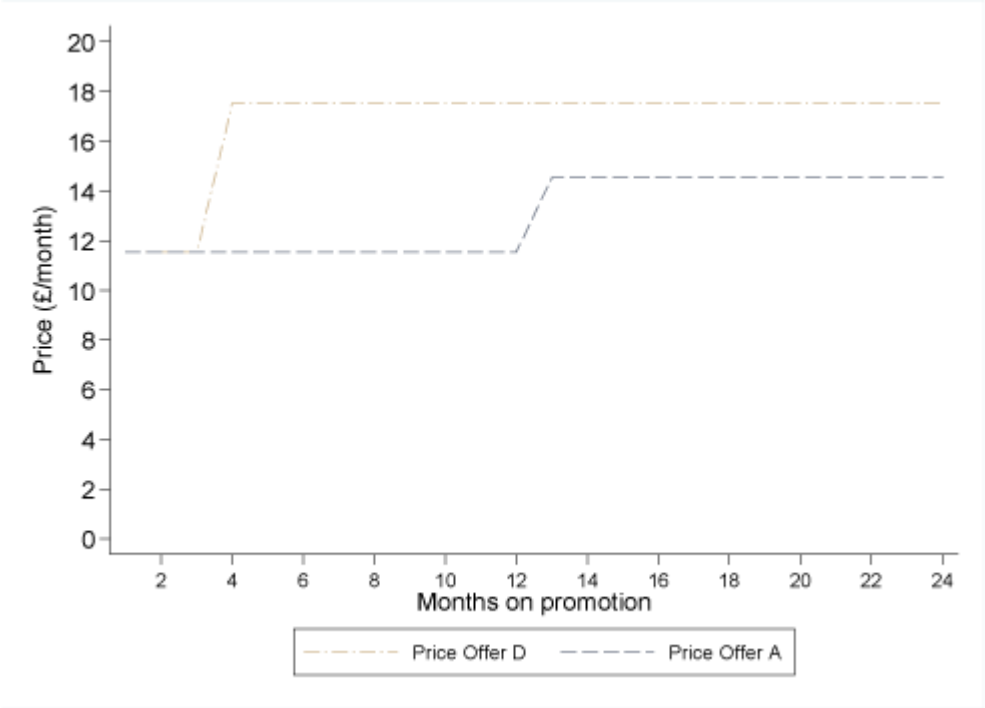
Aggregate price data were purchased on our behalf by Ofcom from PurePricing for the observation period of January 2009 until March 2010. Reported were the prices for each of the main CPs (including BT) for each of the fixed-line voice services described above.

We will use two sources of price variation in this study to identify the effects discounts on prices offered by various contracts have on households' willingness to switch from BT. The first exploits differences across time in the reduction in discount for BT voice products as customers come off of fixed-term contracts. Figure 13 below demonstrates the magnitude of these price changes for

[37] Ofcom (2009a), Figure 4.1 and page 32.

two of the most common BT fixed-term promotions for UEWP and UAP plans called "Offer A"[38] and "Offer D". "Offer A" is a promotion with a UEWP plan, an 18-month MCP, and a price discount on the corresponding standard plan during the first 12 months. "Offer D" is a promotion with a UAP plan, a 12-month MCP, and a price discount on the corresponding standard plan during the first 3 months.

Figure 13: Fixed-term prices by tenure on promotion



Source: Own calculations based on BT data.

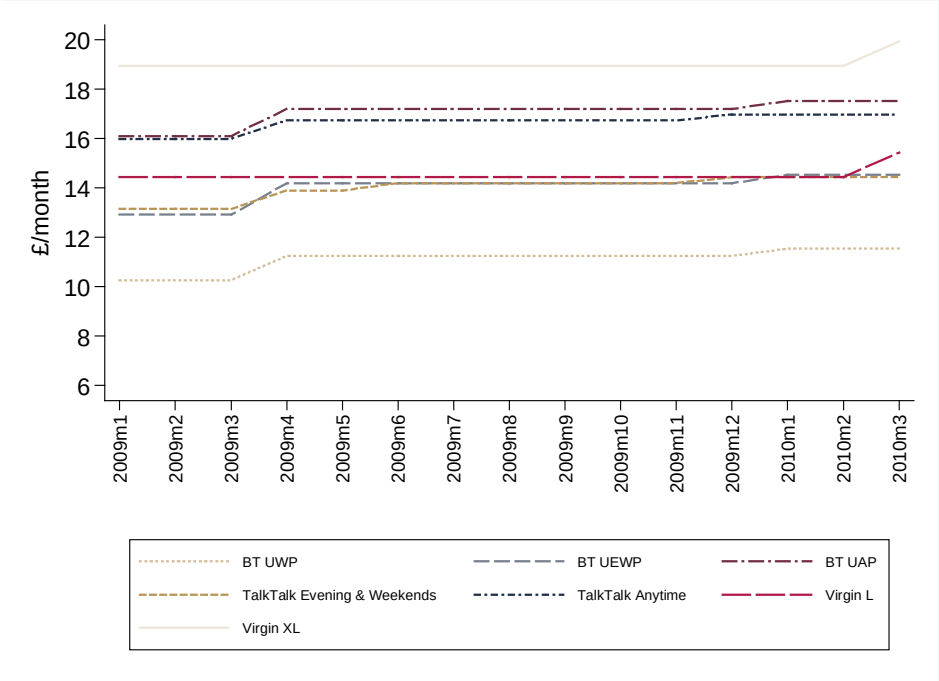
Notes: "Offer D" is a promotion with a UAP plan and a 12-month MCP. "Offer A" is a promotion with a UEWP plan and an 18-month MCP.

The second exploits price differences across time for different CPs. Figure 14 below demonstrates the magnitude of these price differences by plotting plan prices for BT (standard-contract UWP, UEWP, and UAP),[39] TalkTalk (Evenings & Weekend and Anytime) and Virgin (L and XL).

[38] Please see Appendix 5 for a description of these offers.

[39] BT plan prices are for paper-free billing and direct-debit payment.

Figure 14: Monthly plan prices by plan and communications provider



Source: PurePricing and BT.

Finally, aggregate macroeconomic variables (i.e. the unemployment rate) by month and region were provided by the UK's Office for National Statistics.[40]

[40] The regions include England's Government Office Regions, Scotland, Wales, and Northern Ireland.

3 Econometric model

3.1 Switching

We analyse the impact of BT's rollover contracts using a discrete-choice panel-data model of consumer switching behaviour. We begin our exposition of the econometric model under the assumption that there is no self-selection of households into rollover contracts.[41] In the next subsection, we generalize the econometric model to account for this possibility.

As described in the data section above, our data consists of 1,984,406 monthly observations on 144,861 BT customers. Let *i* index households and *t* index months. For each household *i* in month *t*, define $Switch_{it}$ = *1* if they switched away from BT by the end of that month (and zero otherwise).[42] The values of $Switch_{it}$ for each household *i* in the dataset are either a sequence of 15 zeros (if they are still with BT at the end of the observation period) or a sequence of zeros followed by a 1 (in the month they left BT).

We model the decision of a consumer switching away from BT following standard practice in the modelling of discrete decisions. Let

$$S_{it}^{*} = x_{it}^{'}\beta + \varepsilon_{it} \qquad (1)$$

be the latent utility to household *i* from switching in period *t*. x_{it} and ε_{it} are factors influencing the decision to switch plans; x_{it} are observable and ε_{it} is unobservable. We discuss the key elements of x_{it} in what follows below.

Let

$$Switch_{ijt} = \begin{cases} 1 & if\ S_{it}^{*} \geq 0 \\ 0 & if\ S_{it}^{*} < 0 \end{cases}$$

Different distributional assumptions on ε_{it} imply different functional forms for the probability household *i* will switch in month *t*, which we denote $P(Switch_{it})$. We assume that ε_{it} is distributed as a Standard Normal random variable, implying $P(Switch_{it})$ has the Probit form:

[41] As described further below, "selection" is defined as unobserved differences in households' likelihood of switching that might be correlated with unobserved factors affecting their decision to select a rollover contract.

[42] As we believe Ofcom is most interested in the impact of the rollover contract on competition between providers, we base our analysis on switches to a plan not offered by BT (or no plan). Extending the analysis to consider switching between plans within BT, while interesting, is beyond the scope of this study.

$$P(Switch_{it}) = \Phi(x_{it}'\beta) = \int_{-\infty}^{x_{it}'\beta} \phi(s)ds \quad (2)$$

where ϕ (Φ) is the Standard Normal probability (cumulative) distribution function.

3.1.1 Model specification

Our primary focus is to measure the effect of the introduction of BT's rollover contract on the incidence of households switching away from BT. We write this as

$$P(Switch_{it}) = \Phi(\beta_0 + tenure_{it}\beta_1 + plan_{it}\beta_2 + MCP_{it}\beta_3 + contract_{it}\beta_4 + p_{it}\beta_5 + x_{it}'\beta_6) \quad (3)$$

where $tenure_{it}$ includes various measures of household *i*'s tenure in month *t* (both with BT and on a given promotion), $plan_{it}$ includes dummies for the various plans offered by BT, MCP_{it} includes measures of whether household *i* is in a MCP, $contract_{it}$ includes dummies for the various contracts offered by BT (including, critically, one for rollover contracts), and p_{it} includes measures of relative price differences across plans and providers. X_{it} includes other factors that might influence switching behaviour, including other BT services purchased by household i, time dummies, and macroeconomic variables.

If we can consistently estimate the parameters in Equation (4), then the parameter on indicators of rollover contracts (part of β_4) will estimate the causal effect of BT's rollover contracts on the probability a household switches away from BT, controlling for the discount offered on such plans (β_5) and the length of time a household has been on a plan (β_1). Descriptive statistics for the variables included in the model were given in Table 1.

We estimate this Probit model by Maximum Likelihood Estimation (MLE). MLE selects the vector of parameters, β, to maximize the likelihood of seeing the choices we actually see in our data. If the error in the switching equation, ε_{it}, is independent of each of the explanatory variables on the right-hand side of (4), then MLE estimates are consistent and asymptotically normal and can form the basis for hypothesis tests about the elements in β, particularly the effect of rollover contracts in β_4. In the results to follow, we estimate the model using Stata and report standard errors that allow for arbitrary serial correlation within individuals over time, so-called "clustered" standard errors.

3.2 Self-selection into rollover contracts

It is reasonable to assume that households differ in their willingness to switch from BT in a given month. Indeed this is one of the sources of randomness captured by the random shock, ε_{it}, in (1). It is possible, however, that households that are less likely to switch are also more likely to choose a rollover contract. This might happen because they value the lower price associated with rollover contracts and don't mind that this means higher costs to switching providers. They may be quite happy with BT and are happy to both pay less and stay with them. Micro-econometricians call such effects "self-selection", or simply "selection".

In the presence of selection, household *i*'s choice of a rollover contract is (negatively) correlated with their willingness to switch, ε_{it}, and the MLE estimate of β_4 will be inconsistent and biased.

In particular, lower values of ε_{it}, indicating a lower willingness to switch from BT, are likely associated with a higher incidence of taking a rollover contract. This induces negative correlation between ε_{it} and $rollover_{it}$ and likely induces a negative bias, suggesting we are likely to *over-estimate* the (negative) effect of rollover contracts on switching behaviour. In this case, we may conclude that rollover contracts have a negative effect on switching (or a larger negative effect on switching) than is truly the case. This is clearly a cause for concern.

Accommodating discrete right-hand-side endogenous variables (the decision to enrol in a rollover contract) is challenging when both the dependent variable (switching) and endogenous explanatory variable (rollover) are themselves discrete (e.g., Wooldridge, 2002). Methods commonly used for continuous dependent and/or explanatory variables like Instrumental Variables (IV) estimation are not typically available. One is usually forced to make stronger assumptions and to jointly model both decisions.

We follow that approach here. We jointly estimate a switching equation (Equation (4) above) as well as a "selection equation" estimating household *i*'s choice of a rollover contract in month *t*. Following notation analogous to that above, let

$$R_{it}^{*} = x_{it-1}^{'}\beta_1 + z_{it}^{'}\beta_2 + \eta_{it-1} \qquad (4)$$

be the latent utility to household *i* from choosing a rollover contract in period *t*. x_{it-1} (η_{it-1}) are observable (unobservable) factors influencing the decision to select a rollover contract in period t-1 and z_t are observable factors that influence such decisions in period t. We discuss the key elements of x_{it-1} and z_{it} in what follows below.

We note that there is an important difference in the specification of the switching equation (3) and the rollover equation (4) in that the latter includes lagged variables. This difference is due to differences in the timing of decisions in the model. To understand these differences, consider a BT customer in a rollover contract at the beginning of time period *t-1* and let x_{it-1} measure information about their "state" at the beginning of the period (e.g. their plan, their contract, etc.). During period *t-1*, they must decide what plan and contract to select in period *t*, or perhaps decide to switch away from BT before then. Whether they are in a rollover contract in period *t* clearly depends on x_{it-1}.

The switching decision, however, is defined to happen at the *end* of each period (month). Thus the switching decision in month *t* depends on period-t state variables, x_{it}, (as in equation (4)) while the rollover decision depends on period *t-1* state variables, x_{it-1}.[43] We include other, period *t* covariates, z_{it}, to allow for some period-*t* effects on rollover choices (e.g. time dummies).

Let

$$Rollover_{it} = \begin{cases} 1 & if\ R_{it}^{*} \geq 0 \\ 0 & if\ R_{it}^{*} < 0 \end{cases}$$

[43] An alternative notational convention would be to define all states to occur at the beginning of each period. In this case, we would say someone switching in period t would have $S_{t+1} = 1$ and there would be a similar lagged relationship between outcomes and covariates in both equations.

Different distributional assumptions on η_{it-1} imply different functional forms for the probability household *i* will switch in month *t*, which we denote *P(Rollover$_{it}$)*. In what follows, we will assume ε_{it} and η_{it-1} are distributed as a joint normal random variable independent of all the exogenous variables in both models with correlation coefficient ρ. If, as we suspect, unobserved differences in households' willingness to switch from BT are negatively correlated with their choice of rollover contracts, this will result in a statistically significant, negative estimate of ρ. Formally, the model estimated is a bivariate probit (Greene, 2000, and Maddala, 1983).

The goal of the rollover equation is to predict whether a household enters a rollover contract. Included in the specification are variables that influence either the benefit or the cost of doing so. When choosing our specification, it is important to remember the goal is to accurately estimate the causal effect of rollover contracts in the switching equation. Modelling the rollover decision is more likely to achieve this goal when one can identify variables (instruments) that influence the rollover decision but not the switching decision (cf. Wooldridge, 2002).

The difference in timing of the switching and rollover decisions helps us identify candidate instruments. In practice, any/all of the period-*t* covariates entering the switching equation, x_{it}, could enter (with lags) in the rollover equation. In practice, we include lags of the contract and plan variables and time dummies.[44] We therefore specify the rollover equation as:

$$P(Rollover_{it}) = \Phi(\beta_0 + X_{it-1}\beta_1 + Z_{it}\beta_2) \quad (5)$$

where X_{it-1} are lagged measures of explanatory variables that influence the rollover decision, Z_{it} are time dummies, and, from above, Φ is the standard normal CDF (suitably modified to accommodate the correlation in the errors in the two equations).

3.2.1 Discussion

There are a number of assumptions implicit in the econometric model specified in this section that warrant further discussion.

First, note that the model presented here is a simplified version of a more general, dynamic, model that analyses a household's choice of plans, *j*, among all plans available in the market in month *t*. In such a model, a household switches when the present discounted value of her utility to the new plan, *k*¸ exceeds that of her utility to her existing plan, *j*.[45] Unfortunately, estimating a dynamic model of plan choice requires both more detailed data (especially regarding the providers and plans households leaving BT switch into) as well as significantly more researcher and computation time. Such models are at the frontier of applied micro-econometric research and are beyond the scope of this study. We have included some dynamics by exploiting the differences in timing in the selection and rollover equations. While our model may not allow us to jointly analyse the optimal sequence of household rollover and switching decisions, it is likely to be adequate for measuring the average effect of rollovers on switching.

[44] The qualitative results were largely insensitive to the exact variables included in the rollover equation.

[45] This complicated dynamic model could even itself be augmented to account for "behavioural" effect (e.g. context effects, default bias) typically missing from a dynamic utility-maximizing framework.

A second important assumption is that of no persistent unobserved heterogeneity, e.g. that the error in the switching equation cannot be written as $\varepsilon_{it} = c_i + \tilde{\varepsilon}_{it}$. Allowing for unobserved heterogeneity is a hallmark of linear panel data estimation (e.g. fixed-effects models), but it is significantly more complicated in a discrete-choice setting. It is possible to do fixed-effects logit estimation in some settings by conditioning on the set of observations with a given number of outcomes (switches). In our case, however, every household either switches or doesn't and, if they do switch, it is always in the last period of the data. Furthermore, as many households do not change contracts in the data, we would have to rely on the much smaller set of BT customers who switch plans within our observation period. Similarly, estimating a random-effects model (e.g. a Random Effects Probit) either requires making untenable assumptions about the distribution of the random effect (e.g. unobserved tastes, c_i, are independent of the explanatory variables, *including tenure*) or coding an appropriate estimation method by hand. Such models are also at the frontier of applied micro-econometric research and beyond the scope of this study.

Regardless, we feel unobserved heterogeneity in the switching equation is unlikely to bias our results in ways we could predict. The primary bias from any time-persistent unobservables is likely to most be felt by the tenure variables.[46] The tenure variables aren't the focus of our study, however. While bias or inconsistency in any single parameter generally contaminates the estimates of all other parameters, assigning any such "transmitted bias" to our rollover coefficient is difficult. While it is too strong to say unobserved heterogeneity is clearly not a problem, neither is it true to say that it would obviously bias the effects of rollover contracts on switching one way or another.

A final concern is that unmodelled dynamics or unobserved heterogeneity could influence the legitimacy of our self-selection correction. For example, there could exist indexes of unobserved heterogeneity in both rollover and selection equations that are negatively correlated with each other. The tenure variable and lagged contract variables in the switching and rollover equations, respectively, could (unintentionally) capture these effects, muting our estimates of that correlation. In our opinion, this is the area of greatest concern with our proposed modelling framework, and so we conduct a specification test to assess the possibility of such effects after presenting our baseline results.

[46] Unobserved heterogeneity bias makes it difficult to disentangle whether long-time BT customers switch less because they simply like BT (unobserved heterogeneity) or because being with BT in any single period makes them want to switch less in the following period (so-called state dependence).

4 Results

4.1 Specifications

4.1.1 Switching equation

We considered a number of specifications of the switching equation based on the econometric model outlined in the last section. In the final specification below, we included the following variables:

Macroeconomic Variables: As switching can be driven by macroeconomic factors unrelated to the issues analysed here, we include two controls for macroeconomic effects: (1) The unemployment rate (varying by both region and month) and (2) Month dummies for the 15 months in our sample. We chose not to report these variables due to space constraints.

Tenure: As shown in Figure 5 and Figure 12, customers in the data differ considerably in their tenure with BT and this tenure is strongly (negatively) correlated with switching rates. We include three measures of tenure: (1) log of the household's tenure with BT (in months), (2) log of the household's tenure on their current promotion (i.e., contract, plan, and discount; in months), and (3) whether or not they are a new customer, defined as a customer whose BT start date is no more than 15 days earlier than her promotion start date.

Plan Dummies: As certain plans may be more or less attractive to households (and because when we introduce prices we want to account for differences in the amount of calls services provided), we include plan dummies to measure these effects. The included dummies are two: (1) the Unlimited Evening and Weekend Plan and (2) the Unlimited Anytime Plan. The Unlimited Weekend Plan is the excluded plan.

Other Product Dummies: We were able to obtain information about other BT products being purchased by each BT household at the time of the sampling date. These were BT's Broadband Service, BT Vision (Multi-channel TV service), Friends & Family Mobile, and F&F International. We include these as households may be less likely to switch if they also subscribe to one of these products due to higher perceived benefits from staying with BT and/or higher perceived switching costs from leaving BT.

Month in MCP (First 12 months): Over 96% of customers on fixed-term or rollover contracts sign up for a 12-month Minimum Contract Period. For these customers, we included dummies indicating in which month of their first MCP is each observed month.[47] This will measure the impact of households having to pay ETCs in order to switch from BT. As ETCs are higher the more months remaining in a MCP, we expect this effect to be strongest for months early in the MCP. To

[47] Not reported are separate effects for customers on 18-month contracts.

isolate the effects of MCPs on rollover contracts versus fixed-term contracts, we measure these effects in *just* the first 12 months of a household's contract. After this 12-month period, fixed-term and rollover contracts are very different: the former have no contractual restrictions (but do have higher prices) compared to the latter. After being unable to reject their difference, the Month-in-MCP dummies were constrained to be the same for customers on rollover and fixed-term contracts, but only in the first 12 months.[48]

Fixed-term Contract Dummy (Post-MCP): The month in MCP dummies capture the impact of being in the first 12 months of a MCP on switching behaviour for fixed-term customers. After those 12 months, we include a single dummy to measure any subsequent differences in switching behaviour between customers who were originally on a fixed-term contract but no longer face contractual restrictions relative to those households who were never on a term contract.

Rollover Dummy (Post-MCP): The month in MCP dummies also capture the impact of being in the first 12 months of an MCP on household switching behaviour for rollover customers.[49] After those 12 months, we include a single dummy to measure any subsequent differences in switching behaviour between customers who were originally on a rollover contract relative to those who were never on a term contract. As rollover-contract households are the only types of households that face ETCs under their new MCP, we expect their switching rates to be lower than other customers.[50]

Price Difference (Some specifications): In all but our first specification, we also control for price effects. We do so by including, for each household, the difference between the price they pay for their chosen plan and the lowest price in the market for that same plan at rival providers TalkTalk and/or Virgin.[51] We expect that the higher is BT's price in the market relative to its rivals, the more likely it is for households to switch. As defined, this variable will also capture changes in the price paid by households for their chosen BT plan as any price discounts are removed due to the expiration of a promotional period. For households on standard and rollover contracts, there is no price change as there either is no discount or the discount is effectively permanent. For households on fixed-term contracts, this will capture the increase in the price for Evenings and Weekend (similarly Anytime) service after the first 3 (similarly 12) months of their MCP (cf. Figure 12). We measure this variable as a percentage of the price of the household's chosen service.[52]

The last two (sets of) variables above are our key explanatory variables. The rollover dummy in particular measures the extent to which customers on rollover contracts are less likely to switch

[48] Motivated by the switching patterns we observe in the data, we ignore throughout our analysis the fact that ETCs are applicable not only on special offers, but also during the first 12 months of all new accounts.

[49] We tested the hypothesis that the impact of being in the first 12 months of the MCP differed between those on fixed-term and rollover contracts, but couldn't reject that they were the same. As such, the "Month in MCP" dummies are estimated to apply equally to households in both fixed-term and rollover contracts.

[50] Note this post-MCP rollover dummy will measure the impact of both (a) ETCs in subsequent MCPs as well as (b) any direct effect of rollover contracts independent of these ETCs. Unfortunately, there is no way to credibly separate these effects in our baseline model. Since the focus of our study is the cumulative effect of rollover contracts, for convenience we specify a single dummy variable to capture these cumulative effects. In the ETC analysis in Appendix 2, we make stronger assumptions about the relationship of ETCs to switching and are able to separately estimate both these effects.

[51] We elected not to include prices for Sky voice service as these are only available to Sky TV customers, implying the price comparison being made by households is not just that for fixed-voice services.

[52] E.g. price difference = 100*(price – min_rivals_price) / price

in month 13 onward relative to both standard (un-contracted) and fixed-term customers, *controlling for* the price discount they receive on the service.

4.1.2 Rollover (selection) equation

In our final specification, we also accommodate the possibility of self-selection by jointly estimating the switching and rollover equations, (4) and (5). The specification for the switching equation is as above. We included the following variables in the rollover equation:

Lagged Contract/Plan Choices: We include lagged contract and plan dummies to predict the choice of rollover contracts in the current month. The lagged dummies included are (1) Plan type (Evening & Weekend and Anytime plans, Weekend plan omitted), (2) On a fixed-term contract (separately during, and at the end of, and after the end of the MCP), and (3) On a rollover contract (separately during and at the end of each rollover period).

Month Dummies: We include month dummies to capture aggregate trends in subscriptions to rollover contracts, e.g. due to variation in BT's marketing focus and/or expenditure over the sample period.

4.1.3 Identification

The key effect of interest is the impact of rollover contracts on household switching, controlling for tenure, other services purchased by the household, price discounts, and selection. Fundamentally the effect of rollover contracts on switching are identified by the patterns shown in Figure 11 and Figure 12: how often do households on rollover contracts switch *after their MCP* relative to both fixed-term and standard contracts. The data suggested they switch less, a result the econometric analysis confirms.

Of course, customers who have long been with BT (i.e. have longer tenure) in general switch less. We control for that by including the tenure variables described above. The data are rich enough to, in principle, flexibly estimate the impact of rollover contracts for households at each possible tenure (e.g. customers that have been with BT for 0, 1, 2, etc. years). We have done this and found the effect of tenure is well-captured by the log(tenure) specification above and for parsimony simply report those results.

Customers on rollover contracts also receive price discounts. Failing to account for these discounts will tend to attribute a lack of switching to the presence of the rollover contract instead of the lower price being paid by households. We account for this by estimating the effect lower monthly prices have on switching rates, *controlling for* contract and plan characteristics. The variation in the data that identifies the price effects largely come from differences in *relative* switching probabilities across plans and time. For example, customers on fixed-term contracts for Evening and Weekend plans face higher prices at the end of their contracts. Similarly for customers on term contracts for Anytime plans. The econometric model allows for different baseline switching probabilities for these plans and very flexible effects for both during their MCPs. The price effect is identified by comparing how much the switching rate increases for fixed-term Anytime customers (after the MCP and relative to the baseline Anytime rate) compared to how much it increases for fixed-term Evening and Weekend customers (after the MCP and relative to the baseline Evening and Weekend rate) relative to the different increases in

price charged on the two plans. Once the price effect is identified, it can help explain some of the reduced switching in the case of households on rollover contracts.

Finally we wish to control for selection into rollover contracts based on unobservable differences in willingness to switch that are correlated with tastes for key characteristics of rollover contracts (such as lower prices in exchange for greater restrictions on churn). As further discussed in Section 3.2, the selection model will have power to the extent we have identified instruments that can influence the choice of rollover contracts and not switching. Exogenous variation in the instruments will exogenously „move rollover“ and identify the causal effect of rollover contracts on switching. Correlation in the deviations in the predicted from the actual switching and the predicted and actual rollover will then identify the correlation in the unobservables in the two equations.

4.2 Results

Table 2 below presents the results of the switching regressions under three specifications. The first specification measures the effect of rollover contracts on switching behaviour but does not account for either the effects of the price discounts or selection into rollover contracts. This specification is closest in spirit to the patterns presented in the raw data in Section 2.1.5. The second specification includes the price effects described above. The third specification accounts for self-selection into rollover contracts.

The estimates in the table report the marginal effects of the variables at left on the probability of switching away from BT in a given month, measured as a percentage point. The predicted switching rate for the average observation in our dataset (reported in the last set of rows) is slightly below 1.0% per month. This corresponds to something slightly below 11% per year. Estimates that are significant at the 10%, 5%, and 1% level are reported with 1, 2, and 3 stars.

As an example on how to read the table, consider the switching rates for the Evening and Weekend plan (denoted UEWP). Switching is an estimated 0.05 percentage points higher on the Evening and Weekend plan than for the Weekend only plan (the excluded category), or 5.3% of the baseline 0.95% switching rate.[53] This is a relatively small effect.

We begin by considering the results of tenure, plan characteristics, other services, and month in the MCP in the baseline specification (Column 1). All are consistent with prior expectation as well as the patterns described in the data section.

Tenure is shown to strongly influence the probability a household switches. Long-standing BT households switch much less. For example, a household who has been with BT for 4 years that increases its tenure by 100% (to 8 years) is predicted to switch with 0.59 percentage points lower probability, over 60% of the average baseline switching rate. Tenure on a particular promotion (i.e. plan, contract, and price) is also associated with lower switching rates.

[53] For consistency, we evaluate the percentage effect of a change in any explanatory variable at the predicted switching probability evaluated at the mean of the data. As can be seen at the bottom of the table, this differs slightly from the average predicted probability in the data.

Subscribing to another BT service had mixed effects on switching. The largest effect, both economically and statistically, was for the purchase of BT broadband service. Households that were purchasing broadband at the sampling date had a 0.49 percentage point lower switching rate, just over half of the average baseline rate.[54] This is consistent with operators' views that providing bundles of telecommunications services to households may reduce their willingness to switch.

Households on Evening and Weekend and Anytime plans switch more than those on the default Weekend plan. The unemployment rate and month dummies (not reported) both influence switching, with higher levels of unemployment associated with greater departures from BT.

The effects of being on a MCP are very strong and consistent with expectation. Being in the first month of an MCP is associated with a 0.89 percentage point reduction in the predicted probability of switching, over 90% of the baseline rate! Moving closer to the end of the MCP increases this likelihood, although it stays significantly below the baseline until the very last month, month 12. Here, in the first month in which households can switch without penalty, there is a very large (0.64 percentage point, almost 70% of the baseline) increase in the predicted probability of switching. This demonstrates the importance of MCPs in limiting household switching behaviour.

[54] Of the remaining services analysed, the effect of F&F Mobile was modest (reducing switching by an estimated 12.7%), while the effects of the others (BT Vision and F&F International) were not statistically different from zero.

Table 2: Main marginal effects in the benchmark regressions

	Switching		
	Probit	**Probit**	**Bivariate probit**
Variable	**Without prices**	**With prices**	**With prices and self-selection**
Log(Tenure at BT)	-0.59***	-0.59***	-0.59***
Log(Tenure on promotion)	-0.18***	-0.18***	-0.17***
Broadband	-0.49***	-0.50***	-0.50***
BT Vision	0.09*	0.09	0.09
F&F mobile	-0.08*	-0.13**	-0.12**
F&F International	0.15	-0.067	-0.061
UEWP	0.05*	0.09***	0.08***
UAP	-0.25***	-0.31***	-0.31***
Initial MCP month 1	-0.89***	-0.86***	-0.79***
Initial MCP month 2	-0.84***	-0.79***	-0.79***
Initial MCP month 3	-0.80***	-0.74***	-0.73***
Initial MCP month 4	-0.75***	-0.68***	-0.67***
Initial MCP month 5	-0.71***	-0.63***	-0.62***
Initial MCP month 6	-0.61***	-0.51***	-0.50***
Initial MCP month 7	-0.65***	-0.56***	-0.55***
Initial MCP month 8	-0.53***	-0.41***	-0.40***
Initial MCP month 9	-0.50***	-0.38***	-0.37***
Initial MCP month 10	-0.47***	-0.33***	-0.32***
Initial MCP month 11	-0.45***	-0.31***	-0.31***
Initial MCP month 12	0.64***	0.99***	1.01***
12-month fixed-term after end of MCP	0.39***	0.41***	0.42***
Rollover in subsequent MCP(s)	-0.49***	-0.34***	-0.33***
Percentage price difference from rivals		0.01***	0.01***
Rho (corr. coeff.)			-0.06***
Average predicted switching	1.25%	1.25%	1.24%
Predicted switching for the average observation	0.95%	0.95%	0.95%

Source: Own calculations based on BT data.

Notes: Reported are the estimated marginal effects for most variables in our Probit switching equation evaluated at the mean of the explanatory variables. Switching means switching fixed voice telephone service away from BT. The first column does not control for price differences or self-selection. The second column includes controls for price differences. The third column controls for self-selection by estimating a bivariate probit of the switching and rollover equations (Equations (3) and (5)). A promotion is a combination of plan, contract, price, and additional phone services (if any). F&F mobile/F&F international/Broadband/BT Vision are dummies for other BT services that customers may be purchasing in addition to fixed voice telephone service. UEWP and UAP are BT calling plan dummies. MCP stands for Minimum Contract Period. Percentage price difference from rivals is the price of the household's chosen service minus the minimum price from Virgin & Talk Talk for the comparable voice service, divided by the price of the chosen service. Included in all specifications but not reported are a constant term, month dummies, unemployment, and variables measuring the effects of 18-month term contracts. Included in the rollover equation in column 3 but not reported here (but see Appendix 1) are lagged plan dummies and lagged contract choice variables. Estimates significant at 10%/5%/1% levels denoted by 1/2/3 stars. Significance levels determined based on standard errors that allow for arbitrary correlation across months within each customer.

4.2.1 The effects of rollover contracts

Remaining with the results in column 1, we turn to the contract dummies, including our key parameters of interest. We see that households on rollover contracts switch after their first MCP by 0.49 percentage points (51.7%) less than comparable customers on standard contracts. By contrast, households on fixed-term contracts switch 41.2% more than standard-contract customers, implying rollover customers switch 65.8% less than fixed-term customers.[55] This is no doubt due to the additional ETCs such customers would have to pay compared to either standard or fixed-term customers.

The remaining columns in the table break out the effects of reduced switching by customers on fixed-term and rollover contracts into a portion due to prices and that due to the effects of the contracts themselves.

Column 2 demonstrates that price variation significantly influences switching. It says that a 10 percentage point increase in the monthly price of a fixed-voice service relative to BT's rivals is associated with a 0.11 percentage point increase in the switching rate. Thus the £3 (20.6%) discount on Evening and Weekend Service associated with a rollover contract is predicted to lower the probability of a household switching by an estimated 0.21 percentage points, approximately 22% of the baseline rate.

Note also that accounting for prices has the predicted effect of reducing the magnitude of the Rollover dummy, from -0.49 to -0.34 percentage points. As expected, if we fail to account for the lower prices offered on rollover contracts, we attribute too much to the influence of rollover contracts to the rollover feature (and associated ETCs). That being said, there is still a negative estimated effect of rollover contracts on switching relative to households on standard contracts, by 35.9% relative to standard contracts and by 55.3% relative to fixed-term contracts

The worry is that this effect doesn't only represent the causal effect of rollover contracts but in part captures the self-selection of customers into rollover contracts that are less likely to switch

[55] (-0.49-0.39)/(0.947+0.39)=-0.658.

anyway. The last column of Table 2 addresses this issue by presenting the switching regression results associated with our Bivariate Probit model including a rollover self-selection equation.

The effects of selection are both economically and statistically modest. While we do estimate that there is a statistically significant negative correlation in the unobservable errors in the switching and rollover equations, it is only estimated to be -0.06. As a result, there are few differences in the estimated effects of any of the explanatory variables in column 3 versus column 2. In this, our final, specification, households on rollover contracts switch after their first MCP approximately 34.8% less than comparable customers on standard contracts and by 54.8% less than comparable customers on fixed-term contracts.

4.2.2 Survivor functions

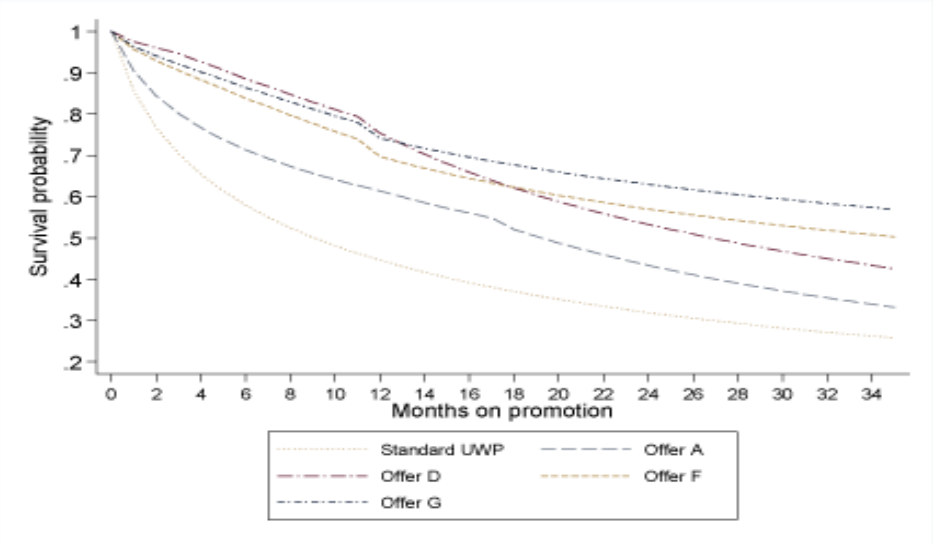
We summarize the aggregate effects of all our estimated parameters by presenting survivor functions based on the Bivariate Probit model whose (main) marginal effects are reported in column 3 of Table 2.

Survivor functions are frequently estimated in biostatistics, labor economics and marketing applications, and show how likely individuals are to remain in an initial state as time elapses. In the context of our application, the initial state is the state of being a BT customer that has initiated a particular promotion, and the event of leaving the initial state is defined as the event of switching away from BT.

In the two figures below, we estimate how these survivor functions are affected by the particular promotion that is initiated. Figure 15 does that for new BT customers (that is, customers on their first promotion with BT), while Figure 16 does that for customers who have already been with BT for five years, as of the start of the promotion. The two figures confirm that, as a result of their being less likely to switch away from BT, customers on rollover contracts ("Offer F"[56] and "Offer G") have flatter survivor functions than customers on fixed-term contracts ("Offer D" and "Offer A") and customers on a standard UWP plan. Survivorships are also significantly affected by overall tenure at BT: survivor functions for new customers (in Figure 15) are significantly steeper than survivor functions for customers with a tenure of 5 years (in Figure 16).

[56] Please see Annex 5 for a description of these offers.

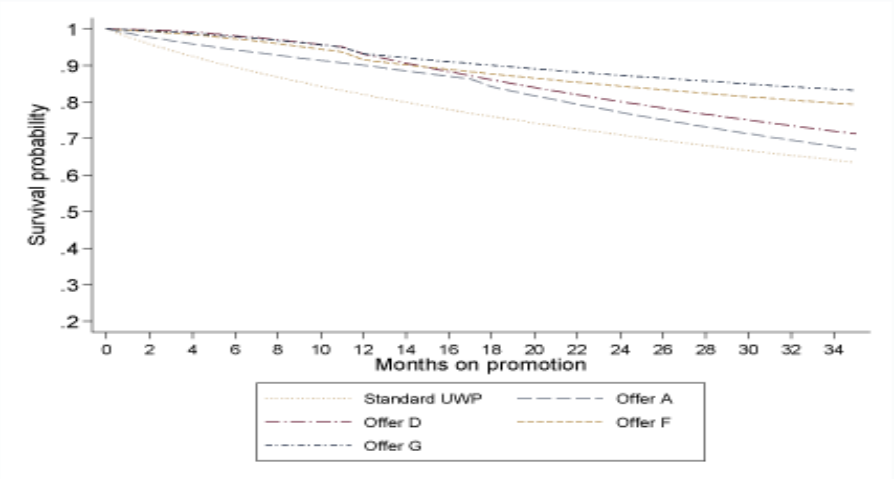
Figure 15: Estimated survivor functions for new customers by plan and contract type



Source: Own calculations based on BT data.

Notes: The survivor functions depicted in this graph are based on the estimation of the Bivariate Probit model whose main marginal effects are reported in Table 2. These survivor functions are for new BT customers, that is for customers with no tenure at BT at the beginning of the promotion. "Offer D"[57] and "Offer A" are promotions for customers accepting fixed-term contracts. "Offer F" and "Offer G" are promotions for customers accepting rollover contracts. Further details about these promotions can be found in Section 2.

Figure 16: Estimated survivor functions for customers with five-year tenure by plan and contract type



Source: Own calculations based on BT data.

Notes: The survivor functions depicted in this graph are based on the estimation of the Bivariate Probit model whose main marginal effects are reported in Table 2. These survivor functions are for BT customers with 5 years of tenure at BT at the beginning of the promotion. "Offer D" and "Offer A" are promotions for customers accepting fixed-term contracts. "Offer F" and "Offer G" are promotions for customers accepting rollover contracts. Further details about these promotions can be found in Section 2.

[57] Please see Appendix 5 for a description of these offers.

4.2.3 Robustness of self-selection correction

As we are concerned that we have accurately modelled the effects of self-selection, we considered several alternative specifications of the rollover equation. Variation in the set of lagged covariates had modest effects of the results; in the final specification we included the lagged contract variables as described above.

We also assessed the possibility of bias in our measurement of self-selection due to unobserved heterogeneity in the rollover and/or selection equations. The best test would be to estimate an unrestricted model that allowed for such unobserved heterogeneity and test the significance of this addition. For the computational reasons discussed in Section 3, however, this was not possible.

Instead, we estimated alternative specifications that omitted the tenure variables from the switching equation and lagged contract choice variables from the rollover equation. The hope is that these specifications remove those variables most likely to be picking up any time-persistent unobserved heterogeneity in each equation, allowing those to (re-)enter the error term and be estimated in our bivariate probit specification. The results were encouraging. Not only was the estimated correlation *not* more negative, it was in fact positive. Indeed, despite the natural increase in the variability of the estimate due to omitting important explanatory factors, large negative values of the correlation coefficient could be rejected.

Figure 12, showing switching rates by month on promotion for both existing and new BT customers, provides further insight into why we may not be finding evidence of self-selection. A reasonable story of self-selection would seem to be that of a loyal BT customer who intends not to switch and is happy to enjoy the price discount offered with a rollover contract. However, such households would also seem more likely to be long-time BT customers, something we can see in the data. If this story were right, we would expect to see no effect of rollover contracts on old customers, but strong effects on new customers. Figure 12, however, shows that, if anything, switching rates for customers on rollover relative to standard contracts are more different for existing than new customers, a result confirmed (but not reported) for the full model. For there to be strong effects of self-selection, it must be that customers *of a given tenure with BT* differ in their unobserved willingness to switch that is correlated with their choice of a rollover contract. Put this way, self-selection seems less likely to be an issue, something confirmed in our empirical results.

While not conclusive, the statistical test and analysis above encourage us to conclude that we are adequately accounting for self-selection in our analysis.

4.3 Discussion

How should one evaluate BT's rollover contracts in light of our results? Two literatures in economics suggest they should be viewed with concern. First, the evidence presented above is consistent with the view that BT's rollover contracts significantly increase switching costs in fixed voice telephony markets. A likely short-run effect is that these switching costs reduce rivals' incentives to attract customers by cutting prices or promoting their own products. In this effect outweighed by the benefits of more aggressive competition for customers willing to enter

such contracts? While the evidence in the economics literature isn't definitive, Farrell and Klemperer (2007) conclude that it is likely that higher switching costs increase average prices and therefore reduce consumer welfare.

A growing literature analysing exclusive contracting in product markets provides an additional cause for concern. This literature analyses the incentives a manufacturer may have to sign exclusive contracts with one or more downstream retailers. When there are economics of scale in manufacturing, such contracts can exclude an efficient upstream entrant.[58] The essential insight is that when any one retailer signs an exclusive deal, it imposes a negative externality on all other retailers by reducing the potential market for (and raising the costs of) the new entrant. This is a kind of coordination failure and it can induce all retailers to sign exclusive contracts when they would jointly prefer to instead buy from the entrant. The implications of this literature for BT's rollover contracts are analogous. Rollover contracts introduce (rolling) exclusive contracts over a portion of BT's customer base. If, as is likely, there are economies of scale in the provision of either existing or new services, this would seem to reduce the likelihood of either new market entry or the introduction of new services by existing rivals, again reducing welfare.

Can rollover contracts be justified on efficiency grounds? The most prominent argument in the economic literature is that exclusive contracts can solve problems of asymmetric information and/or moral hazard,[59] but these are unlikely to be relevant where exclusives are with final customers. Arguments that MCPs help lower signup costs may be credible, but presumably only for the *first* MCP, not on a rolling basis.

While this report has exclusively analysed the impact of BT's rollover contracts on switching from fixed voice telephone service, the analysis in this sub-section is more general. If similar rollover contracts reduce customer switching from BT for access to broadband Internet service (and it seems likely that they would), the conclusions we draw for voice would equally well apply to broadband. Overall, the evidence in the economic literature provides few efficiency justifications for rollover contracts and several reasons why they could reduce social welfare. They are clearly a cause for concern.

[58] E.g., Aghion and Bolton (1987), Rasmussen, Ramseyer, and Wiley (1991), Segal and Whinston (2000). Whinston (2006), Chapter 4 provides a nice introduction to this topic.

[59] See Whinston (2006), Section 4.5.

5 Conclusions

This report evaluates the effects of BT's newly-introduced automatically renewable ("rollover") contracts on their customers' willingness to switch suppliers. Working closely with Ofcom staff, we obtained detailed customer-level billing data from BT for a random sample of almost 180,000 of their fixed-line voice customers as of 31 December, 2008 and followed their choices for the subsequent 15 months. We augmented this with aggregate market-wide information measuring macroeconomic trends and prices offered by rival providers for similar services, yielding a comprehensive dataset well-suited to analyse the factors influencing household switching from BT. Patterns in the raw data strongly support the conclusion that households on rollover contracts switch less than those on standard and (especially) fixed-term contracts.

We specified an econometric model to analyse the factors influencing these switching patterns. The model was designed to estimate not only the direct, causal, effect of rollover contracts on switching away from BT, but also other factors that might influence switching, especially the price discounts included in such contracts and "self-selection", the possibility that there are unobserved differences in households' likelihood of switching that might be correlated with their decision to select a rollover contract.

We found all of these factors were important determinants of households' switching behaviour. In our preferred specification, we found customers respond strongly to facing ETCs in minimum contract periods (MCPs): they switch 83.4% less than the average baseline switching rate in the first month of a MCP, with the effect smoothly lessening until the last month (when customers can switch without paying ETCs), where it jumps to an estimated 80% greater than baseline. We further found that doubling a household's tenure with BT, offering a 21% price discount like that offered by BT on the most popular rollover contract, and purchasing broadband service from BT was associated with an estimated 62.3%, 21.9%, and 52.8% reduction in switching, respectively. Finally, we found only modest evidence of self-selection: unobservable factors influencing households selection of rollover contracts were found to be negatively correlated with unobservable factors influencing their switching from BT, but the magnitude of this correlation was small (-0.06) and its economic effects were negligible.

Our primary result focused on the effect of rollover contracts on switching. We found, after controlling for the effects of tenure, price discounts, broadband purchase, and self-selection, that customers on BT's rollover contracts switch after their first MCP an estimated 34.8% less than comparable customers on standard contracts and by 54.8% less than comparable customers on BT's fixed-term contracts. Furthermore, accounting for the other factors described above were important: omitting the effects of prices and self-selection would have led to the erroneous conclusion that rollover contracts reduced switching after a customer's first MCP by an estimated 51.7% (65.8%) relative to standard (fixed-term) contracts.

In an Appendix, we extended this analysis to account for the reduction in ETCs recently agreed between Ofcom and BT. To do so, we separate the effect of BT's rollover contracts on switching into an effect of the ETCs induced by subsequent MCPs under rollover contracts and the effect of rollover contracts themselves. We found, after controlling for the effects of tenure, price discounts, broadband purchase, and self-selection, households on BT's rollover contracts

switched after their first MCP by 26.0% less than comparable customers on standard contracts and that this fell to 18.8% under the now-lower ETCs agreed between Ofcom and BT.

This evidence is consistent with the view that BT's rollover contracts significantly increase switching and/or entry costs in fixed voice telephony markets. The existing economic literature has raised concerns about the influence such costs may have on competition and welfare that suggests rollover contracts may therefore be cause for concern, particularly in light of BT's continuing (if diminished) role as the largest firm in the market. While we exclusively analyse switching in voice markets, these concerns would also arise in broadband markets to the extent rollover contracts for such services similarly reduce household switching.

6 References

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Appendix 1 Rollover equation

Table 2, in the main body of the study, reports the marginal effects of a set of covariates on the probability of switching, under three alternative specifications. Specifications 1 and 2 are single-equation (Probit) specifications (without and with controlling for prices, respectively) in which only the outcome of switching away from BT is modelled. To address the issue of self-selection into rollover contracts, Specification 3 is a two-equation (Bivariate Probit) specification in which the switching outcome is modelled together with the outcome of choosing a rollover contract.

The marginal effects on the probability of choosing a rollover contract, as emerging from the estimation of the rollover equation in Specification 3, are reported in Table 3.

Table 3: Main marginal effects for the rollover equation

	Switching
	Bivariate probit
Variable	**With prices and self-selection**
Lagged UEWP	9.3***
Lagged UAP	-0.2
Lagged fixed-term	-22.8***
Lagged fixed-term during MCP	-5.2
Lagged fixed-term at end of MCP	25.9***
Lagged rollover during MCP	98.4***
Lagged rollover at end of MCP	77.7***
Average predicted switching	31.24%
Predicted switching for the average observation	23.70%

Source: Own calculations based on BT data.

Table 3 shows in particular (variables "Lagged rollover during MCP" and "Lagged rollover at end of MCP") the impact of state dependence, whereby a customer is more likely to remain on a rollover contract than she is to move to one. Relative to a customer on a standard UWP plan, a customer on a rollover contract and in the middle of an MCP is more likely to "choose" a rollover contract (the default option) by over 4 times (98.4/23.7 = 415%). This effect is attenuated for rollover customers who are at the end of an MCP and therefore they do not have to pay any ETC to move to different contracts.

Appendix 2 ETC analysis

On 17 June, 2010, Ofcom announced they had reached agreement with several major competitors in the fixed telephony market, including BT, to reduce the early termination charges (ETCs) they charge customers for switching service within a minimum contract period (MCP). BT agreed to reduce these charges from between £7.50-£8.00 to between £2.00-£5.00, depending on a customer's chosen plan.[60]

In this Appendix, we consider the likely consequences of these ETC changes on the results of our analysis of the effects of rollover contracts on switching behaviour. Evaluating these consequences requires disentangling the effects of rollover contracts from the effects of any ETCs associated with the contracts. In the main analysis included in the report, we did not do that, in large part because it requires making stronger assumptions about how consumers respond to ETCs. We preferred to flexibly estimate the total effect of rollover contracts without regard to separating them into their various components.

In this section, we make these stronger assumptions for the purpose of evaluating the likely effects of the change in BT's ETCs on the effect of rollover contracts on consumer switching behaviour. To do so, we make three changes to the model estimated in the body of the text:

- **Continuous ETC Measure instead of Month in MCP Dummies:** In our main results, we flexibly estimated the effects on household switching of being in each month of their MCP. The pattern of these effects was quite consistent: being early in an MCP (when ETCs are highest) reduced estimated switching by more than being late in an MCP (when ETCs are lowest). This effect was fairly smooth until there were no months remaining in an MCP (and thus no ETCs to pay), when we estimated a large discontinuous jump in switching.

  We capture this pattern of effects in this Appendix by calculating, in each month for each household, the ETCs that household would have to pay to switch from BT. This amount depends on the household's contract type (e.g. there are no ETCs for standard contracts), the months remaining in their MCP, their chosen plan (as ETCs are higher for higher-cost plans), and the point in our sample period (as BT previously changed ETCs in April 2009). How we calculated ETCs is briefly described here. ETCs on special offers (that is, promotions involving fixed-term or rollover contracts) are constructed in two alternative ways depending on whether the observation refers to before or after April 2009:

  - Before April 2009, ETCs are computed as the number of months remaining on the MCP (ranging, in the discretized dataset, between 11 and 0 months) times the monthly price of the underlying standard plan;
  - From April 2009 onwards, ETCs are computed as the number of months remaining on the MCP times £ 7.5.

[60] See Ofcom press release at http://www.ofcom.org.uk/consumer/2010/06/cheaper-charges-for-uk-consumers-to-end-phone-contracts, accessed 3 July 2010.

Having calculated the ETCs, a household would have to pay, we introduced these into the model in a manner similar to the effects we found for the Month-in-MCP dummies. In particular, households appear to have strong preferences for not paying *any* ETCs. Thus the likely difference between paying an ETC of £0 and an ETC of £5 is likely to be different than that of paying an ETC of £5 and an ETC of £10. We capture these effects by specifying a linear effect for ETCs in all months of a MCP except the last, allowing a dummy variable to pick up the discontinuous jump for the final month when ETCs are zero. As in the main results for the Months-in-MCP dummies, we constrain the linear ETC effects to be the same for customers on rollover and fixed-term contracts in their first 12-month MCP.

- **Separate ETC Effects for First and Subsequent MCPs:** In our main results, we also found differential effects of Months-in-MCP between the first MCP and subsequent MCPs for rollover customers that face additional MCPs. We tested for similar differences in the effects of ETCs on switching and found them to be present here as well. As such, we allow for differential linear effects of ETCs within the first and subsequent rollover periods. We speculate on the reasons for these differential effects after presenting our results.

- **Subsequent versus Common Contract Effects:** In our main results, we measured the effect of rollovers by comparing the difference in switching between rollover customers and standard and fixed-term customers *after their first MCP*. This made sense as the primary contractual difference between fixed-term and rollover contracts were that the latter introduced an additional MCP after the first one. Once we decide to measure the effects of rollover contracts separately from ETCs, it makes sense to allow for the rollover effects to be felt both in the first and subsequent MCPs. As such, in the results to follow we estimate a rollover effect that is common across all MCPs. We similarly estimate a common fixed-term contract effect.

Table 4 below duplicates the results of Table 2 in the text for the key ETC and contracting variables in the regression. Reported are the marginal effects of each of these explanatory variables evaluated at the mean of the data. The effects are comparable to those we found in our main results with a few slight differences. The effect of rollover contracts, *controlling for ETCs*, is estimated to be approximately 0.14 percentage points, or 14.7% of the 0.95% predicted switching rate at the mean of the explanatory variables. We are not able to identify the source of this rollover effect net of ETCs, but note that it could be due to default bias and/or the possibility BT is able to make bespoke retention offers under rollover contracts.

As anticipated by our description above, there are very large positive effects on switching rates associated with being at the end of a MCP and there are important differences in the effects of ETCs in the first MCP compared to subsequent MCP. At the mean of the explanatory variables, an additional £10 in ETCs in the first MCP is associated with a reduction in switching of 0.095 percentage points, or 10.0%, but only 10x(-0.0095+0.0071)=0.024 percentage points, or 2.5% of the baseline switching rate.[61]

[61] While the data insist on their being different effects for ETCs in first versus subsequent contract periods, we cannot say why this is. We speculate that BT may have different rules for enforcing the collection of ETCs in MCPs after the first. As part of their S135 filling, BT reported both (billed) ETC Revenue and ETC Bad Debt for March, 2009 to February, 2010.

Table 4: Main marginal effects in regressions with ETC

	Switching		
	Probit	**Probit**	**Bivariate probit**
Variable	**Without prices**	**With prices**	**With prices and self-selection**
Log(Tenure at BT)	-0.61***	-0.61***	-0.61
Log(Tenure on promotion)	-0.15***	-0.15***	-0.14
Broadband	-0.50***	-0.50***	-0.5
Vision	0.094*	0.093*	0.093
F&F mobile	-0.14***	-0.20***	-0.19
F&F International	0.12	-0.17	-0.16
UEWP	0.068***	0.11***	0.1
UAP	-0.25***	-0.32***	-0.32
ETCs	-0.011***	-0.010***	-0.0096
ETCs in subsequent MCPs	0.0076***	0.0074***	0.0071
12-month fixed-term	0.17***	0.21***	0.21
12-month fixed-term at end of MCP	0.63***	0.67***	0.69
Rollover	-0.40***	-0.14**	-0.14
Rollover at end of MCP	1.34***	1.36***	1.39
Percentage price difference from rivals		0.014***	0.013
Rho (corr. coeff.)			-0.08***
Average predicted switching	1.25%	1.25%	1.24%
Predicted switching for the average observation	0.95%	0.95%	0.95%

Over this period, 63% of billed ETCs were allocated to bad debt. If, for example, BT only had to allocate x% of ETCs charged in early MCPs to bad debt, but y% of ETCs in subsequent MCPs to bad debt (with x small and y large), then we would expect to see the effects we are finding in our results.

Source: Own calculations based on BT data.

Notes: Reported are the estimated marginal effects for the key explanatory variables in our Probit ETC switching equation evaluated at the mean of the explanatory variables. Switching means switching fixed voice telephone service away from BT. ETC stands for Early Termination Charge. The first column does not control for price differences or self-selection. The second column includes controls for price differences. The third column controls for self-selection by estimating a bivariate probit of the switching and rollover equations (Equations (3) and (5)). A promotion is a combination of plan, contract, price, and additional phone services (if any). F&F mobile/ F&F International /Broadband/BT Vision are dummies for other BT services that customers may be purchasing in addition to fixed voice telephone service. UEWP and UAP are BT calling plan dummies. Price relative to rivals is the price of the household's chosen service minus the minimum price from Virgin & Talk Talk for the comparable voice service. Included in all specifications but not reported are a constant term, month dummies, unemployment, and variables measuring the effects of 18-month term contracts. Included in the rollover equation in column 3 but not reported are lagged plan dummies and lagged contract choice variables. Estimates significant at 10%/5%/1% levels denoted by 1/2/3 stars. Significance levels determined based on standard errors that allow for arbitrary correlation across months within each customer. Standard errors could not be computed for the marginal effects of the bivariate probit specification. Please see Appendix 5 for a description of the Offers.

To construct a measure of the effect of rollover contracts comparable to that in the main body of the text, we must combine the marginal effects of rollover contracts with those from ETCs. We formally do this by taking the difference between the mean probability of switching for a customer on a standard contract (i.e., when the rollover dummy and ETCs are both zero) and the mean probability of switching for a customer on a rollover contract. For the latter customer, we set the rollover dummy to one and set the ETC to the average ETC facing rollover customers in MCPs after the first, a fee of £54.8. Doing so yielded predicted switching probabilities of 1.92% in the former case and 1.42% in the latter, a predicted difference of 0.5 percentage points, or 26.0% of the 1.92% switching rate of standard customers. This is comparable to, though slightly lower than, the 34.6% we were finding in our baseline model.

As a final calculation, we predict what would happen under the new ETCs agreed between Ofcom and BT. To do so, we simply re-calculate the average ETC facing rollover customers in MCPs after the first using the now-lower value of ETCs.[62] Based on ETCs of £2.00/month for Unlimited Weekend customers, £2.50/month for Unlimited Evening and Weekend customers, and £5.00/month for Unlimited Anytime customers, the average ETC facing these customers in the subsequent rollover period would be £19.2, a 65.0% reduction. Using this lower average ETC, we continue to calculate a predicted switching probability of 1.92% for households on standard contracts, but now a 1.56% predicted switching probability for rollover customers in their subsequent MCP.[63] This is a predicted difference of 0.36 percentage points, or 18.8% of the 1.92% baseline.

[62] This isn't strictly accurate as we rely on the underlying switching decisions for the customers in our data. These switching decisions were made in a setting with higher ETCs than those for which we are trying to forecast the effects. The effect of these differences is small, however (a 0.14% predicted difference in the monthly switching rate), so we proceed with this calculation.

[63] The reduced ETCs would also have an effect on switching in the initial MCP for both rollover and fixed-term contract customers, but for comparability with our main results, we continue to focus on predicted effects in subsequent MCPs for rollover customers.

In summary, having accounted for the separate effects of ETCs and rollover contracts on household switching, we find that, controlling for all the other factors influencing household switching behaviour, households in rollover contracts switch after their first MCP by 26.0% less than comparable customers on standard contracts and that this would fall to 18.8% under the now-lower ETCs agreed between Ofcom and BT.

Appendix 3 S135 data request

3 March 2010

[✂]

BT Centre

81 Newgate Street

London

EC1A 7AJ

Claudio Pollack

Director of Consumer Affairs

Direct line: [✂]

Direct fax: [✂]

[✂]

[✂]

Dear [✂]

Notice requiring the provision of specified information under section 135 of the Communications Act 2003 (the 'Act')

This is a formal notice under Section 135 of the Communications Act 2003 (the "Act") addressed to BT plc ("BT"), whose registered company number is 1626499, and any subsidiary or holding company, or any subsidiary of that holding company, all as defined in Section 736 of the Companies Act 1985, as amended by the Companies Act 1989.

This notice requires you to provide the information set out in the Annex, in the manner and form specified, for the purpose of ascertaining the impacts of automatically renewable contracts ("ARCs") on consumer switching behaviour, (and whether regulatory intervention may be required).

Background to this exercise

Ofcom has a duty to further the interests of citizens and of consumers, where appropriate, by promoting competition. Effective competition delivers innovation, lower prices and greater choice. It is vital that consumers are able to engage effectively in the competitive process and can switch simply between communication providers. If consumers cannot

switch easily we may need to put in place measures to facilitate easy and reliable switching.

ARCs are currently in use in voice telephony markets. These contracts raise a number of potential policy concerns including creating barriers to switching. Ofcom is gathering information to help assess the impact of automatically renewable contracts and whether regulatory intervention may be required.

As part of our research and assessment of ARCs, we intend to carry out an empirical analysis of BT's ARCs for fixed voice telephony services. This analysis aims to explore the impact of these contracts on consumer switching behaviour.

Provision of specified information

Ofcom has set up a secure file transfer facility—the details of which have been communicated to BT—to enable the secure transfer of data between Ofcom and BT. You are required to provide Ofcom with the information specified in the Annex in the manner and form specified by saving it directly to Ofcom's secure file transfer facility, and informing [✂] via email at [✂] when this is complete.

Please note that the information must be provided in **two phases**, with the following deadlines:

Phase 1: you must save the data request to the secure site and inform [✂] no later than **5pm on 25 March 2010** (15 working days from the date of this request);

Phase 2: you must save the data request to the secure site and inform [✂] no later than **5pm on 20 May 2010** (52 working days from the date of this request);

The phasing will need to be provided in such a way as to enable us to link observations across datasets (that is, the key variables). In particular, the customer ID used for a particular customer, and the identifier/code for a plan/contract in Phase 1 of data provision would have to consistent with the same customer and plan/contract identifiers used in Phase 2.

All information required by this notice must reach the secure site, and you must inform [✂] of this, no later than **5pm on 20 May 2010**.

Data Protection

Disclosure of the information is requested under Section 135 of the Act. The personal data which Ofcom requests will be used for the purposes described above.

Ofcom will ensure that it fully complies with the provisions of the Data Protection Act 1998 ('DPA'). All personal data received by Ofcom from you shall only be used for the purposes

stated above and shall not be further processed or disclosed in a manner incompatible with those purposes.

Ofcom has appropriate technical and organisational measures in place to protect against accidental loss, destruction, damage and disclosure of personal data. These measures are appropriate to the harm which might result from any unauthorised or unlawful processing and have regard to the nature of the personal data.

Personal data will not be processed outside the European Economic Area.

An individual is entitled pursuant to the DPA to ask for a copy of the personal information we hold, and to have any inaccuracies in their information corrected. Any complaints about how we process personal information should, in the first instance, be addressed to:

The Secretary to the Corporation, Ofcom, Riverside House, 2a Southwark Bridge Road, London SE1 9HA.

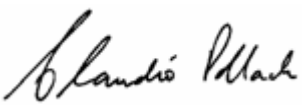
Confidentiality

In the response please set out in a separate annex marked “confidential information” any document or information which you consider to be confidential and supply a written explanation as to why it should be treated as such. Ofcom will take into consideration any representations you make when determining which information it considers to be confidential.

Offences

I draw your attention to sections 138 to 144 of the Act (copies of which are enclosed) which set out, among other things, the offences created by the Act in connection with a failure to comply with a requirement under section 135 of the Act or in connection with the provision of false information. You are therefore required to ensure that your response is complete and is not false in any material particular. Given the seriousness of the potential penalties and offences involved, you may want to seek your own independent legal advice about the contents of this notice.

Yours sincerely



Claudio Pollack

Director of Consumer Affairs

enc

Sections 138 to 144 of the Communications Act 2003

http://www.opsi.gov.uk/acts/acts2003/30021--c.htm#138

ANNEX: AUTOMATICALLY RENEWABLE CONTRACTS INFORMATION REQUEST

This Annex is set out in three parts:

- Part I: Relevant definitions;
- Part II: The data that BT is requested to provide to Ofcom, including the time schedule for provision;
- Part III: The format in which this data should be provided.

PART I: RELEVANT DEFINITIONS

We have defined the following terms and concepts used within this information request as set out below:

- The **sampling date** is 31 December 2008.

- A **BT customer** is an individual who both rents a telephone line and purchases calls from BT as at the sampling date. This definition does not include individuals that only rent the line.

- The **population of interest** is the set of BT customers as at the sampling date.

- An individual's **BT start date** is the month in which the individual became a BT customer (e.g., July 2008).

- The **sampling-date plan** is the plan which the customer was on as at the sampling date.

- If a customer leaves BT, the **BT switching date** is the date on which the customer leaves BT. A customer leaves BT when he or she ceases to rent the line or purchase calls from BT.

- If a customer does not leave BT, the **censoring date** is the latest date for which information on that customer is available.

- A **subsequent plan** is any plan that the customer has bought between the sampling date and the censoring date (i.e. between 1 January 2009 and the censoring date, inclusive).

- A **previous plan** is any plan that the customer had bought before the sampling-date plan.

PART II – THE DATA THAT BT IS REQUESTED TO PROVIDE TO OFCOM

Part II is split into two sections:

Section A: Sampling procedure;
Section B: Data requested.

Section A: Sampling procedure

The dataset we are requesting BT to provide should contain customer-level information on a subset of customers randomly drawn from the population of individuals that were BT customers as at the sampling date (i.e. **31 December 2008.**)

Ofcom would like BT to provide us with an appropriately sampled subset of **180,000 customers**. We believe his sample size would be large enough to allow us to precisely estimate the effects of interest.

For each customer drawn into the sample, please provide information that will allow us to reconstruct, at a monthly frequency, the history of the relationship between the customer and BT, from **1 January 2007** (or the date he or she began their relationship with BT, if after January 2007) to either the **end of the sampling period (31 January 2010)** or the time at which he or she left BT. In addition to the information needed to reconstruct customer histories, we will need information about the customers. This includes the plan and contract they are on, features of those plans/contracts, and other variables. We describe this in greater detail in section B, below.

Please draw a random sample from the BT customer databases when selecting customers as of the sampling date.

Section B: Data requested

Please provide us with the following information **in two phases** as set out below, in relation to the sample:

Phase 1: Information to be provided by 5pm on 25 March 2010 (15 working days from the date of this request).

*For questions 1-4, please provide the relevant information for **each BT customer included in the sample:***

1. The BT start date.

2. Please link the details of the plans and contracts requested under 2(a) and 2(b) to a separate database that contains the information requested under question 4.

   2 (a) The plan identifier/code for the sampling-date plan. If the same plan identifier/code is used to indicate plans with different contract terms, please provide additional information to identify the contract which applies to each BT customer.

   2 (b) The start date of the sampling-date plan.

3. The post-code of the BT customer.

4. Plan identifiers/codes and associated plan information, including:

   4 (a) Plan (calls) price.

   4 (b) Line rental price.

   4 (c) Services offered with a description of, and the prices for, those services.

   4 (d) Any minimum contract period (MCP) and the Early Termination Charges (ETCs) associated with that MCP, noting if/when ETCs changed due to *Ofcom's review of additional charges*, published in December 2008.

5. The attached Excel spreadsheet entitled *'Spreadsheet 1 ARC populations 2008'* provides general information relating to the number and proportion of customers on an automatically renewable contract in 2008, and was sent to Ofcom as part of the response to a previous S135 in 2009. Please update this information with the relevant 2009 figures in Spreadsheet 1 as part of your response to this request.

6. Please provide any internal analyses carried out by BT relating to ARCs.

Phase 2: Information to be provided by 20 May 2010 (within 52 working days from the date of this request)

For questions7-12, please provide relevant information ***for each BT customer included in the sample:***

7. The end date of the sampling-date plan (if any)

8. The BT switching date or censoring date (indicating which it is).

   8(a) If switching, please provide the reason for leaving BT (understanding that this may not be available for all customers).

   8(b) If switching, please specify whether the customer stops renting the line, or stops purchasing calls, or both.

9. Plan identifiers/codes for subsequent plans (if any), up to the BT switching date or censoring date, and information including:

   9 (a) For every subsequent plan (if any), start date, and end date or censoring date.

   9 (b) For every subsequent plan, the plan identifier/code. If the same plan identifier/code is used to indicate plans with different contract terms, please provide additional information to identify the contract which applies to each BT customer.

10. Plan identifiers/codes for previous plans (if any), from 1 January 2007 (or the BT start date, if after January 2007) up to the start date of the sampling-date plan, and information including:

10(a) For every precedent plan (if any), start date (at least if after 31 December 2006) and end date.

10(b) For every precedent plan, the plan identifier/code. If the same plan identifier/code is used to indicate plans with different contract terms, please provide additional information to identify the contract which applies to each BT customer.

11. The set of other (non-voice) packages purchased by the customer (i.e. broadband, video, etc.). We understand this information may be difficult to obtain and/or incomplete. If incomplete, please provide a description of the reasons for incompleteness.

12. Demographic information by post-code of the BT customer, for example information on lifestyle, occupation, age, and income, as far as this is available.

13. As far as possible, please provide BT marketing expenditure by month, for fixed voice, split by promotion type:

13(a) In particular, please split the marketing expenditure into that which promotes automatically renewable fixed-voice contracts versus that which promotes non-automatically renewable fixed-voice contracts.

14. As far as possible, please provide total revenue collected by month from ETCs for all BT fixed-voice. Please split this by contract-type within fixed-voice (e.g. ARCs, other). While we recognize that BT does not collect all the billed revenue from its ETCs, please provide whatever information BT regularly collects and uses itself for monitoring ETCs, whether this is billed ETCs, collected ETC revenue, or other related information.

PART III – FORMAT FOR PROVIDING THE REQUESTED DATA

Data shape

Please send data to Ofcom either in a cross-sectional or a longitudinal format. In the cross-sectional format, one record (row) in the dataset corresponds to one customer. In longitudinal format, one record corresponds to one customer in one time period (a month). Keeping constant the amount of information, a cross-sectional dataset will contain fewer records (rows) but will contain more fields (columns), since information about variables that change over time will have to be contained in separate, time-indexed, fields. An intermediate option would be to have one record for each plan for each customer. A sample Excel spreadsheet entitled *'Spreadsheet 2 sample data format'* is attached to this request with an example of this intermediate format.

BT may send the requested information in several different datasets (for example, a dataset containing characteristics of the different plans, another dataset containing characteristics of the different contracts, and a further dataset containing characteristics of the customers). In this case, however, it is crucial that records in each dataset are unambiguously identified by a (set of) key field(s) and that a scheme is provided allowing us to appropriately link records across datasets.

Data format and support

We would like to receive the data in text files in which data fields are separated by pipes (|): this is a light data format which also allows the user to easily import the raw data into data-analysis applications such as SAS or Stata. The resulting data files should be transferred to Ofcom using a secure file transfer protocol that Ofcom has arranged for BT.

Appendix 4 Construction of the estimation dataset

The raw data

The customer dataset

In the S135 information request to Ofcom we asked for the histories of a random sample of 180,000 customers from the population of BT customers as of 31 December 2008 from that point in time onwards (and backwards through 1 January 2007), up until the time they left BT or the end of the observation period (31 March 2010), as they moved across promotions—be they standard contracts (UWP, UEWP, or UAP), fixed-term contracts (for example, Offer D or Offer A), or rollover contracts (for example, Offer H, Offer K, or Offer F).[64]

This information came in two dataset, a customer dataset that contains the spells of the customers on the promotions (where by spell we mean the time spent by a customer on a promotion, between the promotion start date and the promotion end date) and a data dictionary that translated the promotion codes contained in the customer dataset into a full description of the promotion (whether the contract is fixed-term or rollover, the duration of the Minimum Contract Period,…)

The customer dataset contained 519,168 observations, corresponding to 179,957 customers on spells on different promotions.

The most important variables contained in the customer dataset are a customer id, a promotion code, the promotion and account start and end dates (at the daily level), and postcode.[65]

For promotions and accounts that were still active at the end of the observation period (31 March 2010), the variables corresponding to the end date of such accounts or promotions would contain particular values.

Using the language of the microeconometrics literature, we call the customers whose account was still active at the end of the observation period censored customers.

Because our sample was drawn from the population of customers as of 31 December 2008 and because we focused on the time interval in which these customers were "at risk" of leaving BT, we dropped from the customer dataset spells that ended before 1 January 2009.

We define switching, which is the outcome on which we focus throughout the study, precisely as the event of closing a BT account.

[64] Please see Appendix 5 for a description of these offers.

[65] The customer dataset also contains contract start and end date variables. These variables, however, did not prove very useful in that the contract end date referred to the end of a MCP, not the actual date in which the customer left a contract. Furthermore, contract dates associated with rollover contracts referred at times to the overall spell on a promotion and at times to a specific (first or subsequent) MCP.

The data dictionary

Associated to the customer dataset comes another dataset called the data dictionary, which translated promotion codes into a full description of the promotions. On the basis of the data dictionary we were able to assign to most promotion codes appearing in the customer dataset a set of characteristics:

- Whether the promotion was a UWP, UEWP, or UAP plan;
- Whether it was a standard plan or a special offer—that is, a fixed-term or a rollover contract;
- For special offers, whether the contract was fixed-term or rollover, the duration of the Minimum Contract Period, and other details.

We dropped from the data dictionary codes associated with additional lines and codes associated with "grandfather products" like BT Together Local and BT Working Together.

The data cleaning process

After dropping from the data dictionary codes associated with additional lines and codes associated with "grandfather products" like BT Together Local and BT Working Together, we were able to match the promotion codes in the customer dataset with the promotion characteristics in the data dictionary for 161,616 out of 179,957 customers.

We now describe three steps that were required to take in order to transform the raw data into a set of consistent histories (meaning histories of transitions between promotions) without holes or overlaps. When this was not possible, the corresponding, critical, customers were dropped from the sample. Absolute care was taken not to lose spells on fixed-term or rollover contracts, nor to modify the promotion and end dates of such spells.

For several reasons, it is the case that to the same underlying promotion there have been several codes attached (265 promotion codes were found in the customer dataset, focusing on promotions ending after 31 December 2008).

The first step of the cleaning of the customer dataset thus consisted in eliminating this redundancy. This was done by grouping—within each customer—all the observations that shared the same promotion type (UWP, UEWP, UAP), contract type (standard plan, fixed-term contract, rollover contract), and special offer name (Offer F, Offer H Renewable, Anytime Plan), and that were temporally overlapping. For each such group of observations—effectively referring to the same underlying spell on a promotion—all but one observation was eliminated, and the remaining observation would have as the promotion start date the earliest promotion start date within the group and as the promotion end date the latest promotion end date within the same group.

This first step of the cleaning process reduced the number of observations in the dataset from 395,354 to 233,646 observations, with no loss of customers

Once consistency across observations pertaining to the same promotion spell is attained, we move to the second step of the cleaning process. In this second step of the cleaning process we take care of observations that, while referring to different promotions, have the same start date:

- We eliminate observations with the same promotion start and end dates, giving precedence in elimination to standard plans and fixed-term contracts;

- We eliminate observations corresponding to standard plans that start on the same date as but end before other standard plans, fixed-term contracts, or rollover contracts;

- We push forward the start date of standard plans that start on the same date as other promotions but end later. In this case, the new start date is assigned as the end date of the other promotion.

This second step of the cleaning process reduced the number of observations in the dataset from 233,646 to 208,983 observations, without loss of customers.

At the beginning of the third step of the cleaning process we drop customers for whom the latest end date of a promotion does not fall in the same month as the end date of the account or for whom the latest date of a promotion is not censored while the account is censored—meaning that the customer keeps renting the line from BT (at least until the end of the observation period, that is 31 March 2010) but is observed to move the calls to another communications provider. In this way we lose 3,271 plus 9,798 observations, corresponding to 161,177 - 150,825 = 10,352 customers.

After we do this, we take care of remaining holes/overlaps in the histories of customers with BT, depending on their complexity. In particular, for customers with relatively simple histories (that is, having only two spells left over at this stage of the data-cleaning process) we apply the following rules. At this stage, 118,808 customers (or 73.70%) have only one spell, 37,400 have two (23.20%), and the others (5,006, or 3.10%) have more.

- In the case of overlapping spells, we modify the end date of standard plans (by pushing it backwards) when they start and end earlier than the other plan. In particular, we push it backwards to the start date of the later plan;

- We split a standard-plan spell that temporally fully incorporates the other spell by making the first sub-spell end when the other spell begins and by making the second sub-spell begin when the other spell ends;

- We drop fully nested spells that could not be fixed;

- We drop customers for whom consistent histories could not be created, meaning that they still have overlapping spells or have a hole of more than 30 days between consecutive spells.

This process, applied to all customers originally with two spells, leaves us with 34,562 out of 37,400 customers.

Because of their higher complexity, customers with more than two remaining spells are handled less exhaustively:

- If a standard plan ends after the next spell begins, its end date is moved backward to the beginning of the next spell;
- We drop fully nested spells that could not be fixed;
- We drop customers for whom consistent histories could not be created, meaning that they still have overlapping spells or have a hole of more than 30 days between consecutive spells.

This process, applied to all customers with more than two remaining spells, leaves us with 2,898 out of 5,006 customers.

The last step of the data cleaning process consists in moving from a relatively short dataset in which an observation corresponds to a spell to a longer dataset in which an observation corresponds to a month in the observation period—that is, ranging between January 2009 and either March 2010 or the month in which the customer left BT. This step involves the temporal *discretization* of the dataset, since it requires moving from (promotion and account start and end) dates measured at the daily frequency to dates measured at the monthly frequency. In the course of this discretization process we noticed that there exist in the data heaps of switches in the very few days following the end of a MCP. On the basis of this observation, and considering it unlikely that these customers were actually charged maximum ETCs, we assumed that switches occurring up to 370 days after the promotion/contract start date are switches that occurred before the end of the MCP.

This left us with a dataset containing 1,984,406 observations, corresponding to 144,861 customers (in the first month of the observation period).

This dataset was then merged with information about regional unemployment rates, plan prices, and marketing expenditures.

Appendix 5 Key for Offer names

Offer name	Marketing description of offer	Contract type
Offer A	UEWP for the price of UWP for 12 months	Fixed term
Offer B	UEWP for £1.45 per month	Fixed term
Offer C	One off discount on connection fee. Full monthly rental applies for relevant package (UWP, UEWP, UAP) chosen	Fixed term
Offer D	Free UK Calls (UAP) For 3 Months, full UAP price applies for the remainder of the 12 month contract	Fixed term
Offer E	Free UK Calls (UAP) For 3 Months, full UAP price applies for the remainder of the 18 month contract	Fixed term
Offer F	UEWP for the price of UWP	ARC
Offer G	Unlimited Anytime Plan for £4.99 - 12 months	ARC
Offer H	UEWP and Mobile Saver for the price of UWP	ARC
Offer J	Anytime non renewable 12 month contract no discount	Fixed term
Offer K	Mobile Saver product added to UWP or UEWP for no extra charge (discount on all mobile calls without paying Mobile saver rental)	ARC

Source: BT data

About ESMT

ESMT European School of Management and Technology was founded in October 2002 on the initiative of 25 leading German companies and associations with the aim of establishing an international management school with a distinctly European focus. ESMT provides executive education and offers an international full-time MBA program, as well as an Executive MBA. ESMT is located in Berlin with further campuses in Munich and Cologne. As a private institution of higher education, ESMT is fully accredited by German authorities.

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More information:

ESMT European School of Management and Technology
Schlossplatz 1, 10178 Berlin
Phone: +49 (0) 30 212 31-1042
Fax: +49 (0) 30 212 31-1069
www.esmt.org

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More information:

ESMT Competition Analysis GmbH
Schlossplatz 1, 10178 Berlin
Phone: +49 (0) 30 212 31-7000
Fax: +49 (0) 30 212 31-7099
www.esmt.org/competition_analysis

ESMT Competition Analysis GmbH

Schlossplatz 1
10178 Berlin
Phone: +49 (0)30 212 31-7000

www.esmt.org/competition_analysis