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End-of-contract notifications

An ex-post evaluation of the impact of the introduction of ECNs on re-contracting and pricing for broadband services

Welsh overview available

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1. Overview

We believe that customers should get a fair deal for their communication services. We want people to be able to shop around with confidence, make informed choices and switch easily. To further this objective, we introduced a new requirement on communication providers ("CPs") to send end-of-contract notifications (ECNs) to their broadband, mobile, home phone and pay-TV customers when their minimum contract period is coming to an end. [1,2,3] The aim of this policy was to encourage customers to engage with the market and consider different options available to them at the end of their minimum contract period, to save or to find better deals, with their existing or other communication providers. We took this decision in May 2019 and the new rules came into effect in February 2020 as part of several policies introduced to increase customer engagement.

As part of our 2019 decision, we committed to monitor and evaluate the implementation of ECNs to ensure they were delivering the desired outcomes for consumers. Specifically, we intended to monitor the impact of our policy on consumer awareness, engagement, satisfaction, speed and confidence in navigating the market. We already analysed how customer behaviour has changed since the ECN policy was implemented. In November 2021, we published a review of the impacts of ECNs and pricing commitments by broadband and mobile providers suggesting that, overall, customer engagement had increased since the introduction of ECN policy. [4] At the time, we also said that we would conduct an ex-post evaluation of broadband ECNs using econometric techniques to provide further insight into their effectiveness. This report captures that analysis building on the findings set out in our review published in November 2021.

The assessment in this report focuses of the impacts of ECNs on fixed broadband customer outcomes. We use econometric techniques to assess the direct effects of ECNs on customer re-contracting whilst controlling for other factors.[5] While not a focus of the ECN requirement, we also study the impact of ECNs on prices re-contracting customers pay for their broadband services.

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[1] Ofcom, *Helping consumers get better deals - Statement on end-of-contract notifications and annual best tariff information,* May 2019, section 6, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/148140/statement-helping-consumers-get-better-deals.pdf.

[2] We also required communication providers to send annual best tariff notifications (ABTNs) to out-of-contract customers to inform them about benefits of re-contracting and switching. ECNs and ABTNs apply to residential and business customers, but in this report, we only consider residential customers (which may include small companies who use a service aimed at residential customers for business purposes) and ECNs, since most CPs only began sending ABTNs towards the end of the ABTN implementation period which was February 2021. Ofcom, *Helping customers get better deals - A review of the impact of end-of-contract notifications and pricing commitments by broadband and mobile providers*, November 2021, p. 5, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/228742/helping-customers-get-better-deals-2021.pdf.

[3] Where we refer to 'minimum contract period' or 'end-of-contract', this refers to customers' fixed commitment period.

[4] Ofcom, *Helping customers get better deals - A review of the impact of end-of-contract notifications and pricing commitments by broadband and mobile providers*, November 2021, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/228742/helping-customers-get-better-deals-2021.pdf.

[5] Re-contracting customers refer to fixed broadband customers who renew with their existing communication providers up to 40 days before and 30 days after the end of a customer's minimum contract period. We recognise that customers can re-contract or switch at any time, but if they do so significantly before or after the end of their broadband minimum contract period, their behaviour may not be linked to ECNs, and therefore does not inform us whether ECNs directly increase re-contracting.

Our assessment

We used data provided to us by CPs to measure the impact of our ECN policy intervention on:

- the rate at which customers re-contract at the end of their minimum contract period; and
- the prices broadband customers paid after re-contracting in response to an ECN.

Summary of findings

- We find that re-contracting has increased because of ECNs, which is in line with our 2021 Review on ECNs, although the ECN effect varied by communication provider.
- Plusnet customer re-contracting increased the most, by 13 percentage points, while ECNs' impact on TalkTalk customers was the lowest increase across providers of 3 percentage points.
- On the price effect, we found evidence that re-contracting customers with some communication providers paid lower prices, and higher prices with others.

Conclusion

Overall, our latest analysis provides further evidence that ECNs increased re-contracting among broadband customers after the ECNs came into effect in February 2020, and we can attribute some of the increase in re-contracting in the broadband market directly to the ECN policy, rather than external factors.

2. Background and our approach to assessing the effectiveness of ECNs

2.1 Customers of communications services often sign up to contracts which commit them to paying for that service for a minimum length of time, usually 12, 18 or 24 months. This means customers cannot cancel their service or switch to a different communication provider without incurring a cancellation charge. Once the minimum contract period ends, customers are free to switch to a different deal with their existing supplier or move to a new supplier.

2.2 For those customers who consider switching to a new deal the communications market offers many choices, but these may often be complex and difficult to navigate. Further, there has often been a material difference between prices when a customer is in contract and when they are out of contract. As a result, customers who have not taken advantage of the options of switching or re-contracting available to them once their minimum contact period has ended, may pay more than they need to (e.g. for being out-of-contract) or experience automatic changes to their services. To help address this problem, we introduced an obligation on CPs to ensure customers are informed at an appropriate point about the status of their contract, so that they can consider taking action.

2.3 In May 2019, we decided ("2019 Statement") to introduce new requirements on communication providers ("CPs") to send ECNs to their customers who approach the end of their minimum contract period.[6] The aim of this policy was to encourage customers to engage with the market and consider different broadband options available to them at the end of their minimum contract period. These rules came into effect in February 2020 and were one of several policies introduced to increase customer engagement.[7]

2.4 Under these new requirements, CPs must tell their broadband customers when their minimum contract period is due to end, and any changes to their price and services that would occur at this point. CPs were also required to provide tariff information as part of the ECN including the best tariffs they currently had available.[8] Additionally, these rules require CPs to tell their customers how to terminate the contract, any notice period for leaving the provider and that early termination charges for the contract no longer apply from the point the fixed commitment period ends.

2.5 We allowed CPs some discretion over the format of ECNs and how to implement them. For example, the ECN alerts can be sent by text, email, or letter and should be sent between 10 and 40 days before a customer's broadband minimum contract period is due to end.[9]

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[6] Ofcom, *Helping consumers get better deals - Statement on end-of-contract notifications and annual best tariff information,* May 2019, section 6, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/148140/statement-helping-consumers-get-better-deals.pdf. In the remainder of this document, we refer to this as the **2019 Statement**.
[7] See footnote 2 for details.
[8] This includes, where applicable, information about discounts available to new customers only (i.e. not to the ECN recipient, as existing customers), so that customers are made aware of the benefits of switching.
[9] Ofcom 2019 Statement, p. 3.

Customer engagement increased after ECNs were introduced

2.6 We recognised in the 2019 Statement that we would need to monitor and evaluate the implementation of ECNs in order to ensure our objectives were being achieved. In line with this, we have already performed a detailed analysis to understand how customer behaviour has changed since the ECN policy was implemented in February 2020.

2.7 In November 2021, we published a review of the impacts of ECNs and pricing commitments by broadband and mobile providers ("2021 Review").[10] We found that the proportion of broadband customers who switched or re-contracted three months prior to or three months after their minimum contract period ended increased from 47% in July 2019 to 62% in September 2020.[11] Individual CP findings showed a similar pattern, although our findings for TalkTalk customers varied depending on the reference period used between 2019 and 2020.[12]

2.8 Although we observed this positive trend in customer engagement, we could not categorically say that it was due to the introduction of ECNs. In the 2021 Review, we also looked at customer engagement among out-of-contract broadband customers and found there was an increase in the proportion of out-of-contract customers who engaged in the period from 2019 to 2020.[13] Specifically, 17% of customers who were already out-of-contract on 1 September 2020 engaged in the subsequent 90-day period, while 10% of out-of-contract customers engaged within 90 days of 1 July 2019.[14]

2.9 As out-of-contract customers do not receive an ECN, this upward trend in engagement among out-of-contract customers is unrelated to them receiving ECNs. We also acknowledged that increases in engagement in general "may have been driven to some extent by factors unrelated to end-of-contract notifications", as the year-on-year comparison does not account for external factors or wider trends in the broadband market.[15]

2.10 Our 2021 Review also analysed the difference in prices paid between out-of-contract customers and in-contract customers, and found that, the per person monthly price differential in 2020 was £5.10, compared to £4.70 in September 2019.[16] At the time we noted that this change was in part due to further discounting of new customer prices as well as a reduction in the number of out-of-contract customers. However, our previous

[10] Ofcom, *Helping customers get better deals - A review of the impact of end-of-contract notifications and pricing commitments by broadband and mobile providers*, November 2021, p. 22, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/228742/helping-customers-get-better-deals-2021.pdf. In the remainder of this document, we refer to this as the **2021 Review**.
[11] We compared customer engagement (re-contracting with their existing CPs/switching to an alternative CP) by customers whose contracts were due to end in (Jul-Sept) 2019 to customers in a comparable situation in (Sept-Nov) 2020. Ofcom 2021 Review, pp. 25-31.
[12] Ofcom 2021 Review, Tables 3.2.
[13] These customers would not have received ECNs as only people nearing their minimum contract period are eligible for one.
[14] Ofcom 2021 Review, p. 23.
[15] Ofcom 2021 Review, p. 28.
[16] Ofcom 2021 Review, p. 38.

analysis did not establish whether ECNs affected the prices re-contracting consumers pay for their broadband services. We know in-contract customers typically pay a lower price for the same service than out-of-contract customers, so if ECNs increase engagement then we would expect them to have an indirect effect on the prices an average customer pays, although the direction of this effect may be unclear because customers may choose to change the components of their service when they re-contract.

2.11 Against this background and in order to build on our previous analysis, we have sought to use this ex-post evaluation to:

a) investigate how much of the increasing engagement in the broadband market is attributable to ECNs rather than other factors; and

b) assess if the change in engagement due to ECNs has impacted prices customers pay for their broadband services.

2.12 We have not sought to revisit the evaluation of the implementation of ECNs which was comprehensively covered in our 2021 Review.

Our analytical approach to assessing the impact of ECNs

2.13 In this publication we focus on empirically establishing a causal link between ECNs and the observed customer outcomes. We consider customer contract histories from six of the largest CPs[17], and investigate whether the introduction of ECNs affected re-contracting and prices, or whether changes we observe can be attributable to other factors and trends.

2.14 Our analysis focuses on re-contracting, rather than engagement as a whole, as the data do not allow us to establish when customers switch CPs with sufficient accuracy.[18] While there would be some benefit to consider customers who switch as part of our analysis, we considered it to be disproportionate to gather a significant amount of additional data from the CPs on switching, when most of the observed increase in engagement among out-of-contract customers between 2019 and 2020 was due to re-contracting.[19] While re-contracting may have increased, it is possible that if switching decreased more than re-contracting increased, overall engagement may have fallen. However, the evidence in the 2021 Review suggests that overall engagement increased year-on-year in 2020, meaning it is unlikely that a fall in switching would outweigh the effect on re-contracting. We discuss the data and our assumptions in the annex.

Our definition of re-contracting and our econometric approach

2.15 Our definition of re-contracting includes broadband contract renewals up to 40 days before and 30 days after the end of a customer's minimum contract period. We recognise that customers can re-contract or switch at any time, but if they do so significantly before

[17] BT, EE, Plusnet, Sky, TalkTalk and Virgin Media.
[18] We can identify customers that switched CP between September 2019 and September 2020, but we do not have data for all customers on the date they switched, and therefore cannot apply the method we use with re-contracting to customers that switch CPs.
[19] Ofcom 2021 Review, p. 5.

or after the end of their broadband minimum contract period, their behaviour may not be linked to ECNs, and therefore does not inform us whether ECNs directly increase re-contracting.

2.16 After 15 February 2020, all CPs began sending ECNs to their customers nearing the end of their minimum contract period. Ofcom's rules require ECNs to be sent in a "timely manner, before the end of the relevant commitment period", and the guidance states that this should be between 10 and 40 days before the end of the minimum contract period.[20,21] To assess the impact of ECNs on re-contracting, we compared re-contracting rates of customers who received an ECN to customers who did not. An econometric technique called regression discontinuity design (RDD) allows us to account for external factors and compare customers' behaviour shortly before and after the introduction of the ECNs.[22] The idea behind an RDD approach is that customers close to before and after the introduction of the ECN are similar and therefore comparable.[23]

2.17 In order to employ the RDD, we allocate customers in two groups: "untreated" and "treated".[24] The untreated group includes customers with their minimum contract period ending who did not receive an ECN and the treated group those who did. To achieve this comparison, we establish a cut-off date, which represents the date after which all customers close to the end of their minimum contract period received an ECN.

2.18 To be confident that all customers after our cut-off date in fact received an ECN, we account for differences in the CPs' approach to sending ECNs and the ECN policy implementation date. If we applied 15 February as our cut-off, not all customers in our "treated" group would have actually received an ECN, given that ECNs should be sent between 10 and 40 days before the customer's minimum contract period ends. For this reason, and for the purposes of our analysis, we consider 26 March, (40 days after 15 February), as the effective ECN cut-off date.[25] One exception is Virgin Media, which started sending ECNs to customers with a minimum contract period ending on or after 15 February.[26] We therefore use 15 February as the cut-off date for Virgin Media. We also treat EE slightly differently for reasons discussed in more detail in section 3.

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[20] Ofcom, *General Conditions of Entitlement – Unofficial Consolidated Version,* December 2021, paragraphs C1.23-C1.29, https://www.ofcom.org.uk/__data/assets/pdf_file/0016/209500/annex-3-revised-gc-eecc-17-dec-21.pdf.

[21] Ofcom, *Ofcom's Guidance under General Condition C1 - contract requirements,* December 2021, paragraphs 1.61-1.102, https://www.ofcom.org.uk/__data/assets/pdf_file/0028/229852/ofcom-guidance-general-condition-c1-contract-requirements.pdf.pdf.

[22] Details about our econometric model are in the annex.

[23] We test this assumption more formally in the annex.

[24] For these groups to be comparable customers need to be randomly allocated between them, and we assume they are, since customers typically signed broadband contracts 12-24 months prior to 15 February 2020 with no knowledge of the ECN policy implementation.

[25] Because we do not have the exact date an ECN was sent to a customer, we take the approach described in the paragraph. This means that a few weeks prior to our cut-off date we may mix treated and untreated customers, and we may overestimate the effect of re-contracting prior to the cut-off (the probability of receiving an ECN before the cut-off is greater than 0 but less than one, and after the cut-off, it increases to one. The implication of this is that everyone in the treated group received an ECN, while some, but not many, also did in the untreated group). Overall, expecting an increase in re-contracting from ECNs, this means we may underestimate the effect of re-contracting from ECNs. However, because we utilise data as far as 90 days away from the cut-off, we expect the bias to be relatively small.

[26] We confirmed this in discussions with Virgin Media.

ECNs and broadband pricing approach

2.19 We also analyse the price effects of ECNs. We would not expect customers in all cases to make savings in response to re-contracting due to ECNs since some of them might decide to upgrade their packages at the time of re-contracting. A practical issue we face is that not all customers who received an ECN responded to it by re-contracting. To address this issue empirically we use a fuzzy regression discontinuity design (FRD).[27] This approach accounts for the effect of some customers receiving an ECN, but not responding to it, and provides an estimate of the effect of re-contracting due to ECNs on prices.

[27] Further details of FRD are in the annex.

3. Impact of ECNs on customer outcomes

3.1 In this section, we outline the results of our analysis of the impacts of ECNs on re-contracting and the prices paid by broadband customers because of re-contracting due to ECNs. We present both a graphical analysis and our econometric results.

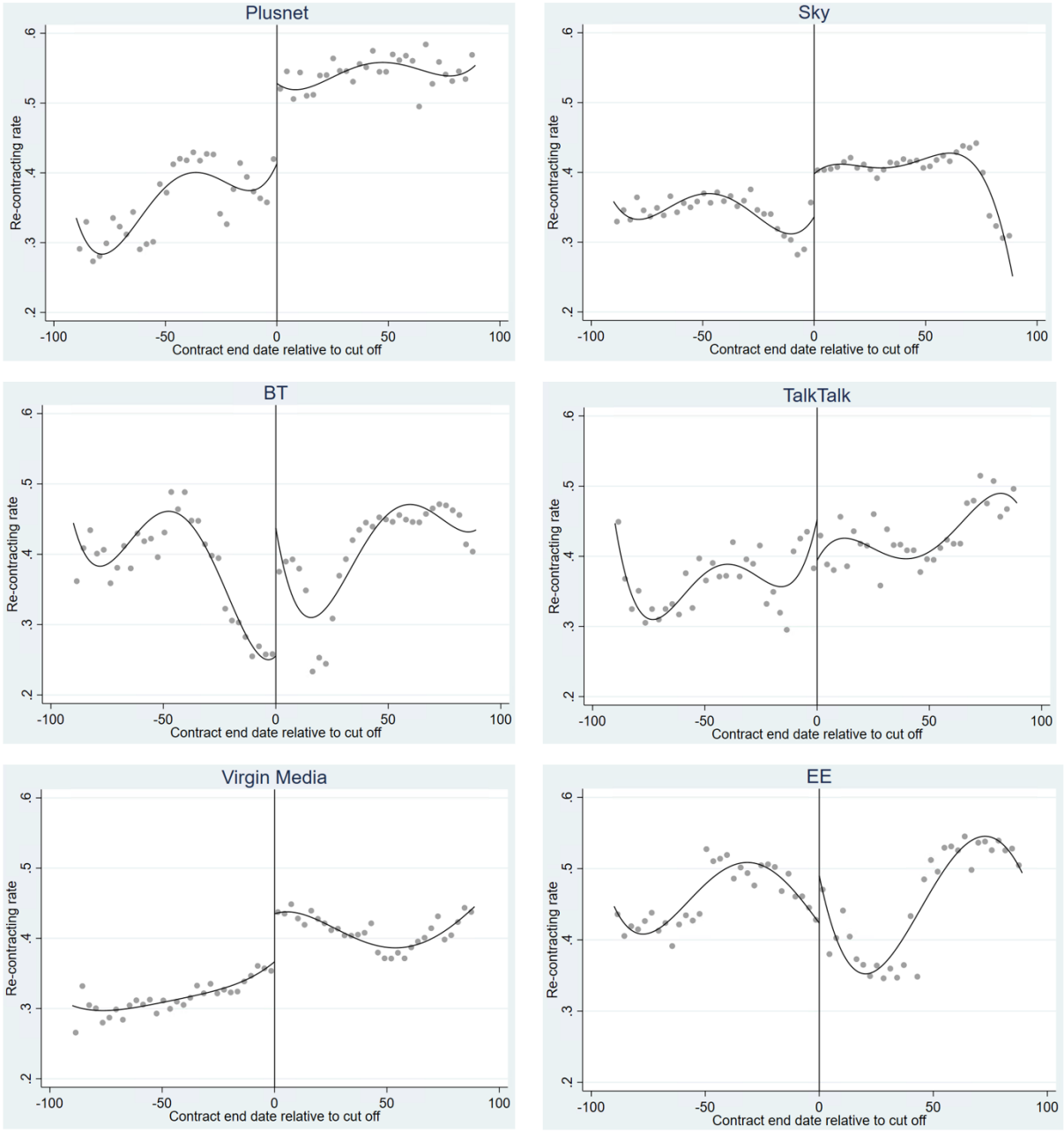
Customer re-contracting before and after ECNs were introduced

Graphical analysis of re-contracting

3.2 In Figure 1 we plot customer re-contracting rates over time by CP, to illustrate the effect ECNs may have had on re-contracting and to confirm regression discontinuity design (RDD) is an appropriate way to estimate the ECN effects.[28] The horizontal axis in Figure 1 shows the difference in the number of days between the end of a customer's minimum contract period and the date after which all CP customers received an ECN, which we refer to as the ECN cut-off.[29] A negative number of days refers to the pre-ECN period, when CPs' customers did not receive an ECN. The vertical axis shows the rate of re-contracting, and each point on the graph is the re-contracting rate in a three-day window.[30] We also fit a line through the points to help visualise potential changes in re-contracting over time.[31] If ECNs had an impact on re-contracting, we should see a jump in the rate of re-contracting at the cut-off.

[28] If a jump is not clear in the graphical analysis, RDD is unlikely to show a strong effect.
[29] In the graph, 0 represents that day at which the CPs started sending out ECNS; see paragraphs 2.17-2.18.
[30] We divided the number of customers that re-contracted in the three-day window by the total number of customers with their minimum contract periods ending in the same three-day window.
[31] In line with academic literature on RDDs, we use a 4th order polynomial to allow for flexibility in trends. Lee, David and Lemieux, Thomas. *Regression Discontinuity Designs in Economics.* Journal of Economic Literature Volume 48, NO. 2, June 2010, pp. 281-355, https://www.aeaweb.org/articles?id=10.1257/jel.48.2.281.

Figure 1: Re-contracting rates for the main six broadband providers[32]



Note: Results for Virgin Media are based on a cut-off of 15 February 2020, and 26 March for all other CPs.

3.3 Figure 1 shows that there was a jump in re-contracting at the cut-off among Plusnet, Sky, Virgin Media and BT customers, suggesting that ECNs increased re-contracting. Meanwhile, there was no jump in re-contracting among TalkTalk customers at any point in the period covered, signifying ECNs did not influence re-contracting behaviour for these customers. These findings align with Ofcom's previous analysis on the impact of ECNs on engagement.[33]

[32] We include observations up to 90 days either side of the cut-off.
[33] Ofcom 2021 Review, p. 27.

3.4 The graphical analysis for EE suggests that there was no significant change in the re-contracting rate at the cut-off of 26 March. However, re-contracting increased approximately 40 to 50 days before this.

3.5 After conducting this analysis, we discussed our findings with the CPs. EE confirmed that customers were sent additional notifications (unrelated to ECNs) in January and February, alerting all customers of an incoming price rise due to occur from 1 April.[34] These notifications also contained contract offers, meaning they may have had a similar impact to ECNs, potentially leading to the increase in re-contracting earlier than we were expecting. Considering this, for our econometric analysis we move the cut-off point to 3 February 2020 for EE, which measures the jump in re-contracting we see at this point on the graph.

3.6 Our cut-off is very close to the first Covid-19 lockdown which may affect our findings. Specifically, Figure 1 suggests that there are large changes in the re-contracting rate around the cut-off date that are likely due to Covid-19. Staff absence and strict stay-at-home restrictions impacted CPs' customer service capability during the early days of pandemic[35], with some CPs temporarily suspending ECNs[36], which could have indirectly impacted customer re-contracting. While a fall in consumer confidence in March/April 2020[37] may have influenced customer engagement, potentially leading customers to delay their re-contracting decisions.

3.7 Although the Covid-19 lockdown potentially caused the dip in re-contracting which we observe for some providers, it is also possible it contributed to the increase in the re-contracting rate. As more people worked from home, greater emphasis was placed on a fast and reliable broadband service, which may have influenced customer decisions and led to an increase in re-contracting after the initial dip in engagement. This means our results may be affected in some way by the impacts of Covid-19.

Econometric analysis of re-contracting

3.8 The graphical analysis indicates that ECNs increased re-contracting, but to get more precise estimates of ECNs' effect, we used a regression discontinuity design (RDD).

[34] Price increases for both in and out of contract customers. These alerts also included options to upgrade.
[35] Ofcom's review of the effects of Covid-19 on the industries we regulate suggested that TalkTalk and Virgin Media call centre capacity was particularly badly impacted by Covid-19, p. 2 and p. 16, https://www.ofcom.org.uk/__data/assets/pdf_file/0027/218655/comparing-service-quality-2020.pdf.
[36] We said that while we encouraged providers to send ECNs as normal, we would take a pragmatic approach to compliance with rules like this, recognising the significant challenges providers faced at the time and the steps they needed to take to respond to the impact of the coronavirus. Ofcom, *Press release*, April 2020, https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/broadband-and-mobile-firms-commit-helping-customers-during-coronavirus.
[37] UK Consumer Confidence Index dropped to -9 in March 2020 and further to -34 in April 2020 (the largest fall since the survey began in 1974). GfK, *Consumer Confidence Barometer on behalf of the European Commission*, June 2020, https://www.gfk.com/en-gb/press/uk-consumer-confidence-gains-six-points.

Table 1: Econometric analysis – percentage point increase in re-contracting due to ECNs[38]

CP	RDD results
Plusnet	13%
Sky	8%
BT	10%
TalkTalk	3%
Virgin Media*	10%
EE*	10%

**Note: Results for Virgin Media and EE are based on a cut-off of 15 February 2020 and 3 February 2020, respectively. See paragraphs 2.18 and 3.5. All results are significant at the 1% level.*

3.9 Consistent with the graphical analysis in Figure 1, we find that ECNs increased the re-contracting rate by 3-13 percentage points, varying by CP (Table 1). The large jumps in re-contracting illustrated in Figure 1 for Plusnet, Sky, BT and Virgin Media align with our regression results; re-contracting increased by a significant margin for all four CPs. Similarly, our regression results confirm that the ECNs' impact on TalkTalk customers was marginal, with the lowest increase across CPs of 3 percentage points.[39]

3.10 Figure 1 suggested that the jump in re-contracting for EE customers occurred earlier, around 3 February 2020, and when using this as the cut-off our regression results confirm there was an increase in re-contracting among EE customers by 10 percentage points. Although this increase in re-contracting was not driven by ECNs, we consider it positive that a notification similar to an ECN led to an increase in re-contracting among EE customers.

Prices before and after the ECNs were introduced

3.11 We have also looked at the impacts ECNs may have had on the prices re-contracting customers paid for their new broadband contracts. Unlike for consumer engagement, we do not necessarily expect to see the introduction of ECNs leading to an observable impact in a specific direction on the prices that consumers are paying. Although we would expect better engagement to lead to consumers getting better deals, consumers may change what they buy as part of the re-contracting process and potentially re-contract with higher priced services. We also recognise that if consumers become more engaged, and a higher proportion of customers re-contract or switch CPs at the end of their fixed contract period, CPs may respond by revisiting their broadband pricing, which could result in higher prices

[38] The results in this table are from the model using observations 90-days either side of the cut-off, for results from the model using observations 60-days either side of the cut-off, refer to Table 4 in the annex.
[39] Although ECNs appeared to have a marginal effect on TalkTalk customers, the 2021 Review notes that in September 2020 TalkTalk customers were still more engaged than the average across the market. Ofcom 2021 Review, p. 27.

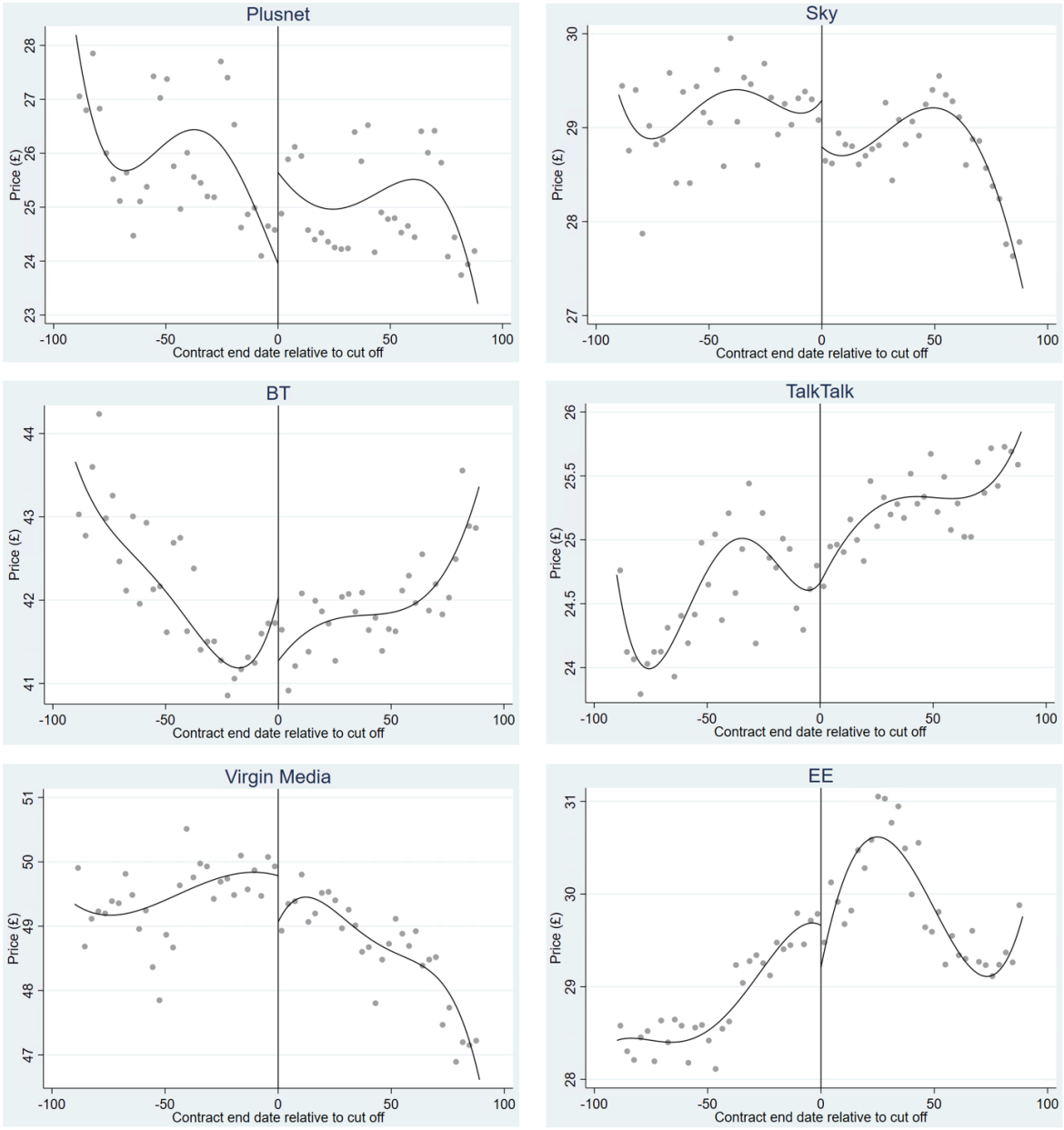
for some consumers. It is also possible that if prices of some broadband services reduce as a result of ECNs, CPs may increase prices for other services to sustain revenues.

3.12 Nevertheless, we believe there is value in trying to understand whether there was an impact on prices from the introduction of ECNs. To perform this analysis, we have followed a similar structure to our re-contracting analysis, initially presenting a graphical representation of prices, followed by our econometric results.

Graphical analysis of prices

3.13 Figure 2 shows average prices customers paid for their broadband contracts over time on the vertical axis and the number of days between the end of a customer's minimum contract period and the ECN cut-off date on the horizontal axis, the date after which all CP customers received an ECN. Each point in the graph is the average new price paid for those with contracts ending in a three-day window. A line fitted through the points helps to visualise any significant changes in price over time.

Figure 2: Prices for the main six CPs



Note: Results for Virgin Media are based on a cut-off of 15 February 2020, and 26 March for all other CPs.

3.14 For most of the CPs there is no significant change in prices customers pay at the cut-off. The prices TalkTalk, Virgin Media and EE customers pay show a continuous trend through the cut-off. Plusnet customers appear to have paid more for their broadband contracts after ECNs were implemented. Meanwhile, Sky customers appear to pay somewhat lower prices as the ECNs come into effect, potentially signifying the customers that re-contracted because of ECNs took out cheaper contracts than they had been on previously.

3.15 Since we see no jump in EE customer prices at the cut-off, we estimate the price effects for EE using the 3 February 2020 as the cut-off. Although this does not inform us if ECNs impacted prices, it would give an indication as to whether EE's price rise notifications, which were similar to ECNs, had an impact on the prices paid by customers.

Econometric analysis of prices

3.16 As set out in Section 2, we use FRD to gain more precise estimates of the potential price effect of ECNs.[40] The results from this analysis should be interpreted differently from the re-contracting analysis; the results in Table 2 are the average monthly price differences for those who responded to an ECN, by CP.

Table 2: Econometric analysis – price effects of re-contracting in response to receiving an ECN

CP	FRD results
Plusnet	Statistically insignificant effect[41]
Sky	-£9.26
BT	£2.45
TalkTalk	£7.81
Virgin Media*	-£7.74
EE*	Statistically insignificant effect

**Note: Results for Virgin Media and EE based on a cut-off of 15 February 2020 and 3 February 2020, respectively. See paragraphs 2.18 and 3.5. Results are significant at the 1% level.*

3.17 The impact of ECNs on monthly prices re-contracting customers paid varies by provider; Sky and Virgin Media customers who re-contracted as the result of receiving an ECN paid less for their broadband than before, on average, than those who did not, while BT and TalkTalk customers appear to have paid more. These findings broadly follow the trends shown in Figure 2, except for BT, where there is no clear trend on prices. Our estimated price effect on EE and Plusnet customers is not statistically significant, suggesting the re-contracting increase we observed due to EE's price rise notifications and Plusnet's ECNs had little impact on the prices paid by customers with contracts ending in this period.

3.18 As discussed at the start of this section, we do not view the direction of the price effect as a direct indication of whether these consumers are better or worse off as there are several reasons why prices could have gone up or down as a result of the introduction of ECNs.[42] Due to limitations in the data available to us, we were not able to assess the potential other reasons for the price effects we observe and therefore cannot draw a definitive conclusion on the impact of ECNs on pricing.

3.19 Understanding the impacts of ECNs on retail broadband price could be improved if it is embedded in a more general analysis of retail price drivers, which we will consider for future iterations of this work. Additionally, in Ofcom's plan of work 2022/23, we said we would carry out a further review of the impact of ECNs and annual best tariff notifications

[40] Further details of FRD are in the annex.
[41] This means any result we found may have been due to chance.
[42] Since the ECN impact on prices is unclear, we checked whether limiting observations to cover 60-days on either side of the cut-off would change our findings, but our results remained similarly inconclusive. For the breakdown of results, see Tables 5 and 6 in the annex.

(ABTN) in future to understand the extent to which these measures are effective in achieving our objectives.[43]

[43] Ofcom, *Ofcom's plan of work 2022/23*, March 2022, p. 46, https://www.ofcom.org.uk/__data/assets/pdf_file/0019/234334/Statement-Plan-of-Work-2022_23.pdf.

4. Conclusions

4.1 Ofcom introduced the requirement to provide ECNs as a way of improving the engagement of customers reaching the end of their minimum contract period to help them get better deals on their broadband services. When putting this policy in place, we committed to monitor and evaluate how it performed over time. Our econometric analysis in section 3 builds on the analysis performed for the 2021 Review and confirms that ECNs increased the rate of re-contracting among broadband customers after the ECNs came into effect in February 2020. This is a strong indicator that ECNs are working in the way which Ofcom intended and bringing benefits to broadband consumers.

4.2 We also studied the effect of ECNs on prices. We find that, on average, there is mixed evidence on prices with some customers paying more and others paying less than before ECNs were introduced. This varies by CP but is also likely to reflect different actions customers take when re-contracting in response to an ECN. However, due to the limitations of the data available to us, we were not able to draw a definitive conclusion about the impact of the introduction of ECNs on prices. Instead, we consider the increased re-contracting we observed as a signal the ECNs are working as intended.

A1. Data, methodology and detailed results

A1.1 In this annex we:

a) outline the assumptions and the data we use for our analysis;

b) discuss our methodology to estimate how the introduction of end-of-contract notifications (ECNs) affected customer re-contracting rates and the prices customers who re-contracted paid; and

c) outline our results in more detail and discuss some limitations of our analysis.

Overview of the data

A1.2 For our analysis we combined datasets we obtained in 2019 and 2020 from six of the largest CPs. These information requests covered:

a) **2019**: the contract history for all customers who were billed between 1 July 2019 and 30 September 2019.[44] The contract history data contain details about the most recent contract and a customer's previous contract.[45]

b) **2020**: all contracts between 1 September 2019 and 30 November 2020 for customers who had an active contract on 1 September 2020, and customers who joined between 1 September 2020 and 30 November 2020.

c) In addition to contract history, we also have information on other services purchased with broadband, and contract characteristics such as the advertised speed and technology the contract runs on (e.g. fibre to the cabinet, fibre to the premises etc.).

d) We also have the billing information of customers in three months of 2019 (July, August, and September), and 2020 (September, October, November), which shows the broadband billing information for customers in the relevant month. We use this information for the price analysis.

Re-contracted customers

A1.3 A shortcoming of the analysis is that we are not able to identify when customers switch (i.e. move from one CP to another). For example, while we can observe if a customer leaves the CP between the 2019 and 2020 data, we do not know, in all cases, the exact date this customer switched.[46] We therefore are not able to establish whether a customer switched in response to receiving an ECN. We have therefore removed customers who

[44] Contracts for customers billed, rather than services provided.
[45] The 2019 data included live contracts for July, August and September 2019; if a contract spanned across all three months it appeared in three separate rows. We only considered the latest data point in our analysis, September 2019.
[46] In the 2019 data we have "stop dates" for customers if they ended their contracts between 1 July 2019 and 30 September 2019, and the 2020 data includes "stop dates" for customers if the customer contract stopped between 1 September 2020 and 30 November 2020. Based on these data alone we are unable to replicate our re-contracting analysis for switching across CPs; at minimum, we would require "stop dates" to cover 30 days before and after 15 February 2020.

switched from the analysis, so they are not captured in our un-engaged group. While there would be some benefit to considering customers that switch, we considered it to be disproportionate to gather a significant amount of additional data from the CPs on this, when most of the observed increase in engagement among out-of-contract customers between 2019 and 2020 was due to re-contracting.[47]

A1.4 We define a re-contracting event where a customer's unique ID is linked to multiple contract start dates that take different values. We have removed any customer contracts missing the contract start date and contract length as we require these to identify re-contracting events.

A1.5 Our previous analysis of the impact of ECNs on engagement found that most broadband customers engage between 40 days before to 30 days after their broadband contract is expected to end.[48] Based on this finding, our analysis considered that customers re-contracted if they acted up to 40 days before, and no later than 30 days after their minimum contract period end date.[49] We removed customers who re-contracted more than 40 days before their expected contract end date.[50]

Duplicate customer contracts

A1.6 Since the 2019 and 2020 data cover a lot of the same period, many contracts appear in both datasets. After initially removing any duplicate contracts based on the multiple variables in the data, a duplicate contract may remain in our data because:

a) the contract length is recorded differently in the two datasets.

b) the customer contract includes different services and each of these services are included separately.

A1.7 We identify these duplicates in the 2019 and 2020 data, and we remove all but one entry per customer contract. Our approach to keeping a contract entry was broadly as follows:

a) We keep a contract if the details matched in 2019 and 2020. Otherwise, we keep the 2020 data point as we considered it more accurate.

b) If the duplicate originates from the same year but some contract details do not match, we removed both entries.[51]

[47] Ofcom 2021 Review, p. 5.
[48] Ofcom 2021 Review, p. 26.
[49] We recognise that customers can re-contract or switch at any time, but if they do so significantly before or after the end of their broadband minimum contract period, their behaviour may not be linked to ECNs, and therefore does not inform us whether ECNs directly increase re-contracting.
[50] If we left these customers in, they would be included in the un-engaged group and cause re-contracting rates to appear lower than they are.
[51] We checked if including these duplicates impacted the results, but they did not, and we excluded them.

Econometric method and our assumptions

A1.8 Where a policy applies to all customers, as after the introduction of ECNs, there is no control group of customers that did not receive the treatment to act as a comparison. However, the ECN policy introduction created a discontinuity, or a cut-off, which represents the date after which all customers close to the end of their minimum contract period received an ECN; customers with their minimum contract period end before and after the ECN introduction, or the cut-off, are treated differently with respect to receiving an ECN or not. Moreover, we expect that customers are unlikely to be able to influence whether or not they receive an ECN because their minimum contract period end is determined by customers signing a contract at least six months earlier. This suggests that customers are quasi-randomly assigned into two groups: "untreated" and "treated", or customers before and after the cut-off.

a) The **untreated group** are customers that did not receive an ECN (in the re-contracting analysis) and customers that did not re-contract (in the pricing analysis).

b) The **treated group** are those that received an ECN (in the re-contracting analysis), and re-contracted (in the pricing analysis).

A1.9 We exploit this discontinuity in our econometric approach by comparing re-contracting and prices in these two groups.

The econometric model

A1.10 The regression discontinuity design (RDD) was first used as an alternative to randomised experiments by Thistlethwaite and Campbell (1960) to evaluate the effectiveness of social programmes and other interventions in the USA.[52] The RDD was intended for situations where it was not possible to assign subjects into treatment and control groups. Instead, subjects in an RDD study are split into groups based on whether they receive a treatment or not; and assignment to the treatment is determined, either completely or partly, by a forcing variable that places a subject on either side of a fixed treatment threshold.

A1.11 Lee and Lemieux (2010)[53] suggest that the strengths of RDD include that it is a straightforward and transparent alternative to randomised experiments in estimating programme effects, and it does not require strong assumptions to apply in practice.

A1.12 Recent examples of RDD based on time as the forcing variable include Ito (2015) that considered the impact of rebates on electricity saving in California.[54] The paper looks at

[52] Thistlethwaite, D. L., and Campbell, D. T., *Regression-discontinuity analysis: An alternative to the ex post facto experiment*. Journal of Educational Psychology, 51(6), 1960, pp. 309–317. https://doi.org/10.1037/h0044319.
[53] Lee, David and Lemieux, Thomas. Regression Discontinuity Designs in Economics. Journal of Economic Literature Volume 48, NO. 2, June 2010, pp. 281-355, https://www.aeaweb.org/articles?id=10.1257/jel.48.2.281.
[54] Ito, Koichiro, *Asymmetric Incentives in Subsidies: Evidence from a Large-Scale Electricity Rebate Program*, American Economic Journal: Economic Policy 2015, 7(3), August 2015, pp. 209-237, https://www.aeaweb.org/articles?id=10.1257/pol.20130397.

how customers responded to a policy to induce energy savings which affected only customers who signed with their energy provider before a certain date.

The regression discontinuity design (RDD)

Re-contracting analysis

A1.13 In our re-contracting analysis, every customer receives an ECN after the cut-off. We therefore use a sharp RDD. We define the re-contracting variable of customer i as y_i where the variable takes the value 0 if a customer has not re-contracted and 1 otherwise.[55] Let d_i denote whether individual i has received an ECN. The specification we estimate is:

$$y_i = \alpha + \beta d_i + f(x_i) + \varepsilon_i$$

A1.14 The identification assumption is that the error ε_i is uncorrelated with the ECN indicator, conditional on controlling for the running variable, x_i. In our case, the running variable is the number of days between a customers' minimum contract period end and the introduction of the ECN policy. Following Imbens and Lemieux (2008) we use a quadratic term[56] to approximate the impact of the running variable.[57]

A1.15 An important issue in RDDs is the selection of the 'bandwidth', meaning over which time period to include observations in the analysis. For our main specification we include 90 days of observations either side of the cut-off to ensure we capture enough customers to give us a reliable picture of the underlying trends.[58] We also present results based on a bandwidth of 60 days as a sensitivity check (Tables 4 and 6). We considered extending the bandwidth to 120 days on either side to increase the precision of our estimates but thought this risked biasing the regression results.[59]

A1.16 We control for the changes in trends in re-contracting before and after the introduction of the ECNs. The dips in re-contracting observed around the cut-off in Figure 1 suggest this is particularly important.

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[55] We define re-contracting as customers that renew their broadband contract with their existing provider up to 40 days before and no more than 30 days after their minimum contract period ended.

[56] For robustness we also test a linear trend.

[57] Imbens, Guido and Lemieux, Thomas, *Regression discontinuity designs: A guide to practice,* Journal of Econometrics Volume 142, Issue 2, February 2008, pp. 615-635, https://www.sciencedirect.com/science/article/abs/pii/S0304407607001091.

[58] In previous studies which use time as the running variable, the bandwidth of observations considered on either side of the treatment start date vary between one week (Busse et al. [2006]) and 90 to 120 days (Ito [2015]). Our choice is based on the timing of the ECN policy implementation, and the first Covid-19 lockdown, ensuring we allow a sufficient number of observations after it. For these reasons, we consider observations 60 to 90 days on either side of the cut-off. Moreover, we decided against a too narrow bandwidth to avoid issues related to some customers receiving ECNs prior to the effective cut-off we have chosen. Busse, M. et al., *$1,000 Cash Back: The Pass-through of Auto Manufacturer Promotions*, American Economic Review 96(4), NO. 4, September 2006, pp. 1253-1270, https://www.aeaweb.org/articles?id=10.1257/aer.96.4.1253.

[59] The trade-off between the estimate bias and precision is discussed in Lee, David and Lemieux, Thomas, *Regression Discontinuity Designs in Economics,* Journal of Economic Literature 48, NO. 2, June 2010, pp. 281-355, https://www.aeaweb.org/articles?id=10.1257/jel.48.2.281.

Price effect analysis

A1.17 For the analysis of the price effects, while all customers receive an ECN, not all of them re-contract. This implies that the rate of customers taking up the treatment[60] (re-contracting) does not change from 0 to 1 as a result of receiving an ECN. We therefore use a fuzzy RDD design, as common in the previous literature, to estimate the local average effect of re-contracting on a customer's price outcome after the implementation of the ECN policy. Let p_i denote the price a customer pays for their broadband after the ECN policy came into effect. The regression model is:

$$p_i = \alpha_1 + \pi y_i + f_1(x_i) + \xi_i$$

A1.18 The challenge of estimating the above equation is that the treatment (re-contracting) y_i is not a random variable and may be correlated with the error term. Specifically, because customer may not take up the treatment, it is likely that there are selection effects. Following the literature on fuzzy RDD, we instrument the treatment variable y_i with the treatment indicator, d_i, i.e. whether the customer's minimum contract period end is after the cut-off of 26 March 2020.[61,62] If customers' minimum contract period end dates are after this cut-off date, they should all have received an ECN, which would increase their probabilities of re-contracting. This instrument is valid as while it is a strong predictor of whether customers re-contract or not, it only has an indirect effect on the price via re-contracting.

A1.19 Following the previous literature, we employ the two-stage least square (TSLS) estimator to estimate the average treatment effect of whether customers re-contract on the broadband price that they pay. Formally, the equations to estimate in two stages are:

$$(1)\ \ y_i = \alpha_2 + \beta d_i + f_2(x_i) + \varepsilon_i$$
$$(2)\ \ p_i = \alpha_1 + \pi \hat{y}_i + f_1(x_i) + \xi_i$$

A1.20 In the first stage, we estimate the rate of customer re-contracting by using the instrumental variable d_i and a function of the running variable x_i as regressors. This yields the predicted value of the rate of customer re-contracting $\hat{y}_i$. We then use $\hat{y}_i$ to estimate the equation (2) in the second stage and obtain the estimated local average treatment effect $\hat{\pi}$.

Validity testing

A1.21 A key assumption for our analysis is that individuals are not able to influence whether they receive the treatment or not (i.e. which side of the ECN introduction date their minimum contract period end falls). A concern about the validity of an RDD is that there could be

[60] In the price effect analysis, the treatment is whether customers re-contract or not, which is different from the re-contracting analysis, where the treatment is whether customers receive an ECN or not.
[61] van der Klaauw, Wilbert, *Estimating the effect of financial aid offers on college enrolment: a research-discontinuity approach*, International Economic Review Volume 43, Issue 4, November 2002, pp. 1249-1287, https://www.jstor.org/stable/826967.
[62] We use the cut-off of 15 February and 3 February for Virgin Media and EE, respectively. See paragraphs 2.18 and 3.5.

self-selection into receiving treatment at the cut-off.[63] This could indicate that the two groups are different in their observable and unobservable characteristics. This difference would violate the central RDD validity assumption, which relies on customers being similar before and after the cut-off. However, because ECNs are sent to all customers, and most customers have a contract length of one to two years, we think it is unlikely that customers approaching their minimum contract period end postponed re-contracting until the end of their minimum contract period to receive an ECN.[64]

A1.22 We test the validity of the RDD by analysing the continuity assumption.[65] Figure 3 visualises the number of minimum contract period ends over time by CP split into three-day windows. If our assumptions hold, we should observe a similar number of minimum contract period ends on both sides of the cut-off. While there is volatility in the data, we do not observe a jump in customer numbers at the introduction of the ECNs. This suggests that customers did not self-select into the treatment group.[66]

[63] Treatment here refers to receiving an ECN or not; with the pricing analysis the treatment is whether the customer re-contracts or not.
[64] Customers could have re-contracted when the policy was announced so their minimum contract period end date would fall after the introduction of ECNs. For the purpose of our analysis, we have assumed that the number of customers who would recontract as a result of the announcement of the policy would be very small or negligible.
[65] This is the assumption that other characteristics do not differ between the groups before and after the introduction of ECNs. The characteristics should be continuous in nature, i.e., showing no change around the cut-off.
[66] We would expect to see a jump after the introduction of the ECNs in minimum contract period ends if there is self-selection.

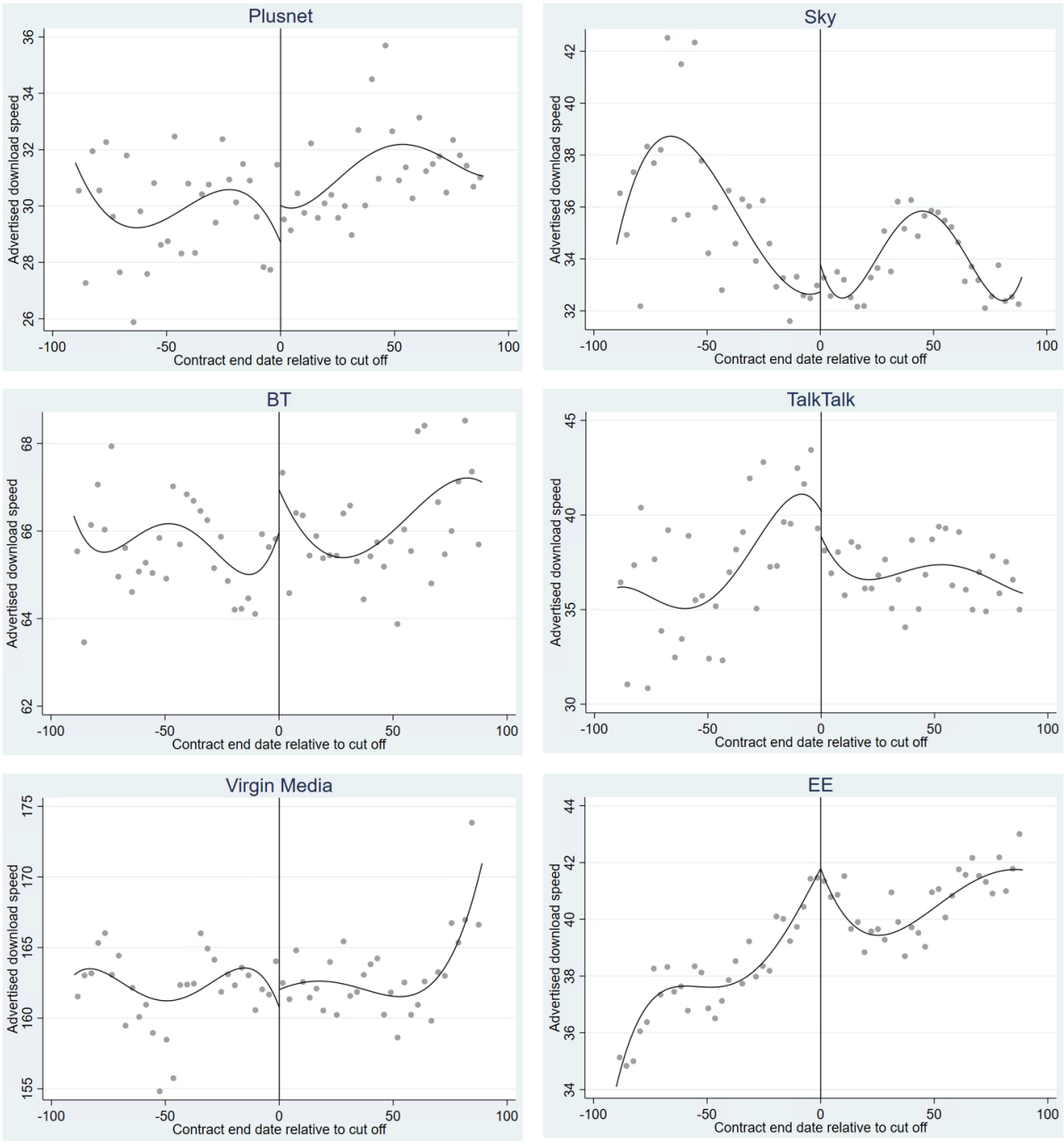
Figure 2: Total number of minimum contract period ends by CP over time

Note: Results for Virgin Media are based on a cut-off of 15 February 2020, and 26 March for all other CPs.

A1.23 As a further check of the continuity assumption, we consider differences in contract characteristics 90 days prior and after the introduction of ECNs, specifically advertised broadband speed of the contracts with minimum contract period ending before and after the introduction of the ECN policy. Advertised broadband speeds were unaffected by the ECN because the contracts were signed at least six months before the policy introduction. We can therefore use this contract characteristic to test the validity of the continuity assumption. Like the contract end analysis in Figure 3, if the continuity assumptions hold, we should not see a jump in these characteristics around the cut-off.

A1.24 Figure 4 shows how customers' advertised download speed varies across the period analysed by CP. None of the variable values jump significantly over the period analysed, supporting our use of RDD.[67]

Figure 3: Continuity checks – advertised download speed by CP



Note: Results for Virgin Media are based on a cut-off of 15 February 2020, and 26 March for the other CPs.

[67] For two CPs we also ran similar tests focusing on customer age and found no violation of the continuity assumption.

Regression analysis results

A1.25 An overview of our results is in section 3. Here we show more detailed results and discuss some potential shortcomings of our analysis.

Re-contracting analysis

A1.26 Our main specification uses a quadratic fit, as the quadratic model fits the data better, i.e. has a higher R^2, and allows for more flexibility in the functional form of the trend. We also tested a linear model, which shows a similar treatment effect for most CPs. Table 3 presents our RDD model results with a 90-day bandwidth, and Table 4 with a 60-day bandwidth.

Table 3: RDD regression output – 90-day bandwidth, quadratic fit by CP

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Plusnet	Sky	BT	TalkTalk	Virgin Media	EE
ECN	0.133***	0.0836***	0.0953***	0.0264***	0.0954***	0.0979***
	(0.00834)	(0.00320)	(0.00310)	(0.00455)	(0.00325)	(0.00698)
Time	-0.00121***	-0.00221***	-0.00867***	0.00143***	0.00161***	0.000299
	(0.000297)	(0.000124)	(0.000108)	(0.000174)	(0.000118)	(0.000262)
Time squared	-2.88e-05***	-2.10e-05***	-7.85e-05***	9.19e-06***	1.03e-05***	2.27e-06
	(3.28e-06)	(1.41e-06)	(1.17e-06)	(1.93e-06)	(1.25e-06)	(2.87e-06)
Time interaction	0.00273***	0.00457***	0.0123***	-0.00312***	-0.00420***	-0.00117***
	(0.000425)	(0.000175)	(0.000159)	(0.000238)	(0.000170)	(0.000367)
Time squared interaction	1.47e-05***	-1.18e-05***	5.75e-05***	2.06e-05***	1.60e-05***	-1.83e-05***
	(4.60e-06)	(1.95e-06)	(1.72e-06)	(2.62e-06)	(1.84e-06)	(4.01e-06)
Constant	0.379***	0.300***	0.207***	0.401***	0.362***	0.428***
	(0.00572)	(0.00219)	(0.00209)	(0.00326)	(0.00224)	(0.00490)
Observations	140,105	717,470	941,414	419,217	748,093	170,532
R-squared	0.036	0.006	0.012	0.008	0.011	0.008

*Note: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Virgin Media and EE results based on a 15 February 2020 and 3 February 2020 cut-off, respectively, and 26 March for the other CPs.*

Table 4: RDD regression output – 60-day bandwidth, quadratic fit by CP

Variables	(1) Plusnet	(2) Sky	(3) BT	(4) TalkTalk	(5) Virgin Media	(6) EE
ECN	0.163***	0.104***	0.173***	0.0221***	0.0770***	0.0815***
	(0.0103)	(0.00388)	(0.00383)	(0.00555)	(0.00394)	(0.00855)
Time	-0.00378***	-0.00193***	-0.0105***	0.00120***	0.00185***	0.000340
	(0.000530)	(0.000215)	(0.000195)	(0.000318)	(0.000209)	(0.000465)
Time squared	-7.04e-05***	-1.47e-05***	-0.000104***	1.40e-05***	1.55e-05***	3.33e-06
	(8.24e-06)	(3.55e-06)	(3.15e-06)	(5.08e-06)	(3.36e-06)	(7.54e-06)
Time interaction	0.00466***	0.00202***	0.00782***	-0.00144***	-0.00246***	0.000513
	(0.000776)	(0.000311)	(0.000294)	(0.000433)	(0.000305)	(0.000665)
Time squared interaction	7.04e-05***	1.62e-05***	0.000194***	-1.27e-05*	-2.59e-05***	-4.91e-05***
	(1.24e-05)	(5.20e-06)	(4.77e-06)	(6.92e-06)	(4.98e-06)	(1.07e-05)
Constant	0.353***	0.302***	0.187***	0.395***	0.363***	0.428***
	(0.00712)	(0.00268)	(0.00255)	(0.00401)	(0.00273)	(0.00592)
Observations	91,603	513,813	619,827	270,744	506,503	120,434
R-squared	0.027	0.006	0.017	0.001	0.009	0.006

*Note: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Virgin Media and EE results based on a 15 February 2020 and 3 February 2020 cut-off, respectively, and 26 March for the other CPs.*

A1.27 Tables 3 and 4 show that re-contracting rate increased because of the ECN policy; our ECN treatment dummy is statistically significant at a 1% level across all providers, with both the 90- and 60-day bandwidths.[68]

Pricing analysis

A1.28 In the data we observe customers' broadband bills issued in July, August and September 2019 and in September, October and November 2020. For customers who re-contracted or remained out-of-contract in the period of our analysis we used bills issued in 2020 as an approximation of the prices they paid after their minimum contract period ended.[69] For a customer who re-contracted more than 30 days after their minimum contract period, we are unable to observe the initial price they paid when out-of-contract.[70] To address this, we assume these customers continued to pay the same prices after their contracts ended, and use the 2019 billing data.

A1.29 To avoid biased estimates caused by measurement errors, we also excluded customers who had inconsistent billing data within each dataset.[71] If a customer was billed the same amount for their broadband in two months but paid a different price in the third month, we use the prices that match across the two months in our analysis as the broadband price

[68] For EE, the increase does not represent the impact of ECNs, rather the impact of the price rise notifications, which included information on re-contracting options, that EE sent out earlier in the year. See paragraph 3.5.
[69] The amount a customer is billed does not necessarily reflect the advertised price of a contract. Customer bills may vary over time as they may receive a discount as the result of promotion or a refund due to a previous overpayment.
[70] In our analysis, these customers are defined as customers who did not re-contract in response to an ECN (who did not take the treatment). Thus, we could not use 2020 broadband bills in September, October, November for these customers, as these bills are for their new contracts, not the prices they paid as the result of not re-contracting after receiving an ECN.
[71] We tested the results including these customers and they were broadly the same for the majority of CPs.

paid by that customer.[72] We also exclude customers who received refunds or were billed nothing in at least two months, since these bills are unlikely to reflect actual monthly contract prices.

A1.30 Table 5 presents our FRD model results with a 90-day bandwidth, and Table 6 with a 60-day bandwidth. As with our re-contracting analysis, we use a quadratic fit.

Table 5: FRD regression output – 90-day bandwidth, quadratic fit by CP

Variables	(1) Plusnet	(2) Sky	(3) BT	(4) TalkTalk	(5) Virgin Media	(6) EE
Re-contract	1.545	-9.263***	2.452***	7.812***	-7.739***	-1.579
	(1.164)	(0.521)	(0.665)	(2.634)	(1.338)	(1.049)
Time	-0.0473***	-0.0296***	0.0271***	-0.0224***	0.0233***	0.00704*
	(0.00460)	(0.00138)	(0.00465)	(0.00571)	(0.00570)	(0.00398)
Time squared	-0.000321***	-0.000338***	0.000541***	-0.000293***	7.72e-05	0.000153***
	(3.98e-05)	(1.69e-05)	(4.40e-05)	(4.56e-05)	(5.08e-05)	(4.23e-05)
Time interaction	0.0727***	0.0952***	-0.0430***	0.0472***	-0.0236***	0.0193***
	(0.00582)	(0.00336)	(0.00870)	(0.00859)	(0.00670)	(0.00529)
Time squared interaction	-5.16e-05	-0.000538***	-0.000244***	1.44e-05	-0.000364***	-0.000163**
	(4.31e-05)	(3.27e-05)	(2.56e-05)	(3.52e-05)	(6.43e-05)	(7.58e-05)
Constant	23.92***	31.96***	40.88***	21.52***	52.86***	29.24***
	(0.699)	(0.182)	(0.174)	(1.094)	(0.561)	(0.525)
Observations	102,127	688,160	901,271	390,430	681,281	137,514

*Note: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Virgin Media and EE results based on a 15 February 2020 and 3 February 2020 cut-off, respectively, and 26 March for the other CPs.*

Table 6: FRD regression output – 60-day bandwidth, quadratic fit by CP

Variables	(1) Plusnet	(2) Sky	(3) BT	(4) TalkTalk	(5) Virgin Media	(6) EE
Re-contract	7.920***	-3.246***	-1.547***	12.94***	-3.366*	-5.461***
	(1.404)	(0.496)	(0.428)	(4.883)	(2.032)	(1.417)
Time	-0.0656***	-0.0239***	0.0196***	-0.0538***	-0.0133	0.0174***
	(0.00761)	(0.00253)	(0.00366)	(0.0112)	(0.0110)	(0.00668)
Time squared	-0.000169	-0.000326***	0.000750***	-0.000820***	-0.000529***	0.000331***
	(0.000136)	(4.66e-05)	(5.36e-05)	(0.000153)	(0.000149)	(0.000104)
Time interaction	0.0787***	0.0253***	-0.00638	0.0873***	0.00481	0.0387***
	(0.0141)	(0.00430)	(0.00648)	(0.0114)	(0.0116)	(0.00908)
Time squared interaction	-0.000456***	0.000535***	-0.000761***	0.000458**	0.000366	-0.000965***
	(0.000145)	(6.52e-05)	(6.13e-05)	(0.000188)	(0.000236)	(0.000198)
Constant	20.10***	30.06***	41.95***	19.27***	50.97***	31.06***
	(0.815)	(0.181)	(0.124)	(1.992)	(0.848)	(0.698)
Observations	66,952	492,732	593,187	252,788	462,894	97,463

*Note: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Virgin Media and EE results based on a 15 February 2020 and 3 February 2020 cut-off, respectively, and 26 March for the other CPs.*

[72] We also tested a stricter condition, where a customer's price had to be consistent across all three months in both datasets. This led to broadly similar results for the majority of CPs.

A1.31 Sky and Virgin Media results are consistent across the 90- and 60-day bandwidths; customers that re-contracted after receiving an ECN paid less for their broadband contracts. TalkTalk results also show consistency, with both bandwidths showing an increase in price for those customers who re-contracted. However, there is variation for the other providers. For EE and Plusnet customers, with the 90-day specification our results are not significant, while in the 60-day specification our findings are statistically significant, and we find a decrease in prices paid by EE customers and an increase for Plusnet customers. Meanwhile, the result for BT customers changes direction between the two bandwidths. BT's graph in Figure 2 shows average prices are lower just after the cut-off, increasing afterwards. The 60-day bandwidth puts more weight on observations close to the cut-off, explaining the sign reversal between the two bandwidths.

Potential caveats to our analysis

A1.32 As highlighted in paragraph 3.6, the timing of Covid-19 impacts the interpretation of our regression analysis. It is likely that the pandemic impacted all CPs and customers in some way. As ECNs came into effect at a similar time that Covid-19 was beginning to affect the UK, it is possible some of the increase in re-contracting was driven by the surge in customers working from home, putting more emphasis on a requirement for a fast broadband service.

A1.33 As mentioned in paragraph A1.28, we assume broadband prices are still the same after the minimum contract period for customers who re-contracted more than 30 days after their contract ended. This could lead to potential bias in estimated effects of re-contracting on prices, since these customers could have paid higher prices after their contract ended as they did not re-contract in response to an ECN.[73]

A1.34 Since we only observe broadband billing data in periods some months away from the ECNs introduction, we cannot be sure that the prices we observe are an exact reflection of the prices which were paid at the time. The prices we observe may have been affected by inflation, or CP price rises, which somewhat affects the reliability of our findings.

[73] For example, say a customer whose contract ended on 26 March 2020 paid £30 during their contract, but did not recontract until August 2020, we do not consider this re-contracting as the result of the ECN. As we do not observe how much they paid immediately after their contract ended, we assume that they still paid £30 after their contract ended. If they actually paid more than £30, we would have under-estimated the effect of the ECN, since failing to recontract in response to the ECN leads to a higher price.