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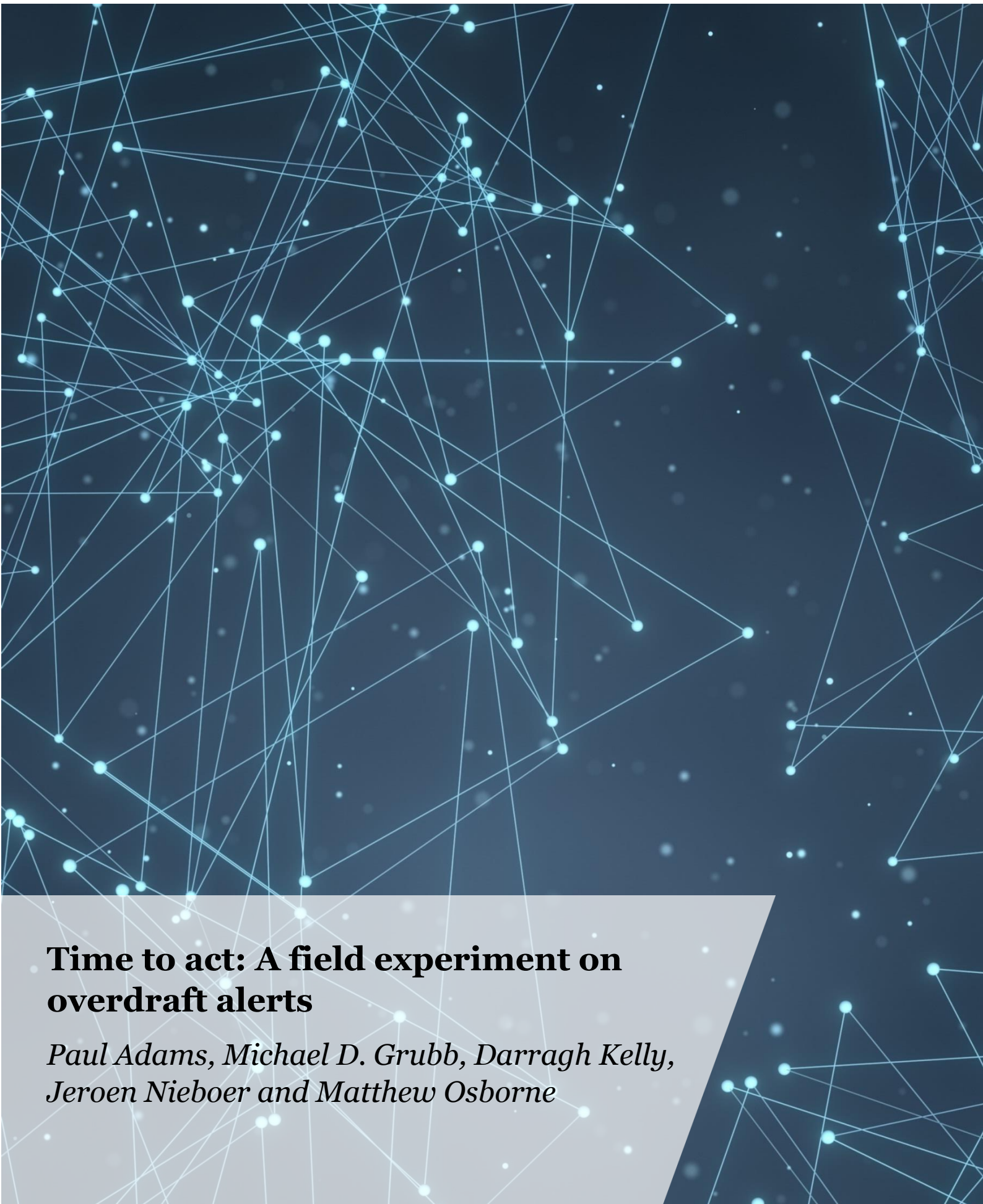

Time to act: A field experiment on overdraft alerts

Paul Adams, Michael D. Grubb, Darragh Kelly, Jeroen Nieboer and Matthew Osborne

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Authors

- Paul Adams and Jeroen Nieboer work in the FCA's Behavioural Economics and Data Science Unit. Jeroen is also Visiting Fellow at the London School of Economics.
- Darragh Kelly is a data scientist at Google but completed this work whilst in the FCA's Behavioural Economics and Data Science Unit.
- Michael D. Grubb is Associate Professor of Economics at Boston College.
- Matthew Osborne is Assistant Professor of Marketing in the Department of Management at the University of Toronto Mississauga, with a cross-appointment to the Marketing Area at Rotman School of Management.

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Contents

1 Executive summary

Despite the growth of digital banking and the rapidly expanding offering of money management applications, a substantial proportion of UK banking customers still incur overdraft and unpaid item charges. This can add up: 19 million people use their overdraft each year and firms made 2.3 billion in revenues from overdrafts in 2016.

Although in many cases these charges reflect a demand for conveniently accessed credit, it is likely that some charges could have been avoided if consumers had been better aware of their financial position. In fact, recent FCA research found that sending consumers a text message alert before they incur charges for unarranged overdraft usage or unpaid items reduces these charges by 21-25% (Caflisch Grubb, Kelly, Nieboer and Osborne, 2018).

Despite these considerable savings, few people had signed up for alerts of their own accord: 3-8% had registered for any type of alert by early 2015. One way of addressing this issue is automatic enrolment. By now, all major UK banks have enrolled their customers to receive just-in-time unarranged overdraft and unpaid item alerts – either on the bank's initiative or due to a policy that mandated enrolment by February 2018.[1]

Given the benefits from alerting consumers of impending charges, the FCA wanted to know whether alerts in addition to those already mandated would be beneficial. In this paper, we report results of a large field experiment on automatically enrolling consumers into additional alerts. We test whether consumers would benefit from:

- just-in-time alerts for arranged overdraft usage
- early warning alerts for (arranged and unarranged) overdraft usage, and/or
- early warning alerts for unpaid items

We also provide experimental estimates of the effect of just-in-time unarranged overdraft and unpaid item alerts, for comparison with the results reported in Caflisch et al (2018).

Although we are mainly interested in the reduction of total overdraft charges, we wanted to measure the wider impact of automatic enrolment. We look at secondary outcomes that help us identify why the alerts work, such as digital banking usage, balances, transaction patterns and the length of overdraft spells.

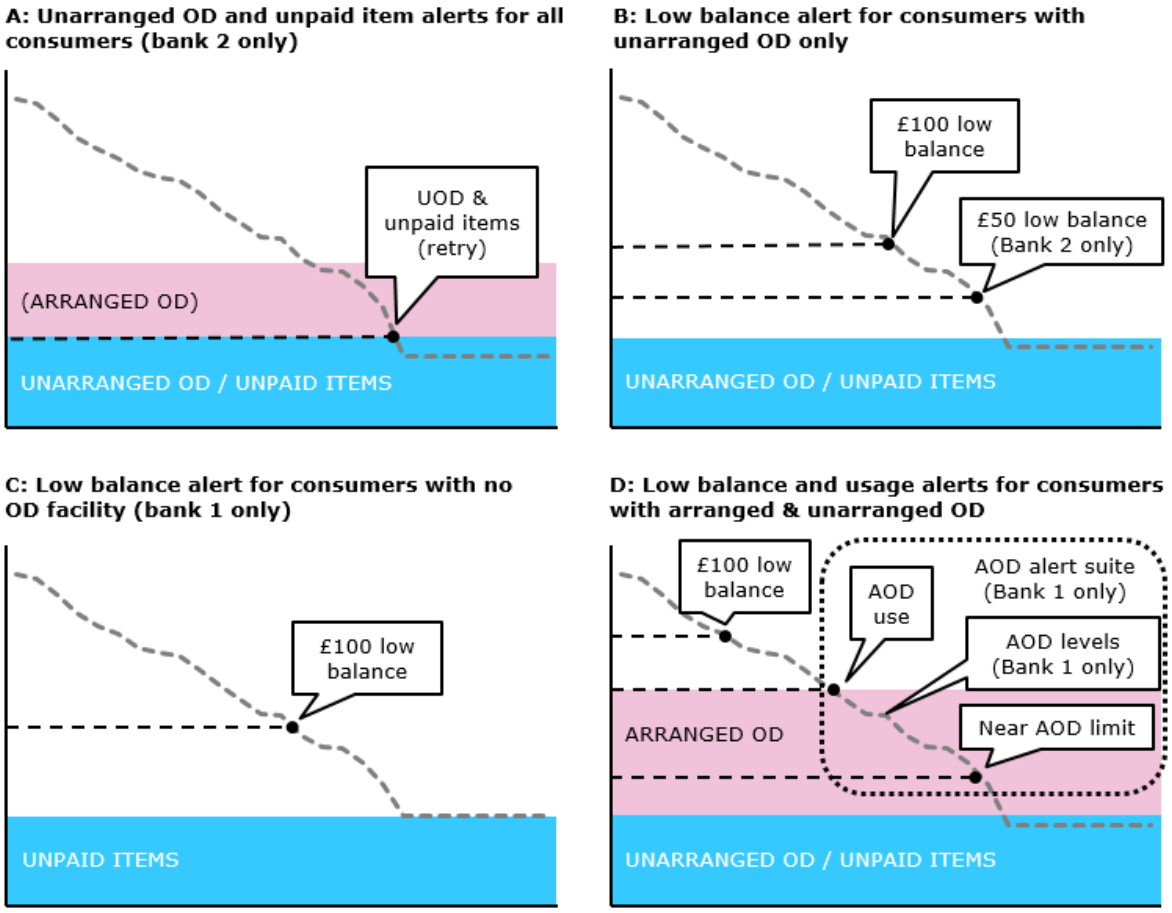
We conducted a telephone survey with a sub-sample of participants, to gauge the effect of alerts on awareness of charges, measure participants' attitudes towards automatic enrolment and to learn more about the actions that people take after receiving an alert. We also use this survey to investigate whether alerts might contribute to information overload, fatigue or annoyance. By combining hard administrative data on primary and secondary outcomes with survey information, we are able to say whether the alerts helped consumers and give possible reasons for their effect.

[1] CMA Retail Banking Investigation Order 2017. The 2 alert types evaluated in Caflisch et al. satisfy the requirements of the CMA's Order, but note that the unpaid item alerts evaluated were implemented as retry alerts (giving consumers the chance to retry a rejected payment on the same day), which is not strictly a requirement of the CMA's Order. The Order applies to banks with more than 150,000 PCAs; the FCA is currently consulting on extending the threshold of applicability of the alerts in the Order to banks and building society brands with more than 70,000 PCAs (see FCA consultation paper 18/13).

The field experiment

We worked in collaboration with 2 major UK retail banks to carry out a field trial involving over 1 million PCA customers between November 2017 and April 2018. Figure 1 illustrates the treatments across the 4 separate trials. Trial A provides an experimental estimate of automatic enrolment into unarranged overdraft and unpaid item alerts, by contrasting 2 treatment groups that were enrolled into these alerts in November 2017 and February 2018 (the date by which automatic enrolment became mandatory), respectively. Trials B, C and D tested additional alerts, including for low balances and arranged overdraft use, but all customers received the mandated alerts.

Figure 1: Overview of trials



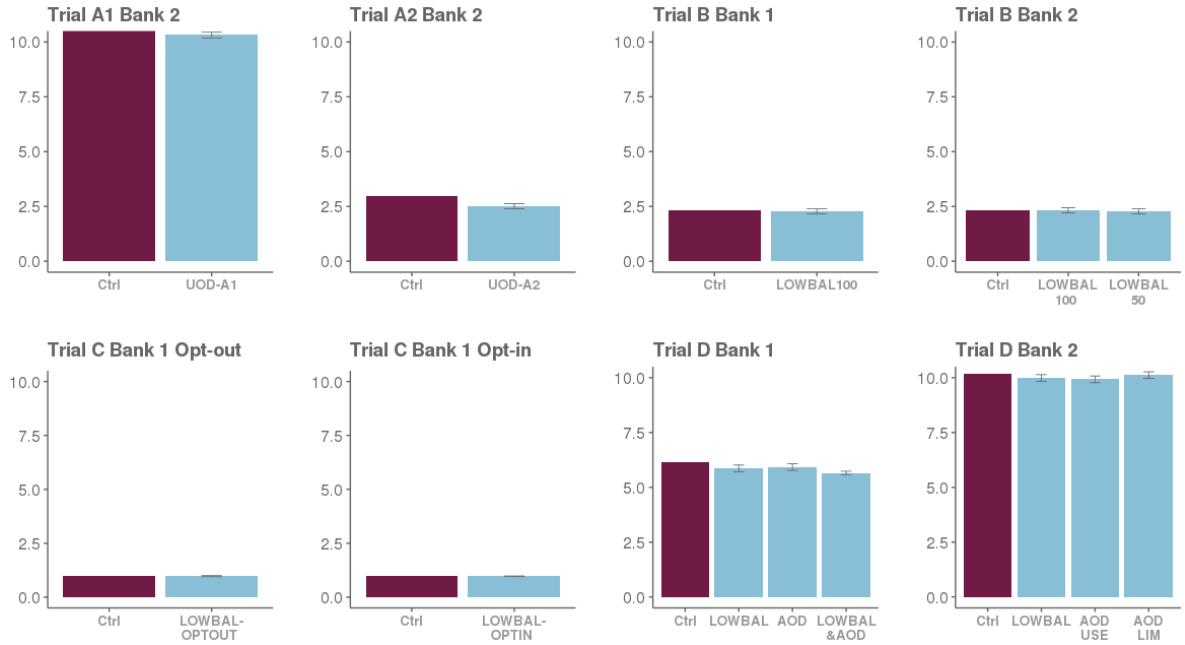
Notes: The x-axis represents time and the y-axis represents the balance in the consumer's account. Speech bubbles represent the alerts tested in each trial. Trial A alerts were tested separately for consumers with and without an arranged overdraft facility. Control groups for trials B, C, and D were also enrolled into the alerts tested in Trial A; the control groups for Trial A received no alerts.

All alerts are at the start of a 1-day grace period (Trial A) or in real time (Trials B, C and D), allowing customers to take timely action. Consumers could take action by transferring funds before a specified cut-off time (Trial A), ensuring their account balance does not drop below a certain level (Trials B and C), or both (Trial D).

Results

For all our trials, our primary outcome of interest is changes to total overdraft charges per person per month. We give the average effect across all individuals within each trial, including those who don't incur any charges at all.

Figure 2: Overview of findings



Notes: The y-axis is total overdraft charges (arranged overdraft charges, unarranged overdraft charges, paid and unpaid item fees) per month. Ctrl indicates charges in the relevant control treatment.

Figure 2 shows the effects of our different treatments on total charges per month. We find the following effects of automatic enrolment in the 4 trials:

Trial A (Alerting consumers – with or without an arranged overdraft – when they are using their unarranged overdraft facility and/or may incur unpaid items):

- We find that the average consumer in Trial A sees a reduction of 13-18% in unarranged overdraft and unpaid item charges when enrolled into unarranged overdraft and unpaid item alerts. This is equivalent to or £0.39-0.46 per month. These estimates are similar to the non-experimental estimates presented in Caflisch et al. (2018).

Trial B (Alerting consumers without an arranged overdraft when their balance is approaching zero – acting as an early warning for unarranged overdrafts):

- We do not find convincing evidence that low balance alerts help these consumers avoid using their overdraft.

Trial C (Alerting consumers with no overdraft facility when their balance is approaching zero – acting as an early warning for unpaid items):

- We find no evidence that enrolling customers without any overdraft facility into low balance alerts leads to a reduction in charges. In addition, when we encourage

consumers to self-register for these alerts we see a registration rate of almost 10% and also find no reduction in charges.

Trial D (Alerting consumers with an arranged overdraft):

- We find that the average customer in Trial D sees a reduction of 3-8% in arranged overdraft charges when enrolled into an alert that warns of arranged overdraft usage in real time, or £0.28-0.45 per month. Enrolling consumers into a low balance alert does not lead to a further reduction. We also find no effect on charges of notifying consumers who are approaching their arranged overdraft limit.

Survey responses show that consumers overwhelmingly relied on their own liquid savings, cuts to non-essential spending and informal credit to avoid using overdrafts. Respondents are broadly supportive of automatic enrolment into alerts. The strongest support was for the arranged overdraft usage alert. Importantly, survey respondents did not find them distracting or annoying. Even those who decided to opt-out of receiving alerts supported them.

Policy implications

Our findings corroborate Caflisch et al. (2018), which found very similar estimates of the impact of automatic enrolment into unarranged overdraft and unpaid items alerts, albeit in a non-experimental setting. This provides further evidence that these estimates are a reliable indicator for the effects of the alerts across the market.

Our research provides support for automatic enrolment of consumers into further alerts, particularly the arranged overdraft usage alert tested in Trial D. The evidence in support of low balance alerts, however, is weak. Although consumers are broadly supportive of all the alerts we tested, it is not clear whether automatically enrolling people into 'early warning' alerts will reduce their overdraft charges.

Importantly, testing these alerts showed us that some alerts help consumers avoid overdraft charges, whilst others do not. By combining hard data on consumer outcomes from the trials with a survey, we are also confident that the alerts are seen as helpful and do not appear to contribute to consumers feeling overloaded with information – there is little 'alert fatigue'.

Testing digital interventions such as SMS alerts is likely to become more common, both for regulators and for industry. Comparing outcomes between groups allows a clear understanding of what works and what doesn't. In fact, modern digital approaches to interventions can allow randomisation and implementation to happen relatively easily, allowing experiments to increase in scale.

2 Introduction

The amount that UK Personal Current Account (PCA) customers pay for their overdrafts has been a source of concern for many regulators in the recent past. In 2008, the Office of Fair Trading (OFT) reported that overdraft charging models were opaque and that many consumers were unaware of the charges they incurred.[2] A more recent market investigation by the Competition and Markets Authority (CMA), the OFT's successor, reported that consumers continued to show 'limited awareness and engagement with their overdraft usage'.[3]

Much has changed since then. Following the OFT study, PCA providers voluntarily agreed to send consumers annual summaries of their account usage, to increase awareness of costs. In 2012, a joint initiative from HM Treasury and the Department for Business Innovation Skills ensured that PCA providers gave their customers access to a suite of overdraft alerts by text message (some of which were already available). These were expected to reduce consumers' account monitoring costs and provide them with timely notifications to take action when at risk of incurring charges.[4] In an evaluation of these 2 regulatory measures, Hunt, Kelly and Garavito (2015) found that annual summaries had no effect on overdraft charges incurred, whereas consumers opting in to overdraft alerts were significantly less likely to incur overdraft charges.

Of course, the availability of effective overdraft alerts does not mean that they will be adopted by all consumers who would benefit from them. Following the 2016 market study, the CMA therefore issued an Order requiring PCA providers to automatically enrol consumers into 2 types of overdraft alerts: unarranged overdraft and unpaid item alerts. In a previous paper (Caflisch et al., 2018), we estimated that automatic enrolment into these alerts reduces unpaid item charges by 21-24% and reduces unarranged charges by 25%.[5] The FCA is currently consulting on extending the coverage of these alerts to a wider consumer population.[6]

Given the benefits from alerting consumers of impending charges, the FCA wanted to know whether additional alerts could help further. In this paper, we report results of a field experiment testing the impact of automatically enrolling consumers into further overdraft alerts. Specifically, in addition to the unarranged and unpaid item alerts already in place we wanted to answer whether consumers would benefit from alerts on arranged overdraft usage and early warning alerts for arranged overdraft, unarranged overdraft and unpaid items.

Our field experiments were carried out over a 5-month period in collaboration with 2 major UK retail banks, whose combined customer base represents over a quarter of the

[2] OFT personal current accounts market study.

[3] CMA retail banking market investigation final report (2016), p. 173 and appendix 6.4.

[4] BIS and HM Treasury Consumer credit and personal insolvency review (2011).

[5] For unpaid item alerts, the CMA Order does not require firms to offer customers an opportunity to avoid unpaid item charges. In practice, however, most firms have operated a 'retry' system since 2014 – giving consumers time until the afternoon to deposit funds so a previously unpaid transaction can be re-attempted. The unpaid item alerts required by the CMA can be implemented as retry alerts. Both Caflisch et al. and this paper refer to these alerts as unpaid item alerts.

[6] FCA Consultation Paper 18/13.

UK PCA market. The experiment involved more than 1 million consumers and we have detailed information on their demographic characteristics, transactions and incurred charges.

The treatments tested in the field experiments were carefully designed following the analysis of a rich dataset on PCA holders – described in more detail in Caflisch et al. (2018) and FCA CP18/13. This dataset allowed us to calibrate the trigger level of early warning alerts, design an effective treatment allocation strategy and estimate sample sizes for the required level of statistical power (using a "minimum detectable effect" criterion). Our tested treatments did not test the content of the alert message – this question was considered in a separate piece of commissioned research.[7]

We are primarily interested in estimating the effect of alerts on average overdraft charges per person per month. However, we also estimate the impact on several secondary outcomes using detailed data on balances, transactions, digital banking and a telephone survey. These secondary outcomes allow us to investigate why our treatments do or do not work, as well as measure important consumer outcomes that cannot be inferred from the trial data. They also allow us to answer a number of other questions of interest. Do alerts have psychological benefits (or costs)? Who opts out of alerts and why? In an opt-in regime, do the 'right' kind of consumers sign up to alerts in this setting? And how do their alert settings (trigger levels of low balance alerts) compare to those set by us?

The rest of the paper is organised as follows. Section 3 discusses prior literature and the context of our experimental treatments, Section 4 explains the experimental design, Section 5 discusses the results and Section 6 concludes.

[7] Decision Technology (2018): FCA Prompts and Alerts Design: Behavioural Evidence.

3 Context

Overdrafts

PCAs are a crucial part of consumers' participation in the UK's financial system and a source of credit. Many accounts offer customers an overdraft, which allows them to borrow money from their bank on an ad-hoc basis. There are 2 types of overdraft credit in the UK:

- An **arranged overdraft** is a line of credit with a pre-agreed borrowing limit, which consumers automatically use when their account balance drops below zero. Around half of PCA holders have an arranged overdraft and, in 2016, 37% of consumers used their arranged overdraft facility to borrow money.
- An **unarranged overdraft** occurs when a transaction takes place that takes the consumer over their arranged overdraft limit or, if they do not have an arranged overdraft, below zero. The extension of unarranged overdraft credit for a particular transaction is at the bank's discretion. If the bank decides not to extend any (further) credit, the transaction will be rejected with the customer typically incurring fees for these unpaid items.[8] Many PCAs in the UK have an unarranged facility by default, but many customers do not know they have this account feature. In 2016, 14% of consumers used an unarranged overdraft.

Although charging models differ between providers, unarranged overdraft credit is generally more expensive than an arranged overdraft. On average, for each £1 lent, PCA providers make 10 times more revenue from unarranged lending than for arranged lending.[9]

Automatic enrolment and alerts

A policy of automatic enrolment of consumers into overdraft alerts consists of 2 important elements, automatic enrolment and the alerts themselves. Automatic enrolment can help some customers overcome barriers to signing up to alerts, while alerts themselves can help individuals pay attention to a particular task in a timely manner.[10]

Automatic enrolment

Automatically enrolling people means that customers have to opt-out rather than opt-in. Changing the default choice to opt-out rather than opt-in can dramatically increase the targeted behaviour. This been shown to work in saving for retirement (Beshears, Choi,

[8] Some unpaid items, such as attempted cash withdrawals from an ATM, do not incur a fee. Unpaid item fees are typically charged for scheduled transactions, such as standard orders and direct debits.

[9] Reported overdraft usage and cost statistics are from FCA Consultation Paper 18/13.

[10] It may also be that automatic enrolment makes consumers more attentive to the alert event, either after being notified of enrolment or by learning over time (although, arguably, consumers may become less attentive if they know they will receive an alert).

Laibson and Madrian, 2009; Madrian and Shea, 2001; Thaler and Benartzi, 2004), registering for organ donation (Johnson and Goldstein, 2003) and using clean energy (Sunstein and Reisch, 2013; Ghesla, Grieder and Schubert, 2018). Such nudges can be a useful way of overcoming inertia when the default option matches what the consumer would have chosen in the absence of friction.

If opting in or out of alerts was frictionless for consumers, then mandating that alerts be offered on an opt-in basis would provide all the possible benefits of alerts, as all consumers who could benefit would take advantage. However, Caflisch et al (2018) find that find that at most large banks, less than 8% of eligible consumers actively enrol in alerts in an opt-in framework, with few opt-outs. This is probably because it is not frictionless – opting in takes time and effort – and because humans are fallible. In fact, our field experiments show that 90-99% of participants adopt the default alerts setting. As a result, changing the default alert setting from opt-in to opt-out via automatic enrolment is expected to have large benefits by ensuring that all those who can benefit from alerts are enrolled.

Even a fully aware, attentive, and rational consumer, who has not registered for existing alerts but checks their account balance with sufficient regularity to avoid charges, may benefit from automatic enrolment. For instance, alerts may free up some of their time and effort currently spent tracking their balances, and automatic enrolment may let them receive those benefits without the hassle of actively signing up. If we also allow for the possibility that some consumers are unaware of the option to enrol in alerts, procrastinate enrolment, or underestimate the possibility of future lapses of attention to their accounts, then the expected benefits of automatic enrolment increase considerably.

Although we did not have evidence that consumers wanted the alerts we tested – indeed the opt-in rate for some of these alerts was low – Caflisch et al. (2018) found that consumers tended not to opt-out of alerts when they were automatically enrolled. Qualitative survey evidence conducted prior to our trials also suggested that consumers were in favour of alerts.[11] This suggests that enrolment into timely overdraft alerts would be welcomed by most consumers, or at least would not lead to significant harm. Further, if consumers did not value the alerts then they could easily ignore them or switch them off altogether.[12]

Consumer attention

Alerts themselves lower the cost of staying on top of things – alerts make it easier for consumers across the market to monitor their account and act if required. Consumers may benefit by saving time (keeping on top of things with less effort), saving money (by better managing their accounts and reducing charges), enjoying the psychological benefits of knowing their account comes with a warning light, or all of the above.

Alerts can be thought of as serving 2 roles simultaneously. First, they act as a reminder for consumers to engage with their current accounts. Second, they provide new information - namely that the current moment is the right time to engage because a particular balance threshold has been crossed. Reminders that serve only the first role, reminding individuals to take desired actions without actually providing new information, have been found to be effective in a wide range of settings. Reminders improve medical

[11] Collaborate (2018) report for the FCA: 'Future personal current account prompts and alerts'.

[12] The latter condition is not to be taken for granted. For example, Ghesla et al. (2018) find that a green energy default for electricity leads to poorer households paying more than they would want to.

appointment attendance (Reekie and Devlin 1998, Bourne, Knight, Guy, Wand, Lu and McNulty, 2011), loan repayment (Cadena and Schoar 2011, Karlan, Morten, and Zinman 2015), influenza vaccination rates (Szilagyi and Adams 2012), library returns (Apesteguia, Funk, and Iriberri 2013), dental appointment creation (Altmann and Traxler 2014), rebate redemption (Tasoff and Letzler 2014), medication adherence (Bobrow, Farmer, Springer, Shanyinde, Yu, Brennan and Levitt 2016), savings (Karlan, McConnell, Mullainathan and Zinman, 2016), and gym attendance (Calzolari and Nardotto 2016).[13]

The success of reminders in other settings suggests that alerts may be effective in helping consumers avoid overdraft charges. This is particularly true because, without alerts, there is evidence that people are inattentive to important aspects of their banking arrangements and overdraft usage. An Office of Fair Trading survey (2008) found that only 7% of UK PCA holders exceeded arranged overdraft limits because they 'knew it would happen but had to make a payment'.[14] In a survey of overdraft users in the United States, Stango and Zinman (2014) found that over 50% of overdraft charges were avoidable by using alternative accounts with available liquidity and that 60% of overdraft users did so because they 'thought there was enough money in [their] account'.

Stango and Zinman also report that answering charge-related survey questions made consumers less likely to incur overdraft charges. This suggests that the prominence of bank fees in consumers' minds affects their behaviour and that making bank fees more salient can increase effort consumers make to avoid them. Alan, Cemalcilar, Karlan and Zinman (2018) find that a bank's marketing campaign of overdraft discounts leads to an unexpected reduction in overdraft usage, whereas similar messages that do not mention overdraft charges lead to an increase. This finding provides additional support for the idea that many overdraft charges are incurred due to lack of attention rather than intentional borrowing.

Early-warning versus just-in-time disclosure and deadline effects

The CMA's Order ensured that all eligible consumers were automatically enrolled into alerts that notify them when they have 'exceeded a Pre-agreed limit' or 'attempted to exceed a Pre-agreed credit limit and will incur a charge' by February 2018.[15] For unarranged overdraft alerts, the Order requires that a fee-free 'grace period' should be communicated. This period should provide customers with an opportunity to take action to avoid or reduce charges. For unpaid item alerts, the Order does not require a grace period but most firms have effectively implemented one.[16]

An important aspect of the CMA mandated alerts is that they can be thought of as providing "just-in-time" disclosure with a deadline to act. Caflisch et al (2018) estimate using historical data and a staggered rollout in 2 UK banks the effect of automatically enrolling consumers into 2 types of alerts that conform to the CMA Order:

- Unarranged overdraft alerts, informing the customer that they will be charged for using their unarranged overdraft unless they transfer funds before a cut-off time

[13] See Altmann and Traxler (2014) for a helpful summary of results from several of these studies.

[14] OFT personal current accounts market study, p. 69 and Annexe D.

[15] CMA Retail Banking Investigation Order 2017. The Order applies to banks with more than 150,000 PCAs; the FCA is currently consulting on extending the threshold of applicability of the alerts in the Order to banks and building society brands with more than 70,000 PCAs (see FCA consultation paper 18/13).

[16] As a result of an industry agreement in 2014, most firms operate a retry system for unpaid items – giving consumers time until the afternoon to deposit funds so a previously unpaid transaction can be re-attempted. This means that unpaid item alerts, which are sent after the initial 'try', have an implied grace period as they are implemented as part of this retry system.

- Unpaid item (retry) alerts*,* informing the customer that a scheduled payment will be rejected and a fee may be applied, unless they transfer funds before a cut-off time

They found that automatic enrolment into these alerts reduces unpaid item charges by 21-24% and reduces unarranged charges by 25%.

These 2 alerts are examples of just-in-time disclosure: the consumer is informed of the situation and provided with a window of opportunity to change the outcome. The evidence suggested that a large part of the reduction in charges was due to consumers responding to the alert before the cut-off time: the number of overdraft episodes per month fell by 19.7%. Importantly, and unlike other forms of disclosure, the information is provided in real time and an action is required in relatively short timescales, reducing the possibility that attention is lost or that the task falls out of prospective memory.

In the current study we test a variety of such 'just-in-time' alerts with short deadlines to act, but we also test low-balance alerts that may be considered as providing 'early-warning' and do not provide deadlines for action. Early-warning alerts may provide additional benefits above and beyond just-in-time alerts because they allow more time to take corrective action. There are 2 potential drawbacks however:

First, by giving early-warning, low-balance alerts are necessarily less precise than just-in-time alerts. A just-in-time alert is never a false alarm, but low balance alerts can frequently be triggered when there is no danger of an overdraft because, unbeknown to the bank, a deposit is already imminent. If false alarms are too common, consumers could learn to ignore early-warning alerts, making them ineffective.

Second, if consumers are present biased, theory suggests that absence of a deadline could lead consumers to procrastinate and to delay corrective action, leading to higher charges (O'Donoghue and Rabin 1999, Herweg and Müller 2011). Moreover, procrastination can be particularly harmful, and so deadlines particularly beneficial, if a task that is delayed a short time risks being forgotten altogether due to inattention (Holman and Zaidi 2010, Ericson 2017). Moreover, deadlines have been found to increase action and improve performance in practice. Ariely and Wertenbroch (2002) show that students earn higher grades on papers when subject to shorter deadlines, and moreover that students choose to give themselves shorter deadlines when given the opportunity. Similarly, Madeira (2015) finds that US consumers are more likely to switch Medicare Part D insurance plans when given a shorter deadline. However, short deadlines are not always effective. For instance, following text message prompts to make a charitable donation, Damgaard and Gravert (2017) find that whether the deadline is midnight tomorrow or longer has no effect on giving.

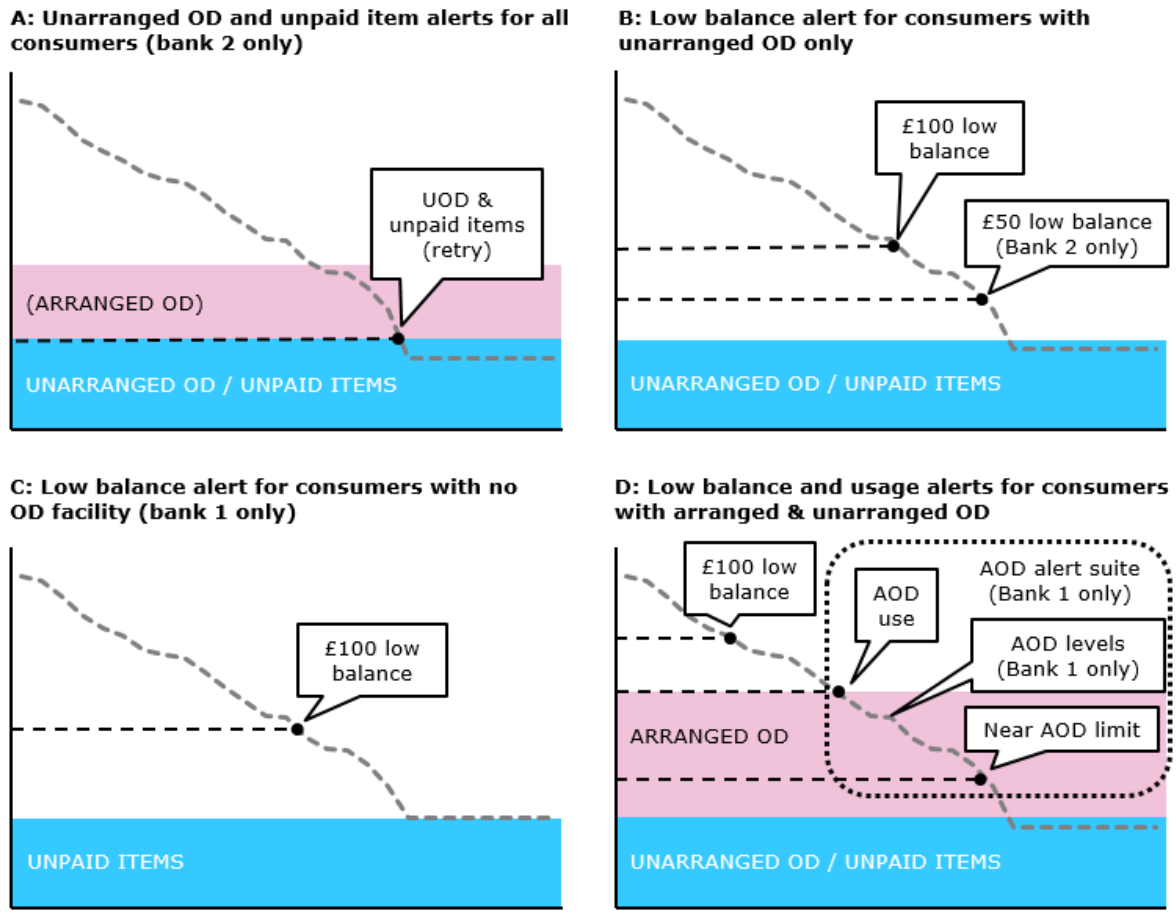
In short, it is not clear whether early-warning alerts will be most effective because they allow more time for corrective action, or whether just-in-time alerts will be most effective because they are more precise and contain clear deadlines for immediate action.

4 Experimental design

Our field experiments were carried out over a 5-month period in collaboration with 2 major UK retail banks. We carried out 4 trials across different customer bases:

- **Trial A: Alerting consumers (with or without an arranged overdraft)** when they are using their unarranged overdraft facility and/or may incur unpaid items.
- **Trial B: Alerting consumers without an arranged overdraft** when their balance is approaching zero – acting as an early warning for unarranged overdrafts.
- **Trial C: Alerting consumers with no overdraft facility** when their balance is approaching zero – acting as an early warning for unpaid items.
- **Trial D: Alerting consumers with an arranged overdraft** when their balance is approaching zero and/or when they are using their arranged overdraft facility.

Figure 3: Overview of trials



Notes: * = Speech bubbles represent the alerts tested in each trial. Trial A alerts were tested separately for consumers with and without an arranged overdraft facility. Control groups for trials B, C, and D were also enrolled into the alerts tested in Trial A; the control groups for Trial A received no alerts.

Each of these alerts allows consumers to avoid charges by taking action. Consumers can take action by transferring funds before a specified cut-off time (Trial A), ensuring their account balance does not drop below a certain level (trials B and C), or both (Trial D).

Figure 3 represents the alerts in each trial graphically. The x-axis represents time and the y-axis represents the balance in the consumer's account. The speech bubbles in the figure represent the alerts that consumers in the trial receive when their balance drops below certain threshold levels (or projected balance levels, in the case of unpaid item re-try alerts). All alerts are at the start of a 1-day grace period (Trial A) or in real time (trials B, C and D).

With the exception of Trial C, consumers in all trials had an unarranged overdraft facility. Whether consumers actually receive unarranged overdraft credit depends on the size of the outgoing transaction they attempt – banks typically operate a 'shadow overdraft limit' beyond which they will not extend credit. This is represented in the figure by the combined unarranged overdraft / unpaid items section in blue. Consumers may also have an arranged overdraft, shaded in pink.

Enrolment

Each alert was implemented on an opt-out basis: customers in the treatment group were automatically enrolled into the alert at the start of the trial, after receiving a notification from their bank that explained automatic enrolment and how to opt out. Automatic enrolment was implemented slightly differently by the 2 banks. Bank 1 notified their customers by e-mail and text message of automatic enrolment, with an easy opt-out mechanism provided by the consumer replying directly to the text message ('reply NO to this message'). Bank 2 similarly provided an e-mail notification at the start of enrolment, but no text message response option. We would therefore expect opt-out rates to be higher for Bank 1.[17]

In Trial C we also compared automatic enrolment with 'prompted enrolment'. Under the prompted enrolment treatment the bank sent an e-mail to customers encouraging them to register for this alert and explaining to them how to do so.

Mandated alerts

The 2 alerts tested in Trial A were designed to meet the requirements of the CMA Order, which mandated automatic enrolment into unarranged overdraft "grace period" alerts and unpaid items alerts for customers of major UK banks by February 2018. [18] Since our trials started in late 2017, we have 2 months of data for the control groups (consumers not enrolled into any alerts) for Trial A, as all consumers in the control groups were enrolled right at the end of January 2018 to comply with the Order.

Since Trials B, C and D were designed to test the impact of alerts additional to the mandated alerts, participants in both treatment and control groups for these trials were already enrolled into the mandated alerts for the entire 5 months of the trial. The control

[17] Customers of both banks could configure alerts through internet banking, telephone banking or going into branch. At the time of our trial, neither of the banks offered the possibility to opt out in their mobile banking application.

[18] CMA Retail Banking Investigation Order 2017. The FCA is currently consulting on extending the threshold of applicability of these alerts to banks and building society brands with more than 70,000 PCAs (see FCA consultation paper 18/13).

groups for Trials B, C and D are therefore representative of the regulatory status quo post February 2018.

Alert balance triggers for low balance alerts

A key challenge when designing low balance alerts is where to set the balance threshold that triggers the alert. Since it was not practical or feasible to test multiple low balance thresholds across all trials, so we considered the trade-offs between higher and lower balance thresholds. Our primary objective in setting the thresholds for low balance alerts was to maximise the chances that they help consumers avoid preventable bank charges.

First, we assumed that consumers prefer salient, round numbers for balance thresholds and additionally that they prefer not to have many thresholds and/or receive a multitude of alerts. It also seems reasonable to assume that the consumer populations in our 3 trials would benefit from different alerting thresholds, depending on their transaction behaviour.

Second, we considered different low balance thresholds empirically, based on the sizes of transactions that bring consumers close to, and into, overdrafts. Using a transaction-level PCA dataset collected by the FCA, we analyse 2 random samples of 250,000 customers from 2 large UK banks (Bank X and Y) in 2015 and 2016.[19] The data allowed us to consider 3 metrics that provide information on the relative benefits that consumers might receive from sending alerts at different low balance thresholds:

1. **True positive rate**: the proportion of overdraft episodes that would receive an alert prior to going into overdraft.
2. **Positive predictive value**: of the instances where customers drop below the balance threshold, the proportion of times the account becomes overdrawn.
3. **Time to act**: of the instances where customers went into overdraft after dropping below the alert threshold (true positives), the average time between these events.

The true positive rate is related to the size of the typical transaction that brings the consumer into overdraft. If balances are always above £100 just before overdrawing then £100 low balance alerts would not be useful. Positive predictive value allows us to understand how many consumers would avoid overdrafts without alerts: if balances drop below a threshold but then very rarely enter overdraft, then alerts could lead to nuisance costs for consumers. Time to act tells us how much time consumers have to act between receiving an alert and going overdrawn.

Following our assumptions and after observing the existing set of low balance alerts offered by banks, we compute our metrics at thresholds £50, £100 and £150. We did this separately for consumers who have an arranged overdraft facility and for consumers who do not have an arranged overdraft facility. We did not have any data for consumers who had no overdraft facility at all (such as our Trial C population), so we make the assumption that this population is similar to those without an arranged overdraft facility We use data from 2 banks to ensure that our findings our not bank specific.

Table 1 summarises our results. Our first observation is that we find stark differences in metrics between consumers with and without an arranged overdraft facility. In particular,

[19] Further details on this dataset can be found in FCA Occasional Paper 36. Banks X and Y are not necessarily the same 2 banks that were involved in the trials.

we would need to set the threshold higher for consumers with an arranged overdraft to attain the same true positive rate as for consumers without an arranged overdraft. We also note that the positive predictive value of our alerts thresholds is substantially lower for consumers without an arranged overdraft facility.

Time to act increases more or less linearly with balance threshold and the shortest time to act consumers would have from would be just over half a day. If customers with an arranged overdraft received alerts at £50 they would have a particularly short time window to act: 0.64 days at Bank X. As a rule of thumb, we decided that consumers would need to have at least a day to act after receiving an alert. Given the trade-off on the other 2 metrics is no clear tie-breaker, we opted for the salient £100 alert threshold level for those with arranged overdraft facilities. For those without arranged overdrafts, we opted for testing both £50 and £100 low balance alerts.

Table 1 - Metrics for low balance alerts at different thresholds

	True positive rate (%)		Positive predictive value (%)		Time to act (days)	
Customers with an arranged overdraft facility						
Bank	X	Y	X	Y	X	Y
£50	58%	42%	61%	55%	0.64	0.67
£100	71%	58%	51%	47%	1.18	1.16
£150	78%	66%	44%	41%	1.66	1.58
Customers without an arranged overdraft facility						
Bank	X	Y	X	Y	X	Y
£50	80%	69%	15%	16%	1.35	1.42
£100	88%	81%	12%	14%	2.07	2.11
£150	91%	86%	11%	12%	2.64	2.70

Treatments

We now discuss the treatments in each trial. For reasons of commercial confidentiality, we provide illustrative text for each type of alert but not the exact content of the alert.

Since our unit of observation is the individual consumer, but joint account holders of the sampled consumers were also treated, the total number of people actually enrolled into alerts will have been slightly higher than the sample sizes reported in this subsection.

Trial A - Alerting customers (with or without an arranged overdraft)

We ran Trial A with Bank 2 only, for 2 months. As explained above, due to regulatory requirements all consumers in the control group were automatically enrolled in the same alerts as the treatment groups after these 2 months. To compensate for the shorter sample period, we increased the control group size for this trial.

We tested enrolment into the following 2 types of alerts:

- Alert when the consumer uses their unarranged overdraft, communicating the cut-off time for transferring funds and avoiding charges (UOD-A1).
- Alert when a scheduled payment will go unpaid due to lack of funds, communicating the cut-off time for transferring funds for a payment re-try which would avoid charges (UOD-A2).

Table 2 shows the treatments in Trial A, including sample sizes. We estimate separately the effect of automatic enrolment into both alerts, for consumers with and without an arranged overdraft facility. Caflisch et al. (2018) estimated the effects into these alerts using a natural experiment on automatic enrolment by 2 banks. Trial A presents us with an estimate from a fully randomised experiment, which can be compared with the findings presented in Caflisch et al.

Table 2: Trial A treatments

Treatment	Arranged overdraft	Alert example content	Bank 2
CONTROL-A1	Yes		n=201,356
UOD-A1	Yes	• You are now using your unarranged overdraft. Transfer funds before cut-off to avoid charges. • A scheduled payment will go unpaid. Transfer funds before cut-off to avoid charges.	n=33,605
CONTROL-A2	No		n=156,618
UOD-A2	No	• You are now using your unarranged overdraft. Transfer funds before cut-off to avoid charges. • You will incur an unpaid item today. Transfer funds before cut-off to avoid charges.	n=34,989

Notes: Reported sample sizes are numbers of consumers (excluding those treated because they held joint accounts with sampled consumers).

Trial B - Alerting customers without an arranged overdraft

We ran Trial B with both banks, on a sample of consumers without an arranged overdraft but with an unarranged overdraft facility. Since these consumers were already enrolled into the mandated alerts from Trial A, the alerts tested in Trial B were effectively early warnings for getting into unarranged overdraft or incurring unpaid items. In other words, we tested whether timely low balance warnings would be helpful in avoiding unarranged overdraft usage or impending unpaid items in the first place.

We used the banks' existing systems for sending alerts for Trial B, which meant that consumers would receive the alert at a balance level pre-set by us (but that they could

change through their alert settings). We tested automatic enrolment into low balance alerts with different balance defaults:

- An alert when the consumer's account balance goes below £100 (LOWBAL100).
- An alert when the consumer's account balance goes below £50 (LOWBAL5).

Table 3 shows the treatments run with each bank, including sample sizes. We ran treatment LOWBAL100 with both banks, allowing us to see if this alert had a similar effect across banks. In addition, comparing default balance levels (LOWBAL100 and LOWBAL50) with Bank 2 allows us to see which is more effective.

Table 3: Trial B treatments

Treatment	Alert example content	Bank 1	Bank 2
CONTROL-B		n=36,526	n=34,989
LOWBAL100	Your balance is now below £100	n=37,728	n=34,920
LOWBAL50	Your balance is now below £50		n=34,986

Notes: Reported sample sizes are numbers of consumers (excluding those treated because they held joint accounts with sampled consumers).

Trial C - Alerting customers with no overdraft facility

We ran Trial C with Bank 1 only, on a sample of consumers that had neither an arranged nor an unarranged overdraft facility. These consumers had no access to overdraft credit and would incur unpaid items charges if they attempted a transaction that would bring their account balance below zero. Since these consumers were already enrolled into the mandated alerts that warned of an impending unpaid item, the alerts we tested were early warnings to avoid unpaid items.

In this trial, we tested 2 different enrolment mechanisms:

- Automatic enrolment into an alert sent when the consumer's account balance goes below £100 (LOWBAL-OPTOUT).
- An e-mail prompt to set up low balance alerts, with no default or suggested balance level (LOWBAL-OPTIN).

Table 4: Trial C treatments

Treatment	Alert example content	Enrolment	Bank 1
CONTROL-C		N/A	n=141,153
LOWBAL-OPTOUT	Your balance is now below £100	Automatic (opt-out)	n=37,654
LOWBAL-OPTIN	Your balance is now below £X*	Prompted (opt-in)	n=141,387

Notes: Reported sample sizes are numbers of consumers (excluding those treated because they held joint accounts with sampled consumers).* = X has no default and is set by the consumer.

Table 4 shows treatments and sample sizes. In treatment LOWBAL-OPTOUT, consumers received the usual communications for automatic enrolment (an e-mail and a text message with reply functionality) into a £100 low balance alert. In treatment LOWBAL-OPTIN, consumers received an e-mail prompting them to register for low balance alerts and explaining how they could do so. The e-mail prompt did not mention a suggested balance level to set the alert at. We are interested in whether prompted enrolment allows consumers to benefit from alerts to the same extent as automatic enrolment, given that the prompting mechanism only requires action from those who want to receive alerts.

Trial D - Alerting customers with an arranged overdraft

Trial D was run with both banks, with a sample of consumers that had both an arranged and an unarranged overdraft facility. The alerts were provided to users of the arranged overdraft facility, for which no alerts are currently mandated in the UK market. Although arranged overdraft usage is typically cheaper than unarranged usage, and despite the fact that arranged overdrafts are agreed with the consumer, it is still possible that consumers slip into their arranged overdraft without noticing. The alerts tested in Trial D are intended to make consumers aware that they are using their arranged overdraft – a credit product that they are being charged for.

We tested automatic enrolment into combinations of 4 different alert types:

- An alert when the consumer's account balance goes below £100 (LOWBAL100).
- An alert when the consumer's account balance goes below £0 - the consumer has started to use their arranged overdraft facility (AOD-USE).
- An alert when the consumer's account balance is within £50 of their arranged overdraft limit (AOD-LIM).
- Two types of alerts: (i) the consumer's account balance goes below £0 and a small buffer – the consumer has started to use their arranged overdraft; (ii) further alerts for different levels of the amount borrowed through an arranged overdraft (AOD).

Table 5 shows the treatments run with each bank, including sample sizes. We ran treatment LOWBAL with both banks, allowing us to see if this alert had a similar effect across banks. We leveraged the banks' existing low balance alert functionality for LOWBAL, which means that consumers could also change the threshold balance level that triggered the alert. Also note the partial overlap between the other treatments. Differences in implementation between banks aside, participants in treatment AODUSE and AODLIM with Bank 1 effectively received 1 of the alerts from the suite of alerts tested in treatments AOD and LOWBAL&AOD with Bank 2.

Table 5: Trial D treatments

Treatment	Alert example content	Bank 1	Bank 2
CONTROL-D		n=113,520	n=33,605
LOWBAL	Your balance is now below £100	n=37,763	n=33,760
AODUSE	Your balance is now below £0		n=33,731
AODLIM	You are approaching your arranged overdraft limit		n=33,806
AOD	• You are now using your overdraft and may incur charges • You are now using £x of your arranged overdraft • You are approaching your arranged overdraft limit	n=37,728	
LOWBAL&AOD	• Your balance is now below £100 • You are now using your overdraft and may incur charges • You are now using £x of your arranged overdraft • You are approaching your arranged overdraft limit	n=37,812	

Notes: Reported sample sizes are numbers of consumers (excluding those treated because they held joint accounts with sampled consumers).

Sampling

Our unit of observation is the consumer – an individual randomly sampled without replacement from the eligible customer population. If a sampled individual held joint accounts at the bank, all other account holders were also selected for treatment (and subsequently removed from the eligible population). This avoids the situation in which only 1 joint account holder is treated, which would not be representative of the corresponding regulatory policy and could give rise to spill-over in the experimental treatment.

Eligibility for sampling was determined as follows. We agreed with the banks to exclude consumers with a deceased flag on their record, those with legal representatives (eg power of attorney), dormant accounts and those that could not be enrolled into alerts (because they have already self-registered, the bank does not hold a valid mobile number and/or e-mail address for them or they have explicitly opted out of e-mail and/or text message communications). In addition, in the interest of statistical power, we exclude consumers unlikely to benefit from alerts: those who do not incur charges for overdraft usage and unpaid items (e.g. student accounts) and those whose account balance did not fall below £1,000 in the 6 months preceding the trial.

From the population of consumers eligible for testing, banks randomly selected a sample for each treatment and control group. Bank 1 was able to stratify (block randomise) on

key pre-treatment variables.[20] Bank 2 used random sampling for treatment allocation. To ensure balanced treatment groups, both banks submitted distributional statistics for each treatment group to the FCA before the trials commenced. We verified that treatment and control groups were balanced on pre-treatment observables – see Annex 2 for more details.

Comparisons and representativeness

Comparing consumer behaviour across trials is not straightforward. For example, consumers with an arranged and unarranged overdraft (Trial D) are likely to differ from those without any overdraft (Trial C). In addition to self-selection into these features, there is selection through the banks' commercial strategy.[21] To see how participant groups differ between trials, Table 6 below shows pre-treatment averages of key variables.

Table 6: Trial samples means comparison

Trial	A1	A2	B	B	C	D	D
Bank	Bank 2	Bank 2	Bank 1	Bank 2	Bank 1	Bank 1	Bank 2
Gender	0.50	0.49	0.48	0.49	0.513	0.48	0.50
Age	45.51 (13.0)	40.28 (15.6)	47.50 (12.0)	40.21 (15.5)	34.64 (12.5)	46.32 (12.7)	45.43 (13.0)
Tenure	6.55 (7.13)	5.51 (6.38)	14.98 (6.09)	5.49 (6.37)	5.94 (4.79)	16.83 (7.48)	5.51 (7.09)
Balance	1,316 (6,063)	1,594 (5,614)	1,005 (3,594)	1,608 (5,301)	691 (2,175)	938 (3,190)	1,323 (6,009)
AOD limit	891 (914)	-	-	-	-	994 (933)	883 (899)
Mobile log-ins	9.12 (17.3)	11.02 (20.5)	12.81 (19.5)	10.94 (21.2)	19.31 (25.1)	12.81 (20.1)	9.06 (16.9)
Online log-ins	3.59 (7.66)	2.45 (7.33)	2.16 (6.09)	2.54 (6.71)	1.72 (6.56)	2.16 (5.73)	3.57 (7.54)
AOD charges	7.93 (12.43)	-	-	-	-	5.72 (13.01)	7.88 (12.38)
UOD charges	1.46 (8.20)	1.28 (7.66)	4.14 (10.14)	1.29 (7.92)	1.16 (3.05)	0.44 (1.88)	1.45 (8.06)
n	201,356	156,618	74,254	104,895	320,194	226,823	134,902

Notes: Values reported in cells are means, standard errors in parentheses. Gender is binary (1=female); age and tenure reported in years; remaining variables are monthly totals averaged over the 6 months pre-treatment period.

[20] Arranged overdraft limit, median account turnover in last 6 months, total overdraft charges in last 6 months, mean account balance in last 6 months, total mobile app usage in last 3 months, gender, age and tenure.

[21] Generally speaking, banks are more likely to offer overdraft facilities to those with higher credit scores. In addition, banks will have different policies (that may be product specific) with respect to how overdraft facilities are structured and offered.

As Table 6 shows, there are few dramatic differences between trial populations on observables. Consumers without arranged overdraft limits are younger on average, and correspondingly are more likely to use mobile banking. Consumers in Trial C, who do not have any type of overdraft facility, are the youngest group on average. The participant samples in Trial B and D are generally similar across the 2 banks, although the Bank 2 samples are younger on average and have higher average balances. Consumer samples with arranged overdraft facilities pay higher total charges across both banks; of those without an arranged facility, consumers in Trial B with Bank 1 pay the highest overdraft charges.

It is also instructive to compare our trial samples to the wider PCA market. Table 71 (Annex 6) shows the means of the Table 1 variables in a nationally representative dataset collected by the FCA in 2017. This dataset is comprised of a random sample of 250,000 consumers for each of the 6 largest UK PCA providers for 2015-2016. For comparability, we calculated averages for the last 6 months of the representative dataset (i.e. the last 6 months of 2016). A comparison between the 2 tables shows that our trial samples are younger than the representative dataset and have correspondingly lower tenure. Online logins in the 2 samples are similar, but mobile logins are higher in our sample; the latter difference may partly reflect the time 6-month time difference between the 2 samples. Unsurprisingly given our sampling strategy, average balances in our sample are lower and arranged overdraft charges are higher. Unarranged overdraft charges (including unpaid and paid item charges) are similar.

Outcome variables

Our main outcome variable is total overdraft charges: arranged overdraft fees, unarranged overdraft fees and unpaid item fees. In addition to total charges, we also report the effects on these types of fees separately (subsuming unpaid item fees in unarranged overdraft charges).

Heterogeneous treatment effects

Our heterogeneous treatment effects focus on the treatment effects for consumers who incur different levels of average monthly total charges in our pre-treatment period, based on the notion that past charges are reliable predictors of future charges. For each trial, we create 3 groups of consumers:

- **Rare**: consumers that incurred no charges in the pre-treatment period.
- **Occasional**: consumers that incurred less than the median of charges in the pre-treatment period, conditional on being charged.
- **Heavy**: consumers that incurred more charges than the median of charges in the pre-treatment period, conditional on being charged.[22]

Secondary outcomes

In addition to total charges, we also estimate the effects of treatment on secondary behavioural outcomes. We chose our secondary outcome variables based on the specific behaviours that we hypothesise could be affected by our treatments or that could be driving the reduction in preventable bank charges. We look at: measures of monthly

[22] Customers incurring the median charge, conditional on being charged, are allocated to the Heavy group.

consumer spending, transfers and the sizes of account buffers: debit turnover, credit turnover, minimum monthly balance and mobile and online banking log-ins.

We also look at the number of customer-initiated credit transfers per month to check if accounts are being topped up more (if these amounts are sufficiently small then they may go undetected by looking only at credit turnover). We also observe outcomes for unarranged and arranged overdrafts separately: amount of charges, number of 1 day spells and total number of spells. Finally, we look at the monthly average implied daily interest rate as a measure of value for money for those who are using their overdraft.

Survey

Finally, we ran a telephone survey on 4,007 participating consumers across both banks (*n*=2,956 in treatment groups, *n*=1,051 in control groups) at the end of the trial period. In this survey, we capture outcomes that cannot be inferred from observational data: subjective financial well-being, awareness of overdraft charges and alerts, the actions consumers took after receiving alerts and, importantly, their attitudes towards automatic enrolment. Where individual survey participants agree to, we also anonymously match their survey responses back to their detailed transaction data from the bank.

Econometric specification

We estimate treatment effects using analysis of covariance methods, as discussed in Burlig, Preonas and Woerman (2017). These regression specifications include only post-treatment observations and control for the pre-treatment level of the outcome variable at the individual level (we use the 6 months prior to our experiment). We additionally control for time fixed effects. Each observation measures consumer i at time $t > 0$:

$$Y_{i,t} = Treatment_{i,t}\,\beta_1 + \overline{Y}_{\,i,t<0}\,\beta_2 + \theta_t + \varepsilon_{it}$$

where $Y_{i,t}$ is the outcome variable (e.g. total charges) for individual $\boldsymbol{i}$ in month $\boldsymbol{t}$, $Treatment_{i,t}$ is an indicator for the relevant treatment group, $\overline{Y}_{\,i,t<0}$ is the mean of the outcome variable for customer $\boldsymbol{i}$ in the 6-month pre-treatment period and θ_t are calendar-month fixed effects. Standard errors are clustered at the consumer level.

In our tables of results, we report a baseline for each regression. The baseline is calculated as the mean of the outcome variable for the control group during the experiment - this can be interpreted as the mean outcome absent treatment. We also report a percentage effect, which is the treatment effect divided by the baseline.

Procedure

After initial conversations about the banks' operational constraints and technology, we presented a shortlist of alerts for testing to the banks. The final set of treatments tested was then agreed with both banks separately, based on such factors as the size of the consumer population available for testing, the banks' communications technology and the FCA's twin objectives of (i) testing all treatments on our shortlist and (ii) running the same trial with both banks where possible. The final set of treatments, trial dates and sample sizes was agreed with each bank in a 'Terms of Reference' document signed by the bank and the FCA.

In line with established FCA procedures, we conduct an ethical review of our research considering the rights, welfare and dignity of individuals, benefits to society and whether there are specific aspects of the research that heighten risks.[23] This review agreed to proceed with the research as planned.

After sampling was complete and agreed between each bank and the FCA, both trials started in early November 2017. At the start of the trials, both banks communicated automatic enrolment to those customers that would now be receiving alerts. As previously discussed in the enrolment section, Bank 1 also allowed its customers to opt out via responding to a text message within a 2-day window at the start of the trial.

To enable us to carry out the telephone survey, both banks shared the contact details of a limited number of randomly selected trial participants directly with a market research agency employed by the FCA. The agency conducted interviews of circa 10-15 minutes with respondents. Each respondent was specifically asked for consent to link their survey responses to the observational data collected from the banks. 72.4% of Bank 1 respondents and 73.7% of Bank 2 respondents gave their consent. We report aggregate survey findings for the entire population of respondents. We only link responses to observational data for those who gave their consent (using anonymised unique participant identifier codes).

At the end of the 5-month trial period, both banks shared anonymised trial participant data with the FCA on account and consumer characteristics, transactions and balances, internet and mobile log-ins for the 6 months preceding the trial and the 5 months of the trial. Since overdraft and unpaid item charges are only incurred after the end of a consumer's billing cycle plus some delay, we constructed our main measures of charges by combining transaction behaviour with detailed information on charging models received from the banks. Our approach is thus to infer charges from behaviour, rather than use the charges actually deducted from the account. This approach allows us to estimate treatment effects on consumers' marginal charges per trial month.[24] As a robustness check, we also run our analysis using actual charges. Annex 3 compares our measure of inferred charges with actual charges and presents estimates of treatment effects on actual charges.

[23] See FCA (2018b): When and how we use field trials.

[24] Charges are allocated to the monthly billing cycle in which they occur, with consumers having different billing cycle start dates (typically the mensiversary of their account opening date). Banks also apply monthly caps for certain types of charges. Our approach sums daily marginal charges – taking caps into account – and allocates them to the trial month they occurred in. We infer overdraft usage from account balances and we observe unpaid items directly in the transactional data. Note that we do not observe rescinded charges (eg a consumer complained to their bank and the bank agreed to waive some charges), which may lead us to slightly overestimate the charges.

5 Results

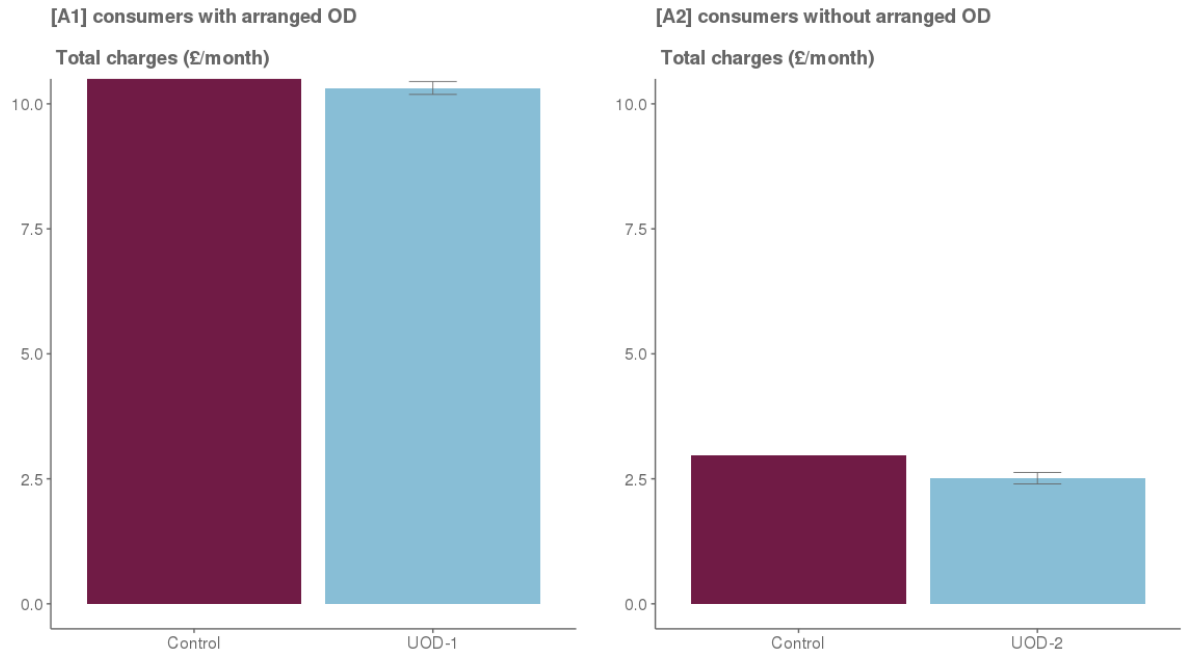
This section contains our estimates of the effects of our treatments. We present all of our results for each trial separately, with results broken down by average treatment effects for total charges, heterogeneous treatment effects, effects on secondary outcome variables and survey responses.[25] For the average treatment effect, where applicable, we also report the contribution of arranged overdraft and unarranged overdraft charges to the treatment effect. Where we report unarranged overdraft charges, this also includes unpaid and paid item charges.

Trial A

Treatment effect on total charges

Figure 4 shows the results of Trial A, representing the treatment coefficient estimate in Table 32 (Annex 3) versus baseline total overdraft charges in the control group. We find that automatically enrolling consumers into unarranged overdraft and unpaid item alerts has a material impact on total charges incurred at Bank 2. In Trial A1, for consumers with an arranged overdraft facility, we find that total charges are reduced by 3.7% (-£0.39 per month). In Trial A2, for consumers without an arranged overdraft facility, total charges are reduced by 18.0% (-£0.46 per month). Note that the absolute effect sizes are strikingly similar in both groups.

Figure 4 - Trial A at Bank 2 - Impact on total charges



Notes: Control level is Baseline and treatment effect shown is the Treatment coefficient in Table A32 in Annex 3. Error bars show 95% confidence interval.

[25] Note also that we present a simple comparison of post-treatment mean charges in Table 27 (Annex 3).

The difference between the relative effect sizes can be explained by the fact that consumers in Trial A2 cannot incur any arranged overdraft charges. In Trial A1, the savings due to alerts are almost entirely driven by a reduction in unarranged overdraft charges. When we test the impact separately for unarranged and arranged overdraft charges, we find that unarranged charges are reduced by 13% (-£0.36) whereas we do not find a statistically significant effect for arranged charges (Tables 33 and 34, Annex 3). In Trial A2, unarranged overdraft and unpaid item charges are the only charges that the consumer can incur, so they account for the entire £0.46 per month reduction.

Our estimated reductions in charges are slightly higher in absolute terms, but are slightly lower as a percentage of unarranged overdraft charges than those obtained by Caflisch et al. (-£0.34 per month or a 26% reduction) in a natural experiment of automatic enrolment into the same 2 alerts at a different bank. This difference may be due to differences in timing, bank-specific effects or sampling: the sample in Caflisch et al. is broadly representative of the PCA market, whereas our experimental sample is designed to include a higher proportion of consumers incurring charges. Note also that the Caflisch et al. estimates were obtained on a mixed sample of consumers with and without arranged overdrafts.

Heterogeneous treatment effects

Tables 62-64 (Annex 5) summarise the findings on total charges for consumers with different types of usage. For Trial A1, we find that rare overdraft users do not appear to benefit from the alerts, consistent with the view that these consumers rarely receive these alerts – if they use any overdraft, they are more likely to use arranged overdrafts. Medium and heavy users both benefit substantially (6% and 4% reductions), although the high baseline (£30.00) for heavy users shows that these consumers still incur substantial charges after being automatically enrolled in the alerts.

For Trial A2, we find that rare users benefit the most in relative terms (28% reduction), medium users do not benefit and heavy users benefit substantially (9% reduction). Due to high baseline charges (£19.00) for heavy users, the smaller relative reduction in chargers is due to a larger absolute reduction in charges, similar to the findings reported in Caflisch et al..

Treatment effect on secondary outcomes

Remarkably, we find that the reduction in charges for consumers in trials A1 and A2 come with few changes in observable behaviour. As shown in Tables 45-48 (Annex 4), we find no evidence of changes to debit or credit turnover, number of transfers into the account, minimum balances or digital banking activity. Surprising as these findings may be, they are in line with findings from Caflisch et al. It may be possible that these alerts are helping consumers reduce their charges through better timing of their activity rather than more or less activity.

We did, however, find that automatic enrolment into alerts reduced the number of unarranged overdraft episodes that consumers are charged for (when they last longer than the 1-day grace period) by 8% in Trial A1 and A2. In both cases, part of this decrease is explained by an increase in 1-day unarranged overdraft spells, which do not incur a charge due to the grace period. These findings, which are consistent with the findings in Caflisch et al., therefore suggest that an important part of the reduction in

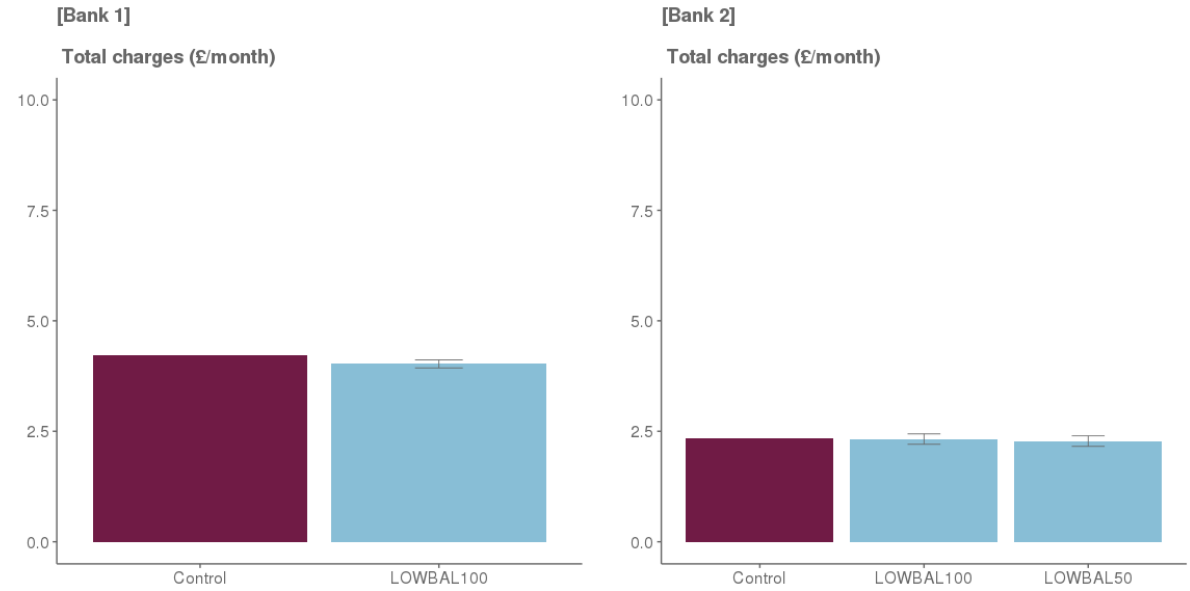
charges is due to consumers transferring money to their account during the grace (or retry, in the case of unpaid items) period.

Trial B

Treatment effect on total charges

Figure 5 shows the results of Trial B for both banks, representing the treatment coefficient estimates in Table 27 and Table 35 (Annex 3) versus baseline total overdraft charges in the control group. At Bank 1, we find that automatically enrolling consumers into a £100 low balance alerts (LOWBAL100) reduces total charges by 4.6% (-£0.20 per month). By contrast, at Bank 2 we do not find a statistically significant effect for the same treatment (LOWBAL100) on total charges. We also find that at Bank 2 a £50 low balance alert (LOWBAL50) has no statistically significant effect. Since consumers in Trial B did not have an arranged overdraft facility, the measured reductions are in unarranged overdraft charges (including charges for paid and unpaid items).

Figure 5 - Trial B at Banks 1 and 2 – Impact on total charges



Notes: Control level is Baseline and treatment effect shown is the Treatment coefficient in Tables A27 (left panel) and A35 (right panel) in Annex 3. Error bars show 95% confidence interval.

The difference in alert effectiveness between banks is surprising, given that the low balance alerting functionality of both banks is very similar. One explanation could be that either self-selection into or bank policy towards overdraft products differs between the banks, leading to different types of consumers ending up with only an unarranged overdraft. Outcomes in control group and the pre-treatment data suggests there may be some merit to this argument: the sample of consumers for Bank 1 has higher charges, higher account turnover and is older than the Bank 2 consumer sample.

Heterogeneous treatment effects

Tables 53-55 (Annex 5) summarise the findings on total charges for Bank 1 consumers with different types of usage. We find that the £100 low balance alerts was effective for

both the rare and medium usage groups (16% and 17% reductions in total overdraft charges, respectively), whereas heavy overdraft users do not benefit.

In line with the lack of an average treatment effect for Bank 2, we find that the 81% of consumers who are rare users do not benefit from either the £100 or the £50 low balance alert (Tables 65-67, Annex 5). However, occasional users benefit from both alerts (12%-15%) and heavy users benefit from the £100 alert.

Treatment effect on secondary outcomes

In line with our main findings of limited impact on total charges, we find little or no evidence of changes to debit or credit turnover, number of transfers into the account, minimum balances or digital banking activity.[26] This is the case for both banks, with our findings reported in Annex 4: Tables 40 and 41 for Bank 1 and Tables 49 and 50 for Bank 2.

We do find evidence that the alerts changed the number of unarranged overdraft episodes. For Bank 1, we find that the number of episodes of any duration decreases (Table 41). This suggests that the low balance alert in LOWBAL100 is having the intended effect of helping people avoid unarranged overdraft usage altogether – in contrast to the "grace period" alerts from Trial A, which work by reducing the number of episodes longer than the 1-day grace period. For Bank 2, we find a similar effect for the LOWBAL50 treatment, although this does not lead to a significant reduction in unarranged overdraft charges. This is likely due to the relatively small reduction and lower baseline level of unarranged overdraft charges for Bank 2.

Trial C

Treatment effect on total charges

Figure 6 shows the results of Trial C, representing the treatment coefficient estimate in Table 28 (Annex 3) versus baseline total overdraft charges in the control group. As explained earlier, Trial C was run with Bank 1 customers who had no overdraft facility and could therefore only incur unpaid items charges. We find that automatically enrolling consumers into £100 low balance alerts (LOWBAL-OPTOUT) does not reduce charges. That is, we find no statistically significant effects on charges.

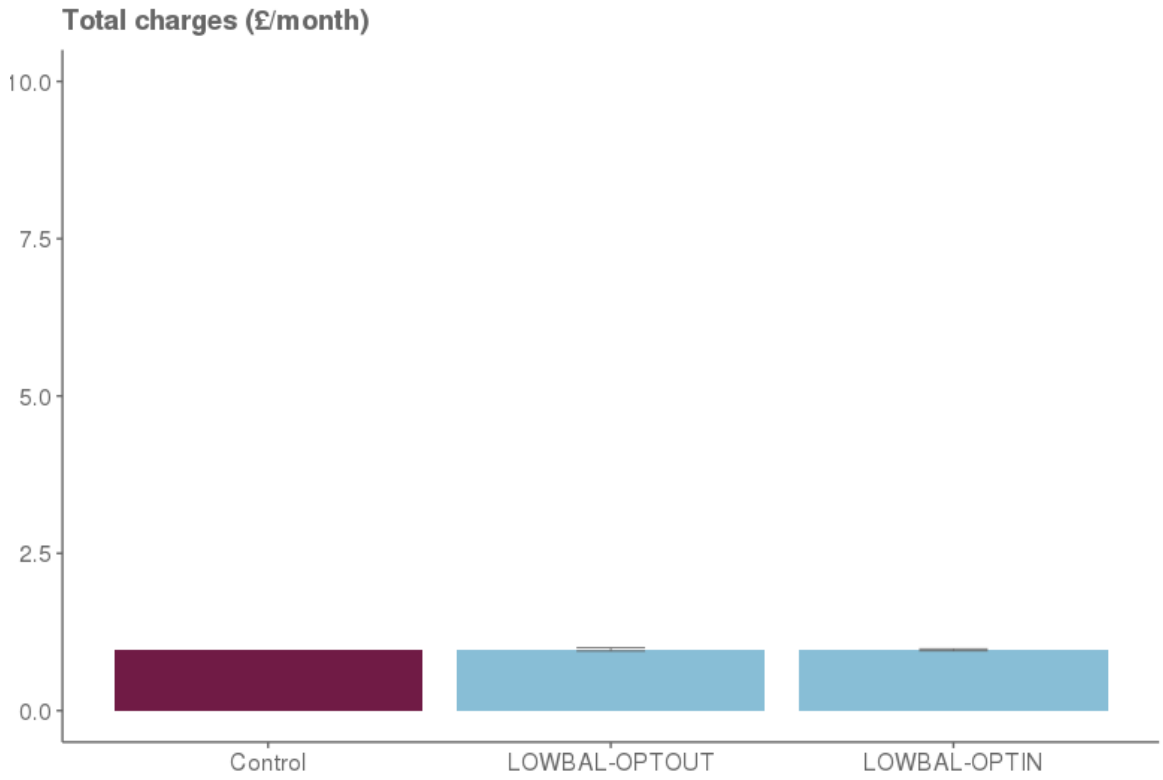
If, instead of automatically enrolling consumers into these alerts, we prompt consumers to opt in to these alerts (treatment LOWBAL-OPTIN), we also find no statistically significant effect on total charges. 9.1% of those prompted subsequently signed up for a low balance alert.

For this treatment we also estimated the effect of actively signing up to low balance alerts, by using instrumental variable estimation (see rightmost column of Table 28). We instrumented signing up to these alerts with exogenous treatment assignment to estimate the effect. Similarly, we find no statistically significant effect of signing up to these £100 low balance alerts on total charges. These results show that neither the average consumer, nor the 9% susceptible to prompts, benefit from the alert. Unfortunately, this does not help us understand whether those who could benefit most from an alert are those who disproportionately respond to prompted enrolment

[26] In fact, at Bank 2 there is *some* evidence for an effect on digital activity, but it is inconsistent across alerts and digital platforms and of low statistical significance.

campaigns, because it is possible that this alert was not beneficial for any consumers in the trial.

Figure 6 - Trial C at Bank 1– Impact on total charges



Notes: Control level is Baseline and treatment effect shown is the Treatment coefficient in Table A28 in Annex 3. Error bars show 95% confidence interval.

Heterogeneous treatment effects

Tables 56-58 (Annex 5) summarise the findings on total charges for Bank 1 consumers with different types of usage. In line with the lack of an average treatment effect, we find no evidence that any of the usage type groups benefits from being automatically enrolled or prompted to enrol into the low balance alert.

Treatment effect on secondary outcomes

In line with the lack of an effect on our main outcome variable, we find no statistically significant effects on debit or credit turnover, number of transfers into the account, minimum balances, digital banking activity, or any other secondary outcome in Trial C (Table 42, Annex 4).

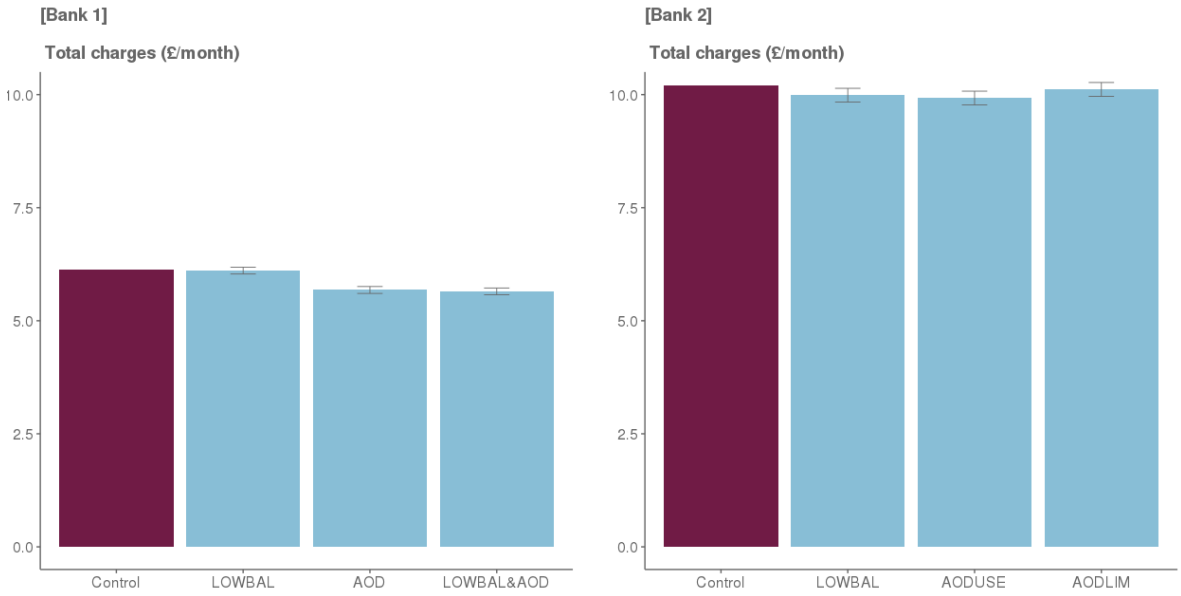
Trial D

Treatment effect on total charges

Figure 7 shows the results of Trial D, representing the treatment coefficient estimates in Tables A29 and A26 (Annex 3) versus baseline total overdraft charges in the control group. This trial was conducted with consumers with an arranged overdraft facility, for both banks.

Automatically enrolling consumers of Bank 1 into a suite of arranged overdraft alerts (AOD) reduces total charges by 7.3% (-£0.45 per month) and this reduction is driven entirely by a reduction in arranged overdraft charges (Table 30, Annex 4). As the reader might recall, the suite included not only an arranged overdraft usage alert but also further alerts for different levels of the total amount borrowed. There is no additional effect from enrolling these consumers into the suite and low balance alerts at the same time (treatment LOWBAL&AOD).

Figure 7 - Trial D at Banks 1 and 2 - Impact on total charges



Notes: Control level is Baseline and treatment effect shown is the Treatment coefficient in Tables A29 (left panel) and A36 (right panel) in Annex 3. Error bars show 95% confidence interval.

We did not test the same suite of alerts with Bank 2, but we did test 2 separate alerts that correspond to alerts in the AOD suite (AODUSE and AODLIM). We find that the initial arranged overdraft usage alert is effective as a stand-alone alert at Bank 2: automatic enrolment into this alert reduced total charges by 2.7% (-£0.28 per month) and this reduction is entirely driven by lower arranged overdraft charges (Table 37, Annex 3). Arranged overdraft usage alerts thus lead to the largest absolute reductions in total charges in our experiment (excepting the results from Trial A on the alerts already mandated). We do not find evidence of the effectiveness of the near-limit alert, however: the treatment coefficient for automatic enrolment into this alert is not significantly different from zero.

In sum, we find that the alerts tested in Trial D work by reducing arranged overdraft charges only. For all alerts tested in Trial D, we find no effects on unarranged overdraft charges. By contrast, we find that AOD at Bank 1 reduced arranged overdraft charges by 7.7% (-£0.45 per month), LOWBAL at Bank 2 reduced arranged charges by 2.4% (-£0.20 per month) and AODUSE at Bank 2 reduced arranged charges by 3.4% (-£0.30 per month). These reductions effectively correspond to the absolute reductions in total charges.

Heterogeneous treatment effects

Tables 59-61 (Annex 5) summarise the findings on total charges for Bank 1 consumers with different types of usage and Tables 68-70 summarise the findings for Bank 2. For the treatments that showed no significant average treatment effect, we find no significant effects on total charges for the usage type groups either.

For the treatments that did show an effect, we find similar patterns across both banks: in all but 1 case, absolute benefits from alerts increase across usage groups, but less than proportionally with baseline charges so that the percentage fee reduction decreases. The exception is for heavy users at Bank 2, who show no evidence of any benefit at all. In this case the difference is especially striking for the arranged overdraft usage alerts, where rare users at Bank 2 save a quarter (-23% in AOD-USE) of charges due to auto-enrolment in alerts, whereas heavy users in this treatment saves nothing and continues to pay an average of more than £27 per month in total overdraft charges.

Treatment effect on secondary outcomes

Unlike the other trials, we find some effects on secondary outcomes for Trial D (Tables 43-44 and 51-52, Annex 4). First there is some evidence that particular alert combinations may raise mobile banking logins or minimum balances. However, the evidence is inconsistent across banks and alert combinations, so cannot be interpreted with confidence.[27]

Second, and with more confidence, we can shed some light on the mechanism by which consumers are managing to reduce their arranged overdraft charges. At both banks, all treatments that were found to be effective at reducing charges also have the following 2 effects: (i) The number of consumer-initiated transfers slightly increases following automatic enrolment (0.8-1.5%); (ii) The number of charged arranged overdraft episodes of 1-day duration and the number of 1 day or longer duration both decrease following automatic enrolment. For treatment LOWBAL with Bank 2, the number 0-day overdraft episodes also decrease, suggesting this treatment works by helping consumers avoid arranged overdraft usage altogether. For other treatments, the number of 0-day overdraft episodes increase, suggesting that these alerts work by helping consumers make timely transfers to resolve an arranged overdraft position before the end of the day.

Participant survey

We now turn to findings from our participant survey, which we conducted with both banks at the end of the trial period. The survey was designed to answer questions that could not be answered with transactional data: knowledge and awareness of overdraft charges, subjective financial wellbeing, attitudes towards and non-financial costs imposed by automatic enrolment (e.g. alert fatigue) and self-reported responses to alerts. We deliberately over-sampled consumers in treatment groups and consumers that had received alerts during the trial period; to correct for these biases and a potential bias introduced by self-selection into the survey, all the numbers reported below are re-

[27] Mobile bank log-ins appear to increase with Bank 2's LOWBAL and AOD-LIMIT alerts but not the AOD_USE alert. Nearly the opposite is found at Bank 1, where mobile banking logins increase with Bank 1's AOD-SUITE alerts, but only if they are not combined with the LOWBAL alert. We also find that treatment AOD-SUITE at Bank 1 encouraged consumers to keep a slightly higher minimum balance, but only when the AOD-SUITE alerts are paired with the low balance alert, despite the fact that the low balance alert yields no incremental reduction in charges.

weighted back to the full sample (per trial, per bank) based on key pre-treatment observables.[28] Since re-weighting requires us to link survey responses to transactional data, we use for our analysis only the data of respondents that gave us consent to do so (72.4% for Bank 1 and 73.7% for Bank 2).

Since we ran Trial A for the first 2 months of our 5-month experimental period, consumers in both treatment and control groups had been automatically enrolled into the alerts by the time we surveyed consumers for this trial. We therefore report average responses for all treatments and control groups together, giving us a total sample size of 473 respondents for Trial A (249 in A1, 224 in A2). In Trial B, we surveyed 205 control group respondents and 582 treatment group respondents. In Trial C, we surveyed 96 control group respondents and 395 treatment group respondents. In Trial D, we surveyed 220 control group respondents and 1,173 treatment group respondents.

Knowledge and awareness

Our survey echoes previously reported findings that respondents' knowledge of overdraft charges is generally low.[29] The third, fifth and seventh columns of Table 7 summarise the percentage of correct answers per trial as weighted mean of all respondents, showing that when we ask respondents how much it would cost them to be in overdraft for a day, or how much a single unpaid item would cost, the vast majority cannot provide a correct answer. This is despite both banks charging flat fees in all 3 cases.

Table 7: Knowledge of overdraft charges

Trial	Bank	Arranged OD		Unarranged OD		Unpaid item	
		All	Recent charge	All	Recent charge	All	Recent charge
A1	2	21.6%	22.6%	6.6%	19.2%	3.9%	8.2%
A2	2	N/A	N/A	6.3%	11.8%	8.9%	11.1%
B	1	N/A	N/A	10.5%	23.2%	6.5%	13.9%
B	2	N/A	N/A	2.3%	1.1%	4.2%	12.2%
C	1	N/A	N/A	N/A	N/A	13.7%	37.6%
D	1	12.1%	16.0%	1.9%	1.2%	13.2%	37.7%
D	2	32.4%	37.2%	3.3%	4.8%	2.1%	7.5%

Notes: Weighted percentages of survey respondents in each trial that correctly answered the questions "How much would your bank charge you if you dipped into your arranged overdraft by £100 for one day?" (Arranged OD), "How much would your bank charge you if you dipped into your unarranged overdraft by £50 for one day?" (Unarranged OD) and "How much would your bank charge you for a single unpaid transaction?" (Unpaid item). The recent charge sub-sample consists of people that incurred a charge (of the relevant type) in the three months before the survey.

When we restrict the sample of respondents to those who have incurred the relevant fee in the 3 months before the survey (i.e. the last 3 months of the trial), the rates of correct answers are substantially higher. This can be seen in the fourth, sixth and eighth column

[28] Age, gender and average balance.

[29] CMA 2016 retail market investigation; Atticus Consumer research on overdrafts (2018).

of Table 7 – the percentage of correct answers is much higher for this sub-sample than for the total sample of respondents.

Subjective financial well-being

Our financial wellbeing questions capture 2 aspects of day-to-day money management: 3 items from the UK Wealth and Asset Survey (WAS) that provide a self-reported measure of money management issues and 3 items from Netemeyer, Warmath, Fernandes and Lynch (2017) that measure the amount of stress associated with money management. We construct a composite measure for money management issues from the WAS items, capturing whether the respondent considers keeping up with repayments a heavy burden, struggles to keep up with repayments and/or runs out of money "always" or "most of the time" at the end of the month. We also construct a composite measure for money management stress, that indicates whether the respondent says 1 of the 3 items describes them 'completely' or 'very well'.[30]

Using weighted logistic regression of the measures above on a treatment indicator, we can statistically compare treatment and control groups on financial wellbeing. We find no differences between the treatment and control groups on either money management issues or stress (all coefficient tests $p>0.1$). Since the financial wellbeing questions were asked at the start of the survey, before any mention of overdraft alerts, these findings provide evidence that there is no difference in financial wellbeing between participants in treatment and control groups.

Attitudes towards automatic enrolment

In addition to knowledge and financial wellbeing questions, we also asked respondents in trials B, C and D about their attitude towards auto-enrolment into the alert. The response was positive: 68.6-77.8% of respondents in the treatment groups agreed that their bank should offer the alerts automatically, with 20.7-27.8% of respondents saying they would prefer to be given the opportunity to register themselves. The most popular alert was the overdraft usage alert, which was favoured for automatic enrolment by 77.8% and 71.2% of Bank 1 and Bank 2 respondents, respectively.

We also asked treatment group respondents in trials B, C and D whether they liked or disliked the alerts and whether the alerts were perceived as helpful or unhelpful. Again, the responses were broadly supportive of alerts. Only 3.8-7.3% of respondents reported they disliked the alerts (versus 55.6-64.5% responding they liked the alerts) and 1.8-4.7% found the alerts unhelpful (versus 83.7-90.0% responding the alerts were helpful). We additionally asked these respondents what they thought of the frequency of alerts. The vast majority of respondents (86.3-90.7%) found the alert frequency "about right", with only 2.4-5.0% reporting they received the alerts too often.

Of particular interest are those respondents who opted out of the alerts during the experiment. We asked these respondents what their reasons were for opting out, distinguishing between whether the respondent found the alerts simply not useful or incurred some psychological cost from receiving the alerts (i.e. received too many alerts, was irritated by the alerts, or felt anxious or embarrassed due to the alerts). We find that the majority of those opted out (67.4-79.4%) did so because they did not find the alerts useful, with a minority (20.6-32.6%) reporting they opted out because they incurred

[30] The items used were "My financial situation controls my life"; "Whenever I feel in control of my finances, something happens that sets me back" and "I am unable to enjoy life because I worry too much about money".

some kind of psychological cost from receiving the alerts. It is worth noting that many of the respondents that opted out mentioned online or mobile banking as the main reason they had no use for the alerts.

Responses to alerts

Finally, we asked respondents in Trial B, C and D treatment groups what actions they after receiving an alert. The responses of those who said they remembered receiving an alert and taking action are reported in Table 8. Note that multiple answers were possible so the values in each row sum to more than 100%.

Table 8: Action taken after receiving alert

Trial	Bank	Transferred money from savings	Let a bill go unpaid	Cut back on spending	Borrowed from friends, family, employer	Used their credit card	Other formal borrowing
B	1	60.6%	14.0%	43.6%	24.6%	5.8%	0.0%
B	2	51.4%	6.8%	40.0%	33.5%	2.4%	3.2%
C	1	55.2%	20.5%	48.5%	43.9%	3.2%	6.6%
D	1	60.3%	11.8%	37.3%	29.8%	3.1%	4.6%
D	2	60.5%	7.1%	29.2%	25.2%	2.3%	3.9%

Notes: Weighted percentages of survey respondents in treatment groups who said they had taken action after receiving an alert.

The most common actions taken, across all treatments, are transferring money from savings, cutting back on spending and borrowing informally. Much less important are prioritising the avoidance of overdraft over a household bill and using alternative formal sources of credit.

Further analysis

Opt-outs and opt-ins

As shown in the left half of Table 9, opt-out rates for automatic enrolment treatment are similar within banks but substantially larger at Bank 1 than Bank 2. For Bank 1, opt-out rates range between 7% and 10%; for Bank 2, they cluster around 1%. The higher opt-out rates for Bank 1 are not surprising, given that customers of this bank could opt out by simply replying to a text message at the start of the enrolment period. Indeed, opt-outs by text message represent 94.2% of all opt-outs in Bank 1's automatic enrolment treatments. This means that less than a percent of those auto-enrolled by Bank 1 opted out through changing their alert settings, only slightly below the proportion of Bank 2 customers that opts out (by changing their settings).[31] These patterns show that (i) the ease with which consumers can opt out strongly affects opt-out rates and (ii) the vast majority of consumers remain opted in to the alerts, even when opting out is easy.

[31] For Bank 2, changing alert settings was the only available opt-out mechanism. Not reported in the table is the proportion of consumers changing the level of the low balance alert, which is remarkably similar across treatments at 0.5-0.6%.

The right half of Table 9 shows opt-in rates for all control treatments and the prompted enrolment treatment in Trial C. If a consumer opts in to any of the alerts tested in the respective trial, we count this as an opt-in. In general, we observe low opt-in rates in the control treatments during our experiment (0.0%-0.4%). One possible explanation for the low opt-in rates is that consumers who value alerts had already opted in prior to our observation window – these consumers were excluded by design from our experiment. This seems unlikely to be the full story, however: we would expect opt-out rates in the automatic enrolment treatments to be much higher if consumers in our trials did not value the alerts. Furthermore, our experiment is hardly targeting a niche population of inert consumers: Caflisch et al. (2018) find that only 3-8% of consumers in the UK market had registered for alerts out of their own volition by 2015, meaning that inaction with regards to alert registration is widespread.

Table 9: Opt-in and opt-out rates

Opt-out rates				**Opt-in rates**			
Trial	Treatment	Bank 1	Bank 2	Trial	Treatment	Bank 1	Bank 2
A	UOD-1		0.5%	A	CONTROL-A1		<0.1%
A	UOD-2		0.7%	A	CONTROL-A2		<0.1%
B	LOWBAL100	8.3%	1.1%	B	CONTROL-B	0.4%	0.2%
B	LOWBAL50		1.0%				
C	LOWBAL-OPTOUT	9.5%		C	CONTROL-C	0.4%	
				C	LOWBAL-OPTIN	9.1%	
D	LOWBAL	9.8%	1.7%	D	CONTROL-D	0.4%	0.4%
D	AODUSE		1.5%				
D	AODLIM		0.6%				
D	AOD	6.9%					
D	LOWBAL&AOD	7.9%					

Tables 10 and 11 show the pre-treatment means of key variables for those who opted out compared to those who stayed in, as well as those who opted in after prompted enrolment in treatment LOWBAL-OPTIN with Bank 1. So as not to confuse selection with treatment, we present statistics on the pre-treatment period only.

Considering the difference between those who opted out and stayed in, the data for trials B, C and D shows a pattern: consumers that opt out are more likely to be male, have slightly longer tenures, have substantially lower average balances, are more frequent users of digital banking and incur higher levels of charges. By contrast, opt-outs in Trial A do not show such clear differences. Interestingly, those opting out in Trial A have higher, instead of lower balances.

Table 10: Pre-treatment means by opt-out/in status, Bank 1

	Trial B		Trial C (opt out)		Trial C (opt in)		Trial D	
	Stayed in	Opted out	Stayed in	Opted out	Opted in	Stayed out	Stayed in	Opted out
Gender	0.48	0.43	0.52	0.46	0.50	0.51	0.49	0.46
Age	47.40 (11.9)	49.32 (12.9)	34.41 (12.3)	36.21 (13.9)	36.71 (13.5)	34.38 (12.4)	46.11 (12.6)	49.64 (13.7)
Tenure	15.01 (6.05)	15.34 (6.31)	5.91 (4.77)	6.19 (4.83)	5.91 (4.82)	5.94 (4.79)	16.80 (7.45)	17.10 (7.74)
Balance	1,045 (3646)	662 (1868)	741 (2657)	455 (1488)	742 (1737)	681 (1574)	969 (3403)	640 (2938)
AOD limit	-	-	-	-	-	-	987 (921)	1050 (1002)
Mobile log-ins	10.19 (18.3)	16.81 (24.5)	18.61 (24.5)	27.61 (18.3)	21.40 (24.6)	19.10 (24.6)	12.49 (19.3)	18.22 (24.5)
Online log-ins	2.17 (6.11)	2.75 (7.29)	1.71 (7.29)	1.75 (6.11)	1.56 (5.38)	1.73 (6.75)	2.11 (5.32)	2.61 (7.01)
AOD charges	-	-	-	-	-	-	5.40 (12.6)	8.83 (16.5)
UOD charges	4.02 (9.78)	5.12 (11.6)	1.13 (11.6)	1.16 (9.78)	1.12 (2.90)	1.15 (2.98)	0.42 (1.78)	0.49 (1.95)

Notes: Values reported in cells are means, standard errors in parentheses. Gender is binary (1=female); age and tenure reported in years; remaining variables are monthly totals averaged over the 6 months pre-treatment period.

Note also that there are no meaningful differences in charges between those who opted in and those who did not in Trial C, both for the automatic enrolment treatment (LOWBAL-OPTOUT) and the prompted enrolment treatment (LOWBAL-IN). The only slight difference is average balance level – those who either stayed in or opted in hold slightly higher average balances in their accounts. Crucially, the different groups of consumers in this trial have very similar levels of charges.

Consumers' preferences for alert thresholds

Many of our experimental treatments rely on the banks' existing low balance alerting functionality. Consumers can change the balance level that triggers the alert, either after they have been automatically enrolled into the alert with a default level (treatment groups) or when they first register for the alerts (control groups and treatment LOWBAL-OPTIN in Trial C). It is helpful to look at the thresholds that consumers set for themselves, as it gives us an idea of how consumers perceive the default threshold levels.

First, we note that changes to the alert thresholds are very rare in our treatment groups. Of those who were automatically enrolled some sort of low balance alert, only 0.1% of Bank 1 participants and 0.5% of Bank 2 participants made a change to the alert

threshold. The difference between the banks is perhaps not surprising, given that Bank 1 customers had an easy opt-out opportunity at the start of the trial. The majority of threshold changes (80.4%) are reductions of thresholds below the default level. An interesting comparison is treatments LOWBAL50 and LOWBAL100 with Bank 2 in Trial B, especially given the similar opt-out levels for these treatments (see Table 9). The treatments have similar percentages of threshold changes (0.5% and 0.6%, respectively) and similar numbers of participants changing between threshold levels of £50 and £100.

Table 11: Pre-treatment means by opt-out/in status, Bank 2

	Trial A1		Trial A2		Trial B		Trial D	
	Stayed in	Opted out	Stayed in	Opted out	Opted in	Stayed out	Stayed in	Opted out
Gender	0.50	0.54	0.49	0.53	0.49	0.42	0.49	0.48
Age	45.52 (13.0)	44.50 (14.8)	40.31 (15.5)	41.18 (17.1)	40.18 (15.5)	40.50 (15.4)	45.44 (13.0)	45.12 (12.1)
Tenure	6.56 (7.13)	4.90 (5.84)	5.53 (6.39)	4.05 (5.26)	5.48 (6.37)	6.03 (6.40)	6.52 (7.09)	7.35 (7.26)
Balance	1,315 (6075)	1,436 (4096)	1,586 (5611)	2,382 (5897)	1,615 (5313)	938 (4074)	1,336 (5897)	296 (2263)
AOD limit	892 (914)	795 (823)	-	-	-	-	880 (896)	1,058 (973)
Mobile log-ins	9.12 (17.3)	8.57 (15.0)	11.04 (20.5)	9.72 (17.9)	10.92 (21.1)	13.88 (24.3)	9.10 (16.8)	10.00 (20.3)
Online log-ins	3.60 (7.67)	3.24 (6.19)	2.45 (7.34)	3.24 (6.07)	2.44 (6.48)	11.99 (16.2)	3.41 (7.24)	11.72 (14.9)
AOD charges	7.94 (12.4)	5.90 (10.4)	-	-	-	-	7.75 (12.3)	14.88 (14.2)
UOD charges	2.27 (8.19)	2.32 (8.43)	2.02 (7.64)	2.70 (8.73)	2.07 (7.92)	2.35 (8.65)	2.24 (8.11)	2.59 (8.33)

Notes: Values reported in cells are means, standard errors in parentheses. Gender is binary (1=female); age and tenure reported in years; remaining variables are monthly totals averaged over the 6 months pre-treatment period.

It is also instructive to look at the alert thresholds people set for themselves when they register for alerts. We have 2 sources of data: participants in the control groups who opted in during the trial period and participants in LOWBAL-OPTIN in Trial C. Interestingly, the distribution of thresholds in LOWBAL-OPTIN is very similar to that of the control group for Trial C. The most popular (40%) threshold for both of these groups is £10, which is quite surprising given that these participants did not have access to an unarranged overdraft facility and were already enrolled in an unpaid items alert. The next most popular levels are £50 (18%) and £100 (14%). For Trial B, consumers without an arranged overdraft but with an unarranged overdraft facility, equal proportions of participants choose £10 (29%), £50 (27%) and £100 (24%) and virtually no other

thresholds were chosen. For Trial D, consumers with both an arranged overdraft and an unarranged overdraft facility, the most popular threshold (44%) was £100 and roughly equal proportions of participants set thresholds of £10 (16%) and £50 (13%).

Impact of automatic enrolment on account management

Some of the changes in behaviour due to automatic enrolment into alerts may be driven by automatic enrolment itself, not the alerts. In line with the findings of Stango and Zinman (2014) and Alan et al. (2018), overdrafts may have become more salient to trial participants after being notified of automatic enrolment.

Although we cannot fully disentangle the effect of increased salience from the effects of the alerts themselves, we can look at whether there is a treatment effect on the first time that a consumer passes an alert threshold (e.g. the first time since the start of the trial that the account balance of someone in the LOWBAL100 treatment dips below £100). By definition, this treatment effect cannot be driven by alerts themselves. We test this hypothesis by running a series of Cox proportional hazard models on participants in treatments with alert thresholds and their controls. We exclude Trial A, since unpaid item alerts may have been sent before the consumer crossed into unarranged overdraft. The key statistical test is on the coefficient of the treatment indicator. Our findings are reported in Table 12.

Table 12: Cox Proportional Hazard models of time to passing alert threshold

Trial	Bank	Treatment	Hazard rate (Treatment)	95% C.I.	p-value
B	Bank 1	LOWBAL100	0.971	[0.953, 0.99]	0.002**
B	Bank 2	LOWBAL100	0.993	[0.975, 1.01]	0.47
B	Bank 2	LOWBAL50	0.999	[0.98, 1.02]	0.92
C	Bank 1	LOWBAL-OPTIN	0.999	[0.99, 1.01]	0.73
C	Bank 1	LOWBAL-OPTOUT	0.992	[0.979, 1.01]	0.24
D	Bank 1	LOWBAL	1.02	[1, 1.03]	0.025*
D	Bank 2	LOWBAL	1	[0.978, 1.01]	0.61
D	Bank 1	LOWBAL&AOD	1.01	[1, 1.03]	0.042*
D	Bank 1	AOD	0.997	[0.982, 1.01]	0.75
D	Bank 2	AODUSE	1.01	[0.976, 1.01]	0.6
D	Bank 2	AODLIM	0.996	[0.986, 1.02]	0.65

Notes: The relevant account balance events are dropping below 100 (LOWBAL100, LOWBALOPT-IN, LOWBAL-OPTOUT, LOWBAL, LOWBAL&AOD), below 50 (LOWBAL50), below zero (AOD, AODUSE) and below £50 from the arranged overdraft limit (AODLIM). Significance indicators are *** p<0.001, ** p<0.01, * p<0.05.

We cannot find a clear pattern in the effect of automatic enrolment on the timing of first passing the alert threshold. For the majority of treatments, there is no significant difference between treatment and control groups. For Bank 1, which sent out 2 communications upon automatic enrolment instead of 1 (an email followed by a 2-way

SMS), we find effects for some treatments. In Trial B, the account balances in the treatment group were less likely to drop below the threshold level for the first time than the control group at any point in time (in line with greater salience of overdrafts). In the low balance treatments of Trial D, we find the opposite effect: balances of those in the treatment group were more likely to drop below the threshold level for the first time. The latter result is consistent with consumers becoming less attentive to their balances (or holding smaller buffers) as they start relying on the timely warning from the alerts. The increase in consumer-initiated transfers into accounts observed in Trial D is also consistent with this explanation.

6 Discussion

Our findings show that automatically enrolling consumers into overdraft alerts, in addition to the alerts already mandated by existing rules, can lead to substantial reductions in total overdraft charges. We can now return to the 3 questions that motivated our research:

1. **Would consumers benefit from just-in-time alerts on arranged overdraft usage?** Yes. We find that the average consumer in Trial D will save £0.28-0.45 in total overdraft charges per month when enrolled into an alert that warns of arranged overdraft usage in real time.
2. **Would consumers benefit from early warning alerts for overdraft usage?** The evidence of effectiveness is weak; mixed, at best. First, evidence from both banks indicates that an arranged overdraft usage alert is more effective than a £100 low balance alert for arranged overdraft users and evidence from Trial D with Bank 1 suggests that there is no additional benefit from enrolling customers into the low balance alongside the overdraft usage alert. Second, we find no effect on total overdraft charges of notifying consumers who are approaching their arranged overdraft limit (Trial D, Bank 2). Finally, the Trial B results on low balance alerts for consumers without an arranged overdraft facility are inconclusive: we find a (£0.20 per month) reduction in total charges for Bank 1, but we find no effects for the 2 levels of low balance alerts tested with Bank 2.
3. **Would consumers benefit from early warning alerts for unpaid items?** We find no evidence that enrolling customers without any overdraft facility into low balance alerts leads to a reduction in charges. In addition, when we encourage consumers to self-register for these alerts – and see a registration rate of almost 10% - we also find no reduction in charges.

In addition to answering the 3 questions above, Trial A allowed us to compute an experimental estimate of automatic enrolment into unarranged overdraft and unpaid item alerts, complementing the staggered roll-out estimates presented in our earlier paper (Caflisch et al., 2018). Although there are some differences between implementations, notably the firms involved and the timing of automatic enrolment, we find that our experimental and non-experimental estimates are remarkably similar. This provides support for the non-experimental estimates, which necessarily rely on stronger assumptions for identification.

Our analysis of secondary outcomes suggests that low balance alerts, when effective, mostly work by helping people avoid overdraft altogether. The effect of overdraft usage alerts, by contrast, is strongly driven by helping people end an overdraft episode before they get charged.

Surveying trial participants was an important part of our approach to policy testing. It allows us to check for unintended consequences of our intervention – given that overdrafts are the most common source of unsecured consumer credit, this was a key consideration in policy design. Our survey findings show that consumers overwhelmingly

relied on their own liquid savings, cuts to non-essential spending and informal credit to avoid using overdrafts. This is reassuring, as we wanted to avoid consumers taking out more expensive forms of credit and/or forgoing essential expenditure. A second key finding from the survey is that respondents are broadly supportive of automatic enrolment into alerts, with lower-than-expected variation between the approval rates of different alerts but the strongest support for the arranged overdraft usage alert.

We find that opt-out rates are low, although they appear strongly related to the opt-out mechanism. For Bank 1, which offered opt-outs via responding to an SMS message, opt-outs are much higher than for Bank 2. This confirms the importance of transaction or 'hassle' costs to consumers' decisions on alert registration and has 2 important implications. First, it underlines the importance of defaults, even when the cost of diverging from the default seems small. Second, as more and more private and public organisations are starting to rely on digital notification technology, our findings suggest that giving consumers an easy way to opt out of unwanted information may be an important aspect of maintaining the relevance of notifications.

The development of alerting technology

We find that enrolling consumers into just-in-time notifications on revolving credit usage is a useful way of reducing the cost of monitoring one's account, resulting in lower levels of credit charges. A simple message that immediately warns of usage of credit is found to be particularly timely, relevant and perceived as helpful by those who receive it.

With the continued development of account management and monitoring software, there may soon be other types of alert that prove helpful to consumers: for example alerts that predict overdraft usage, alerts with data-driven thresholds and warnings, and alerts that connect accounts within and across providers. Further development of technology that makes it easier for consumers to configure alerts may also improve consumers' engagement with their financial products.

Testing in a digital environment

As technology improves and the use of A/B testing of digital tools such as alerts increases, we can expect more firms to conduct this sort of research to help inform product development. But these are important techniques for regulators, too. Digital interventions can be relatively quickly and easily tested, allowing regulators the ability to quickly learn about what works and what doesn't, as well as increase the scale, scope and complexity of field experiments.

Annex 1: Sample adjustments

We exclude consumers deemed to be:

1. **Not holding a primary account with the bank**. Consumers are removed if their 3-month rolling average of their monthly credit turnover falls lower than £500 and their 3-month rolling average of their monthly number of transactions drops below 2.

2. **Defaulted**. Consumers are removed if they incur unarranged overdraft charges in at least 1 of their accounts for 3 consecutive months and they also do not credit their account for 3 months.

3. **Using an account for business purposes**. Consumers are defined as business users if 1 or more of the following apply to at least 1 of their accounts:
   - 3-month rolling average monthly credit turnover higher than £30,000;
   - 3-month rolling average monthly credit transactions is higher than 50.
   - arranged overdraft limit is higher than £10,000.

We exclude 0.6 and 1.2% of consumers on these 3 criteria for Bank 1 and Bank 2, respectively, during the 11-month sample period. Exclusions are done on a rolling basis. Once consumers are excluded from our sample they do not re-enter in later months.

Annex 2: Balance of covariates

This annex presents tables showing the distribution of covariates across control and treatment groups in the pre-treatment period. Covariates are aggregated to the customer level (by averaging over 6 pre-treatment months) and regressions are performed.

Tables show simple linear regressions, regressing covariates on dummy variables that represent treatment groups. F-Tests on the equality of the coefficients on control and treatment groups are performed and the F-Statistics and p-values are reported.

This annex contains the following tables:

Table 13 - Bank 1 sample balance for Trial B (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
LOWBAL100	0.016	-0.0004	-4.052	-20.007	0.129
	(0.075)	(0.076)	(14.751)	(20.089)	(0.196)
Constant	4.133***	4.137***	1,700.552***	1,717.445***	26.236***
	(0.052)	(0.053)	(10.346)	(14.089)	(0.137)
F Statistic (df = 1)	0.04	0	0.08	0.99	0.43
F Statistic p-val	0.83	1	0.78	0.32	0.51
Observations	73,887	73,887	73,887	73,887	73,887
Adjusted R^2	-0.00001	-0.00001	-0.00001	-0.00000	-0.00001

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 14 – Bank 1 sample balance for Trial B (2)

	Mobile log ins	Online log ins	Age	Male
	(1)	(2)	(3)	(4)
LOWBAL100	0.079	-0.020	-0.086	0.007*
	(0.140)	(0.045)	(0.088)	(0.004)
Constant	10.701***	2.211***	47.524***	0.472***
	(0.098)	(0.031)	(0.062)	(0.003)
F Statistic (df = 1)	0.32	0.2	0.94	3.66
F Statistic p-val	0.57	0.65	0.33	0.06
Observations	73,887	73,887	73,883	73,883
Adjusted R^2	-0.00001	-0.00001	-0.00000	0.00004
Note:			* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 15 – Bank 1 sample balance for Trial C (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
LOWBAL-OPTOUT	0.007	0.008	-2.756	1.684	0.141
	(0.018)	(0.017)	(9.954)	(10.659)	(0.186)
LOWBAL-OPTIN	0.017	0.015	-8.879	-5.524	0.111
	(0.018)	(0.017)	(9.953)	(10.657)	(0.186)
Constant	1.147***	0.987***	1,694.686***	1,673.178***	37.745***
	(0.016)	(0.015)	(8.845)	(9.470)	(0.165)
F Statistic (df = 2)	0.64	0.5	0.64	0.56	0.29
F Statistic p-val	0.53	0.61	0.53	0.57	0.75
Observations	319,485	319,485	319,485	319,485	319,485
Adjusted R^2	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 16 - Bank 1 sample balance for Trial C (2)

	Mobile log ins	Online log ins	Age	Male
	(1)	(2)	(3)	(4)
LOWBAL-OPTOUT	-0.121	0.005	0.048	-0.002
	(0.145)	(0.038)	(0.073)	(0.003)
LOWBAL-OPTIN	-0.169	0.00002	0.034	-0.002
	(0.145)	(0.038)	(0.073)	(0.003)
Constant	19.467***	1.717***	34.594***	0.515***
	(0.129)	(0.034)	(0.064)	(0.003)
F Statistic (df = 2)	0.69	0.02	0.22	0.31
F Statistic p-val	0.5	0.98	0.8	0.73
Observations	319,485	319,485	319,479	319,479
Adjusted R^2	-0.00000	-0.00001	-0.00000	-0.00000
Note:				* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 17 - Bank 1 sample balance for Trial D (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
LOWBAL	-0.043	-0.046	12.916	21.654	0.161
	(0.100)	(0.096)	(17.609)	(19.955)	(0.222)
AOD	-0.012	0.035	5.921	15.624	-0.094
	(0.100)	(0.096)	(17.600)	(19.945)	(0.222)
LOWBAL&AOD	-0.022	0.016	14.385	21.527	0.002
	(0.082)	(0.078)	(14.370)	(16.285)	(0.181)
Constant	6.177***	5.695***	2,641.756***	2,641.088***	40.570***
	(0.071)	(0.068)	(12.445)	(14.103)	(0.157)
F Statistic (df = 3)	0.07	0.28	0.39	0.63	0.46
F Statistic p-val	0.98	0.84	0.76	0.6	0.71
Observations	225,040	225,040	225,040	225,040	225,040
Adjusted R^2	-0.00001	-0.00001	-0.00001	-0.00000	-0.00001
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 18 - Bank 1 sample balance for Trial D (2)

	Overdraft limit	Mobile log ins	Online log ins	Age	Male
	(1)	(2)	(3)	(4)	(5)
LOWBAL	-12.213*	0.189	-0.018	-0.004	0.004
	(6.822)	(0.146)	(0.042)	(0.093)	(0.004)
AOD	-7.699	0.033	-0.025	0.032	-0.002
	(6.819)	(0.146)	(0.042)	(0.093)	(0.004)
LOWBAL&AOD	-10.989**	0.014	0.029	-0.003	-0.002
	(5.567)	(0.119)	(0.034)	(0.076)	(0.003)
Constant	-984.857***	12.804***	2.148***	46.339***	0.482***
	(4.821)	(0.103)	(0.030)	(0.066)	(0.003)
F Statistic (df = 3)	1.5	0.81	1.19	0.08	1.19
F Statistic p-val	0.21	0.49	0.31	0.97	0.31
Observations	225,040	225,040	225,040	225,036	225,037
Adjusted R^2	0.00001	-0.00000	0.00000	-0.00001	0.00000
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 19 - Bank 2 sample balance for Trial A1 (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
UOD-A1	0.010	-0.025	-35.462**	-24.576	-0.365*
	(0.098)	(0.093)	(14.472)	(18.012)	(0.211)
Constant	10.188***	9.963***	2,975.894***	3,029.142***	52.738***
	(0.091)	(0.086)	(13.398)	(16.676)	(0.195)
F Statistic (df = 1)	0.01	0.07	6	1.86	3
F Statistic p-val	0.92	0.79	0.01	0.17	0.08
Observations	236,260	236,260	236,260	236,260	236,260
Adjusted R^2	-0.00000	-0.00000	0.00002	0.00000	0.00001
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 20 - Bank 2 sample balance for Trial A1 (2)

	Overdraft limit	Mobile log ins	Online log ins	Age	Male
	(1)	(2)	(3)	(4)	(5)
UOD-A1	-6.795	-0.098	0.018	0.077	-0.001
	(5.376)	(0.102)	(0.045)	(0.077)	(0.003)
Constant	898.280***	9.214***	3.577***	45.420***	0.497***
	(4.977)	(0.094)	(0.041)	(0.071)	(0.003)
F Statistic (df = 1)	1.6	0.92	0.16	1	0.21
F Statistic p-val	0.21	0.34	0.69	0.32	0.65
Observations	236,260	236,260	236,260	236,138	236,133
Adjusted R^2	0.00000	-0.00000	-0.00000	0.00000	-0.00000
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 21 - Bank 2 sample balance for Trial A2 (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
UOD-A2	-0.036	-0.018	-11.044	-14.728	0.066
	(0.046)	(0.045)	(11.908)	(15.616)	(0.196)
Constant	2.068***	1.962***	1,818.784***	1,871.588***	35.472***
	(0.041)	(0.040)	(10.766)	(14.119)	(0.177)
F Statistic (df = 1)	0.62	0.16	0.86	0.89	0.11
F Statistic p-val	0.43	0.69	0.35	0.35	0.74
Observations	191,712	191,712	191,712	191,712	191,712
Adjusted R^2	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 22 - Bank 2 sample balance for Trial A2 (2)

	Mobile log ins	Online log ins	Age	Male
	(1)	(2)	(3)	(4)
UOD-A2	0.158	0.003	0.060	0.001
	(0.119)	(0.042)	(0.092)	(0.003)
Constant	10.865***	2.447***	40.247***	0.491***
	(0.108)	(0.038)	(0.083)	(0.003)
F Statistic (df = 1)	1.75	0	0.42	0.06
F Statistic p-val	0.19	0.94	0.52	0.81
Observations	191,712	191,712	191,622	191,615
Adjusted R^2	0.00000	-0.00001	-0.00000	-0.00000
Note:				* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 23 - Bank 2 sample balance for Trial B (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
LOWBAL50	0.024	0.047	0.213	-13.399	0.140
	(0.060)	(0.059)	(15.468)	(20.492)	(0.252)
LOWBAL100	-0.003	0.033	-8.339	-12.711	-0.096
	(0.060)	(0.059)	(15.466)	(20.490)	(0.252)
Constant	2.068***	1.962***	1,818.784***	1,871.588***	35.472***
	(0.042)	(0.041)	(10.936)	(14.489)	(0.178)
F Statistic (df = 2)	0.12	0.34	0.2	0.27	0.44
F Statistic p-val	0.89	0.71	0.82	0.76	0.64
Observations	104,963	104,963	104,963	104,963	104,963
Adjusted R^2	-0.00002	-0.00001	-0.00002	-0.00001	-0.00001
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 24 - Bank 2 sample balance for Trial B (2)

	Mobile log ins	Online log ins	Age	Male
	(1)	(2)	(3)	(4)
LOWBAL50	0.245	0.084*	-0.042	-0.003
	(0.154)	(0.050)	(0.117)	(0.004)
LOWBAL100	-0.091	0.099**	0.010	0.002
	(0.154)	(0.050)	(0.117)	(0.004)
Constant	10.865***	2.447***	40.247***	0.491***
	(0.109)	(0.035)	(0.083)	(0.003)
F Statistic (df = 2)	2.54	2.3	0.11	1.23
F Statistic p-val	0.08	0.1	0.9	0.29
Observations	104,963	104,963	104,906	104,908
Adjusted R^2	0.00003	0.00002	-0.00002	0.00000
Note:				* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 25 - Bank 2 sample balance for Trial D (1)

	Total charges	Billed charges	Credit turnover	Debit turnover	# Transactions
	(1)	(2)	(3)	(4)	(5)
LOWBAL	-0.094	-0.095	-39.707**	-37.810*	-0.531*
	(0.128)	(0.121)	(18.930)	(22.580)	(0.273)
AODUSE	-0.066	-0.077	-57.399***	-47.355**	-0.782***
	(0.128)	(0.121)	(18.926)	(22.575)	(0.273)
AODLIM	-0.072	-0.136	-43.730**	-33.958	-0.414
	(0.128)	(0.121)	(18.922)	(22.571)	(0.273)
Constant	10.188***	9.963***	2,975.894***	3,029.142***	52.738***
	(0.090)	(0.086)	(13.398)	(15.982)	(0.193)
F Statistic (df = 3)	0.2	0.44	3.39	1.67	2.86
F Statistic p-val	0.9	0.72	0.02	0.17	0.04
Observations	135,546	135,546	135,546	135,546	135,546
Adjusted R^2	-0.00002	-0.00001	0.0001	0.00001	0.00004
Note:					* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 26 - Bank 2 sample balance for Trial D (2)

	Overdraft limit	Mobile log ins	Online log ins	Age
	(1)	(2)	(3)	(4)
LOWBAL	-14.483**	-0.062	0.001	-0.044
	(6.956)	(0.130)	(0.058)	(0.100)
AODUSE	-16.515**	-0.133	-0.071	-0.031
	(6.954)	(0.130)	(0.058)	(0.100)
AODLIM	-14.680**	-0.263**	0.037	0.017
	(6.953)	(0.130)	(0.058)	(0.100)
Constant	898.280***	9.214***	3.577***	45.420***
	(4.923)	(0.092)	(0.041)	(0.071)
F Statistic (df = 3)	2.43	1.5	1.23	0.16
F Statistic p-val	0.06	0.21	0.3	0.93
Observations	135,546	135,546	135,546	135,467
Adjusted R^2	0.00003	0.00001	0.00001	-0.00002
Note:				* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Annex 3: Average treatment effects

This annex presents regression tables for the main results discussed in the paper.

The econometric specification used in these regressions is set out at the start of the results section in the main paper.

This annex contains the following tables:

- Table 27 - Bank 1 Trial B - Impact on total charges
- Table 28 - Bank 1 Trial C - Impact on total charges
- Table 29 - Bank 1 Trial D - Impact on total charges
- Table 32 - Bank 2 Trial A1 and A2 impact on total charges
- Table 35 - Bank 2 Trial B - Impact on total charges
- Table 36 - Bank 2 Trial D - Impact on total charges

Table 27 - Bank 1 Trial B - Impact on total charges

	LOWBAL100
Treatment	-0.196***
	(0.046)
Pre-trial fees	0.790***
	(0.004)
Baseline monthly charges	4.23
Effect size	4.6%
No. customers	60,932
Observations	297,181
Adjusted R^2	0.500
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 28 - Bank 1 Trial C - Impact on total charges

	LOWBAL-OPTOUT	LOWBAL-OPTIN	LOWBAL-OPTIN - IV
	(1)	(2)	(3)
Treatment	0.002	-0.00000	-0.00001
	(0.013)	(0.009)	(0.097)
Pre-trial fees	0.517***	0.516***	0.516***
	(0.005)	(0.004)	(0.004)
Baseline monthly charges	0.973	0.973	0.973
Effect size	-0.16%	0.00012%	0.00012%
No. customers	154,117	243,567	243,567
Observations	751,341	1,187,710	1,187,710
Adjusted R^2	0.192	0.193	0.193
Note:			* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 29 - Bank 1 Trial D - Impact on total charges

	LOWBAL	AOD	LOWBAL&AOD
	(1)	(2)	(3)
Treatment	-0.021	-0.450***	-0.482***
	(0.039)	(0.039)	(0.038)
Pre-trial fees	0.897***	0.894***	0.894***
	(0.004)	(0.004)	(0.004)
Baseline monthly charges	6.13	6.13	6.13
Effect size	0.34%	7.3%	7.9%
No. customers	135,080	134,989	135,132
Observations	662,039	661,577	662,214
Adjusted R^2	0.720	0.720	0.721
Note:		* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 30 - Bank 1 Trial D - Impact on arranged overdraft charges

	LOWBAL	AOD	LOWBAL&AOD
	(1)	(2)	(3)
Treatment	-0.028	-0.443***	-0.489***
	(0.037)	(0.037)	(0.036)
Pre-trial fees	0.915***	0.912***	0.911***
	(0.004)	(0.004)	(0.004)
Baseline monthly charges	5.8	5.8	5.8
Effect size	0.49%	7.60%	8.40%
No. customers	134,970	134,847	134,964
Observations	661,719	661,006	661,388
Adjusted R^2	0.734	0.734	0.735
Note:		* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 31 - Bank 1 Trial D - Impact on unarranged overdraft charges

	LOWBAL	AOD	LOWBAL&AOD
	(1)	(2)	(3)
Treatment	0.009	-0.008	0.005
	(0.008)	(0.008)	(0.008)
Pre-trial fees	0.496***	0.491***	0.495***
	(0.009)	(0.009)	(0.009)
Baseline monthly charges	0.341	0.341	0.341
Effect size	-2.60%	2.40%	-1.60%
No. customers	134,970	134,847	134,964
Observations	661,719	661,006	661,388
Adjusted R^2	0.183	0.181	0.183
Note:			* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 32 - Bank 2 Trial A1 and A2 impact on total charges

	UOD-A1	UOD-A2
	(1)	(2)
Treatment	0.385***	0.459***
	(0.066)	(0.058)
Pre-trial fees	0.902***	0.774***
	(0.003)	(0.009)
Baseline monthly charges	10.3	2.54
Effect size	-3.7%	-18%
No. customers	218,096	160,169
Observations	434,108	318,379
Adjusted R^2	0.561	0.213
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 33 - Bank 2 Trial A1 impact on arranged overdraft charges

	UOD-A1
	(1)
Treatment	0.022
	(0.035)
Pre-trial fees	0.909***
	(0.002)
Baseline monthly charges	7.94
Effect size	-0.28%
No. customers	218,050
Observations	434,103
Adjusted R^2	0.754
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 34 - Bank 2 Trial A1 impact on unarranged overdraft charges

	UOD-A1
	(1)
Treatment	0.359***
	(0.051)
Pre-trial fees	0.810***
	(0.007)
Baseline monthly charges	2.38
Effect size	-15%
No. customers	218,050
Observations	434,103
Adjusted R^2	0.273
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 35 - Bank 2 Trial B - Impact on total charges

	LOWBAL50	LOWBAL100
	(1)	(2)
Treatment	-0.056	-0.008
	(0.062)	(0.062)
Pre-trial fees	0.629***	0.625***
	(0.012)	(0.011)
Baseline monthly charges	2.43	2.43
Effect size	2.3%	0.35%
No. customers	58,974	58,874
Observations	287,364	286,836
Adjusted R^2	0.188	0.187
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 36 - Bank 2 Trial D - Impact on total charges

	LOWBAL	AODUSE	AODLIM
	(1)	(2)	(3)
Treatment	-0.209***	-0.279***	-0.082
	(0.077)	(0.078)	(0.078)
Pre-trial fees	0.833***	0.834***	0.830***
	(0.005)	(0.005)	(0.005)
Baseline monthly charges	10.2	10.2	10.2
Effect size	2.0%	2.7%	0.8%
No. customers	62,547	62,476	62,638
Observations	306,176	305,991	306,694
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 37 - Bank 2 Trial D - Impact on arranged overdraft charges

	LOWBAL	AODUSE	AODLIM
	(1)	(2)	(3)
Treatment	-0.200***	-0.307***	-0.059
	(0.045)	(0.045)	(0.045)
Pre-trial fees	0.882***	0.880***	0.884***
	(0.003)	(0.004)	(0.003)
Baseline monthly charges	7.93	7.93	7.93
Effect size	2.50%	3.90%	0.75%
No. customers	62,492	62,419	62,591
Observations	306,132	305,961	306,715
Adjusted R^2	0.707	0.708	0.708
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 38 - Bank 2 Trial D - Impact on unarranged overdraft charges

	LOWBAL	AODUSE	AODLIM
	(1)	(2)	(3)
Treatment	-0.014	0.027	-0.038
	(0.057)	(0.057)	(0.057)
Pre-trial fees	0.682***	0.683***	0.673***
	(0.011)	(0.011)	(0.012)
Baseline monthly charges	2.23	2.23	2.23
Effect size	0.61%	-1.20%	1.70%
No. customers	62,492	62,419	62,591
Observations	306,132	305,961	306,715
Adjusted R^2	0.273	0.212	0.22
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 39: Comparison of post-treatment means

			Average charges (£/month)		
Trial	Bank	Treatment	UOD	AOD	Total
A1	2	A1-CONTROL	7.96	2.46	10.42
A1	2	A1-UOD	7.93	2.19	10.12
A2	2	A2-CONTROL	0.12	2.52	2.64
A2	2	A2-UOD	0.11	2.18	2.30
B	1	B-CONTROL	0.02	4.20	4.22
B	1	B-LOWBAL100	0.02	4.00	4.02
B	2	B-CONTROL	0.11	2.18	2.30
B	2	B-LOWBAL50	0.12	2.13	2.25
B	2	B-LOWBAL100	0.11	2.20	2.32
C	1	C-CONTROL	0.02	0.97	0.98
C	1	C-LOWBAL-OPTOUT	0.02	0.96	0.98
C	1	C-LOWBAL-OPTIN	0.02	0.97	0.98
D	1	D-CONTROL	5.79	0.34	6.13
D	1	D-AOD	5.32	0.33	5.65
D	1	D-LOWBAL	5.77	0.35	6.13
D	1	D-LOWBAL&AOD	5.31	0.35	5.65
D	2	D-CONTROL	7.93	2.19	10.12
D	2	D-LOWBAL	7.72	2.17	9.89
D	2	D-AODUSE	7.57	2.19	9.76
D	2	D-AODLIM	7.85	2.09	9.94

Annex 4: Secondary outcomes

This annex presents regression tables for secondary outcomes discussed in the paper. The econometric specification used is the same as the specification for our main results, which is set out in the main paper. The number of secondary outcomes that are considered vary by trial depending on customer overdraft arrangements in each trial. The secondary outcomes considered are defined here:

- Debit turnover: value of debits per month
- Credit Turnover: value of credits per month
- Min Balance: minimum account balance per month
- Mobile log-ins: number of mobile log ins per month
- Online log-ins: number of online log ins per month
- Transfers: number of customer initiated transfers per month
- Eff Interest Rate: the average monthly implied daily interest rate
- Unarranged charges: unarranged charges per month
- 1-Day UoD: number of unarranged overdraft spells of 1 day per month
- >1-Day UoD: number of unarranged overdraft spells of more than 1 day per month
- Arranged charges: arranged charges per month
- 0-Day AoD: number of arranged overdraft spells of less than a day per month
- 1-Day AoD: number of arranged overdraft spells of 1 day per month
- >1-Day AoD: number of arranged overdraft spells of more than 1 day per month

Table 40: Bank 1 Trial B - secondary outcomes (1)

	Debit Turnover	Credit Turnover	Min Balance	Mobile log-ins	Online log-ins	Transfers
	(1)	(2)	(3)	(4)	(5)	(6)
LOWBAL100	-5.45	-8.62	3.04	0.01	-0.033	-0.026*
	-9.81	-9.66	-11.6	-0.069	-0.02	-0.013
pre-treatment	0.716***	0.772***	0.607***	0.953***	0.902***	0.908***
	-0.014	-0.006	-0.071	-0.01	-0.019	-0.011
Baseline	1810	1840	571	12.7	2.16	2.12
No. customers	60,827	60,827	60,827	60,827	60,827	60,827
Observations	296,675	296,675	296,675	296,675	296,675	296,675
Adjusted R^2	0.31	0.319	0.476	0.745	0.747	0.63
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 41: Bank 1 Trial B - secondary outcomes (2)

	0-Day UOD	1-Day UOD	>1-Day UOD
	(1)	(2)	(3)
LOWBAL100	-0.005**	-0.002**	-0.008***
	-0.003	-0.001	-0.002
pre-treatment	0.794***	0.542***	0.747***
	-0.009	-0.013	-0.005
Baseline	0.223	0.0425	0.184
No. customers	60,827	60,827	60,827
Observations	296,675	296,675	296,675
Adjusted R^2	0.372	0.124	0.441
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 42: Bank 1 Trial C - secondary outcomes

	Debit Turnover	Credit Turnover	Min Balance	Mobile log-ins	Online log-ins	Transfers
	(1)	(2)	(3)	(4)	(5)	(6)
LOWBAL-OPTOUT	-5.75	-7.48	1.05	-0.012	0.007	0.004
	-6.55	-6.72	-5.92	-0.085	-0.024	-0.024
LOWBAL-OPTIN	0.596	1.17	-2.26	-0.053	0.009	-0.013
	-4.32	-4.37	-3.77	-0.055	-0.015	-0.015
pre-treatment	0.751***	0.770***	0.841***	0.876***	0.821***	0.888***
	-0.005	-0.003	-0.038	-0.003	-0.013	-0.006
Baseline	1800	1830	352	22.2	1.69	4.29
No. customers	275,464	275,464	275,464	275,464	275,464	275,464
Observations	1,343,164	1,343,164	1,343,164	1,343,164	1,343,164	1,343,164
Adjusted R^2	0.328	0.325	0.456	0.625	0.591	0.556

Note: *p<0.1; **p<0.05; ***p<0.01

Table 43: Bank 1 Trial D - secondary outcomes (1)

	Debit Turnover	Credit Turnover	Min Balance	Mobile log-ins	Online log-ins	Transfers
	(1)	(2)	(3)	(4)	(5)	(6)
LOWBAL	6.44	12.4	6.43	0.036	0.022	0.0001
	-9	-8.79	-7.24	-0.054	-0.016	-0.012
AOD	2.26	10.7	12	0.166***	0.033**	0.040***
	-9.28	-8.85	-8.45	-0.055	-0.016	-0.012
LOWBAL&AOD	2.19	6.65	22.600***	0.072	0.029*	0.031***
	-8.95	-8.82	-7.92	-0.053	-0.016	-0.012
pre-treatment	0.720***	0.792***	0.775***	0.940***	0.887***	0.907***
	-0.016	-0.003	-0.041	-0.004	-0.007	-0.007
Baseline	2610	2650	296	14	2.05	2.71
No. customers	202,427	202,427	202,427	202,427	202,427	202,427
Observations	992,747	992,747	992,747	992,747	992,747	992,747
Adjusted R^2	0.311	0.326	0.608	0.743	0.693	0.618

Note: *p<0.1; **p<0.05; ***p<0.01

Table 44: Bank 1 Trial D - secondary outcomes (2)

	0-Day AOD	1-Day AOD	>1-Day AOD	0-Day UOD	1-Day UOD	>1-Day UOD
	(1)	(2)	(3)	(4)	(5)	(6)
LOWBAL	0.002	0.0001	-0.003	-0.001	0	0.00005
	-0.002	-0.001	-0.002	-0.002	-0.00002	-0.0001
AOD	0.032***	-0.005***	-0.042***	-0.011***	-0.00002*	-0.0001
	-0.002	-0.001	-0.002	-0.002	-0.00001	-0.00004
LOWBAL&AOD	0.031***	-0.005***	-0.041***	-0.012***	0.00003	0.0001
	-0.002	-0.001	-0.002	-0.002	-0.00002	-0.0001
pre-treatment	0.772***	0.504***	0.737***	0.833***	0.004	0.018*
	-0.005	-0.006	-0.003	-0.008	-0.004	-0.01
Baseline	0.267	0.0607	0.329	0.12	0.0000217	0.00011
No. customers	202,427	202,427	202,427	202,427	202,427	202,427
Observations	992,747	992,747	992,747	992,747	992,747	992,747
Adjusted R^2	0.322	0.089	0.404	0.371	0.00003	0.001

Note: *p<0.1; **p<0.05; ***p<0.01

Table 45: Bank 2 Trial A1 - secondary outcomes (1)

	Debit Turnover	Credit Turnover	Min Balance	Mobile log-ins	Online log-ins	Transfers
	(1)	(2)	(3)	(4)	(5)	(6)
UOD-A1	-12	-4.3	13.4	-0.044	-0.021	-0.01
	-10.6	-10.7	-11.1	-0.05	-0.021	-0.01
pre-treatment	0.735***	0.807***	0.695***	1.070***	1.010***	0.967***
	-0.009	-0.003	-0.046	-0.028	-0.005	-0.004
Baseline	2880	2860	418	10.4	3.82	3.4
No. customers	218,096	218,096	218,096	218,096	218,096	218,096
Observations	434,108	434,108	434,108	434,108	434,108	434,108
Adjusted R^2	0.364	0.372	0.619	0.752	0.776	0.766

Note: *p<0.1; **p<0.05; ***p<0.01

Table 46: Bank 2 Trial A1 - secondary outcomes (2)

	0-Day AOD (1)	1-Day AOD (2)	>1-Day AOD (3)	0-Day UOD (4)	1-Day UOD (5)	>1-Day UOD (6)
UOD-A1	-0.002	0.003**	-0.007**	-0.002	0.0005	-0.006***
	-0.003	-0.001	-0.003	-0.001	-0.001	-0.001
pre-treatment	0.784***	0.488***	0.784***	0.714***	0.442***	0.747***
	-0.005	-0.007	-0.003	-0.01	-0.01	-0.006
Baseline	0.303	0.069	0.495	0.0622	0.0215	0.0748
No. customers	218,096	218,096	218,096	218,096	218,096	218,096
Observations	434,108	434,108	434,108	434,108	434,108	434,108
Adjusted R^2	0.326	0.08	0.402	0.232	0.056	0.251

Note: *p<0.1; **p<0.05; ***p<0.01

Table 47: Bank 2 Trial A2 - secondary outcomes (1)

	Debit Turnover (1)	Credit Turnover (2)	Min Balance (3)	Mobile log-ins (4)	Online log-ins (5)	Transfers (6)
UOD-A2	-6.87	2.51	0.777	0.014	0.016	-0.003
	-9.72	-9.69	-12.1	-0.06	-0.021	-0.013
pre-treatment	0.689***	0.792***	0.829***	1.050***	1.020***	0.973***
	-0.013	-0.004	-0.03	-0.014	-0.007	-0.005
Baseline	1960	1970	973	14	2.84	3.32
No. customers	160,169	160,169	160,169	160,169	160,169	160,169
Observations	318,379	318,379	318,379	318,379	318,379	318,379
Adjusted R^2	0.346	0.363	0.751	0.79	0.761	0.745

Note: *p<0.1; **p<0.05; ***p<0.01

Table 48: Bank 2 Trial A2 - secondary outcomes (2)

	0-Day UOD (1)	1-Day UOD (2)	>1-Day UOD (3)
UOD-A2	-0.002	0.003***	-0.006***
	-0.001	-0.001	-0.001
pre-treatment	0.694***	0.434***	0.724***
	-0.012	-0.011	-0.008
Baseline	0.0684	0.022	0.0751
No. customers	160,169	160,169	160,169
Observations	318,379	318,379	318,379
Adjusted R^2	0.215	0.049	0.206
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 49: Bank 2 Trial B - secondary outcomes (1)

	Debit Turnover (1)	Credit Turnover (2)	Min Balance (3)	Mobile log-ins (4)	Online log-ins (5)	Transfers (6)
LOWBAL50	15.9	10.5	2.59	0.146*	-0.031	0.005
	-10.6	-9.84	-16.3	-0.086	-0.028	-0.016
LOWBAL100	4.94	-2.49	21.6	0.113	-0.065**	0.008
	-10.5	-9.87	-17.9	-0.084	-0.027	-0.016
pre-treatment	0.678***	0.778***	0.720***	1.030***	0.978***	0.922***
	-0.017	-0.005	-0.036	-0.02	-0.007	-0.007
Baseline	1950	1970	997	14.4	2.9	3.22
No. customers	87,484	87,484	87,484	87,484	87,484	87,484
Observations	426,248	426,248	426,248	426,248	426,248	426,248
Adjusted R^2	0.305	0.334	0.609	0.709	0.712	0.701
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 50: Bank 2 Trial B - secondary outcomes (2)

	0-Day UOD	1-Day UOD	>1-Day UOD
	(1)	(2)	(3)
LOWBAL50	-0.001	-0.002**	-0.003**
	-0.001	-0.001	-0.001
LOWBAL100	-0.001	-0.0001	-0.00003
	-0.001	-0.001	-0.001
pre-treatment	0.660***	0.378***	0.572***
	-0.019	-0.011	-0.009
Baseline	0.068	0.0196	0.058
No. customers	87,484	87,484	87,484
Observations	426,248	426,248	426,248
Adjusted R^2	0.19	0.044	0.174
Note:		*p<0.1; **p<0.05; ***p<0.01	

Table 51: Bank 2 Trial D - secondary outcomes (1)

	Debit Turnover	Credit Turnover	Min Balance	Mobile log-ins	Online log-ins	Transfers
	(1)	(2)	(3)	(4)	(5)	(6)
LOWBAL	-15.7	-5.51	-16.4	0.193***	0.043	0.026**
	-11.4	-11	-16.6	-0.069	-0.027	-0.012
AODUSE	0.753	6.22	-2.23	0.073	0.04	0.027**
	-11.2	-11	-14.8	-0.064	-0.027	-0.012
AODLIM	-1.5	5.43	3.63	0.149**	0.033	0.01
	-11.3	-11	-14.7	-0.064	-0.027	-0.012
pre-treatment	0.722***	0.802***	0.708***	1.040***	0.984***	0.932***
	-0.011	-0.003	-0.04	-0.004	-0.006	-0.004
Baseline	2860	2890	433	11	3.84	3.32
No. customers	125,202	125,202	125,202	125,202	125,202	125,202
Observations	613,568	613,568	613,568	613,568	613,568	613,568
Adjusted R^2	0.353	0.351	0.645	0.696	0.733	0.742
Note:					*p<0.1; **p<0.05; ***p<0.01	

Table 52: Bank 2 Trial D - secondary outcomes (2)

	0-Day AOD (1)	1-Day AOD (2)	>1-Day AOD (3)	0-Day UOD (4)	1-Day UOD (5)	>1-Day UOD (6)
LOWBAL	-0.006**	-0.003**	-0.020***	-0.002	0.001	0.0002
	-0.003	-0.001	-0.003	-0.001	-0.001	-0.001
AODUSE	0.013***	-0.005***	-0.026***	0.0001	-0.0001	-0.0004
	-0.003	-0.001	-0.003	-0.001	-0.001	-0.001
AODLIM	0.001	-0.001	-0.004	-0.002	-0.002***	-0.003**
	-0.003	-0.001	-0.003	-0.001	-0.001	-0.001
pre-treatment	0.742***	0.466***	0.728***	0.643***	0.382***	0.619***
	-0.007	-0.006	-0.003	-0.011	-0.008	-0.007
Baseline	0.294	0.0727	0.471	0.06	0.0185	0.0604
No. customers	125,202	125,202	125,202	125,202	125,202	125,202
Observations	613,568	613,568	613,568	613,568	613,568	613,568
Adjusted R^2	0.305	0.071	0.373	0.186	0.05	0.213

Note: *p<0.1; **p<0.05; ***p<0.01

Annex 5: Heterogeneous treatment effects

This annex presents regression tables for heterogeneous treatment effects discussed in the paper. Customers are split up into 3 groups using their average pre-treatment total charges:

- **Rare** are consumers that incurred no charges in the pre-treatment period.
- **Occasional** are consumers that incurred less or at the median of charges in the pre-treatment period conditional on being charged.
- **Heavy** are consumers that incurred more charges than the median of charges in the pre-treatment period conditional on being charged.

The econometric specification used is the same as our main econometric specification except we do not include pre-treatment charges as a covariate. This is because customers are already split by their pre-treatment charges and there is no variation in pre-treatment charges for the Rare group.

This annex contains the following tables:

Table 53 - Bank 1 Trial B - rare pre-treatment charges

	LOWBAL100
treatment	-0.084***
	(0.025)
Effect size	16%
Baseline	0.535
No. customers	41,822
Observations	203,856
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 54 - Bank 1 Trial B – medium pre-treatment charges

	LOWBAL100
treatment	-0.569***
	(0.134)
Effect size	17%
Baseline	3.44
No. customers	9,475
Observations	46,396
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 55 - Bank 1 Trial B - heavy pre-treatment charges

	LOWBAL100
treatment	-0.422
	(0.311)
Effect size	2.0%
Baseline	21.3
No. customers	9,530
Observations	46,423
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 56 - Bank 1 Trial C - rare pre-treatment charges

	LOWBAL-OPTOUT	LOWBAL-OPTIN
	(1)	(2)
treatment	-0.001	-0.0001
	(0.009)	(0.006)
Effect size	0.47%	0.021%
Baseline	0.275	0.275
No. customers	111,006	175,278
Observations	540,575	853,746
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 57 - Bank 1 Trial C - occasional pre-treatment charges

	LOWBAL-OPTOUT	LOWBAL-OPTIN
	(1)	(2)
treatment	0.005	0.014
	(0.042)	(0.028)
Effect size	-0.48%	-1.3%
Baseline	1.07	1.07
No. customers	16,505	26,322
Observations	81,227	129,587
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 58 - Bank 1 Trial C- heavy pre-treatment charges

	LOWBAL-OPTOUT	LOWBAL-OPTIN
	(1)	(2)
treatment	-0.024	-0.013
	(0.073)	(0.046)
Effect size	0.62%	0.33%
Baseline	3.85	3.85
No. customers	26,273	41,458
Observations	127,940	201,908
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 59 - Bank 1 Trial D - rare pre-treatment charges

	LOWBAL	AOD	LOWBAL&AOD
	(1)	(2)	(3)
treatment	-0.010	-0.080***	-0.084***
	(0.012)	(0.012)	(0.012)
Effect size	3.8%	31%	32%
Baseline	0.259	0.259	0.259
No. customers	65,367	65,416	65,463
Observations	319,887	320,233	320,350
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 60 - Bank 1 Trial D- medium pre-treatment charges

	LOWBAL	AOD	LOWBAL&AOD
	(1)	(2)	(3)
treatment	0.020	-0.580***	-0.594***
	(0.055)	(0.049)	(0.046)
Effect size	-0.93%	27%	28%
Baseline	2.13	2.13	2.13
No. customers	34,779	34,734	34,830
Observations	170,972	170,664	171,218
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 61 - Bank 1 Trial D- heavy pre-treatment charges

	LOWBAL	AOD	LOWBAL&AOD
	(1)	(2)	(3)
treatment	-0.036	-0.939***	-0.850***
	(0.248)	(0.251)	(0.254)
Effect size	0.17%	4.5%	4.0%
Baseline	21.1	21.1	21.1
No. customers	34,947	34,850	34,852
Observations	171,244	170,729	170,706
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 62 - Bank 2 Trial A – rare pre-treatment charges

	UOD-A1	UOD-A2
	(1)	(2)
treatment	-0.005	-0.275***
	(0.020)	(0.035)
Effect size	1.6%	28%
Baseline	0.305	0.966
No. customers	85,089	131,493
Observations	169,303	261,308
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 63 - Bank 2 Trial A– medium pre-treatment charges

	UOD-A1	UOD-A2
	(1)	(2)
treatment	-0.293***	-0.420
	(0.093)	(0.280)
Effect size	6.2%	8.0%
Baseline	4.69	5.22
No. customers	66,298	14,209
Observations	131,926	28,293
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 64 - Bank 2 Trial A– heavy pre-treatment charges

	UOD-A1	UOD-A2
	(1)	(2)
treatment	-1.292***	-1.750***
	(0.245)	(0.560)
Effect size	4.3%	9.2%
Baseline	30	19
No. customers	66,709	14,467
Observations	132,879	28,778
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 65 - Bank 2 Trial B- rare pre-treatment charges

	LOWBAL50	LOWBAL100
	(1)	(2)
treatment	-0.007	-0.026
	(0.039)	(0.037)
Effect size	0.96%	3.6%
Baseline	0.721	0.721
No. customers	47,773	47,757
Observations	232,721	232,687
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 66 - Bank 2 Trial B - occasional pre-treatment charges

	LOWBAL50	LOWBAL100
	(1)	(2)
treatment	-0.660**	-0.506*
	(0.285)	(0.290)
Effect size	15%	12%
Baseline	4.35	4.35
No. customers	5,056	5,040
Observations	24,723	24,667
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 67 - Bank 2 Trial B- heavy pre-treatment charges

	LOWBAL50	LOWBAL100
	(1)	(2)
treatment	0.263	1.046*
	(0.566)	(0.558)
Effect size	-1.8%	-7.3%
Baseline	14.4	14.4
No. customers	5,504	5,498
Observations	26,811	26,687
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$	

Table 68 - Bank 2 Trial D - rare pre-treatment charges

	LOWBAL	AODUSE	AODLIM
	(1)	(2)	(3)
treatment	-0.057**	-0.092***	0.012
	(0.027)	(0.026)	(0.028)
Effect size	14%	23%	-3%
Baseline	0.396	0.396	0.396
No. customers	24,355	24,369	24,452
Observations	119,064	119,262	119,597
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 69 - Bank 2 Trial D- occasional pre-treatment charges

	LOWBAL	AODUSE	AODLIM
	(1)	(2)	(3)
treatment	-0.340***	-0.518***	-0.173
	(0.117)	(0.119)	(0.118)
Effect size	7.2%	11%	3.7%
Baseline	4.74	4.74	4.74
No. customers	18,989	19,038	19,017
Observations	92,914	93,056	93,010
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Table 70 - Bank 2 Trial D- heavy pre-treatment charges

	LOWBAL	AODUSE	AODLIM
	(1)	(2)	(3)
treatment	-0.087	-0.044	-0.030
	(0.288)	(0.291)	(0.286)
Effect size	0.31%	0.16%	0.11%
Baseline	27.8	27.8	27.8
No. customers	19,202	19,068	19,168
Observations	94,197	93,672	94,086
Note:	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$		

Annex 6: Representativeness

Table 71: Trial sample means comparisons

	All	AOD	No AOD
Gender	0.50	0.50	0.50
Age	47.1	50.10	43.69
Tenure	15.10	19.36	10.25
Balance	4,321.22	4,422.50	4,195.68
AOD limit	533.52	878.26	-
Mobile log-ins	7.38	5.76	9.40
Online log-ins	2.76	2.88	2.61
AOD charges	2.85	4.63	-
UOD charges	1.50	1.58	1.41

Notes: Values reported in cells are means. Gender is binary (1=female); age and tenure reported in years; remaining variables are monthly totals averaged over the last 6 months of 2016. Statistics for primary account holders from a random selection of 250,000 customers for 6 biggest UK PCA providers after correction for dormancy (similar to that described in Annex 1) but before other exclusions, yielding 1,366,355 customers across 6 banks. Metrics are weighted by PCA provider account market shares (market shares for 2015 provided by the CMA based on their market investigation data). Tenure is based on the opening date of a customer's first account with the bank.

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12 Endeavour Square, London E20 1JN
Telephone: +44 (0)20 7066 1000 Website: www.fca.org.uk