Sending out an SMS: Automatic Enrollment Experiments for Overdraft Alerts

MICHAEL D. GRUBB, DARRAGH KELLY,
JEROEN NIEBOER, MATTHEW OSBORNE,
and JONATHAN SHAW*

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Abstract

At-scale field experiments at major UK banks show that automatic enrollment into "just-in-time" text message alerts reduces unarranged overdraft and unpaid item charges 17–19% and arranged overdraft charges 4–8%, implying annual market-wide savings of £170–240 million. Incremental benefits from additional "early warning" alerts, triggered by low account balances are not statistically significant, although economically significant effects are not ruled out. Prior to the experiments, over half of overdrafting could have been avoided by using lower-cost liquidity available in savings and credit card accounts (FCA, 2018c). Alerts help consumers achieve less than half of these potential savings.

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*Michael D. Grubb is at Boston College. Darragh Kelly is at Google. Jeroen Nieboer is at Deliveroo and the London School of Economics. Matthew Osborne is at the University of Toronto, UTM Department of Management and Rotman School of Management. Jonathan Shaw is at the Financial Conduct Authority and Institute for Fiscal Studies. Earlier versions of this work circulated in two separate FCA Occasional Papers, Occasional paper No. 36, "Sending out an SMS: The impact of automatically enrolling consumers into overdraft alerts" and Occasional paper No. 40, "Time to act: A field experiment on overdraft alerts". We thank Andrea Caflisch and Paul Adams for their collaboration on these earlier versions of our work as well as Enrique Seira and Marieke Bos for careful reading and insightful comments on the earlier versions. We also thank John Beshears and Lucas Coffman for their expert feedback and Jaeyeong Kim and Arnab Palit for their excellent research assistance. We are indebted to Editor Stefan Nagel, an anonymous Associate Editor and two anonymous referees. All views expressed are those of the authors and are not purported to reflect those of the Financial Conduct Authority. In compliance with the *Journal of Finance* disclosure policy, we disclose that the UK Financial Conduct Authority (FCA) has an interest in this paper. The FCA provided access to the data and reviewed the paper prior to publication. Darragh Kelly and Jeroen Nieboer were FCA employees at the time of data collection and Jonathan Shaw is a current FCA employee. The project received approval from the FCA's ethics review board. Further details are available in our disclosure statement.

Correspondence: Michael Grubb, Boston College, 140 Commonwealth Ave, 341 Maloney Hall, Chestnut Hill, MA 02467; e-mail: michael.grubb@bc.edu.

Disclosure Statement

Michael D. Grubb

The UK Financial Conduct Authority (FCA) has an interest in this paper. The FCA provided me access to the data and will have a right to review the paper prior to publication. I did not participate in the data collection. The Boston College Office for Research Protections determined that IRB review was not required for data analysis.

Darragh Kelly

The UK Financial Conduct Authority (FCA) has an interest in this paper. I was an employee of the FCA at the time of data collection. The project received approval from the FCA's ethics review board. The FCA will have a right to review the paper prior to publication.

Jeroen Nieboer

The UK Financial Conduct Authority (FCA) has an interest in this paper. I was an employee of the FCA at the time of data collection. The project received approval from the FCA's ethics review board. The FCA will have a right to review the paper prior to publication.

Matthew Osborne

The UK Financial Conduct Authority (FCA) has an interest in this paper. The FCA provided me access to the data and will have a right to review the paper prior to publication. I did not participate in the data collection. I received REB approval from University of Toronto for data analysis. .

Jonathan Shaw

The UK Financial Conduct Authority (FCA) has an interest in this paper. I am an employee of the FCA. The FCA provided me access to the data and will have a right to review the paper prior to publication. I did not participate in the data collection. The project received approval from the FCA's ethics review board.

Bank overdrafts are both one of the most common forms of consumer borrowing and one of the most expensive options (Alan et al., 2018; Armstrong and Vickers, 2012; Stango and Zinman, 2009, 2014). Until recently in the UK, overdrafts incurred a mix of per-transaction (£5–15), per-day (£0.50–10), per-month (£6–10), and interest charges (equivalent annual rates of 11–67%) in addition unpaid item charges of £5–25 per declined transaction. Unarranged overdrafts (also referred to as unauthorized overdrafts) could be especially expensive—incurring charges in excess of 10% effective interest per day, prompting a regulatory pricing intervention by the Financial Conduct Authority (FCA) (FCA, 2018a; FCA, 2018c). Overdraft and unpaid item charges in 2017 totaled an estimated £2.6 billion, of which 50% was paid by less than 5% of consumers (FCA, 2018c). In the UK's most economically deprived areas (as measured by the English Index of Multiple Deprivation), the 1% heaviest users spent £380 on average in 2016 (1.9% of average household income net of housing expenses) on unarranged overdraft charges (FCA, 2018a; FCA, 2018c).

High effective interest rates often generate debate about whether the rates are efficient or exploitative. (For instance, Zinman (2014) and Beshears et al. (2018) summarize evidence on both sides for payday lending.) Expensive credit can be efficient when lenders have similarly high costs due to high default rates and borrowers have a high value for additional liquidity. Neither appears to be typical for overdraft borrowing. Adjusting for the risk of default, the FCA estimates that overdraft charges reflect average markups that are three times higher than those for credit-card lending or unsecured personal loans (FCA, 2018c). Moreover, previous studies show that consumers often have access to lower-cost sources of liquidity at the time of their overdraft borrowing (Stango and Zinman, 2009; FCA, 2018c).

A leading hypothesis for consumers' behavior is inattention to account balances (Stango and Zinman, 2009, 2014; Armstrong and Vickers, 2012; Grubb, 2015b; Liu et al., 2018). This is consistent with the CMA's (2016) finding that half of UK overdraft users were unaware they had recently used their overdraft facility. If inattention causes overdrafting, requiring banks to automatically enroll customers into overdraft text alerts should reduce overdraft charges. Such a policy was recently implemented by the UK Competition and Markets Authority (CMA) and then extended by the FCA based on our study (CMA, 2016; FCA, 2018c).

We present two sets of at-scale field experiments that measure the effect of automatic enrollment in overdraft text alerts. The experiments were conducted in 2017–2018 by two large national UK retail banks (Banks A and B) with a combined sample of 1.1 million

banking customers. The experiments automatically enrolled current (checking) account customers into a variety of "just-in-time" alerts that are triggered either upon entry into overdraft or when a pending transaction is ready to be declined and "early warning" alerts that are triggered at low balances before customers overdraft. We test both "stand-alone" early warning alerts sent to consumers who do not receive a corresponding just-in-time alert and "incremental" early-warning alerts sent to consumers who already receive a corresponding just-in-time alert.

Each alert is designed to warn of either an unpaid item (declined transaction) or one of the two types of overdraft facilities offered in the UK—arranged and unarranged. An *arranged overdraft* facility is a line of credit with a borrowing limit pre-agreed between bank and consumer, on average of about £1,000, which consumers automatically use when their current (checking) account balance drops below zero. An *unarranged overdraft* facility is used when a bank approves a transaction that takes the consumer past their arranged overdraft limit or, if they do not have an arranged overdraft, below zero.

These experiments are complemented by descriptive evidence of consumer overdraft behavior at all six large UK retail banks (which served 90% of the UK current account market at the time) and a follow-up survey linked to the field experiments. (Staggered rollouts of alerts in 2015 at Banks C and D are also analyzed as complementary natural experiments in Internet Appendix F.)

Our primary hypothesis is that just-in-time alerts, stand-alone early warning alerts, and incremental early warning alerts will all help consumers avoid overdraft charges. Our primary findings are twofold. First, all stand-alone alerts tested (including both just-in-time and early warning alerts) significantly reduced the overdraft charges that they were designed to warn of, and the effects are large. Automatic enrollment into stand-alone alerts reduced the sum of unarranged overdraft (UOD) charges and unpaid item (UI) charges by 5–19% (17–19% for just-in-time alerts), and reduced arranged overdraft (AOD) charges by 2–8% (4–8% for just-in-time alerts).[1] (Unless otherwise noted, stated ranges reflect variation in point estimates across treatments rather than confidence intervals.) Second—evidence for incremental benefits of adding an early-warning alert when a corresponding just-in-time

[1]The effect sizes for UOD and UI charges are substantially larger than those of 3–9% found by Ben-David et al. (2021) for a related email alert, consistent with the lower opening rate for emails relative to text messages.

alert is already in place is weaker. Incremental early-warning alerts have no statistically significant effects. Importantly, this may reflect a lack of statistical power rather than a lack of effectiveness—economically significant effects are not ruled out.

Beyond our primary hypothesis, we investigate three secondary questions: First, which customers benefit from alerts? Policymakers are concerned most about low-income customers and heavy overdrafters. It is possible that alerts benefit these groups little despite having substantial benefits on average. Low-income consumers may have limited available cash to transfer into an overdrawn account upon receiving an alert. Alerts may be uninformative for heavy overdrafters if they primarily overdraft intentionally rather than due to inattention, as suggested by Liu et al.'s (2018) finding that overdrafting at a US bank is negatively correlated with balance checks for light overdrafters but not for heavy overdrafters. Nevertheless, we find that alerts do benefit both customers with low account inflows (our proxy for income, the monthly sum of funds deposited into a customer's observed accounts) and heavy overdrafters. In fact, absolute fee reductions increase with pretreatment overdraft usage, although less than proportionally, so that percentage fee reductions are the smallest for the heaviest overdraft users. Consistent with this finding, alerts reduce days per month in overdraft across a wide range of the distribution—reducing both the chance of exceeding zero overdraft days in a month and the chance of exceeding 15 overdraft days in a month.

We also find that customers with high pretreatment measures of "close calls", in which account balances approach or cross overdraft thresholds without accruing charges, experience larger benefits of alerts. Relatedly, low average balances and (for those with positive average balances) high variability in account balances in the pretreatment period are associated with a larger absolute benefit from alerts. Finally, for many (but not all) treatments, lower account engagement measured by account logins is associated with larger benefits from alerts.

Second, how do customers react to alerts to achieve the measured savings? Bank A login data show alerts draw customers' attention to their accounts, increasing same-day account logins by 10–53% (0.13–0.49 logins). Bank A transaction data show that spending reductions are economically small but that each alert triggers as much as an additional 0.27 transfers (each averaging £465) into the account on the same day.[2] Although we cannot rule out economically significant effects from early warning alerts, this provides a reason

[2]In contrast, Stango and Zinman (2014) find that raising overdraft fee salience via a survey question reduces spending during the following two years but does not affect account inflows.

why their effects might be small: The theoretical benefit of incremental early warning alerts is that they allow customers to avoid an overdraft by cutting spending in advance, but in practice, consumers' spending is relatively inelastic to these alerts. One reason spending may be relatively inelastic to these alerts is that the amount of early warning they provide is often short—up to a third of early warning alerts arrive the same day as the corresponding just-in-time alert.

Third, do alerts eliminate overdrafting mistakes? In other words, when alerts are active, is all remaining overdraft borrowing optimal conditional on available liquidity?[3] We find that just-in-time alerts reduce days in overdraft by 4–21%, while the FCA (2018c) finds that 50-60% of days in overdraft could be avoided by using savings or less costly credit-card borrowing. This suggests that alerts eliminate less than half of overdraft charges arising from frictions such as inattention rather than from optimal borrowing. Moreover, while we do not observe savings or credit-card balances in our data, the 5% of customers with an overdraft facility for whom we observe a second current account provide additional supporting evidence that overdraft mistakes are prevalent even when alerts are active.

Extrapolating our primary findings to all consumers in the market using 2017 charges as a baseline suggests that just-in-time alerts could lower annual overdraft and unpaid item charges by £170 million to £240 million, of which £48 million to £110 million is due to the just-in-time AOD alerts.[4] Based on these findings, in 2019 the FCA expanded the CMA's mandate for just-in-time UOD and UI alerts to cover more banks (by reducing the size threshold for which the regulation applies) and added a mandate for just-in-time AOD alerts, but chose not to mandate any early warning alerts (FCA, 2018c). Banks self-reported estimates to the FCA of their costs for implementing these AOD alerts. Taking these numbers at face value, the FCA estimates industry-wide costs of implementing the new AOD alerts are at most £25 million in one-time costs and £17 million in ongoing annual costs of sending the text messages (FCA, 2018a).

A potential concern is that while some consumers benefit financially from alerts, other

[3]Overdraft borrowing may be optimal in the short run conditional on lack of alternative liquidity, but from a long-run perspective holding such low levels of liquid assets that necessitate overdraft borrowing is likely itself suboptimal (Beshears et al., 2018; Ericson and Laibson, 2019).

[4] In 2017 AOD, UOD, and UI charges were £1,700 million, £688 million, and £236 million respectively (FCA, 2018c). Just-in-time alert effect sizes of 17–19% for UOD and UI charges and 4–8% for AOD charges are applied to 75% of baseline charges as banks only hold mobile numbers for 75% of customers.

consumers might find them irritating and yet fail to avoid them by opting out due to hassle costs (particularly at banks that do not offer opt-out via text message). Our survey suggests that this is not a large concern: among consumers who remained enrolled in alerts, 84–92% rated alerts as helpful, and 69–81% agreed that enrollment should be automatic. A caveat is that our survey sample is selected based on which customers were willing to participate (the response rate was at least 5%; details are in Internet Appendix B).

Our estimated consumer benefits do not take into account banks' equilibrium pricing responses which are not observed in our experiments. On the one hand, theory predicts that benefits could be substantially larger because alerts could make consumers more elastic to overdraft charges and hence lead banks to lower them.[5] On the other hand, consumer benefits from text alerts could be substantially smaller due to the "waterbed effect" whereby banks raise other charges. Agarwal et al. (2015) show that the 2009 U.S. CARD Act reduced hidden credit-card charges in the U.S. by $29 billion annually without any resulting increase in other fees, reduction in credit, or other waterbed effects.[6] Like the regulated credit-card charges, overdraft charges are "hidden" in the sense that customers are typically unaware of them—for instance, when asked what their bank would charge for a one-day unarranged overdraft, 68–83% responded "don't know". To the extent that U.K. retail banks might respond to regulated cuts in hidden charges similarly to U.S. retail banks, there is reason to hope that pricing responses will not undermine the policy's consumer benefits.

The rest of the paper is organized as follows. Section I discusses related literature. Section II describes our data, experimental context, experimental design, sampling, and estimation approach. Section III reports our results and Section IV concludes.

I. Related Literature

The only other overdraft alert experiment that we are aware of is Ben-David et al.'s contemporaneous study of email alerts sent by the personal finance application Mint to a sample of its users. In contrast to this study, ours is "at scale" in terms of sample representativeness and

[5]For this reason, Grubb and Osborne (2015) predict usage alerts would lead U.S. cellular carriers to reduce the marginal price of phone calls, consistent with the rise in unlimited calling plans after usage alerts were mandated by the CTIA in 2013.

[6]See Agarwal et al. (2014); Grubb (2015a) for a theory of the waterbed effect.

implementation (Muralidharan and Niehaus, 2017): Our sample population is representative of the UK banking customers affected by an opt-out policy for overdraft text alerts. Our tested text alerts are the same alerts implemented by the same bank IT departments that would be rolled out in response to regulation. We estimate larger effect sizes than Ben-David et al. (2021), consistent with the fact that text messages are opened by 99% of recipients (Lane, 2010) while Mint's emails were only opened by 28-31% of users. Our study therefore provides a tighter lower bound on the fraction of overdrafting due to inattention. (Even with 99% reach, this is only a lower bound because a recipient can open a text message without redirecting their full attention to their current account balance.)

Like alerts, reminders can draw their recipient's attention to take action. Reminders have been found to be effective in a wide range of settings. Reminders can improve medical appointment attendance (Reekie and Devlin, 1998; Bourne et al., 2011), loan repayment (Cadena and Schoar, 2011; Karlan et al., 2015; Medina, 2021), influenza vaccination rates (Szilagyi and Adams, 2012), library returns (Apesteguia et al., 2013), dental appointment creation (Altmann and Traxler, 2014), medication adherence (Pop-Eleches et al., 2011; Bobrow et al., 2016), savings (Karlan et al., 2016; Kast et al., 2018), and gym attendance (Calzolari and Nardotto, 2017). However, reminders are sometimes ineffective in some of the same settings (Karlan et al., 2015; Bursztyn et al., 2019) or have unintended consequences (Damgaard and Gravert, 2018; Medina, 2021). See Hummel and Maedche (2019) and DellaVigna and Linos (2022) for meta-analyses of additional reminder studies. Unlike reminders, alerts contain real-time information that is not already known. Hence, individuals cannot replicate them using calendar software if they are not provided by banks.

A variety of studies inform optimal alert or reminder design by testing variations in message content. For instance, message effectiveness can increase with simplification (Ben-David et al., 2021) and personalization (Karlan et al., 2015). In our setting, policymakers had no intention to specify exact message text, so we tested banks' own chosen language that would be implemented for mandated alerts. Our study is one of only a few that we are aware of to investigate alert or reminder design with respect to timing (Karlan et al., 2015, 2016; Guyton et al., 2017; Medina, 2021). Most relevant is Medina's (2021) finding in support of early reminders—that sending five credit-card bill reminders spread over the month preceding the due date is more effective at inducing on-time payment than sending only the last two reminders.

II. Data, Background, and Methods

A. *UK Current Account Market*

Overdraft facilities are borrowing facilities tied to consumers' current (checking) accounts. 97% of UK adults have a current account and the product is universally used for receiving income, holding funds and making payments (CMA, 2016). Over two-thirds of accounts have an overdraft facility, which can either be arranged or unarranged. Transactions that take a consumer past their arranged overdraft limit or, if they do not have an arranged overdraft, below zero, are automatically rejected for a customer without a UOD facility. For those with a UOD facility, such transactions are processed at the bank's discretion based on how much credit would need to be extended. Either the bank extends credit to process the transaction as an unarranged overdraft, or the bank rejects the transaction and the customer typically incurs an *unpaid item* (UI) fee.[7]

Table I shows how arranged and unarranged overdraft fees were structured at each of the six major U.K. banks in May 2018, just after our field experiments concluded and prior to recent regulation (effective April 2020) restricting overdraft pricing to a simple interest rate. (See Appendix Table AIII for 2023 prices.) In 2018, arranged overdraft fees could include daily charges of £0.50–3.00 per day in overdraft, monthly charges of £6–10 per billing cycle in overdraft, and interest charges on overdraft balances with equivalent annual rates (EAR) of 11-67%. Unarranged overdraft fees could include daily charges of £5–10 per day in overdraft, interest charges on overdraft balances with EAR of 16-19%, and paid item charges of £5–15 per cleared transaction that results in an unarranged overdraft balance. Unpaid item charges could be £5–25 per declined transaction. Checkmarks in Table I show which of these fees each of the six major U.K. banks utilized in their overdraft fee structure. Several other features affect total monthly charges. No overdraft charges are incurred unless an account is in overdraft after an end-of-day grace period and the balance falls below a "buffer zone". Buffer zones were typically £10–15. Moreover, beginning in September 2017, banks were required to set their own monthly caps for the sum of unarranged overdraft and unpaid

[7]Unpaid item charges are typically charged for scheduled transactions, either scheduled by the account holder (such as regular rent payments) or scheduled by third parties with a mandate to draw on the account (commonly used for bill payments). Some unpaid items, such as attempted cash withdrawals from an ATM, do not incur a fee.

item fees called maximum monthly charges (MMC). MMC ranged £50–95. Some banks also voluntarily capped monthly arranged overdraft charges. No MMC is listed for Llyods Banking Group (LBG) because it ended unarranged overdraft in November 2017 (Milligan, 2017).

Table I

U.K. Overdraft Fee Structure in May 2018

Checkmarks in the table show which fees each of the six major U.K. banks utilize in their overdraft fee structure. No overdraft charges are incurred unless an account is in overdraft after an end-of-day grace period and the balance falls below a "buffer zone". Buffer zones are typically £10–15. The sum of unarranged overdraft and unpaid item fees is capped by the maximum monthly charge (MMC). LBG ended unarranged overdraft in November 2017 (Milligan, 2017). Additional acronyms stand for equivalent annual rate (EAR), Lloyds Banking Group (LGB), and Royal Bank of Scotland (RBS). † = We classify Barclays' "Emergency Borrowing" as unarranged overdraft even though it is opt-in. Source: Financial Conduct Authority (2018a, p. 42 Table 1).

Panel A: Arranged Overdraft Fees

	Daily (£0.50–3.00)	Monthly (£6–10)	Interest (EAR) (11–67%)
Barclays	✓		
HSBC			✓
LBG			✓
Nationwide			✓
RBS		✓	
Santander	✓		

Panel B: Unarranged Overdraft and Unpaid Item Fees

	Daily (£5–10)	Paid Item (£5–15)	Interest (EAR) (16–19%)	Unpaid Item (£5–25)	MMC (£50–95)
Barclays†	✓			✓	£67/mo.
HSBC	✓				£80/mo.
LBG					NA
Nationwide	✓	✓	✓	✓	£50/mo.
RBS	✓			✓	£80/mo.
Santander	✓			✓	£95/mo.

In collaboration with the FCA, we obtained a one-year representative panel of 1.5 million adult account holders in 2015 from the six largest retail banks. For each individual sampled from a bank, the data includes all current accounts held at the bank and all their transactions in 2015. Descriptive statistics for this observational dataset are shown in Table II. These six banks served a combined 90% of account holders in the UK, providing us extensive coverage of the UK consumer population (CMA, 2016). All six banks have a national branch

network and retail presence and offer all mainstream retail financial products alongside current accounts. Consumer surveys indicate there is little to differentiate their current account offerings in terms of quality (CMA, 2016).

Table II

Descriptive Statistics of a Representative Sample of UK Current Accounts, 2015

This table reports sample statistics for primary account holders as of January 2015 (age, tenure, gender, online and mobile banking registration) or aggregated over 2015 (all other variables), weighted to bank market shares as of 2015 (not provided). Acronyms stand for arranged overdraft (AOD) and unarranged overdraft (UOD). Tenure measures years since account opening; online and mobile registration are the proportion of customers who are registered for online or mobile account access as of January 2015; AOD facility is the proportion who had an arranged overdraft facility in 2015; AOD limit is the limit for arranged overdraft borrowing; and AOD (UOD) used is the proportion who had positive AOD (UOD) charges in 2015. Note that age through AOD facility are stock variables, while AOD used through total charges are flow variables measured per year. The total sample size is 1,366,355 customers across six banks, after exclusions for account dormancy as explained in Internet Appendix F.5.

	Q25	Median	Mean	Q75	Q95	Q97.5
Age (years)	32	46	47.11	61	80	85
Tenure (years)	5	10	13.03	19	31	40
Gender (=1 if Female)			0.50			
Online banking registration			0.67			
Mobile banking registration			0.41			
AOD facility			0.58			
AOD limit (£)	0.00	200.00	1180.46	1100.00	5000.00	8100.00
AOD used in 2015			0.33			
AOD annual charges (£)	0.00	0.00	32.49	2.25	217.46	337.63
UOD used in 2015			0.24			
UOD annual charges (£)	0.00	0.00	13.98	0.00	70.00	174.00
Unpaid item annual charges (£)	0.00	0.00	5.93	0.00	30.00	70.00
Total annual overdraft charges (£)	0.00	0.00	52.40	20.00	316.80	473.74

Customer characteristics and overdraft usage are relatively similar across the six banks. Mean age and gender proportions are similar to the dataset mean for all banks (across banks, mean age ranges 45–50 years, gender proportion female ranges 0.48–0.52). Banks' policies on overdraft facilities differ slightly, but the proportion of customers with an arranged overdraft facility at the different banks is similar (0.47–0.63). The (highly skewed) distribution of total annual overdraft charges is also remarkably similar across banks, with customers up to the 75th percentile paying relatively little (£8–36 per year), rising steeply for those at higher percentiles (£223–363 per year at the 95th percentile). Appendix Figure A1 shows the 2015 distribution of arranged and unarranged overdraft charges for all six banks.

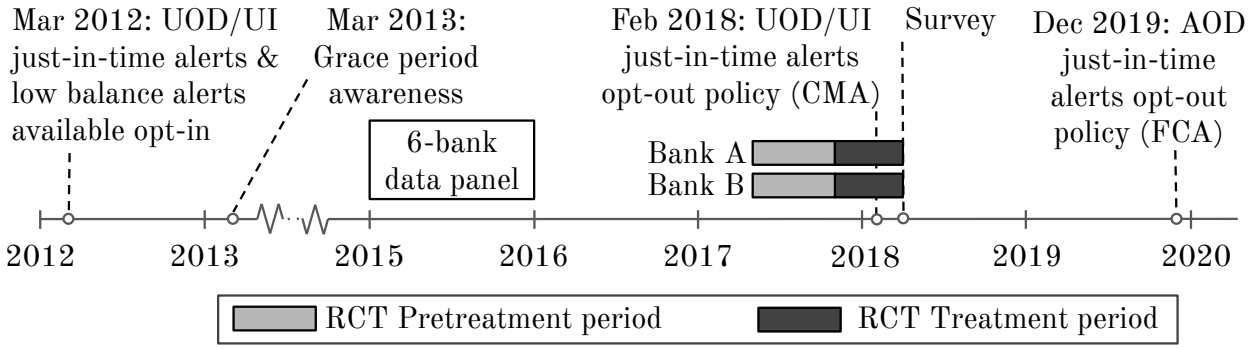

Figure 1. Dates of policy changes, observational data, and field experiments (RCTs). Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), unpaid item (UI), Competition and Markets Authority (CMA), Financial Conduct Authority (FCA), and randomized controlled trial (RCT).

Note that the six-bank panel dataset we use is a subset of that used by the FCA to complete its High-Cost Credit Review, as their panel extended a second year to the end of 2016 and was linked to information about customers' other financial accounts via credit reporting agencies. Hence, for more extensive descriptive statistics (including many we cite in this paper), see Financial Conduct Authority (2018c).[8]

B. Overdraft Alerts

Figure 1 shows the timing of policy changes that affected the availability of overdraft alerts relative to our observational data, field experiments, and survey. UK government policy mandated that, by March 2012, all large UK banks provide their customers opt-in access to three types of text message alerts.[9] The first two are both just-in-time alerts, which are sent (i) when customers enter UOD and (ii) when transactions are scheduled to be rejected

[8]The Consumer Financial Protection Bureau (CFPB) reports detailed descriptive statistics about overdrafting in the U.S. market based on similar customer-level account data drawn in 2011-2012 from study banks that have a total of 40 million U.S. customers (Low et al., 2017). The CFPB's more recent work relies on aggregate statistics reported at the bank level from core processors (Kelly and Nagypál, 2021) or bank "call reports" (CFPB, 2023).

[9]A previous 2008 agreement for UK banks to send customers an annual summary of their account usage and costs was found to have no effect on charges or likelihood of switching provider (Hunt et al., 2015), indicating that alert effectiveness is due in part to their timeliness.

and UI charges are pending. The third is an early-warning or low-balance alert, sent when a customer's balance falls below a threshold (BIS & HM Treasury, 2011). Although causal impact estimates for the opt-in policy are not available, they are likely to be modest as voluntary sign-up rates for these alerts two years after their introduction range from 1% to 8% (Caflisch et al., 2018).[10]

In 2016, the CMA mandated that all large UK banks must automatically enroll their customers in the just-in-time UOD and UI alerts by February 2018, thereby changing the policy from opt-in to opt-out for these alerts (CMA, 2016). Effective December 2019, following the release of our findings in a policy paper (Adams et al., 2018), AOD just-in-time alerts were also mandated on an opt-out basis by the FCA (FCA, 2018c). The effect size estimates in earlier versions of this paper directly informed the design of this policy. Early warning alerts remain available on an opt-in basis.

The arrival of just-in-time alerts coincides with an intraday grace period. The CMA requires that the timing of alerts with respect to UOD grace period deadlines must "allow customers a reasonable opportunity to take action to avoid or reduce charges" (Competition & Markets Authority, 2016, paragraph 15.38).[11] If sufficient funds are deposited sufficiently early on the day an alert is received, overdraft charges are avoided as they are only assessed when the end-of-day balance is in overdraft. Similarly, rejected transactions will clear without incurring UI charges when banks make second attempts to process the transactions later in the day.

For a hypothetical consumer who has both AOD and UOD facilities and is enrolled in all alerts, Figure 2 illustrates when just-in-time and early warning alerts are sent as the consumer's account balance decreases. We refer to the alert labeled "UOD/UI early warning" as providing early warning for UI in addition to UOD because extension of credit through a UOD facility is at the banks discretion and is typically limited—meaning that any account on the verge of incurring UOD charges is also on the verge of incurring UI charges.

[10] Hunt et al. (2015) estimate that active opt-in to alerts reduces UOD charges 5–8%, but the effect cannot be distinguished from learning following the overdraft episode that triggered opt-in.

[11] UOD grace periods are required while AOD grace periods are provided voluntarily. Banks committed to make customers aware of the grace periods by March 2013 (BIS & HM Treasury, 2011). As far as we are aware, banks do not delay sending alerts to reduce their effectiveness. For instance, Bank A sends early warning alerts and just-in-time AOD and UOD alerts in real-time (with a quiet period between 7:30 PM–6:30 AM) and just-in-time UI alerts in batches at least 3 hours before the end of the grace period.

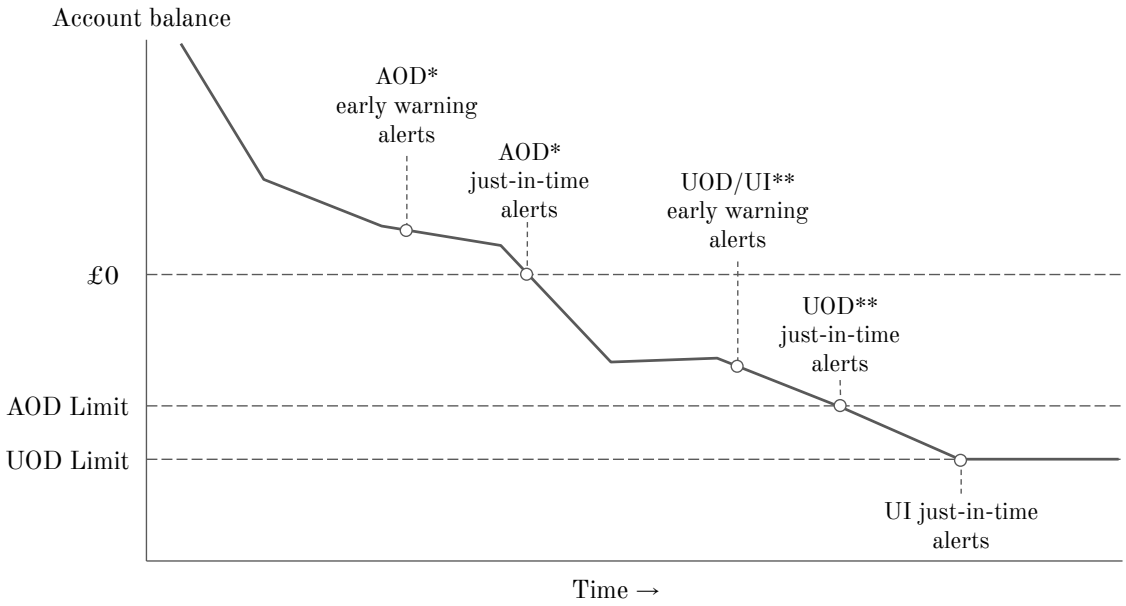

Figure 2. Illustration of balance thresholds at which alerts are sent. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). The AOD limit is pre-agreed between bank and consumer, whereas the UOD limit is unknown to the consumer. * = If the consumer does not have an AOD facility, this will be a UOD/UI alert. ** = If the consumer does not have an UOD facility, this will be a UI alert.

C. Field Experiment Design

Under FCA auspices, we conducted two sets of field experiments in 2017–2018 in collaboration with two of the six top UK national retail banks (Banks A and B). The FCA's objective was to test if automatic enrollment into alerts in addition to those already mandated by the CMA (just-in-time UOD and UI alerts) would be beneficial to consumers. The treatments, trial dates, and sample sizes were agreed with each bank in a 'Terms of Reference' document signed by the bank and the FCA, which serves as our pre-registration of key study details (see Internet Appendix J). An ethics review was conducted in accordance with established FCA procedure.[12]

After sampling was complete, both banks automatically enrolled treatment group customers into treatment alerts at the beginning of November 2017 (we provide details on

[12]The ethics review considered the rights, welfare, and dignity of individuals, benefits to society, and whether there are specific aspects of the research that heighten risks to participants. See FCA (2018b) for details on our ethics procedure.

the structure of treatments in the following section). For shared bank accounts, all account holders with a registered mobile number receive alerts. Upon enrollment, both banks sent an email notifying automatically enrolled customers that they would now be receiving alerts. Bank A also allowed its customers to opt-out by responding to a text message within a 2-day window at the start of the experiment.

Both banks shared a pre-agreed dataset on all individuals in control and treatment groups with the FCA. This dataset includes six months of pretreatment data and five months of post-treatment data. The data includes all transactions during the sample period and contains the same variables as the 2015 observational dataset with some small differences between banks. Bank A was able to share with us the date that a particular alert was sent; Bank B was able to share with us any changes that customers made to the threshold level of their early warning alerts. Internet Appendix Table H.I reports sample descriptive statistics for each bank.

The experiments let us measure the incremental benefit of a treatment alert relative to the overdraft alerts already in use in both treatment and control groups. We denote the latter type of alerts as 'baseline' alerts. Figure 3 shows the experimental timing of automatic enrollment into both treatment alerts and baseline alerts. Months 1–6 (May–October 2017) are the pretreatment period; months 7–11 (November 2017–March 2018) are the treatment period. The alerts in use at baseline varied over the 11-month sample period as both banks had to comply with the regulatory mandate to automatically enroll all customers into just-in-time UOD and UI alerts prior to month 10 (February 2018). We refer to months 1–9 as pre-mandate and months 10-11 as post-mandate.

Bank A enrolled all sampled customers into just-in-time UI alerts prior to our sample period, and into just-in-time UOD alerts at the regulatory deadline during the treatment period (Figure 3 Design A). In contrast, for most treatments, Bank B automatically enrolled treatment and control customers into just-in-time UOD and UI alerts at the start of the treatment period (Figure 3 Design B1). The exception is that, to test just-in-time UOD and UI alerts, Bank B used a staggered rollout by automatically enrolling treatment group customers at the start of the treatment period and control group customers at the regulatory deadline (Figure 3 Design B2).

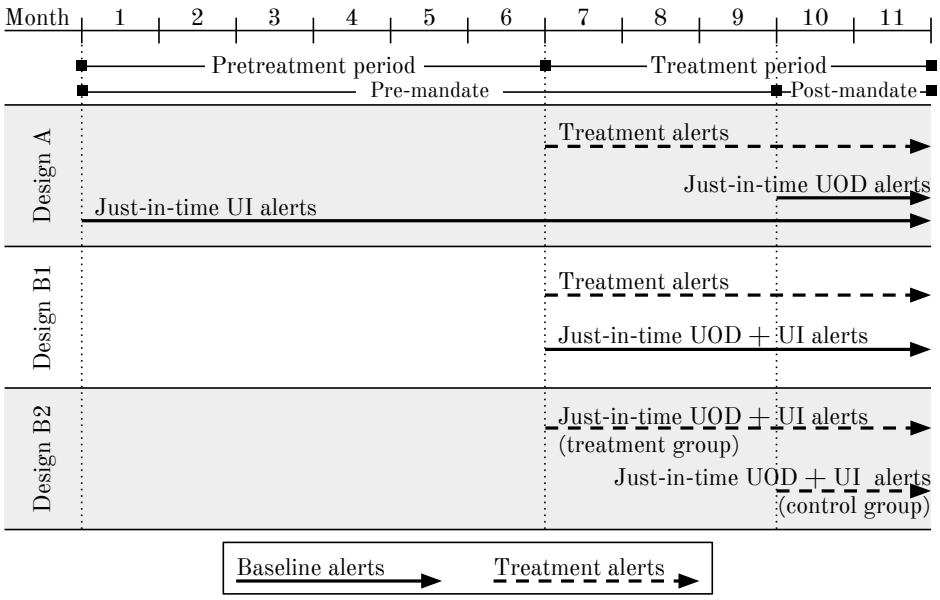

Figure 3. Experiment timeline. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). Month 1 is May 2017. Baseline alerts are introduced to control and treatment groups at the same time. Policy mandated automatic enrollment into just-in-time UOD and UI alerts prior to month 10 (February 2018). These alerts were added to the baseline during the experiments to comply with the deadline. Bank A used Design A for all its experiments (treatments 1, 7, 10, 11). Bank B used Design B1 for all its experiments except the tests of just-in-time UOD and UI alerts (treatments 2, 5, 6, 8, 9). To comply with the regulatory deadline, these alerts were tested using a staggered rollout approach as shown in Design B2 (treatments 3, 4). Treatment alerts are introduced to all treatment groups in month 7 and, in the staggered-rollout Design B2, to control groups in month 10.

D. Treatments

Table III shows the treatments studied at Banks A and B. For each intervention, Table III reports (1) the treatment number; (2) the bank; (3) the treatment design A, B1, or B2 described in Figure 3; (4) the overdraft facility of the target population (AOD+ is arranged with or without unarranged); (5) the treatment alert "target" (which is the set of charges—AOD, UOD, or UI—that the alert is intended to warn of); (6) the treatment alert warning threshold (which specifies how close a customer's balance must be to incurring charges to trigger an alert, either zero for just-in-time alerts or £50 or £100 for early warning alerts);

Table III

Experimental Treatments

This table describes our experimental treatments, with cross references to descriptions of treatment designs A, B1, and, B2 in Figure 3 and representative text for message numbers 1–6 in Table IV. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. Enrollment into alerts was either automatic (auto) or a 'prompted enrollment' treatment, where customers were encouraged in an e-mail campaign to actively opt-in to an early warning alert. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. Following experimental Design A, treatment 9 tested an early warning UOD and UI alert that was stand-alone for the first three treatment months (pre-mandate) and incremental thereafter (post-mandate). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels.

				Treatment alert					Baseline just-in-time alerts	
Treatment	*Bank*	*Design*	*Overdraft facility*	*Alert target*	*Alert threshold*	*Message*	*Enrollment*	*Stand-alone*	*UOD (message 3)*	*UI (message 4)*
1	A	A	AOD+	AOD	0†	1a-c	auto	Yes	post-mandate	Yes
2	B	B1	AOD+	AOD	0	2	auto	Yes	Yes	Yes
3	B	B1	AOD+	AOD	100	5	auto	Yes	Yes	Yes
4	B	B2	AOD+	UOD + UI	0	3,4	auto	Yes	post-mandate	post-mandate
5	B	B1	AOD+	UOD + UI	50	6	auto	No	Yes	Yes
6	B	B2	UOD only	UOD + UI	0	3,4	auto	Yes	post-mandate	post-mandate
7	B	B1	UOD only	UOD + UI	50	5	auto	No	Yes	Yes
8	B	B1	UOD only	UOD + UI	100	5	auto	No	Yes	Yes
9	A	A	UOD only	UOD + UI	100	5	auto	pre-mandate	post-mandate	Yes
10	A	A	None	UI	100	5	auto	No	post-mandate	Yes
11	A	A	None	UI	100	5	prompted	No	post-mandate	Yes

(7) a message number that cross-references representative alert text in Table IV; (8) whether treatment was automatic enrollment into an alert or an email prompt to self-enroll; (9) whether the treatment alert was stand-alone or incremental to an alert with different timing but the same targeted charges; and (10) whether baseline alerts sent to both treatment and control groups included just-in-time UOD and UI alerts for the whole treatment period or only post mandate. We group treatments by the overdraft facility of the target population and the alert target, and order them within these groups by the tested warning threshold. (See Appendix Table AII for average total monthly observed charges for each treatment and control group.)

We categorize the different treatments into four different sets, according to the type of alerts individuals in each treatment group may receive. Our first set of treatments measures the effect of automatic enrollment into stand-alone just-in-time AOD alerts (treatments 1 and 2 in the first two rows of Table III). In treatment 1 at Bank A, the customer was simultaneously enrolled into a suite of four alerts: (1) An alert sent upon entering arranged overdraft, (2) an alert for exceeding 90% of the AOD limit, and (3) two additional alerts for crossing the balance thresholds of -£1,000 and -£2,000 in the case that 90% of the AOD limit had not already been reached.[13] The control group for treatment 1 will be individuals within the same bank, having the same facility, who only receive the baseline alerts identified in Figure 3, Design A. Control groups are similarly defined for the other treatments. All of the alerts mentioned arranged overdraft, and the first alert mentioned the (extra) charges that the customer would incur if no action was taken (Table IV messages 1a–c). In treatment 2 at Bank B, the customer was enrolled into a single alert notifying the customer that their balance was below zero without mentioning arranged overdraft or charges (Table IV message 2). This subtle difference between the two banks' implementations is similar to what we might expect to happen if a policy of mandatory arranged overdraft alerts came into force (as it did in December 2019).

Our second set of treatments, shown in rows 4 and 6, measures the effect of simultaneous automatic enrollment into the two CMA-mandated alerts: a just-in-time UOD alert sent when a customer enters UOD, and a just-in-time UI alert sent when a pending transaction is

[13]Bank A's alert for exceeding 90% of the AOD limit might be classified as an early warning alert for unpaid item charges. However, we include the entire suite of alerts with just-in-time AOD alerts because the predominant alert issued in the suite is the alert sent upon entering AOD. Alerts for entering AOD comprise 57% of Bank A's issued AOD alerts, while alerts for exceeding 90% of the AOD limit comprise 33%.

Table IV

Representative Alert Message Text

This table reports representative text of alerts tested in our experiments. Exact text cannot be reproduced to protect bank anonymity. The bank's name appears as the sender of each text message, so recipients recognize alerts as coming from their bank. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). Table III lists message numbers corresponding to each experimental treatment.

No.	Type	Target	Bank	Representative text
1a	just-in-time	AOD	A	You are now using your overdraft and may incur charges
1b	part of AOD alert suite		A	You are now using £x of your arranged overdraft
1c	part of AOD alert suite		A	You are approaching your arranged overdraft limit
2	just-in-time	AOD	B	Your balance is now below £0
3	just-in-time	UOD	B	You are now using your unarranged overdraft. Transfer funds before cut-off to avoid charges.
4	just-in-time	UI	B	A scheduled payment will go unpaid. Transfer funds before cut-off to avoid charges.
5	early warning	AOD/UOD/UI	A/B	Your balance is now below £X (For $X = 100$ or 50)
6	early warning	UOD/UI	B	You are approaching your arranged overdraft limit

about to be declined. These are tested by Bank B for customer samples with an AOD facility (treatment 4) and with only a UOD facility (treatment 6). Alert messages (Table IV messages 3 and 4) prompt customers to transfer funds to avoid charges. These two treatments have a staggered rollout design (Figure 3 Design B2). As in all experiments, treatment group individuals were auto-enrolled at the start of month 7, but for these two treatment arms only, control group individuals were also auto-enrolled at the start of month 10 to comply with the February 2018 regulatory deadline for automatic enrollment.

Our third set of treatments (3, 5, and 7–10) tests the effectiveness of automatic enrollment into alerts that provide early warning for AOD (treatment 3), for UOD and UI (treatments 5 and 7–9), and for UI alone for customers without a UOD facility (treatment 10). Alerts are triggered at a default low-balance threshold of either £100 or £50 above zero or above the AOD limit in treatment 5 (for early warning of UOD and UI to customers with an AOD facility).[14] Customers are able to adjust the level of these thresholds themselves

[14]The ideal early warning alert would be triggered prior to the day the overdraft occurs (so that it does provide earlier warning than a just-in-time alert) but only be triggered if an overdraft is going to occur. In practice, low thresholds do not provide early warning, while high thresholds often lead to false alarms. Our threshold choices were designed to balance the competing goals of providing early warning while minimizing false alarms in a reasonable way, as discussed in Adams et al. (2018).

post-enrollment, but (as expected) few choose to do so. Alerts notify customers of their low balance but do not mention charges or explicitly prompt action (messages 5 and 6).

Our final treatment is treatment 11, which is identical to treatment 10, except that it tests prompted rather than automatic enrollment. In treatment 11, customers were encouraged to set up early warning UI alerts through an e-mail campaign.[15]

All tested just-in-time alerts were 'stand-alone' in the sense that at baseline customers had not been automatically enrolled into any other alerts that targeted the same charges. For example, just-in-time AOD alerts were tested with UOD or UI alerts present at baseline but no other AOD alerts (treatments 1 and 2). In contrast, almost all early warning alerts were 'incremental' in the sense that, at baseline, customers had already been automatically enrolled in just-in-time alerts that targeted the same charges. Two exceptions are treatments 3 and 9. Treatment 3 tested a stand-alone early warning AOD alert, while treatment 9 tested an early warning UOD and UI alert that was stand-alone for the first three treatment months and incremental thereafter (following experimental Design A).

Table IV reports representative text of tested alerts. (Exact text is not reproduced to protect bank anonymity.) This shows that while most tested just-in-time alerts (excluding Bank B's just-in-time AOD alert) specifically mention impending charges, no early warning alerts do so. Moreover, Bank B's just-in-time UOD and UI alerts specifically prompt action before a deadline, instructing recipients to "Transfer funds before cut-off". Thus any differences found in effectiveness across just-in-time and early warning alerts may be due to variation in charge salience and the prompts for action, as well as variation in timing.

In particular, lower fee salience and absence of deadlines could be expected to lower the effectiveness of early warning alerts. Existing work shows that increasing bank fee salience leads to reduced incidence of overdraft charges (Stango and Zinman, 2014; Alan et al., 2018). The absence of a deadline could lead consumers to procrastinate and to delay corrective action (O'Donoghue and Rabin, 1999; Herweg and Müller, 2011), perhaps until forgetting about the problem altogether (Holman and Zaidi, 2010; Ericson, 2017), leading to higher charges.[16]

[15]Even in this prompted enrollment treatment, in which the hassle costs of selecting a different alert threshold were low conditional on actively opting in, only 2% of enrollees chose a different threshold than the £100 default.

[16]Ariely and Wertenbroch (2002) show that students earn higher grades on papers when subject to shorter deadlines, and Madeira (2015) finds that US consumers are more likely to switch Medicare Part D insurance

E. Sampling

Eligibility for sampling for our field experiments was restricted to customers for whom automatic enrollment into text message overdraft alerts is a relevant policy. We agreed with the banks to exclude consumers with a deceased flag on their record, those with legal representatives (e.g. power of attorney), dormant accounts, those that could not be enrolled into alerts because 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, and (in the case of Bank A) those who had already self-enrolled in the alerts. In addition, in the interest of statistical power, we excluded 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 six months preceding the trial. Which specific treatment groups customers were eligible for was then determined by their overdraft facilities.

Our unit of observation is the customer—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 the same treatment (and subsequently removed from the eligible population).

Allocation of customers to treatment was done as follows: From the population of consumers eligible for testing, banks randomly selected a sample for each treatment and control group. Bank A was able to stratify (block randomize) on key pretreatment variables.[17] Bank B 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 verify that treatment and control groups are balanced on pretreatment observables in Internet Appendix Table H.II. Appendix Table AI shows how we construct our estimation sample by dropping observations with inconsistent or missing data and dropping customers who lack an active primary account, have defaulted, or are using

plans when given a shorter deadline. However, Bertrand et al. (2010) find that longer loan-offer deadlines lead to higher rather than lower take-up of high-cost credit. Moreover, following text message prompts to make a charitable donation, Damgaard and Gravert (2017) finds that whether the deadline is midnight tomorrow or longer has no effect on giving.

[17]Arranged overdraft limit, median account inflows in last six months, total overdraft charges in last six months, mean account balance in last six months, total mobile app usage in last three months, gender, age, and tenure.

their account for business purposes.

F. *Measure of Overdraft Charges*

We use two separate measures of overdraft charges derived from account transaction data. First, when an account balance becomes negative and enters arranged overdraft, we can compute the resulting arranged overdraft charge based on our knowledge of each bank's fee schedule. We call this the "inferred" arranged overdraft charge. Second, in the following billing cycle, a transaction will appear in our data labeled as an arranged overdraft fee, which deducts arranged overdraft charges accrued in the preceding billing cycle. We call this the "observed" arranged overdraft charge. Similarly, we use both inferred and observed measures of unarranged overdraft and unpaid item charges. Inferred and observed overdraft charges are highly but imperfectly correlated (Internet Appendix Table C.I) due to imperfections in our computation of inferred charges. Observed charges are our preferred measure. We sometimes use inferred charges for our analysis, however, because observed charges are measured at the monthly billing cycle level rather than daily and because they are observed with delay (so are missing for our final treatment month).

G. *Econometric Specification*

We estimate the intent-to-treat (ITT) effect of automatic enrollment into tested alerts with a difference-in-differences specification:

$$Y_{i,t} = \beta_1 \, Treatment_i \times I(t \geq 7) + \beta_2 \, Treatment_i \times I(t = 7) + \eta_i + \mu_t + \epsilon_{i,t}, \tag{1}$$

where $Y_{i,t}$ is the outcome variable (e.g., overdraft charges) for individual i in month t. $Treatment_i$ is an indicator equal to 1 if customer i was assigned to the treatment group. $I(t \geq 7)$ is an indicator for the treatment period and $I(t = 7)$ is an indicator for the first treatment month. Finally, η_i are individual fixed effects, μ_t are month fixed effects, and we cluster standard errors by individual and month. Our results report the parameter of interest, β_1 (the effect of being automatically enrolled into treatment alerts).

Treatments 4 and 6 use a staggered rollout design (design B2). Goodman-Bacon (2021) show that, for staggered rollouts, the standard difference-in-difference estimate is difficult

to interpret if treatment effects vary over time. New methods that allow for time-varying treatment effects rely on the existence of never-treated units (Cengiz et al., 2019; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021; Borusyak et al., 2022). Hence, we drop the last two months (10 and 11) when all customers are treated. With this restriction, we can use the standard specification above.

We include (but do not report) an enrollment-month treatment effect ($\beta_1 + \beta_2$) separately from the main treatment effect (β_1) only when the outcome variable is observed overdraft charges. Overdraft charges are deducted from individuals' accounts (and hence observed as transactions) once per billing cycle with approximately a 25-day lag following the billing cycle in which they were incurred. Because treatment began at the beginning of a calendar month, but individuals' billing cycle start dates vary across the calendar month, observed charges that we allocate to the enrollment month are, on average, from a billing cycle that was only half in the treatment period. Therefore we expect the estimated enrollment month effect to be approximately half that of the main treatment effect. For all other outcome measures, we drop the enrollment month effect and estimate a single treatment effect.

III. Results

A. Treatment Effect on Enrollment

Prior to automatic enrollment, cumulative opt-in rates for any alert across the six major banks were at most 8% (Caflisch et al., 2018).[18] During our treatment period, cumulative opt-out rates were all below 10%. As a result, automatic enrollment dramatically raised enrollment in all treatments. Opt-in and opt-out rates reported in Appendix Table AII imply that automatic enrollment raised enrollment by 95–99 percentage points across Bank B treatments and at least 91–93 percentage points across Bank A treatments.[19] In contrast, Bank A's prompted enrollment treatment was less successful by an order of magnitude; it

[18]Personal experience of one coauthor at two of the major banks is that opting in was not easy. It required locating a difficult-to-find option on the online portal and could not be completed in person or by phone. This may help explain low opt-in rates.

[19]These calculations use reported opt-in rates of 0.8–3.2% for Bank B (Appendix Table AII) but the 8% upper bound on opt-in rates (Caflisch et al., 2018) for Bank A. This is because reported opt-in rates are cumulative over the history of alerts for Bank B, but only over the sample period for Bank A, since previously opted-in customers were excluded from the Bank A sample.

only caused 8.7% of treated customers to enroll. (For survey results about consumers' reasons for opting out see Internet Appendix B. For a comparison of customers who opt-in, opt-out, or follow the default, see Internet Appendix Table H.IV.)

Although cumulative opt-out rates are all below 10%, opt-out rates are much larger at Bank A (6.9– 9.2%) than at Bank B (0.1–1.6%). The higher opt-out rates for Bank A are not surprising, as Bank A customers could easily opt out by replying to a text message at the start of the enrollment period, whereas Bank B customers had to log in to their accounts to change settings. The comparison between bank opt-out rates shows that the ease with which consumers can opt out strongly affects opt-out rates but that the vast majority of consumers remain opted-in to the alerts, even when opting out is as easy as possible.

B. Treatment Effect on Average Charges

Table V reports our main results: the intent-to-treat effect in pounds sterling per month on observed AOD charges, UOD/UI charges, and total charges in the months after automatic enrollment in alerts. Two patterns are clear. First, all tested stand-alone alerts (both just-in-time and early warning) reduce total monthly charges by a statistically and economically significant amount: 27–56 pence per month or 3–19 percent. (Effects are statistically significant at the 1% level.[20]) In contrast, all tested incremental early warning alerts have statistically insignificant effects, although imprecision means we cannot rule out economically significant effects of similar magnitude.

Second, alerts primarily affect the charges they target (highlighted in gray): Although there may be some spillover effects to other charges, they have small point estimates and are statistically insignificant. Thus estimated absolute effects for targeted charges are similar to those for total charges. Henceforth, we therefore focus on targeted charges, for which relative effect sizes are more comparable across treatments.

Moving beyond these two clear patterns, we find no statistical difference between alerts that differ only in timing. Treatments 2 and 3 both test a stand-alone AOD alert at Bank B with similar wording, but vary whether the alert is a just-in-time alert (treatment 2) or an early warning alert with a £100 threshold (treatment 3). Point estimates suggest that the

[20]Results for all primary hypotheses in Table V are robust to a Bonferroni correction for $n = 11$ trials except for treatment (3) which drops from significance at the 1% level to significance at the 5% level.

Table V

Automatic & Prompted Enrollment in Alerts—Effect on Observed Monthly Overdraft Charges

This table reports the effect of automatic & prompted enrollment in alerts on observed monthly overdraft charges in pounds sterling per month. Dependent variables include arranged overdraft (AOD) charges, the sum of unarranged overdraft and unpaid item charges (UOD+UI), and total overdraft charges. Total charges are AOD+UOD+UI charges for treatements 1–5, UOD+UI charges for treatments 7–9, and UI charges for treatments 10–11. Treatment 6–11 AOD fee estimates are blank because the customers in those subsamples do not have an AOD facility. Estimates for treatments 1–10 are intent-to-treat (ITT) for automatic enrollment. Two estimates are provided for the 'prompted enrollment' treatment 11 where customers were encouraged in an e-mail campaign to actively opt-in to an early warning alert: an ITT estimate (column 11) and a latent average treatment effect (LATE) estimate of alert registration instrumented by the prompted enrollment treatment (column 12, first stage F-statistics 6710 and 6710). Treatments 4 and 6 exclude months 10–11 when all units in those treatments are treated. Customer and month fixed effects are included and error terms are clustered by customer and month. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. Gray highlighted estimates are those for charges targeted by the treatment alert. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+					UOD only				None		
Alert target	AOD			UOD + UI		UOD + UI				UI		
Alert threshold	0†	0	100	0	50	0	50	100		100	100 (prompted)	
Bank	A	B	B	B	B	B	B	B	A	A	A	A
Treatment	1	2	3	4	5	6	7	8	9	10	11	11
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
AOD fees	-0.529***	-0.302***	-0.194***	0.039	-0.017							
s.e.	(0.070)	(0.042)	(0.045)	(0.034)	(0.043)							
p-value	0.00003	0.00006	0.002	0.284	0.696							
Baseline mean	6.26	7.99	7.99	8.06	7.99							
Effect size	8.4%	3.8%	2.4%	-0.5%	0.2%							
UOD+UI fees	0.000	-0.030	-0.081	-0.438***	-0.105	-0.557***	-0.123	-0.090	-0.270***	0.002	-0.013	-0.140
s.e.	(0.010)	(0.050)	(0.049)	(0.063)	(0.074)	(0.056)	(0.079)	(0.092)	(0.051)	(0.014)	(0.014)	(0.152)
p-value	0.991	0.569	0.131	0.0001	0.186	0.000009	0.154	0.355	0.0005	0.913	0.381	0.382
Baseline mean	0.37	1.95	1.95	2.52	1.95	3.00	2.29	2.29	4.93	1.18	1.18	1.18
Effect size	-0.0%	1.5%	4.2%	17%	5.4%	19%	5.4%	3.9%	5.5%	-0.1%	1.1%	12%
Total	-0.528***	-0.331***	-0.275***	-0.399***	-0.123	-0.557***	-0.123	-0.090	-0.270***	0.002	-0.013	-0.140
s.e.	(0.069)	(0.068)	(0.072)	(0.067)	(0.091)	(0.056)	(0.079)	(0.092)	(0.051)	(0.014)	(0.014)	(0.152)
p-value	0.00003	0.0009	0.004	0.0003	0.212	0.000009	0.154	0.355	0.0005	0.913	0.381	0.382
Baseline mean	6.63	9.94	9.94	10.58	9.94	3.00	2.29	2.29	4.93	1.18	1.18	1.18
Effect size	8.0%	3.3%	2.8%	3.8%	1.2%	19%	5.4%	3.9%	5.5%	-0.1%	1.1%	12%
Estimate	ITT	ITT	ITT	ITT	ITT	ITT	ITT	ITT	ITT	ITT	ITT	LATE
Stand-alone alert	Yes	Yes	Yes	Yes	No	Yes	No	No	Pre-mandate	No	No	No
No. customers	138,532	64,718	64,743	226,033	64,654	188,755	68,842	68,856	70,935	173,595	274,471	274,471
No. observations	1,316,817	636,106	636,280	2,001,911	635,863	1,538,839	619,620	618,933	630,132	1,567,011	2,477,109	2,477,109
Adjusted R^2	0.78	0.69	0.68	0.69	0.68	0.36	0.37	0.38	0.69	0.39	0.40	0.40

just-in-time alert is 1.6 times as effective as the early warning alert in reducing AOD charges, and 1.2 times as effective in reducing total charges, but neither difference is statistically significant.

Based on these findings, in 2019 the FCA expanded the CMA's mandate for just-in-time UOD and UI alerts to cover more banks (by reducing the size threshold for which the regulation applies) and added a mandate for just-in-time AOD alerts, but chose not to mandate any early warning alerts (FCA, 2018c). Our point estimates predict that these mandated alerts reduce AOD charges 4–8% and reduce UOD and UI charges by 17–19%. Using 2017 market-wide charges as a baseline, this implies consumer savings of £170 million to £240 million (see footnote 4 for details).

C. *Secondary Outcomes and Evidence for Partial Substitutability of Early Warning and Just-in-time Alerts*

In this section, we use secondary outcomes to conduct a robustness check on our main results, and to examine substitutability between early warning and just-in-time alerts. Table VI reports the effect of automatic enrollment for a stand-alone alert on secondary outcomes: inferred (rather than observed) targeted charges, the number of unpaid items, the days spent in overdraft, and the number of overdraft episodes of different lengths—all measured on a per-month basis. For treatment 9, which tests an early-warning UOD alert using design A, columns (6)–(7) report separate treatment effects when the alert was stand-alone during months 7–9 (pre-mandate) and when the alert was incremental during months 10–11 (post-mandate, after Bank A automatically enrolled all customers in just-in-time UOD alerts).

Results for inferred charges are similar to our main results using observed charges. Stand-alone alerts cause significant reductions in charges that are matched by significant reductions in days spent in overdraft, and additionally in significant reductions in unpaid items for those alerts targeting UOD and UI charges.

For inferred charges, treatment 9 shows a sharp difference pre and post mandate:[21] Post-mandate, the estimated treatment effect is statistically insignificant, and the 95% confidence interval rules out a treatment effect larger than 14 pence per month. Pre-mandate,

[21] Pre and post mandate treatment effects are estimated with inferred rather than observed charges because they provide sharp onset of the just-in-time UOD alerts in month 10 and are available in month 11.

however, the 95% confidence interval implies that automatic enrollment reduces UOD and UI charges by 22–38 pence per month. While a 14 pence per month effect would be economically significant, this shows that when we vary whether an alert is stand-alone or incremental, while holding the customer sample and other dimensions of alert design fixed, the stand-alone version provides a significantly larger effect.[22] This finding is reasonable because it means that just-in-time and early-warning alerts are partial substitutes—consistent with the fact that if a customer responds effectively to an early warning alert, they may stop a just-in-time alert from being sent.

Turning to overdraft episodes, the length of an episode is the number of consecutive closing daily balances that are in overdraft. One-or-more-day overdraft episodes incur charges, but zero-day episodes, in which overdraft is entered and then exited again within the same day, are merely "close calls" that do not incur charges due to the grace period. Table VI shows that all stand-alone alerts significantly reduce the number of one-or-more-day episodes. In contrast, treatment effects on zero-day episodes vary in a way that shows early-warning alerts cause customers to resolve overdraft episodes earlier than just-in-time alerts do.

First, compare treatments 2 and 3. These test Bank B's AOD alerts, which are similar apart from their timing. The just-in-time alert (treatment 2) causes a nearly identical increase in zero-day episodes to its reduction in one-or-more-day episodes, while the early warning alert (treatment 3) has no effect on zero-day episodes. The increase in zero-day episodes in treatment 2 is mechanical: Just-in-time alerts are sent too late to avoid overdrafting altogether, so avoided one-or-more-day episodes must be resolved as zero-day episodes. The fact that treatment 3 does not affect zero-day alerts implies that early-warning alert recipients do respond earlier—in time to avoid overdraft episodes before they begin.

Second, compare Bank A's early warning UOD/UI alert in the pre-mandate period (column (6)) to the post-mandate period (column (7)). The estimates show that early warning alerts lead customers to act early and resolve overdraft episodes before they occur, whether or not a just-in-time alert is already in place. However, when the just-in-time alert is already in place (post-mandate), this early action has a smaller financial benefit because it primarily avoids costless zero-day episodes. These zero-day episodes would otherwise have been resolved following just-in-time alerts, that now are no longer sent.

[22]The fact that there is no such difference for other treatments at Bank A confirms that the difference is not due to other changes in months 10–11. See Internet Appendix Table G.I.

Table VI

Automatic Enrollment in Alerts—Effect on Secondary Outcome Variables

This table reports the effect of automatic enrollment in alerts on secondary outcome variables. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. Columns (6)–(7) report treatment 9 effects separately for the pre-mandate period (when the alert was stand-alone) and the post-mandate period (when the alert was incremental). Row labels specify dependent variables, which are flows computed per month. Inferred charges are measured for the type of overdraft targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; in pounds sterling per month), as are days in overdraft and overdraft episodes. Zero-day overdraft episodes occur when a custome enters and exits overdraft within the same day without incurring charges. Customer and month fixed effects are included and error terms are clustered by customer and month. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+				UOD only		
Alert target	AOD			UOD + UI	UOD + UI		
Alert threshold	0†	0	100	0	0	100	100
Bank	A	B	B	B	B	A	A
Treatment	1	2	3	4	6	9	9
Treatment period	All	All	All	All	All	Pre-mandate	Post-mandate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inferred charges	-0.481***	-0.317***	-0.222***	-0.423***	-0.570***	-0.301***	-0.035
s.e.	(0.056)	(0.047)	(0.048)	(0.072)	(0.112)	(0.041)	(0.052)
Baseline mean	5.93	8.09	8.09	2.68	2.93	4.78	4.02
Effect size	8.1%	3.9%	2.7%	16%	19%	6.3%	0.9%
No. unpaid items	-0.002	0.001	-0.000	-0.012***	-0.009***	-0.007***	-0.003
s.e.	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Baseline mean	0.05	0.03	0.03	0.04	0.04	0.04	0.06
Effect size	2.9%	-2.3%	1.5%	28%	25%	19%	4.9%
Days in overdraft	-0.499***	-0.296***	-0.190***	-0.063***	-0.081***	-0.119***	-0.042
s.e.	(0.047)	(0.042)	(0.040)	(0.016)	(0.016)	(0.029)	(0.027)
Baseline mean	5.73	7.64	7.64	0.41	0.39	2.17	1.81
Effect size	8.7%	3.9%	2.5%	15%	21%	5.5%	2.3%
No. overdraft episodes	0.003	-0.002	-0.017***	-0.006**	-0.008**	-0.010**	-0.012***
s.e.	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)
Baseline mean	0.47	0.59	0.59	0.11	0.12	0.31	0.29
Effect size	-0.6%	0.4%	2.9%	5.7%	6.5%	3.1%	3.9%
No. 0-day episodes	0.050***	0.025***	0.004	0.003	0.003	0.001	-0.011***
s.e.	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Baseline mean	0.11	0.11	0.11	0.04	0.05	0.10	0.13
Effect size	-45%	-22%	-3.8%	-8.6%	-6.3%	-0.9%	8.4%
No. 1+ day episodes	-0.047***	-0.027***	-0.021***	-0.010**	-0.011**	-0.011***	-0.001
s.e.	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.002)	(0.002)
Baseline mean	0.35	0.48	0.48	0.07	0.07	0.21	0.16
Effect size	13%	5.6%	4.4%	13%	15%	5.1%	0.4%
Stand-alone alert	Yes	Yes	Yes	Yes	Yes	Yes	No
No. customers	138,532	64,718	64,743	226,033	188,755	70,935	70,935
No. observations	1,443,829	698,652	698,795	2,001,911	1,538,839	688,546	688,546

Note that, counter to expectation, Bank B's just-in-time UOD/UI alerts (columns (4)–(5)) do not increase zero-day episodes as much as they decrease one-or-more-day episodes. This likely results from Bank B's implementation of the UOD grace period.[23]

D. Heterogeneity

We have shown that alerts help consumers on average, addressing the primary research question of our paper. Our first secondary question, presented in the Introduction, asks which consumers benefit and if automatic enrollment will help the consumers that policymakers care most about—those with low income or high overdraft charges? In this section, we document how the impact of automatic enrollment varies with pretreatment measures of account usage and customer-specific characteristics, which lets us answer this question and shed light on who alerts help most. Due to the lack of statistical significance of incremental alerts, here and in the rest of the paper, we primarily focus on the six treatments that test stand-alone alerts and, unless otherwise noted, for treatment 9 include only the first three treatment months when the tested alert was stand-alone.

First, we divide the sample into three bands based on our proxy measure for income, account inflows (Table VII). Account inflows is the monthly sum of funds deposited into a customer's account, which we average over the pretreatment period. This proxy is imperfect because it omits income deposited to unobserved accounts such as savings accounts and it includes transfers between accounts that are not income. While there is no clear correlation between effect size and account inflows that is consistent across treatments, effects are economically and statistically significant in the lowest account-inflows band for five of six stand-alone alert treatments, including all just-in-time alerts. Thus consumers with low account inflows do benefit from alerts.

Second, we consider pretreatment charge levels. For this analysis, we split the population

[23]Alerts are triggered based on pending balances, while charges and our measure of overdraft episodes are based on cleared balances. While many transactions are initiated and clear simultaneously, others may be pending for up to a day before clearing. One possibility is that, to implement the *required* UOD grace periods, Bank B holds some transactions in pending status longer than normal—possibly until the end of the grace period. In this case, consumers may resolve overdrafts before the pending transactions that trigger the just-in-time UOD alerts clear, and hence we would not measure even a 0-day overdraft episode based on the cleared balance. Apparently, this explanation does not apply to Bank B's tested just-in-time AOD alert because Bank B did not take the same approach to implement the *voluntary* grace period for AOD.

Table VII

Heterogeneous Treatment Effects by Account-Inflows (a Proxy for Income)

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges by pretreatment account-inflows band (a proxy for income). Row labels specify the subpopulation. Account inflows, a proxy measure for monthly income, is the monthly sum of funds deposited into a customer's account, which we average over the pretreatment period. This proxy is imperfect because it omits income deposited to unobserved accounts such as savings accounts and it includes transfers between accounts that are not income. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot$ estimate/ (baseline mean). All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Account inflows 0–1500	-0.45***	-0.23**	-0.14	-0.57***	-0.62***	-0.23***
s.e.	(0.08)	(0.08)	(0.08)	(0.13)	(0.08)	(0.06)
Baseline mean	5.74	6.54	6.54	2.81	3.03	4.09
Effect size	7.9%	3.5%	2.1%	20%	21%	5.5%
No. cust.	49,480	17,402	17,480	61,622	103,742	41,482
Account inflows 1500–3000	-0.49***	-0.27***	-0.19**	-0.49***	-0.42***	-0.31***
s.e.	(0.09)	(0.07)	(0.07)	(0.09)	(0.08)	(0.08)
Baseline mean	6.49	8.56	8.56	3.05	3.41	5.70
Effect size	7.6%	3.1%	2.2%	16%	12%	5.5%
No. cust.	43,534	22,908	22,912	79,381	50,107	17,381
Account inflows 3000+	-0.63***	-0.39***	-0.24**	-0.30***	-0.60***	-0.28*
s.e.	(0.09)	(0.09)	(0.09)	(0.06)	(0.12)	(0.13)
Baseline mean	6.49	8.41	8.41	1.83	2.35	4.42
Effect size	9.8%	4.6%	2.8%	16%	25%	6.2%
No. cust.	45,518	24,408	24,351	85,030	34,906	12,072

into three groups: rare, occasional and frequent overdrafters. Rare overdrafters are individuals who have no charges in the pretreatment period. Occasional overdrafters have charges below the pretreatment median (conditional on charges being positive), while heavy overdrafters incur charges at or above the median level. Table VIII shows that as an individual's pretreatment overdraft propensity rises, the impact of automatic enrollment in stand-alone alerts has a larger absolute effect on charges (in magnitude), but a smaller percentage effect. (Point estimates are larger in magnitude for frequent overdrafters than rare overdrafters in all treatments in Table VIII and differences are statistically significant at the 1% level for treatments 1, 2, 4, and 6.) The fact that heavy overdrafters benefit most in absolute terms from alerts is good news for policymakers that care about reducing the right tail of charges, which we also examine in the following section.

Third, we divide the sample by pretreatment account balance levels and variability, measures which may also relate to financial vulnerability and hence be of interest to policymakers. We find that absolute treatment effect sizes fall with average account balances, while relative treatment effect sizes rise with average account balances (Internet Appendix Table G.II). This is consistent with our analysis by pretreatment charge levels, which are negatively correlated with pretreatment balances (Internet Appendix Table G.VII). Next, we use the coefficient of variation to measure account balance variability relative to balances since this could be related to the risk of an unanticipated overdraft—and hence the benefit of alerts. Consistent with this conjecture, we find that conditional on a positive coefficient of variation, absolute treatment effect sizes increase with the coefficient of variation (Internet Appendix Table G.III). Note that we state this result conditional on a positive coefficient of variation because negative average balances imply high overdraft incidence irrespective of balance variability and hence absolute effect sizes are largest for those with a negative coefficient of variation. To the extent that low balances and high balance variability are related to financial vulnerability, these findings could also be good news about alerts for policymakers.

Next, we move beyond pretreatment measures related to income, high charges, or financial vulnerability and investigate what else identifies the largest beneficiaries of alerts. We consider pretreatment measures of "close calls" in which an account came close to incurring an overdraft charge but did not. First, we split the population by whether or not they had any zero-day overdrafts in the pretreatment period. (Recall that zero-day overdrafts do not

Table VIII

Heterogeneous Treatment Effects by Pretreatment Targeted Charges

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges by level of pretreatment targeted charges (rare, occasional, or frequent). Row labels specify the subpopulation. For the type of overdraft targeted by the treatment alert, Rare OD is customers with no pretreatment overdrafts and, conditional on positive pretreatment overdrafts, Occasional OD (Frequent OD) is customers with below (above) median pretreatment overdraft charges. Acronyms stand for overdraft (OD), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Rare OD	-0.09***	-0.12***	-0.08**	-0.17***	-0.33***	-0.15***
s.e.	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)	(0.03)
Baseline mean	0.22	0.45	0.45	0.64	1.12	0.55
Effect size	39%	26%	18%	27%	29%	28%
No. cust.	72,560	24,787	24,778	188,503	158,551	52,426
Occasional OD	-0.67***	-0.43***	-0.27***	-0.95***	-0.98***	-0.35*
s.e.	(0.08)	(0.06)	(0.08)	(0.27)	(0.27)	(0.18)
Baseline mean	2.66	3.84	3.88	4.99	5.11	4.19
Effect size	25%	11%	6.8%	19%	19%	8.4%
No. cust.	33,119	19,967	20,137	18,794	15,141	9,295
Frequent OD	-1.30***	-0.41***	-0.27*	-2.47***	-2.11***	-0.65**
s.e.	(0.21)	(0.11)	(0.12)	(0.32)	(0.50)	(0.27)
Baseline mean	22.30	20.96	21.06	18.59	18.01	25.17
Effect size	5.8%	2.0%	1.3%	13%	12%	2.6%
No. cust.	32,853	19,964	19,828	18,736	15,063	9,214

result in charges; they occur when a customer's account balance falls below the threshold to incur an overdraft but rebounds above the threshold by the end of the same-day grace period.) Internet Appendix Table G.IV shows that alerts reduce charges more for those with zero-day overdrafts in the pretreatment period than those without. (Point estimates are larger for all treatments in Internet Appendix Table G.IV and differences are statistically significant at the 1% level for treatments 1, 2, 4, and 6.) Second, we split the population by the number of days during the pretreatment period in which account balances were close to an overdraft threshold (meaning they fell within £100 of an overdraft threshold without crossing the threshold). Results in Internet Appendix Table G.V are similar, showing larger effects for customers with more close calls in the pretreatment period.

Finally, we divide the sample into three engagement bands by the number of pretreatment account logins per month (0–5, 5–15, or 15+; see Internet Appendix Table G.VI). Five out of six stand-alone alert treatments show smaller benefits of alerts for the most engaged customers than the least engaged (differences are significant at the 5% level or higher for treatments 2, 4, 5, and 9). This makes sense if, without alerts, those who are most engaged with their accounts are more aware of their account balances. The exception to this narrative is treatment 1, which shows the opposite pattern: benefits are largest for the most engaged (and the difference between most and least engaged is significant at the 5% level).

E. Treatment Effect on the Distribution of Days in Overdraft and Overdraft charges

Policymakers are often most concerned about the right tail of the fee distribution—the large fees paid by frequent overdrafters—rather than average charges. To better understand how alerts affect the entire distribution of charges, and complement our heterogeneous treatment effect analysis by pretreatment overdraft levels, Table IX reports estimates of the treatment effect on the probability (in percentage points) that days in a month spent in the overdraft targeted by an alert exceed a sequence of thresholds ranging from 0 to 25 days or equaling the full month. Unsurprisingly, baseline rates of exceeding the thresholds and absolute effect sizes both fall as the thresholds increase. However, all treatments show statistically significant reductions in the likelihood of exceeding the 0, 5, 10, and 15 day thresholds. Moreover, within each treatment, point estimates of the relative effect sizes are fairly stable over this range.

Table IX

Treatment Effect on Probability of Exceeding Threshold Days in Overdraft

This table reports the effect of automatic enrollment in stand-alone alerts on the probability (in percentage points) that the number of days in a month a customer is in the targeted overdraft exceeds a threshold value or equals the full month. Row labels specify the dependent variable, which is an indicator for whether the number of days customer i is in the targeted overdraft facility during month t exceeds a threshold value or equals the full month. Estimates are multiplied by 100 to be in percentage points. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Over 0 days	-3.71***	-1.96***	-1.48***	-0.73**	-0.87*	-0.95***
s.e.	(0.20)	(0.18)	(0.20)	(0.28)	(0.39)	(0.15)
Baseline mean	33.31	43.79	43.79	6.40	6.64	16.42
Effect size	11%	4.5%	3.4%	11%	13%	5.8%
Over 3 days	-3.03***	-1.64***	-1.24***	-0.56***	-0.74***	-0.57***
s.e.	(0.19)	(0.18)	(0.19)	(0.13)	(0.13)	(0.11)
Baseline mean	27.50	37.18	37.18	3.25	3.25	12.31
Effect size	11%	4.4%	3.3%	17%	23%	4.6%
Over 5 days	-2.58***	-1.31***	-1.07***	-0.42***	-0.52***	-0.52***
s.e.	(0.20)	(0.17)	(0.20)	(0.09)	(0.10)	(0.13)
Baseline mean	25.31	34.35	34.35	2.42	2.34	10.76
Effect size	10%	3.8%	3.1%	17%	22%	4.8%
Over 10 days	-1.74***	-1.13***	-0.80***	-0.22***	-0.26***	-0.47***
s.e.	(0.16)	(0.17)	(0.18)	(0.05)	(0.07)	(0.12)
Baseline mean	20.83	28.73	28.73	1.21	1.12	8.15
Effect size	8.4%	3.9%	2.8%	18%	23%	5.8%
Over 15 days	-1.42***	-0.93***	-0.56***	-0.13***	-0.13***	-0.42***
s.e.	(0.15)	(0.16)	(0.17)	(0.04)	(0.03)	(0.10)
Baseline mean	17.45	24.16	24.16	0.69	0.60	6.37
Effect size	8.1%	3.8%	2.3%	19%	21%	6.7%
Over 20 days	-1.06***	-0.67***	-0.35**	-0.07**	-0.06*	-0.28**
s.e.	(0.15)	(0.18)	(0.16)	(0.02)	(0.03)	(0.09)
Baseline mean	14.39	19.28	19.28	0.39	0.32	4.72
Effect size	7.3%	3.5%	1.8%	19%	20%	5.9%
Over 25 days	-0.70***	-0.39**	-0.07	-0.02	-0.03	-0.15
s.e.	(0.13)	(0.14)	(0.13)	(0.02)	(0.02)	(0.09)
Baseline mean	10.96	14.19	14.19	0.23	0.19	3.14
Effect size	6.4%	2.7%	0.5%	10%	16%	4.6%
Full month	-0.46***	-0.24**	0.00	0.01	-0.02	-0.05
s.e.	(0.10)	(0.10)	(0.11)	(0.01)	(0.01)	(0.08)
Baseline mean	7.68	9.03	9.03	0.13	0.12	1.81
Effect size	6.0%	2.7%	-0.0%	-5.7%	16%	2.7%
No. customers	138,532	64,718	64,743	226,033	188,755	70,935
No. observations	1,443,829	698,652	698,795	2,001,911	1,538,839	571,328

This suggests that alerts help customers curtail overdrafting in both periods of light and heavy overdrafting.

Point estimates for a similar analysis of overdraft fee thresholds (Internet Appendix Table G.VIII) are consistent but lack the same level of statistical significance. Importantly, curtailing overdrafting in heavy months was mechanically less financially rewarding because banks have been required since September 2017 to cap the sum of UOD and UI charges (Competition & Markets Authority, 2016), and some banks also voluntarily capped monthly AOD charges. (See Table I for typical fee caps.) For those months in which a customer hits the fee cap, small reductions of days in overdraft needn't affect charges. Hence even though alerts reduce days in overdraft across the entire distribution, they could have a limited effect on the fraction of customers paying the maximum fees. Nevertheless, Internet Appendix Table G.VIII treatment (4) clearly shows that Bank B's just-in-time UOD/UI alert reduces charges in the right tail of the distribution—the probability that a consumer pays more than £50 in a month in unarranged and unpaid item fees falls from 2.0% to 1.7% (statistically significant at the 1% level).

F. Behavioral Response to Alerts: How do Alerts Reduce Charges?

In this section and the following one (Section III.G), we address our next secondary question: How do customers react to alerts to achieve the measured savings? To better understand how alerts help customers reduce their overdraft charges, we investigate how customers respond immediately following an alert. We focus our analysis on Bank A because, for Bank A, we observe the dates on which an individual actually received an alert and are confident in our ability to predict alerts for those in the control group. (Correlation between predicted and actual alerts is reported by treatment in our results Tables X–XI and ranges between 0.48–0.83.) We estimate the effect of receiving the first alert on daily outcome $Y_{i,t}$ for customer i on day t with the following specification:

$$Y_{i,t} = \sum_{k=-3}^{3} \gamma_k(k\text{-}Days.after.predicted.alert_{i,t}) + \lambda Treatment_i \times I(t \geq 7) + \sum_{k=-3}^{3} \beta_k(k\text{-}Days.after.alert_{i,t}) + \eta_i + \mu_t + \epsilon_{i,t}, \quad (2)$$

where we instrument for $k\text{-}Days.after.alert_{i,t}$ with

$$k\text{-}Days.after.predicted.alert_{i,t} \times Treatment_i \times I(t \geq 7). \tag{3}$$

There are two sets of alert indicators. First, $k\text{-}Days.after.predicted.alert_{i,t}$ equals 1 if and only if day t falls k days after customer i is predicted to have received their first treatment alert. (This is computed for both treatment and control customers as if all had been enrolled in alerts.) Second, $k\text{-}Days.after.alert_{i,t}$ equals 1 if and only if day t is k days after customer i received their first treatment alert in the treatment period. Indicators are included for $k \in \{-3, \ldots, 3\}$, where the indicators for $k = 3$ control for being 3 *or more* days after a predicted or actual alert. (Being 4 or more days prior to a predicted or actual alert is the excluded group.) We instrument for alert arrival indicators ($k\text{-}Days.after.alert_{i,t}$) with predicted alert arrival interacted with treatment (equation (3)) because receiving an alert is endogenous to opt-in and opt-out decisions and our predicted alert indicators have measurement error.

The specification in equations (2)-(3) lets us compare a 6-day window around the arrival of an alert to a 6-day window in which an alert would have been sent had the control group been treated. Coefficient γ_k measures account activity in the control group k days after the first treatment alert would have been sent had they been enrolled. (γ_k is relative to the excluded period of 4 or more days before the first treatment alert would have been sent.) Coefficient λ measures the effect of being *notified* of enrollment into alerts—any effect of automatic enrollment in alerts that occurs from enrollment until 4 or more days before the first treatment alert is sent.

The coefficients of interest are β_k for $k \in \{0, 1, 2, 3\}$. These measure the effect of receiving the first treatment alert k days ago, relative to the control group k days after an alert would have been sent were they enrolled (γ_k) plus the notification-of-enrollment effect (λ). (Coefficients $\{\beta_{-3}, \ldots, \beta_{-1}\}$ should all be zero because an alert should not affect account activity before it is sent.) Finally, we include customer (η_i) and day (μ_t) fixed effects and cluster standard errors by customer and day.

In principle, customers may respond to notification of enrollment in alerts, in addition to the alerts themselves. (Banks A and B informed enrolled participants by email at the start of the trial; Bank A also sent a two-way SMS message that allowed customers to reply

to opt-out.) For instance, upon enrollment in low-balance alerts, customers no longer need to login to check whether their balance is low. Low-balance alerts could therefore increase logins following an alert but reduce logins on other days, implying a negative value of λ. Our estimates of λ in Tables X–XI are close to zero with small standard errors, showing that if any such response occurs, it is economically small. (Complementary analysis in Internet Appendix D is consistent.)

F.1. Alert Prompted Account Logins

A priori, we expect alerts to prompt consumers to log in to their accounts (via internet website, mobile app, or phone). Table X reports the effect of alert arrival on account logins per day for all three of Bank A's automatic enrollment treatments (excluding the fourth prompted enrollment treatment). For treatment 9, we estimate treatment effects separately pre and post mandate. The results are strikingly similar across columns.

In the control groups, logins are elevated about 0–0.34 logins per day (0–46%) in the window around the day an individual would have received an alert, but did not, and 0.25–0.44 logins (42–80%) on that counterfactual "day zero". (These numbers are relative to an average day 4 or more days prior to the first alert.) Thus, even without the treatment alerts, individuals are more likely to log in to their account during periods when they may be at risk of an overdraft or unpaid item.

As expected, the results are consistent with no causal effects of an alert prior to its arrival (all point estimates of β_{-3}, β_{-2}, and β_{-1} are economically small and all are insignificant at the 5% level). They then show a sharp positive treatment effect on the day the alert is sent, and little to no effect thereafter. Alerts cause on average 0.13 to 0.49 additional logins (10–53%) on the day they are sent across treatments (relative to what would have occurred were the alert not sent). The increase in logins is larger for treatment 1 (0.49) than treatments 9 and 10 (0.27 and 0.13). The larger effect size for treatment 1 may be because treatment 1 alerts are just-in-time, mention charges, target arranged OD, or because they target a customer population with more access to credit.

For day 0 and later, the elevated baseline attention in the control groups for treatments 9–10 could be due in part to the arrival of baseline just-in-time alerts shortly after early-warning balance thresholds are crossed (recall that all individuals in these treatments receive baseline UI alerts pre-mandate, and UOD+UI alerts post mandate, as shown in Figure 3

Table X

First Treatment Alert—Effect on Daily Account Logins

This table reports the effect of the first treatment alert at Bank A on the daily number of customer account logins (via internet, mobile-app and phone) in the days surrounding the first predicted alert in the treatment period. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. We instrument for $k\text{-}Days.after.alert_{i,t}$ with $k\text{-}Days.after.predicted.alert_{i,t} \times Treatment_i \times I(t \geq 7)$. The minimum F-statistic for instruments in the table is 10,300,000. Customer and month fixed effects are included and error terms are clustered by customer and day. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. All estimates are intent to treat (ITT). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+	UOD only		None
Alert target	AOD	UOD + UI		UI
Alert threshold	0†	100		100
Treatment	1	9		10
Treatment period	All	Pre-mandate	Post-mandate	All
	(1)	(2)	(3)	(4)
-3 days after predicted alert	-0.006	0.022**	0.065***	0.061***
s.e.	(0.009)	(0.009)	(0.014)	(0.013)
-2 days after predicted alert	0.014	0.056***	0.097***	0.138***
s.e.	(0.013)	(0.009)	(0.015)	(0.015)
-1 days after predicted alert	0.086***	0.173***	0.252***	0.343***
s.e.	(0.020)	(0.015)	(0.027)	(0.026)
0 days after predicted alert	0.245***	0.289***	0.436***	0.412***
s.e.	(0.013)	(0.014)	(0.040)	(0.024)
1 days after predicted alert	0.081***	0.035***	0.155***	0.099***
s.e.	(0.014)	(0.012)	(0.030)	(0.014)
2 days after predicted alert	0.046***	0.033**	0.078***	0.066***
s.e.	(0.011)	(0.013)	(0.021)	(0.013)
3+ days after predicted alert	0.018***	0.025***	0.032***	0.059***
s.e.	(0.006)	(0.008)	(0.009)	(0.010)
$Treatment_i \times I(t \geq 7)$	0.003	0.001	0.003	0.008*
s.e.	(0.002)	(0.003)	(0.004)	(0.004)
-3 days after alert	0.007	0.028*	0.035	-0.002
s.e.	(0.011)	(0.015)	(0.037)	(0.020)
-2 days after alert	0.018*	-0.021	0.008	-0.020
s.e.	(0.010)	(0.016)	(0.026)	(0.016)
-1 days after alert	0.007	0.032	-0.027	-0.008
s.e.	(0.019)	(0.020)	(0.057)	(0.014)
0 days after alert	0.495***	0.269***	0.260***	0.131***
s.e.	(0.023)	(0.023)	(0.096)	(0.019)
1 days after alert	0.001	0.058***	-0.053	-0.024
s.e.	(0.013)	(0.019)	(0.072)	(0.020)
2 days after alert	0.006	0.005	0.002	-0.016
s.e.	(0.011)	(0.020)	(0.052)	(0.014)
3+ days after alert	0.004	0.001	-0.008	-0.011*
s.e.	(0.004)	(0.006)	(0.007)	(0.006)
Stand-alone alert	Yes	Yes	No	No
Avg. daily baseline	0.59	0.54	0.55	0.84
Day zero baseline	0.93	0.93	0.92	1.27
Day zero effect size	53%	29%	28%	10%
Corr(alert, predicted-alert)	0.83	0.65	0.48	0.66
No. customers	138,532	70,935	70,935	173,595
No. observations	44,354,906	17,585,922	15,655,588	52,583,106
Adjusted R^2	0.34	0.36	0.36	0.29

Design A). Consistent with this hypothesis, comparing columns (2) and (3) shows that the baseline attentiveness in this period is substantially higher in the post-mandate period. This is likely due to the fact that many customers will receive a just-in-time UOD alert soon after crossing the £100 low-balance early-warning threshold, but only in the post-mandate period when these alerts are activated.

While baseline just-in-time alerts raise baseline attentiveness, a comparison of columns (2) and (3) suggests they do not reduce the additional log-ins caused by early warning alerts. Estimates in the post-mandate period in column (3) are noisy because fewer customers have first alerts sent during this period. However, day zero point estimates for additional logins of 0.27 (pre-mandate, column (2)) and 0.26 (post-mandate, column (3)) are remarkably similar. This suggests that the reduced effectiveness of the early warning alert in the post-mandate period is not driven by reduced attention.

F.2. Transactions Analysis

What do customers do once an alert has drawn their attention to their account? Survey responses (Internet Appendix Table B.I Panel B) show that 61–73% of customers report taking action to avoid charges following an alert. Customers most often self-report transferring money from savings (50–64%), borrowing informally from friends and family (25–43%), and cutting back on spending (31–48%). Other responses are much less common, including letting a bill go unpaid (8–24%), borrowing on a credit card (2–7%), or other formal borrowing (0–7%).

Although we cannot observe informal borrowing in our transaction data, we can investigate transfers and reduced spending. Specifically, via the same approach we use to examine alert-prompted account logins, we investigate how account transactions are affected by the arrival of an alert at Bank A. Consistent with consumer self-reports, we find no causal effects on any transaction types other than an increase in transfers into the account and a reduction of debit card spending. Table XI shows the effect on the number of transfer (TFR) and debit card (CRD) transactions. (Internet Appendix Table G.IX shows the effect on the sum of the transaction amounts, but estimates are too noisy to be informative for all but the just-in-time AOD alert.)

In the control group, debit card transactions are elevated 3–15% in the three days leading up to crossing an alert threshold and 59–84% on the day the threshold is crossed.

Table XI

First Treatment Alert—Effect on No. Daily Debit Card & Transfer Transactions

This table reports the effect of the first treatment alert at Bank A on the daily number of customer debit card transactions and account transfers in the days surrounding the first predicted alert in the treatment period. Acronyms stand for debit card transaction (CRD), transfer (TFR), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. We instrument for $k\text{-}Days.after.alert_{i,t}$ with $k\text{-}Days.after.predicted.alert_{i,t} \times Treatment_i \times I(t \geq 7)$. The minimum F-statistic for instruments in the table is 10,300,000. Customer and month fixed effects are included and error terms are clustered by customer and day. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. All estimates are intent to treat (ITT). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+		UOD only				None	
Alert target	AOD		UOD + UI				UI	
Alert threshold	0†		100				100	
Treatment	1		9				10	
Treatment Period	All		Pre-mandate		Post-mandate		All	
Charge Type	CRD	TFR	CRD	TFR	CRD	TFR	CRD	TFR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-3 days after predicted alert	0.022***	-0.033***	0.023***	-0.007	0.018	0.014	0.047***	-0.005
s.e.	(0.007)	(0.005)	(0.007)	(0.006)	(0.017)	(0.016)	(0.008)	(0.008)
-2 days after predicted alert	0.041***	-0.031***	0.049***	-0.004	0.061***	0.034	0.059***	0.028**
s.e.	(0.008)	(0.008)	(0.007)	(0.009)	(0.021)	(0.026)	(0.012)	(0.012)
-1 days after predicted alert	0.066***	-0.012	0.068***	0.066***	0.073***	0.120***	0.127***	0.129***
s.e.	(0.010)	(0.013)	(0.011)	(0.011)	(0.026)	(0.044)	(0.015)	(0.021)
0 days after predicted alert	0.494***	0.230***	0.461***	0.231***	0.332***	0.343***	0.628***	0.270***
s.e.	(0.032)	(0.011)	(0.026)	(0.013)	(0.029)	(0.024)	(0.029)	(0.027)
1 days after predicted alert	-0.042***	0.094***	-0.033***	0.046***	-0.023	0.115***	-0.004	0.061***
s.e.	(0.010)	(0.011)	(0.010)	(0.008)	(0.019)	(0.015)	(0.014)	(0.010)
2 days after predicted alert	-0.072***	0.055***	-0.070***	0.033***	-0.075***	0.085***	-0.092***	0.050***
s.e.	(0.007)	(0.009)	(0.008)	(0.007)	(0.017)	(0.017)	(0.008)	(0.011)
3+ days after predicted alert	-0.007	0.009***	-0.015**	0.012***	0.006	0.012***	-0.011	0.035***
s.e.	(0.008)	(0.003)	(0.007)	(0.005)	(0.006)	(0.004)	(0.007)	(0.007)
$Treatment_i \times I(t \geq 7)$	-0.001	0.000	0.002	-0.001	0.002	-0.001	0.003	-0.001
s.e.	(0.002)	(0.001)	(0.002)	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)
-3 days after alert	0.007	-0.011	0.009	-0.006	0.016	-0.030	-0.004	-0.005
s.e.	(0.011)	(0.007)	(0.018)	(0.011)	(0.034)	(0.019)	(0.016)	(0.008)
-2 days after alert	0.012	0.019***	0.003	-0.004	-0.021	-0.011	0.016	-0.001
s.e.	(0.014)	(0.006)	(0.017)	(0.009)	(0.026)	(0.016)	(0.014)	(0.009)
-1 days after alert	0.005	-0.002	-0.031*	0.015	0.017	-0.036	0.004	0.008
s.e.	(0.014)	(0.007)	(0.017)	(0.014)	(0.034)	(0.023)	(0.015)	(0.009)
0 days after alert	0.007	0.272***	-0.008	0.055***	0.065	-0.038	0.014	0.031***
s.e.	(0.017)	(0.015)	(0.021)	(0.015)	(0.065)	(0.057)	(0.017)	(0.012)
1 days after alert	-0.043***	-0.010	-0.023	0.005	-0.055	-0.052	0.008	0.007
s.e.	(0.016)	(0.010)	(0.017)	(0.011)	(0.062)	(0.033)	(0.015)	(0.009)
2 days after alert	-0.041***	-0.012*	-0.028	-0.012	-0.020	-0.063	-0.010	-0.003
s.e.	(0.013)	(0.007)	(0.017)	(0.012)	(0.041)	(0.039)	(0.014)	(0.010)
3+ days after alert	0.000	0.001	-0.003	-0.001	-0.000	-0.002	-0.001	0.001
s.e.	(0.004)	(0.001)	(0.005)	(0.002)	(0.006)	(0.002)	(0.005)	(0.002)
Stand-alone alert	Yes	Yes	Yes	Yes	No	No	No	No
Avg. daily baseline	0.82	0.25	0.55	0.21	0.57	0.21	0.86	0.33
Day zero baseline	1.51	0.53	1.10	0.47	0.82	0.53	1.53	0.61
Day zero effect size	0.5%	52%	-0.7%	12%	7.9%	-7.1%	0.9%	5.2%
Corr(alert, predicted-alert)	0.83	0.83	0.65	0.65	0.48	0.48	0.66	0.66
No. customers	138,532	138,532	70,935	70,935	70,935	70,935	173,595	173,595
No. observations	44,354,906	44,354,906	17,585,922	17,585,922	15,655,588	15,655,588	52,583,106	52,583,106
Adjusted R^2	0.32	0.15	0.33	0.16	0.33	0.16	0.27	0.21

This makes sense, as elevated card spending is likely one reason for crossing a low-balance threshold. Transfers are elevated 82–160% on the day an alert threshold is crossed. During the following two days, transfers continue to be elevated 15–54%, and debit card transactions are depressed 1–13%. (These numbers are relative to an average day 4 or more days prior to the first alert.) This suggests that, at baseline, consumers may be using transfers and (to a much smaller extent) reduced spending to resolve overdrafts.

Relative to this baseline (adjusted by the negligible estimated effect of enrollment notification, $\hat{\lambda}$), treatment 1's stand-alone AOD alert causes 0.27 (52%) additional transfers on the same day with an average value of about £465 per transfer (or about £126 per alert), and 0.08 (9%) fewer debit card transactions averaging approximately £47 each over the following two days (or about £4 per alert). This suggests that the primary mechanism for avoiding overdraft and unpaid item charges is transferring money into the account, and cutting back on spending is much less important because spending is relatively inelastic to alerts. On average, 2.7 days in overdraft are avoided per additional transfer.[24]

Treatments 9 and 10 show no statistically significant decreases in card transactions, although standard errors allow for small effect sizes comparable to treatment 1. Treatments 9 (pre-mandate) and 10 do show statistically significant, albeit substantially smaller, increases of 0.06 and 0.03 additional transfers on the day of their early warning UOD/UI alerts. (Estimates for treatment 9 post-mandate are too imprecise to be informative.) Although smaller in magnitude, the additional transfers for treatment 9 in the pre-mandate period likely still account for the majority of the reduction in overdraft charges. On average, 3.2 days in overdraft are avoided per additional transfer due to treatment 9 pre-mandate.

Thus, Bank A's tested just-in-time AOD alert, pre-mandate early warning UOD/UI alert, and early warning UI alert all cause customers to log in to their accounts and transfer money into them—to pay attention and make transfers at high enough rates to explain the magnitude of observed treatment effects. In contrast, while some alerts trigger statistically significant reductions in debit card spending, the reductions are economically small and appear to contribute little to the overall reductions in overdraft charges caused by alerts. For the early warning alerts, the prompted transfers are made early—the same day the alert arrives. (A point which is consistent with the finding above in Table VI that early warning

[24] We compute days-in-overdraft-avoided-per-additional-transfer as $\frac{\textit{days-in-overdraft-avoided-per-month}}{\textit{treatment-alerts-per-month} \times \textit{transfers-per-treatment-alert}}$. Treatments 1, 9, and 10 generate 0.69, 0.67, and 1.6 alerts per month, respectively.

alerts lead to the resolution of overdrafts before they occur.)

F.3. Long Run Actions

The preceding analysis focuses on immediate actions customers take following an alert to resolve a low balance and avoid immediate overdraft charges. In the US, Stango and Zinman (2014) find that making overdraft fees more salient causes consumers to cancel automatic recurring withdrawals, a one-time action which helps them avoid *future* overdraft charges. In contrast, we find no statistically significant evidence that automatic enrollment into alerts prompts customers to reduce automatic recurring withdrawals or negotiate higher AOD limits. For the AOD limit, our estimates are fairly precise zeros in absolute terms (95% confidence intervals rule out average increases larger than 3 pounds). For automatic recurring withdrawals, estimates allow for moderate effects (e.g., 95% confidence intervals allow for up to a 3% reduction in the number of standing orders). See Internet Appendix Table G.X.

G. Length of Early Warning

The underlying idea behind early warning was to give consumers time to avoid overdrafting by cutting debit card spending before running out of money (for instance, by shifting it to a credit card). Unfortunately, our estimates show that debit-card spending is relatively inelastic to tested alerts, which limits the benefit of the alerts. One explanation is that customers value making their purchases more than the overdraft charges,[25] although this does not explain why customers do not shift spending to their credit cards. Another possibility is that the early warning may simply not have been early enough to give consumers time to cut spending.

Based on account balances in the control groups, we compute the time elapsed between account balances crossing an early warning threshold and the corresponding just-in-time threshold, which measures the amount of advanced warning that would be provided were alerts activated. Results reported in Table XII show that 10–35% of early warning alerts would arrive on the same day as a corresponding just-in-time alert would, meaning they provide less than a day of advance warning. Median advance warning time is 1 to 5 days (in

[25]This could be due to standard time-consistent preferences or due to behavioral factors such as present focus, which Allcott et al. (2022) estimate to be substantial in payday lending.

contrast Medina (2021) found early bill reminders beneficial 13–27 days in advance). It is therefore possible that low-balance thresholds larger than £100 pounds might do better. At the same time, Table XII shows that control-group accounts crossed a just-in-time threshold in only 13–79% of the months that an early warning threshold was crossed, meaning that up to 21–89% of early warning alerts could be "false" alarms. Raising the low-balance thresholds higher would increase this problem and could thereby make them less rather than more effective.

Table XII

Alert Threshold Crossings and Early Warning Alert Lead Times

For the control groups of early warning treatments, this table reports the frequency of crossing early warning and just-in-time alert thresholds as well as how much advanced warning early warning alerts provide. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. All statistics are measured for control groups in the treatment period. "Mo. EW threshold crossed" is the percentage of months in which the low balance threshold for the treatment alert is crossed at least once. "Mo. JIT threshold crossed" in the percentage of months in which the balance crosses the corresponding just-in-time alert threshold. "Mo. JIT / Mo. EW" is the ratio of "Mo. JIT threshold crossed" to "Mo. EW threshold crossed". "Instances same day" is the percentage of times crossing a just-in-time alert threshold occurs on the same day as crossing the preceding low balance alert threshold. "Lead time" is the number of days prior to a just-in-time alert threshold crossing that the previous early warning alert threshold was crossed.

Overdraft facility	AOD+		UOD only			None
Alert target	AOD	UOD + UI	UOD + UI			UI
Alert threshold	100	50	50	100		100
Bank	B	B	B	B	A	A
Treatment	3	5	7	8	9	10, 11
	(1)	(2)	(3)	(4)	(5)	(6)
Mo. EW threshold crossed (pct)	50	18	40	46	44	63
Mo. JIT threshold crossed (pct)	39	6.6	7.2	7.2	17	8.2
Mo. JIT / Mo. EW (pct)	79	36	18	16	38	13
Instances same day (pct)	35	34	30	18	24	10
Median lead time (days)	1	1	2	3	2	5
Stand-alone alert	Yes	No	No	No	Pre-mandate	No
No. customers	32,269	32,269	34,422	34,422	34,892	137,031
No. observations	157,081	157,081	147,738	147,738	145,573	582,264

H. *Evidence Suggests Alerts Eliminate Less than Half of Overdraft Borrowing Mistakes*

We conclude the discussion of our results by addressing our final secondary question: Do alerts eliminate overdrafting mistakes? The motivation for consumer protection policy via "nudge"—mandating overdraft text alerts be opt-out rather than opt-in—is to protect consumers from costly but accidental borrowing without limiting the availability of credit when it is needed. The fact that just-in-time alerts reduce overdraft borrowing shows that in the absence of alerts a substantial portion of overdraft borrowing is unintentional due to lack of awareness about account balances. An interesting question is how much of the overdraft borrowing that continues after alerts are turned on reflects intentional borrowing valued above its cost, and how much only persists due to frictions other than inattention that are not eliminated by alerts.

The clearest evidence that overdraft borrowing results from a behavioral friction (such as inattention or hassle costs of account management) rather than a high value for credit is availability of lower-cost liquidity from another account. Unfortunately, we do not observe our customers' credit-card accounts or savings accounts, so we cannot observe the primary alternative sources of liquidity. However, the FCA (2018c, Technical Annex Chapter 5 Table 1) has access to such data for a large representative 2016 sample. They report that, in 2016, 27% of days in AOD and UOD could have been avoided by using available savings. Further, 50% of days in UOD and 60% of days in AOD could have been avoided by using available savings and available credit-card balances.

In comparison, we find in Table VI that just-in-time AOD alerts reduce days in AOD by 4–9% and just-in-time UOD alerts reduce days in UOD by 15–21%. This suggests that alerts eliminate only 6–15% of unnecessary days in AOD, and 31–41% of unnecessary days in UOD.[26] Thus it is likely that the substantial benefits of alerts eliminate (and inattention accounts for) less than half of overdraft charges that result from frictions rather than optimal borrowing.

Additional evidence comes from the 5% of customers with overdraft facilities in our

[26]The figures would be 14–32% for AOD and 57–76% for UOD if we only account for available savings, not available credit-card balances. The FCA's figures are based on our observational dataset linked to savings and credit-card data that we did not have access to. Thus, the FCA sample is earlier and includes more banks. See Internet Appendix Table G.XI.

experimental sample who have two current accounts at the same bank. For this sample, using only alternative current-account liquidity, we find that alerts eliminate less than 29–78% of unnecessary overdrafting charges (likely much less since it does not account for savings accounts or credit cards). See Internet Appendix E.

IV. Concluding Discussion

Automatically enrolling U.K. banking customers into just-in-time arranged overdraft alerts reduces arranged overdraft charges 4–8 percent, and enrolling customers into just-in-time unarranged overdraft and unpaid item alerts reduces unarranged overdraft and unpaid item charges 17–19 percent. Extrapolated to the entire U.K. market in 2017, this represents potential annual consumer savings of £170–240 million.

Savings from alerts increase in customers' pretreatment overdraft propensity and decrease in customers' pretreatment average balances, but less than proportionally, so that frequent overdrafters and customers with low average balances benefit most from alerts but end up responsible for an even larger share of total overdraft charges after alerts are in place. Among those with positive average balances, savings from alerts are also larger for customers with high pretreatment variability in balances. While it is not clear whether low-income consumers benefit more or less than high-income consumers, it is clear that customers with low account inflows do benefit. Altogether, this suggests that low income consumers, heavy overdrafters, and more financially vulnerable consumers who policymakers may most want to help do share in the benefits of alerts.

Why did so few customers (less than 8% (Caflisch et al., 2018)) take advantage of these benefits by actively opting-in to alerts prior to automatic enrollment? It could be a combination of three possible factors: (1) high nuisance costs of receiving alerts; (2) high hassle costs of enrolling in alerts (consistent with one coauthor's personal experience that opting in was not easy); or (3) informational or behavioral frictions (such as unawareness of the option to enroll, underestimation of the benefits of enrolling, or procrastination), consistent with Bronchetti et al.'s (2023) finding that individuals underinvest in attention aids. Of the three possible explanations, only high nuisance costs could mean automatic enrollment reduces consumer surplus—due to consumers who are irritated by alerts but fail to opt-out. This seems unlikely, however, because the nuisance cost would have to be substantial

(e.g. exceeding 77 pence per alert for Bank A's just-in-time AOD alert). Moreover, survey respondents (a group admittedly selected based on willingness to participate) who do not opt-out of alerts show broad agreement that alerts are helpful.

The large impact of alerts shows that, in their absence, a substantial portion of the high effective interest rates paid for overdraft borrowing do not reflect a high value for credit but rather inattention to account balances. Moreover, evidence suggests that alerts eliminate less than half of overdraft charges arising from frictions such as inattention rather than optimal borrowing. As a result, there remains scope for alternative interventions to further reduce borrowing mistakes, such as sweep accounts that automatically transfer funds across accounts when needed.

In principle, customers could respond to alerts either by depositing funds into their accounts or by reducing spending. There is greater scope for avoiding borrowing charges via reduced spending if one starts cutting spending before account balances are depleted. Hence we expected substantial incremental benefits for early warning alerts triggered when balances fall within £50 or £100 of an overdraft threshold. However, while we cannot rule out economically significant benefits of incremental early warning alerts, such effects are not statistically detectable in our study. A potential explanation is that spending is not an important margin of response to alerts. Instead, transfers of funds (which are instantaneous in the U.K.) account for most of the savings in overdraft charges.

It is an open question as to why consumers are not more elastic on their current account spending, as the FCA has shown about half of overdrafts could be avoided by shifting spending onto their lower-cost credit cards without cutting consumption (FCA, 2018c). One possibility is that customers do not realize that their effective overdraft interest rates are higher than their credit-card borrowing rates because overdraft charges were quoted in pounds per chargeable event (per day or per transaction, etc.) which are not easily comparable to credit-card interest rates. This is one motivation for the recent FCA policy (effective April 2020) requiring banks to price overdraft borrowing using interest rates rather than daily charges and encouraging them to disclose overdraft interest rates to consumers as an effective annual rate (EAR) (FCA, 2019a). (Table I and Appendix Table AIII describe overdraft pricing before and after the regulatory change.) The hope is that, by making overdraft rates easily comparable to credit-card borrowing rates, banks will be forced to offer overdraft rates that are competitive with credit-card rates.

Our headline findings for policymakers are that (1) Given intraday grace periods, automatic enrollment in just-in-time alerts provides a large consumer benefit without offsetting consumer harm; (2) Any incremental benefit from additional early warning alerts is not statistically detectable in our study. Based on these findings, in 2019 the FCA expanded the CMA's mandate for just-in-time UOD and UI alerts to cover more banks (by reducing the size threshold for which the regulation applies) and added a mandate for just-in-time AOD alerts, but chose not to mandate any early warning alerts (FCA, 2018c). Our experimental tests of alerts do not reveal what banks' equilibrium pricing responses will be once alerts are in place across the market. Since alert mandates represent a regulated cut in hidden charge revenue, a natural concern is that banks will raise overdraft fees or other charges to offset the lost revenue. Nevertheless, we are optimistic that U.K. retail banks will respond to the regulated cut in hidden charges similarly to U.S. retail banks, which did not adjust prices to offset 2009 CARD Act reductions in hidden credit-card charges (Agarwal et al., 2015). Investigating whether our optimism is borne out in practice is left for future work.

Appendix: Sample Statistics and Overdraft Pricing

Sample deletions: Table AI shows how we construct our estimation sample by dropping observations with inconsistent or missing data and dropping customers who lack an active primary account, have defaulted, or are using their account for business purposes.

Table AI

Field Experiment Sample Deletions

This table reports deletions from the field experiment sample. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility.

Bank	Bank A			Bank B	
Overdraft facility	AOD+	UOD only	none	AOD+	UOD only
Initial no. customers sampled	151,414	74,947	326,295	339,384	270,148
Dropped due to inconsistent or missing data	12,882	3,904	14,319	16,043	9,153
Dropped due to inactive, default, or business	0	108	941	0	3,386
Final no. customers	138,532	70,935	311,035	323,341	257,609

Treatment and control means: Table AII reports average monthly total observed overdraft charges for each treatment and control group, opt-in rates for control groups and the treatment group in prompted enrollment treatment 11, as well as opt-out rates for treated groups in automatic enrollment treatments 1–10.

Overdraft fee distribution: Figure A1 shows the distribution of customers' monthly arranged and unarranged overdraft charges at each of the six major U.K. banks in 2015.

2023 overdraft pricing: Table AIII shows how arranged and unarranged overdraft fees are structured for basic account types at each of the six major U.K. banks in July 2023, when overdraft pricing is restricted to a simple interest rate. EARs for basic accounts are 35 to 39.94 percent. Premium accounts, student accounts, and recent graduate accounts sometimes offer EAR discounts of 10–20 percentage points or, alternatively, buffers of up to £3000 for which interest charges do not accrue. Most banks either do not offer unarranged overdraft borrowing (apart from a small buffer) or charge the same EAR as for arranged overdraft. Unpaid item fees are either zero or are a maximum of £2.15 per month at Royal Bank of Scotland (RBS).

Table AII

Sample Sizes, Monthly Charges, Opt-out Rates, and Opt-in Rates, By Treatment

This table reports treatment and control group sample sizes, monthly charges, opt-out rates, and opt-in rates, by treatment. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. An observation is a customer-month. Monthly charges are an average of total observed overdraft and unpaid item charges during the treatment period in pounds per month. Opt-out rates are cumulative opt-outs during the sample period. Opt-in rates are cumulative opt-ins over the sample period for Bank A, but cumulative opt-ins over the history of alert availability for Bank B. Treatment 11 is a 'prompted enrollment' treatment, and hence opt-in rates rather than opt-out rates are reported for its treatment group. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels.

Overdraft facility	AOD+					UOD only				None	
Alert target	AOD			UOD + UI		UOD + UI				UI	
Alert threshold	0†	0	100	0	50	0	50	100	100	100	100
Bank	A	B	B	B	B	B	B	B	A	A	A
Treatment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Treatment Group											
No. customers	34,540	32,449	32,474	32,269	32,385	34,422	34,420	34,434	36,043	36,564	137,440
No. observations	328,329	318,948	319,122	317,158	318,705	309,743	309,877	309,190	320,683	330,305	1,240,403
Monthly charges (£)	6.02	9.53	9.58	9.90	9.64	2.34	2.20	2.28	4.68	1.12	1.12
Opt-out rates (pct)	6.9	1.3	1.6	0.1	0.6	0.1	0.9	1.0	8.3	9.2	
Opt-in rates (pct)											8.7
Control Group											
No. customers	103,992	32,269	32,269	193,764	32,269	154,333	34,422	34,422	34,892	137,031	137,031
No. observations	988,488	317,158	317,158	1,903,942	317,158	1,389,809	309,743	309,743	309,449	1,236,706	1,236,706
Monthly charges (£)	6.52	9.90	9.90	10.24	9.90	2.74	2.34	2.34	4.85	1.12	1.12
Opt-in rates (pct)	0.2	3.2	3.2	1.2	2.6	0.8	2.8	2.8	0.2	0.2	0.2
Stand-alone alert	Yes	Yes	Yes	Yes	No	Yes	No	No	Pre-mandate	No	No

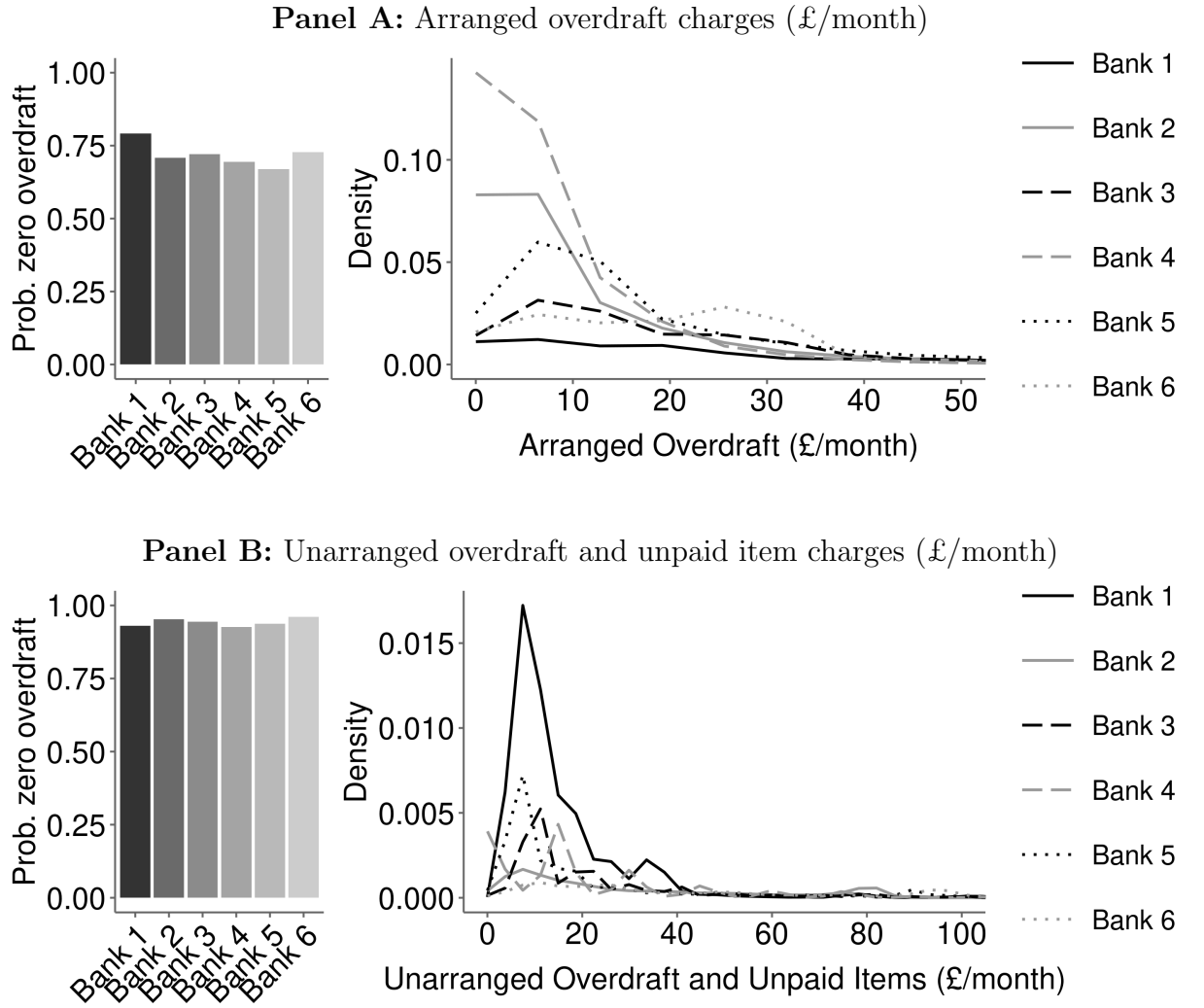

Figure A1. Distribution of overdraft charges. These plots show the distribution of customers' monthly arranged overdraft charges (Panel A) and unarranged overdraft and unpaid item charges (Panel B) for each of the U.K.'s six major banks in 2015. Plots are based on observed charges in pounds sterling per month. In each panel, the left-hand plot shows the average fraction of the sample that has none of the relevant charges in a given month. The right-hand panel shows a kernel density of the relevant charges for ranges that exclude zero ($(0, £50]$ for AOD charges and $(0, £100]$ for UOD charges). The kernel densities are scaled to be unconditional (rather than conditional) on positive charges.

Table AIII

2023 U.K. Overdraft Fee Structure for the Six Largest Retail Banks

This table reports the 2023 overdraft fee structure for the U.K.'s six largest retail banks. Acronyms stand for Lloyds Banking Group (LBG: includes Lloyds Bank, Halifax, and Bank of Scotland), Royal Bank of Scotland Group (RBSG: includes Royal Bank of Scotland and NatWest), HSBC Group (HSBCG: includes HSBC and First Direct), arranged overdraft (AOD), unarranged overdraft (UOD), and equivalent annual rate (EAR). Overdraft pricing is reported for each bank's most basic account type that includes an overdraft service. These are the LBG Classic account, Halifax/Bank of Scotland Current account, RBS/NatWest Select Account, Barclays Personal Overdraft account, HSBC Bank Account, First Direct 1st Account, Santander Everyday Current Account, and Nationwide FlexPlus account. Since April 2020, banks have only been able to charge a simple annual interest rate for overdraft borrowing, and additional fees such as paid item fees have been prohibited. AOD Buffer refers to the amount of interest-free borrowing before the interest charges accrue. The UOD cap is the maximum UOD fee charged in a month (the monthly maximum charge or MMC). In the table, "n.a." for UOD and UOD cap means that a bank doesn't offer an unarranged overdraft service. In this case, if a transaction is initiated that would lead to UOD borrowing, the bank tries to decline the transaction without an unpaid item fee. If the bank fails to decline the transaction, there are no associated charges. Some banks offer premium or student accounts with larger buffers (up to £3000 for an HSBC recent graduate account) while others offer premium accounts with lower interest rates (EAR discounts of 10–20 percentage points). † = This unpaid item fee is charged at most one time per billing cycle (i.e. the monthly cap for UI charges is £2.15). ‡ = Up to a £250 buffer. * = 25 for HSBC(Bank Account) and 250 for First Direct(1st Account). Sources and access dates: LBG (www.lloydsbank.com, Jun 27, 2023), RBS (www.rbs.co.uk, July 3, 2023), Barclays (www.barclays.co.uk, Jun 29, 2023), HSBC (www.hsbc.co.uk, Jun 27, 2023), Santander (www.santander.co.uk, Jun 29, 2023), Nationwide (www.nationwide.co.uk, Jun 27, 2023), Halifax (www.halifax.co.uk, July 3, 2023), Bank of Scotland (www.bankofscotland.co.uk, Jun 30, 2023), NatWest (www.natwest.com, Jun 29, 2023), First Direct (www.firstdirect.com, July 3, 2023).

	AOD Buffer (£)	AOD (EAR %)	UOD (EAR %)	UOD Cap (£)	Unpaid Item (£)
LBG	0	39.90	n.a.	n.a.	0
RBSG	0	39.49	39.49	17.25	2.15†
Barclays	15	35.00	n.a.	n.a.	0
HSBCG	25-250*	39.90	39.90	20	0
Santander	0	39.94	0‡	n.a.	0
Nationwide	0	39.90	n.a.	n.a.	0

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Internet Appendix for "Sending out an SMS: Automatic Enrollment Experiments for Overdraft Alerts"

MICHAEL D. GRUBB, DARRAGH KELLY, JEROEN NIEBOER, MATTHEW OSBORNE, and JONATHAN SHAW*

Abstract

Internet Appendices B–J provide additional material supporting the main text including: (B) survey results; (C) a comparison of our two measures of overdraft charges; (D) time-to-first-alert analysis; (E) analysis of foregone savings by multi-account holders; (F) natural experiment results; (G) tables of additional results; (H) sample comparison tables for subsamples and sample balance; (I) the survey script; and (J) the field experiment terms of reference documents.

Appendix B. Survey Results

To conduct a telephone survey after the field experiments, both Banks A and B shared the contact details of 40,000 randomly selected trial participants directly with a market research agency employed by the FCA to interview 2,000 customers at each bank. The agency conducted interviews of circa 10–15 minutes with 2004 Bank A respondents and 2003 Bank B respondents. (Approximately one-third of Bank A respondents are not relevant to this paper because they did not participate in the trials we study.) The agency did not report how many trial participants were called in order to reach this number of respondents, so we can only say that the response rate exceeds 5%.

Questions written by us concerned customer rationale for opting-out, responses to alerts, attitudes towards and non-financial costs imposed by automatic enrollment (e.g. alert fatigue), knowledge and awareness of overdraft charges, and subjective financial well-being. Question text is reported in Internet Appendix I.

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Each respondent was specifically asked for consent to link their survey responses to the observational data collected from the banks (using anonymized unique participant identifier codes). 72% of Bank A respondents and 74% of Bank B respondents gave their consent. We only report survey results from those linked to their observational data, as they can be re-weighted to correct for oversampling when we report aggregate responses. (The survey oversampled customers who had opted out of alerts and customers who were likely to have received alerts.)

Note that all customers were automatically enrolled in just-in-time UOD and UI alerts by the time of the survey (although some will have since opted-out), and customers were asked about their responses to any of the alerts they received—not only the treatment alerts. As a result, while survey results do vary by treatment group, it is unclear how to interpret the differences. Hence, we aggregate responses across treatment groups within the same customer group as defined by bank and available overdraft facility. Our final sample includes 2,355 customers: 946 for Bank A (272 with AOD+ facility, 231 with UOD facility only, and 443 with no overdraft facility) and 1409 for Bank B (809 with AOD+ facility and 600 with UOD facility only).

Note that our sample is selected based on which customers answered their phone when called and were willing to participate, which could bias our results. For instance, if customers who are irritated by alerts are less likely to agree to participate, then we could overstate consumers' positive attitudes to alerts.

Findings from our participant survey are shown in Table B.I. Panel A shows reported reasons customers chose to opt-out of alerts, as discussed below. 'Alerts cause psychological cost" aggregates responses indicating alerts were "too many", "irritating", or led the respondent to feel "anxious" or "embarrassed". Panel B shows reported responses to alerts, as discussed in Section III.F.2. Panel C shows reported attitudes towards alerts, while Panel D shows reported knowledge of overdraft charges, both discussed below. All percentages are weighted to correct for oversampling. Additional survey questions about subjective financial wellbeing are discussed in an earlier version of our work (Adams et al., 2018).

Table B.I

Survey Responses

This table reports survey responses by bank and overdraft facility. Acronyms stand for overdraft (OD), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. Averages are weighted to correct for oversampling of those who opted-out and those who received alerts. The survey script is in Internet Appendix I. Panel A row labels are: "Alerts not useful" = question 3B.1 response 1 ("Alert not useful"); "Alerts cause psychological cost" = question 3B.1 response 2 ("Received too many alerts"), 3 ("Found the alerts irritating"), 4 ("Felt anxious as a result of the alerts"), or 5 ("Felt embarrassed as a result of the alerts"). Panel B row labels are: "Took action to avoid charges" = yes to question 3.7; "Transfer from savings" = yes to question 3.8.e; "Friends and family borrowing" = yes question 3.8.b; "Cut spending" = yes to question 3.8.c; "Let bill go unpaid" = yes to question 3.8.d; "Credit card borrowing" = yes to question 3.8.a with response code 1 ("Use existing credit card"); "Other formal borrowing" = yes to question 3.8.a without response code 1.

Bank	Bank A			Bank B	
Overdraft facility	AOD+ (1)	UOD only (2)	None (3)	AOD+ (4)	UOD only (5)
Panel A: Opt-out rationale (Sample: opted-out)					
Alerts not useful	58%	46%	40%	-	-
s.e.	(9%)	(9%)	(7%)	-	-
Alerts cause psychological cost	27%	40%	38%	-	-
s.e.	(8%)	(8%)	(7%)	-	-
Observations	33	35	52	0	0
Panel B: Alert response (Sample: received an alert)					
Took action to avoid charges	73%	61%	64%	61%	64%
s.e.	(4%)	(5%)	(4%)	(3%)	(3%)
Transfer from savings	61%	64%	56%	61%	50%
s.e.	(5%)	(6%)	(5%)	(3%)	(4%)
Friends and family borrowing	32%	25%	43%	27%	34%
s.e.	(5%)	(6%)	(5%)	(3%)	(4%)
Cut spending	35%	46%	48%	31%	40%
s.e.	(5%)	(7%)	(5%)	(3%)	(4%)
Let bill go unpaid	9%	15%	24%	8%	8%
s.e.	(3%)	(5%)	(5%)	(2%)	(2%)
Credit card borrowing	4%	7%	4%	2%	2%
s.e.	(2%)	(3%)	(2%)	(1%)	(1%)
Other formal borrowing	4%	0%	7%	3%	3%
s.e.	(2%)	(0%)	(3%)	(1%)	(1%)
Observations	111	97	200	328	271

Continued

Table B.I. —*Continued*

Survey Responses

Panel C row labels are: "Like alerts" = question 3.3 answer 1, "Dislike alerts" = question 3.3 answer 2, "Alerts are helpful" = question 3.4 answer 1, "Alerts are unhelpful" = question 3.4 answer 2, "Alert frequency about right" = question 3.2 answer 2, "Alert frequency too often" = question 3.2 answer 1, "Bank should auto-enroll" = question 4.1 answer 1. Panel D reports the fraction of respondents who did not answer "I don't know" to questions about charges (questions 2.8, 2.9, and 2.10). The fraction is reported as a share of the full sample (denoted "All") and of the subsample who incurred one of the relevant charges in the preceding three months (denoted "Recent charge").

Bank	Bank A			Bank B	
Overdraft facility	AOD+ (1)	UOD only (2)	None (3)	AOD+ (4)	UOD only (5)
Panel C: Alert attitude (Sample: did not opt-out)					
Like alerts	58%	54%	64%	59%	56%
s.e.	(5%)	(5%)	(4%)	(3%)	(3%)
Dislike alerts	6%	3%	7%	8%	6%
s.e.	(2%)	(2%)	(2%)	(1%)	(1%)
Alerts are helpful	85%	87%	92%	84%	90%
s.e.	(3%)	(3%)	(2%)	(2%)	(2%)
Alerts are unhelpful	5%	3%	1%	3%	2%
s.e.	(2%)	(2%)	(0%)	(1%)	(1%)
Alert frequency about right	91%	91%	87%	90%	90%
s.e.	(3%)	(3%)	(3%)	(2%)	(2%)
Alert frequency too often	5%	2%	3%	5%	4%
s.e.	(2%)	(1%)	(1%)	(1%)	(1%)
Bank should auto-enroll	81%	76%	70%	71%	69%
s.e.	(3%)	(4%)	(3%)	(2%)	(2%)
Observations	238	195	391	809	600
Panel D: Knowledge of charges (Sample: all)—Fraction who did **not** say "I don't know"					
Arranged overdraft (All)	57%	-	-	53%	-
s.e.	(4%)	-	-	(2%)	-
Arranged overdraft (Recent Charge)	62%	-	-	58%	-
s.e.	(4%)	-	-	(3%)	-
Unarranged overdraft (All)	-	25%	-	21%	25%
s.e.	-	(4%)	-	(2%)	(2%)
Unarranged overdraft (Recent Charge)	-	42%	-	38%	36%
s.e.	-	(7%)	-	(7%)	(5%)
Unpaid item (All)	32%	17%	29%	26%	21%
s.e.	(4%)	(3%)	(3%)	(2%)	(2%)
Unpaid item (Recent Charge)	74%	40%	43%	39%	39%
s.e.	(9%)	(13%)	(7%)	(22%)	(13%)
Observations (All)	272	231	443	809	600
Observations (Recent Charge)	197	116	96	605	246

Rationale for opt-out: Table B.I Panel A shows that approximately half of those who opted out of alerts at Bank A (40–58%) did so because the alerts were "not useful" or "not needed", with a smaller share (27–40%) reporting they opted out because they incurred some psychological cost (such as irritation, anxiety, or embarrassment) from receiving the alerts. Of the remaining (15–22%) of responses, roughly half explained that they did not realize they had opted out, and roughly half did not give a reason. 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. This is consistent with the finding in Table H.IV that online banking logins are more frequent among those who opt-out. We did not obtain survey responses from those who opted-out of alerts at Bank B.

Attitudes towards alerts: Table B.I Panel C shows attitudes towards alerts and automatic enrollment reported by our survey participants. Ideally, consumers for whom alerts are more unpleasant than helpful would opt-out. However, it is possible that many consumers are irritated by alerts but fail to opt-out due to hassle costs. Fortunately this is not the case, as Panel C reports broad satisfaction with alerts, their frequency, and automatic enrollment among respondents who did not opt-out.

Respondents were asked whether they liked or disliked the alerts and whether the alerts were perceived as helpful or unhelpful. Only 3–8% of respondents reported they disliked the alerts (versus 54–64% responding they liked the alerts), and only 1–5% found the alerts unhelpful (versus 84–92% responding the alerts were helpful). Respondents were also asked to rate the frequency of alerts as too often, about right, or insufficient. Most respondents (87–91%) found alert frequency "about right", while only 2–5% reported receiving alerts "too often". Respondents were also positive about auto-enrollment into the alert: 69–81% of respondents in the treatment groups agreed that their bank should offer the alerts automatically, with 20–28% of respondents saying they would prefer to be given the opportunity to register themselves.

Evidence that overdraft charges are hidden fees: Survey participants were asked, "How much would your bank charge you if you dipped into your arranged overdraft by £100 for one day?", "How much would your bank charge you if you dipped into your unarranged overdraft by £50 for one day?" and "How much would your bank charge you for a single

unpaid transaction?". Table B.I Panel D reports the percentage of respondents answering each question rather than stating "don't know", both for the full sample ("All"), and for the sub-sample of respondents that incurred a charge (of the relevant type) in the three months before the survey ("Recent Charge"). For those who answered, Figure B.1 shows histograms of responses (separately for those that recently incurred a relevant charge and those that did not) where responses have been normalized so that the correct answer is 1.

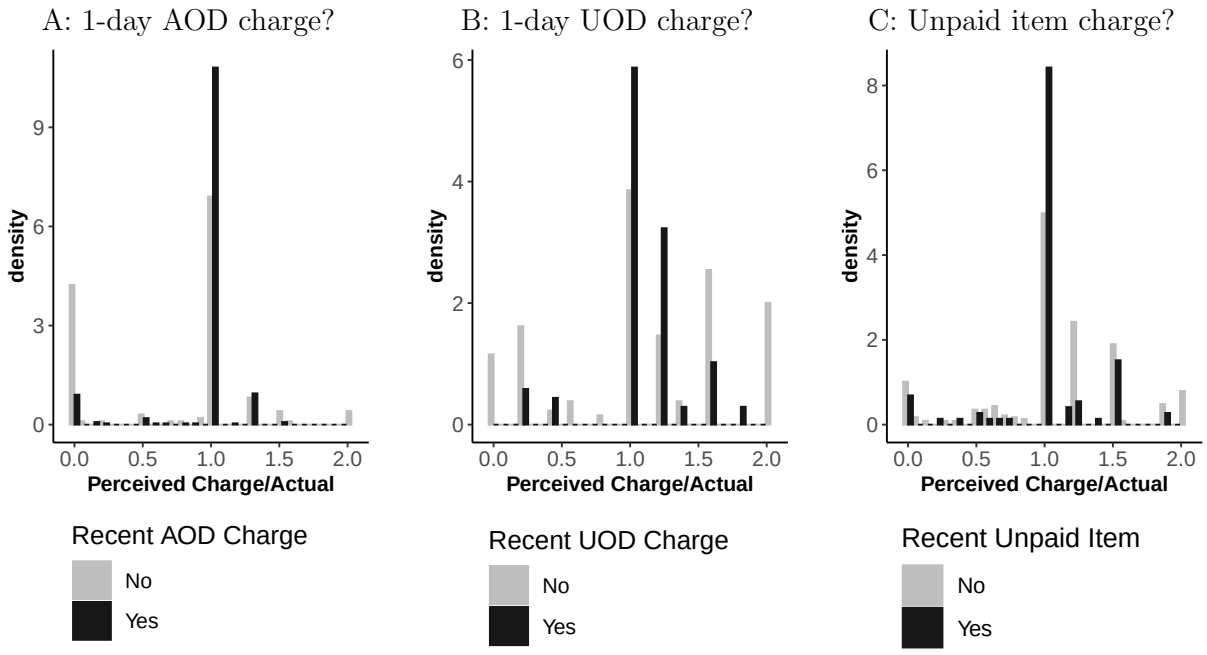

Figure B.1. Knowledge of charges. Acronyms stand for arranged overdraft (AOD) and unarranged overdraft (UOD). Plots show histograms of answers to questions about arranged overdraft, unarranged overdraft, and unpaid item charges (aggregated across both treatments and banks) excluding "I don't know" responses. Answers are normalized such that the correct answer is equal to one. Reported for those respondents who incurred a relevant charge in the preceding three months and those who did not. The survey script is in Internet Appendix I; responses are from questions 2.8, 2.9, and 2.10.

In the full sample, almost half (43–47%) state "don't know" for a 1-day arranged overdraft fee, and the vast majority (68–83%) answer "don't know" for the cost of a 1-day unarranged overdraft or unpaid item fee (despite both banks charging flat fees in all 3 cases). Of those that attempt to answer, many do so incorrectly. Thus overall, customers answer

within 10% of the correct answer less than a third of the time. Knowledge is much higher among those who recently paid the relevant charge, but the maximum rate of near-correct answers is still less than half. This limited awareness of overdraft charges echoes previous findings (OFT 2008; CMA 2016; Atticus 2018).

Appendix C. Inferred Charges

We use two separate measures of overdraft charges derived from account transaction data. First, when an account balance becomes negative and enters arranged overdraft, we can compute the resulting arranged overdraft charge based on our knowledge of each bank's fee schedule. We call this the "inferred" arranged overdraft charge. Second, in the following billing cycle, a transaction will appear in our data labeled as an arranged overdraft fee, which deducts arranged overdraft charges accrued in the preceding billing cycle. We call this the "observed" arranged overdraft charge. Similarly, we use both inferred and observed measures of unarranged overdraft and unpaid item charges.

Observed charges are our preferred measure due to imperfections in our computation of inferred charges. However, since overdraft and unpaid item charges are only deducted from a customer's account after the end of a consumer's billing cycle plus a 3–4 week delay, our main results based on observed charges must (1) drop the last treatment month, and (2) must allow for a transitional month at treatment onset since billing cycles do not coincide with calendar months. We use inferred charges when we need to avoid these limitations.

We infer charges by combining transaction behaviour with detailed information on charging models received from the banks. Observed charges are allocated to the monthly billing cycle in which they occur, with consumers having different billing cycle start dates (typically the anniversary 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. Thus treatment onset should be sharp, rather than involving a transitional month, for our inferred charges. We infer overdraft usage from account balances and we observe unpaid items directly in the transactions data. Note that inferred charges do not account for possible rescinded charges (e.g.; a consumer complained to their bank and the bank agreed to waive some charges), which may lead us to slightly overestimate the charges.

Table C.I compares our measure of inferred charges summed to the billing-cycle (rather than trial month) with actual charges. Our inferred charges overestimate actual charges by 5–10%, except in the case of Bank B UI charges, which we underestimate by 27%. We underestimate UI charges substantially for Bank B because we are only able to observe a subset of unpaid items in our transaction data, so this shortcoming is expected. Outside of this case, correlation between inferred and observed charges is 93–99%, and OLS regressions of observed charges on inferred charges yield coefficient estimates between 0.86 and 0.93 and adjusted R^2 between 0.77 and 0.93. Hence we are confident that we can rely on treatment effect estimates based on inferred charges when necessary.

Table C.I

Observed versus Inferred Charges

This table reports regressions of observed charges on inferred charges for each bank and charge type. Observed charges are observed from the transactions which deduct charges from customers' accounts, which are identifiable by bank transaction codes that designate the transactions as arranged overdraft (AOD), unarranged overdraft, (UOD) or unpaid item (UI) charges. Inferred charges are computed from daily account balance information using our knowledge of each bank's fee structure. Observations are at the account-month level for the entire sample period. Charges are in pounds sterling per month. Customer and month fixed effects are included and error terms are clustered by customer and month. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Bank	A			B		
Charge type	AOD	UOD	UI	AOD	UOD	UI
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.104***	0.033***	0.039***	0.019***	0.075***	0.045***
	(0.003)	(0.004)	(0.001)	(0.003)	(0.002)	(0.001)
Inferred charges	0.933***	0.933***	0.862***	0.897***	0.860***	0.953***
	(0.0002)	(0.0004)	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Mean inferred	5.39	4.35	0.71	7.78	2.02	0.14
Mean observed	5.13	4.09	0.66	7.00	1.81	0.18
Pct. difference	5%	6%	8%	10%	10%	-27%
Correlation	0.97	0.96	0.93	0.99	0.93	0.83
No. accounts	217,326	65,688	584,755	339,375	607,179	607,179
No. observations	1,914,978	561,186	5,046,027	3,313,067	5,688,937	5,688,937
Adjusted R^2	0.928	0.919	0.766	0.880	0.788	0.639

Appendix D. Time to First Alert Analysis

Some of the changes in behavior due to automatic enrollment into alerts in our field experiments may be driven by notification of enrollment rather than the arrival of 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 enrollment. (Banks A and B informed enrolled participants by email at the start of the trial; Bank A also sent a two-way SMS message that allowed customers to reply to opt-out.)

Table D.I

Time to First Alert

This table reports the effect of automatic enrollment in alerts on the time elapsed between the start of the treatment period and the first occurrence of the event that triggers the alert (or would have triggered the alert if enrolled, in the case of the control group participants). Estimates are from a Cox proportional hazard model with a single treatment term. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. Bank B just-in-time UOD/UI alert treatments are excluded because the time of the first just-in-time UI alert is not observed. Note that Bank B informed enrolled participants by email at the start of the trial; Bank A sent an email as well as a two-way SMS message. Months 10–11 are excluded for treatments 4 and 6 (when all subjects are treated) and treatment 9 (when it is no-longer stand-alone). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+				UOD only			None
Alert target	AOD			UOD + UI	UOD + UI			UI
Alert threshold	0†	0	100	50	50	100	100	100
Bank	A	B	B	B	B	B	A	A
Treatment	1	2	3	5	7	8	9	10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-0.011	-0.011	-0.007	-0.008	-0.003	-0.004	-0.031***	-0.020***
s.e.	(0.009)	(0.010)	(0.009)	(0.014)	(0.011)	(0.010)	(0.010)	(0.007)
Stand-alone alert	Yes	Yes	Yes	No	No	No	Pre-mandate	No
Observations	129,434	63,481	63,496	63,450	60,148	60,064	60,382	150,861

Although we cannot fully disentangle the effect of increased salience from the effects of the alerts themselves, we can do two things. First, we can look at whether behavior changes prior to the arrival of the first alert. In Section III.F equation (2), the coefficient λ on $Treatment_i \times I(t \geq 7)$ measures the effect of notification of enrollment on daily logins, debit card transactions, and account transfers in the days from enrollment to four days before

the first treatment alert is received. Estimates in Tables X–XI are small and statistically insignificant—consistent with no treatment effect of enrollment beyond the effect of alerts themselves.

Second, we can measure whether treatment affects the time from alert enrollment until a consumer first passes an alert threshold (e.g. the first time since the start of the trial that the account balance of someone in an early warning alert treatment dips below the £50 or £100 alert threshold). By definition, these treatment effects cannot be driven by alerts themselves. In this appendix, we test this hypothesis by estimating a Cox proportional hazard model for each treatment, reported in Table D.I. We exclude Bank B's trial of just-in-time UOD and UI alerts, since we do not observe the time to the first just-in-time UI alert at Bank B.

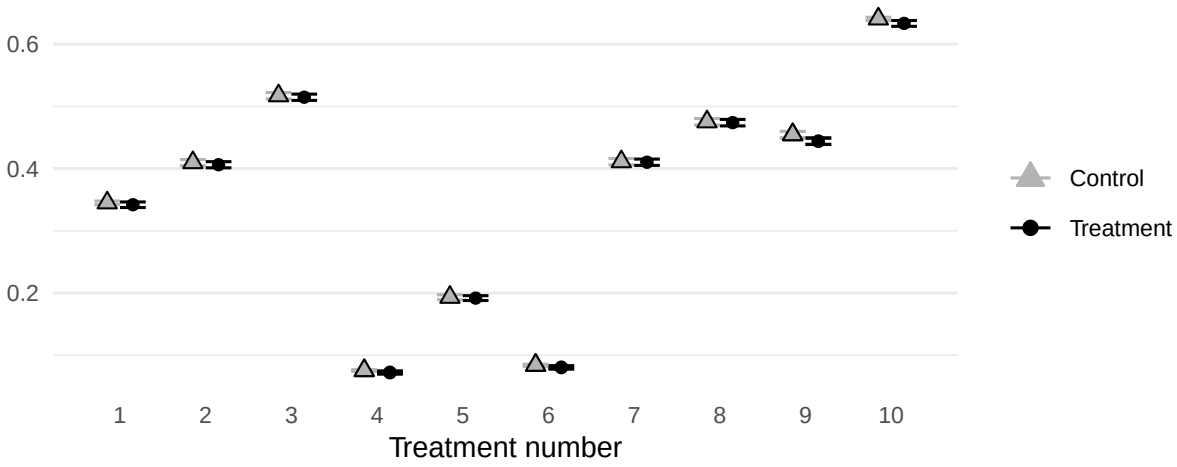

Figure D.1. Probability of crossing treatment alert threshold within 30 days. This figure reports the probability of crossing the account balance threshold that triggers a treatment alert within 30 days of from the start of the treatment period, as predicted by the Cox proportional hazard model estimates reported in Table D.I. Bars show 95% confidence intervals. Note that Bank B informed enrolled participants by email at the start of the trial; Bank A sent an email as well as a two-way SMS message.

In most trials, our point estimates of the treatment indicator coefficient are negative, consistent with automatic enrollment delaying the time until first crossing an alert balance threshold. However, only for Bank A and customers without an AOD facility (treatments 9 and 10) are the effects statistically significant. (The stronger finding for Bank A is consistent

with text messages having a higher opening rate than emails.) To help interpret the magnitude of the estimates, Figure D.1 plots estimated probabilities (with 95% confidence intervals) that a customer's account balance crosses a treatment alert threshold within 30 days of the start of the treatment period. The figure shows negligible effects for treatments 1–8 and small effects for treatments 9–10.

Appendix E. Multiple Current Account Analysis

Across all treatments, 2–7% of customers have multiple current accounts at the same bank, which enables us to look at alternative current-account liquidity. Almost all multiple-account holders have exactly two accounts, and we focus on this group for simplicity.

A household with two adults, one joint account, and one non-joint account may borrow on the joint account when there is liquidity in the non-joint account for reasons of intra-household bargaining and resource allocation. To avoid incorrectly interpreting such a scenario as unnecessary borrowing due to frictions, we conservatively restrict our sample to customers with two current accounts that are both accessible by the same set of household members. The fraction of customers who have two accounts accessible to the same set of household members is 6.2% for Bank A customers with an AOD facility, 2.0% for Bank B customers with an AOD facility, and 2.4% for Bank B customers with a UOD facility.

Clearly, our subsample of customers with two-accounts is highly selected. Table H.III reports differences in observable pretreatment customer characteristics between our full sample and our dual-account holder sample separately by overdraft facility and bank. Note that account balances, borrowing limits, and charges are summed across accounts rather than averaged for individuals with two accounts. Compared to single-account holders, Table H.III shows that dual-account holders have approximately two years longer tenure with their bank, higher average balances, larger overdraft borrowing limits, higher account inflows, higher overdraft charges, and higher account engagement. Put simply, people with more current accounts have more of all the things that come with current accounts. It is likely that their rate of overdraft borrowing that is avoidable with alternative account liquidity (which we cannot compare) is also not representative. This will be a caveat to all our results for this subsample.

Table E.I presents our analysis of dual-account holders and just-in-time alerts. To

increase the limited sample sizes, we group the early warning treatment groups (which showed no effect of treatment in Table V) with the customers who received only just-in-time UOD and UI alerts. This approximately triples the size of our control group in column (2) and our treatment groups in columns (3) and (4). All overdraft charges reported are inferred rather than observed charges.

Rows (1)–(3) of Table E.I show control and treatment group means of overdraft charges targeted by the treatment alerts, and the corresponding within-sample treatment effect estimate. Estimated treatment effects for just-in-time AOD alerts on AOD charges at Banks A and B are not statistically different from those estimated on the full sample, and although noisy, have similar point estimates to those estimated on the full sample. Estimated treatment effects for just-in-time UOD alerts on UOD and UI charges at Bank B are economically and statistically larger than those estimated on the full sample. These comparisons hold both with respect to full-sample estimates using observed charges (Table V) and those using inferred charges (Table VI). The larger treatment effect estimates may be due to the fact that dual-account holders are more likely to have available liquidity with which to address the problem when they receive an alert.

We know from existing literature that account-holders often overdraft when they have available liquidity in other accounts (Stango and Zinman, 2009; FCA, 2018c). But is this still true after they are enrolled in just-in-time alerts, or do the alerts prompt individuals to take advantage of their other accounts to the full extent feasible? The remaining rows (4)–(6) show that in fact customers with two accounts do still overdraft when they have liquidity in their second current account even when enrolled in alerts.

Consider the following counterfactual simulation for the treatment group in the subsample of dual-account holders: Whenever a customer overdraws one account, if there is sufficient liquidity in the second account to cover the overdraft balance for the entire overdraft episode (while maintaining a positive balance in the second account), then simulate how much charges would be reduced if funds were transferred between accounts to avoid the overdraft episode.

Table E.II illustrates an example of how counterfactual account balances are simulated. In the example, there is a counterfactual 13 November 2017 transfer of £206.30 from a customer's second current account to their first current account which is reversed on 16 November 2017. In the observed balances, the first current account experiences a 3-day overdraft from 13 November to 15 November, with a minimum balance of negative £206.30 on

Table E.I

Avoidable Overdraft Charges for Dual-Account Holders

For customers with two current accounts, this table compares the reduction in overdraft charges from alerts to the total overdraft charges that could have been avoided using liquidity in the second account. The sample includes all customers with two current accounts that are both accessible by the same set of household members. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. Charges are inferred charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts). Estimates in rows 1–5 are in pounds sterling per month; savings in row 6 is in pounds sterling per avoidable overdraft episode. Customer and month fixed effects are included and error terms are clustered by customer and month. Only treatment effect (row 2) and potential savings (row 4) estimates are labeled for statistical significance. Percentages in rows (2) and (4) are relative to baseline, the treatment-period control-group mean in row (1). The control group in column (2) and the treatment groups in columns (3) and (4) combine observations from treatment arms that included early warning alerts in addition to just-in-time UOD and UI alerts. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. Treatments 4 and 6 (columns 3–4) exclude months 10–11, when all units in treatments 4 and 6 are treated. All estimates are Intent To Treat (ITT). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+			UOD only
Alert target	AOD		UOD + UI	UOD + UI
Alert threshold	0†	0	0	0
Bank	A	B	B	B
Treatment	1	2	4	6
	(1)	(2)	(3)	(4)
(1) Control group mean of overdraft charges	7.357	14.446	3.932	3.715
	(0.268)	(0.510)	(0.246)	(0.241)
(2) Treatment effect (− Achieved savings)	-0.455**	-0.345	-1.230***	-1.314***
	(0.189)	(0.379)	(0.311)	(0.294)
	6.2%	2.4%	31%	35%
(3) Treatment group mean of overdraft charges	6.869	14.611	2.752	2.494
	(0.384)	(0.772)	(0.202)	(0.236)
(4) Treatment group mean of potential savings from second account liquidity	0.356***	0.864***	0.339***	0.664***
	(0.023)	(0.110)	(0.068)	(0.135)
	4.8%	6.0%	8.6%	18%
(5) Treatment group mean of counterfactual overdraft charges = row (3) − row (4)	6.512	13.747	2.412	1.829
	(0.382)	(0.771)	(0.188)	(0.210)
(6) Savings per avoidable overdraft episode	3.022	4.149	21.025	22.465
	(0.176)	(0.472)	(2.098)	(0.802)
(7) $\frac{\text{Achieved savings } (-\text{row 2})}{\text{Achieved savings } (-\text{row 2}) + \text{Forgone savings (row 4)}}$	56%	29%	78%	66%
No. control cust.	7,025	2,032	4,054	3,896
No. control obs. (all periods)	76,535	22,242	44,497	42,290
No. treatment cust.	2,335	719	2,032	2,638
No. treatment obs. (all periods)	25,374	7,861	22,242	28,635

the last day, 15 November. By transferring this amount on the first day, the entire overdraft episode is avoided with one counterfactual deposit. The £206.30 is returned to the second current account once the observed overdraft episode ends.

Table E.II

Counterfactual Inter-account Transfer to Avoid Overdraft Charges

This table illustrates a counterfactual transfer of funds between a dual-account holder's accounts to avoid an overdraft charge. The counterfactual transfer of £206.30 is from account 2 to account 1 on 13 November 2017 and is reversed on 16 November 2017. Balances are daily closing balances. Dates of the observed overdraft episode and counter-factually adjusted balances are highlighted in gray.

	Observed Balances		Counterfactual Balances	
Date	Account 1	Account 2	Account 1	Account 2
11-Nov-2017	189.35	1500.00	189.35	1500.00
12-Nov-2017	139.36	1500.00	139.36	1500.00
13-Nov-2017	-120.32	1500.00	85.98	1293.70
14-Nov-2017	-126.31	1500.00	79.99	1293.70
15-Nov-2017	-206.30	1500.00	0.00	1293.70
16-Nov-2017	2293.70	1500.00	2293.70	1500.00
17-Nov-2017	2169.18	1500.00	2169.18	1500.00

Returning to the real data, Table E.I row (4) reports the average monthly savings forgone by not following this counterfactual strategy, and row (5) shows what counterfactual monthly overdraft charges would be if the savings were achieved. Average forgone savings are statistically larger than zero at the 1% level in all treatments and are economically large—being 5–9% of control-group overdraft charges for dual-account holders with an AOD facility, and 18% for those without. Row (6) reports forgone savings per avoidable overdraft episode of £3–4 for AOD episodes and £21—22 for UOD episodes (reflecting the higher daily charges for UOD).

These results show that while just-in-time overdraft alerts help dual-account holders avoid unintentional overdraft borrowing due to unawareness of account balances, a substantial portion of remaining overdraft borrowing looks like a mistake and must be due to other frictions. The magnitude of forgone potential savings implies that alerts eliminate no more than 29–78% of unnecessary overdrafting charges for dual-account holders (Table E.I row (7)). These figures are the ratio of achieved savings (the negative of the treatment effect in row 2) to the sum of achieved savings and forgone potential savings feasible with second current-account

liquidity (row 4). The denominator is a lower bound for avoidable overdrafting charges absent alerts. The true level of avoidable overdraft charges is likely to be much larger due to additional potential savings using liquidity in unobserved savings accounts and credit cards. Hence, alerts likely eliminate much less than 29–78% of unnecessary overdrafting charges for dual-account holders. This is consistent with the findings in Section III.H suggesting that overdraft alerts eliminate less than half of unnecessary overdrafting in the full population of account holders.

Appendix F. Natural Experiments

F.1. Staggered Rollout

We present two natural experiments conducted by two out of the six largest national retail banks, which we call Banks C and D, who completed a staggered roll-out of one or both of the just-in-time UOD and UI alerts in 2014–2015 (in advance of the February 2018 regulatory deadline. The latter portion of these staggered rollouts (47% of customers for Bank C and 49% of customers for Bank D) is captured in the 2015 observational dataset and is supplemented by further implementation details provided to us by the two banks.

Our natural experimental treatment at Bank C is automatic enrollment into just-in-time UI alerts, which we examine for customers with and without an AOD facility (those without include a mix of those with a UOD facility and those without any overdraft facility). Our natural experimental treatment at Bank D is automatic enrollment into just-in-time alerts, both UOD and UI, which we examine for customers with an AOD facility and with a UOD facility only.

Figures F.1–F.2 shows how automatic enrollment was staggered over time at each Bank during our sample period. Bank C and D's staggered roll-out of alerts excluded customers already actively enrolled in alerts and those that were ineligible due to the bank not holding a mobile number for these customers. Bank C's staggered rollout was irregular, with substantial numbers of customers enrolled in February, March, April, October, and December 2015, but few enrollments between those dates. Bank D conducted a wave of enrollments entirely within our sample period, between June and November 2015. Our unit of observation is the customer. If a consumer has multiple accounts with the bank, they would be enrolled into

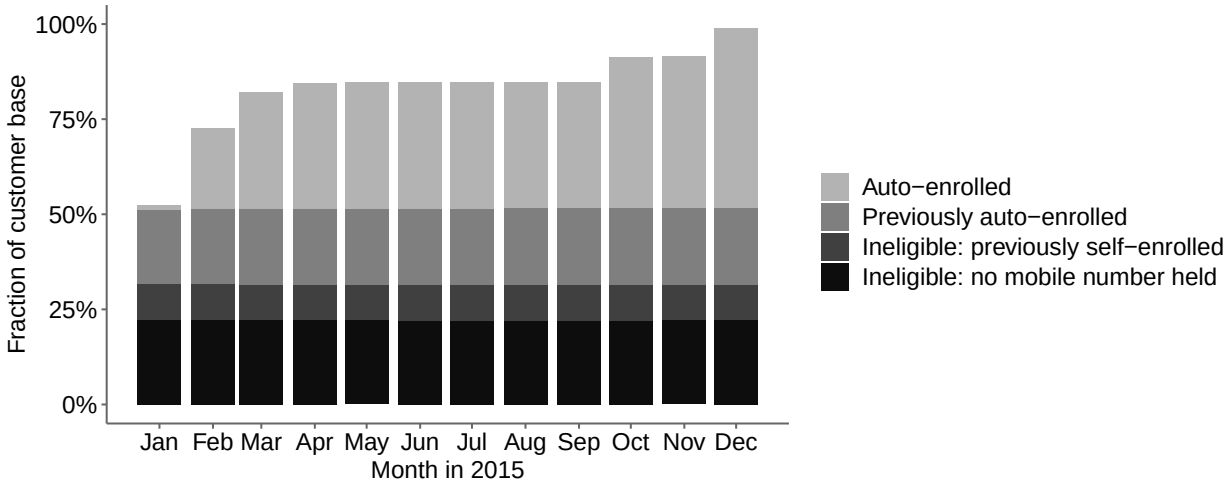

Figure F.1. Bank C staggered rollout of just-in-time UI alerts. Note that our estimates use data from January to November 2015 for cohorts who were auto-enrolled on or after March 2015.

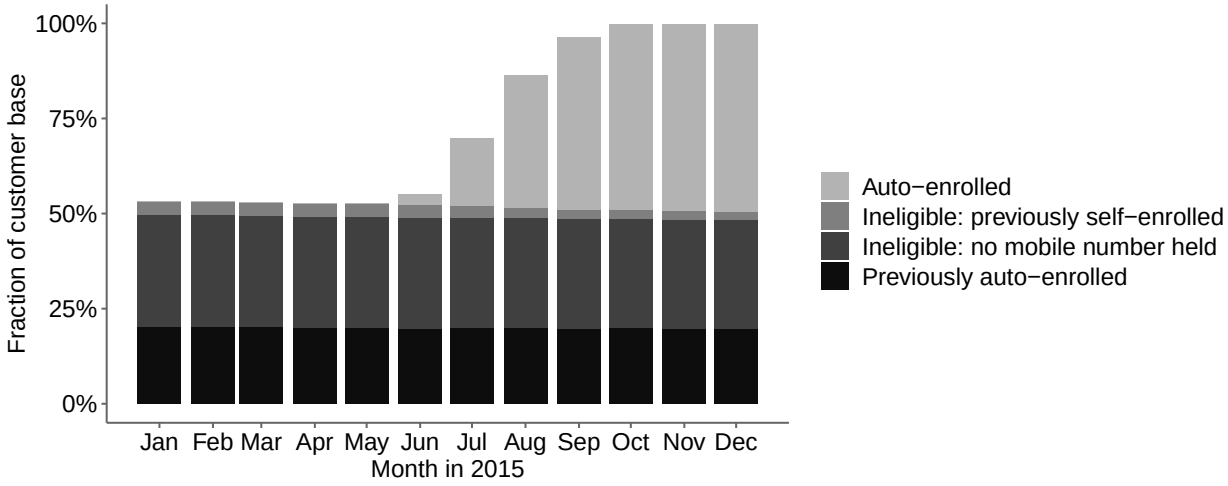

Figure F.2. Bank D staggered rollout of just-in-time UOD and UI alerts. Note that our estimates use data from January to October 2015 for cohorts who were auto-enrolled on or after June 2015.

alerts for all accounts at the same time, both at Bank C and Bank D. Joint account holders were enrolled at the same time.

Our analysis restricts attention to those who were not auto-enrolled until March 2015 or later so that we observe at least two months of pre-enrollment data for each account, which is restrictive for Bank C but not Bank D. As discussed below, we also restrict our estimation sample by dropping months on or after the date the last cohort is auto-enrolled so that the last enrollment cohort are "never-treated" in our estimation sample. As a result, our estimation samples include Bank C data from January to November 2015 for cohorts who were auto-enrolled on or after March 2015 and Bank D data from January to October 2015 for cohorts who were auto-enrolled on or after June 2015.

Internet Appendix F.6 Table F.III reports natural experiment pretreatment sample statistics by bank, overdraft facility, and enrollment month cohort (including the absolute number of customers in each enrollment cohort in our sample). Sample statistics are averages for the sample months preceding enrollment by the first cohort in our estimation sample (January–February 2015 for Bank C and January–May 2015 for Bank D). For Bank C, focusing on months with substantial enrollment (March, April, October, and December 2015) cohort characteristics are relatively similar. For Bank D, however, those enrolled earlier have higher account tenures, are older, more likely to have an arranged overdraft, have higher balances, are less likely to use mobile banking, and have lower average overdraft charges. Based on these patterns in the data and our conversations with Bank D, we put these differences down to automatic enrollment timing at Bank D being driven by an account identifier correlated with tenure. This can explain all the noted correlations between cohort characteristics and enrollment date because tenure is positively correlated with age, having an arranged overdraft facility, and having higher balances, and is negatively correlated with mobile banking and overdraft charges.

F.2. Empirical Approach

We restrict our sample by excluding the 17–25% of customers who lack an active primary account, have defaulted, or are using their account for business purposes. Internet Appendix F.5 documents these exclusions and other data construction details, while Table H.I reports sample descriptive statistics for each bank.

For our natural experiments, we estimate two model specifications. The first model is a difference-in-differences specification that is similar to equation (1) from our RCT, with the addition of tenure fixed effects $\theta_{\tau(i,t)}$, where $\tau(i,t)$ is customer i's tenure with the bank at time t:

$$Y_{i,t} = \beta_1 Auto.enrolled_{i,t} + \beta_2 Enroll.month_{i,t} + \eta_i + \mu_t + \theta_{\tau(i,t)} + \epsilon_{i,t} \tag{F1}$$

$Auto.enrolled_{i,t}$ is an indicator that is 1 for any month in which customer i has already been automatically enrolled into alerts. Because of the staggered rollout design, this indicator will vary both within a customer (since we restrict our sample to customers who were auto-enrolled during or after March 2015, all customers have pretreatment data) and across customers, since customers were enrolled at different time periods (Figures F.1–F.2). $Enroll.month_{i,t}$ is an indicator that is 1 only for the first month customer i is automatically enrolled, and controls for the fact that individuals are sometimes automatically enrolled some days into the month, and may not experience the full treatment in their first month. Tenure fixed effects are necessary because, as discussed above, enrollment date within the staggered rollout at Bank D appears to have been driven by an account identifier correlated with tenure. Moreover, account tenure is negatively correlated with overdraft charges.[27] Under the assumption of common (time and tenure) effects for individuals across the population, as well as no heterogeneity in the treatment across individuals and over time, we obtain an unbiased estimate of the average effect of automatic enrollment by comparing the outcomes of those consumers already enrolled to those not (yet) enrolled.

Recent literature on the estimation of difference-in-differences models with a staggered rollout design has suggested the possibility of biased estimates of the regression estimator of β_1 in equation (F1) (Goodman-Bacon, 2021). Hence, we apply the correction procedure of Sun and Abraham (2021) to the estimator of β_1. (We discuss our choice of correction procedure in Internet Appendix F.5.) When we apply the correction procedure, we do not include the regressor $Enroll.month_{i,t}$, but do not expect the lower effect in the enrollment month to have a large effect on our estimate.[28]

[27] Based on our conversations with the banks about the enrollment programs, we do not believe any other variables are unobserved to us which would have influenced the banks' enrollment of customers. In addition, all eligible customers were enrolled without prior notice. Therefore, customers could not have taken any purposeful action (to influence their eligibility) that may have affected their likelihood of being enrolled at all, or at a particular time.

[28] The procedure of Sun and Abraham (2021) is designed to correct the estimate of β_1 for the fact that

Panel A: Treatments 1–2.

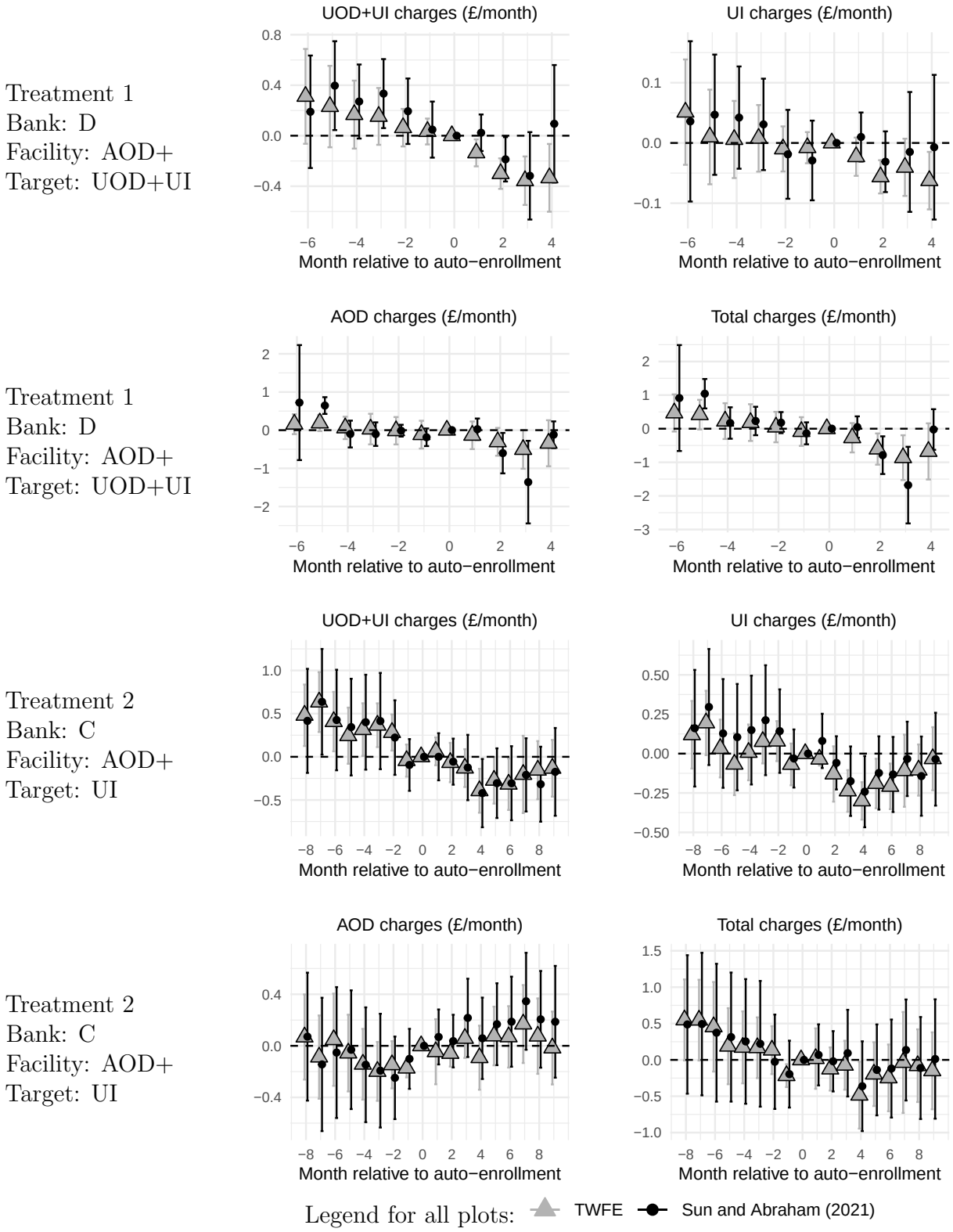

Figure F.3. Natural experiment event study plots. This figure shows event study plots of estimates from Table F.IV. See Panel B footnote for details.

Panel B: Treatments 3–4

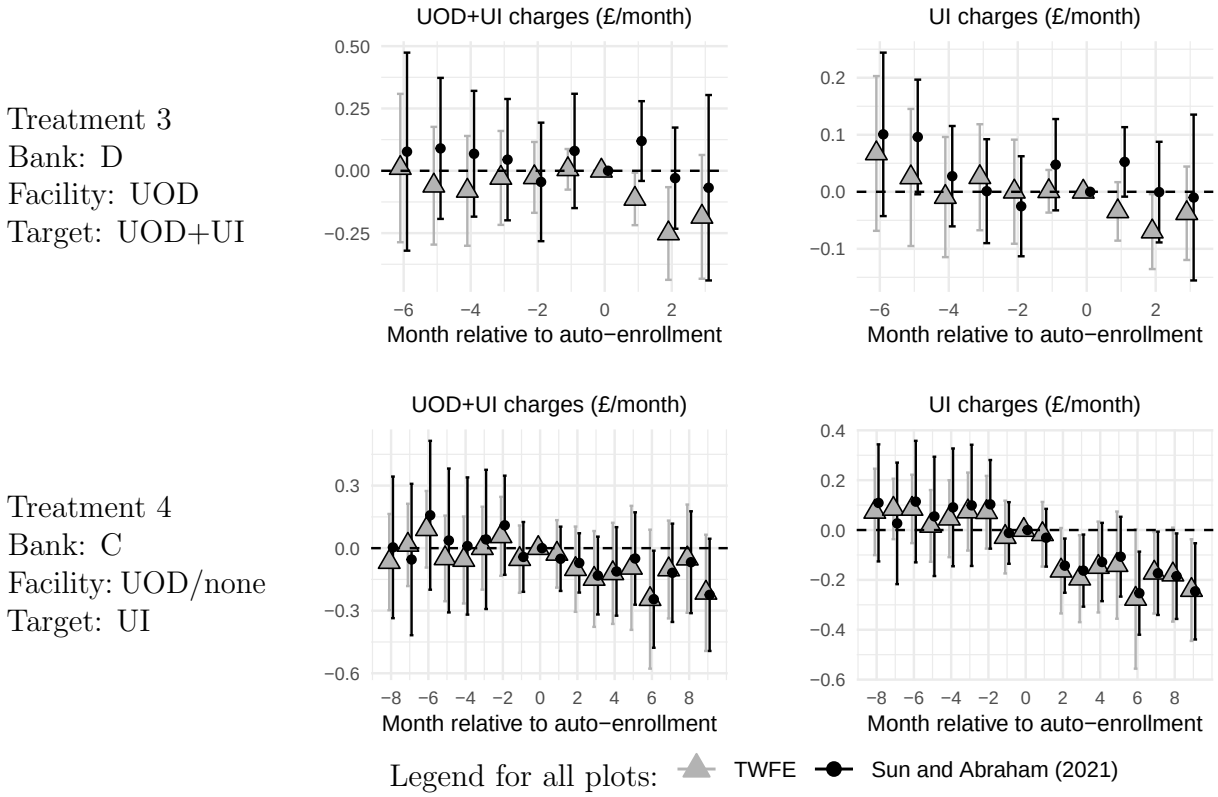

Figure F.3. —***Continued.*** **Natural experiment event study plots.** This figure shows event study plots of estimates from Table F.IV. Month 1 is the first month following automatic enrollment. Charges in the prior month 0 are normalized to zero. The dependent variables are observed monthly overdraft charges (as specified by plot titles, in pounds sterling per month). Total charges are AOD+UOD+UI. Gray triangles plot estimates from two-way fixed effect models and black circles plot estimates using the Sun and Abraham (2021) correction. Acronyms stand for three-way fixed effects (TWFE), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. "Facility" refers to the customer's overdraft facility and "Target" refers to the alert target, which specifies the set of charges that the alert is intended to warn of.

To check pre-trends and see if treatment effects vary over time, we also estimate an event study version of equation (F1), where we allow the treatment effect to vary relative to the time at which an individual is automatically enrolled:

$$Y_{i,t} = \sum_{m} \beta_m Auto.enrolled_{i,t-m} + \eta_i + \mu_t + \theta_{\tau(i,t)} + \epsilon_{i,t}. \tag{F2}$$

The main difference between equations (F1) and (F2) is that (F2) allows the treatment effect β_m to depend on the number of months prior to (if m is negative) or after an individual is automatically enrolled. Thus, it can be used as evidence for or against the hypothesis of parallel trends, and to examine whether the treatment effects increase or decrease post-treatment. We estimate equation (F2) using a standard fixed effects estimator, as well as using the correction procedure of Sun and Abraham (2021).

Borusyak et al. (2022) note in Section 3.2 of their paper that the fully dynamic model specification (F2) is under identified if there are no never-treated units. As all customers in our sample are eventually treated, in line with their finding we could not identify all of the β_m coefficients in the event study specification. Our solution is to drop the time periods during and after which the last cohort of customers was treated in each bank. Doing this means that the last cohort is a "never treated" cohort that is a control for all other customers in the sample, which resolves the identification problem. As a result, during our estimation, our sample ends in November 2015 for Bank C, and October 2015 for Bank D. To be consistent, we apply the same sample selection procedure when we estimate both equations (F1) and (F2). The trade-off that comes with dropping the last time periods in our sample is statistical power—in particular, our estimated treatment effects in equation (F1) are less precise than if we used the entire sample.

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the treatment effect may vary over time and across individuals; a treatment effect that is different for the enrollment month is a special case of time-varying treatment effects. The resulting estimate is a weighted average of the treatment effect at different times. Ideally, we would report a weighted average that placed zero weight on the enrollment month effect. However, as far as we are aware, this functionality is not built into the estimation package. Importantly, the impact of the enrollment month is likely to be relatively small at its default weight in the estimate.

F.3. Event Study Coefficients and Parallel Trends

Although the assumption of parallel trends cannot be formally tested, Figure F.3 plots the estimated coefficients, β_m, from equation (F2), which can be used to check the parallel trends assumption (See Internet Appendix F.6 Table F.IV Panels A–C for coefficient estimates). In Figure F.3, we plot the estimated coefficients from the three-way fixed effects model with triangles and the corrected estimates with black circles. (We abbreviate the three-way fixed effects estimates with TWFE; in the literature, the acronym TWFE sometimes refers to the analogous two-way fixed effects regression model, where time and unit fixed effects are included.) Focusing on the corrected estimates of the pre-trend coefficients in Table F.IV, Panel A shows positive and significant estimated pre-trends for month -5 and (in a single outcome) for month 3, at the 5% level. In Panel B, there is only a single month (-7) where a significant pre-trend coefficient is estimated. In Panel C, none of the pre-trend variables are significant. Taken together, the lack of significance in the vast majority of estimated pre-trend coefficients suggests that we cannot reject the hypothesis of parallel trends in the pretreatment period, which helps support our identification assumptions. A significant caveat to this conclusion is that a recent literature has developed that suggests problems with pre-trend analysis; in particular, tests of pre-trends in natural experiments may be underpowered (Freyaldenhoven et al., 2019; Bilinski and Hatfield, 2020; Roth, 2022). As a result, the results of the natural experiments analysis should be viewed with some caution, and as complementary to the results from the RCTs, where identification can be better assured.

F.4. Results

In Table F.I, we present the estimated values of β_1 from regression specification (F1) across banks, facilities, and outcomes. In odd-numbered columns, we present the TWFE estimates, and the even-numbered columns present estimates using the Sun and Abraham (2021) correction. Focusing on targeted charges, the TWFE results show significant (at the 5% level) decreases in monthly charges for three of the four treatments. The corrected results are somewhat weaker, showing a marginally significant decrease in monthly UOD+UI fees for bank D, treatment 1, and a significant reduction in monthly UI fees for bank C, treatment 4.

Comparing the estimated coefficients to those from the RCT, we can compare natural

Table F.I

Effect of Automatic Enrollment in Alerts—Natural Experiment Results

This table reports results from natural experiments measuring the effect of automatic enrollment in alerts on overdraft charges. The dependent variables are observed monthly overdraft charges (as specified by row labels, in pounds sterling per month). Acronyms stand for three-way fixed effects (TWFE), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. "UOD/None" denotes a mix of customers with UOD only and with no OD facility. The alert target specifies the set of charges that the alert is intended to warn of. Total charges are AOD+UOD+UI charges for treatments 1–2 and UOD+UI charges for treatments 3–4. Gray highlighted estimates are those for charges targeted by the treatment alert. Customer and month fixed effects are included and error terms are clustered by customer and month. The baseline mean for estimates is the average fitted value of the outcome variable for treated observations less the estimated treatment effect. The reported effect size equals $-100 \cdot$ estimate/ (baseline mean). Treatment 3–4 AOD fee estimates are blank because the customers in those subsamples do not have an AOD facility. Estimates from two-way fixed effect models are shown in odd columns, while estimates using the Sun and Abraham (2021) correction are in even columns. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+				UOD		UOD/None	
Alert target	UOD+UI		UI		UOD+UI		UI	
Bank	D		C		D		C	
Treatment	1		2		3		4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AOD fees	-0.24	-0.84**	0.14	0.16				
s.e.	(0.17)	(0.35)	(0.08)	(0.13)				
p-value	0.196	0.018	0.128	0.216				
Baseline	6.45	7.13	4.72	4.67				
Effect size	3.7%	12%	-2.9%	-3.5%				
UOD+UI fees	-0.25***	-0.22*	-0.17	-0.23	-0.27**	-0.04	-0.10	-0.12
s.e.	(0.06)	(0.12)	(0.15)	(0.16)	(0.10)	(0.11)	(0.07)	(0.08)
p-value	0.004	0.075	0.265	0.144	0.025	0.732	0.184	0.147
Baseline	1.11	1.13	2.43	2.50	1.30	1.15	1.57	1.60
Effect size	22%	19%	7.1%	9.1%	21%	3.2%	6.5%	7.6%
UI fees	-0.05**	-0.02	-0.14	-0.12	-0.09**	-0.00	-0.16**	-0.17***
s.e.	(0.01)	(0.03)	(0.09)	(0.09)	(0.03)	(0.05)	(0.05)	(0.06)
p-value	0.018	0.486	0.126	0.184	0.036	0.959	0.012	0.004
Baseline	0.21	0.20	0.83	0.82	0.50	0.44	1.12	1.15
Effect size	22%	12%	17%	14%	17%	0.5%	15%	15%
Total	-0.49**	-1.06***	-0.03	-0.06	-0.27**	-0.04	-0.10	-0.12
s.e.	(0.20)	(0.38)	(0.20)	(0.25)	(0.10)	(0.11)	(0.07)	(0.08)
p-value	0.048	0.005	0.866	0.803	0.025	0.732	0.184	0.147
Baseline	7.56	8.26	7.15	7.17	1.30	1.15	1.57	1.60
Effect size	6.5%	13%	0.5%	0.9%	21%	3.2%	6.5%	7.6%
Estimate	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb
Stand-alone alert*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. customers	69,162	69,162	26,913	26,913	25,960	25,960	26,498	26,498
No. observations	548,043	951,150	284,063	381,923	202,127	345,839	264,720	353,682
Adjusted R^2	0.63	0.63	0.73	0.73	0.35	0.35	0.57	0.57

experiment treatment 1 in Table F.I to RCT treatment 4 in Table V. The estimated coefficient on monthly targeted UOD+UI charges in natural experiment treatment 1 is about half the size of that in RCT treatment 4, but the effect sizes are similar. Notably, the natural experiment shows a larger effect on total charges due to a statistically significant decrease in AOD charges. (This contrasts with findings in the RCT, where we did not see spillovers from UOD or UI alerts to AOD charges.) Additionally, we can compare natural experiment treatment 3 in Table F.I to RCT treatment 6 in Table V. The TWFE estimate on targeted UOD+UI charges is again about half that of the RCT estimate with a similar effect size, while the corrected estimate is approximately zero. There is no good RCT comparison for natural experiment treatment 2. Natural experiment treatment 4 in Table F.I tests a stand-alone just-in-time UI alert, while RCT treatment 10 tests an incremental early-warning UI alert. The stand-alone alert shows a significant treatment effect, while the incremental alert does not, consistent with comparisons across RCT treatments.

F.5. Natural Experiment Subappendix: Details on Data Construction and Estimation

Sample exclusions: Descriptive statistics of the 2015 observational dataset in Table II exclude customers with dormant accounts. Analysis of the natural experiments further excludes three additional groups of customers:

(1) We exclude customers whose accounts are dormant on a rolling basis if they do not carry out any transactions over twelve months. To ensure consistency over time, we asked the submitting banks to exclude consumers with a (pre-2015) history of at least 12 months of inactivity. Across the banks in our sample, we exclude 7–8% of consumers on this criterion during the sample period.

(2) We exclude customers who do not hold a primary account with the bank. Consumers are removed if their three-month rolling average of their monthly account inflows falls lower than £500 and their three-month rolling average of their monthly number of transactions drops below 2. Across the banks in our sample, we exclude 10–16% of consumers on this criterion during the sample period (of those not yet excluded due to dormancy).

(3) We exclude customers who have defaulted on overdraft charges. Consumers are removed if they incur unarranged overdraft charges in at least one of their accounts for three

consecutive months and they also do not credit their account for three months. Across the banks in our sample, we exclude 0.1–0.8% of consumers on this criterion during the sample period (of those not already excluded due to one of the 2 criteria above).

(4) We exclude customers using an account for business purposes. Consumers are defined as business users if one or more of the following apply to at least one of their accounts: (i) three-month rolling average monthly account inflows higher than £30,000; (ii) three-month rolling average monthly credit transactions is higher than 50; (iii) arranged overdraft limit is higher than £10,000. Across the banks in our sample, we exclude 1.1–1.6% of consumers on this criterion during the sample period (of those not already excluded due to one of the three criteria above).

If consumers are excluded from our sample they do not re-enter in later months. As a result of using three-month rolling means, we can only classify customers into the above categories from March 2015. For the customers who do not fall into the above categories from March 2015 we include their data from January and February 2015. For customers excluded from March 2015 onwards, we also exclude January and February 2015. In total, 17–25% of customers are excluded for part of the sample.

Active opt-ins: A small fraction of consumers actively opt-in to alerts during the rollout periods: Monthly active opt-in rates are only 0.08% for Bank C and 0.35% for Bank D. We include these customers in the control group. We suspect that constructing the control group in this way will lead to an underestimate in the effect of automatic enrollment, since some individuals who receive alerts will be in the control group, making the control group more similar to the treatment group. Given the low opt-in rates, we believe any bias that arises will be small.

Estimation: Turning to estimation details, we note that there are a number of procedures for correcting difference-in-differences estimators in a staggered rollout setting, including Sun and Abraham (2021), Borusyak et al. (2022), and Callaway and Sant'Anna (2021). We explored all three of the packages implementing these correction procedures, and settled on the Sun and Abraham (2021) one because it most easily incorporated three-way fixed effects, and was the least computationally burdensome. Although the package implementing Borusyak et al. (2022)'s estimator can include multi-way fixed effects, we found we ran into

memory errors, due to the large size of our estimation data. The package implementing the method of Callaway and Sant'Anna (2021) was only able to include two-way (time and unit-level) fixed effects.

F.6. Natural Experiment Subappendix: Cohort Comparison and Event Study Tables

Table F.III reports natural experiment pretreatment sample statistics by bank, overdraft facility, and enrollment cohort. Table F.II defines the variables reported in Table F.III. Natural experiment event study coefficients are reported in Table F.IV.

Table F.II

Sample Statistic Variable Definitions

This table defines variables used in sample statistic tables (Tables F.III and H.I–H.IV). Note that Account inflows, AOD charges, Days in AOD, UOD charges, Days in UOD, UI charges, Total charges, and Digital logins are all flow variables, while the rest are stock variables.

Variable	Definition
Age	In years as of 2017
Gender	Equal to 1 for female, 0 for male
Tenure	Years since a customer's account was opened as of 2017
Average balance	In pounds sterling
Account inflows	Sum of funds deposited into a customer's account in pounds per month
AOD limit	Prearranged limit of arranged overdraft borrowing in pounds
AOD charges	Sum of arranged overdraft charges incurred by a customer in pounds per month
Days in AOD	Number of days per month a customer's account is in arranged overdraft
UOD charges	Sum of unarranged overdraft charges incurred by a customer in pounds per month
UI charges	Sum of unpaid item charges incurred by a customer in pounds per month
Total charges	AOD+UOD+UI charges for treatments 1–5, UOD+UI charges for treatments 6–9, and UI charges for treatments 10–11
Digital logins	The number of times a customer logs into their accounts per month via web or mobile app

Table F.III

Natural Experiment Enrollment Cohort Comparison

This table reports natural experiment pretreatment means and standard deviations of demographic and overdraft related variables by bank, overdraft facility, and cohort (automatic enrollment month). The pretreatment period is January–February 2015 for Bank C and January–May 2015 for Bank D. Variables are defined in Internet Appendix F.6 Table F.II. Reported charges are observed charges. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI).

Panel A: Bank C Customers with an AOD Facility

Cohort	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015
Age	53.08	53.02	47.15	44.45	50.88	51.8	51.68	53.41	51	53.7
	(14.72)	(13.88)	(14.37)	(14.5)	(14.68)	(16.24)	(14.6)	(13.71)	(16)	(13.72)
Gender	0.53	0.51	0.48	0.34	0.49	0.34	0.44	0.58	0.52	0.58
	(0.5)	(0.5)	(0.5)	(0.48)	(0.5)	(0.48)	(0.5)	(0.49)	(0.5)	(0.49)
Tenure	26.99	25.92	20.47	16.82	27.57	25.25	25.62	27.83	26.49	28.2
	(19.49)	(19.4)	(15.73)	(14.04)	(21.03)	(18.15)	(19.23)	(19.26)	(19.95)	(19.18)
Average balance	3297.19	3079.93	894.58	1061.59	2831.4	2213.23	1200.71	3363.33	2186.45	3483
	(10493.36)	(8419.42)	(2878.27)	(3429.32)	(4537.59)	(4188.16)	(1810.48)	(12064.45)	(7349.57)	(12176.12)
Account inflows	3401.78	2979.05	3077.88	1955.05	6450.98	3634.31	3288.71	5994.04	2835.87	5860.41
	(12681.56)	(8989.74)	(7201.23)	(2249.65)	(19880.07)	(5794.69)	(4093.49)	(36494.87)	(5457.59)	(44799.26)
AOD limit	1225.52	1082.46	974.81	1419.25	1463.36	1048.86	703.29	1755.17	1507.48	1624.75
	(4040.06)	(1465.93)	(985.51)	(2844.2)	(2697.09)	(1383.8)	(888.37)	(2714.78)	(3779.8)	(2453.99)
AOD charges	4.53	5.03	8.19	7.22	4.42	5.29	4.63	7.43	8.54	7.4
	(13.79)	(14.18)	(20.09)	(17.17)	(14.56)	(11.68)	(11.94)	(20.8)	(19.52)	(21.07)
Days in AOD	4.89	5.54	9.16	9.72	5.1	7.6	6.53	6.61	10.3	6.63
	(9.74)	(10.22)	(11.46)	(12.26)	(9.63)	(10.44)	(10.68)	(10.98)	(12.53)	(11.05)
UOD+UI charges	2.19	2.52	4.8	3.91	0.99	0.99	3.83	3.8	1.73	3.54
	(13.47)	(13.46)	(20.46)	(23.33)	(8.39)	(4.82)	(18.99)	(19.67)	(10.67)	(19.22)
Total charges	6.72	7.55	13	11.14	5.42	6.28	8.46	11.23	10.28	10.94
	(24.99)	(25.49)	(38.18)	(38.21)	(20.81)	(12.91)	(28.38)	(36.79)	(24.67)	(36.35)
Digital Logins	2.22	2.37	5.54	4.33	5.08	5.51	5.29	3.22	2.75	3.04
	(9.26)	(8.82)	(15.29)	(9.13)	(12.8)	(12.34)	(13.65)	(11.59)	(7.78)	(11.16)
No. customers	9,048	2,426	52	53	60	35	37	7,092	62	8,347
No. observations	128,311	33,857	709	731	836	501	479	101,159	902	118,596

Continued

Table F.III. —*Continued*

Natural Experiment Enrollment Cohort Comparison

Panel B note: AOD variables are blank because this sample does not have an AOD facility.

Panel B: Bank C Customers without an AOD Facility										
Cohort	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015
Age	39.46	40.72	34.11	37.38	38.19	36.29	31.91	41.06	37.91	40.98
	(15.42)	(15.94)	(12.71)	(15.67)	(15.28)	(14.78)	(14.85)	(16.11)	(17.65)	(16.29)
Gender	0.52	0.51	0.45	0.47	0.49	0.4	0.37	0.54	0.54	0.55
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.49)	(0.49)	(0.5)	(0.5)	(0.5)
Tenure	8.48	8.52	5.78	6.97	8.03	5.47	5.77	9.59	8.32	9.51
	(11.45)	(11.64)	(5.65)	(10.09)	(11.4)	(5.69)	(4.91)	(13.15)	(14.14)	(12.9)
Average balance	1392.85	1324.76	747.23	1639.73	1239.81	573.1	591.8	1624.84	959.74	1703.69
	(6516.48)	(4292.69)	(2007.15)	(6228.08)	(4499.41)	(1071.98)	(965.14)	(13838.1)	(2269.75)	(6560.37)
Account inflows	1812.41	1579.9	1939.19	1911.41	2304.03	1795.18	1206.84	2315.65	2001.96	2525.57
	(9038.37)	(4778.91)	(4670.67)	(3877.68)	(5537.41)	(3774.38)	(1220.87)	(9366.87)	(6262.86)	(16542.73)
AOD limit	-	-	-	-	-	-	-	-	-	-
AOD charges	-	-	-	-	-	-	-	-	-	-
Days in AOD	-	-	-	-	-	-	-	-	-	-
UOD+UI charges	1.24	1.77	2.61	3.03	2.11	2.18	0.51	1.77	0.93	1.55
	(6.59)	(8.3)	(8.38)	(15.75)	(6.5)	(4.93)	(2.31)	(9.74)	(3.41)	(8.33)
Total charges	1.72	2.81	3.54	4.39	2.3	2.58	1.62	2.89	1.15	2.51
	(9.45)	(13.36)	(13.85)	(23.1)	(6.71)	(5.71)	(7.34)	(16.08)	(3.85)	(13.73)
Digital Logins	4.5	2.81	7.28	7.49	11.15	6.71	10.16	2.3	8.13	2.62
	(13.3)	(10.84)	(14.84)	(15.14)	(20.04)	(11.44)	(20.24)	(9.31)	(13.62)	(11.18)
No. customers	10,098	2,938	77	101	100	63	53	6,211	68	7,251
No. observations	135,721	37,566	1,072	1,439	1,395	925	733	83,651	966	96,744

Continued

Table F.III. —*Continued*

Natural Experiment Enrollment Cohort Comparison

Panel C: Bank D Customers with an AOD Facility						
Cohort	June 2015	July 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015
Age	48.75	51.09	40.36	42.12	35.82	36.47
	(12.6)	(13.89)	(14.87)	(16.29)	(12.6)	(12.7)
Gender	0.54	0.5	0.51	0.5	0.51	0.47
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Tenure	22.32	23.81	14.37	13.97	9.85	13
	(8.13)	(8.89)	(9.01)	(10.23)	(4.15)	(8.56)
Average balance	4327.38	3978.4	2160.13	2527.6	1457.61	1383.12
	(15119.76)	(16235.11)	(11741.41)	(10856.16)	(9424.49)	(7430.92)
Account inflows	6294.44	4984.8	3773.44	4008.73	3499.22	2667.34
	(18186.63)	(19379.51)	(13108.87)	(16172.65)	(18322.54)	(5821.19)
AOD limit	2791.93	2579.67	1767.8	1256.55	1012.74	1520.18
	(2219.88)	(2099.27)	(1765.65)	(1448.38)	(1227.42)	(1324.06)
AOD charges	7.25	6.41	5.89	3.57	4.71	6.65
	(18.1)	(15.43)	(14.14)	(10.11)	(23.81)	(10.33)
Days in AOD	7.65	7.23	9.95	8.44	10.65	12.77
	(11.57)	(11.48)	(12.46)	(11.88)	(12.36)	(13.01)
UOD+UI charges	0.56	0.62	1.39	1.34	1.69	1.73
	(5.2)	(5.48)	(8.06)	(7.77)	(8.24)	(6.95)
Total charges	7.81	7.03	7.28	4.91	6.4	8.38
	(19.77)	(17.24)	(17.17)	(13.43)	(25.64)	(13.32)
Digital Logins	10.58	9.95	16.61	16.87	20.5	19.69
	(17.04)	(18.04)	(25.16)	(27.89)	(28.39)	(30.79)
No. customers	4,911	27,092	23,112	10,648	3,399	262
No. observations	67,405	374,178	317,028	145,999	46,540	3,580

Continued

Table F.III. —*Continued*

Natural Experiment Enrollment Cohort Comparison

Panel D note: AOD variables are blank because this sample does not have an AOD facility.

Panel D: Bank D Customers without an AOD Facility						
Cohort	June 2015	July 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015
Age	49.07	49.15	38.02	36.11	33.81	33.67
	(16.08)	(17.76)	(14.67)	(15.49)	(14.47)	(13.81)
Gender	0.52	0.52	0.53	0.51	0.51	0.54
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Tenure	19	18.28	9.2	5.53	7.15	7.78
	(10.21)	(10.81)	(5.51)	(5.65)	(4.01)	(4.82)
Average balance	4742.89	5386.78	2304.67	2096.2	1773.25	7403.21
	(9065.79)	(15936.8)	(13206.76)	(18144.06)	(8502.71)	(74474.12)
Account inflows	5468.29	3459.6	2458.78	2071.24	2014.18	2642.74
	(21474.88)	(11739.38)	(8443.07)	(7470.73)	(6320.63)	(26378.31)
AOD limit	-	-	-	-	-	-
AOD charges	-	-	-	-	-	-
Days in AOD	-	-	-	-	-	-
UOD+UI charges	0.37	0.61	1.09	1.16	1.06	1.66
	(2.82)	(5)	(6.08)	(6.49)	(6.08)	(5.95)
Total charges	0.58	0.73	1.14	1.19	1.09	1.66
	(3.99)	(6.13)	(6.16)	(6.54)	(6.25)	(5.95)
Digital Logins	11.07	10.9	19.05	18.79	18.57	24.5
	(21.39)	(20.11)	(28.52)	(28.57)	(31.16)	(41.98)
No. customers	493	3,352	10,987	8,563	3,058	138
No. observations	6,535	45,027	147,228	112,813	40,771	1,820

Table F.IV

Natural Experiment Event Studies

This table reports natural experiment event study estimates that measure the effect on overdraft charges of automatic enrollment in UOD and UI alerts at Bank D and automatic enrollment in UI alerts at Bank C. Acronyms stand for three-way fixed effects (TWFE), Sun and Abraham (SunAb), overdraft (OD), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The dependent variables are observed monthly overdraft charges (as specified by column headers, in pounds sterling per month). Total charges are AOD+UOD+UI. Estimates from two-way fixed effect models are shown in odd columns, while estimates using the Sun and Abraham (2021) correction are in even columns. Month 4 treatment effects were not estimated for treatment 3 so are blank. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Panel A: Bank D Customers with and without an AOD Facility—Treatments 1 and 3

OD facility	AOD+								UOD only			
Treatment	1								3			
Charges	AOD		UOD + UI		UI		Total		UOD + UI		UI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Month -6	0.16	0.72	0.31	0.19	0.05	0.04	0.47	0.91	0.01	0.08	0.07	0.10
s.e.	(0.13)	(0.77)	(0.19)	(0.23)	(0.04)	(0.07)	(0.28)	(0.80)	(0.15)	(0.20)	(0.07)	(0.07)
Month -5	0.19	0.65***	0.23	0.40**	0.01	0.05	0.42	1.04***	-0.06	0.09	0.03	0.10*
s.e.	(0.11)	(0.11)	(0.16)	(0.18)	(0.04)	(0.05)	(0.22)	(0.22)	(0.12)	(0.14)	(0.06)	(0.05)
Month -4	0.06	-0.10	0.17	0.27*	0.01	0.04	0.23	0.17	-0.08	0.07	-0.01	0.03
s.e.	(0.15)	(0.18)	(0.14)	(0.15)	(0.03)	(0.04)	(0.27)	(0.24)	(0.11)	(0.13)	(0.05)	(0.04)
Month -3	0.03	-0.10	0.15	0.33**	0.01	0.03	0.18	0.23	-0.03	0.04	0.03	0.00
s.e.	(0.20)	(0.16)	(0.11)	(0.14)	(0.03)	(0.04)	(0.28)	(0.22)	(0.10)	(0.12)	(0.05)	(0.05)
Month -2	-0.01	-0.01	0.06	0.19	-0.01	-0.02	0.05	0.18	-0.03	-0.04	0.00	-0.03
s.e.	(0.18)	(0.08)	(0.08)	(0.13)	(0.02)	(0.04)	(0.23)	(0.16)	(0.07)	(0.12)	(0.05)	(0.04)
Month -1	-0.12	-0.19	0.03	0.05	-0.01	-0.03	-0.08	-0.14	0.01	0.08	0.00	0.05
s.e.	(0.19)	(0.12)	(0.05)	(0.11)	(0.01)	(0.03)	(0.22)	(0.17)	(0.04)	(0.12)	(0.02)	(0.04)
Month 1	-0.13	0.03	-0.14**	0.02	-0.02	0.01	-0.27	0.05	-0.11*	0.12	-0.03	0.05*
s.e.	(0.18)	(0.14)	(0.05)	(0.07)	(0.02)	(0.02)	(0.22)	(0.16)	(0.05)	(0.08)	(0.03)	(0.03)
Month 2	-0.31	-0.60**	-0.30***	-0.19**	-0.06***	-0.03	-0.61**	-0.79***	-0.25**	-0.03	-0.07*	-0.00
s.e.	(0.19)	(0.27)	(0.06)	(0.09)	(0.01)	(0.03)	(0.24)	(0.29)	(0.09)	(0.10)	(0.03)	(0.05)
Month 3	-0.51*	-1.36**	-0.36***	-0.32*	-0.04	-0.01	-0.86**	-1.68***	-0.18	-0.07	-0.04	-0.01
s.e.	(0.26)	(0.55)	(0.10)	(0.18)	(0.02)	(0.05)	(0.34)	(0.58)	(0.13)	(0.19)	(0.04)	(0.07)
Month 4	-0.34	-0.12	-0.33**	0.09	-0.06**	-0.01	-0.68	-0.02	-	-	-	-
s.e.	(0.31)	(0.18)	(0.14)	(0.24)	(0.02)	(0.06)	(0.43)	(0.31)				
Estimate	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb
No. customers	69,162	69,162	69,162	69,162	69,162	69,162	69,162	69,162	25,960	25,960	25,960	25,960
No. observations	951,150	951,150	951,150	951,150	951,150	951,150	951,150	951,150	345,839	345,839	345,839	345,839
Adjusted R^2	0.66	0.66	0.39	0.39	0.29	0.29	0.63	0.63	0.35	0.35	0.31	0.31

Continued

Table F.IV. —*Continued*

Natural Experiment Event Studies

Panel B: Bank C Customers with an AOD Facility—Treatment 2

Charges	AOD		UOD + UI		UI		Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Month -8	0.07	0.07	0.48**	0.42	0.12	0.16	0.55*	0.49
s.e.	(0.17)	(0.25)	(0.18)	(0.31)	(0.11)	(0.19)	(0.28)	(0.49)
Month -7	-0.09	-0.14	0.63***	0.64**	0.19*	0.30	0.55*	0.49
s.e.	(0.16)	(0.26)	(0.18)	(0.31)	(0.10)	(0.19)	(0.28)	(0.50)
Month -6	0.05	-0.05	0.41**	0.43	0.03	0.13	0.46	0.37
s.e.	(0.18)	(0.26)	(0.18)	(0.30)	(0.09)	(0.18)	(0.31)	(0.48)
Month -5	-0.06	-0.03	0.24	0.34	-0.07	0.10	0.19	0.31
s.e.	(0.15)	(0.24)	(0.17)	(0.29)	(0.10)	(0.17)	(0.27)	(0.45)
Month -4	-0.14	-0.15	0.32*	0.40	0.01	0.15	0.17	0.25
s.e.	(0.14)	(0.23)	(0.16)	(0.28)	(0.09)	(0.18)	(0.25)	(0.44)
Month -3	-0.20	-0.19	0.37**	0.41	0.08	0.21	0.17	0.22
s.e.	(0.12)	(0.23)	(0.13)	(0.28)	(0.07)	(0.18)	(0.21)	(0.44)
Month -2	-0.15	-0.25	0.28**	0.22	0.08	0.14	0.13	-0.03
s.e.	(0.09)	(0.16)	(0.11)	(0.22)	(0.06)	(0.14)	(0.17)	(0.33)
Month -1	-0.17***	-0.10	-0.04	-0.09	-0.07	-0.03	-0.22**	-0.20
s.e.	(0.04)	(0.12)	(0.10)	(0.15)	(0.07)	(0.09)	(0.08)	(0.23)
Month 1	-0.05	0.07	0.06	0.00	-0.04	0.08	0.02	0.07
s.e.	(0.13)	(0.11)	(0.08)	(0.14)	(0.02)	(0.09)	(0.21)	(0.21)
Month 2	-0.06	0.04	-0.07	-0.06	-0.13	-0.06	-0.13	-0.02
s.e.	(0.05)	(0.10)	(0.12)	(0.14)	(0.09)	(0.09)	(0.15)	(0.21)
Month 3	0.06	0.22	-0.13	-0.12	-0.24***	-0.18	-0.07	0.09
s.e.	(0.08)	(0.16)	(0.11)	(0.19)	(0.07)	(0.11)	(0.17)	(0.30)
Month 4	-0.09	0.06	-0.39**	-0.42**	-0.30***	-0.24**	-0.49*	-0.36
s.e.	(0.13)	(0.16)	(0.13)	(0.20)	(0.06)	(0.12)	(0.23)	(0.32)
Month 5	0.08	0.17	-0.27*	-0.31	-0.19**	-0.12	-0.20	-0.14
s.e.	(0.12)	(0.16)	(0.14)	(0.21)	(0.08)	(0.12)	(0.22)	(0.32)
Month 6	0.07	0.19	-0.32*	-0.31	-0.21**	-0.13	-0.25	-0.12
s.e.	(0.12)	(0.18)	(0.15)	(0.22)	(0.07)	(0.12)	(0.23)	(0.34)
Month 7	0.17	0.35*	-0.20	-0.21	-0.11	-0.03	-0.04	0.14
s.e.	(0.15)	(0.19)	(0.23)	(0.22)	(0.12)	(0.12)	(0.35)	(0.35)
Month 8	0.08	0.21	-0.16	-0.32	-0.10	-0.14	-0.08	-0.11
s.e.	(0.15)	(0.19)	(0.17)	(0.22)	(0.08)	(0.13)	(0.26)	(0.36)
Month 9	-0.02	0.19	-0.13	-0.17	-0.03	-0.04	-0.15	0.01
s.e.	(0.14)	(0.22)	(0.17)	(0.26)	(0.10)	(0.15)	(0.27)	(0.42)
Estimate	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb	TWFE	SunAb
No. cust.	26,913	26,913	26,913	26,913	26,913	26,913	26,913	26,913
No. obs.	381,923	381,923	381,923	381,923	381,923	381,923	381,923	381,923
Adjusted R^2	0.79	0.79	0.60	0.60	0.39	0.39	0.73	0.73

Continued

Table F.IV. —*Continued*

Natural Experiment Event Studies

Panel C: Bank C Customers without an AOD Facility—Treatment 4				
Charges	UOD + UI		UI	
	(1)	(2)	(3)	(4)
Month -8	-0.07	0.00	0.07	0.11
s.e.	(0.12)	(0.17)	(0.09)	(0.12)
Month -7	0.02	-0.05	0.08	0.03
s.e.	(0.10)	(0.19)	(0.06)	(0.12)
Month -6	0.09	0.16	0.08	0.11
s.e.	(0.09)	(0.18)	(0.07)	(0.12)
Month -5	-0.05	0.04	0.02	0.05
s.e.	(0.10)	(0.18)	(0.07)	(0.12)
Month -4	-0.06	0.01	0.05	0.09
s.e.	(0.11)	(0.17)	(0.08)	(0.12)
Month -3	-0.00	0.04	0.07	0.10
s.e.	(0.10)	(0.17)	(0.08)	(0.12)
Month -2	0.06	0.11	0.07	0.10
s.e.	(0.10)	(0.12)	(0.07)	(0.09)
Month -1	-0.05	-0.04	-0.03	-0.01
s.e.	(0.08)	(0.09)	(0.07)	(0.06)
Month 1	-0.03	-0.05	-0.02	-0.03
s.e.	(0.08)	(0.08)	(0.07)	(0.06)
Month 2	-0.10	-0.07	-0.16*	-0.14***
s.e.	(0.10)	(0.07)	(0.09)	(0.06)
Month 3	-0.15	-0.13	-0.20*	-0.16**
s.e.	(0.12)	(0.10)	(0.09)	(0.07)
Month 4	-0.12	-0.11	-0.15	-0.13
s.e.	(0.12)	(0.11)	(0.09)	(0.08)
Month 5	-0.09	-0.05	-0.14	-0.11
s.e.	(0.15)	(0.11)	(0.11)	(0.08)
Month 6	-0.24	-0.24**	-0.28*	-0.25***
s.e.	(0.17)	(0.12)	(0.14)	(0.09)
Month 7	-0.10	-0.12	-0.17*	-0.17**
s.e.	(0.12)	(0.12)	(0.08)	(0.09)
Month 8	-0.05	-0.07	-0.18*	-0.19**
s.e.	(0.13)	(0.12)	(0.10)	(0.09)
Month 9	-0.21	-0.22	-0.24**	-0.25**
s.e.	(0.14)	(0.14)	(0.10)	(0.10)
Estimate	TWFE	SunAb	TWFE	SunAb
No. customers	26,498	26,498	26,498	26,498
No. observations	353,682	353,682	353,682	353,682
Adjusted R^2	0.57	0.57	0.38	0.38

Appendix G. Additional Field Experiment Results Tables

Table G.I

Automatic Enrollment in Alerts—Effect on Inferred Overdraft Charges at Bank A

This table reports the effect of automatic and prompted enrollment in alerts on inferred targeted monthly overdraft charges at Bank A. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is inferred monthly charges of the type targeted by the alert (AOD for AOD alerts, UOD and UI for UOD alerts, and UI for UI alerts; all in pounds sterling per month). Reported coefficients are for $Treatment_i \times I(7 \leq t \leq 9)$ (Treatment pre-mandate) and $Treatment_i \times I(t \geq 10)$ (Treatment post-mandate). Customer and month fixed effects are included and error terms are clustered by customer and month. The reported baseline mean is mean charges in the control group for the relevant portion of the treatment period (either pre- or post-mandate). The reported effect size equals $-100 \cdot$ estimate/ (baseline mean). Estimates for models (1)–(3) are Intent To Treat (ITT) for automatic enrollment. Two estimates are provided for the 'prompted enrollment' treatment 11 where customers were encouraged in an e-mail campaign to actively opt-in to an early warning alert: an ITT estimate (model 4) and a Latent Average Treatment Effect (LATE) estimate of alert registration instrumented by the prompted enrollment treatment (model 5, first stage F-statistics 6890 and 868). An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+	UOD only	None		
Alert target	AOD	UOD+UI	UI		
Alert threshold	$0^{\dagger}$	100	100	100 (prompted)	
Treatment	1	9	10	11	11
	(1)	(2)	(3)	(4)	(5)
Treatment pre-mandate	-0.457***	-0.301***	0.018	-0.008	-0.090
s.e.	(0.072)	(0.041)	(0.018)	(0.009)	(0.093)
p-value	0.00008	0.00002	0.328	0.352	0.352
Baseline mean pre-mandate	5.96	4.78	0.80	0.80	0.80
Effect size pre-mandate	7.7%	6.3%	-2.3%	1.0%	11%
Treatment post-mandate	-0.517***	-0.035	0.002	-0.013	-0.138
s.e.	(0.053)	(0.052)	(0.015)	(0.011)	(0.119)
p-value	0.000002	0.514	0.877	0.273	0.273
Baseline mean post-mandate	5.88	4.02	1.24	1.24	1.24
Effect size post-mandate	8.8%	0.9%	-0.2%	1.0%	11%
Estimate	ITT	ITT	ITT	ITT	LATE
Stand-alone alert	Yes	Pre-mandate	No	No	No
No. customers	138,532	70,935	173,595	274,471	274,471
No. observations	1,443,829	688,546	1,711,688	2,705,694	2,705,694
Adjusted R^2	0.84	0.64	0.36	0.36	0.36

Table G.II

Heterogeneous Treatment Effects by Average Balance

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges by pretreatment average balance. Row labels specify the subpopulation. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot$ estimate/ (baseline mean). All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Avg. Balance below 0	-1.15***	-0.36**	-0.26	-0.80***	15.60	-0.83*
s.e.	(0.26)	(0.15)	(0.15)	(0.14)	(10.16)	(0.40)
Baseline mean	28.26	25.40	25.40	7.13	29.37	32.82
Effect size	4.1%	1.4%	1.0%	11%	-53%	2.5%
No. cust.	21,624	12,935	13,026	45,574	227	3,666
Avg. Balance 0–500	-0.60***	-0.45***	-0.20**	-0.71***	-0.83***	-0.20*
s.e.	(0.07)	(0.08)	(0.08)	(0.16)	(0.10)	(0.09)
Baseline mean	3.86	6.16	6.16	2.82	5.03	5.13
Effect size	16%	7.4%	3.3%	25%	16%	3.9%
No. cust.	45,517	18,172	18,291	63,543	91,508	34,173
Avg. Balance 500–1000	-0.28***	-0.36***	-0.25**	-0.21***	-0.44***	-0.38***
s.e.	(0.06)	(0.08)	(0.09)	(0.05)	(0.08)	(0.09)
Baseline mean	1.69	2.89	2.89	0.84	1.98	2.15
Effect size	17%	13%	8.6%	25%	22%	18%
No. cust.	29,020	11,896	11,777	40,683	38,493	14,963
Avg. Balance 1000+	-0.33***	-0.13*	-0.12	-0.13***	-0.28***	-0.13*
s.e.	(0.06)	(0.06)	(0.07)	(0.04)	(0.05)	(0.06)
Baseline mean	1.14	1.75	1.75	0.40	0.90	1.02
Effect size	29%	7.5%	6.7%	31%	32%	12%
No. cust.	42,371	21,715	21,649	76,233	58,527	18,133

Table G.III

Heterogeneous Treatment Effects by Coefficient of Variation of Account Balance

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges by pretreatment average monthly coefficient of variation of daily closing account balance. Row labels specify the subpopulation. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Bal Coef Var below 0	-1.26***	-0.51***	-0.37**	-0.80***	-3.75	-0.45
s.e.	(0.24)	(0.14)	(0.14)	(0.14)	(3.11)	(0.44)
Baseline mean	25.35	22.93	22.93	6.63	25.54	28.88
Effect size	5.0%	2.2%	1.6%	12%	15%	1.6%
No. cust.	22,789	14,025	14,049	49,350	843	4,176
Bal Coef Var 0–0.6	-0.18***	-0.21***	-0.07	-0.17***	-0.36***	-0.20***
s.e.	(0.05)	(0.05)	(0.06)	(0.03)	(0.03)	(0.04)
Baseline mean	1.38	2.03	2.03	0.58	0.96	1.16
Effect size	13%	10%	3.6%	29%	37%	17%
No. cust.	58,642	24,598	24,442	86,084	105,439	39,015
Bal Coef Var 0.6+	-0.58***	-0.31***	-0.23***	-0.50***	-0.76***	-0.28**
s.e.	(0.07)	(0.06)	(0.06)	(0.09)	(0.12)	(0.10)
Baseline mean	3.59	5.26	5.26	2.08	5.15	5.60
Effect size	16%	5.8%	4.4%	24%	15%	5.0%
No. cust.	56,320	25,735	25,911	89,339	79,357	26,672

Table G.IV

Heterogeneous Treatment Effects by Zero-Day Overdraft Frequency

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges for customers with and without zero-day overdraft episodes in the pretreatment period. Row labels specify the subpopulation: customers with (Some 0-day OD) or without (Zero 0-day OD) pretreatment zero-day overdrafts of the type targeted by the treatment. Zero-day overdraft episodes occur when a custome enters and exits overdraft within the same day without incurring charges. Acronyms stand for overdraft (OD), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot$ estimate/ (baseline mean). All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Zero 0-day OD	-0.41***	-0.17**	-0.15**	-0.34***	-0.37***	-0.24***
s.e.	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)	(0.04)
Baseline mean	6.58	8.06	8.06	1.72	2.16	3.53
Effect size	6.2%	2.1%	1.8%	19%	17%	6.8%
No. cust.	99,827	46,770	46,734	199,324	165,095	55,287
Some 0-day OD	-0.81***	-0.63***	-0.31***	-1.19***	-1.64***	-0.32**
s.e.	(0.12)	(0.10)	(0.10)	(0.28)	(0.19)	(0.13)
Baseline mean	5.49	7.81	7.81	8.38	8.05	7.77
Effect size	15%	8.1%	4.0%	14%	20%	4.1%
No. cust.	38,705	17,948	18,009	26,709	23,660	15,648

Table G.V

Heterogeneous Treatment Effects by Near-Overdraft Frequency

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges by the number of pretreatment days per month the account balance is near the targeted overdraft. An account balance is near an overdraft if it is above the overdraft threshold but by no more than £100. Row labels specify the subpopulation. Acronyms stand for overdraft (OD), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Zero Days/mo. near OD	-0.13	-0.01	-0.09	-0.09***	-0.14***	-0.07
s.e.	(0.07)	(0.06)	(0.06)	(0.02)	(0.02)	(0.04)
Baseline mean	6.12	5.27	5.27	0.19	0.29	0.89
Effect size	2.2%	0.2%	1.7%	48%	47%	8.3%
No. cust.	33,183	14,614	14,590	132,210	55,303	19,137
0–5 Days/mo. near OD	-0.65***	-0.31***	-0.19**	-0.80***	-0.49***	-0.45***
s.e.	(0.08)	(0.07)	(0.07)	(0.11)	(0.11)	(0.08)
Baseline mean	7.67	9.91	9.91	2.70	1.70	5.42
Effect size	8.4%	3.2%	1.9%	29%	29%	8.3%
No. cust.	60,734	33,619	33,522	51,984	43,878	21,018
5+ Days/mo. near OD	-0.64***	-0.54***	-0.31***	-1.07***	-0.85***	-0.22
s.e.	(0.11)	(0.10)	(0.09)	(0.22)	(0.09)	(0.12)
Baseline mean	4.26	6.34	6.34	9.55	5.38	6.20
Effect size	15%	8.5%	5.0%	11%	16%	3.5%
No. cust.	44,615	16,485	16,631	41,839	89,574	30,780

Table G.VI

Heterogeneous Treatment Effects by Monthly Account Logins

This table reports the effect of automatic enrollment in stand-alone alerts on observed targeted monthly overdraft charges by pretreatment account engagement measured by account logins per month. Row labels specify the subpopulation. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is observed monthly overdraft charges of the type targeted by the treatment alert (AOD charges for AOD alerts, UOD and UI charges for UOD/UI alerts; all in pounds sterling per month). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
0–5 Logins/mo.	-0.37***	-0.42***	-0.30***	-0.54***	-0.73***	-0.40***
s.e.	(0.07)	(0.08)	(0.08)	(0.09)	(0.10)	(0.07)
Baseline mean	4.99	6.20	6.20	2.51	2.92	4.50
Effect size	7.4%	6.8%	4.9%	22%	25%	8.9%
No. cust.	50,521	20,915	21,064	73,748	73,359	31,028
5–15 Logins/mo.	-0.56***	-0.31***	-0.09	-0.52***	-0.45***	-0.26***
s.e.	(0.11)	(0.08)	(0.08)	(0.09)	(0.09)	(0.07)
Baseline mean	5.48	6.90	6.90	2.06	2.49	4.08
Effect size	10%	4.5%	1.3%	25%	18%	6.3%
No. cust.	36,323	19,732	19,565	68,764	46,532	17,126
15+ Logins/mo.	-0.64***	-0.19**	-0.19*	-0.29***	-0.49***	-0.11
s.e.	(0.10)	(0.08)	(0.09)	(0.07)	(0.08)	(0.09)
Baseline mean	7.89	10.36	10.36	2.91	3.40	5.14
Effect size	8.2%	1.9%	1.8%	9.9%	14%	2.1%
No. cust.	51,688	24,071	24,114	83,521	68,864	22,781

Table G.VII

Correlations Between Pretreatment Variables

This table reports the correlation between pretreatment variables used for heterogeneous treatment analysis by bank and overdraft facility. A customer is an observation; Panel A has 129,440 observations and Panel B has 317,176 observations. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), unpaid item (UI), and coefficient of variation (CV). See Panel C–D legend for variable definitions.

Panel A: Bank C customers with an AOD facility

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. AOD charges	5.61	12.48	1.00										
2. 0-day AOD	0.12	0.31	-0.05	1.00									
3. Near AOD	4.91	7.14	-0.11	0.30	1.00								
4. UOD charges	0.35	1.82	0.28	-0.01	-0.05	1.00							
5. 0-day UOD	0.10	0.33	0.38	0.11	-0.03	0.43	1.00						
6. Near UOD/UI	2.34	5.76	0.50	-0.00	-0.03	0.40	0.55	1.00					
7. Avg. bal	1,138	4,478	-0.18	-0.02	-0.09	-0.07	-0.08	-0.13	1.00				
8. CV bal	0.52	23.39	-0.01	0.00	0.01	-0.00	-0.00	-0.01	0.00	1.00			
9. Logins	17.38	21.81	0.09	0.19	0.11	0.08	0.17	0.17	-0.04	0.00	1.00		
10. Age	45.42	12.44	-0.10	-0.03	-0.05	-0.08	-0.08	-0.15	0.05	-0.00	-0.11	1.00	
11. Account inflows	3,312	5,498	-0.01	0.12	-0.04	-0.02	0.02	-0.07	0.42	0.00	0.12	0.01	1.00

Panel B: Bank D customers with an AOD facility

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. AOD charges	7.98	12.12	1.00										
2. 0-day AOD	0.11	0.29	-0.05	1.00									
3. Near AOD	3.86	5.53	-0.11	0.36	1.00								
4. UOD charges	2.25	8.06	0.23	-0.01	-0.02	1.00							
5. 0-day UOD	0.04	0.15	0.29	0.13	0.02	0.20	1.00						
6. Near UOD/UI	2.67	5.42	0.53	0.03	0.13	0.37	0.39	1.00					
7. Avg. bal	1,777	7,332	-0.19	-0.05	-0.11	-0.07	-0.06	-0.13	1.00				
8. CV bal	0.14	210.92	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	0.00	1.00			
9. Logins	16.52	20.50	0.18	0.22	0.11	0.03	0.21	0.23	-0.04	-0.01	1.00		
10. Age	45.27	13.02	-0.07	-0.10	-0.13	-0.11	-0.09	-0.16	0.07	-0.00	-0.20	1.00	
11. Account inflows	3,577	5,401	-0.00	0.08	-0.09	-0.04	0.02	-0.09	0.44	-0.00	0.12	0.03	1.00

Continued

Table G.VII. —*Continued*

Correlations Between Pretreatment Variables Continued

This table reports the correlation between pretreatment variables used for heterogeneous treatment analysis by bank and overdraft facility. A customer is an observation; Panel C has 60,382 observations and Panel D has 225,267 observations. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), unpaid item (UI), and coefficient of variation (CV). All variables are calculated at the customer-month level and then averaged across the pretreatment period (months 1–6) to create a single observation per customer. In Panels A–D, included variables are overdraft charges (AOD and UOD, in pounds sterling per month), 0-day overdrafts (AOD and UOD, the number of days per month a customer enters and exits overdraft within the same-day grace period), Near overdraft (AOD and UOD, the number of days per month a customer is within £100 of an overdraft threshold without crossing it), Avg. bal (average balance in pounds), CV bal (coefficient of variation of daily ending balance), Logins (number of times a customer logs in to their account per month), Age (in years as of 2017), and Account inflows (sum of funds deposited into a customer's account in pounds per month).

Panel C: Bank C customers with a UOD facility only

Variable	M	SD	1	2	3	4	5	6	7	8
1. UOD charges	4.55	10.52	1.00							
2. 0-day UOD	0.11	0.34	0.12	1.00						
3. Near UOD/UI	6.47	8.36	-0.01	0.20	1.00					
4. Avg. bal	1,169	4,545	-0.09	-0.03	-0.13	1.00				
5. CV bal	0.54	13.37	-0.01	0.01	0.02	-0.00	1.00			
6. Logins	15.84	21.32	0.06	0.22	0.13	-0.02	0.00	1.00		
7. Age	46.68	11.53	-0.06	-0.04	-0.06	0.03	-0.01	-0.14	1.00	
8. Account inflows	2,314	4,426	-0.01	0.11	-0.10	0.37	0.00	0.15	-0.02	1.00

Panel D: Bank D customers with a UOD facility only

Variable	M	SD	1	2	3	4	5	6	7	8
1. UOD charges	2.26	8.07	1.00							
2. 0-day UOD	0.05	0.17	0.18	1.00						
3. Near UOD/UI	7.76	9.37	0.14	0.19	1.00					
4. Avg. bal	1,923	7,268	-0.05	-0.05	-0.16	1.00				
5. CV bal	0.63	15.13	-0.01	0.01	0.02	-0.01	1.00			
6. Logins	18.02	23.74	0.03	0.19	0.19	-0.05	0.01	1.00		
7. Age	39.57	15.33	-0.08	-0.06	-0.16	0.11	-0.00	-0.20	1.00	
8. Account inflows	2,418	4,318	-0.02	0.05	-0.12	0.45	-0.00	0.13	0.06	1.00

Table G.VIII

Treatment Effect on Probability of Exceeding Overdraft Charge Threshold

This table reports the effect of automatic enrollment in stand-alone alerts on the probability (in percentage points) that observed targeted monthly overdraft charges exceed a threshold value. Row labels specify the dependent variable, which is an indicator for whether observed overdraft charges (of the type targeted by the alert) for customer i in month t exceed a threshold value. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Panel A: £0–20 Thresholds

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Over £0	-3.22***	-1.81***	-1.24***	-0.73***	-0.73**	-0.79**
s.e.	(0.63)	(0.34)	(0.33)	(0.19)	(0.25)	(0.27)
Baseline mean	33.38	43.67	43.67	6.43	7.08	15.94
Effect size	9.6%	4.2%	2.8%	11%	10%	4.9%
Over £5	-1.91***	-0.95***	-0.75**	-0.73***	-0.72**	-0.61**
s.e.	(0.42)	(0.25)	(0.29)	(0.19)	(0.25)	(0.22)
Baseline mean	23.19	33.78	33.78	6.42	7.08	13.99
Effect size	8.2%	2.8%	2.2%	11%	10%	4.3%
Over £10	-1.25***	-0.89***	-0.63**	-0.55***	-0.69***	-0.54**
s.e.	(0.29)	(0.25)	(0.26)	(0.15)	(0.20)	(0.22)
Baseline mean	18.14	27.91	27.91	5.14	5.77	12.66
Effect size	6.9%	3.2%	2.3%	11%	12%	4.3%
Over £15	-0.92***	-0.68***	-0.31*	-0.59***	-0.68***	-0.54**
s.e.	(0.20)	(0.18)	(0.15)	(0.14)	(0.20)	(0.18)
Baseline mean	14.65	23.08	23.08	4.70	5.45	11.76
Effect size	6.3%	2.9%	1.4%	13%	13%	4.6%
Over £20	-0.46**	-0.44**	-0.15	-0.57***	-0.64***	-0.43*
s.e.	(0.20)	(0.18)	(0.14)	(0.11)	(0.19)	(0.21)
Baseline mean	10.74	18.38	18.38	3.91	4.47	10.90
Effect size	4.3%	2.4%	0.8%	14%	14%	3.9%
No. customers	138,532	64,718	64,743	226,033	188,755	70,935
No. observations	1,316,817	636,106	636,280	2,001,911	1,538,839	571,328

Continued

Table G.VIII. —*Continued*

Treatment Effect on Probability of Exceeding Overdraft Charge Thresholds

Panel B: £25–100 Thresholds

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Over £25	-0.27*	-0.27	0.03	-0.55***	-0.61***	-0.40*
s.e.	(0.12)	(0.16)	(0.12)	(0.09)	(0.17)	(0.19)
Baseline mean	6.21	13.22	13.22	3.52	4.01	10.24
Effect size	4.3%	2.0%	-0.2%	16%	15%	3.9%
Over £30	-0.18*	-0.14	-0.06	-0.46***	-0.52***	-0.40**
s.e.	(0.09)	(0.14)	(0.10)	(0.10)	(0.14)	(0.17)
Baseline mean	5.33	5.74	5.74	3.07	3.47	9.68
Effect size	3.4%	2.5%	1.0%	15%	15%	4.1%
Over £40	-0.17**	-0.08	-0.09	-0.41***	-0.42**	-0.03
s.e.	(0.07)	(0.05)	(0.05)	(0.11)	(0.13)	(0.07)
Baseline mean	3.73	2.20	2.20	2.50	2.77	2.14
Effect size	4.6%	3.5%	4.0%	16%	15%	1.4%
Over £50	-0.17**	-0.04	-0.01	-0.32***	-0.36**	-0.07
s.e.	(0.06)	(0.05)	(0.05)	(0.08)	(0.13)	(0.07)
Baseline mean	2.08	1.34	1.34	1.98	2.25	1.01
Effect size	8.2%	2.7%	0.7%	16%	16%	7.4%
Over £75	-0.11*	-0.03	-0.01	-0.18***	-0.23*	0.01
s.e.	(0.05)	(0.03)	(0.02)	(0.05)	(0.10)	(0.02)
Baseline mean	1.28	0.30	0.30	0.99	1.39	0.08
Effect size	8.6%	9.9%	4.7%	18%	16%	-16%
Over £100	0.00	-0.01	-0.01	-0.00	-0.01	0.00
s.e.	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Baseline mean	0.24	0.04	0.04	0.04	0.03	0.02
Effect size	-1.3%	22%	20%	12%	39%	-15%
No. customers	138,532	64,718	64,743	226,033	188,755	70,935
No. observations	1,316,817	636,106	636,280	2,001,911	1,538,839	571,328

Table G.IX

First Treatment Alert—Effect on Sum of Daily Debit Card & Transfer Transaction

This table reports the effect of the first treatment alert at Bank A on the daily sum of transaction amounts for debit card transactions and account transfers in pounds sterling per day for the days surrounding the first predicted alert in the treatment period. Acronyms stand for debit card transaction (CRD), transfer (TFR), arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. We instrument for $k\text{-}Days.after.alert_{i,t}$ with $k\text{-}Days.after.predicted.alert_{i,t} \times Treatment_i \times I(t \geq 7)$. The minimum F-statistic for instruments in the table is 10,300,000. Customer and month fixed effects are included and error terms are clustered by customer and day. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. All estimates are intent to treat (ITT). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+		UOD only				None	
Alert target	AOD		UOD + UI				UI	
Alert threshold	0†		100				100	
Treatment	1		9				10	
Treatment Period	All		Pre-mandate		Post-mandate		All	
Charge Type	CRD	TFR	CRD	TFR	CRD	TFR	CRD	TFR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-3 days after predicted alert	0.50	-21.31***	1.13*	-13.03	0.20	-12.07***	-0.22	-16.69*
s.e.	(1.22)	(5.72)	(0.59)	(9.70)	(1.19)	(2.95)	(0.42)	(9.17)
-2 days after predicted alert	-0.70	-30.85***	-0.38	-8.96***	-1.30	-15.30	-0.86	-5.36*
s.e.	(0.85)	(9.01)	(0.70)	(3.31)	(1.10)	(10.27)	(0.58)	(3.19)
-1 days after predicted alert	-3.73**	-28.24***	-2.22**	-23.41***	-3.43	-78.01**	-2.78***	-16.53***
s.e.	(1.73)	(5.82)	(1.01)	(2.99)	(3.50)	(31.22)	(0.55)	(4.19)
0 days after predicted alert	-44.82***	122.44***	-37.64***	-7.62	-68.13***	29.82	-35.78***	-34.28**
s.e.	(2.93)	(23.76)	(2.55)	(20.45)	(13.84)	(62.61)	(1.48)	(15.03)
1 days after predicted alert	7.89***	90.13***	6.68***	61.79***	4.52*	84.09***	6.74***	35.30***
s.e.	(0.60)	(12.19)	(0.54)	(13.96)	(2.45)	(15.71)	(0.59)	(4.31)
2 days after predicted alert	4.46***	58.17***	5.98***	24.55*	5.56***	70.45***	5.69***	27.64***
s.e.	(0.85)	(8.37)	(0.55)	(13.50)	(1.91)	(20.02)	(0.50)	(4.40)
3+ days after predicted alert	0.23	8.33***	0.51	9.96***	0.21	6.82***	0.74***	9.27***
s.e.	(0.31)	(1.11)	(0.36)	(1.29)	(0.44)	(1.49)	(0.25)	(1.60)
$Treatment_i \times I(t \geq 7)$	-0.01	-0.11	-0.00	-1.43	-0.37	0.40	0.05	0.91
s.e.	(0.30)	(1.72)	(0.29)	(1.56)	(0.57)	(2.09)	(0.24)	(1.94)
-3 days after alert	0.21	-8.17	-4.02**	10.71	1.42	-12.83*	0.54	4.30
s.e.	(2.07)	(6.74)	(1.97)	(16.92)	(2.99)	(6.73)	(1.15)	(14.38)
-2 days after alert	1.05	13.84	-1.58	-4.28	4.57	-5.59	-1.43	-1.38
s.e.	(1.92)	(12.42)	(2.26)	(9.51)	(3.52)	(11.96)	(1.27)	(3.47)
-1 days after alert	3.21	1.23	2.57	25.96**	-0.23	53.45	-0.15	5.24
s.e.	(2.48)	(7.42)	(2.07)	(10.83)	(6.02)	(44.93)	(1.29)	(6.48)
0 days after alert	-5.40	126.37***	-17.92*	18.43	4.75	-77.82	-0.07	4.68
s.e.	(5.30)	(37.21)	(9.42)	(41.62)	(33.44)	(151.39)	(2.34)	(30.38)
1 days after alert	-0.12	-14.83	-7.32	-23.98	11.61**	19.87	-1.09	-14.25*
s.e.	(1.24)	(12.50)	(7.86)	(27.05)	(5.41)	(33.24)	(1.47)	(8.35)
2 days after alert	4.09***	8.54	-0.89	22.62	6.17	-45.52	0.64	-5.95
s.e.	(1.39)	(12.70)	(1.52)	(25.31)	(4.34)	(44.42)	(0.86)	(5.18)
3+ days after alert	-0.57	-0.67	0.21	-0.12	-0.03	0.68	-0.12	-1.25
s.e.	(0.47)	(1.96)	(0.52)	(1.82)	(0.76)	(2.89)	(0.30)	(2.09)
Stand-alone alert	Yes	Yes	Yes	Yes	No	No	No	No
Avg. daily baseline	-26.55	50.30	-18.19	32.73	-18.25	31.50	-20.03	32.49
Day zero baseline	-74.10	167.89	-56.23	19.80	-86.65	60.35	-55.76	-7.84
Day zero effect size	7.3%	75%	32%	93%	-5.5%	-129%	0.1%	-60%
Corr(alert, predicted-alert)	0.83	0.83	0.65	0.65	0.48	0.48	0.66	0.66
No. customers	138,532	138,532	70,935	70,935	70,935	70,935	173,595	173,595
No. observations	44,354,906	44,354,906	17,585,922	17,585,922	15,655,588	15,655,588	52,583,106	52,583,106
Adjusted R^2	0.009	-0.001	0.023	-0.002	0.023	-0.002	0.017	-0.002

Table G.X

Automatic Enrollment in Alerts—Effect on Long-run Outcome Variables

This table reports the effect of automatic enrollment in stand-alone alerts on long-run outcome variables. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The AOD limit is the arranged overdraft credit limit (in pounds sterling). Standing orders are automatic recurring withdrawals of the same amount, such as a recurring rent payment. Direct debits are automatic recurring withdrawals of varying amounts, such as a recurring utility bill payment. AOD limit estimates are blank for treatments 6 and 9 because these customers do not have an AOD facility. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
AOD limit	-0.294	0.047	0.265	-0.774		
s.e.	(0.938)	(1.302)	(1.297)	(0.891)		
Baseline mean	1050.16	973.50	973.50	968.97		
No. standing orders	-0.006	-0.004	-0.004	0.003	-0.001	0.006
s.e.	(0.005)	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)
Baseline mean	1.52	0.39	0.39	0.38	0.23	0.96
No. direct debits	-0.005	0.027	0.012	-0.024*	-0.003	0.005
s.e.	(0.011)	(0.016)	(0.015)	(0.012)	(0.011)	(0.013)
Baseline mean	6.44	8.82	8.82	8.90	4.77	4.49
Stand-alone alert	Yes	Yes	Yes	Yes	Yes	Pre-mandate
No. customers	138,532	64,718	64,743	226,033	188,755	70,935
No. observations	1,443,829	698,652	698,795	2,001,911	1,538,839	571,328

Table G.XI

Automatic Enrollment in Alerts—Effect on Days per Month in Overdraft

This table reports the effect of automatic enrollment in stand-alone alerts on days per month in overdraft. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The alert target specifies the set of charges that the treatment alert is intended to warn of. The alert threshold specifies, in pounds sterling, how close a customer's balance must be to incurring those charges to trigger an alert. The dependent variable is the number of days in month t customer i is in the type of overdraft targeted by the treatment alert (AOD for AOD alerts, UOD for UOD alerts). Feasible effect size with cash (& credit) is the fraction of days in overdraft for which alternative liquidity was available in cash accounts (or available credit card balances) reported by the FCA (2018c, Technical Annex Chapter 5 Table 1). Fraction achieved is the ratio of effect size to feasible effect size. All estimates are Intent To Treat (ITT). Customer and month fixed effects are included and error terms are clustered by customer and month. All treatments test stand-alone alerts. An alert is stand-alone rather than incremental unless, at baseline, consumers are already automatically enrolled in other alerts that target the same charges. The reported baseline mean is mean charges for the treatment period in the control group. The reported effect size equals $-100 \cdot \text{estimate}/\,(\text{baseline mean})$. All estimates are intent-to-treat (ITT). Treatments 4 and 6 exclude months 10–11, when all units in those treatments are treated. Treatment 9 excludes treatment months 10–11 when the treatment alert was no longer stand-alone. † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Overdraft facility	AOD+				UOD only	
Alert target	AOD			UOD + UI	UOD + UI	
Alert threshold	0†	0	100	0	0	100
Bank	A	B	B	B	B	A
Treatment	1	2	3	4	6	9
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	-0.499***	-0.296***	-0.190***	-0.063***	-0.081***	-0.119***
s.e.	(0.047)	(0.042)	(0.040)	(0.016)	(0.016)	(0.029)
Baseline mean	5.73	7.64	7.64	0.41	0.39	2.17
Effect size	8.7%	3.9%	2.5%	15%	21%	5.5%
Feasible effect size with cash	27%	27%	27%	27%	27%	27%
Fraction achieved	32%	14%	9%	57%	76%	20%
Feasible effect size with cash & credit	60%	60%	60%	50%	50%	50%
Fraction achieved	15%	6%	4%	31%	41%	11%
No. customers	138,532	64,718	64,743	226,033	188,755	70,935
No. observations	1,443,829	698,652	698,795	2,001,911	1,538,839	571,328

Appendix H. Sample Comparison Tables

Tables H.I–H.IV present pretreatment sample statistics (means and standard deviations) for a variety of subsamples. Included variables are defined in Internet Appendix Table F.II. Reported charges are observed charges.

Table H.I presents sample statistics for each bank. Reported statistics for AOD limits are conditional on the customer having an AOD facility. (Bank A and B's pretreatment samples are May–October 2017; Bank C's pretreatment sample is January–February 2015 for those customers auto-enrolled on or after March 2015; and Bank D's pretreatment sample is January–May 2015 for those customers auto-enrolled on or after May 2015.)

Table H.II Panels A–C show good pretreatment sample balance for each treatment and control group in our field experiments.

Table H.III compares pretreatment statistics for the subsample with two current accounts to the full field experiment sample by overdraft facility and bank for those groups analyzed in Internet Appendix E. Note that account balances, borrowing limits, and charges are summed across accounts rather than averaged for individuals with two accounts. Compared to single-account holders, Table H.III shows that dual-account holders are highly selected, having approximately two years longer tenure with their bank, higher average balances, larger overdraft borrowing limits, higher account inflows, higher overdraft charges, and higher account engagement.

Table H.IV Panels A–C show pretreatment statistics to compare whether those in automatic enrollment trials (treatments 1–10) who opt-out differ observably from those who do not and, likewise, whether those in the prompted enrollment trial (treatment 11) who opt-in differ observably from those who don't. As our heterogeneous treatment effects analysis in Section III.D shows that savings due to alerts are increasing in pretreatment overdraft propensity, one might expect those who opt-out to be relatively rare overdrafters and those who opt-in to be relatively heavy overdrafters. However, as reported in Table H.IV, we see no difference between those who opt-in and stay out in the prompted enrollment trial, and mostly see the opposite pattern for the automatic enrollment trials: Those who opt-out have significantly higher overdraft and unpaid item charges than those who stay in across all treatments that included Bank A customers with an overdraft facility or Bank B customers with an AOD facility.

Table H.I

Pretreatment Sample Statistics by Bank

This table reports pretreatment means and standard deviations of demographic and overdraft related variables, by bank. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. For Banks A and B, the sample is the pretreatment period (May–October 2017), and observations are weighted to be representative of each bank's customer base. For Bank C, the sample is January–February 2015 for those customers auto-enrolled on or after March 2015. For Bank D, the sample is January–May 2015 for those customers auto-enrolled on or after June 2015. Reported statistics are pretreatment means and, in parentheses, standard deviations. Included variables are defined in Internet Appendix Table F.II. Reported charges are observed charges. Reported statistics for AOD limits are conditional on the customer having an AOD facility.

Bank	A	B	C	D
Age	40.41	43.60	46.95	43.34
	(13.56)	(14.03)	(16.35)	(15.86)
Gender	0.51	0.51	0.54	0.51
	(0.49)	(0.43)	(0.50)	(0.50)
Tenure	12.24	6.38	18.41	15.78
	(11.31)	(7.03)	(18.70)	(10.43)
Average balance	951.95	1817.18	2444.63	2930.30
	(6149.26)	(9072.01)	(10078.70)	(14333.13)
Account inflows	2563.54	3200.27	3474.08	3901.04
	(9650.06)	(10679.05)	(24246.94)	(15155.74)
AOD limit	1037.06	960.97	1473.53	2066.33
	(1012.64)	(967.55)	(3085.54)	(1967.89)
AOD charges	2.55	5.42	3.58	4.20
	(9.52)	(11.44)	(14.18)	(13.12)
Days in AOD	2.69	5.30	3.49	6.21
	(7.86)	(10.24)	(8.62)	(10.92)
UOD+UI charges	0.95	2.21	2.30	1.04
	(4.61)	(11.10)	(13.52)	(6.71)
Total charges	3.50	7.63	5.89	5.24
	(10.73)	(16.79)	(24.96)	(15.39)
Digital logins	19.31	16.33	3.07	14.91
	(25.89)	(23.39)	(11.15)	(24.63)
No. customers	520,502	580,950	53,257	96,015
No. observations	2,939,597	3,346,513	106,130	382,442

Table H.II

Treatment and Control Sample Balance

This table reports field experiment pretreatment means and standard deviations of demographic and overdraft related variables, by treatment and control group. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. Included variables are defined in Internet Appendix Table F.II. Reported charges are observed charges. AOD variables are blank for subsamples without an AOD facility (treatments 6–11). UOD variables are blank for subsamples with no overdraft facility (treatments 10–11). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels.

Panel A: Treatments 1–3

Overdraft facility	AOD+					
Alert target	AOD					
Balance threshold	0†		0		100	
Bank	A		B		B	
Treatment	1		2		3	
Sample	Treat	Control	Treat	Control	Treat	Control
Age	45.41	45.41	45.24	45.29	45.21	45.29
	(12.45)	(12.44)	(12.92)	(13.02)	(13.06)	(13.02)
Gender	0.53	0.53	0.51	0.51	0.52	0.51
	(0.48)	(0.48)	(0.42)	(0.42)	(0.42)	(0.42)
Tenure	18.10	18.16	6.77	6.79	6.72	6.79
	(13.01)	(12.98)	(7.28)	(7.33)	(7.25)	(7.33)
Average balance	1140.98	1124.93	1785.60	1741.56	1762.89	1741.56
	(6485.84)	(5815.17)	(9174.01)	(7710.71)	(9028.52)	(7710.71)
Account inflows	3239.84	3263.43	3592.18	3641.81	3565.22	3641.81
	(10941.25)	(11282.06)	(12842.10)	(10828.02)	(10651.87)	(10828.02)
AOD limit	1037.66	1036.86	958.37	967.32	950.16	967.32
	(1009.96)	(1013.53)	(960.46)	(976.16)	(950.22)	(976.16)
AOD charges	5.50	5.56	7.90	7.95	7.87	7.95
	(13.38)	(13.46)	(13.13)	(13.01)	(12.99)	(13.01)
Days in AOD	5.80	5.86	7.70	7.79	7.69	7.79
	(10.71)	(10.79)	(11.58)	(11.59)	(11.49)	(11.59)
UOD+UI charges	0.34	0.35	2.22	2.28	2.24	2.28
	(2.42)	(2.49)	(11.04)	(11.16)	(11.11)	(11.16)
Total charges	5.84	5.90	10.12	10.23	10.11	10.23
	(14.08)	(14.19)	(18.29)	(18.28)	(18.22)	(18.28)
Digital logins	16.60	16.53	16.07	16.25	16.03	16.25
	(22.67)	(23.04)	(21.58)	(21.95)	(21.38)	(21.95)
No. customers	34,540	103,992	32,449	32,269	32,474	32,269
No. observations	200,222	602,719	192,288	191,244	192,462	191,244

Continued

Table H.II. —*Continued*

Treatment and Control Sample Balance

Panel B: Treatments 4–7

Overdraft facility	AOD+				UOD only			
Alert target	UOD + UI				UOD + UI			
Balance threshold	0		50		0		50	
Bank	B		B		B		B	
Treatment	4		5		6		7	
Sample	Treat	Control	Treat	Control	Treat	Control	Treat	Control
Age	45.29	45.33	45.30	45.29	39.90	39.96	39.94	39.90
	(13.02)	(13.02)	(13.09)	(13.02)	(15.32)	(15.38)	(15.39)	(15.32)
Gender	0.51	0.51	0.51	0.51	0.52	0.52	0.51	0.52
	(0.42)	(0.42)	(0.42)	(0.42)	(0.45)	(0.45)	(0.45)	(0.45)
Tenure	6.79	6.79	6.73	6.79	5.47	5.55	5.53	5.47
	(7.33)	(7.33)	(7.27)	(7.33)	(6.18)	(6.31)	(6.31)	(6.18)
Average balance	1741.56	1797.26	1790.09	1741.56	1913.50	1875.70	1887.67	1913.50
	(7710.71)	(9447.39)	(10595.45)	(7710.71)	(8457.69)	(8699.26)	(8040.84)	(8457.69)
Account inflows	3641.81	3603.17	3612.25	3641.81	2359.25	2322.66	2355.05	2359.25
	(10828.02)	(10917.14)	(12068.27)	(10828.02)	(8533.94)	(8830.72)	(12754.25)	(8533.94)
AOD limit	967.32	962.69	958.64	967.32				
	(976.16)	(968.81)	(975.67)	(976.16)				
AOD charges	7.95	7.97	7.93	7.95				
	(13.01)	(13.13)	(13.06)	(13.01)				
Days in AOD	7.79	7.78	7.74	7.79				
	(11.59)	(11.61)	(11.59)	(11.59)				
UOD+UI charges	2.28	2.25	2.12	2.28	2.18	2.14	2.17	2.18
	(11.16)	(11.11)	(10.69)	(11.16)	(11.22)	(11.12)	(11.25)	(11.22)
Total charges	10.23	10.21	10.06	10.23	2.18	2.14	2.17	2.18
	(18.28)	(18.35)	(17.97)	(18.28)	(11.22)	(11.12)	(11.25)	(11.22)
Digital logins	16.25	16.07	16.02	16.25	16.75	16.87	16.73	16.75
	(21.95)	(22.46)	(21.94)	(21.95)	(23.20)	(25.74)	(25.49)	(23.20)
No. customers	32,269	193,764	32,385	32,269	34,422	154,333	34,420	34,422
No. observations	191,244	1,148,196	192,157	191,244	191,030	857,004	191,161	191,030

Continued

Table H.II. —*Continued*

Treatment and Control Sample Balance

Panel C: Treatments 8–11								
Overdraft facility	UOD only				None			
Alert target	UOD + UI				UI			
Balance threshold	100				100			
Bank	B		A		A		A	
Treatment	8		9		10		11	
Sample	Treat	Control	Treat	Control	Treat	Control	Treat	Control
Age	39.88	39.90	46.82	46.75	34.51	34.55	34.55	34.55
	(15.39)	(15.32)	(11.56)	(11.55)	(12.42)	(12.42)	(12.47)	(12.42)
Gender	0.52	0.52	0.54	0.54	0.49	0.49	0.49	0.49
	(0.45)	(0.45)	(0.48)	(0.48)	(0.49)	(0.49)	(0.49)	(0.49)
Tenure	5.57	5.47	15.11	15.10	6.03	6.02	6.03	6.02
	(6.33)	(6.18)	(7.05)	(7.20)	(5.17)	(5.08)	(5.07)	(5.08)
Average balance	1884.14	1913.50	1141.54	1163.81	753.50	759.33	735.74	759.33
	(7740.08)	(8457.69)	(5771.06)	(6671.41)	(3981.82)	(8196.35)	(4262.27)	(8196.35)
Account inflows	2337.97	2359.25	2204.30	2204.15	1926.36	1954.92	1923.85	1954.92
	(8547.38)	(8533.94)	(9104.21)	(8981.73)	(5812.88)	(10042.51)	(5614.72)	(10042.51)
AOD limit								
AOD charges								
Days in AOD								
UOD+UI charges	2.21	2.18	4.37	4.34				
	(11.39)	(11.22)	(11.79)	(11.71)				
Total charges	2.21	2.18	4.37	4.34	1.01	1.02	1.03	1.02
	(11.39)	(11.22)	(11.79)	(11.71)	(4.01)	(4.03)	(4.04)	(4.03)
Digital logins	17.09	16.75	14.73	14.84	22.84	22.72	22.66	22.72
	(28.81)	(23.20)	(22.09)	(22.37)	(28.90)	(28.49)	(28.52)	(28.49)
No. customers	34,434	34,422	36,043	34,892	36,564	137,031	137,440	137,031
No. observations	190,971	191,030	199,297	192,513	205,246	768,609	770,991	768,609

Table H.III

Sample Statistics—Full Sample versus Dual Account Holders

This table reports field experiment pretreatment means and standard deviations of demographic and overdraft related variables by overdraft facility and bank for the full sample and the subsample of dual-account holders. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. The subsample of dual-account holders includes all customers with two current accounts that are both accessible by the same set of household members. Included variables are defined in Internet Appendix Table F.II. Reported charges are observed charges. AOD variables are blank for subsamples without an AOD facility (last two columns).

Facility	AOD+				UOD only	
Bank	A		B		B	
Sample	Full	Dual	Full	Dual	Full	Dual
Age	45.41	46.95	45.30	45.56	39.94	39.29
	(12.45)	(10.88)	(13.02)	(11.92)	(15.37)	(13.93)
Gender	0.53	0.55	0.51	0.54	0.52	0.57
	(0.48)	(0.48)	(0.42)	(0.41)	(0.45)	(0.45)
Tenure	18.14	21.24	6.78	9.02	5.54	7.24
	(12.98)	(6.68)	(7.31)	(7.88)	(6.30)	(6.48)
Average balance	1128.93	1885.94	1786.36	2381.97	1883.48	2756.11
	(5989.44)	(6499.42)	(9343.39)	(9007.26)	(8458.41)	(12087.96)
Account inflows	3257.55	5813.73	3603.02	5927.83	2333.92	3933.75
	(11198.04)	(14682.48)	(11209.74)	(13293.48)	(9378.47)	(11395.68)
AOD limit	1037.06	1893.62	961.05	1612.56		
	(1012.64)	(1394.13)	(967.56)	(1307.35)		
AOD charges	5.54	7.17	7.95	14.69		
	(13.44)	(18.00)	(13.10)	(21.07)		
Days in AOD	5.84	7.46	7.76	14.27		
	(10.77)	(14.89)	(11.59)	(19.19)		
UOD+UI charges	0.34	0.26	2.23	3.21	2.16	2.67
	(2.47)	(2.37)	(11.07)	(14.37)	(11.19)	(12.37)
Total charges	5.89	7.43	10.18	17.89	2.16	2.67
	(14.16)	(18.75)	(18.29)	(27.74)	(11.19)	(12.37)
Digital logins	16.54	18.68	16.08	21.05	16.87	24.92
	(22.95)	(22.74)	(22.16)	(24.03)	(25.82)	(27.35)
No. customers	138,532	9,360	323,341	6,805	257,609	6,533
Fraction trial cust.	100	6.8	100	2.1	100	2.5
No. observations	802,941	55,946	1,916,347	40,822	1,430,166	38,980
Fract trial obs.	100	7.0	100	2.1	100	2.7

Table H.IV

Sample Statistics by Opt-out Status

This table reports field experiment pretreatment means and standard deviations of demographic and overdraft related variables, by opt-out status. Acronyms stand for arranged overdraft (AOD), unarranged overdraft (UOD), and unpaid item (UI). "AOD+" denotes customers with an AOD facility with or without a UOD facility. Included variables are defined in Internet Appendix Table F.II. Reported charges are observed charges. AOD variables are blank for subsamples without an AOD facility (treatments 6–11). UOD variables are blank for subsamples with no overdraft facility (treatments 10–11). † = At Bank A, the AOD just-in-time alert was combined with further alerts at three salient borrowing levels.

Panel A: Treatments 1–3

Overdraft facility	AOD+					
Alert target	AOD					
Balance threshold	0†		0		100	
Bank	A		B		B	
Treatment	1		2		3	
Sample	Stayed in	Opted out	Stayed in	Opted out	Stayed in	Opted out
Age	45.16	48.68	45.23	45.62	45.22	45.11
	(12.34)	(13.48)	(12.94)	(11.88)	(13.07)	(12.20)
Gender	0.52	0.54	0.51	0.51	0.52	0.51
	(0.48)	(0.47)	(0.42)	(0.40)	(0.42)	(0.39)
Tenure	18.06	18.60	6.76	7.67	6.70	7.73
	(12.96)	(13.59)	(7.27)	(7.51)	(7.23)	(7.73)
Average balance	1178.51	647.32	1809.48	377.94	1790.91	371.40
	(6672.50)	(3082.33)	(9242.85)	(2720.12)	(9109.04)	(2648.77)
Account inflows	3234.54	3309.59	3585.92	3960.87	3561.82	3733.93
	(11152.49)	(7636.89)	(12919.43)	(6880.83)	(10723.56)	(6110.82)
AOD limit	1028.10	1163.38	954.53	1185.47	946.44	1135.59
	(1002.17)	(1099.71)	(957.61)	(1092.35)	(947.16)	(1076.08)
AOD charges	5.08	10.97	7.75	16.72	7.75	13.96
	(12.82)	(18.43)	(13.03)	(16.00)	(12.93)	(14.71)
Days in AOD	5.44	10.62	7.56	15.84	7.58	13.49
	(10.39)	(13.41)	(11.51)	(12.85)	(11.44)	(12.80)
UOD+UI charges	0.33	0.47	2.22	2.30	2.25	1.90
	(2.38)	(2.86)	(11.05)	(10.36)	(11.14)	(9.22)
Total charges	5.41	11.44	9.97	19.01	10.00	15.86
	(13.52)	(19.14)	(18.24)	(19.31)	(18.21)	(17.95)
Digital logins	16.11	23.11	15.92	24.65	15.84	25.12
	(22.03)	(29.09)	(21.44)	(27.61)	(21.23)	(26.12)
No. customers	32,105	2,435	31,914	535	31,837	637
No. observations	186,075	14,147	189,081	3,207	188,663	3,799

Continued

Table H.IV. —*Continued*

Sample Statistics by Opt-out Status

Panel B: Treatments 4–7

Overdraft facility	AOD+				UOD only			
Alert target	UOD + UI				UOD + UI			
Balance threshold	0		50		0		50	
Bank	B		B		B		B	
Treatment	4		5		6		7	
Sample	Stayed in	Opted out	Stayed in	Opted out	Stayed in	Opted out	Stayed in	Opted out
Age	45.27	47.85	45.30	46.00	39.87	46.38	39.94	40.44
	(13.02)	(12.70)	(13.09)	(12.76)	(15.32)	(14.51)	(15.40)	(14.26)
Gender	0.51	0.50	0.51	0.50	0.52	0.53	0.51	0.54
	(0.42)	(0.41)	(0.42)	(0.43)	(0.45)	(0.45)	(0.45)	(0.45)
Tenure	6.78	7.95	6.73	7.35	5.47	6.81	5.52	6.27
	(7.33)	(8.28)	(7.27)	(7.36)	(6.18)	(7.14)	(6.31)	(6.53)
Average balance	1746.96	705.52	1798.27	578.57	1916.02	1330.65	1896.39	1087.95
	(7727.68)	(2851.17)	(10626.70)	(3537.34)	(8474.10)	(2628.74)	(8057.45)	(6285.66)
Account inflows	3639.19	4142.84	3611.68	3695.91	2357.20	2832.33	2356.31	2239.55
	(10830.33)	(10368.85)	(12096.75)	(6610.51)	(8537.28)	(7712.19)	(12817.54)	(3782.20)
AOD limit	966.90	1047.17	958.14	1032.69				
	(975.25)	(1135.00)	(975.67)	(973.27)				
AOD charges	7.93	12.59	7.87	17.06				
	(12.99)	(15.25)	(13.00)	(17.71)				
Days in AOD	7.76	12.56	7.68	16.23				
	(11.57)	(13.74)	(11.55)	(14.05)				
UOD+UI charges	2.26	5.66	2.11	3.86	2.18	2.66	2.16	2.76
	(11.12)	(17.28)	(10.66)	(14.22)	(11.22)	(12.17)	(11.24)	(12.06)
Total charges	10.19	18.26	9.98	20.91	2.18	2.66	2.16	2.76
	(18.24)	(24.44)	(17.91)	(22.96)	(11.22)	(12.17)	(11.24)	(12.06)
Digital logins	16.21	24.87	15.95	26.80	16.72	21.89	16.57	31.22
	(21.88)	(31.04)	(21.90)	(25.16)	(23.18)	(25.67)	(25.38)	(30.75)
No. customers	32,103	166	32,170	215	34,279	143	34,068	352
No. observations	190,252	992	190,869	1,288	190,208	822	189,098	2,063

Continued

Table H.IV. —*Continued*

Sample Statistics by Opt-out Status

Panel C: Treatments 8–11								
Overdraft facility	UOD only				None			
Alert target	UOD + UI				UI			
Balance threshold	100				100			
Bank	B		A		A		A	
Treatment	8		9		10		11	
Sample	Stayed in	Opted out	Stayed in	Opted out	Stayed in	Opted out	Opted in	Stayed out
Age	39.88	40.31	46.67	48.45	34.35	36.05	36.55	34.36
	(15.39)	(15.79)	(11.47)	(12.34)	(12.26)	(13.70)	(13.55)	(12.34)
Gender	0.52	0.59	0.54	0.59	0.48	0.55	0.51	0.49
	(0.45)	(0.44)	(0.48)	(0.46)	(0.49)	(0.49)	(0.50)	(0.49)
Tenure	5.56	6.18	15.08	15.46	5.99	6.37	5.99	6.03
	(6.33)	(6.32)	(6.97)	(7.86)	(5.04)	(6.29)	(5.29)	(5.05)
Average balance	1895.96	858.48	1171.57	824.25	786.29	444.63	795.18	730.12
	(7777.48)	(2914.84)	(5887.82)	(4337.38)	(4147.19)	(1756.84)	(3479.72)	(4328.98)
Account inflows	2339.64	2193.67	2225.53	1979.94	1932.47	1868.77	2343.80	1884.10
	(8586.24)	(3909.34)	(9267.09)	(7156.74)	(5914.65)	(4748.14)	(6403.87)	(5532.55)
AOD limit								
AOD charges								
Days in AOD								
UOD+UI charges	2.22	1.57	4.28	5.28				
	(11.41)	(9.39)	(11.66)	(13.00)				
Total charges	2.22	1.57	4.28	5.28	1.02	0.99	0.98	1.03
	(11.41)	(9.39)	(11.66)	(13.00)	(4.01)	(4.03)	(3.92)	(4.05)
Digital logins	16.96	28.62	14.00	22.45	21.95	31.21	23.76	22.56
	(28.78)	(29.04)	(21.29)	(28.12)	(28.20)	(33.74)	(27.93)	(28.57)
No. customers	34,059	375	32,927	3,116	33,098	3,466	11,571	125,869
No. observations	188,795	2,176	182,065	17,232	185,548	19,698	66,669	704,322

Appendix I. Survey Script

7651 FCA QUESTIONNAIRE

INTRODUCTION

Good morning/afternoon/evening, please may I speak to [RESPONDENT NAME FROM SAMPLE]?

My name is _____and I am calling on behalf of the Financial Conduct Authority (FCA). They are the financial regulator for the UK, with responsibility for protecting consumers of financial products and services.

The FCA has asked us, Facts International, an independent research agency, to undertake a telephone survey about consumers' views and experiences of certain financial products. IF EMAILS SENT: You may remember having received an email explaining that you would be contacted.

Would you be able to spare 10 minutes to answer some questions?

Thank you. Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society.

I'd also like to inform you that this call will be recorded and may be monitored for the purposes of training and quality control.

IF NECESSARY:
Your details have been passed to us by [BANK NAME], which is regulated by the FCA. The FCA requested your details be passed to us so that we could contact you for the purposes of this research only. The information you provide will not be shared with anyone other than the FCA, who will only have access to anonymised responses.

IF NECESSARY:
This is confidential market research and not a sales call. Taking part will not affect your ability to borrow from lenders or your credit score, and you will not be contacted as a result. You do NOT need to answer any questions you feel uncomfortable answering.

IF NECESSARY:
If you have any questions about the project or would like to confirm that the FCA is commissioning this research, please call the FCA's Contact centre on 0800 111 6768. If you would like to check the validity of this call or check we are a bona fide research agency, you can ring the Market Research Society freephone number on 0500 39 69 99. If you would like to contact Facts International, please call 01233 637 000.

IF RESPONDENT ASKS: [BANK NAME] passed details to Facts International based on a request from the FCA

SECTION 1 – FINANCIAL WELL-BEING

ASK ALL
[This part of the questionnaire should be administered to individuals in treatment and controls groups.]

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q1
I will read you three statements that could be used to describe a person's financial situation. Could you tell me how much each of these statements describes your current situation?

1.1 My financial situation controls my life.
1.2 Whenever I feel in control of my finances, something happens that sets me back.
1.3 I am unable to enjoy life because I worry too much about money.

SINGLE CODE
SHOW AS A HORIZONTAL SCALE

Describes you completely	1
Describes you very well	2
Describes you somewhat	3
Describes you very little	4
Does not describe you at all	5
DO NOT READ OUT: Don't know	99

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q1.4
Thinking of any non-mortgage debts you may hold, e.g. credit cards, overdrafts, or personal loans, to what extent is keeping up with the repayment of them and any interest payments a financial burden to you?

Would you say it was:

SINGLE CODE

a) A heavy burden	1
b) Somewhat of a burden	2
c) Or, not a problem at all?	3
DO NOT READ OUT: Don't hold any non-mortgage debt	4
DO NOT READ OUT : Don't know	99

ASK ALL IN TREATMENT AND CONTROLS GROUPS

Q1.5
Which one of the following statements best describes how well you are keeping up with your bills and credit commitments at the moment? Are you:

SINGLE CODE

a) Keeping up with all of them without any difficulties	1
b) Keeping up with all of them, but it is a struggle from time to time	2
c) Keeping up with all of them, but it is a constant struggle	3
d) Falling behind with some of them	4
e) Having real financial problems and have fallen behind with many of them	5
f) Don't have any commitments	6
DO NOT READ OUT: Don't know	99

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q1.6
In the past 12 months, how often have you run out of money before the end of the week or month or needed to use a credit card or overdraft to get by? Would you say it was:

SINGLE CODE

Always	1
Most of the time	2
Sometimes	3
Hardly ever	4
Never	5
DO NOT READ OUT: Don't know	99

SECTION 2 – AWARENESS OF OVERDRAFT USAGE
ASK ALL
[This part of the questionnaire should be administered to individuals in treatment and controls groups.]

INTRO:
In this section we will ask you some questions about overdrafts. This means when your bank balance falls below a set amount, typically zero.

Specifically, we would like you to focus on the bank account you hold with [BANK NAME]. If you hold multiple current accounts with [BANK NAME], please think about your total overdraft usage across all these accounts.

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q2.1
How many days have you spent over-drawn in the past 3 months?

SINGLE CODE

Record number	1
DO NOT READ OUT: Don't know	99

ASK IF CODE 99 AT Q2.1
Q2.1b
Please could you give an estimate of how many days have you spent over-drawn in the past 3 months, from the following bands?

None	1
1-5 days	2
6-15 days	3
16 days – 1 month	4
Over 1 month but less than 2 months	5
Over 2 months but less than 3 months	6
3 months	7
DO NOT READ OUT: Don't know	99

ASK IF CODE 1 AT Q2.1 / OR IF CODES 2-7 AT Q2.1b
Q2.2
[IF [redacted]
Were these overdrafts arranged in advance with your bank? This is an authorised overdraft. If not, this is an unauthorised overdraft

[IF [redacted]
Your bank offers two types of overdraft, [redacted]. Which one did you use?

SINGLE CODE

Arranged	1
Unarranged overdraft / emergency borrowing	2
Both	3
DO NOT READ OUT: Don't know	99

ASK IF CODE 1 OR 3 AT Q2.2
Q2.3
How much have you spent in arranged overdraft charges over the past three months?

DO NOT READ OUT UNLESS NEEDED
SINGLE CODE

< £10	1
£10 – 50	2
£50 – 100	3
> £100	4
DO NOT READ OUT: Don't know	99

ASK IF CODE 2 OR 3 AT Q2.2
Q2.4
In total over the last three months, how much have you been charged from using your overdraft?

DO NOT READ OUT UNLESS NEEDED
SINGLE CODE

< £10	1
£10 – 50	2
£50 – 100	3
> £100	4
DO NOT READ OUT: Don't know	99

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q2.5
Have you had any bills, payments or cheques go unpaid for lack of funds over the past three months?

SINGLE CODE

Yes	1
No	2
DO NOT READ OUT: Don't know	99

ASK IF CODE 1 AT Q2.5
Q2.6
Banks may charge unpaid item fees if payments are rejected for lack of funds. How much have you been charged in unpaid item fees over the past three months?

DO NOT READ OUT UNLESS NEEDED
SINGLE CODE

< £10	1
£10 – 50	2
£50 – 100	3
> £100	4
DO NOT READ OUT: Don't know	99

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q2.7
Thinking about the way in which your bank charges you for using your overdraft and for refused bills, cheques, or payments, would you say it is:
SINGLE CODE

Simple and easy to understand	1
Fairly easy to understand	2
Neither easy nor difficult to understand	3
Somewhat difficult to understand	4
Complex and difficult to understand	5
DO NOT READ OUT: Don't know	99

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q2.8
How much would your bank charge you if you dipped into your arranged overdraft by £100 for one day?

SINGLE CODE

Record number (between 0 and 100)	1	
DO NOT READ OUT: Don't know	99	

ASK ALL IN TREATMENT AND CONTROLS GROUPS

Q2.9
How much would your bank charge you if you dipped into unarranged overdraft / emergency borrowing by £50 for one day?

SINGLE CODE

Record number (between 0 and 100)	1	
DO NOT READ OUT: Don't know	99	

ASK ALL IN TREATMENT AND CONTROLS GROUPS
Q2.10
How much would your bank charge you for a single unpaid transaction?

SINGLE CODE

Record number (between 0 and 100)	1	
DO NOT READ OUT: Don't know	99	

SECTION 3 – RESPONSE TO ALERTS

[This part of the questionnaire should be administered to individuals in treatment and controls groups, except those who opted-out of alerts.]

INTRO:

I will now ask you some questions about the text alerts that your bank sends you about your current account balance and overdraft usage.

[redacted] sends you two types of alerts. Grace period alerts are sent when you have been granted an unarranged overdraft or are about to have a payment rejected, and give you a chance to avoid charges by transferring money into your account. Low balance alerts are sent when your balances reaches [INSERT THRESHOLD] (you may have changed this threshold in your preferences).

[redacted] sends you [two/three] types of alerts. Grace period alerts are sent when you have entered your emergency borrowing or are about to have a payment rejected, and give you a chance to avoid charges by transferring money into your account. [Low balance alerts are sent when your balance reaches [INSERT THRESHOLD] (you may have changed this threshold in your preferences) AND/OR Overdraft alerts are sent at various stages in your overdraft journey, for instance when you reach 90% of your arranged limit].

ASK ALL IN TREATMENT AND CONTROLS GROUPS [EXCEPT CUSTOMERS WHO OPTED OUT OF ALERTS AND [redacted] 'NO CMA' CONTROL]

Q3.1

Have you received any of the text alerts I mentioned over the past three months?

IF RESPONDENT ASKS READ OUT THE TEXT OF ALERTS AT THE RESPONDENT'S BANK
<INSERT TEXT OF ALERTS AT RESPONDENT'S BANK>

SINGLE CODE

Yes	1
No	2
DO NOT READ OUT: Don't know	99

ASK IF CODE 1 AT Q3.1

Q3.2

How would you rate the frequency of these alerts? Please think about the conditions activating the alerts, as opposed to your own behaviour actually causing them to be sent.

SINGLE CODE

I receive them far too often	1
The frequency is about right	2
I would like to receive them more often	3

READ OUT Please think about [ALERT NAME] specifically when answering the following questions.

ASK IF CODE 1 AT Q3.1

I'm going to ask you some quick questions about your opinion on [ALERT NAME]. Could you tell me which of the following feelings or adjectives you would associate with receiving the alerts? Don't think too much about your answers.

RANDOMISE ORDER OF POSITIVE / NEGATIVE OPTION
SINGLE CODE

Q3.3

Like	1
Dislike	2
Neither	3

Q3.4

Helpful	1
Unhelpful	2
Neither	3

Q3.5

Anxious	1
In control	2
Neither	3

Q3.6

Embarrassed	1
Confident	2
Neither	3

ASK IF CODE 1 AT Q3.1
Q3.7

Do you recall taking action to avoid incurring overdraft fees as a result of the alerts you received?

SINGLE CODE

Yes	1
No	2
DO NOT READ OUT: Don't know	99

ASK IF CODE 1 AT Q3.7
Q3.8

We'd now like you to think about the sort of action you took after reading the alert. Please can you tell me if you took any of the following actions?

a) Did you use alternative sources of **formal** borrowing? This means borrowing from a licensed provider, for instance through a payday loan, credit card, or overdraft.

Yes – if yes, probe for source of formal borrowing
No

PROBE FULLY
DO NOT READ OUT
MULTI CODE

Use existing credit card	1
Take out new credit card	2
Request increase credit limit on credit card	3
On a store card (e.g. Argos, Debenhams)	4
Use existing bank account arranged overdraft	5
Request increase credit limit on overdraft	6
New arranged overdraft	7
Unarranged overdraft / emergency borrowing	8
Payday loan	9
Unsecured personal loan	10
Home credit/doorstep lender (company taking payments from home e.g. Provident)	11
Pawnbroker	12
Hire purchase loan	13
Mail order or catalogue loan	14
Rent-to-own (e.g. Brighthouse)	15
Peer-to-peer	16
Logbook loan	17
Credit union	18
Other form of formal borrowing [PLEASE SPECIFY]	98
No formal borrowing [SINGLE CODE]	99

b) Did you use alternative sources of **informal** borrowing? This means borrowing from an unlicensed provider, for example a friend, family member, or work acquaintance.

Yes – If yes, probe for type of informal borrowing
No

PROBE FULLY
DO NOT READ OUT
MULTI CODE

Loan from friend	1
Loan from family	2
Loan from employer	3
Loan from work colleague	4
Loan from someone in community	5
Illegal lender/loan shark	6
Other credit product (specify)	7
Other form of informal borrowing [PLEASE SPECIFY]	98
No informal borrowing [SINGLE CODE]	99

c) Did you cut back or go without something? For example, were you unable to purchase something? What was that?

Yes – If yes, probe for what they did
No

PROBE FULLY
DO NOT READ OUT
MULTI CODE

Bought lower quality goods	1
Affects running of business	2
Unable to buy food	3
Unable to buy clothing	4
Unable to purchase consumer electronics	5
Unable to purchase large item for home (e.g. sofa and white goods)	6
Unable to purchase car/vehicle	7
Unable to replace or repair something that had unexpectedly broken	8
Unable to gamble	9
Unable to go on holiday	10
Unable to attend social even	11
Unable to make a gift to a relative or friend	12
Other form of informal borrowing [PLEASE SPECIFY]	98
No cutting back / going without something [SINGLE CODE]	99

d) Were you unable to meet other financial commitments? Which ones?

Yes – if yes, probe for the financial commitments
No

PROBE FULLY
DO NOT READ OUT
MULTI CODE

All of them	1
Unable to pay deposit for rental agreement	2
Unable to pay rent payment	3
Unable to pay mortgage payment	4
Unable to pay Gas/Electricity/Water	5
Unable to pay mobile phone bill	6
Unable to pay TV/landline/internet/tv licence	7
Unable to pay Council or other taxes	8
Unable to pay off other debts	9
Other form of financial commitment missed [PLEASE SPECIFY]	98
Able to meet all financial commitments [SINGLE CODE]	99

e) Did you have to transfer money from available savings?

Yes – Probe for what the respondent did
No

PROBE FULLY
DO NOT READ OUT
MULTI CODE

Used savings from a savings account	1
Used savings from an ISA or other investment facility	2
Transferred funds from another current account	3
Paid available cash into bank account	4
Other form of savings used [PLEASE SPECIFY]	98
Did not transfer money from available savings [SINGLE CODE]	99

f) Did you take any other action after reading the alert? For example, did you contact your bank, sell something, or consolidate your debts?

Yes – Probe for the other action
No

PROBE FULLY
DO NOT READ OUT
MULTI CODE

Requested more time to repay money owed	1
Sold something	2
Sought debt advice	3
Unable to pay debts or other commitments	4
Enter County Court Judgement (CCJ)/insolvency/bankruptcy proceedings	5
Start debt management plan	6
Consolidate debts	7
Other [PLEASE SPECIFY]	98
Nothing - had nowhere else to borrow the money from [SINGLE CODE]	99

SECTION 3B – REASON FOR OPTING OUT
[This part of the questionnaire should only be administered to customers who opted out of alerts.]

ASK ALL CUSTOMERS WHO OPTED OUT OF ALERTS
Q3B.1

You recently opted out of receiving low-balance alerts from your bank. What was the main reason behind your choice?
READ OUT
SINGLE CODE

Alert not useful	1
Received too many alerts	2
Found the alerts irritating	3
Felt anxious as a result of the alerts	4
Felt embarrassed as a result of the alerts	5
Other (please specify)	98

ASK ALL IF CODE 1 at Q3B.1
Q3B.2

Why didn't you find the alerts useful?

SINGLE CODE

Does not use any overdraft facility	1
Is already aware of using overdraft	2
Alert is sent too late to act	3
Cannot take action because of lack of funds	4
Does not use any overdraft facility	5
Other (please specify)	98

SECTION 4 – ATTITUDE TO AUTO-ENROLMENT

ASK ALL IN TREATMENT GROUPS ONLY [EXCEPT CUSTOMERS WHO OPTED OUT OF ALERTS]
Q4.1

Do you think your bank should offer these alerts automatically?

SINGLE CODE

Yes, I think it's fine for the bank to register me into these alerts	1
No, I would prefer if the bank made these alerts available and offered me the chance to register	2
DO NOT READ OUT: Don't know	99

ASK TO 50-100 INDIVIDUALS IN TREATMENT GROUPS ONLY
ASK IF CODE 1 AT Q3.1
Q4.2

Is there anything else you would like to say about these alerts being turned on automatically for your account?

OPEN END

CHIME Insight & Engagement Group | FACTS International

FCA FINANCIAL CONDUCT AUTHORITY

CONSENT TO MATCHING QUESTION

ASK ALL
Q5.1

The Financial Conduct Authority (FCA) would like to anonymously link your answers from the survey to data it holds from regulated firms as part of its ongoing remit to help protect consumers. This includes information about how you used your current account over the past year, as well as your credit files. Consent to sharing your data will not affect your involvement with any financial services providers. The information will be treated in strict confidence and used for research and to help the regulator of financial services to protect consumers. Do you give your consent to matching your data?

IF NECESSARY

Who are the FCA?
The Financial Conduct Authority (FCA) is the regulator of financial services. It has an objective of protecting consumers. It is an independent public body, accountable to the Treasury, which is responsible for the UK's financial system, and to Parliament. For more information, see https://www.fca.org.uk/about/the-fca

How will the linkage be done?
We'd like to link your survey with your credit file and current account transaction history, including information on your use of mobile and online banking. Your current account history includes information about when and how often you use your overdraft. Your credit file includes your credit score as well as information on your borrowing on other products, for example credit cards. Importantly, the matching process will protect your personal data.

We will pass the survey results to the FCA, but the information which identifies you will be removed. All personal information, such as your name, will be deleted after the survey. The FCA will use anonymised, numerical identifiers to match your responses with an anonymised extract from your credit file, provided by a credit reference agency, and with anonymised data on your current account and overdraft usage, provided by your bank.

How will your data be used?
The FCA will use the anonymised dataset to research consumer interactions with financial service products. This research will inform the FCA in delivering its objectives of promoting effective competition in the interests of consumers, ensuring consumers are appropriately protected when using financial products and the UK financial services market has integrity and is protected.

Yes	1
No	2

Appendix J. Field Experiment Terms of Reference

J.1. Bank A Field Experiment Terms of Reference

Note that the Bank A terms of reference describes two treatment arms that are not included in the paper because their implementation failed—treatment groups were not treated. Further, the terms of reference omit treatment 11. Bank A completed the prompted enrollment treatment because they wanted to (believing it could have been a better option than automatic enrollment) rather than because the FCA asked them to; hence it was not part of the terms of reference.

Financial Conduct Authority (FCA) – [redacted]

Terms of Reference (ToR)

This is an agreement between the FCA's Behavioural Economics & Data Science Unit (BDU) and [redacted] aiming to clarify how the research project ***'Overdraft alerts trials'*** *is planned to be carried out. The FCA are grateful for [redacted] being willing to trial overdraft alerts in this way. The trial provides [redacted] an opportunity to learn more about their customers and assists the FCA in making effective interventions. This document is not legally binding.*

Agreed on 20 October 2017 by Graeme Mclean on behalf of the FCA & [redacted], [redacted] on behalf of [redacted]

	Signature	Date
FCA Representative	[redacted]	30/10/17
Firm Representative	[redacted]	31/10/17

1. Field trial participation

1.1. [redacted] is agreeing to make a portion of its customers available in order to take part in the FCA overdraft alerts trial. The number of customers and details of the trial are specified in the Annexes to this document.

1.2. The FCA will not reveal the name of the firm participating in the trial, explicitly unless [redacted] provides written consent to do so. (Any reference to [redacted] proprietary terms or products will be anonymised). [redacted] agrees not to communicate externally its participation in the trial until the FCA's publications describing the research outcomes have been published. After this time it may communicate its participation based on its own assessment of the merits and risks of this.

1.3. [redacted] has considered the financial cost of participating in this trial (e.g. lost revenue from changing customer behaviour, resource costs of changing systems for the trial) and is happy to proceed.

1.4. [redacted] has reviewed that the terms and conditions of customers' agreements with the firm enable them to participate in the trial. The FCA and [redacted] agree that the treatments and invitation to participate in a consumer survey do not constitute direct marketing (as set out in the Information Commissioner's Office's guidance on Privacy and Electronic Communications Regulations).

1.5. Before the trial is implemented it will go through the FCA's ethics procedure.

1.6. [redacted] will keep the FCA updated on the progress of the trial at least once a month for the duration of the trial.

2. Details of the trial

2.1. [redacted] will select the customers participating in the trial in accordance with the sampling procedure specified in Annex 1 of this document.

2.2. The FCA will supervise the correct application of the sampling procedure. As part of this process, [redacted] will provide the FCA with profile information on all treatment and control groups in advance of the trial. It will also provide the FCA

with documentation on the process by which participating customers were allocated to treatment and control groups.

2.3. [redacted] agrees to implement the treatments in the format specified in Annex 2 of this document.

2.4. The delivery channel for all treatments in the trial will be by text message. An exception can be made where customers have the mobile banking app and have actively opted in to receive push notifications, where the delivery channel can be push notifications through the app instead of by text message.

2.5. Treated customers should be notified of enrolment into the trials.

2.6. Customers will be given the opportunity to opt-out of treatment should they wish to do so, using [redacted] alert settings panel available via online banking, mobile banking (if available), or telephone banking or branch.

3. Data collection and analysis

3.1. Ahead of trial commencement the FCA will provide the firm with a draft of the data it plans to collect to provide the firm with an opportunity to provide feedback regarding the data and provisional timelines for collecting data *(see spreadsheet titled [redacted] RCTs Data Request', sent 24 October 2017)*. There will be two data submissions using the same template: an intermediate data request in February 2018 and a final data request at the end of the trial (5 months following commencement).

3.2. After considering feedback from [redacted] the FCA will collect data by issuing a notice for information using its powers under Section 165 of the Financial Services and Markets Act (FSMA 2000). This notice for information will be sent following approval by the FCA's governance processes.

3.3. The data will be stored and analysed on systems that meet the FCA's security requirements.

3.4. Analysis of this data will be carried out by FCA staff along with academics bound by non-disclosure agreements.

3.5. Information the firm provides to the FCA in response to a Section 165 notice for information is subject to the restriction on disclosure of confidential information under Section 348 of the Financial Services and Markets Act (FSMA 2000).

3.6. The FCA will conduct a survey on a subset of the customers selected for participation in the trial, excluding those customers that have requested not to be conducted for market research. The FCA also intends to collect data from credit reference agencies. [redacted] agrees to facilitate this by providing identifiers for these customers, noting that this information is personal information.

3.7. At the end of the trial the FCA will contact individuals in the trial to invite them to fill in a voluntary consumer survey. [redacted] agrees to provide the FCA contact details for these customers, which will only be used for the purpose of the survey and subsequently deleted, excluding any customers that have previously requested not to be contacted for future market research activity. Before contacting [redacted] customers the FCA will provide [redacted] with:

- An opportunity to comment on the consumer survey questionnaire and invitation to participate.
- Commitment that any customer requests to be excluded from future market research will be provided to [redacted] for inclusion in the [redacted] Market Research opt-out database.

- Commitment that the data provided to facilitate research will not be used for any other activity, without [redacted] agreement.

3.8. Individual identifiers (e.g. account identifiers) collected from [redacted] will be transferred to the FCA, which will then contact one or more credit reference agency in order to extract data held by these organisations on these individuals.

4. *Agreed output*

4.1. The FCA will use the insights from this research to inform its understanding of the personal current account market and consumer behaviour in financial markets. Data collected for this trial will be used to advance the FCA's statutory objectives and may be published in a form which does not violate Section 348 of FSMA.

4.2. The FCA intends to publish the main findings from this trial through its Occasional Paper series. Analysis of the data collected may also be used in other publications, such as the High Cost Credit review consultation paper planned for Spring 2018.

4.3. Ahead of external publication the FCA will share with [redacted] outputs from its analysis of [redacted] trial data.

4.4. The FCA will publish summary statistics of the characteristics of consumers participating in the trial along with results of the effects of the trial.

4.5. Sections of the FCA's publication which display summary statistics from a single firm's data will be shared with the firm ahead of external publication in order to agree a suitable degree of redaction to preserve firm anonymity.

Annex 1: Sampling and randomisation

Sample selection

1. The sample should be selected at the customer level (not account level).
2. Only customers who have an arranged overdraft facility and who do not have an emergency borrowing facility are eligible for trial A.
3. Only customers without an arranged overdraft facility and who do not have an emergency borrowing facility are eligible for trial B1.
4. Only customers without an arranged overdraft facility but with an emergency borrowing facility are eligible for trial B2.
5. The following exclusions should be applied to all trials:
    a. Exclude accounts already registered for alerts
    b. Exclude dormant accounts
    c. Exclude accounts with deceased customers
    d. Exclude account with legal representatives (Power of Attorney)
    e. Exclude customers on accounts that don't offer overdrafts, or where overdrafts are fee free
    f. For joint accounts, either both or neither customer should be set up for alerts
    g. Exclude customers whose account balances have not dipped below £1000 for six months preceding the start of the trial
    h. Exclude customers without an email address.
    i. Exclude customers impacted by a sort code change, required to facilitate ring - fenced banking implementation.
6. No other exclusions should be applied except by prior agreement.

Randomization

1. After having applied the above exclusions, [redacted] will randomly draw customers from its book into each trial's overall sample.
2. [redacted] will randomly assign the sampled customers to treatment and control groups in accordance with the proportions specified in Annex 2. Attention should be paid to avoid possible sources of bias – e.g. assigning chunks of customers to treatment groups by account number where this correlates with years since account opening. Ways of avoiding such bias include using a random number generator and assigning customers to treatments in an alternating fashion:
    a. Customer #1: treatment 1
    b. Customer #2: treatment 2
    c. Customer #3: control group
    d. Customer #4: treatment 1
    e. Customer #5: treatment 2
    f. Customer #6: control group
    g. Customer #7: treatment 1
    h. Etc.
3. The relevant treatment status should apply to all of the customer's relevant accounts.
4. Where one of the customer's accounts is a joint account, other joint account holders will also be selected to receive the same treatment.
5. Assignment of customers to treatment will involve stratified random sampling from each trial's overall sample according to the following variables:

a. Arranged OD limit
b. Incurred OD charges (charges on account in last 6 months)
c. Mobile app activity (customer has used mobile app in last 3 months)
d. Age
e. Years since account opening
f. Gender
g. Average account balance (last month)
h. A proxy of consumer income (e.g. median monthly credit turnover)

6. To ensure randomization has been correctly carried out, the FCA will examine the means and distribution of variables across groups, using a sample overview provided by [redacted]

Annex 2: Overview of field trial treatments

Trial	Treatment arm descriptions (code)		Sample size[1] (# Customers)
Trial A (Approaching) arranged overdraft usage alert	Control group (AC)		120k
	Low balance alert at £100	Auto enrolled (AA1)	40k
	Overdraft alerts suite	Auto enrolled (AA2)	40k
	Low balance alert at £100 & overdraft alerts suite	Auto enrolled (AA3)	40k
Trial B1 Approaching unpaid items alert	Control group (B1C)		150k
	Low balance alert at £100	Auto enrolled (B1A)	40k
Trial B2 Approaching emergency borrowing alert	Control group (B2C)		40k
	Low balance alert at £100	Auto enrolled (B2A)	40k

[1] Note that sample sizes may be slightly larger in practice due to the inclusion of additional customers in joint accounts

J.2. Bank B Field Experiment Terms of Reference

Financial Conduct Authority (FCA) – [redacted]

Terms of Reference (ToR)

This is an agreement between the FCA's Behavioural Economics & Data Science Unit (BDU) and [redacted] aiming to clarify how the research project ***'Overdraft alerts trials'*** *is planned to be carried out. The FCA are grateful for [redacted] being willing to trial overdraft alerts in this way. The trial provides [redacted] an opportunity to learn more about their customers and assists the FCA in making effective interventions. This document is not legally binding.*

Agreed on 20 October 2017 by Graeme Mclean on behalf of the FCA & [redacted] on behalf of [redacted]

	Signature	***Date***
FCA Representative	Graeme McLean	30/10/17
[redacted] Representative	[redacted]	2/11/17

1. *Field trial participation*

1.1. [redacted] is agreeing to make a portion of its customers available in order to take part in the FCA overdraft alerts trial. The number of customers and details of the trial are specified in Annex 2 of this document.

1.2. The FCA will not reveal the name of the firm participating in the trial unless [redacted] provides written consent to do so. [redacted] agrees not to communicate externally its participation in the trial until the FCA's publications describing the research outcomes have been published. After this time it may communicate its participation based on its own assessment of the merits and risks of this.

1.3. [redacted] has considered the financial cost of participating in this trial (e.g. lost revenue from changing customer behaviour, resource costs of changing systems for the trial) and is happy to proceed.

1.4. [redacted] has reviewed that the terms and conditions of customers' agreements with the firm enable them to participate in the trial. The FCA and [redacted] agree that the treatments and invitation to participate in a consumer survey do not constitute direct marketing (as set out in the Information Commissioner's Office's guidance on Privacy and Electronic Communications Regulations).

1.5. Before the trial is implemented it will go through the FCA's ethics procedure.

1.6. [redacted] will keep the FCA updated on the progress of the trial at least once a month for the duration of the trial.

2. *Details of the trial*

2.1. [redacted] will select the customers participating in the trial in accordance with the sampling procedure specified in Annex 1 of this document.

2.2. [redacted] will provide the FCA with profile information on all treatment and control groups in advance of the trial. It will also provide the FCA with documentation on the process by which participating customers were allocated to treatment and control groups.

2.3. [redacted] agrees to implement the treatments in the format specified in Annex 2 of this document.
2.4. The delivery channel for all treatments in the trial will be text message.
2.5. Following (advance) notification by email, customers will be auto-enrolled by [redacted] into the assigned treatments.
2.6. Customers will be given the opportunity to opt-out of treatment should they wish to do so, through online banking, by visiting a local branch or by calling [redacted]
2.7. [redacted] will notify and auto-enrol trial participants in the week commencing November 6th 2017. This marks the start of the trial.
2.8. The trial will last for five months - [redacted] agrees not to change the operation or content of the "low Balance" and "balance close to overdraft limit" alerts received by trial participants in the treatment groups during this period. After these five months, [redacted] will have discretion over whether customers participating in the trial will continue to receive the alerts they were auto-enrolled in.
2.9. [redacted] will make some changes to the operation and content of the alerts that will be used to comply with the CMA order (Part 6) in January 2018; these alerts are the CMA alerts referenced to in Annex 2.

3. Data collection and analysis

3.1. Ahead of trial commencement the FCA will provide [redacted] with a draft of the data it plans to collect to provide [redacted] with an opportunity to provide feedback regarding the data and provisional timelines for collecting data *(see spreadsheet titled '[redacted] RCT Data Request', sent 3 August 2017)*. There will be two data submissions using the same template: an intermediate data request in February 2018 and a final data request at the end of the trial.
3.2. After considering feedback from [redacted], the FCA will collect data by issuing a notice for information using its powers under Section 165 of the Financial Services and Markets Act (FSMA 2000). This notice for information will be sent following approval by the FCA's governance processes.
3.3. The data will be stored and analysed on systems that meet the FCA's security requirements.
3.4. Analysis of this data will be carried out by FCA staff along with academics bound by non-disclosure agreements.
3.5. Information [redacted] provides to the FCA in response to a Section 165 notice for information is subject to the restriction on disclosure of confidential information under Section 348 of the Financial Services and Markets Act (FSMA 2000).
3.6. The FCA will conduct a survey on a subset of the customers selected for participation in the trial; the FCA also intends to collect data from credit reference agencies. [redacted] agrees to facilitate these two exercises by providing contact details and identifiers for these customers, noting that this information is personal information.
3.7. At the end of the trial the FCA (or a market research company on the FCA's behalf) will contact individuals in the trial for a voluntary consumer survey by phone or e-mail. The FCA agrees not to contact any consumers that have opted out of being contacted for research. [redacted] agrees to provide the FCA contact details for eligible customers (those that have not opted out of being contacted

for research). Before contacting [redacted] customers the FCA will provide [redacted] with an opportunity to comment on the consumer survey questionnaire and invitation to participate.

3.8. Individual identifiers (e.g. account identifiers) collected from [redacted] will be transferred to the FCA, which will then contact one or more credit reference agency in order to extract data held by these organisations on these individuals.

4. Agreed output

4.1. The FCA will use the insights from this research to inform its understanding of the personal current account market and consumer behaviour in financial markets. Data collected for this trial will be used to advance the FCA's statutory objectives and may be published in a form which does not violate Section 348 of FSMA.

4.2. The FCA intends to publish the main findings from this trial through its Occasional Paper series. Analysis of the data collected may also be used in other publications, such as the High Cost Credit review consultation paper planned for Spring 2018.

4.3. Ahead of external publication the FCA will share with [redacted] outputs from our analysis of [redacted] data.

4.4. The FCA will publish summary statistics of the characteristics of consumers participating in the trial along with results of the effects of the trial.

4.5. Sections of the FCA's publication which display summary statistics from a single firm's data will be shared with [redacted] ahead of external publication in order to agree a suitable degree of redaction to preserve firm anonymity

Annex 1: Sampling and randomisation

Sample selection

1. The sample should be selected at the customer level (not account level).
2. Only customers who have an arranged overdraft facility are eligible for trials A and B1.
3. Only customers who do not have an arranged overdraft facility are eligible for trial B2.
4. The following exclusions should be applied to all trials:
    a. Exclude accounts already registered for alerts
    b. Exclude accounts where nobody holds an email address
    c. Exclude dormant accounts
    d. Exclude accounts with deceased customers
    e. Exclude account with legal representatives
    f. Exclude customers whose minimum balance over the past 6 months is greater than £1,000
    g. Exclude customers on accounts that don't offer overdrafts, or where overdrafts are fee free. This includes Student Accounts, Basic Current Account and customers in their fee free switcher period.
    h. For joint accounts, either both or neither customer should be set up for alerts
5. No other exclusions should be applied except by prior agreement.

Randomization

1. After having applied the above exclusions, [redacted] will randomly select 400'000 customers from the book of accounts with an arranged overdraft facility (trials A and B1), and 300'000 customers from the book of accounts without an arranged overdraft facility (trial B2).
2. [redacted] will then randomly assign the sampled customers to treatment and control groups in accordance with the proportions specified in Annex 2. Attention should be paid to avoid possible sources of bias – e.g. assigning chunks of customers to treatment groups by account number where this correlates with years since account opening. One way of avoiding such bias is to assign customers to treatments in an alternating fashion:
    - Customer #1: treatment 1
    - Customer #2: treatment 2
    - Customer #3: control group
    - Customer #4: treatment 1
    - Customer #5: treatment 2
    - Customer #6: control group
    - Customer #7: treatment 1
    - Etc.
3. The relevant treatment status should apply to all of the customer's relevant accounts.
4. Where one of the customer's accounts is a joint account, other joint account holders will also be selected to receive the same treatment.

Annex 2: Overview of field trial treatments

Trial	Treatment arm descriptions (code)	Sample size
Trial A (Approaching) arranged overdraft usage alert	Control group with CMA alert (AC1)	40k customers
	Control group without CMA alert (AC2)	240k customers
	Low balance alert at £0 threshold & CMA alerts (AT1)	40k customers
	Low balance alert at £100 threshold & CMA alert (AT2)	40k customers
Trial B1 Approaching unarranged overdraft (from arranged) alert	*Control groups the same as in trial A (AC1 & AC2)*	*See above*
	Account balance close to overdraft limit & CMA alert (BT1)	40k customers
Trial B2 Approaching unarranged overdraft (from credit balance) alert	Control group with CMA alert (CC1)	40k customers
	Control group without CMA alert (CC2)	180k customers
	Low balance alert at £100 threshold & CMA alert (CT1)	40k customers
	Low balance alert at £50 threshold & CMA alert (CT2)	40k customers

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Appendix A. Reply to Editor

Dear Stefan,

Thank you for conditionally accepting our paper—and for your patience while we have been waiting for the Financial Conduct Authority to clear the paper for publication—which they have finally done today. We have made the expositional changes suggested by the referees that we felt made the paper better. Following your guidance, we did not conduct new analysis when suggested by the referees, although we did add some additional analysis to the appendix that was in our prior response letters. We explain our changes or rationale for the lack of change to each referee comment below. We also describe several other minor changes following these responses. Note that due to reformatting to fit JF style guidelines (and adding a couple of paragraphs in response to referee suggestions), the paper takes more pages—so we have moved the Survey Results Appendix out of the main text appendix and into the Internet Appendix.

Note that we have submitted our zipped replication package.

Sincerely,
Michael Grubb

Appendix B. Detailed response to R1's comments

1. ***Estimation of extent of overdraft charges that could be avoided with readily available cheaper sources of liquidity.*** *The inference here has residue of the overclaiming that plagued the initial submission. To me the evidence is merely suggestive and should be presented as such, given that you are relying exclusively on different samples that may be highly selected and have not been fully vetted by peer review.*

   Response: This was a good suggestion, and we made several minor changes to implement it. Note, however, that the sample used in Financial Conduct Authority (2018c)) is not highly selected and has limited difference to our own large and representative observational sample. It is the same representative sample of 1.5 million customer accounts from the 6 largest retail banks except that it uses 2016 observations (rather than 2015) and is linked to data on customers' other accounts.

   - Introduction: We changed "implies" to "suggests" in "This suggests that alerts eliminate less than half of overdraft charges arising from frictions such as inattention rather than from optimal borrowing."
   - Results:
     - We changed the Section III.H title from "Alerts eliminate less than half of overdraft borrowing mistakes" to "Evidence suggests alerts eliminate less than half of overdraft borrowing mistakes"
     - We already use language "suggestive" and "it is likely that" in describing results. Similarly for the multi-account sample we qualify "For this sample". Hence no change to the text was needed.
   - Conclusion: We inserted "evidence suggests that" into "Moreover, evidence suggests that alerts eliminate less than half of overdraft charges arising from frictions such as inattention rather than optimal borrowing."

2. ***Exposition cleanup:***

   a. *Unarranged vs. arranged overdraft (UOD vs. AOD)*

      i. *You state that UOD and overdraft protection are synonymous, in the first para. of the paper. This is not true in the US context at least—in USA overdraft*

protection would be more akin to AOD– and so early in the paper at least I would just explain UOD as unauthorized.

Response: We deleted "or overdraft protection" from paragraph 1.

ii. *You need to provide a short summary definition of AOD when you introduce it in the Intro... without it the reader is disoriented and forced to skip ahead.*

Response: We moved text from Section 3.1 into the introduction. In particular, we removed from Section 3.1 the following text:

"An *arranged overdraft* (AOD) facility is a line of credit with a borrowing limit pre-agreed between bank and consumer, on average of about £1,000, which consumers automatically use when their account balance drops below zero. An *unarranged overdraft* (UOD) occurs when a transaction takes place that takes the consumer past their arranged overdraft limit or, if they do not have an arranged overdraft, below zero."

In the introduction, we added:

"Each alert is designed to warn of either an unpaid item (declined transaction) or one of the two types of overdraft facilities offered in the UK—arranged and unarranged. An *arranged overdraft* facility is a line of credit with a borrowing limit pre-agreed between bank and consumer, on average of about £1,000, which consumers automatically use when their current (checking) account balance drops below zero. An *unarranged overdraft* facility is used when a bank approves a transaction that takes the consumer past their arranged overdraft limit or, if they do not have an arranged overdraft, below zero."

iii. *Since high cost of OD credit is central to the motivation, you should be summarizing pricing/costs when you introduce UOD and AOD in the Intro, and providing the requisite summary details in the text in Section 3.1—the reader shouldn't have to go to the Appendix to find motivation and institutional details that are central to the paper.*

Response: We added a summary of overdraft pricing to the first paragraph of the introduction. We also moved Table 15 (now Table I) out of Appendix A into Section 3.1 (and shortened the Table footnote) along with an explanatory paragraph. This Table shows overdraft pricing at the six major UK banks close to the time of our experiments.

b. *Change "economically deprived" (first para. of paper) to "low-income" or whatever you mean here*

Response: We don't change the wording "economically deprived" because we already are saying what we mean. To clarify this, we have added "(as measured by the English Index of Multiple Deprivation)" to paragraph 1.

c. *Table 1* [Now Table II]

i. *Add AOD credit limit*

Response: Good suggestion—we followed it.

ii. **OD used should say over what timeframe in row labels*

Response: Good suggestion—we followed it.

d. *Table 2:* [now Table III] *add column for whether alert mentions charges (see below)*

Response: This would be an excellent idea were we to follow R1 suggestion 3a. However, as we explain below, we don't have the right variation in our data to pursue this suggestion. As a result, adding this column would not add value.

e. *Regression tables: "Baseline mean" would be clearer than "Baseline", if the longer label fits, formating-wise*

Response: We have followed this suggestion everywhere except in the daily-level regression tables.

f. *"Credit turnover":*

i. *"credit" is used in the accounting sense here, which is confusing. Just call this what it is: "total deposits" or better yet "total inflows".*

Response: We now use the term "account inflows" instead of "credit turnover"

ii. *Fine to motivate this as a proxy for income, but misleading to proceed to label it income (e.g., on p. 26). Just call it what it is: total inflows, or total inflows as proxy for income.*

Response: We made the suggested changes on former page 26 and considered every other usage of "income" in the paper. We made one additional change in the Concluding Discussion. There, we changed the following clause to refer to "customers with low account inflows" rather than "low income customers":

"it is clear that customers with low account inflows do benefit."
However, we left unchanged the following sentence since it bears the caveat "this suggests that":
"Altogether, this suggests that low income consumers, heavy overdrafters, and more financially vulnerable consumers who policymakers may most want to help do share in the benefits of alerts."

3. ***Clarifying motivation:***

   a. *Inattention to charges/prices, a la Gabaix and Laibson (2006 QJE) and Alan et al. You don't consider this until the Conclusion, and yes your design is more focused on treating potential inattention to balances, but you do have some alerts that mention charges. To me there is strong motivation to estimate whether there is differential effectiveness, within alert-type and bank, between charge-mentioning and not-mentioning alerts.*

   Response: This is a nice suggestion. However we lack the necessary variation to follow it. While we have variation in messages across alert-type and bank, we have none within alert-type and bank. Hence, we would not be able to make any credible comparisons.

   b. *Reminders vs. information. Strictly speaking, a reminder is about something that is already known. So a statement like "Alerts act as salient reminders by providing timely new information" strikes me as a non-sequitur.*

   Response: This is a good suggestion. We replaced "Alerts act as salient reminders by providing timely new information." with "Like alerts, reminders can draw their recipient's attention to take action." Further, we changed "alerts contain real-time information" to "alerts contain real-time information that is not already known"

   c. *Deadlines literature (fn 16): see also Bertrand et al (QJE 2010), where demand for high-cost credit increases strongly with longer deadlines*

   Response: We added a citation to Bertrand et al. (2010) to the footnote.

4. **Strongly motivated and straight-forward extensions to the analysis**

   a. *See 3a. above.*

Response: See our response to 3a. above.

b. *The heaviest overdrafters—those in the far right tail—are rightly key to the motivation, starting in the first para. of the paper. So why not focus your heterogeneous treatment effect analysis (HTEs) more on these overdrafters? E.g., if heavy overdrafting tends to persist over time, why not estimate TEs on the pretreatment heaviest overdrafters?*

Response: We already do this in the paper—see Table VIII.

c. *Overdraft avoidance through one-time actions, a la Stango and Zinman (2014)'s finding that avoidance is partly engineered by a reduction in recurring auto-debits.*

   i. *Another link to other work is that one-time actions are interesting theoretically, as they economize on atention and time costs.*

   ii. *Practically speaking, they have the added benefit of being identifiable without making strong assumptions on how action timing maps into a treatment effect; e.g., you can simply estimate ITT on (binary) measures of changes in pertinent one-time actions over a long time window.*

R1 raised this idea in their report on our first submission. In our previous response letter, we responded as follows:

> Thanks for this excellent suggestion. We looked into this and focused on three preventative measures, (1) AOD limit (the arranged overdraft borrowing limit), (2) direct debits (automatic debits for things like automatic payment of a utility bill that vary in size to match the bill), and (3) standing orders (automatic recurring transfers of a fixed size, such as a recurring automatic transfer to an investment account). For direct debits and standing orders, we looked at both the number of transactions per month and the total transactions in pounds per month. We looked to see whether enrollment in alerts led to increased AOD limits, reduced standing orders, or reduced direct debits, focusing on the average effect in the treatment period (rather than in the days around an alert). We found nothing is statistically significant (out of 30 estimates for 5 outcome variables across 6 treatments of stand-alone-alerts, only one is statistically significant at the 90% confidence level). For the AOD limit, our estimates

are fairly precise zeros in absolute terms (we can rule out average increases larger than 3 pounds). For other outcomes, we cannot rule out moderate effects. For instance, across treatments, 95% confidence intervals allow for both 3% reductions in the number of standing orders but also 2% increases in the number of standing orders. Given the limited amount we learn from these estimates, the length of the paper, and the fact that you described this comment as falling under "free disposal," we decided not to include these results in the paper. We can, of course, add them if you think it would be valuable.

We have interpreted R1 raising this issue a second time as advice to put this work into the paper. Hence we have added Section III.F.3 "Long Run Actions" and accompanying Internet Appendix G Table G.X. The text of the new "Long Run Actions" section is the following paragraph:

> The preceding analysis focuses on immediate actions customers take following an alert to resolve a low balance and avoid immediate overdraft charges. In the US, Stango and Zinman (2014) find that making overdraft fees more salient causes consumers to cancel automatic recurring withdrawals, a one-time action which helps them avoid *future* overdraft charges. In contrast, we find no statistically significant evidence that automatic enrollment into alerts prompts customers to reduce automatic recurring withdrawals or negotiate higher AOD limits. For the AOD limit, our estimates are fairly precise zeros in absolute terms (95% confidence intervals rule out average increases larger than 3 pounds). For automatic recurring withdrawals, estimates allow for moderate effects (e.g., 95% confidence intervals allow for up to a 3% reduction in the number of standing orders). See Internet Appendix G Table G.X.

Appendix C. Detailed response to R2's comments

A. *Comment 1: Clearer presentation of the treatment alerts and baseline alerts*

The primary limitation of the current presentation of the 11 treatments is that the readers must go back and forth between Figure 3, Table 2, and Table 3. I recommend that Table 2 be the focal point for the most critical aspects of the treatments, especially concerning alerts received by both the treatment and control groups. To address this, I suggest adopting a table layout as shown below to:

- *include the treatment and control alert types and display them side by side*
- *reduce the redundancy from having both the 'Bank' column and the 'Design' column.*

Treatment	Facility	Target	Threshold	Enrollment	**Treatment alerts**	**Control alerts**	Design	Standalone
1	AOD+	AOD	0	Auto	Just-in-time AOD (1a-c); Just-in-time UI (?)	Just-in-time UI (?)	A	Yes
…	…	…	…	…	…	…	…	…
8	UOD only	UOD + UI	100	Auto	Early warnings UOD/UI (5); Just-in-time UOD + UI (3/4)	Just-in-time UOD + UI (3/4)	B1	No - Incremental
9	UOD only	UOD + UI	100	Auto	Early warnings UOD/UI (5); Just-in-time UI (?)	Just-in-time UI (?)	A	No – incremental; Control alert pre-mandated
…	…	…	…	…	…	…	…	…

Indexes in the parentheses of the 'Treatment Alerts' and 'Control Alerts' columns should crossreference the message text in the current Table 3. I recommend moving Table 3 to the Appendix.

Response: Note, former Tables 2 and 3 are now Tables III and IV.

We appreciate R2's suggestion to incorporate information about alerts offered in treatment and control groups more clearly. This information was included indirectly via the "design" column, but accessing the information required cross-referencing Figure 3. We have substantially revised the table in light of R2's suggestion (now Table III). We have tried to follow the spirit of R2's comment despite not following the exact suggestion. The drawback of R2's suggestion for a "control alerts" column that list which alerts are sent to

the control group is that the important information is during what months they were sent. All control groups are eventually sent just-in-time UOD and UI alerts, as mandated by the CMA. The variation across Designs A, B1, and B2 is when those alerts begin to be sent. As an alternative, we have added two columns "UOD alert" and "UI alert" under the joint header "Baseline just-in-time alerts (messages 3,4)". In these columns we mark "Yes" if the alert was offered to the control group during the entire treatment period and "post-mandate" if the alert was only offered to the control group post-mandate (sample months 10-11). We have also reordered the columns to make the table more readable, grouping columns with information about the treatment alert under a "Treatment alert" heading.

We elected not to move the table with representative message text (now Table IV) to the appendix because we believe some readers (such as R1) find the messages to be important.

B. *Comment 2. Clarifying questions about the treatment target*

I find the definition of AOD+ confusing in the context of the RCTs. In treatments 4 & 5, the subpopulation targeted are AOD+ individuals, i.e., those with AOD, irrespective of whether they have a UOD facility. However, the treatment alert targets UOD and UI facilities. I am curious about whether the presence of a pre-treatment UOD facility makes any difference.

Response: We sympathize with R2 about the vagueness of "AOD+". Unfortunately, this vagueness is intentional to guarantee bank confidentiality. At 5 of 6 large banks, having an AOD facility implies having a UOD facility. At the 6th bank, having an AOD facility implies not having a UOD facility. We therefore cannot reveal whether customers at Banks A and B who had an AOD facility also had a UOD facility without compromising confidentiality.

Is it correct to assume that people with a UOD facility who did not opt into the alert receive the same treatment alerts as those without a UOD facility? What about individuals who opted into the alert before the treatment? Is the treatment 'incremental' in this scenario?

Some clarification in Section 3.4 would be useful.

Response: The answer to R2's second question is that no, the treatment is not

"incremental" for someone who opted into the alert before treatment. This is for two reasons, both of which we have revised the paper to clarify.

First, it does not matter whether or not a customer previously opted in to alerts because we are reporting intent-to-treat (ITT) estimates of automatic enrollment. To clarify, we have changed the first sentence of Section II.G to state, "We estimate the intent-to-treat (ITT) effect of automatic enrollment into tested alerts with a difference-in-differences specification:"

Second, an alert is only incremental if the *customer sample* was already *automatically enrolled* in another alert targeting the same charges. Our previous explanation could have been interpreted as defining incremental on a customer-by-customer basis depending on whether they were individually enrolled (either automatically or actively) in a similar alert. To clarify that we require enrollment in the similar alert to be automatic for the customer sample, we have revised the paragraph explaining "stand alone" and "incremental" in Section II.D as follows (emphasis added for the letter only):

> All tested just-in-time alerts were 'stand-alone' in the sense that at baseline customers had not been **automatically** enrolled into any other alerts that targeted the same charges. For example, just-in-time AOD alerts were tested with UOD or UI alerts present at baseline but no other AOD alerts (treatments 1 and 2). In contrast, almost all early warning alerts were 'incremental' in the sense that, at baseline, customers had already been **automatically** enrolled in just-in-time alerts that targeted the same charges. Two exceptions are treatments 3 and 9. Treatment 3 tested a stand-alone early warning AOD alert, while treatment 9 tested an early warning UOD and UI alert that was stand-alone for the first three treatment months and incremental thereafter (following experimental Design A).

The distinction between UOD and UI is not presented in a crystal clear manner. In Figure 2, these two facilities are depicted in a strict order: UOD just-in-time alerts precede UI just-in-time orders. However, the first paragraph on page 7 notes that banks have discretion over whether to proceed with a UOD or UI when a transaction exceeds the AOD limit, conditional on the existence of a UOD. This seems non-trivial given that in Design A, the just-in-time UI alert was pre-mandated, whereas the just-in-time UOD alert was mandated post the treatment.

Response: Discretion is exercised because most banks do not fix a UOD credit limit in advance. Rather they make the decision about how much credit to extend at the time of the transaction. To make it clear that the discretion is about how much credit to extend, we have revised the sentence R2 references to state

"For those with a UOD facility, such transactions are processed at the bank's discretion based on how much credit would need to be extended."

In practice, discretionary UOD limits are large enough that customers will typically get their first UOD alert before their first UI alert—hence Figure 2 is a good guide to what typically happens so we don't need to worry about reinterpreting Design A.

C. Comment 3. Heterogeneity in balance volatility

> *Table 31 in Appendix G shows the heterogeneous treatment effects in the risk of an unanticipated overdraft, measured by the coefficient of variation (CV) of the end-of-day account balance. Since balances can be negative, this variable can take negative values. The authors have chosen to focus on individuals with positive average balances and assert on page 26 and in the introduction that* 'absolute treatment effect sizes increase with the coefficient of variation.'
>
> *CV has limitations if the daily balance takes both positive and negative values, and the average is near zero. In this case, CV can be substantial even if the balance is not particularly volatile.*
>
> *Moreover, the table reveals no apparent correlation between CV and treatment effect sizes when considering individuals with average negative balances. In fact, these consumers experience the most substantial treatment effects (in absolute terms).*
>
> *I wonder if the authors could present additional results using alternative measures of unanticipated overdraft risk, such as the peak-to-trough ratio, defined as (peak value – trough value) / peak value.*

Response: We chose to follow your guidance to limit ourselves to making expositional changes and did not conduct new analysis based on the peak-to-trough ratio.

R2 notes that CV can be substantial even if the balance is not particularly volatile when the balance is near zero. This is actually the strength of CV because in this case the

customer is still highly uncertain about whether their balance will be positive or negative, and hence alerts are useful. This is why we say "account balance variability relative to balances ... could be related to the risk of an unanticipated overdraft".

R2 notes that those with a negative CV have substantial absolute treatment effects. This makes sense because we see that in Internet Appendix G Table G.II when we split the sample by average balance. Absolute treatment effects are largest for low balances because low balances are what trigger charges and the potential need for alerts. To clarify this, we have added the sentence "Note that we state this result conditional on a positive coefficient of variation because negative average balances imply high overdraft incidence irrespective of balance variability and hence absolute effect sizes are largest for those with a negative coefficient of variation."

D. Comment 4. Waterbed effects

> *The discussion about the waterbed effects is very informative, though it applies to the US setting. I wonder if the authors can find anecdotes to support that UK banks did not increase fees elsewhere and/or incur suffer millions of losses post the alert mandate.*

This is an excellent suggestion and we wish we could follow it. However, we are not aware of anecdotes worth citing. Vasilev et al. (2023) did an evaluation of the effect of the FCA's more recent 2020 regulation of overdraft prices. While they found no evidence of a waterbed effect, it could be because they did not look very hard—they only looked for waterbed effects within overdraft-related charges and did not look at the obvious possibility that banks could have increased monthly account fees. Hence, this result seems to be too uninformative to be worth adding to a footnote.

E. Comment 5. Other minor comments:

Table 4 can be moved to Appendix.

Response: Good idea, we moved the table.

It would be useful to have some summary statistics on the demographics of consumers at 95% of the overdraft usage and fees when the authors describe the distribution of the overdraft charges on page 7.

Response: We chose to follow your guidance to limit ourselves to making expositional changes and did not compute new statistics. In part, this is because we have limited demographic information (age, gender, and account inflows) and we already (1) report correlations between these variables, and (2) show how average charges vary by account-inflow bands.

Appendix D. Detailed list of additional changes

1. We removed "Days in UOD" from several sample balance tables in the appendix because this could have been informative about bank identity.

2. We updated statistics in Table II to be customer level rather than account level to be consistent with the rest of the paper. (It was an oversight that we had not done this already. The numbers change little.)

3. We updated summary statistics for the natural experiment Bank C and D samples in Internet Appendix Tables H.I and F.III to correct for two minor coding errors. The changes in numbers are small and do not affect results.

References

Bertrand, Marianne, Dean Karlan, Sendhil Mullainathan, Eldar Shafir, and Jonathan Zinman. 2010. "What's Advertising Content Worth? Evidence from a Consumer Credit Marketing Field Experiment." *The Quarterly Journal of Economics* 125 (1): 263–306. 10.1162/qjec.2010.125.1.263.

Financial Conduct Authority. 2018c. "High-Cost Credit Review: Overdrafts Consultation Paper and Policy Statement." Consultation Paper CP18/42. Accessed from FCA website at https://www.fca.org.uk/publication/consultation/cp18-42.pdf (paper) and https://www.fca.org.uk/publication/consultation/cp18-42-annexes.pdf (technical annex) on January 4, 2020.

Stango, Victor, and Jonathan Zinman. 2014. "Limited and Varying Consumer Attention: Evidence from Shocks to the Salience of Bank Overdraft Fees." *Review of Financial Studies* 27 (4): 990–1030. 10.1093/rfs/hhu008.

Vasilev, Danail, David Farmer, Richard Scott, Rory Lawless, and Benjamin Gregg. 2023. "An Evaluation of Our 2019 Overdrafts Intervention." April, https://www.fca.org.uk/publications/corporate-documents/evaluation-paper-23-1-evaluation-our-2019-overdrafts-intervention, accessed on 2023-12-06, Financial Conduct Authority Evaluation Paper 23/1.

Appendix E. Table Check list

1. Stand-alone note
2. Balance 0 note
3. variable definitions
4. acronyms (OD, ADO+,)
5. Important new info at top legend so can stop reading
6. using "Internet Appendix" prefix for Tables, FIgurse, and SEctions appropriately

Appendix F. Table List

1. Table I: created manually, no code
2. Table II: 6 bank sample stats Jaeyeong is building this in `6_desc_stats/create_panel_a_new.R`. It is output from R as `table_pca_descriptive_stat.tex`
3. Table AII: Sample means by treatment `3_regressions_new2` Sections 121–122.
4. Table IV: created manually, no code.
5. Table AI (sample deletions): "sample.construction.slim100pct" Created by `3_regressions_new2.R` section 13
6.

A. JF Table 5–6, 23–24: Main Effects

`3_regressions_new2.R` section 31-32

B. JF Table 7: CMA Table

Note: No Bacon-corrected version because that was the other bank! No r.s version because can't do cma version in that case.

`3_regressions_new2.R` section 31–32 (check)

In revision, moving this to appendix or dropping

C. Het Treatment Effects

Notes on new results.

C.1. JF Table 8: Het Effects by pretreatment charges

C.2. JF Table 33: Het Effects by age

`3_regressions_new2.R` section 41-42

C.3. JF Table 34: Het Effects by income

`3_regressions_new2.R` section 41-42

C.4. New Table: Het Effects by pre average balance

`3_regressions_new2.R` section 41-42

C.5. New Table: Het Effects by pre sd balance

`3_regressions_new2.R` section 41-42

C.6. New Table: Het Effects by pre cv.bal

`3_regressions_new2.R` section 41-42

C.7. New Table: Het Effects on n.days by pre n.days

`3_regressions_new2.R` section 41-42

C.8. New Table: Het Effects on targeted charges by targeted pre 0day

`3_regressions_new2.R` section 41-42

C.9. New Table: Het Effects on targeted charges by targeted pre n.days

`3_regressions_new2.R` section 41-42

C.10. New Table: Het Effects by pre any.log

`3_regressions_new2.R` section 41-42

C.11. New Table: Het Effects by pre in.100.target

`3_regressions_new2.R` section 41-42

C.12. New Table: Het Effects by banking facility

`3_regressions_new2.R` section 41-42

C.13. New Table: Het Effects by Close calls

`3_regressions_new2.R` section 41-42 Combines pre-od and pre-in-100 tables into one with 2 panels

D. JF Table 9: Secondary Effects

`3_regressions_new2.R` section 31-32

E. Update to only include standalone columns

F. JF Table 10: Mistakes

`3_regressions_new2.R` section 71-72

G. JF Tables 11–12: Daily Analysis

No change. [But need code] `run_analysis.R` section 6

H. JF Table 13: Alert Lead times

`3_regressions_new2.R` section 121-122 Only one version, see main text Table XII.

I. JF Table 14 and Figure 3: Nat Experiment Parallel Trends

J. JF Table 15: Multi-account manual example

No change.

K. JF Table 16 and JF Figure 4: Survey

No change.

Code: `FCA/Academic Paper/code/code archive/code files/New Survey Code/construct_surv`

Update: Now code run from analysis section 9: but would need to update data path in `construct_curvey_tables_v5.R` to its location on server (previously was `C:/Users/MattOsborne/Documents/fca/wellbeing_dataset_v5/`)

L. JF Tables 17–20: Natural Experiment Sample Balance

Tables F.III–F.III in `tables/descriptive/Nat_Expt_Summary_Tables.tex`

Bank labels are updated; no more changes unless want to re-order rows to match the update to RCT sample balance tables (which can do by hand since a row operation).

This code is now consolidated in `6_desc_stats/representative_dataset_stats_new.R` called by section 1 of `run_analysis.R`. Previously there was a separate file `transpose_appendix_tables.R`, but this is now redundant.

New versions are here (and now in main text) This version links to both manually edited old rows, and automatically created new rows. Comment in the best version.

M. JF Table 21: Observed vs. Inferred Charges

Leave unchanged. `3_regressions_new2.R` section 8

N. JF Table 22: Cox Proportional Hazard model

Update: now run-analysis Section 5

Code is in code/Various. See santander-cox-pph.R and barclays-cox-pph.R. J sent results in an excel file (email). `run_analysis.R` section 5

Ask Jay to incorporate this into a single code file that outputs latex called by run.analysis? Done.

See Academic Paper/paper output/Manual Latex Construction/cox.xlsx and cox.jfrevision.xlsx for my manual re-arrangement of columns, that is now updated in the paper as Table D.I.

O. JF Table 23–24: See above

No longer need this appendix. Commented out. (But may want to move some of its text to the main paper.)

P. JF Table 25: Descriptive Statistics

No change? Matt table Guess a combination of `6_desc_stats/representative_dataset_stats.R` and `Tables from J/transpose_appendix_tables.R` Needs integrating into code better.

Update: now `run_analysis` section 1

Update: but does not output this table. This file creates JF Tables 17–20, nat exp sample bal.

Matt's `Summary_Table_Matt.R` creates rct bank columns. This is now in `3_regression_new2.R` section 11. But where do nat exp bank columns come from? What code puts them together? Looks like `descstats_bank_weighted.tex` output by this file contains 2 rct bank columns. How do they get into `descstats_allbanks_weighted.tex`?

I see; these are put together in `Table2_Template.xlsx` in `Acadenuc Oaoer/paper output/Tables from J/`

Update: Assembled in Sec 111-112 after Bank C-D computed in `representative_dataset_stats_new.R`. To Do: Footnote/caption should clarify that mean/sd is pre-treatment - month1–6 rct, bank A is ¡2015-03-01, bank B is ¡2015-06-01. Also

clarify answers to questions below.

Q. JF Table 26: Days in Overdraft

See `tables/secondary_regressions/tqab.mitsakes.tex`. Where is code that produced this? If I made by hand where is the spreadsheet? Looks like in Google Sheet in PCA folder in "Daily Regression Results" sheet, tab "multi-frac-saved". Do we want to expand this to all baseline!=Yes ? (header.6). Okay, added code to output this table to end of Section 32. See Table G.XI

Now: `3_regressions_new2.R` section 32

R. JF Table 27–31

Need to re-order columns and have inferred/observed versions. Originally produced by Matt's code `WP/RCT-working/code/5_main_effects/Summary_Tables_Matt.R` which we just copied into `3_regressions_new2` `3_regressions_new2.R` section 11.

Update: Here is a version done with my code `3_regressions_new2.R` Section 111-112 (Matt's code is still in Section 11):

S. Threshold Effects - Monthly

T. Threshold Effects - Average 61-62

These are for collapsed data. Thresholds based on average monthly outcomes, not monthly outcomes. Latex tables have bacon and treat9 "FALSE" because correction is done at the collapse stage, not create.table.set stage.