Financial Conduct Authority

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The impact of annual summaries, text alerts and mobile apps on consumer banking behaviour

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1. Executive summary

The UK personal current account market generated £8.1 billion revenue in 2013. 94% of adults have at least one account and 40% have more than one (CMA, 2014a). Despite the market's importance and penetration, there have been ongoing public concerns about how well it functions. Two key concerns are the low transparency of overdraft charges and the low levels of switching personal current accounts.

The Office of Fair Trading (OFT) recommended that personal current account providers issue annual summaries to consumers following the OFT market study in 2008. Major banks voluntarily agreed to issue these summaries and rolled them out several years later. The government ensured that text alert services were available at major banks by March 2012 (HM, Treasury). These market initiatives were intended to help consumers understand and reduce the costs of their current account or switch to an account that better meets their needs (OFT, 2008). Over the same period, major banks also rolled out commercial services, such as mobile banking apps for smart phones.

In the context of a potential market investigation into the retail banking sector, the Financial Conduct Authority (FCA), in collaboration with the OFT, wanted to understand the impact of annual summaries, text alerts and mobile banking apps on consumers. We pin down the causal effects of these initiatives by applying econometric techniques to granular data, with over 300 million observations, from one bank and aggregated data from another bank. The current CMA market investigation makes this research even more relevant.

We show that annual summaries, as designed by the banks we looked at, have no effect on consumer behaviour in terms of incurring overdraft charges, altering balance levels or switching to other current account providers. In contrast, signing up to text alerts or mobile banking apps reduces the amount of unarranged overdraft charges incurred by 5% to 8%, and signing up to both services has an additional effect, resulting in a total reduction of 24%. The additional impact of the combination of both services shows the benefit of receiving information upon automatic triggers, without having to actively acquire it, as well as the facility to act quickly upon receiving information. Text alerts and mobile banking apps also decrease average current account balances by 17% to 24%, which is beneficial for consumers as they reduce the cost of holding balances in accounts with no (or low) credit interest. Consumers who sign up to these services are also more likely to become inactive at their bank, which we measure using the number and value of consumers' credits and debits per month. This suggests that these services facilitate banking with multiple providers.

We discuss a range of implications and questions brought forth by our findings in the conclusion of our paper, including those in relation to incentives for innovation, the role of regulation, how to design effective disclosure rules and issues to address in the regulation of personal current accounts.

Data and methodology

To infer the impact of the initiatives, we analysed monthly data on customers of two major banks in the UK over 2011 to 2014. We obtained unique account level data on a representative sample of 500,000 customers over 30 months for one bank (Bank A) and aggregated data over 36 months for another bank (Bank B), which allows us to cross-check some important results.

Because annual summaries are progressively rolled out to consumers, some people receive summaries before others. This staggered roll-out is a 'natural experiment' that allows us to estimate the impact: we can compare the behaviour of those people that receive their summaries early to those who receive them later while controlling for many other factors.

To infer the effect of text alerts and the mobile banking app on customers at Bank A, we compare the behaviour of those who sign up for these services to their own behaviour before signing up and to those who do not sign up. As customers choose whether or not to sign up, it is possible that those who do sign up (self-select) are systematically different to those who choose not to. To address this, we control for any fixed differences between those who sign up and those who do not using econometric techniques. Moreover, we control for shocks that affect customers over time and for how long customers have been with the bank. While it is not possible to control for the fact that those who sign up might do so as part of a deliberate effort to change their behaviour in relation to managing their account, it is unlikely that this is the reason for such a large number of sign-ups during our sample.

For Bank B, we use a spike in sign-up rates after the release of the mobile banking app as a natural experiment to estimate the impact. We could not analyse switching or the effect of text alerts for consumers at Bank B due to data limitations and the lack of a suitable natural experiment.

Main findings

Overall, annual summaries have:

- no effect on unarranged and arranged overdraft charges incurred
- no effect on balance levels
- no effect on switching[1] to other current account providers
- a small effect of 1.02%, annualised, on internal switching from a 7% base in the first year of receiving a summary only. The effect is mainly driven by packaged bank account holders switching to other accounts

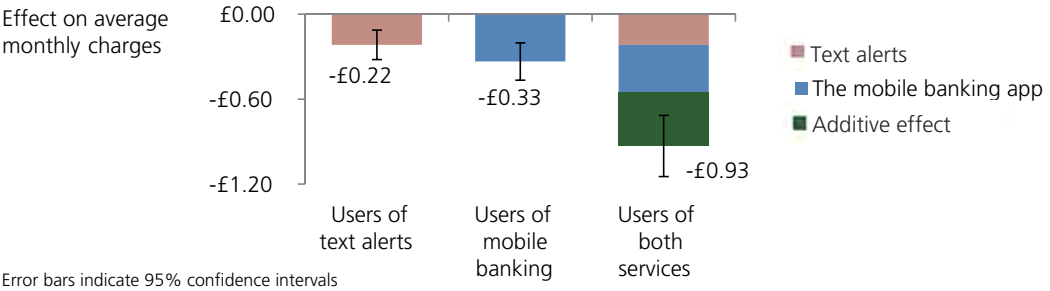
In contrast we find marked effects of text alerts and mobile banking apps. As most consumers do not incur unarranged overdraft charges, the average monthly charge seems small, e.g. £2.47 for those who can incur unarranged overdraft charges at Bank A, and changes in charges smaller still, just tens of pence. But these changes represent large amounts for those who are

1 We define three forms of switching: full switch, a switch to another provider when the old account is closed; inactivity, which is a proxy for customers who gradually move their banking elsewhere; and internal switch, which is changing account type in the same bank

charged. The percentage changes we note are relative to consumer behaviour before they sign up and the baseline is different for consumers who sign up to each service.

We find that text alerts reduce monthly unarranged overdraft charges by 6% (£0.22) for Bank A. Mobile banking apps reduce monthly unarranged overdraft charges by 8% (£0.33) for Bank A and by 5% (£0.23) for Bank B. Signing up to both services reduces monthly charges by 24% (£0.93) for Bank A, an effect greater than the sum of the individual effects of each service (an additive effect). These effects are shown in Figure 1.

Figure 1 – Impact of text alerts and the mobile app at Bank A – Unarranged overdrafts

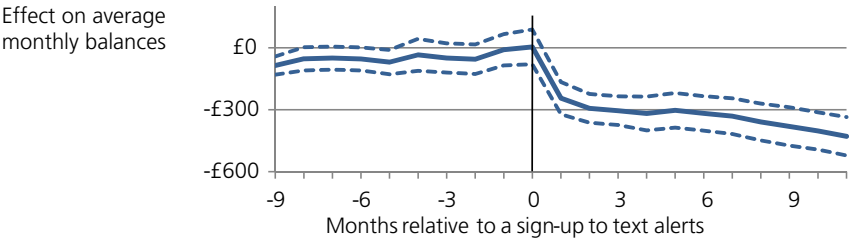


Error bars indicate 95% confidence intervals

These effects are driven by a reduced likelihood of incurring charges rather than a reduced amount of charges for those charged. 40-59 year olds and those with higher incomes see the largest reduction in unarranged overdraft charges in both absolute and percentage terms. Neither service has a significant effect on incurring arranged overdraft charges.

Text alerts reduce monthly average current account balances by 24% (£307) – see Figure 2, which shows the effect over time relative to signing up – and the mobile banking app reduces them by 17% (£170) for Bank A. Consumers may intentionally keep high balances to protect themselves from incurring overdraft charges, especially if they find the cost of paying attention to their account to be high. These services reduce the time and effort needed to monitor balances, so consumers can keep a lower buffer in their account while continuing to avoid overdraft charges and earn interest on excess balances in accounts with higher credit interest rates. The mobile app at Bank A increases monthly easy access savings balances by 7% (£318) and reduces online banking usage considerably, while text alerts have much less of an effect.

Figure 2 – Impact of text alerts at Bank A – Balance levels



Dashed lines indicate 95% confidence intervals

Text alerts and the mobile banking app at Bank A are also associated with annualised reductions of 0.2% and 0.9% for full switching, respectively, relative to a rate of 1.8% in the whole sample[2]. And annualised increases of 2.4% and 2.6% for inactivity, respectively, relative to an inactivity rate of about 7% for those who sign up to these services over the whole sample. Consumers can become inactive at their current account provider if they (partially or fully) move their banking to other providers without closing their account. Our results suggest that these services allow consumers to hold accounts with multiple providers more easily.

We also uncover a number of descriptive findings in our data:

- the amount of unarranged overdraft charges incurred first rises and then falls with age, peaking at 40-49; and increases with income
- current account balance levels increase with both age and income
- switching rates systematically decrease with age and income

Overall, we find that middle-aged consumers with higher incomes, who are arguably the busiest, tend to pay the most overdraft charges, switch the least and benefit the most from receiving timely information automatically through text alerts and having the ability to take action using mobile banking apps.

Lessons

Our results show that it can be difficult to design disclosures that help consumers navigate markets better: annual summaries have very limited impact on consumers. Testing disclosures beforehand can help ensure that they effectively achieve their intended outcomes. Where this is not possible, rigorous ex-post evaluation can be undertaken to understand the true impact of disclosures.

On the other hand, technological innovation has delivered substantial benefits to consumers, as measured by avoidance of unarranged overdraft charges, reduced balance levels, increased savings and, apparently, banking with other providers. The strong impact of text alerts and mobile banking apps together shows the benefit of receiving timely information through automatic triggers, without having to actively acquire it, as well as the facility to act quickly upon receiving information.

Future regulatory work on personal current accounts might consider the possibilities of i) targeting annual summaries to people with clear financial management issues and clear actions they could take, ii) rules to help those who have difficulty managing their finances such as making alerts opt-out, iii) understanding which aspects of technological innovation are most helpful, and iv) thinking carefully how to ensure that incentives for innovation in the personal current account market are sufficiently strong.

2 Results for full switching cannot control for differences in the characteristics of individuals and so are more likely to be caused by selection bias

2. Introduction

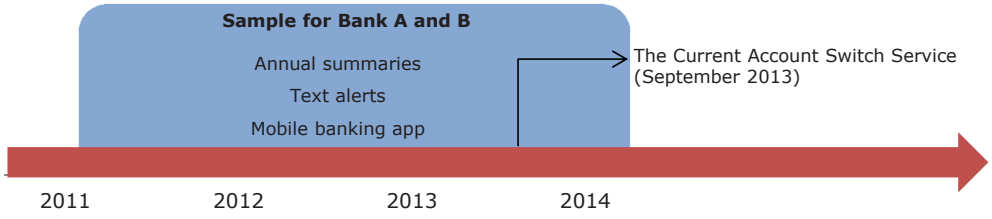
There are approximately 65 million active personal current accounts in the UK. These accounts generated £8.1 billion revenue in 2013, an average of £125 per account (CMA, 2014a). Over a number of years, the market has been subject to many reviews.[3] Two key concerns are the low transparency of overdraft charges and the low levels of switching personal current accounts.

Consumers pay little attention to the implicit costs associated with their current account. They often do not know the costs of their overdraft or understand that holding idle funds in accounts with no (or low) credit interest is also a cost (OFT, 2008). Without clear price anchors, it is difficult to quickly identify tangible gains on other accounts, discouraging shopping around and effective competition in the market. In November 2014, the CMA continued to have concerns about the effectiveness of competition and decided to launch a market investigation into the retail banking sector (CMA, 2014b).

A number of information-based remedies have already been rolled out to help consumers manage their current accounts. Following the Office of Fair Trading's (OFT) market study in 2008, banks voluntarily agreed to issue annual summaries to consumers. A government initiative ensured that text alert services were available at major banks from March 2012, although some banks had already independently introduced these services much earlier (HM Treasury, 2011). There have also been commercial developments in the industry, such as mobile banking apps for smart phones.

We examine the impacts of annual summaries, text alerts and mobile banking apps on consumer behaviour using econometric analysis of data from two large banks. We pin down the effects on consumers' overdraft charges, account balances and switching behaviour. Figure 3 illustrates the combined sample period of both banks relative to the roll-out, or a period of significant take-up, of initiatives. Some initiatives were rolled out at different points in time, which we deliberately do not show to preserve bank anonymity.

Figure 3 – Timeline of initiatives[4] relative to samples



3 Cruickshank (2000), HM treasury (2011), Independent Commission on Banking (2011), OFT (2008; 2009; 2010; 2011; 2013), CMA (2014a; 2014b)

4 We do not cite all market initiatives

The FCA is also conducting a review of the effectiveness of the Current Account Switch Service, which was introduced in September 2013. The service has a number of benefits including reducing the time it takes to switch current accounts to seven days (FCA, 2014a). Our research complements this review and helps build understanding of how initiatives are driving change in the personal current account market.

This paper illustrates the means by which data on consumer behaviour can be used to infer causation from policy initiatives, without the need for a controlled experiment. By identifying naturally occurring sources of variation where the outcome of interest is changed while other factors are held constant, impacts can be accurately estimated. Such methods can provide insights that go beyond other forms of analysis and even surpass consumers' own understanding of their behaviour (Kamenica, Mullainathan, & Thaler, 2011). For example, survey evidence can be biased if respondents are unable to articulate unconscious aspects of their decision-making or if they overestimate their actual willingness to take certain actions, such as switching current accounts.

Quantitative analysis using datasets on hundreds of thousands of people over time can provide nuanced and detailed findings. Not only can it be used to isolate the effects of different initiatives, but it can test for additional benefits of specific combinations of initiatives and understand how they complement each other. Moreover, conducting analysis on large populations can provide insights on different sub-populations e.g. different age groups; and can identify novel behaviour for rare events, such as switching bank accounts, which would not be observed frequently enough in smaller samples. Another key benefit of time series is the ability to analyse whether effects are long term in nature. Ultimately, quantitative methods and large datasets can allow regulators to develop more refined and targeted regulation.

We have written this paper, in part, to inform the CMA's ongoing market investigation into the retail banking sector – our interim results were fed into the CMA's decision to refer the market. We have also written this paper for interested policymakers, regulators, firms and consumers. We report only headline results in the main text; however, the underlying analysis is statistically rigorous and has been academically peer-reviewed. We include our econometric outputs in the annex.

We organise this paper as follows. Section three sets out supporting context to understand the impact of the initiatives. Section four describes the roll-out or take-up for the initiatives we analyse and our empirical approach to infer causality. Section five presents the results. Section six concludes.

3.
Context and descriptive statistics

This section describes the data we use for the two banks analysed. We then describe and contextualise our three main classes of outcomes: overdraft charges, balance levels and switching; and present descriptive statistics from our data.

Data sample

We use data from two large banks in the UK. We obtained a unique dataset from one bank (Bank A) comprising consumer account level data, and a more aggregated dataset from another bank (Bank B). The data from Bank A forms the basis of our analysis due to its granularity, and we use data from Bank B to cross-check our findings, where possible.

For Bank A, we observe a fully representative random sample of 500,000 customers on a monthly basis for 30 months over the 2011 to 2014 period. After data cleaning, we have over 12 million observations per variable. The sample includes detailed account level data, including current account balances, credits, debits, and overdraft charges incurred; demographic information on customers such as age; cross-product holdings, such as savings held with the bank; and customer events, such as receiving an annual summary or signing up to text alerts. We also observe when customers close their accounts and the reported reasons why, allowing us to identify a switch to another provider (although we do not observe where they switch to). We aggregate values in our data to a customer level (in cases where multiple accounts are held) for our analysis. A description of important variables can be found in Table A1 in annex B. We do not present descriptive statistics at the request of the bank.

The granular nature of the data for Bank A allows us to approximately identify customers who are active or who hold their main account with Bank A, and estimate their income after tax. The OFT (2013) find that 20% of accounts are not used regularly.[5] We tested a number of ways to classify customers as inactive and find that using information about a customer's recent incoming and outgoing transactions, and how many times they credit and debit their account was most effective and in line with expected inactivity levels from external sources. In particular, we classify customers as 'inactive' in a given month if they satisfy one or both of the following conditions:

1. the two month moving average of their monthly incoming and outgoing transactions are both below the 25th percentile (£200 and £250, respectively)

2. the two month moving average of their monthly number of credits and debits are both below the 25th percentile (1 and 4, respectively)

5 The OFT find there are 76 million accounts in the UK, of which 61 million (80%) are used regularly

Using this definition, an average of 20% of consumers are inactive in a given month during our sample period. To approximate customer income, we use the average incoming transactions for the first three months that customers are observed and classify customers into estimated monthly income groups.[6]

For Bank B, we have aggregated monthly data on all customers over a 36 month period. We observe aggregated unarranged overdraft charges, average monthly credit balances and customer events.[7] The data is aggregated by customer cohorts, which are defined by the month customers received an annual summary or signed up to the mobile banking app, resulting in two sets of data. We observe the means of these variables by customer cohorts for each month and how many customers give rise to these means. We cannot analyse switching rates due to data limitations and lack suitable exogenous variation to analyse the effects of text alerts. A description and descriptive statistics of important variables for Bank B can be found in Table A2 in Annex B.

Overdrafts

An overdraft is a way for consumers to use their current account to borrow money from their bank. An unarranged overdraft charge occurs when a customer's balance falls below zero or an agreed limit, at which point the bank may extend credit to the customer. An arranged overdraft charge occurs when a bank extends credit to a customer up to an agreed limit. Overdrafts can be useful for emergencies or short term borrowing.

The CMA (2014a) estimates that 36.1% of personal current account revenue is from overdrafts. The OFT (2010) compared the cost of borrowing £100 over a month with different forms of high-cost credit and found unarranged overdrafts were the second most expensive, with an average cost of £37.[8] Which? (2011) made a similar comparison and found that borrowing £100 for one month using unarranged overdrafts can cost between £21 and £186, depending on the institution. More recently, many banks have reduced the cost of their unarranged overdraft charges and implemented a small buffer zone within which overdraft charges would not be levied to help consumers manage their accounts.

Traditional economic models assume that consumers evaluate their decisions based on the costs and benefits associated with their available choices. Under this model, consumers would only use expensive forms of credit if the benefits outweighed the costs (including the cost of time and cognitive effort to actively manage accounts). However, survey evidence suggests the most common reasons for incurring unarranged overdraft charges are consumer mistakes and misiming transactions (OFT, 2008; Jigsaw Research, 2014).

Evidence of consumers making behavioural errors in the personal current account market is well documented. Limited attention reduces consumers' ability to process information and keep track of current account balances (Grubb & Osborne, 2015; Grubb 2015); overconfidence makes consumers underestimate the likelihood of incurring overdraft charges in the future (Armstrong & Vickers, 2012); and present bias causes consumers to sharply discount future utility for immediate gratification (OFT, 2010). Behavioural biases can also cause less sophisticated consumers to pay more than others, effectively cross-subsidising the more sophisticated (Erta, Hunt, Iscenko, & Brambley, 2013; Ussher, Quinn, & Rotik, 2014). At the extreme, the FCA

6 The reason we only use the first three months is to classify consumers before the roll-out of initiatives
7 Average credit balance is defined as the average balance for days the account was in credit
8 The most expensive was home credit

(2014e) found that 1% of customers generate over a quarter of total overdraft revenue for some firms.

Stango and Zinman (2014) find that over 50% of U.S. overdraft charges are avoidable by using alternative accounts with available liquidity (including credit cards) and the reason that 60% of consumers incurred an unarranged overdraft charge was because they thought there was enough money in their account. They also find that shocks to consumer attention temporarily help them avoid overdraft charges, and repeated shocks cause sustained improvements. Grubb (2015) finds that requiring firms to disclose information about prices at the point of sale would help inattentive consumers by ending their cross-subsidisation of attentive consumers and increase competition.

During our 30 month sample period at Bank A, 32% of customers incurred an unarranged overdraft charge at least once. Every month, between 5% and 9% of customers were charged at both banks. The average monthly unarranged overdraft charge per customer (across all customers, i.e. those who do incur overdraft charges are those who do not) is £2.47 for Bank A and £1.95 for Bank B.[9]

Figure 4 provides a breakdown of average monthly unarranged overdraft charges by age and estimated monthly income group at Bank A for active customers. As our measure of income is correlated with account activity, analysing active customers gives a more representative description of consumers. On average, the amount of unarranged overdraft charges incurred:

- first rises and then falls with age, peaking at 40-49
- increases with income

Figure 4 –Unarranged overdraft charges averaged by age and income groups (£/month)

Age group

Estimated monthly income	18-29	30-39	40-49	50-59	60-69	70+	Average
<£500	1.75	2.91	2.82	2.09	1.04	0.40	1.86
£500-£1000	2.77	3.71	3.44	2.50	1.08	0.45	2.18
£1000-£1500	3.33	4.55	4.19	3.29	1.30	0.52	2.79
£1500-£2000	3.58	4.76	4.74	3.28	1.35	0.37	3.15
£2000-£3500	3.62	4.83	5.17	3.46	1.25	0.48	3.53
£3500+	3.10	4.55	4.94	3.07	1.37	0.65	3.34
Average	2.82	4.32	4.40	3.01	1.23	0.47	2.81

One explanation for this distribution could be that consumers aged 30-49 with higher incomes tend to be among the busiest, leaving little time to manage their finances. Moreover, these consumers may find that overdraft charges are a smaller percentage of their income compared to other consumers and do not find it worth paying attention to their current account in favour of saving valuable time. We also note that if we included consumers who hold basic bank accounts (who cannot incur unarranged overdraft charges) in the sample to calculate these

9 For our analysis on overdrafts for Bank A, we only analyse consumers who can incur unarranged overdraft charges. Our samples for Bank A and Bank B are therefore not directly comparable

averages, the results would be further skewed towards consumers in higher income groups as basic bank account holders tend to have lower incomes.

Balance levels

The CMA (2014a) estimates that 39.7% of personal current account revenue is from net credit interest (applied to consumer balances). Consumers typically understand that bank charges are a cost. It is less well understood that the amount of interest foregone is also a cost of personal current accounts. This is the difference between what a consumer earns in credit interest from their current account and what they could earn holding the same money in a savings account or a current account with a higher interest rate.

The OFT's 2008 market study found that only 7% of consumers saw credit interest rates as important when shopping around for a current account. They also found that nearly 8% of consumers held an average balance of more than £5,000, suggesting that consumers underestimate the benefits of switching to a current account with a higher credit interest rate or transferring excess funds in to a savings accounts (OFT, 2013).

Consumers can intentionally keep high balances to protect themselves from incurring unarranged overdraft charges, especially if they find the costs of paying attention and actively managing their account to be high. Holding high balances is, in part, a measure taken to mitigate the costs of poor account management.

In our sample for Bank A, 1% of customer-months have an average monthly balance of over £23,324 and 5% have over £8,259. Table 1 presents descriptive statistics for the average monthly balance for Bank A and the average monthly credit balance for Bank B. For Bank A, we also find that balance levels increase with age and estimated monthly income, although we do not present these results to preserve bank anonymity.

Table 1 – Descriptive statistics of balance levels

	Average balance **Bank A**	Average credit balance[10] **Bank B**
Mean	£1,905	£2,812
Standard deviation	£7,203	£14,088

Switching

The CMA (2014a) estimates that 3% of consumers switched personal current accounts in 2013.[11] This level is much lower than other markets such as credit cards and mortgages. Existing studies outline three hypotheses for the low levels of switching for current accounts: obscure costs make accounts hard to compare and reduce the perceived benefits of switching; consumers

10 The average monthly balance is calculated as the mean of a customer's balances across accounts whereas the average credit balance is the mean across a customer's accounts for the days his account was in credit

11 This includes all forms of switching between banks. They found that (full) switching to other banks using the Current Account Switch Service (and its predecessor) was 1.8% for active accounts

do not trust the switching process to work well; and consumers are generally happy with their account (Consumer Focus, 2010; CMA, 2014a).

If consumers are unsatisfied with their account and do not switch to accounts that better meet their needs, banks can charge higher prices and offer poor quality service without the threat of losing customers to their rivals. Which? (2014a) find that several of the biggest banks have relatively poor customer satisfaction ratings compared to smaller banks. Despite this, they find that incumbent banks still retain high levels of market share which they argue is symptomatic of a lack of effective competition in the market. They also find that some customers would be hundreds of pounds better off within months if they switch banks (Which? 2014b).

Behavioural biases affect consumer decisions to switch current accounts. Limited attention reduces consumers' ability to process information when comparing accounts and present bias causes consumers to sharply discount future streams of benefits from switching accounts for smaller short terms gains (OFT, 2010). Consumers also demonstrate considerable inertia through little switching away from past choices or default options (OFT, 2008). This is particularly true when there are multiple prices to compare (e.g. credit interest rates, unarranged and arranged overdraft charges and monthly fees) and when consumers have limited experience shopping around in the market.

The FCA's previous research has shown that sending reminders to consumers or subtle changes to the presentation of information can have large effects on encouraging consumers to switch accounts and respond to letter mail. In a field trial, sending well-timed reminder letters boosted switching rates by 8% when bonus interest rate periods expired in the cash savings market (Adams, Hunt, Vale & Zaliauskas, 2015). In a consumer redress trial, changing the salience of information in redress letters boosted response rates by 250% (Adams and Hunt, 2013).

We analyse three forms of switching for customers at Bank A, as shown in Table 2. Our measure of inactivity captures customers who i) switch from the bank without closing their account and ii) customers who use current accounts at multiple banks. We note that this inactivity measure is an upper bound for the underlying switching rate as customers can reduce their activity with their bank for a number of other reasons, such as an extended holiday, and can occur several times for one customer.

Table 2 – Measures of switching

Full switch	If a switch to another provider occurs and the old account is closed
Inactivity	If a customer becomes inactive while maintaining an account
Internal switch[12]	If a customer changes account type within Bank A

We calculate the average monthly switching rates for each type of switch and report the annualised rates in Table 3. As the rates are calculated over a 30 month period, they are largely representative of the period before the Current Account Switch Service was introduced. Our measure of inactivity is higher than Internal switching, which is much higher than full switching.

12 These switches include customers who opted in or out of overdraft facilities. We approximate customer initiated internal switches by excluding possible switches due to a change in circumstance, such as a student account switch

Table 3 –Switching rates (annualised) for Bank A

Full switch	Inactivity	Internal switch
1.81%	11.4%	7.02%

Figure 5 provides a breakdown of annualised full switching rates by age and estimated income for all consumers over the sample period. We find a very similar pattern for inactivity (we do not present it for the sake of brevity). We find that switching to other providers:

- decreases with age
- decreases with income
- the exception are 18-29 year olds with the highest income, who switch the most

Figure 5 – Full switching rates by age and income group, annualised (%)

	Age group						
Estimated monthly income	18-29	30-39	40-49	50-59	60-69	70+	Average
<£500	3.23	3.28	2.47	2.10	2.22	2.16	2.75
£500-£1000	2.78	2.41	1.64	1.06	0.80	0.76	1.62
£1000-£1500	2.36	2.15	1.62	1.15	0.82	0.65	1.47
£1500-£2000	2.00	1.95	1.25	0.83	0.59	0.43	1.21
£2000-£3500	2.12	1.59	1.09	0.79	0.72	0.64	1.14
£3500+	3.89	1.34	0.83	0.63	0.54	0.54	0.96
Average	2.91	2.37	1.62	1.24	1.10	1.03	1.81

4. Empirical approach

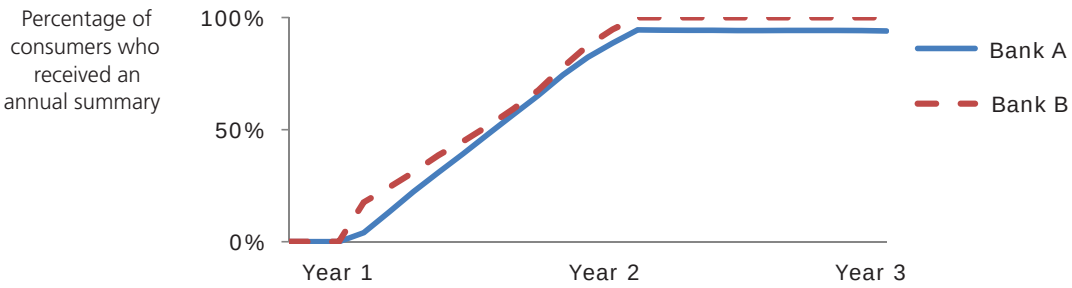
This section describes the three market initiatives we analyse: annual summaries, text alerts and mobile banking apps. We provide details on how they were rolled out or adopted by consumers. We then explain the methodology used to estimate the impact on consumer behaviour.

The roll-out of annual summaries

Annual summaries were intended to remind consumers of the costs and benefits of their current account. They provide a breakdown of any overdraft charges incurred and the amount of credit and debit interest accrued over the last 12 months. Some banks also include information on average credit balances. By focusing consumers' attention on the costs of their account, the reminder was intended to help consumers improve how they manage their finances through reducing unarranged overdraft charges, lowering average balances or switching to an account that better meets their needs (OFT, 2013b).

Annual summaries were rolled out to consumers on the anniversary of their account opening. The annual timing of delivery was intended to provide something akin to a natural break point for a current account contract, which is currently not available (OFT, 2013a). Figure 6 shows the roll-out of annual summaries to consumers from both banks over time. The penetration increases fairly linearly which reflects account opening dates being broadly evenly spread throughout the year.[13,14]

Figure 6 – The roll-out of annual summaries



Our empirical approach relies on the staggered distribution mechanism of annual summaries. If the month during a particular year that consumers previously opened their account is not related to expected changes in consumer behaviour (over and above changes we can control for), then the month they receive an annual summary is also unrelated. This enables a comparison of

13 Calendar dates are not shown to preserve bank anonymity
14 For Bank B, we do not consider customers who join the bank after the start of the roll-out of annual summaries in our analysis (which is why it reaches 100% penetration after one year).

outcomes before and after consumers receive annual summaries, with those who have not yet received them, allowing us to estimate the causal impact.

There are small systematic differences between consumers in relation to the timing of receipt of annual summaries. Students open up more accounts around university start dates, so receive more annual summaries during these dates; and consumers who join the bank after the initial roll-out will not receive an annual summary until their first account anniversary while other consumers will have already received theirs. Using data from the period before the roll-out of annual summaries, we tested for statistically significant differences between the 12 groups of consumers who receive their summaries in the first year of the roll-out. Table A3 in Annex B shows that average balances and overdraft charges incurred are largely balanced across the 12 groups for both banks although there are some statistically significant differences.

The data we have for Bank A allows us to use econometric techniques to control for fixed differences between consumers and for the number of months they have been with the bank (using panel data individual fixed effects and fixed effects for the number of months consumers have been with the bank). The number of months consumers have been with the bank is highly correlated with age (because of the low switching rates), so we are also effectively controlling for changes in outcomes over consumer lifetimes. This is important when assessing overdraft charges because they first rise and then fall with age. We also control for time trends and shocks that commonly affect consumers, such as changes to bank charging structures and macroeconomic shocks (using calendar month fixed effects). These controls allow us to account for the differences between consumers in relation to the timing of receipt of annual summaries so we can accurately estimate the causal impact.

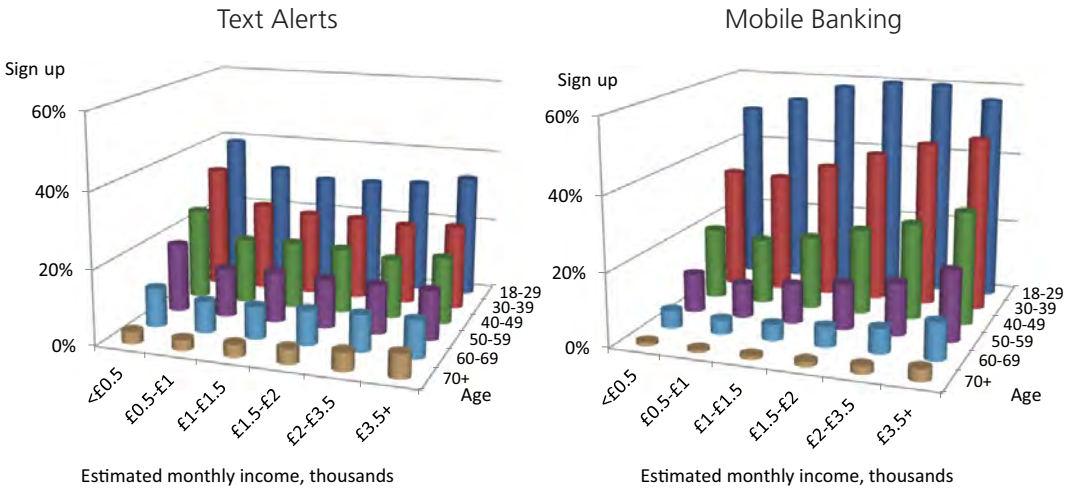
Take-up of text alerts and mobile banking apps

Consumers can sign up to receive regular or event driven text alerts to their phone with information on their balance levels and account charges. For example, a text alert could be sent ahead of an impending overdraft charge or regularly with account balance information, reminding consumers to take action at relevant times. These alerts were intended to help consumers avoid unarranged overdraft charges and improve control over balance levels (HM Treasury, 2011). All personal current account providers offer text alert services to their customers free of charge and some now automatically enrol consumers into the service (OFT, 2013). In our analysis, we consider consumers to be signed up to text alerts if they sign up to any text alert, including regular balance alerts and alerts that are sent upon automatic triggers (e.g. a low balance alert).

Mobile banking apps for smart phones offer an alternative interface for engaging with current accounts. They allow consumers to spend, save and check their balances on-the-go. This functionality means that consumers can quickly rectify shortfalls of funds in their current account by transferring money, if other funds are available. As a result, consumers may be able to exert better control over incurring unarranged overdraft charges and their balance levels.

Towards the end of the sample period for Bank A and Bank B, mobile banking app sign-up rates were over 20%. For Bank A, over 15% were signed to text alerts and 7% were signed up to both. Figure 7 shows the large variation in mobile banking app and text alert sign up rates by age and estimated monthly income groups for active customers at Bank A towards the end of our sample period. Younger customers have a higher tendency to sign up to both services, and particularly to mobile banking. We also find that consumers with higher estimated incomes have higher sign-up rates to mobile banking.

Figure 7 – Sign-up rates by age and estimated monthly income for active customers

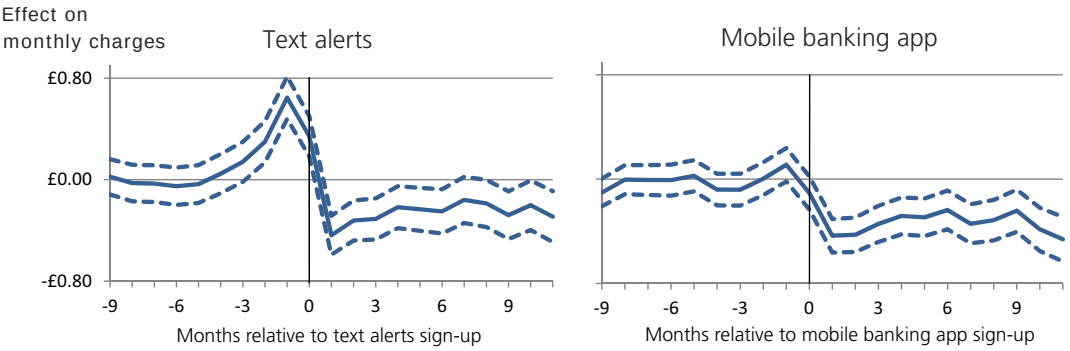


A key challenge for assessing the impact of text alerts and mobile banking apps on consumers relates to selection biases. Consumers who sign up to these services are systematically different to those who do not. However, we control for fixed differences between consumers using econometric techniques (panel data individual fixed effects). This allows us to identify common changes in outcomes for consumers who sign up to these services, and compare these changes to outcomes for those who do not sign up, despite their fixed differences. Moreover, we control for time trends and the number of months consumers have been with the bank (using time fixed effects and fixed effects for the number of months consumers have been with the bank).

Consumers can actively sign up to these services because of their previous behaviour. For example, a consumer may sign up to text alerts because they recently incurred an overdraft charge or because they made an independent decision to put their finances in order. Therefore, changes in outcomes before and after a sign-up might not be caused by the service but by the recent overdraft charge or by their decision. Such selection issues may lead to biased results provided they are sufficiently strong. Using the controls discussed above, we present the statistical output of the change in unarranged overdraft charges nine months before and after signing up to text alerts and the mobile banking app in Figure 8 (including a dummy variable for ten months after signing up). On average, we find that consumers tend to incur more charges leading up to a text alert sign-up (but not for the mobile banking app).[15]

15 We find that the amount of charges incurred from three months prior to a text alert sign-up is statistically significant

Figure 8 – Unarranged overdraft charges relative to signing up for Bank A (Table A11)



Dashed lines indicate 95% confidence internals

Changes in outcomes immediately after a sign-up may reflect a consumer's reaction to incurring a recent overdraft charge (which could be the reason for the sign up) or other changes in behaviour not caused by the sign up. We also understand that a number of consumers are signed up automatically to text alerts at Bank A, although we cannot identify these. To infer causation from text alerts and the mobile banking app for Bank A, we use the controls discussed above and we include additional controls for the four months leading up to a sign-up and two months after (using dummy variables). The effects of the services (which are presented in the next section) on those who signed up is given by the change in outcomes after two months of signing up (using a dummy variable). We tested controlling for different numbers months leading up to a sign-up and chose four months because we find statistically significant effects from three months prior to a sign-up, as shown in Figure 8. Beyond the factors that we can control for in our analysis, we assume that any residual changes in behaviour are caused by signing up to the services in question rather than consumers independently changing their behaviour after they sign up. This assumption is reasonable given the large number of sign-ups during our sample period in a short space of time. It is unlikely that many customers are suddenly and independently altering their behaviour while signing up without these services affecting their behaviour directly. Although our approach addresses the issue of selection bias to an extent, we acknowledge that it still has some limitations.

For Bank B, there was a significant spike in sign-up rates after the release of the mobile banking app which occurred during the sample period. Since the release of the app is not determined by the user, we can exploit it to identify the causal impact of the app. The rationale is as follows. It is very unlikely that a large group of users independently decided to install the app during a given month, and that this month happened to coincide with the month the app was released. Therefore, it is likely that changes in behaviour for these users are caused by the app. To estimate the impact, we analyse users who signed up to the app shortly after its release.[16] While we expect our estimated impacts to be accurately estimated, these are short term impacts on consumers (as opposed to our estimated effects on consumers at Bank A, which represent longer terms effects).

16 Specifically, we ended the analysis period four months after the release of the app

5. Results

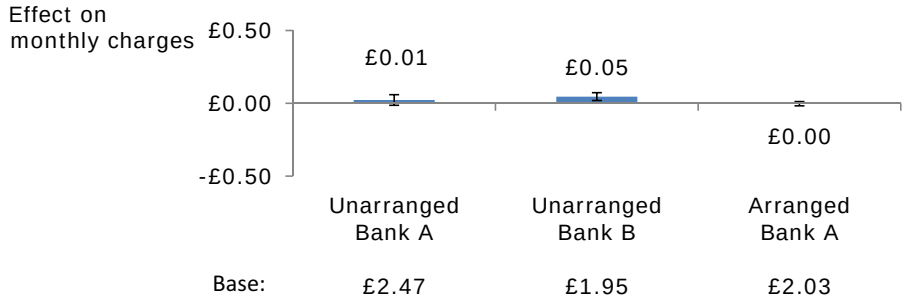
This section first presents our findings in relation to the impact of annual summaries. We then show our findings on the impact of text alerts and mobile banking apps on consumers.

The impact of annual summaries

We begin by analysing the causal effect of annual summaries on the amount of unarranged and arranged overdraft charges consumers incur. Figure 9 represents the statistical results: the thick bars indicate the magnitude of the effect, the error bars indicate 95% confidence intervals, and the average charge per month (the baseline) is presented at the bottom of the chart. If the error bars are entirely displaced from £0, we can say with 95% confidence that there was an effect. For each estimate, we analyse consumers who can incur the relevant overdraft charge, making our results representative of the impact on consumers, for those it can impact.

We find no statistically significant effects on unarranged and arranged overdraft charges for consumers at Bank A (Tables A4 and A5).[17] For those at Bank B, we find a small but statistically significant increase of £0.05 (+2.6% from the average) in unarranged overdraft charges; however, we suspect this may be due to the imperfection of the staggered roll-out of annual summaries and data sample limitations, as we cannot control for dissimilarities between consumers or the amount of time they have been with the bank (Table A6). We do not observe arranged overdraft charges for consumers at Bank B.

Figure 9 – Effect of annual summaries on overdrafts (Table A4, A5 and A6)



Error bars indicate 95% confidence intervals

To check the robustness of our result for Bank A, we also analyse the effect on unarranged overdrafts by age and estimated income groups, and the number of days spent in arranged and unarranged overdraft per month (Tables A4 and A5). Assessing the impact on the number

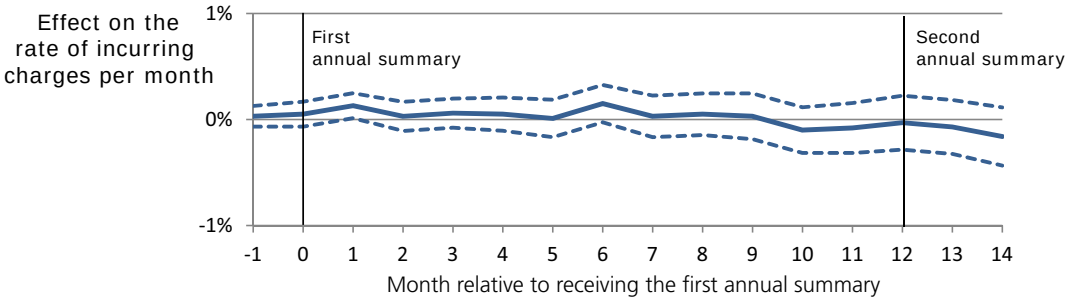
17 In Table A4 in equation (2), we find a small but statistically significant effect of £0.03 at the 10% level, but once we use fixed effects for the number of months consumers have been with their bank (to control for customers who join after the roll-out) we find no effect

of days consumers spend in overdraft per month evaluates changes to underlying consumer account management independent of overdraft pricing structures. We find no statistically significant effects at the 5% level in all cases.

As the distribution of overdraft charges is highly skewed, a small number of consumers incurring many charges could shift the average significantly. To account for this, we tested our model on the probability of incurring overdraft charges per month (extensive margin) and conditional on incurring a charge during a month, the amount incurred (intensive margin) for Bank A (Table A4). We find no relevant effects.[18]

We also analyse the impacts on active customers. Figure 10 illustrates the change in probability of incurring unarranged overdraft charges per month relative to receiving a first annual summary. The base probability here is between 5% and 9%. The solid line represents the effect of the annual summary for each month and the dashed lines represent 95% confidence intervals. Again, we find no important effects.[19]

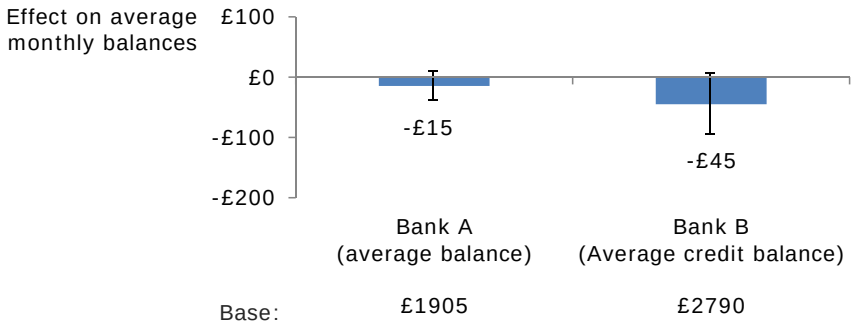
Figure 10 – Effect of annual summaries on incurring unarranged overdraft charges (Table A10)



Dashed lines indicate 95% confidence intervals

The next step of our analysis assesses the effects of annual summaries on average balances for Bank A and average credit balance for Bank B, as shown by Figure 11 (Tables A5 and A6). We find no statistically significant effects in either case. For Bank A, we also tested the effects on minimum and maximum monthly current account balances, and easy access savings balance held with Bank A. The only effect we find is a very small reduction in maximum balances of £55, or 2.41% decrease from the base.[20]

Figure 11 – Effect of annual summaries on balance levels (Table A5 and A6)



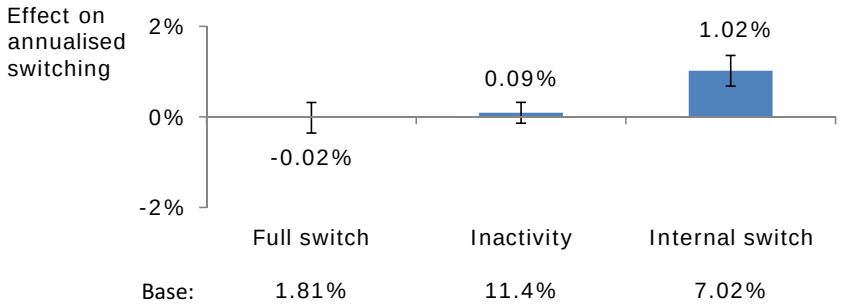
Error bars indicate 95% confidence intervals

18 We find a very small statistically significant increase of 0.1% in the probability of incurring charges per month in equation (3) and a statistically insignificant effect on the intensive margin (after log transforming unarranged overdraft charges to account for the skew)
19 We do not directly observe consumers receiving their second annual summary, but we make the assumption that they do
20 This result is only statistically significant at the 5% level, and we have tested multiple hypothesis without adjusting standard errors

To assess the impact on inactivity and internal switching, we adopt a similar approach as previously described – we use information on how customers alter their activity levels or switch accounts within the bank before and after they receive summaries. We also control for those who frequently become inactive (using individual fixed effects). However, we cannot compare how customers' full switching behaviour changes before and after they receive summaries with data from one bank as summaries are not sent after customers close their account. Instead, we analyse the impact on the time it takes for customers to switch using the Cox Proportional Hazard (CPH) model.[21] The model evaluates the effect on the probability of switching (the hazard) in a given month, given that a customer did not switch up until that month (since opening their account).

Our analysis shows that annual summaries have no statistically significant effects on full switching or inactivity, as shown in Figure 12 (see Tables A7 and A8).[22] Our results are robust to a number of controls, including incurring recent overdraft charges. However, we find a statistically significant increase in monthly internal switching rates of 0.085% or an annualised 1.02%. As we zoom in to the effects for different consumer groups, we find that the effect was mainly driven by packaged bank account holders, who switched by an additional 0.102% per month or 1.23% annualised (Table A8). The principle flows of internal switching during our sample period were towards non-packaged bank accounts. We also find an effect of 0.04% per month or an annualised 0.76% on internal switching for non-packaged bank account holders.

Figure 12 – Effect of annual summaries on switching (Table A7 and A8)



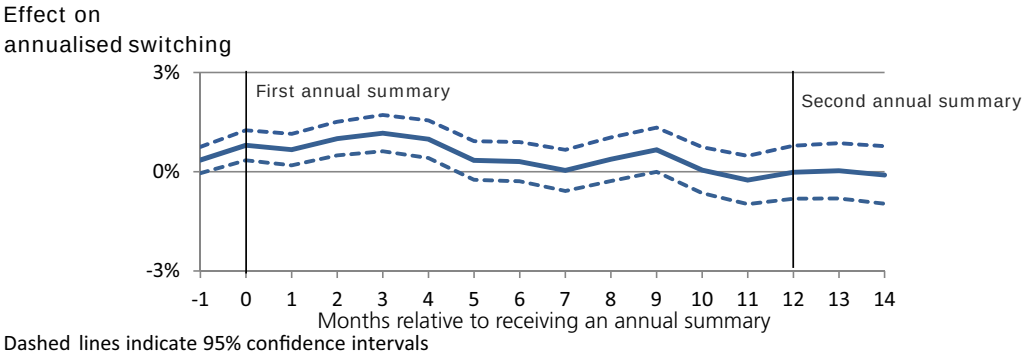
Error bars indicate 95% confidence intervals

Figure 13 illustrates the change in the probability of internal switching caused by annual summaries over time relative to receiving a first annual summary. We uncover a statistically significant effect for four months after receiving an annual summary which peaks at 0.13%, or 1.2% annualised, in the third month – a short term effect. We do not find an effect for the second annual summary (Table A10).

21 This is a well-recognised statistical technique for analysing survival data. We present hazard ratios in Table A7, which are the ratio between the switching rate if an annual summary is received and the baseline switching rate

22 We stratify the Cox Proportional Hazard model by age band to account for different baseline hazards (probability of switching without receiving an annual summary) between age groups. We also run a linear probability model as a robustness check and to confirm that the CPH model is appropriate

Figure 13 –Effect of annual summaries on internal switching (Table A10)



Dashed lines indicate 95% confidence intervals

Overall, we find a near-zero impact of annual summaries on driving change in consumer decision-making in the personal current account market for the outcomes we could observe. We expect the main reasons for this to be related to the infrequent distribution, the timing of delivery and the information contained within the summary that implies no clear action. Moreover, the consumers who, on average, incur the most charges and switch the least (as documented in section three) are consumers over 40 years old and those with higher incomes – who are also arguably the busiest. The FCA's previous research shows that middle-aged consumers are the least likely to respond to redress letters, which may suggest that these consumers may also be the least likely to engage with this form of disclosure (Adams & Hunt, 2013).

It is also worth contrasting what consumers thought of annual summaries. The OFT (2013) estimated that around 58% of current account holders had received an annual summary although their consumer survey showed that only 26% of all respondents said they had received one. 15% of those that received an annual summary felt it helped a great deal in understanding the costs and benefits of their current account, 48% said it helped somewhat and 35% found that summaries were not helpful at all.

We acknowledge that we do not observe other outcomes such as changes in customer satisfaction, complaints or insurance claims on packaged bank accounts, which may have been affected by annual summaries. It is also possible that there may be longer term effects beyond our sample end dates. However, we do not suspect this to be the case as we observe no obvious trend.

The impact of text alerts and mobile banking apps

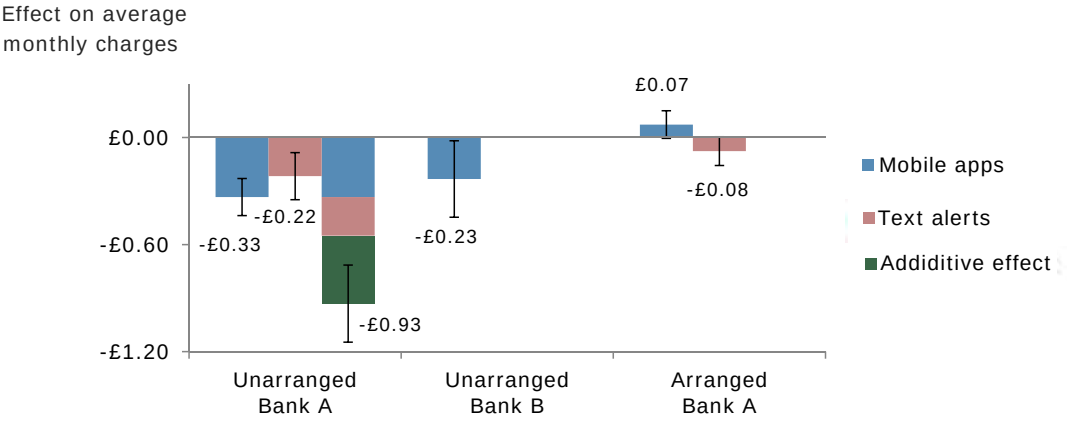
We begin by estimating the impact of text alerts and mobile banking apps on the amount of overdraft charges consumers incur.[23] As the vast majority of consumers do not incur unarranged overdraft charges during a given month, small changes in average charges for the sample can represent large effects for consumers who do incur charges. To put our results in perspective, we report the percentage changes in average charges from consumer behaviour before they sign up.[24] While we can control for the differences between the consumers who do and do not sign up in our analysis, the effects we estimate are for those who sign up and may not extrapolate well to the rest of the population.

23 We constrain our sample to active accounts. This ensures that our results are not contaminated by changes in outcomes (or lack of changes) for inactive accounts, which may have been signed up automatically to text alerts

24 The point estimates are in pound amounts. The percentages are calculated as the point estimate over the average charge for consumers who signed up to the relevant services before they signed up

For consumers at Bank A, we find a statistically significant reduction in monthly unarranged overdraft charges of 8% (£0.33) for the mobile banking app and 6% (£0.22) for text alerts, as shown in Figure 14. Consumers who sign up to both services enjoy an additional (additive) effect of 10% (£0.38) reducing charges even further than the sum of the individual effects of each service, resulting in a total reduction of 24% (£0.93) for these consumers (Table A12). The additive effect is indicated by the green area in Figure 14.[25] The additional impact of the combination of both services shows the benefit of receiving timely information automatically (through text alerts), without having to actively acquire it, as well as having the facility to act quickly upon receiving information (using the mobile banking app). We find no statistically significant effects on arranged overdraft charges at the 5% level for using either service. For Bank B, we find a reduction of 5% (£0.23) for signing up to the mobile banking app on unarranged overdraft charges. We could not assess the effects of text alerts for Bank B due to the lack of a suitable natural experiment.

Figure 14 – Effect of text alerts and mobile banking apps on overdrafts (Table A6 and A12)



Error bars indicate 95% confidence intervals

The effects are mainly driven by a reduced probability of incurring unarranged overdraft charges: the mobile banking app reduces the monthly rate of incurring unarranged overdraft charges by 0.83% and text alerts reduces the rate by 0.36% (Table A12). Signing up to both services leads to a total reduction of 2.51% from a baseline of 16% for these consumers before they sign up, which is equivalent to a 15% reduction in the probability compared to before they sign up. We only find a small effect for the mobile banking app on the amount of charges incurred conditional on being charged in a given month, and no effect for text alerts.

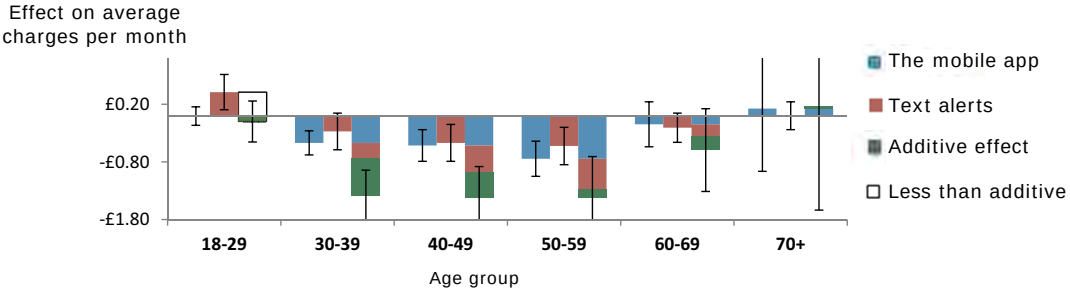
We developed our analysis by looking at the effects of signing up to these services on monthly unarranged overdraft charges by age and estimated income group for Bank A. We present the results on age groups in Figure 15 – for each age group the first bar is the effect for those who sign up to the mobile app, the second bar is for those who sign up to text alerts and the third is for those who sign up to both services. We find:

- the mobile app has large effects on 30-59 year olds, with 50-59 year olds experiencing the largest relative and absolute reduction of 19% (£0.75)

25 The confidence intervals for the addictive effect in Figure 14 show a statistically significant effect if the error bar is entirely displaced from the base of the additive effect

- text alerts has large effects on consumers aged 40-59, with 50-59 year olds experiencing the largest relative and absolute reduction of 14% (£0.52)
- signing up to both services has the largest effect on 30-39 year olds, a total reduction of 28% (£1.38)
- we find a small increase in average charges for 18-29 year olds who sign up to text alerts, although a small amount of residual selection bias likely drives this effect.[26]

Figure 15 – Effect on unarranged overdraft charges by age group (Table A13)



Error bars indicate 95% confidence intervals

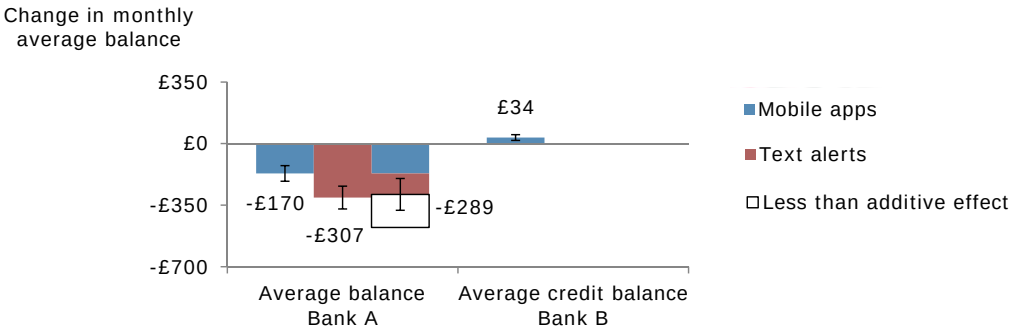
We also assessed the effect by estimated income group (Table A14). We find:

- The mobile banking app has the largest effect on the highest estimated income group, a reduction of 13% (£0.59)
- Text alerts has the largest effect on mid-income groups, a reduction of 13% (£0.50) for the £1500-£2000 estimated monthly income group
- Signing up to both services has the largest effect on higher income groups, a total reduction of 28% (£1.46) for the £2000-£2500 estimated monthly income group

We also analyse the effects of text alerts and the mobile banking app on average monthly balances levels. For Bank A, we find statistically significant effects of a reduction of 17% (£170) from the mobile banking app and 24% (£307) from text alerts. We also find an effect that is less than the sum of the individual effects of each service (a less than additive effect) for consumers who signed up to both services, leading to a total average decrease of £289, as shown by Figure 16. For Bank B, we only find a small increase of £34 for the mobile banking app, however, this is a short term effect whereas our effects from Bank A reflect longer term changes in balances.

26 A possible explanation for this result relates to overdraft usage increasing with age for this age group. While we control for fixed dissimilarities between consumers, the amount of time they have been with the bank and time trends, it is possible that those who sign up to text alerts increase their overdraft use at a faster rate than others, driving the effect

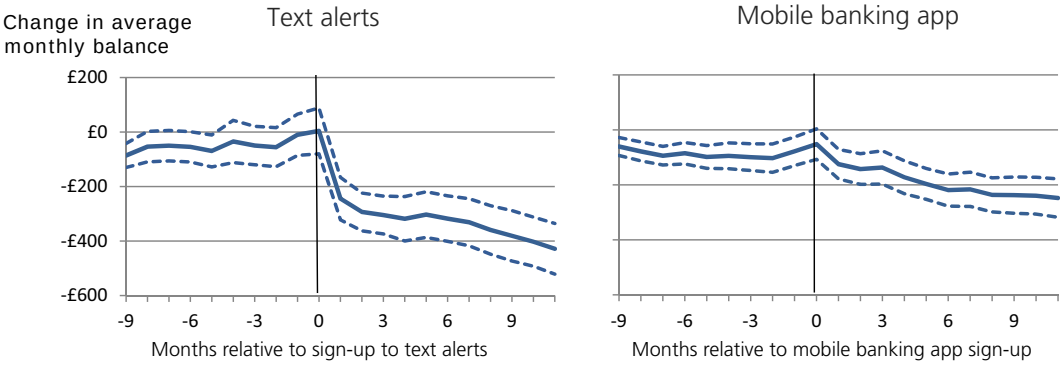
Figure 16 – Effect on balance levels (Table A15)



Error bars indicate 95% confidence intervals

Figure 17 shows the effects of these services on average balances over time relative to signing up. On average, consumers who sign up to text alerts experience an immediate fall in average balances of £244, which continues to slide to £428 over a period of 11 months. On the other hand, consumers who sign up to mobile banking experience a more gradual fall in average balances, which fall by £248 over 11 months. A reduction in balances is beneficial for consumers as they reduce interest foregone – the cost of holding idle funds in current accounts with no (or low) credit interest. If these services make it easier for consumers to keep track of their balances, consumers may require less of a buffer to avoid incurring charges. We cannot directly observe whether consumers move funds to accounts with higher interest rates outside of Bank A or if funds are moved to accounts where they are instantly accessible.

Figure 17 – Effects over time on average balance levels for Bank A (Table A11)



Dashed lines indicate 95% confidence internals

However, we find that the mobile banking app has a statistically significant effect on increasing monthly easy access savings balance by 7% or £317 (Table A15), but we did not find a statistically significant effect for text alerts. The mobile banking app also increases the number of times consumers debit their accounts per month by 3.7 and decreases the likelihood of using online banking in a given month by 30% (Table A16). For text alerts, we find a statistically significant increase of 1.3 in the number of time consumers debit their accounts per month and an increase of 4% in the likelihood of using online banking during a given month. These results are summarised in Table 4. We find no important effects for using both services together.

Table 4 – Other relevant effects of the mobile app and text alerts (Table A15 and A16)

	Mobile app	Text alerts
Easy access savings	+£317	No effect
Debits per month	+3.7	+1.3
Credits per month	+1.32	+0.36
Online banking usage	-30%	+4%

As discussed in section 4, consumers who use the mobile banking app and text alerts are systematically different to those who do not. We could control for these fixed differences using econometric techniques for our previous analysis, however, it is less straight forward to do so for an analysis on switching. Consumers may only conduct one full switch in our sample, so we cannot control for consumers who are more likely to switch than others. However, we can establish correlations between switching and signing up to these services.

We find that signing up to the mobile banking app and text alerts is negatively correlated with full switching, and positively correlated with inactivity and internal switching, as shown in Table 5 (the rates are annualised). Consumers who sign up to these services may be less likely to conduct a full switch because the services help them reduce their overdraft charges incurred and grant increased control over balances. Alternatively, these services may impose additional effort costs on consumers to switch if they have become accustomed to using these services from a specific bank. The increased rates of inactivity suggest that consumers find it easier to bank at multiple banks once they sign up to these services.

Table 5 – Correlations with measures of switching (Table A17)[27]

	Mobile app	Text alerts
Full switching	-0.9%	-0.2%
Inactivity	+2.6%	+2.4%
Internal switching	+2.7%	No effect

Overall, our findings suggest that consumers exert more control over their accounts after signing up to the mobile banking app and text alerts. The increased control is evidenced by lower average current account balances while reducing the amount of unarranged overdraft charges incurred. The additional impact of the combination of both services on unarranged overdraft charges shows the benefit of receiving information upon automatic triggers (receiving text alerts), without having to actively acquire it, as well as the facility to act quickly upon receiving timely information (using the mobile banking app). We draw conclusions and the lessons we can learn from our research in the next section.

27 Switching rates are annualised

6. Conclusion and lessons

In the two banks we studied, we find that the introduction of annual summaries – a regulatory-driven innovation – had no important effect on the behaviour of customers. However, text alerts – a commercially developed and regulatory-backed innovation – led to substantial decreases in the amount of unarranged overdraft charges incurred and balance levels. This shows that consumers were able to improve their account management substantially using text alerts. Mobile apps – a purely commercially-driven innovation – also led to decreases in the amount of overdraft charges incurred and balance levels, among other impacts. The combination of both text alerts and mobile apps was particularly powerful: the combined effect on the amount of overdraft charges incurred is much bigger than the sum of the effect for each initiative individually. We also find consumers that sign up for text alerts and mobile apps are less likely to switch and close their account but more likely to become inactive, which captures switching without closing their account or using multiple banks. So these technological innovations appear to allow consumers to use multiple banks more easily.[28]

We can understand more about why certain initiatives were effective by comparing their different characteristics. Although some considered that annual summaries had had a positive impact on the market, the lack of any impact may not be surprising with the benefit of hindsight. Annual summaries consist of several pages of information and imply no clear action. Furthermore, their timing is based arbitrarily on the anniversary of the account opening date rather than more salient events. Hence, we might expect that many customers would not have the time, ability or willingness to read them and take action.

In contrast, text alerts provide information either regularly (e.g. weekly) or upon certain important triggers (e.g. when a balance has gone below a certain level). Hence, if consumers' balance levels are too low or high, they can adjust their balances in a timely manner. Consumers do not need to decide actively to retrieve information; they receive it automatically at relevant times.

Mobile apps have two roles: they are a potential source of information if customers decide to acquire it actively, and they facilitate immediate action in response to information. Because the combination of text alerts and mobile apps impacts unarranged overdrafts significantly more than mobile apps alone, our results suggest that receiving information automatically is an effective way to drive change in behaviour. Because the combination impacts overdrafts significantly more than text alerts alone, our results suggest that it is also important that customers have the facility to act quickly upon receiving timely information. Having to log into online banking, forgetting or other difficulties in acting must impede the impact of text alerts. Hence, text alerts and the mobile app together allow for better account monitoring and management.

28 While there are some caveats to our results for text alerts and mobile apps, we control for the most concerning form of selection bias, differences across individuals, using fixed effects. An exception is our regressions on consumers switching and closing their account and internal switching where we cannot use these controls.

As discussed, recent academic research provides evidence that much of the use of high-cost unarranged overdrafts represent mistakes by consumers (e.g. Stango and Zinman, 2014). Our results suggest that at least 24% of these charges are unintentional (for consumers who sign up to text alerts and the mobile app) in a sense that they were due to a mistake, limited attention or a preference to not actively manage accounts rather than an underlying desire for credit. This observation highlights an important question for further research: to what extent can further technological innovation or product redesign reduce overdraft usage, high balances or help consumers to shop around? These innovations might take a number of forms e.g. providers might project forward their customers' likely expenditure until their next pay cheque and provide early warnings of overdraft use or give consumers information about their account at the point of transacting.

This paper describes useful examples to consider when there are sufficient incentives for firms to develop and provide new technology and innovation, though we cannot directly provide answers to hypotheses about this topic. It appears plausible that an agreement between the banks and authorities was needed to ensure a wide roll out of text alerts. However, we know that the technological opportunity provided by mobile apps did foster commercial innovation. Why did one technology lead to widespread business change without intervention and one not? Do consumers always demand technology and innovation in their interests or might some types, e.g. text alerts, be insufficiently cogent? These are open but important questions.

Our negative findings in relation to annual summaries chime with other evidence that suggests that financial product disclosure can be ineffective. There has been some scepticism amongst some academics about the role of disclosure in helping consumers make better decisions when choosing and using financial products (e.g. Campbell et al, 2011; Bubb and Pildes, 2014; and Ben-Shahar and Schneider, 2014). However, there is also evidence that disclosure can be effective in some situations (e.g. Sunstein, 2013; Bar-Gill, 2012). For example, the FCA recently published research that finds that disclosure in the savings market can play a useful role in reminding consumers that their interest rates are about to fall (Adams et al, 2015).

We can and should question how disclosure rules or regulations on communication or service provision more generally can be made more effective. This is a considerable area of focus for the FCA[29] and other regulators. Further research on the following areas would be beneficial to understand better the role of information in consumer decisions:

Tailored annual summaries or other communications:
It may be possible to design annual summaries, or alerts with recommendations to see debt counsellors say, that are useful for some people. These targeted communications might be more effective if they were sent only to customers who were clearly having financial management problems, e.g. persistent and expensive use of unarranged overdrafts, and if there were clear actions that a consumer could take, e.g. arrange an overdraft. Research in this area, ongoing consumer testing, standardised terminology and our upcoming discussion paper (which looks at how firms can effectively communicate with consumers) may help annual summaries to be as effective as possible. By way of example, a new form of summary document is being introduced at EU level by the Payment Accounts Directive and the FCA is taking this opportunity to test possible terminology for use in the document with consumers. In addition, the European Banking Authority is mandated to perform consumer testing of a draft standardised template on which the summary will be provided.

29 We will soon publish a discussion paper exploring how we and the industry can work together to improve the information consumers receive about the financial products and services they are considering buying or already have.

Other ways to target specific groups:
One aspect that this paper only addressed in part is whether a redesign of technology and information provision could help some groups of consumers more than others. Many think that it may be more helpful not to think of financial consumers in demographic groups but rather as groups of individuals defined by underlying behavioural characteristics (e.g. see Usher, Quinn & Rotik, 2014). For example, some individuals in particular may have greater difficulty with managing their finances. It may be that text alerts that require consumers to actively sign up primarily help those that are already quite good at managing their finances. Certain groups may benefit from receiving text alerts by default, and need to opt-out, rather than needing to opt-in.

Another significant issue is what measures can help those without smartphones or those less technically able, the 'digitally excluded'. What possibilities, for example, are there for technology based on non-smart phones to help these people?

Refining rules on provision of services:
For text alerts it would be possible to understand exactly which aspects of the service are most useful for consumers. For example, there may be a distinction between what consumers actively demand and what they actually find useful in practice. We might find that integrating receipt of information upon automatic triggers into mobile apps through push notifications allows for even better consumer outcomes than separate text alerts. Or we might find that multi-channel communication, as with the combination of text alerts and mobile apps, is most effective for consumers. It is possible for rules to mandate that firms provide services that are useful for consumers as default if demand is not sufficient to incentivise firms to supply them. Of course, here as elsewhere, regulators should be sufficiently mindful of the potential for rules to inhibit entry or impede the ability of small firms to compete.

Incentives for innovation in the interest of consumers:
Overall, regulators need to think carefully about the incentives that exist for innovation in the market and whether these are sufficient. Regulators need to consider what the public sector can do to enhance such incentives without making rules for firms. Providing information publicly for consumers and for organisations such as Which? on the comparative levels of service of different institutions (e.g. information on the functionality available on mobile apps and user experiences of the different aspects) might stimulate innovation, if the market cannot adequately provide such information itself. Regulators can also work to reduce the costs of entry and provide incentives for challenger institutions to develop disruptive new technology in the interests of consumers. The FCA's Project Innovate is an example of an initiative by a regulator specifically designed to support the development of useful innovation in financial services.[30]

After-the-fact analysis is one good way to test policies, though as in this paper, this may require advanced empirical techniques to pin down impacts. But another possibility is the use of randomised controlled trials in collaboration with firms to see, for example, which of a range of disclosure policies best achieves the outcomes for consumers. The FCA has recently opened up the opportunity for firms to collaborate with it on testing communications in order to make sure that our rules are more effective – greater benefits for consumers, lower costs for firms, or both – and it has invited firms to approach it to work together.[31]

30 http://www.fca.org.uk/firms/firm-types/project-innovate
31 http://www.fca.org.uk/firms/firm-types/project-innovate/test-ideas

Annex A
econometric specifications

Annual summary fixed effects panel data regression for Bank A

$$\boldsymbol{X_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{AS_{i,t}\beta} + \boldsymbol{\theta_t} + \boldsymbol{\theta_i} + \boldsymbol{\theta_k} + \boldsymbol{\varepsilon_{it}}$$

Where $\boldsymbol{X_{i,t}}$ are outcome variables (such as overdraft charges or average monthly balances) for individual $\boldsymbol{i}$ in month $\boldsymbol{t}$, $\boldsymbol{AS_{i,t}}$ is a dummy variable that takes value 1 if individual $\boldsymbol{i}$ has received their first annual summary in month $\boldsymbol{t}$, $\boldsymbol{\theta_t}$ are calendar time fixed effects, $\boldsymbol{\theta_i}$ are individual fixed effects and $\boldsymbol{\theta_k}$ are months with bank fixed effects.

Annual summary fixed effects panel data regression over time for Bank A

$$\boldsymbol{X_{i,t}} = \boldsymbol{\alpha_i} + \sum_{l=-1}^{15} \boldsymbol{AS_{i,t}^{l}\,\beta} + \boldsymbol{AS_{i,t}^{>15}\,\beta} + \boldsymbol{\theta_t} + \boldsymbol{\theta_i} + \boldsymbol{\theta_k} + \boldsymbol{\varepsilon_{it}}$$

Where $\boldsymbol{X_{i,t}}$ are outcome variables, $\boldsymbol{AS_{i,t}^{l}}$ is a dummy variable that takes value 1 if individual $\boldsymbol{i}$ receives their first annual summary $\boldsymbol{l}$ months from month $\boldsymbol{t}$, $\boldsymbol{\theta_t}$ are calendar time fixed effects, $\boldsymbol{\theta_i}$ are individual fixed effects and $\boldsymbol{\theta_k}$ are months with bank fixed effects.

Stratified Cox Proportional Hazard model for Bank A

$$\boldsymbol{h_i(t,\,X) = h_{0i}(t)\exp\left(\beta_1 AS_{i,t} + Controls_{i,t}^{j}\beta_j + \theta_t\gamma_k\right)}$$

Where $\boldsymbol{h_i(t)}$ is the hazard when customers have been with the bank for t months for age group $\boldsymbol{i}$, $\boldsymbol{h_{0i}(t)}$ is the baseline hazard at $\mathbf{t}$ months with bank for age group $\boldsymbol{i}$, $\boldsymbol{AS_{i,t}}$ is a dummy variable that takes value 1 if individual $\boldsymbol{i}$ has received their first annual summary at $\boldsymbol{t}$ months with the bank and $\boldsymbol{\theta_t}$ are calendar time fixed effects.

Mobile banking app and text alerts fixed effects panel data regression for Bank A

$$X_{i,t} = \alpha_i + \sum_{l=-4}^{2} M_{i,t}^{l}\beta + \sum_{l=-4}^{2} T_{i,t}^{l}\beta + \sum_{l=-4}^{2} T * M_{i,t}^{l}\beta + M_{i,t}^{>2}\beta + T_{i,t}^{>2}\beta + T * M_{i,t}^{>2}\beta + \theta_i + \theta_t + \theta_k + \varepsilon_{it}$$

Where $X_{i,t}$ are outcome variables, $M_{i,t}^{l}$ is a dummy variable that takes value 1 if customer i signs up to the mobile app l months from month t. $T_{i,t}^{l}$ and $M * T_{i,t}^{l}$ are similar variables as $M_{i,t}^{l}$ except for signing up to text alerts and to both services, respectively. θ_t are calendar time fixed effects, θ_i are individual fixed effects and θ_k are months with bank fixed effects.

Annual summary and mobile banking app panel data regression for Bank B

$$X_{i,t} = \alpha_i + Initiative_{i,t}\beta + +\theta_t + \theta_i + \varepsilon_{it}$$

Where $X_{i,t}$ are aggregated outcome variables for consumer cohort i (as described in section 3) in month t. $Initiative_{i,t}$ is a dummy variable that takes value 1 if the cohort is signed up to either annual summaries or the mobile app in month t depending on the analysis. θ_t are calendar time fixed effects and θ_i are individual fixed effects.

Annex B tables

Table A1 – Description of variables for Bank A

This table presents a brief description of the variables used in our analysis for Bank A. Variables are defined and observed on a monthly basis.

Variable	Unit	Description
Events		
Annual summary	Binary	If a customer has received their first annual summary
Mobile	Binary	If a customer has signed up to the mobile banking app
Text	Binary	If a customer has signed up to any text alert
Interaction	Binary	If a customer has signed up to text alerts and the mobile banking app
Online banking usage	Binary	If a customer uses online banking during the month
Overdrafts		
Unarranged OD	£/month	Value of unarranged overdraft charges paid
Arranged OD	£/month	Value of debit interest applied to balances in debit (negative balances)
Total OD	£/month	This is the sum of unarranged OD and arranged OD
Incurred unarranged	Binary	If a customer incurred an unarranged overdraft charge during the month
Unarranged OD 3 months	Binary	If a customer incurred an unarranged OD in the last 3 months
Arranged OD 3 months	Binary	If a customer incurred an arranged OD in the last 3 months
High Unarranged OD 3 months	Binary	If a customer incurred an unarranged OD of over £50 during a month, in the last 3 months
High Arranged OD 3 months	Binary	If a customer incurred an arranged OD of over £50 during a month, in the last 3 months
Days in arranged overdraft	Days/ month	Number of days in arranged overdraft per month
Days in unarranged overdraft	Days/ month	Number of days in unarranged overdraft per month
Days in total overdraft	Days/ month	Number of days in arranged and unarranged overdraft per month

Variable	Unit	Description
Transaction data		
Number of debits	No./ month	Number of debits per month (Customer generated transfers only)
Number of credits	No./ month	Number of credits per month (Customer generated transfers only)
Debit turnover	£/month	Value of debits per month (excludes 1st party internal transfers).
Credit turnover	£/month	Value of credits per month (excludes 1st party internal transfers)
Average balance	£/month	Average of customers' current account balances across their accounts during the month
Maximum balance	£/month	Maximum current account balance across customers' accounts during the month
Minimum balance	£/month	Minimum current account balance across customers' accounts during the month
Easy access savings	£/month	Average monthly easy access savings balance that the customer holds with Bank A
Other		
Packaged bank account	Binary	If a customer held a packaged bank account in the first month they are observed
Inactive	Binary	Takes value 1 if the two month moving average of credit and debit turnover are below the 25th percentile (£200 and £250) or if the number of credits and debits are below the 25th percentile (1 and 4)
Inactivity	Binary	If a customer becomes inactive (which may occur multiple times)
Full switch	Binary	If a customer conducts a full switch from the bank and closes their accounts in the process
Internal switch	Binary	If a customer changes account type within Bank A
Tenure	Months	The number of months a customer has been with Bank A

Table A2 – Description of variables and descriptive statistics for Bank B

This table provides a description of the variables used in the analysis for Bank B. There are two sets of data: one with customer cohorts that receive annual summaries and one with customer cohorts that sign up to mobile banking. The cohorts are defined by the month they receive an annual summary for the first dataset and the month they sign up to the mobile banking app for the second dataset. The underlying variables are averaged for each cohort every month for 36 months. For each cohort we observe how many customers give rise to the averages for every month. The descriptive statistics are weighted by the average number of customers in each cohort.

Variable	Unit	Description
Unarranged OD B	£/month	Averaged value unarranged overdraft charges by customer cohort
Credit balance B	£/month	Averaged credit balances by customer cohort
Annual summary B	Binary	If cohort a has received an annual summary
Mobile sign up B	Binary	If cohort a has signed up to mobile banking

Annual summaries

For the data used to analyse the effects of annual summaries, variables are aggregated by the month that customers receive an annual summary. The sample we use consists only of the 12 customer cohorts that receive annual summaries during the year annual summaries were rolled out. Descriptive statistics are weighted by the number of customers in each cohort.

Variable	Units	Mean
Unarranged OD – AS B	£/month	1.95
Credit balance – AS B	£/month	2790

The mobile banking app

For the data used to analyse the effects of the mobile banking app, variables are aggregated by the month consumer cohorts sign up. The sample consists only of customers who signed up during the sample period.

Variable	Units	Mean
Unarranged OD – Mob B	£/month	4.69
Credit balance – Mob B	£/month	1586

Table A3 – Annual summary pre-treatment balance of outcome variables

This table shows OLS regressions of variables on dummy variables for the main groups of consumers that received annual summaries using pre-annual summaries observations for Bank A and Bank B. Annual summary groups are defined by the month consumers receive an annual summary during the roll-out. Wald tests on the equality of 11 annual summary group coefficients are performed and the F-tests and p-values are presented below (the 12th group is dropped).

	Bank A			Bank B	
	(1)	(2)	(3)	(4)	(5)
Annual summary group	Average balance	Unarranged OD	Arranged OD	Credit balance – AS B	Unarranged OD – AS B
Group 1	-89.99	1.2816***	0.9002***	1,792.4042***	-0.7917***
	(59.32)	(0.1145)	(0.0805)	(23.6079)	(0.0779)
Group 2	26.41	0.5337***	0.4315***	-67.3142**	0.0192
	(59.05)	(0.0842)	(0.0575)	(27.8244)	(0.0918)
Group 3	13.35	0.6273***	0.3524***	221.2618***	-0.0933
	(53.53)	(0.0849)	(0.0549)	(27.4192)	(0.0904)
Group 4	29.74	0.5090***	0.3791***	501.0311***	-0.2075**
	(52.84)	(0.0855)	(0.0611)	(27.0033)	(0.0890)
Group 5	86.99	0.3574***	0.2704***	-0.0070	0.0242
	(57.45)	(0.0841)	(0.0559)	(28.0594)	(0.0925)
Group 6	-46.76	0.2639***	0.1947***	33.5974	0.1025
	(55.47)	(0.0815)	(0.0550)	(27.4771)	(0.0906)
Group 7	-107.25**	0.2902***	0.2481***	5.9487	0.1242
	(51.73)	(0.0822)	(0.0579)	(27.0702)	(0.0893)
Group 8	-82.85	0.0480	0.1425***	21.5387	0.0858
	(53.66)	(0.0794)	(0.0512)	(26.5285)	(0.0875)
Group 9	-59.93	0.0190	0.3392***	-84.7052***	0.1133
	(53.86)	(0.0771)	(0.0518)	(25.4499)	(0.0839)
Group 10	27.24	0.0514	0.1715***	-56.8016**	0.0392
	(55.23)	(0.0807)	(0.0525)	(25.7839)	(0.0850)
Group 11	109.08*	0.1066	0.1081*	-142.3760***	0.1583*
	(59.38)	(0.0871)	(0.0571)	(27.2688)	(0.0899)
Constant	1,789.45***	2.2467***	1.0655***	2,207.1659***	2.0242***
	(44.47)	(0.0592)	(0.040018)	(20.7576)	(0.0685)
F-test	5.1	24.44	16.14	2087.13	44.34
Prob>F	0.00	0.00	0.00	0.00	0.00
Observations (m=millions)	1m – 2m	1m – 2m	1m – 2m	144	144
R-squared	0.000	0.001	0.001	0.994	0.772
Sample	Pre-treatment observations	Pre-treatment observations	Pre-treatment observations	Pre-treatment observations	Pre-treatment observations

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A4 –Effects of annual summaries on unarranged overdraft charges for Bank A

These tables report OLS estimates of unarranged OD on annual summary for Bank A. The sample only includes customers who can incur unarranged overdraft charges. Equation (1) is the only equation that presents results without tenure fixed effects. Equation (4)-(5) present results using the sample of months where unarranged overdraft charges were incurred. All regressions have individual and calendar time fixed effects. Panel B and Panel C present the results by age group and estimated income group. Standard errors are clustered by customers. We present ranges for the number of observations to preserve bank anonymity.

Panel A

	(1) Unarranged OD	(2) Unarranged OD	(3) Incurred unarranged	(4) Unarranged OD	(5) ln(Unarranged OD)
Annual summary	0.0306*	0.0078	0.0011***	-0.324623**	-0.001033
	(0.0160)	(0.0191)	(0.0004)	(0.155553)	(0.003815)
Constant	2.6593***	2.3165***	0.0411***	22.352689***	2.906772***
	(0.0155)	(0.4185)	(0.0120)	(3.097221)	(0.085921)
Observations, millions	10 -13	10 - 13	10 - 13	0.3 -1.5	0.3 -1.5
R-squared	0.001	0.001	0.001	0.005	0.004
Tenure FE	No	Yes	Yes	Yes	Yes
Individual and time FE	Yes	Yes	Yes	Yes	Yes

Panel B

	(6) Unarranged OD	(7) Unarranged OD	(8) Unarranged OD	(9) Unarranged OD	(10) Unarranged OD	(11) Unarranged OD
Age group	**18-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70+**
Annual summary	0.0872*	0.0039	-0.0115	-0.0145	0.0116	-0.0182
	(0.0503)	(0.0561)	(0.0551)	(0.0505)	(0.0357)	(0.0210)
Constant	1.0388***	0.4907	2.2707**	2.6065*	-0.4895	0.0914
	(0.3517)	(0.7543)	(1.1544)	(1.3299)	(1.1453)	(0.8270)
Observations, millions	1.5 - 2.1	1.5 - 2.1	1.5 - 2.1	1.5 - 2.1	1.5 - 2.1	1.5 - 2.1
R-squared	0.002	0.001	0.001	0.001	0.001	0.000
Individual, time and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel C

	(12) Unarranged OD	(13) Unarranged OD	(14) Unarranged OD	(15) Unarranged OD	(16) Unarranged OD	(17) Unarranged OD
Estimated Income group, thousands	**<£0.5**	**£0.5-£1**	**£1-£1.5**	**£1.5-£2**	**£2--£3.5**	**>£3.5**
Annual summary	0.0097	-0.0055	-0.0966*	0.0902	0.0052	-0.0433
	(0.0258)	(0.0456)	(0.0517)	(0.0646)	(0.0577)	(0.0632)
Constant	-0.1112	3.1936***	3.3242***	7.3670***	3.8593**	6.9120***
	(0.3792)	(0.9822)	(1.2071)	(1.6611)	(1.5586)	(1.8825)
Observations, millions	3 - 4	1.1 – 1.7	1.1 – 1.7	1.1 – 1.7	1.1 – 1.7	1.1 – 1.7
R-squared	0.001	0.001	0.001	0.002	0.002	0.001
Individual, time and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5 – Effects of annual summaries on overdrafts and balance levels for Bank A

These tables report OLS estimates of variables on annual summary for Bank A. Time, individual and tenure fixed effects are used and errors are clustered by customers. The sample includes only customers who can incur the relevant overdraft charges for (1)-(5) and the whole sample for (6)-(9). We present ranges for the number of observations to preserve bank anonymity.

Panel A

	(1) Arranged overdraft	(2) Total overdraft	(3) Days in unarranged overdraft	(4) Days in arranged overdraft	(5) Days in total overdraft
Annual summary	-0.002595	-0.0014	0.0083	0.0137	0.0141
	(0.013773)	(0.0230)	(0.0086)	(0.0163)	(0.0135)
Constant	1.243104***	3.2913***	-1.8814***	2.7104***	1.0125***
	(0.299439)	(0.4654)	(0.1413)	(0.3370)	(0.2290)
Observations, millions	4 – 9	10 -13	10 -13	4 – 9	10 -13
R-squared	0.001	0.001	0.004	0.005	0.006
Individual, time and tenure FE	Yes	Yes	Yes	Yes	Yes

Panel B

	(6) Average Balance	(7) Maximum Balance	(8) Minimum Balance	(9) Savings Balance
Annual summary	-14.558668	-55.377142**	-0.821578	-51.879288
	(12.476640)	(23.672623)	(10.382559)	(51.899806)
Constant	2,728.21***	2,302.47***	2,343.99***	8,113.05***
	(156.110055)	(585.692624)	(111.080848)	(539.203687)
Observations, millions	10 -13	10 -13	10 -13	10 -13
R-squared	0.001	0.000	0.002	0.000
Individual, time and tenure FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A6 – Effects of annual summaries and the mobile banking app for Bank B

This table reports Weighted OLS estimates of Unarranged OD AS B and Credit balance AS B on annual summary B and mobile sign up B for Bank B. The grouped data is weighted by the square root of group size. Panel A shows the effects of annual summaries on Unarranged OD AS B and credit balance AS B. They include cohort fixed effects and errors are clustered by cohort. Panel B shows the effects of mobile sign-up on unarranged OD Mob B and Credit balance Mob B. The sample ends four months after the release of the mobile banking app.

Panel A

	(1) Unarranged OD AS B	(2) Credit balance AS B
Annual summary B	0.0459***	-44.81
	(0.0095)	(25.6979)
Constant	1.7167***	2,523.49***
	(0.0182)	(32.5893)
Observations	432	432
R-squared	0.903	0.926
Number of cohorts	12	12
Cohort and time FE	Yes	Yes

Panel B

	(1) Unarranged OD Mob B	(2) Credit balance Mob B
Mobile sign up B	-0.2325**	34.3535***
	(0.1092)	(8.3528)
Constant	3.8998***	1,411.0100***
	(0.0410)	(5.7899)
Observations	200 - 800	200 - 800
R-squared	0.914	0.839
Cohort and time FE	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A7 – Effects of annual summaries on full switching for Bank A

These tables report the effects of annual summaries on full switching rates for Bank A. Panel A shows hazard ratios using the Cox Proportional Hazard model stratified by age group on the duration before a full switch. The analysis time is the number of months customers are with the bank and is estimated using calendar month fixed effects. Specification (2) shows the effects on packaged bank account holders using an interaction term. Panel B shows OLS estimates (linear probability model) of full switching on annual summary. The model includes age bands as controls and in (2), interaction terms of age bands with annual summary. The model is estimated using months with bank and calendar month fixed effects.

Panel A – Cox proportional hazard model

	(1) Full switch	(2) Full switch	(3) Full switch
Annual summary	0.9949	0.9783	0.9823
	(0.030)	(0.031)	(0.029)
Unarranged OD 3 months			0.8216***
			(0.019)
Arranged OD 3 months			1.5845***
			(0.037)
High Unarranged OD 3 months			2.2380***
			(0.093)
High Arranged OD 3 months			1.1576
			(0.121)
Packaged bank accounts		1.3945***	
		(0.051)	
Annual summary* Packaged bank accounts		0.9647	
		(0.040)	
Observations, millions	10-13	10-13	10-13
Stratified by age band	Yes	Yes	Yes
Calendar time FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B – Linear probability model

	(1) Full switch	(2) Full switch
Annual summary	-0.000012	0.000002
	(0.000045)	(0.000070)
Age ==18-29	0.000325***	0.000398***
	(0.000050)	(0.000089)
Age ==30-39	0.000351***	0.000312***
	(0.000044)	(0.000084)
Age ==40-49	-0.000009	-0.000025
	(0.000038)	(0.000077)
Age ==50-59	-0.000121***	-0.000060
	(0.000036)	(0.000078)
Age ==60-69	-0.000080**	-0.000072
	(0.000035)	(0.000077)
Annual summary*Age==18-29		-0.000105
		(0.000101)
Annual summary*Age==30-39		0.000055
		(0.000094)
Annual summary*Age==40-49		0.000022
		(0.000087)
Annual summary*Age==50-59		-0.000079
		(0.000087)
Annual summary*Age==60-69		-0.000011
		(0.000086)
Constant	0.001107***	0.001076***
	(0.000177)	(0.000187)
Observations, millions	10-13	10-13
R-squared	0.000	0.000
Time and tenure FE	Yes	Yes

Table A8 – Effects of annual summaries on inactivity and internal switching for Bank A

This table reports OLS estimates of measures of switching on annual summary. Calendar time and months with bank fixed effects are used in all specifications. Individual fixed effects are used on inactivity and internal switch regressions. The sample includes all customers in specifications (1) to (6), only packaged bank account holders in specifications (7) to (9) and non-packaged bank holders in (10) to (12). Errors are clustered by customers.

Panel A

	(1) inactivity	(2) inactivity	(3) Full switch	(4) Full switch	(5) Internal switch	(6) Internal switch
Annual summary	0.000076	0.000059	-0.000016	-0.000033	0.000849***	0.000838***
	(0.000144)	(0.000144)	(0.000045)	(0.000045)	(0.000121)	(0.000121)
Unarranged OD 3 months		0.005723***		-0.000326***		0.002877***
		(0.000150)		(0.000037)		(0.000120)
Arranged OD 3 months		0.002038***		0.000642***		-0.003156***
		(0.000166)		(0.000037)		(0.000201)
High Unarranged OD 3 months		0.007249***		0.001664***		0.004198***
		(0.000352)		(0.000111)		(0.000332)
High Arranged OD 3 months		0.000779		0.000068		0.003247***
		(0.000646)		(0.000184)		(0.000900)
Constant	-0.015866**	-0.015985**	0.001325***	0.001305***	0.005000	0.005442
	(0.006920)	(0.006920)	(0.000173)	(0.000173)	(0.004554)	(0.004555)
Observations, millions	10-13	10-13	10-13	10-13	10-13	10-13
R-squared	0.012	0.012	0.000	0.000	0.001	0.002
Calender time and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	No	No	Yes	Yes

Panel B

	(7) Inactivity	(8) Full switch	(9) Internal switch	(10) Inactivity	(11) Full switch	(12) Internal switch
Annual summary	0.000064	-0.000246**	0.001022***	-0.000006	-0.000004	0.000366***
	(0.000204)	(0.000098)	(0.000347)	(0.000148)	(0.000050)	(0.000116)
Constant	-0.013129	0.002234**	0.012477	0.003252	0.001256***	0.006311
	(0.011072)	(0.001060)	(0.015205)	(0.006815)	(0.000177)	(0.004269)
Observations, millions	1-5	1-5	1-5	5-12	5-12	5-12
R-squared	0.000	0.001	0.002	0.001	0.000	0.003
Calendar time and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	No	Yes	Yes	No	Yes
Sample	Only packaged bank account holders	Only packaged bank account holders	Only packaged bank account holders	All except packaged bank account holders	All except packaged bank account holders	All except packaged bank account holders

Table A9 – Effects of annual summaries on inactivity and internal switching for Bank A

This table reports OLS regressions of annual summary on inactivity (Panel A), and internal switching (Panel B) by age group. Calendar time, individual and months with bank fixed effects are used.

	Panel A					
	(1)	(2)	(3)	(4)	(5)	(6)
	Inactivity	Inactivity	Inactivity	Inactivity	Inactivity	Inactivity
Age group	18-29	30-39	40-49	50-59	60-69	70+
Annual summary	0.0000	0.0001	0.0003	-0.0000	0.0004	0.0000
	(0.0005)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Constant	-0.0255***	-0.0128	-0.0039	-0.0345*	-0.0648***	-0.0447
	(0.0065)	(0.0103)	(0.0146)	(0.0191)	(0.0246)	(0.0312)
Observations, millions	1.6 - 2.2	1.6 - 2.2	1.6 - 2.2	1.6 - 2.2	1.6 - 2.2	1.6 - 2.2
R-squared	0.030	0.015	0.014	0.014	0.012	0.009
Individual, time and tenure FE	YES	YES	YES	YES	YES	YES

	Panel B					
	(7)	(8)	(9)	(10)	(11)	(12)
	Internal switch	Internal switch	Internal switch	Internal switch	Internal switch	Internal switch
Age group	18-29	30-39	40-49	50-59	60-69	70+
Annual summary	0.0009**	0.0008***	0.0011***	0.0010***	0.0011***	-0.0000
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
Constant	0.0005	0.0113	0.0289***	0.0235*	0.0004	-0.0197
	(0.0043)	(0.0073)	(0.0101)	(0.0134)	(0.0175)	(0.0150)
Observations, millions	1.5 - 2.3	1.5 - 2.3	1.5 - 2.3	1.5 - 2.3	1.5 - 2.3	1.5 - 2.3
R-squared	0.003	0.002	0.003	0.002	0.002	0.001
Individual, time and tenure FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A10 – Effects over time of annual summaries on outcome variables for Bank A

This table reports OLS regressions of unarranged overdraft and switching outcome variables on dummy variables, which are defined by the month relative to receiving an annual summary. Time, individual and tenure fixed effects are used. Standard errors are clustered by individuals. The sample includes customers who can incur overdraft charges for (1), active customers who can incur overdraft charges for (2) and all customers for (3) and (4).

	(1) Unarranged OD	(2) Incur unarranged	(3) Inactivity	(4) Internal switch
AS -1 month	0.028098*	0.0003	-0.000092	0.000295*
	(0.015415)	(0.0005)	(0.000179)	(0.000169)
AS	0.027183	0.0005	0.000061	0.000667***
	(0.020470)	(0.0006)	(0.000193)	(0.000193)
AS +1 month	0.015345	0.0013**	0.000136	0.000556***
	(0.023029)	(0.0006)	(0.000200)	(0.000202)
AS +2 months	0.005505	0.0003	0.000135	0.000834***
	(0.025332)	(0.0007)	(0.000213)	(0.000216)
AS +3 months	0.034144	0.0006	0.000124	0.000971***
	(0.027960)	(0.0007)	(0.000233)	(0.000233)
AS +4 months	0.025646	0.0005	-0.000071	0.000818***
	(0.030541)	(0.0008)	(0.000244)	(0.000241)
AS +6 months	0.021652	0.0001	-0.000285	0.000283
	(0.033141)	(0.0009)	(0.000259)	(0.000249)
AS +7 months	0.075286**	0.0015	0.000029	0.000253
	(0.034846)	(0.0009)	(0.000267)	(0.000252)
AS +8 months	0.046055	0.0003	-0.000025	0.000033
	(0.037267)	(0.0010)	(0.000281)	(0.000265)
AS +9 months	0.039505	0.0005	-0.000085	0.000315
	(0.039941)	(0.0010)	(0.000296)	(0.000280)
AS +10 months	0.065452	0.0003	-0.000069	0.000553*
	(0.041867)	(0.0011)	(0.000308)	(0.000284)
AS +11 months	0.044272	-0.0010	-0.000210	0.000039
	(0.044358)	(0.0011)	(0.000321)	(0.000295)
Second AS	0.048483	-0.0008	0.000264	-0.000209
	(0.046949)	(0.0012)	(0.000340)	(0.000310)
Second AS +1 month	0.082471	-0.0003	0.000502	-0.000012
	(0.051429)	(0.0013)	(0.000366)	(0.000340)
Second AS +2 months	0.043445	-0.0007	0.000152	0.000023
	(0.053930)	(0.0013)	(0.000376)	(0.000355)
Second AS +3 months	0.038602	-0.0016	0.000253	-0.000082
	(0.056362)	(0.0014)	(0.000387)	(0.000369)
Second AS >3 months	0.016687	-0.0027*	0.000105	-0.000541
	(0.062178)	(0.0015)	(0.000435)	(0.000424)
Constant	4.265900***	0.0540***	0.002421	0.011186**
	(0.428590)	(0.0180)	(0.006395)	(0.005320)
Observations, millions	10 - 13	8 – 10	10 - 13	10 - 13
R-squared	0.001	0.001	0.001	0.001
Individual, time and tenure FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A11 – Effects over time for signing up to text alerts and the mobile banking app

This table reports OLS estimates of outcome variables on dummy variables defined by the month relative to signing up to the mobile banking app, text alerts or being signed up to both, if they sign up. The sample includes active customers. Calendar time, tenure and individual fixed effects are used and errors are clustered by customers. For (1) the sample includes customers who can incur overdraft charges.

	(1) Unarranged OD	(2) Average Balance	cont.	(1) Unarranged OD	(2) Average Balance	cont.	(1) Unarranged OD	(2) Average Balance
Text -9	0.0226	-86.2642***	Mobile -9	-0.1027*	-60.5428***	Interaction -9	0.1649	37.3188
	(0.0709)	(22.4501)		(0.0537)	(16.7578)		(0.1108)	(29.1383)
Text -8	-0.0270	-53.4773*	Mobile -8	-0.0043	-78.4397***	Interaction -8	0.1307	34.2645
	(0.0733)	(28.6192)		(0.0567)	(17.5446)		(0.1165)	(30.4303)
Text -7	-0.0314	-50.0908*	Mobile -7	-0.0074	-94.0885***	Interaction -7	0.0924	69.4958**
	(0.0739)	(28.5372)		(0.0582)	(17.2175)		(0.1173)	(34.1532)
Text -6	-0.0521	-54.3871*	Mobile -6	-0.0082	-84.9700***	Interaction -6	0.1112	88.7404**
	(0.0750)	(28.2893)		(0.0606)	(19.8244)		(0.1185)	(38.3126)
Text -5	-0.0347	-69.4412**	Mobile -5	0.0255	-98.5554***	Interaction -5	0.0431	144.9030***
	(0.0760)	(29.9649)		(0.0612)	(21.1987)		(0.1206)	(46.9076)
Text -4	0.0474	-34.4510	Mobile -4	-0.0804	-94.5417***	Interaction -4	-0.0056	137.7992**
	(0.0790)	(39.5694)		(0.0619)	(23.9332)		(0.1241)	(54.9271)
Text -3	0.1409*	-49.5843	Mobile -3	-0.0818	-99.2637***	Interaction -3	0.1272	148.5341***
	(0.0802)	(35.9733)		(0.0623)	(24.8972)		(0.1280)	(53.8898)
Text -2	0.2989***	-55.5835	Mobile -2	0.0030	-102.9066***	Interaction -2	0.1547	160.8985***
	(0.0828)	(36.5902)		(0.0642)	(26.2618)		(0.1317)	(56.7257)
Text -2	0.6462***	-9.8131	Mobile -2	0.1103*	-78.1218***	Interaction -2	0.0291	143.0635***
	(0.0852)	(38.6011)		(0.0652)	(26.4487)		(0.1319)	(55.5188)
Text -1	0.3429***	4.1465	Mobile -1	-0.1065*	-51.8776*	Interaction -1	0.0549	160.8238***
	(0.0806)	(42.8498)		(0.0648)	(28.3085)		(0.1288)	(48.0389)
Text	-0.4384***	-244.2182***	Mobile	-0.4342***	-124.7182***	Interaction	0.0227	253.2482***
	(0.0782)	(39.7281)		(0.0657)	(27.4083)		(0.1283)	(54.2009)
Text +1	-0.3220***	-293.2919***	Mobile +1	-0.4268***	-142.5031***	Interaction +1	0.0795	227.9242***
	(0.0803)	(35.4354)		(0.0673)	(28.4074)		(0.1338)	(47.4633)
Text +2	-0.3094***	-304.5246***	Mobile +2	-0.3437***	-136.7575***	Interaction +2	0.1249	212.7583***
	(0.0825)	(35.3635)		(0.0706)	(30.7872)		(0.1384)	(48.6979)
Text +3	-0.2172***	-318.2343***	Mobile +3	-0.2822***	-172.3090***	Interaction +3	0.0545	233.5382***
	(0.0842)	(41.6525)		(0.0720)	(30.6097)		(0.1433)	(49.7643)
Text +4	-0.2339***	-303.0060***	Mobile +4	-0.2931***	-196.6573***	Interaction +4	-0.0427	241.7666***
	(0.0862)	(42.7368)		(0.0735)	(28.6801)		(0.1472)	(51.9995)
Text +5	-0.2500***	-317.7822***	Mobile +5	-0.2364***	-219.0523***	Interaction +5	-0.1135	222.9726***
	(0.0890)	(42.6108)		(0.0758)	(29.9463)		(0.1537)	(51.7816)
Text +6	-0.1600*	-330.9348***	Mobile +6	-0.3428***	-216.2971***	Interaction +6	-0.2557	228.7952***
	(0.0928)	(44.0607)		(0.0764)	(31.7913)		(0.1598)	(54.2135)
Text +7	-0.1877**	-359.2834***	Mobile +7	-0.3149***	-236.3934***	Interaction +7	-0.2545	247.5468***
	(0.0949)	(45.4391)		(0.0792)	(31.6177)		(0.1686)	(55.5250)
Text +8	-0.2800***	-381.0392***	Mobile +8	-0.2422***	-237.4360***	Interaction +8	-0.2546	337.1112***
	(0.0959)	(47.2308)		(0.0826)	(33.6490)		(0.1740)	(94.4037)
Text +9	-0.2014**	-402.3331***	Mobile +9	-0.3850***	-239.3976***	Interaction +9	-0.2383	396.4241***
	(0.0995)	(46.0046)		(0.0845)	(34.2420)		(0.1804)	(102.5882)
Text +10	-0.2914***	-428.5073***	Mobile +10	-0.4615***	-248.0105***	Interaction+10	-0.3452*	443.9149***
	(0.1025)	(47.3925)		(0.0870)	(35.4853)		(0.1843)	(112.9805)
Text >11	-0.5464***	-427.5514***	Mobile >11	-0.5564***	-310.3619***	Interaction>11	-0.4305**	364.5687***
	(0.1051)	(51.5066)		(0.0818)	(35.6058)		(0.1809)	(74.7319)
						Constant	2.7308***	3,458.5667***
							(0.5881)	(227.3340)
Observations, millions							8 - 10	8 - 10
Individual, time and tenure FE							Yes	Yes
R-squared							0.001	0.002

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A12 – Effects of mobile banking, text alerts and their interaction on outcome variables for Bank A

This table reports OLS estimates of overdraft variables on mobile sign up, text alert sign up and an interaction term of both sign-ups for Bank A. (1), (5) and (6) report estimates using the value of charges incurred per month as outcomes variables. Specifications (2) report estimates on the intensive margin while (3) and (4) report results on the extensive margin. Calendar time, months with bank and individual fixed effects are used. The sample includes active customers who can incur overdraft charges.

	(1) Unarranged OD	(2) Incurred unarranged	(3) ln(Unarranged OD)	(4) Unarranged OD	(5) Arranged OD	(6) Total OD
Mobile app >2	-0.3338***	-0.0083***	-0.0133**	-0.7289***	0.0723*	-0.2546***
	(0.0531)	(0.0011)	(0.0066)	(0.2760)	(0.0395)	(0.0664)
Text alerts >2	-0.2165***	-0.0036***	-0.0137	-0.5568	-0.0763*	-0.2708***
	(0.0673)	(0.0013)	(0.0090)	(0.3942)	(0.0411)	(0.0810)
Mobile app*Text alerts >2	-0.3805***	-0.0132***	-0.0125	-0.7286	0.0195	-0.3516**
	(0.1102)	(0.0023)	(0.0128)	(0.5191)	(0.0759)	(0.1371)
Mobile app -4	-0.0587	0.0006	-0.0119	-0.4211	-0.0228	-0.0703
	(0.0504)	(0.0013)	(0.0072)	(0.2669)	(0.0261)	(0.0566)
Mobile app -3	-0.0581	0.0003	-0.0011	-0.1279	0.0027	-0.0488
	(0.0519)	(0.0014)	(0.0073)	(0.2714)	(0.0285)	(0.0592)
Mobile app -2	0.0277	0.0041***	-0.0040	-0.1558	0.0252	0.0577
	(0.0549)	(0.0014)	(0.0074)	(0.2849)	(0.0305)	(0.0631)
Mobile app -1	0.1366**	0.0062***	0.0196**	0.3772	0.0591*	0.1949***
	(0.0561)	(0.0014)	(0.0076)	(0.2874)	(0.0338)	(0.0655)
Mobile app 0	-0.0791	0.0052***	-0.0146*	-0.7609***	0.0577*	-0.0202
	(0.0559)	(0.0014)	(0.0077)	(0.2892)	(0.0331)	(0.0650)
Mobile app +1	-0.4061***	-0.0054***	-0.0199**	-1.1777***	0.0418	-0.3610***
	(0.0572)	(0.0014)	(0.0083)	(0.3068)	(0.0356)	(0.0674)
Mobile app +2	-0.3967***	-0.0065***	-0.0128	-1.0669***	-0.0270	-0.4075***
	(0.0591)	(0.0015)	(0.0085)	(0.3131)	(0.0365)	(0.0695)
Text alerts -4	0.0845	0.0025	0.0002	0.0466	-0.0446	0.0524
	(0.0664)	(0.0017)	(0.0100)	(0.3681)	(0.0309)	(0.0736)
Text alerts -3	0.1817***	0.0070***	0.0111	0.1208	-0.0024	0.1864**
	(0.0691)	(0.0017)	(0.0100)	(0.3739)	(0.0357)	(0.0783)
Text alerts -2	0.3432***	0.0122***	0.0239**	0.4160	-0.0231	0.3300***
	(0.0727)	(0.0018)	(0.0101)	(0.3897)	(0.0352)	(0.0816)
Text alerts -1	0.6955***	0.0238***	0.0519***	1.0780***	0.0460	0.7417***
	(0.0762)	(0.0018)	(0.0099)	(0.3775)	(0.0374)	(0.0862)
Text alerts 0	0.4038***	0.0221***	0.0075	-0.4153	0.1063***	0.4937***
	(0.0722)	(0.0018)	(0.0099)	(0.3912)	(0.0411)	(0.0842)
Text alerts +1	-0.3717***	-0.0049***	-0.0162	-1.3286***	-0.0103	-0.3746***
	(0.0705)	(0.0017)	(0.0107)	(0.4169)	(0.0420)	(0.0828)
Text alerts +2	-0.2509***	-0.0016	-0.0021	-0.7489*	-0.1198***	-0.3387***
	(0.0725)	(0.0017)	(0.0109)	(0.4179)	(0.0443)	(0.0855)
Mobile app*Text alerts -4	-0.0736	-0.0056**	0.0049	-0.0253	0.0712	-0.0109
	(0.1023)	(0.0028)	(0.0136)	(0.4839)	(0.0533)	(0.1162)
Mobile app*Text alerts -3	0.0522	0.0006	0.0085	0.0743	0.0677	0.1128
	(0.1084)	(0.0028)	(0.0140)	(0.5069)	(0.0575)	(0.1239)
Mobile app*Text alerts -2	0.0739	0.0007	-0.0006	0.0670	0.0937	0.1571
	(0.1144)	(0.0029)	(0.0142)	(0.5295)	(0.0627)	(0.1316)
Mobile app*Text alerts -1	-0.0639	-0.0063**	-0.0120	-0.1829	0.0119	-0.0488
	(0.1149)	(0.0029)	(0.0144)	(0.5322)	(0.0693)	(0.1362)
Mobile app*Text alerts 0	-0.0616	-0.0057**	-0.0007	0.3484	0.0391	-0.0229
	(0.1118)	(0.0029)	(0.0146)	(0.5424)	(0.0690)	(0.1322)
Mobile app*Text alerts +1	-0.1022	-0.0050*	-0.0103	0.0688	0.0369	-0.0638

	(1) Unarranged OD	(2) Incurred unarranged	(3) ln(Unarranged OD)	(4) Unarranged OD	(5) Arranged OD	(6) Total OD
	(0.1116)	(0.0028)	(0.0158)	(0.5742)	(0.0670)	(0.1319)
Mobile app*Text alerts +2	-0.0604	-0.0044	-0.0006	0.2530	-0.0187	-0.0649
	(0.1170)	(0.0029)	(0.0159)	(0.5856)	(0.0700)	(0.1383)
Constant	2.7782***	0.0203	2.7598***	17.7185***	1.1107***	3.9027***
	(0.5878)	(0.0167)	(0.1101)	(4.0020)	(0.3806)	(0.6491)
Observations, millions	8 - 10	8 - 10	0.3 - 1.5	0.3 - 1.5	4 -9	8 -10
R-squared	0.001	0.001	0.005	0.006	0.001	0.001
Individual, time and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A13 – Effects of mobile banking and text alerts on unarranged overdraft charges by age for Bank A

This table reports OLS estimates of unarranged OD on mobile banking sign up, text alerts sign and their interaction for Bank A by age group. Time and individual and months with bank fixed effects are used. The sample includes only customers who can incur unarranged overdraft charges and that are active customers.

	(1)	(2)	(3)	(4)	(5)	(6)
	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD
Age group	18-29	30-39	40-49	50-59	60-69	70+
Mobile app >2	-0.0042	-0.4702***	-0.5150***	-0.7458***	-0.1478	0.1248
	(0.0819)	(0.1067)	(0.1399)	(0.1555)	(0.1989)	(0.5557)
Text alerts >2	0.4103***	-0.2710*	-0.4700***	-0.5241***	-0.2068	0.0014
	(0.1562)	(0.1622)	(0.1633)	(0.1656)	(0.1293)	(0.1231)
Mobile app*Text alerts >2	-0.5059***	-0.6444***	-0.4338	-0.1453	-0.2403	0.0498
	(0.1812)	(0.2255)	(0.2742)	(0.3610)	(0.3662)	(0.9240)
Mobile app -4	-0.0372	-0.2221**	0.1125	-0.0581	-0.0712	-0.1128
	(0.0686)	(0.1000)	(0.1352)	(0.1535)	(0.1809)	(0.2043)
Mobile app -3	-0.0361	-0.0948	-0.0239	-0.1038	-0.1753	-0.0155
	(0.0717)	(0.1051)	(0.1378)	(0.1520)	(0.1825)	(0.1733)
Mobile app -2	0.0401	-0.0617	0.1085	-0.0702	-0.0273	0.5627**
	(0.0766)	(0.1112)	(0.1456)	(0.1609)	(0.1901)	(0.2798)
Mobile app -1	0.1034	0.0998	0.2640*	0.0496	0.1139	0.2032
	(0.0799)	(0.1119)	(0.1476)	(0.1724)	(0.2153)	(0.2343)
Mobile app 0	0.0687	-0.1662	-0.1188	-0.3184*	-0.2594	0.4616
	(0.0813)	(0.1110)	(0.1498)	(0.1676)	(0.1876)	(0.3732)
Mobile app +1	0.0693	-0.5865***	-0.8479***	-0.9048***	-0.1243	0.4261
	(0.0839)	(0.1155)	(0.1501)	(0.1741)	(0.1856)	(0.3482)
Mobile app +2	-0.0297	-0.5193***	-0.7483***	-0.6827***	-0.2776	0.0923
	(0.0845)	(0.1202)	(0.1550)	(0.1865)	(0.2022)	(0.2598)
Text alerts -4	0.1188	-0.0335	0.0742	0.2739	0.0433	0.1818
	(0.1280)	(0.1525)	(0.1697)	(0.1672)	(0.1286)	(0.1413)
Text alerts -3	0.1500	0.1475	0.2755	0.2991	0.0700	0.1505
	(0.1266)	(0.1594)	(0.1761)	(0.1828)	(0.1330)	(0.1478)
Text alerts -2	0.4793***	0.3029*	0.4774***	0.3953**	0.1191	-0.0254
	(0.1377)	(0.1680)	(0.1806)	(0.1979)	(0.1435)	(0.1187)
Text alerts -1	0.7105***	0.6337***	0.8792***	0.8611***	0.5600***	0.3054*
	(0.1427)	(0.1787)	(0.1913)	(0.1938)	(0.1713)	(0.1598)
Text alerts 0	0.5307***	0.2472	0.4722***	0.5687***	0.4308***	0.5856***
	(0.1406)	(0.1660)	(0.1821)	(0.1881)	(0.1577)	(0.1707)
Text alerts +1	0.2120	-0.5167***	-0.8087***	-0.5160***	-0.1073	-0.1699
	(0.1430)	(0.1635)	(0.1770)	(0.1844)	(0.1358)	(0.1550)
Text alerts +2	0.3687**	-0.3871**	-0.5165***	-0.4342**	-0.2429*	-0.2352
	(0.1485)	(0.1712)	(0.1766)	(0.1937)	(0.1344)	(0.1603)
Mobile app*Text alerts -4	-0.1933	-0.1201	0.1380	-0.0889	-0.4961	0.1128
	(0.1486)	(0.2034)	(0.2761)	(0.3284)	(0.3461)	(0.5410)
Mobile app*Text alerts -3	-0.0820	-0.0885	0.4047	0.1365	-0.4803	-0.3885
	(0.1559)	(0.2175)	(0.2878)	(0.3534)	(0.3979)	(0.3629)
Mobile app*Text alerts -2	-0.1568	0.1800	0.0665	0.1703	-0.5026	-0.3286
	(0.1647)	(0.2386)	(0.2929)	(0.3704)	(0.3733)	(0.6908)
Mobile app*Text alerts -1	-0.3249*	0.1463	-0.1583	0.1072	-0.7315*	0.4318
	(0.1712)	(0.2383)	(0.2955)	(0.3648)	(0.3956)	(0.7895)
Mobile app*Text alerts 0	-0.3620**	0.0677	0.0125	0.2678	-0.4924	-0.4607
	(0.1673)	(0.2293)	(0.2963)	(0.3758)	(0.3267)	(0.6705)
Mobile app*Text alerts +1	-0.3667**	-0.2840	-0.0186	0.5305	-0.6726**	-0.5172
	(0.1688)	(0.2273)	(0.2906)	(0.3955)	(0.3413)	(0.5144)

	(1)	(2)	(3)	(4)	(5)	(6)
	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD
Age group	18-29	30-39	40-49	50-59	60-69	70+
Mobile app*Text alerts +2	-0.4247**	-0.0619	-0.0198	0.0449	-0.0010	-0.2597
	(0.1743)	(0.2393)	(0.3155)	(0.4047)	(0.3524)	(0.4140)
Constant	1.0576*	0.0269	1.8298	3.3823*	0.1064	1.2410
	(0.5427)	(1.0895)	(1.5707)	(1.8110)	(1.4841)	(1.0594)
Observations, millions	0.9 – 2	0.9 – 2	0.9 – 2	0.9 – 2	0.9 – 2	0.9 – 2
R-squared	0.002	0.002	0.002	0.002	0.001	0.000
Individual, time and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A14 – Effects of mobile banking an text alerts on unarranged overdraft charges by income - Bank A

This table reports OLS estimates of unarranged OD on mobile banking sign up, text alerts sign and their interaction for Bank A by estimated income group. Time and individual and months with bank fixed effects are used. The sample includes only customers who can incur unarranged overdraft charges and that are active customers.

	(1)	(2)	(3)	(4)	(5)	(6)
	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD
Income group, thousands	<£0.5	£0.5-£1	£1-£1.5	£1.5-£2	£2--£3.5	>£3.5
Mobile app >2	0.0037	-0.0558	-0.3320***	-0.3578**	-0.4831***	-0.5937***
	(0.1186)	(0.1155)	(0.1240)	(0.1570)	(0.1194)	(0.1315)
Text alerts >2	-0.1616	-0.0265	-0.1691	-0.5009***	-0.2730*	-0.2307
	(0.1687)	(0.1521)	(0.1487)	(0.1806)	(0.1571)	(0.1790)
Mobile app*Text alerts >2	-0.3795	0.0276	-0.4358*	-0.0809	-0.7083***	-0.4954*
	(0.2748)	(0.2657)	(0.2521)	(0.2989)	(0.2560)	(0.2564)
Mobile app -4	0.0782	0.0042	-0.3521***	-0.0849	-0.0425	0.0515
	(0.1198)	(0.1057)	(0.1149)	(0.1368)	(0.1125)	(0.1350)
Mobile app -3	0.1422	-0.0274	-0.2266*	-0.1107	-0.1572	0.0838
	(0.1240)	(0.1134)	(0.1208)	(0.1375)	(0.1120)	(0.1423)
Mobile app -2	0.3220**	-0.0168	-0.1860	-0.0010	-0.0714	0.1851
	(0.1291)	(0.1172)	(0.1262)	(0.1541)	(0.1203)	(0.1470)
Mobile app -1	0.1818	0.0691	0.0970	0.2463	0.2323*	-0.0292
	(0.1311)	(0.1265)	(0.1305)	(0.1591)	(0.1252)	(0.1422)
Mobile app 0	0.0637	0.0123	-0.1180	-0.1039	-0.0591	-0.2306
	(0.1279)	(0.1240)	(0.1329)	(0.1560)	(0.1250)	(0.1444)
Mobile app +1	-0.1853	-0.1465	-0.3808***	-0.3064*	-0.6977***	-0.5299***
	(0.1250)	(0.1260)	(0.1352)	(0.1622)	(0.1303)	(0.1469)
Mobile app +2	0.0668	-0.0807	-0.4391***	-0.4107**	-0.7215***	-0.5465***
	(0.1431)	(0.1282)	(0.1375)	(0.1655)	(0.1286)	(0.1578)
Text alerts -4	0.0935	0.2988**	0.1462	-0.0417	-0.1460	0.1897
	(0.1832)	(0.1451)	(0.1476)	(0.1859)	(0.1501)	(0.1718)
Text alerts -3	0.4455**	0.2129	0.0604	0.0701	0.0937	0.3111*
	(0.1817)	(0.1520)	(0.1484)	(0.1822)	(0.1681)	(0.1796)
Text alerts -2	0.3047*	0.5638***	0.1826	0.2708	0.3723**	0.3521*
	(0.1756)	(0.1674)	(0.1584)	(0.1957)	(0.1708)	(0.1933)
Text alerts -1	0.7484***	0.8509***	0.5514***	0.7335***	0.5886***	0.7652***
	(0.1871)	(0.1816)	(0.1652)	(0.2025)	(0.1804)	(0.1970)
Text alerts 0	0.3518**	0.4076**	0.2929*	0.6010***	0.4792***	0.3797**
	(0.1646)	(0.1603)	(0.1655)	(0.1943)	(0.1767)	(0.1870)
Text alerts +1	-0.0823	0.0570	-0.3491**	-0.6444***	-0.6081***	-0.5058***
	(0.1705)	(0.1608)	(0.1609)	(0.1915)	(0.1672)	(0.1793)
Text alerts +2	-0.0308	0.1092	-0.2537	-0.4198**	-0.4144**	-0.4124**
	(0.1726)	(0.1704)	(0.1731)	(0.1937)	(0.1693)	(0.1778)
Mobile app*Text alerts -4	-0.2583	-0.0815	0.3204	-0.1994	-0.0372	-0.2750
	(0.2638)	(0.2418)	(0.2331)	(0.2797)	(0.2380)	(0.2420)
Mobile app*Text alerts -3	-0.1907	0.3272	0.1689	0.2063	0.0368	-0.2504
	(0.2582)	(0.2727)	(0.2392)	(0.2871)	(0.2484)	(0.2717)
Mobile app*Text alerts -2	-0.2518	0.0989	0.0936	0.3414	0.0841	0.0388
	(0.2558)	(0.2827)	(0.2511)	(0.3069)	(0.2638)	(0.2959)
Mobile app*Text alerts -1	-0.3690	-0.1205	0.0093	0.2128	-0.0827	-0.0144
	(0.2742)	(0.2768)	(0.2650)	(0.3252)	(0.2670)	(0.2741)
Mobile app*Text alerts 0	-0.4022	0.0907	-0.0383	0.0576	-0.2242	0.1526
	(0.2584)	(0.2761)	(0.2566)	(0.2999)	(0.2569)	(0.2858)
Mobile app*Text alerts +1	-0.2365	0.1036	-0.0863	-0.2038	-0.1538	-0.1410
	(0.2480)	(0.2794)	(0.2562)	(0.3098)	(0.2581)	(0.2739)

	(1)	(2)	(3)	(4)	(5)	(6)
	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD	Unarranged OD
Income group, thousands	**<£0.5**	**£0.5-£1**	**£1-£1.5**	**£1.5-£2**	**£2--£3.5**	**>£3.5**
Mobile app*Text alerts +2	-0.0858	0.0128	0.1100	-0.3487	-0.1704	0.0254
	(0.2879)	(0.2796)	(0.2664)	(0.3096)	(0.2671)	(0.2999)
Constant	-1.1173	2.8123***	2.9174**	6.0235***	2.1804	6.1845***
	(1.1549)	(1.0399)	(1.2437)	(1.6897)	(1.5868)	(1.9270)
Observations, millions	1 - 2	1 - 2	1 - 2	1 - 2	1 - 2	1 - 2
R-squared	0.001	0.001	0.001	0.002	0.002	0.002
Individual, time, and tenure FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A15 – Effects of mobile banking and text alerts on balances for Bank A

This table reports OLS estimates of average balance, savings balance, maximum balance, and minimum balance on mobile sign up, text alert sign up and an interaction term of both sign-ups for Bank A. Calendar time, months with bank and individual fixed effects are used. The sample includes all customers.

	(1) Average Balance	(2) Savings Balance	(3) Maximum Balance	(4) Minimum Balance
Mobile app >2	-169.628618***	317.571201***	-53.834021	-187.089174***
	(22.611998)	(121.979488)	(50.920599)	(17.385864)
Text alerts >2	-307.003660***	292.562812	-251.846769***	-297.344231***
	(33.183544)	(237.284632)	(56.078682)	(28.219864)
Mobile app*Text alerts >2	187.594490***	202.933750	244.517954***	165.417145***
	(46.123399)	(249.108540)	(83.517669)	(37.473252)
Mobile app -4	-49.265010***	146.019895*	-14.396474	-63.037026***
	(18.063849)	(77.081777)	(42.917482)	(14.542344)
Mobile app -3	-53.298169***	220.194036**	71.193715	-68.874066***
	(19.192268)	(90.311771)	(59.737723)	(15.469114)
Mobile app -2	-56.105898***	197.224533**	28.431986	-74.026752***
	(20.854618)	(94.376027)	(50.549685)	(17.040975)
Mobile app -1	-30.432903	236.032187**	199.637632***	-106.859102***
	(21.480605)	(100.792154)	(60.909996)	(16.583339)
Mobile app 0	-3.493894	529.104953***	465.449255***	-130.215432***
	(24.413248)	(122.331997)	(95.610438)	(15.521308)
Mobile app +1	-75.012325***	552.416294***	156.241788**	-112.580226***
	(23.738918)	(118.454024)	(68.227610)	(17.276619)
Mobile app +2	-91.468813***	514.092698***	34.261561	-128.000089***
	(24.986985)	(120.892911)	(62.967531)	(18.001495)
Text alerts -4	1.500871	265.431170**	94.759544	-23.910925
	(34.816362)	(134.036710)	(105.736002)	(26.715147)
Text alerts -3	-12.361396	382.596815**	122.053485*	-36.834515
	(30.678052)	(151.590097)	(68.342582)	(27.092273)
Text alerts -2	-17.019852	441.807346***	111.510446*	-25.302876
	(31.021521)	(135.908623)	(63.369479)	(28.222578)
Text alerts -1	30.483578	527.462275***	353.619618***	-60.837588**
	(33.339860)	(144.170354)	(74.537275)	(28.796809)
Text alerts 0	46.356212	1,473.764729***	1,071.883571***	-302.916588***
	(38.275947)	(175.492700)	(89.422021)	(21.744117)
Text alerts +1	-200.943119***	1,203.750750***	70.346157	-225.993935***
	(34.706513)	(182.945502)	(86.609536)	(28.114634)
Text alerts +2	-248.707339***	1,020.750703***	-162.345170**	-259.229826***
	(29.621473)	(191.260687)	(63.117334)	(22.814824)
Mobile app*Text alerts -4	92.360111**	153.792041	64.560215	97.673570**
	(44.319813)	(196.662689)	(87.215588)	(38.676500)
Mobile app*Text alerts -3	99.814154**	74.785772	-23.276847	106.891702***
	(43.396337)	(208.820653)	(87.859499)	(38.538642)
Mobile app*Text alerts -2	108.244248**	134.199619	75.400867	106.766847**
	(46.211995)	(199.013087)	(87.255026)	(42.220851)
Mobile app*Text alerts -1	85.531382*	158.536541	-58.552159	138.954994***
	(45.194824)	(223.695560)	(94.926897)	(41.566195)
Mobile app*Text alerts 0	97.334503**	-56.041692	7.490558	140.483057***
	(40.156618)	(233.172009)	(133.191474)	(23.878217)
Mobile app*Text alerts +1	186.643600***	-75.419236	137.169826	121.030327***

	(1) Average Balance	(2) Savings Balance	(3) Maximum Balance	(4) Minimum Balance
	(49.228341)	(235.295803)	(106.346118)	(27.959139)
Mobile app*Text alerts +2	158.148179***	88.066832	239.756515**	139.866441***
	(41.388886)	(256.995150)	(99.226769)	(28.320139)
Constant	3,483.618579***	9,826.134632***	2,896.954732***	3,051.238173***
	(227.124577)	(810.673349)	(884.496716)	(161.797244)
Observations, millions	8 - 10	8 - 10	8 - 10	8 - 10
R-squared	0.002	0.001	0.000	0.002
Individual, time and tenure FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A16 – Other effects of mobile banking and text alerts for Bank A

This table reports OLS estimates of the number of credits and debits consumers make per month and online banking usage on mobile sign up, text alert sign up and an interaction term of both sign-ups for Bank A. Calendar time, months with bank and individual fixed effects are used. The sample includes all customers.

	(1) Number of credits	(2) Number of debits	(3) Online Banking Usage
Mobile app >2	1.318919***	3.785568***	-0.298910***
	(0.021937)	(0.075142)	(0.001824)
Text alerts >2	0.361880***	1.360103***	0.043311***
	(0.020592)	(0.081706)	(0.001774)
Mobile app*Text alerts >2	0.417935***	0.355767**	0.015342***
	(0.047547)	(0.154606)	(0.003485)
Mobile app -4	0.169542***	1.187502***	0.014919***
	(0.015252)	(0.061097)	(0.001279)
Mobile app -3	0.207353***	1.353505***	0.017471***
	(0.016099)	(0.064086)	(0.001328)
Mobile app -2	0.253832***	1.672121***	0.015647***
	(0.016666)	(0.066035)	(0.001383)
Mobile app -1	0.312987***	1.683067***	0.014793***
	(0.017415)	(0.069213)	(0.001445)
Mobile app 0	0.970219***	3.427084***	0.013968***
	(0.019946)	(0.072933)	(0.001702)
Mobile app +1	1.078350***	3.340778***	-0.204857***
	(0.022260)	(0.076975)	(0.002130)
Mobile app +2	1.066163***	3.257658***	-0.234283***
	(0.023806)	(0.082122)	(0.002196)
Text alerts -4	0.136051***	0.787646***	0.009747***
	(0.018284)	(0.069127)	(0.001516)
Text alerts -3	0.121211***	0.871292***	0.012364***
	(0.018635)	(0.071988)	(0.001565)
Text alerts -2	0.181848***	1.013465***	0.015681***
	(0.019691)	(0.074119)	(0.001623)
Text alerts -1	0.234702***	1.224542***	0.021467***
	(0.019645)	(0.077040)	(0.001690)
Text alerts 0	0.816766***	1.963124***	0.088782***
	(0.021533)	(0.082263)	(0.001876)
Text alerts +1	0.482977***	1.890631***	0.056819***
	(0.022730)	(0.084436)	(0.001948)
Text alerts +2	0.432434***	1.718627***	0.051573***
	(0.023326)	(0.086530)	(0.001994)
Mobile app*Text alerts -4	0.015724	-0.333566***	-0.006985***
	(0.031904)	(0.117528)	(0.002685)
Mobile app*Text alerts -3	0.071146**	-0.250161**	-0.009499***
	(0.033967)	(0.123844)	(0.002792)
Mobile app*Text alerts -2	0.037431	-0.284070**	-0.008870***
	(0.035746)	(0.130294)	(0.002926)
Mobile app*Text alerts -1	0.034048	-0.201880	-0.006887**
	(0.037394)	(0.135448)	(0.003037)
Mobile app*Text alerts 0	0.175769***	0.001325	0.017398***
	(0.041652)	(0.141872)	(0.003362)
Mobile app*Text alerts +1	0.346314***	0.584736***	0.011439***

	(1) Number of credits	(2) Number of debits	(3) Online Banking Usage
	(0.045796)	(0.148786)	(0.003898)
Mobile app*Text alerts +2	0.385442***	0.505380***	0.013812***
	(0.048155)	(0.155694)	(0.004033)
Constant	6.904487***	5.167294***	0.339979***
	(0.183142)	(0.645274)	(0.015536)
Observations, millions	8 - 10	8 - 10	8 - 10
R-squared	0.029	0.048	0.055
Individual, time and tenure FE	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A17 – Effects of mobile banking and text alerts on switching for Bank A

This table reports OLS of switching metrics on mobile sign up, text alerts sign up and an interaction term for using both services. The sample includes active customers.

	(1) Inactivity	(2) Full switch	(3) Internal switch
Mobile app >2	0.002130***	-0.000789***	-0.002329***
	(0.000246)	(0.000050)	(0.000203)
Text alerts >2	0.001974***	-0.000169***	-0.000047
	(0.000310)	(0.000064)	(0.000270)
Mobile app*Text alerts >2	-0.000704	0.000124	0.001600***
	(0.000471)	(0.000113)	(0.000440)
Mobile app -4	-0.000106	-0.002005***	-0.000473
	(0.000447)	(0.000019)	(0.000377)
Mobile app -3	-0.000834*	-0.001974***	-0.001121***
	(0.000429)	(0.000019)	(0.000369)
Mobile app -2	-0.000637	-0.001998***	-0.001489***
	(0.000423)	(0.000020)	(0.000367)
Mobile app -1	-0.001316***	-0.001993***	0.000576
	(0.000412)	(0.000020)	(0.000384)
Mobile app 0	-0.005836***	-0.001742***	0.006027***
	(0.000362)	(0.000071)	(0.000563)
Mobile app +1	-0.004851***	-0.001646***	0.000814*
	(0.000415)	(0.000080)	(0.000415)
Mobile app +2	0.001704***	-0.001440***	-0.000341
	(0.000462)	(0.000090)	(0.000400)
Text alerts -4	-0.000366	-0.001738***	-0.000172
	(0.000575)	(0.000019)	(0.000524)
Text alerts -3	-0.000478	-0.001721***	-0.000815*
	(0.000565)	(0.000020)	(0.000485)
Text alerts -2	-0.000597	-0.001692***	-0.001858***
	(0.000558)	(0.000020)	(0.000467)
Text alerts -1	-0.001603***	-0.001682***	0.001044**
	(0.000524)	(0.000021)	(0.000509)
Text alerts 0	-0.003765***	-0.001850***	0.063677***
	(0.000445)	(0.000083)	(0.001109)
Text alerts +1	-0.001239	-0.000909***	0.005617***
	(0.000849)	(0.000132)	(0.000526)
Text alerts +2	0.001374**	-0.001106***	0.002601***
	(0.000574)	(0.000119)	(0.000444)
Mobile app*Text alerts -4	-0.000813	0.000767***	-0.000770
	(0.000840)	(0.000033)	(0.000809)
Mobile app*Text alerts -3	0.000259	0.000663***	-0.000591
	(0.000839)	(0.000035)	(0.000773)
Mobile app*Text alerts -2	-0.001186	0.000568***	0.000726
	(0.000795)	(0.000037)	(0.000802)
Mobile app*Text alerts -1	-0.001288*	0.000489***	-0.001209
	(0.000770)	(0.000039)	(0.000818)
Mobile app*Text alerts 0	-0.001564**	0.000564***	0.015216***
	(0.000708)	(0.000118)	(0.001444)
Mobile app*Text alerts +1	-0.006439***	0.000160	0.002208***

	(1) Inactivity	(2) Full switch	(3) Internal switch
	(0.000918)	(0.000152)	(0.000809)
Mobile app*Text alerts +2	-0.000699	0.000234	0.001947***
	(0.000867)	(0.000180)	(0.000754)
Constant	-0.012506*	0.002303***	-0.026359***
	(0.006895)	(0.000198)	(0.004550)
Observations, millions	8 - 12	8 – 12	8 - 12
R-squared	0.012	0.001	0.006
Time and tenure fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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