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Understanding consumer financial wellbeing through banking data

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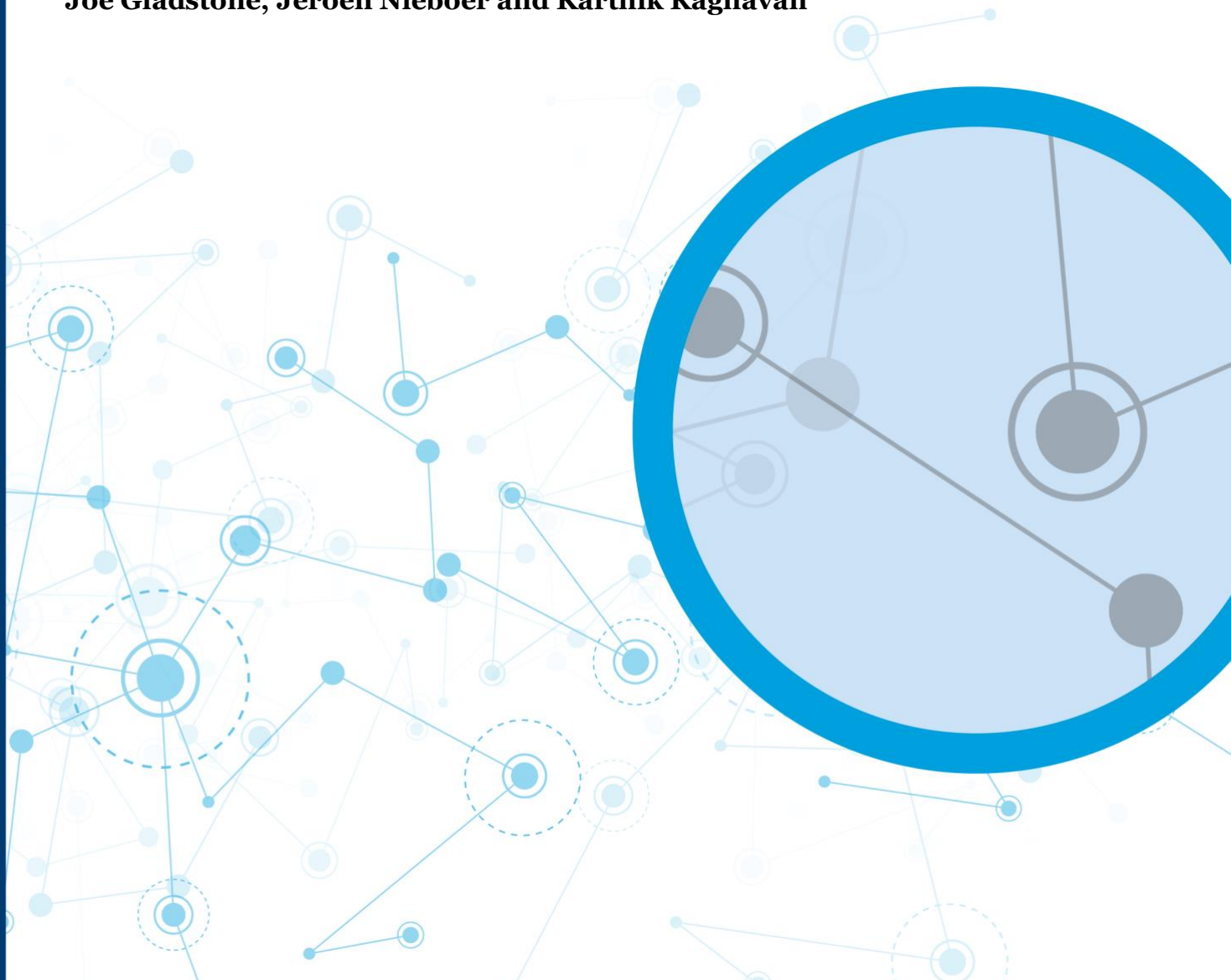

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Executive summary

Measuring how consumers are faring financially is difficult. Financial wellbeing is a multi-faceted concept, with differing perspectives as to what it comprises. Previous policy research has often looked at objective financial outcomes, such as retirement savings, liquidity buffers and timely credit repayment, whereas survey-based consumer finance research has focused on measuring people's perceptions of their financial situation.

In this paper, we integrate the two approaches by investigating the relationship between subjective financial wellbeing, measured by self-reported responses of survey respondents, and objective financial wellbeing, measured by the same respondents' bank account data. This approach is an example of a 'matched dataset', giving regulators and policy bodies a much richer perspective on consumer outcomes. Our objective is to better understand how differences in subjective financial wellbeing, consumers' lived experience, fluctuates with the objective state of their finances.

We investigate potential indicators of low subjective wellbeing such as demographics, average balances, use of credit and digital banking usage patterns. We also investigate the role of volatility in spending, income and account balances. Our hypotheses on volatility, although not causal in nature, are inspired by a growing policy literature on the importance of financial stability. Phenomena such as zero-hour contracts, the 'gig economy' and the recent economic disruption caused by Covid-19 are all thought to contribute to a reduction in such stability. Understanding the role of volatility is therefore, arguably, more important than ever before.

We find that subjective financial wellbeing is correlated with a number of objective metrics that we can straightforwardly derive from bank account records, such as income, available liquidity and overdraft usage. People with higher incomes, more liquidity and fewer days in overdraft report higher financial wellbeing. By contrast, we do not find associations with demographic characteristics like gender and age. We also find, somewhat surprisingly, no relationship between income volatility and subjective financial wellbeing – those with greater fluctuations in monthly inflows into their accounts do not report lower financial wellbeing. We do find that account balance volatility is negatively correlated with wellbeing and that spending volatility is positively correlated with wellbeing. We consider an explanation that can reconcile these results, where lower subjective wellbeing derives from mismatches in the timing of income and expenditure.

Despite our findings being correlational, not causal, there are several ways in which our research can inform future work. First, our measure of subjective financial wellbeing can be used to quantify the psychological impact of changes in objective financial wellbeing. Second, we show that data derived from consumers' bank accounts with their consent can be used to identify consumers with lower financial wellbeing. Third, our findings on financial volatility raise a number of interesting questions for further research, notably on the different possible metrics of irregular income or expenditure.

Contents

1 Introduction

Consumers vary in their everyday financial decisions and the ways in which they manage and spend their money. A large part of this variation is captured, objectively, through their bank account records. While some individuals keep large, stable balances in their current accounts, others have multiple streams of income which vary widely month-to-month. Similarly, bank-account data records patterns in spending and can be used to track consumers' engagement with finances through various (increasingly digital) channels. Especially in the economic conditions created by the Covid-19 pandemic, it is important to understand how these behaviours relate to financial wellbeing.

In this paper, we ask what this objective information can tell us about consumers' *subjective* financial wellbeing; their perceptions and feelings towards their own financial situation. Financial wellbeing is a complex concept, a point we recognise and discuss throughout this paper. Our goal is to better understand financial wellbeing by investigating how objective measures of financial behaviour relate to these subjective experiences. We measure financial wellbeing by asking consumers to report how they feel about their financial situation – for example, indicating the degree to which they identify with statements such as "My financial situation controls my life". By asking respondents about their financial circumstances directly, we aimed to better understand the financial challenges and opportunities facing individuals, and how individuals view their own financial lives. We match these subjective responses with consumers' objective financial data and explore whether the latter can be used to predict which consumers have low financial wellbeing. We specifically focus on the role of financial volatility in account balances and income, as this is often cited as a chief driver of financial stress.

There is growing recognition that using only objective indicators of consumer welfare (such as income or credit score) can be reductive and capture only a part of people's lived experience. For example, the financial circumstances of a wealthy recent immigrant may be poorly reflected in their credit score, and similarly understanding the financial situation of retirees with few outgoings may be limited if relying only on their income. Subjective data is therefore a powerful complement to objective indicators – it can deepen our understanding of the relationship between finances and mental health. Subjective measures allow us to capture variables that are not easily quantifiable in money terms – such as the stress experienced by some consumers in monitoring their bank account balance, and the hassle of finding credit to cover unexpected shortfalls and expenses. Another important set of questions concerns discrepancies between objective and subjective financial wellbeing – are there systematic differences that vary with consumer attitudes, characteristics or circumstances?

We study this topic using a unique dataset, which links over 2,500 consumers' self-reported financial wellbeing with granular transaction and activity data from their Personal Current Account (PCA). Using up to 11 months of PCA data, we construct average measures of key explanatory variables (account balance, income, credit usage) but also variance in these variables (such as income volatility), and also include additional account measures such as mobile banking log-ins.

Our main objective is to better understand the objective factors most closely associated with money management stress, shedding light on the variance that exists in consumers' experience of their financial circumstances. The data we use, including transactions, balances, and mobile logins, is very similar to that collected by innovative players such as mobile payment applications and account aggregators, and is increasingly used by traditional financial institutions in better understanding their customers. Some of it, such as account turnover and credit usage, is also collected by credit reference agencies. The development of Open Banking interfaces will make it easier for consumers to selectively share such data with third parties, meaning the use of customer account data to understand and predict financial distress is expected to grow over the coming years.

We hope this paper will be of interest to policy makers and researchers with an interest in the interaction of objective and subjective wellbeing, as well as firms looking to use consumer data to predict financial wellbeing. We also hope the paper will inspire future work aiming to identify objective indicators of financial wellbeing, including the development of new methods to proactively detect potentially vulnerable consumers to offer them additional support. Since our work is of an exploratory nature, we did not set out to test a specific theory on consumer financial wellbeing, but rather we were guided by current policy debates on financial distress and the role of financial volatility.

Outline

The paper first introduces financial wellbeing as a multi-dimensional concept and its importance to understanding consumer vulnerability. We next describe how we measure people's subjective experience of it using our survey, and provide an overview of past research that has explored the relationship between objective and subjective measures. We explain why we focus on the volatility of consumers' account data, and their overdraft usage, which we expected to be important components of subjective financial wellbeing. This is followed by our methods, results and conclusion.

2 Understanding financial wellbeing

What is financial wellbeing?

Financial wellbeing is a multi-faceted concept, inspiring a variety of research approaches by policy researchers and academics. As a result, it has been hard to come by widely-accepted definitions and measurement methods for financial wellbeing. Opting for one of the more holistic perspectives in the literature, we define financial wellbeing as a state of being wherein a person can fully meet current and ongoing financial obligations, has the capacity to absorb financial shocks when they occur, can feel secure in their financial future, and is able to make financial choices that allow enjoyment of life (CFPB, 2015). It can be thought of as a continuum ranging from the experience of chronic financial stress on one end, to being highly satisfied with one's financial situation on the other.

In prior work, we broadly discern two approaches to assessing financial wellbeing. The first uses objective metrics of financial behaviours and outcomes (such as income, wealth and debt). These are observable to banks and governments, and have the benefit of being able to be assessed at scale (e.g. through tax records and credit files). While these metrics are often captured through administrative data, they are also collected through surveys. Policy-making bodies and regulators have typically focused on these measures to understand changes in key financial behaviours like retirement savings, liquidity buffers and credit arrears.

The second approach focuses on subjective measures of financial wellbeing. These capture consumers' feelings or perceptions and are typically measured through surveys. While subjective measures are harder to scale and interpret, and are potentially noisier, they capture important aspects of consumer welfare (such as anxiety over personal finances) that purely objective financial data cannot. It is also important to recognise that consumers are not all the same. A large overdraft can be a status symbol and/or a crippling liability, depending on the person. This is an example of how people's subjective interpretations of their situation provide additional information beyond objective indicators. While policy-making bodies and regulators have historically paid little attention to the subjective dimension of financial wellbeing, primarily due to a lack of robust measurement techniques, this is now changing. Examples of such approaches include FCA's Financial Lives survey (2017, 2018), the UK's Financial Capability Survey (2018) and the US Consumer Financial Protection Bureau's single measure of financial wellbeing (CFPB, 2015).[1]

In this paper, we focus on what determines people's day-to-day financial wellbeing, as defined by their own (subjective) experience. We combine the two approaches outlined above by investigating the link between subjective experiences and objective metrics. We start from the premise that an important part of people's financial wellbeing is related to their everyday experience of receiving income, spending, borrowing and tracking money

[1] The increasing interest in subjective financial wellbeing is analogous to a greater prominence of subjective wellbeing more generally, as evidenced by publications such as the United Nations World Happiness Report (United Nations, 2020) and the UK Office of National Statistics wellbeing indicators (ONS, 2019).

in their bank account. If so, then studying these experiences can help us understand why some people feel good about their financial situations and others do not.

Financial wellbeing and consumer vulnerability

Many of the factors affecting financial wellbeing also relate to consumer vulnerability. Previous FCA work reports vulnerability as a significant issue: the FCA's Financial Lives survey estimates that over 50% of UK adults display one or more characteristics signalling potential vulnerability (FCA, 2017). A vulnerable consumer is someone who, 'due to their personal circumstances, is especially susceptible to detriment, particularly when a firm is not acting with appropriate levels of care' (FCA, 2015). In a recent consultation, the FCA (2020) sets out guidance for firms on fairly treating these consumers.

Consumer harm can take many forms. It is typically defined in financial terms, but it may also include stress, anxiety, and other psychological costs. These psychological costs can derive directly from financial detriment, or they may cause financial detriment through sub-optimal or inappropriate financial decisions. The relationship between psychological and financial costs can help explain why financial wellbeing is a key predictor of overall wellbeing and is comparable in magnitude to the combined effect of other life domains, such as job satisfaction, physical health assessment, and relationship satisfaction (Joo & Grable, 2004; Netemeyer et al., 2018). Another important link between psychological factors and financial detriment is prevalence of the latter among people with mental health issues. Adults with mental health issues are 3 to 3.5 times more likely to report being in debt or arrears (Mind, 2011; Money and Mental Health Policy Institute, 2019).

How can we measure subjective financial wellbeing?

Measuring how consumers are faring financially is difficult. While there is broad agreement that subjective financial wellbeing comprises more than questions about debt and income, a wide range of approaches has been employed across the literature. Most approaches involve asking people questions on how they perceive their financial situation and then using statistical techniques from the field of psychometrics – the study of measuring mental capacities and processes – to distil a single metric for financial wellbeing (CFPB, 2015; Prawitz et al., 2006).

There are two major challenges in deciding how to measure subjective financial wellbeing. The first is whether to ask questions that focus on relative or absolute levels of financial wellbeing. Academic researchers have stressed the relative nature of financial wellbeing, emphasising that consumers assess their financial situations largely by comparing themselves with other standards (Hagerty, 2000; Haisley et al., 2008; Ordabayeva & Chandon, 2011; Sharma & Alter, 2012; Smith et al., 1989). This conceptualisation draws on the so-called relative models (Campbell et al., 1976; Duesenberry, 1949; Frank, 1985), suggesting that people use social comparison to judge how well they are doing (e.g., assessing income level relative to one's community). Moreover, people may make comparisons with the past and desired levels of consumption (Hagerty, 2000; Tully et al., 2015). Of course, such comparisons may well be in the background when people answer more generally worded questions about their wellbeing – the approach we follow.

A second challenge in measuring subjective financial wellbeing is in deciding whether it is unidimensional – whether it is really a single construct that can be distilled into a single metric. For example, the 2018 UK Financial Capability Survey conceptualised financial wellbeing as consisting of two pillars, *current* and *future* wellbeing, which are both determined by various financial behaviours. We also follow this dual approach, which has been further advocated for in academic studies (Brüggen et al., 2017; Netemeyer et al., 2018). Our measure of current financial wellbeing is based in part on the *money management stress* scale by Netemeyer et al. (2018). We use items from this scale that ask respondents to indicate the extent to which they identify with statements such as "My financial situation controls my life". We chose these questions because they capture the everyday experience of managing money and usage of financial products.

The relationship between objective and subjective financial wellbeing

We link a measure of subjective wellbeing with objective financial data by asking our respondents consent to anonymously match survey responses with data on their personal current account. Since current accounts are the most widespread and frequently used financial product in the UK, we believe that current account data most accurately reflects consumers' day-to-day money management and budgeting situation.

Past research on the link between subjective and objective metrics shows a positive, though not particularly strong association (e.g., r = .19, Netemeyer et al. 2018) between the two types of financial wellbeing metrics (Gasiorowska, 2014; Johnson & Krueger, 2006; Piff et al., 2010; Singh-Manoux et al., 2003; Wilhelm et al., 1993; Zyphur et al., 2015). This highlights how subjective financial wellbeing does not necessarily correspond to objective abundance or lack of money (Tully et al., 2015). People with above average incomes and wealth can still experience financial stress, albeit less frequently than those with greater financial constraints.

Previous FCA research used self-reported data from the UK Wealth and Assets Survey to investigate the relationship between wellbeing (measures of life satisfaction, happiness and anxiety) and keeping up with credit repayments (Gathergood & Guttman-Kenney, 2016). The authors find that those who report having fallen behind with repayments exhibit lower average life satisfaction and higher anxiety than other individuals with consumer credit debts, even after accounting for socio-economic factors such as income and age.

Closest to our approach is recent research by Commonwealth Bank of Australia and the Melbourne Institute (Comerton-Forde & Ross, 2018). The researchers collected a dataset similar to our own, and developed separate scales measuring subjective financial wellbeing and objective financial wellbeing from bank account records. Although the two scales are distinct measures, they find that they are significantly and positively correlated. Academic researchers have also found correlations between subjective financial wellbeing and bank account balances (Ruberton et al., 2016). These results suggest that we should expect to find correlational relationships between current account data and self-reported financial wellbeing.

Financial volatility, credit use and wellbeing

As well as overcoming potential biases in self-reports, a key benefit of detailed bank account data is the fine-grained view it allows of fluctuations in people's finances over time. We can measure the volatility of incomings and outgoings, as well as any use of overdraft credit that may result. An overdraft is most consumers' first liquidity buffer against financial shocks – accessing it does not require any action on the part of the consumer. We are especially interested in the effects that financial volatility and credit use may have on subjective financial wellbeing. Both the longer-term trend of increasing self-employment and the recent economic disruption draw attention to the question of how people respond to volatility in income and liquid wealth. This question is closely linked to the role of easily accessible emergency credit, which continues to be debated, but with little evidence on how it impacts people's subjective wellbeing.

A common way of accommodating volatility in income and expenditure is by using a current account overdraft. In the UK, overdrafts are the most common form of unsecured credit and come in two varieties: arranged and unarranged. An arranged overdraft is a line of credit with a pre-agreed borrowing limit; whereas an unarranged overdraft is emergency borrowing extended at the bank's discretion. Given that unarranged overdrafts are meant to be for emergency credit and are discretionary, we might expect the two overdraft types to have different relationships with wellbeing.[2] But there is, to our knowledge, no prior research that explicitly investigates the relationship between overdraft use and financial wellbeing.

Previous research on financial volatility

There is a growing literature on different types of financial volatility, especially income volatility. Higher income volatility is typically expected to decrease financial wellbeing, for several reasons. Stable, predictable income streams allow consumers to carefully plan their spending and accrue savings. The sense of stability associated with steady income may also enhance people's perceived financial security (Sharma & Keller, 2017). Stable incomes could also help people plan ahead and achieve their goals. For example, stable finances can help build a better credit score, giving people access to more and cheaper credit, starting a virtuous cycle.

In empirical research, income volatility has been associated with financial distress events such as mortgage delinquency (Diaz-Serrano, 2005), greater risk of depression (Prause et al., 2009) and even poor physical health (Halliday, 2008). In low-income households in the US, it has been linked to food insecurity and lower child outcomes such as educational attainment (Chang et al., 2014; Leete & Bania, 2010). Although there is mixed evidence on the effect of temporary income shocks on overall subjective wellbeing (Bayer & Juessen, 2015; Cai & Park, 2016), research focusing on longer-term income volatility suggests that volatility in income has a negative association with financial wellbeing (Aspen Institute, 2016).

Another strand of research has focused on how consumers respond to negative shocks to their income, such as unemployment.[3] Recent evidence from account-level data in both

[2] Although the FCA's High Cost Credit Review (CP 18/43) recently introduced changes that harmonise the two types of overdraft, at the time of our data collection they differed in two important respects: unarranged overdrafts were much more costly and had typically lower credit limits.

[3] Unemployment is not the only source of income volatility. Research on US consumers' account data shows that most income volatility in fact stems from variation in take-home pay within a job rather than job transitions (JP Morgan Chase Institute, 2016).

the US and Iceland shows that consumers who experience short-term unemployment typically reduce their expenditure instead of using debt (Hundtofte et al., 2019). Greater volatility in income could thus be 'balanced out' by expenditures moving in tandem with income. Research based on consumption surveys suggests that the strategy adapting expenditure is more likely to be followed, probably out of necessity, by lower-income households (Blundell et al., 2008; Kaplan & Violante, 2010). If consumption levels do have to fall out of necessity, even temporarily, then it seems likely that people's subjective financial wellbeing will be affected.

Like income, expenditure can vary substantially over time as some expenses are large and unpredictable, meaning the consumer may not be able to spread the cost. There is evidence from the US that consumption has become more volatile in recent times (Gorbachev, 2011). There is much less research on this topic, a recent exception being data from US banking records that suggests unpredictable expenses contribute to low financial wellbeing (JP Morgan Chase Institute, 2016). Especially the combination of income and expenditure fluctuations at different frequencies can make it hard to manage one's finances (JP Morgan Chase Institute, 2016, 2019). As with temporary income shocks, then, it appears that not all households can easily accommodate an unexpected expenditure shock.

3 Methods

Sampling and survey

Our sample consists of 2,695 current account holders that voluntarily participated in a telephone survey at the end of a field experiment on overdraft text message alerts (see Adams et al., 2018). Since the survey sampling methodology involved deliberately oversampling individuals with lower account balances, we expect consumers in our sample to have, on average, lower liquid wealth than the population of account holders.[4] We would therefore also expect this segment of the population to report lower-than-average financial wellbeing, making them particularly relevant for our research question.

Our sample only includes data from survey respondents that consented to having their survey responses matched to their account data.[5] Since respondents were participants in a field experiment in the months prior to the survey, we tested whether responses to financial wellbeing items differed between experimental control and treatment groups using logistic regression on a treatment indicator. We find no evidence that those in the treatment groups report differently for any of the items (logistic regressions on treatment indicators, coefficient tests all $p>0.1$, see also Adams et al. (2018)). Selection for participation in the field experiment was not voluntary, although participants could opt out of the treatment (receiving overdraft alerts) at any point. Given that the field experiment ran over 5 months, with overdraft alerts only sent to those actually using their overdraft, it is unlikely that overdrafts or alerts would have been more salient for our sample as a result of the field experiment.

The financial wellbeing items used to construct the subjective wellbeing measures were deliberately placed at the very beginning of the survey. Although the rest of the survey consisted mostly of questions about overdraft usage and text message alerts, respondents did not know this at the time of answering the financial wellbeing items. Neither did the phone interviewers introduce the survey as being about overdrafts – the interviewer simply stated it would cover "consumers' views and experiences of certain financial products" (see Appendix 1 for the full survey script). The responses to the financial wellbeing items are therefore unaffected by the overall focus of the survey, making it unlikely that respondents were somehow primed to think about a specific aspect of their financial wellbeing.

Account data

For each account holder in the sample, we have 11 months of data on item-level account transactions, running account balances, bank charges and remote logins

[4] Selection for the field experiment was conditional on having registered a balance level below £1,000 in the 6 months preceding the trial (from 11 to 5 months before the survey – for further detail see Adams et al., 2018, p, 21). The survey oversampled individuals whose balances had dropped below £100, £50, or £0 during the trial (the 5 months before the survey).

[5] The full consent question, including further information if asked for, is reproduced in Appendix 1.The consent rate was 72.5%. The field experiment itself was subject to the FCA ethics process before going live.

(internet/mobile/phone banking). We also have demographic and account-level data, including whether the account included a pre-arranged line of credit (arranged overdraft). We capture data from all accounts that the individual holds with the same bank – only 8.7% of our sample holds more than one account.

To construct a monthly income measure from transaction items, we use a combination of transaction type codes and amounts to exclude transfers from the data. Every credit transaction that is of type 'transfer' and is a multiple of £10 is excluded, as well as any internal transfers between accounts held by the same individual. All remaining credit transactions are counted as income. This allows us to pick up non-salary income, such as benefits, rebates, rental income and bonuses. We also compute an indicator of whether the individual typically receives more than 70% of their monthly income in the same 10-day window at a specific time of month, as we would expect for people who receive a regular monthly salary. 52.4% of account holders in our sample fall into this category.[6] We winsorized[7] the highest and lowest 1% of values for income and balance measures to limit the influence of extreme values.

Table 1: Sample summary statistics (monthly means), n=2,695.

	25th quantile	Median	Mean	75th quantile
Gender (1=male)			0.54	
Age	29.00	40.00	41.36	52.00
Tenure with bank (years)	3.00	5.00	8.16	11.00
Average balance	113.93	305.83	488.76	625.40
Minimum balance	-167.07	2.00	-46.72	72.15
Arranged overdraft limit	0.00	100.00	425.57	500.00
Number of days in overdraft	0.00	2.36	14.57	20.36
Income	860.35	1514.00	1820.47	2389.91
Income paid monthly (1=Y)			0.52	
Mobile banking registration (1=Y)			0.65	
Mobile banking logins	0.00	10.64	18.61	28.45
Online banking registration (1=Y)			0.70	
Online banking logins	0.00	0.18	3.06	2.59

Notes: All variables calculated as monthly means at the consumer level. Total number of accounts across all consumers was 3,017. Variables for consumers with multiple accounts were aggregated by summation at the daily level, except gender, age and tenure.

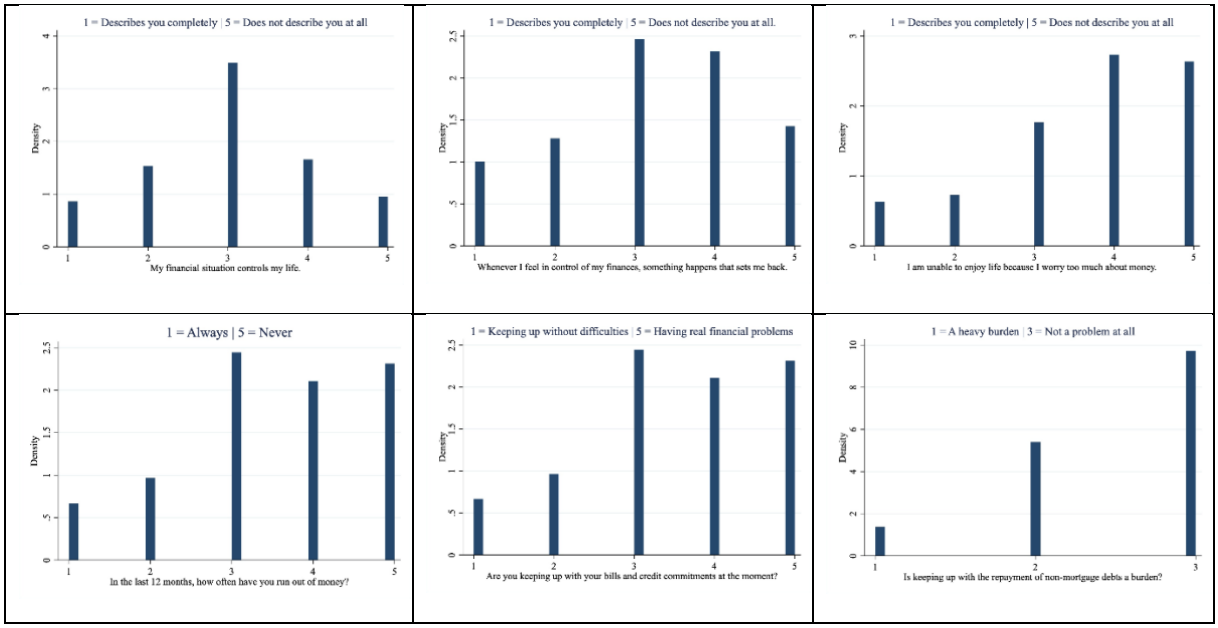
[6] For comparison, the employment rate for adults in the UK in 2017 was estimated at 75% and 85% of these workers reported being paid on a monthly or four-weekly basis, for a cumulative total of 64% (ONS, 2017).

[7] Winsorizing is a method of dealing with outliers, by replacing the smallest and largest values (in our case the top and bottom percent) with the observations closest to them.

Most variables in our observational data are computed as means over the full 11 months of available data. Exceptions are non-time varying factors such as account characteristics, the monthly salary indicator (1 if the 70% income criterion is met in at least two-thirds of months; 0 otherwise), digital banking indicators (1 if registered for internet/mobile banking; 0 otherwise), and our measures of account and income volatility (explained at the end of this section).

Table 1 provides the summary statistics of our sample. Compared to the entire UK market for current accounts (see Caflisch et al., 2018, p. 10), our sample is slightly younger and more likely to be registered for mobile and internet banking. Average and minimum balances are low, as expected given the sampling procedure. The median consumer in our sample has a minimum balance just above zero, with the median consumer spending an average of 2.36 days in overdraft and 69% of our sample having spent at least one day in overdraft during the 11 months we observe. In sum, consumers in our sample go into the red more frequently than the average UK consumer.[8]

Figure 1. Distribution of responses for questions measuring financial wellbeing



Notes: Some items are abbreviated; full item text in Appendix 2.

Next, we summarise responses to the financial wellbeing items in the survey. Figure 1 shows the distribution of answers for each of the six items. The three items in the top panel are taken from the money management stress scale in Netemeyer et al. (2018); bottom panel items are from the UK Wealth and Asset Survey (WAS) and were also used in previous FCA research on financial distress (Gathergood & Guttman-Kenney, 2016).

One notable pattern in Figure 1 is considerable proportions of our sample giving answers near the extremes of the scale, indicating that subjective financial wellbeing varies widely within our sample. We also note that responses to the WAS items, which are closely linked to objective financial measures, are broadly in line with what we observe in the

[8] The FCA estimates that 37% of all consumers use arranged overdrafts and 25% use unarranged overdrafts (see FCA CP18/13) in a given year. This implies an upper bound of overdraft usage in the population of 62%, although the actual percentage is likely to be lower due to overlap between arranged and unarranged overdraft users.

account data. For example, the WAS item on running out of money is consistent with the respondents' data on minimum balances. The other two WAS items suggest that a considerable proportion of consumers in our sample report difficulties keeping up with credit payments, consistent with the frequent use of overdraft credit in the account data. Interestingly, our sample's distribution of responses to the WAS items is also a close match with the general UK population (see Gathergood and Guttman-Kenney, p. 21). This is striking: although consumers in our sample have lower account balances and are more likely to run out of money in their account than the average consumer, they do not report much more difficulty keeping up with commitments.

Account balance, income and spending volatility

We are interested in the effect of financial volatility, both in terms of account balance, income and spending. Using the 11 months of account data, we measure the between-month variation in average account balance (stock), income (flow) and spending. Our approach differs from past research in our estimation of *relative* volatility. To avoid problems arising from standard measures of variation, which are strongly sensitive to the mean and outliers, we instead use the second-order coefficient variation developed by Kvålseth (2016), which expresses volatility as a number between 0 and 1:

$$Volatility = \sqrt{\frac{(\sigma/\mu)^2}{1 + (\sigma/\mu)^2}}$$

where σ is the standard deviation and μ is the mean (both of which may be replaced by sample moments). To illustrate, someone with a completely stable income of £1,000 per month will have a volatility coefficient of zero, someone who alternates between receiving £2,000 per month and £0 has a volatility coefficient of 0.72 and someone who alternates between £500 and £1500 will have a coefficient of 0.46. Someone who alternates between £1000 and £3000 will also have a coefficient of 0.46, illustrating how deviations from the mean are scaled by the mean. This definition matches intuitive notions of volatility, whilst avoiding some of the issues associated with other variance measures.

Scale development

To accurately measure subjective financial wellbeing requires a reliable and internally consistent measurement scale. We therefore assessed whether the six questions measured the same underlying construct and considered the need to remove any questions deemed problematic. We accomplish this by applying standard techniques from psychometrics, the study of measuring mental capacities and processes.

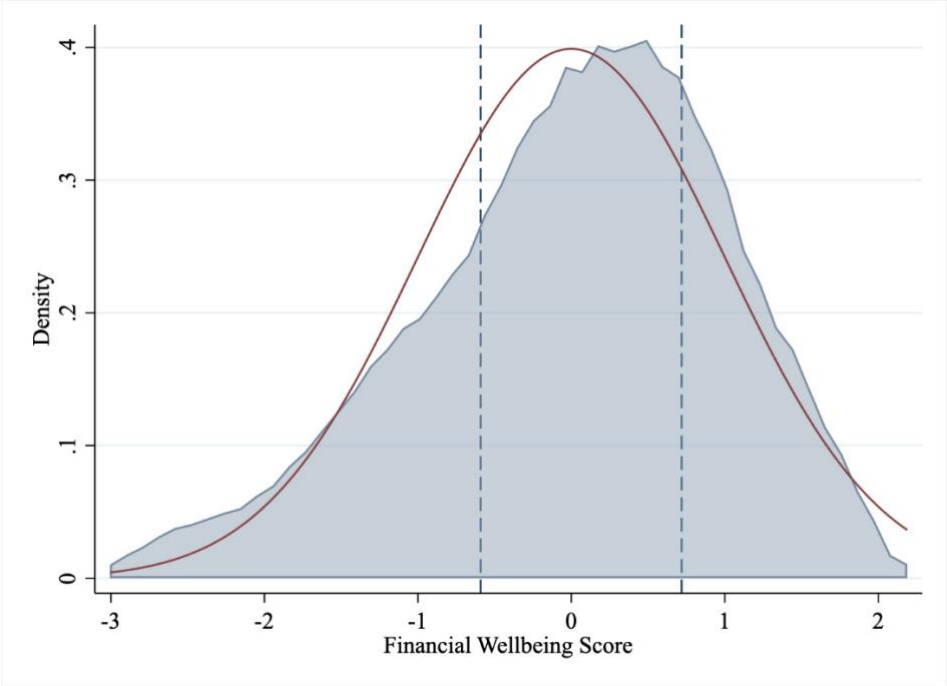
To measure financial wellbeing reliably, our goal was to select questions that have a high correlation with the total score. We calculate the item–rest correlation for each of the questions, which is the correlation between the question and the sum of the rest of the question scores. These were all reasonably high (r = .46–.58), except for the question "Are you keeping up with your bills and credit commitments at the moment?", which had a lower item-rest correlation (r = .29). The low correlation suggests this question is not sufficiently representative of the construct of financial wellbeing compared with the other questions asked in the survey, and we therefore remove this question from further analyses. To measure the internal consistency of the scale, that is, how closely related

the remaining set of five items are as a group, we calculated the Cronbach alpha (α = .76), indicating an acceptable level of reliability.

To generate a single measure of financial wellbeing, we next applied a principal components analysis on the five remaining questions, which is a statistical procedure that reduces the dimensionality of data by transforming a larger set of variables into a smaller one that still contains most of the information in the larger set. The principal component analysis showed only one component with an eigenvalue greater than 1, and this explained the majority (51.34%) of the variance across the questions. We use this metric as our measure of financial wellbeing in subsequent analyses, which is a weighted linear combination of all three 'money management stress' questions and two of the three WAS survey items. To aid interpretation, the principal component was standardisd to reflect a z-score (Mean = 0, SD = 1, Range: -2.82, 2.01). We present a kernel density plot of the measure in Figure 2. For robustness, we also conducted our analysis on a measure based on just the three 'money management stress' items, thus excluding including the WAS items. None of our main findings changes when we use this alternative measure, as shown in the regression table and plots in Appendix 3.

The plot visualises the distribution of our measure overlaid with a red line representing a normally distributed density in red. As can be seen, our measure approximates a normal distribution but has a slight positive skew, with more people reporting above average financial wellbeing scores (Median = .135), and also a more pronounced negative tail of those who feel financially stressed. The dashed lines represent the 25th and 75th percentiles of the sample, meaning that a quarter of our sample had scores below -.591 and above .719.

Figure 2: Kernel density plot illustrating the distribution of financial wellbeing measure



Notes. Dashed lines represent 25th and 75th percentiles.

4 Results

We begin by describing the associations between subjective financial wellbeing and objective metrics from bank account records. We then take a closer look at the role of financial volatility and the use of overdraft credit. Finally, we investigate whether certain objective metrics have a non-linear relationship with wellbeing. Additional analyses and models are included in Appendix 2.

Given the cross-sectional nature of our data, we are only able to describe correlations between our variables; we are not able to provide causal evidence for how objective metrics influence financial wellbeing. Nevertheless, our results show which characteristics and account behaviours are most strongly associated with and predictive of (in a chronological sense) lower financial wellbeing. We hope these insights will motivate future research and interventions to test the potential causal associations between these variables.

Who reports higher subjective financial wellbeing?

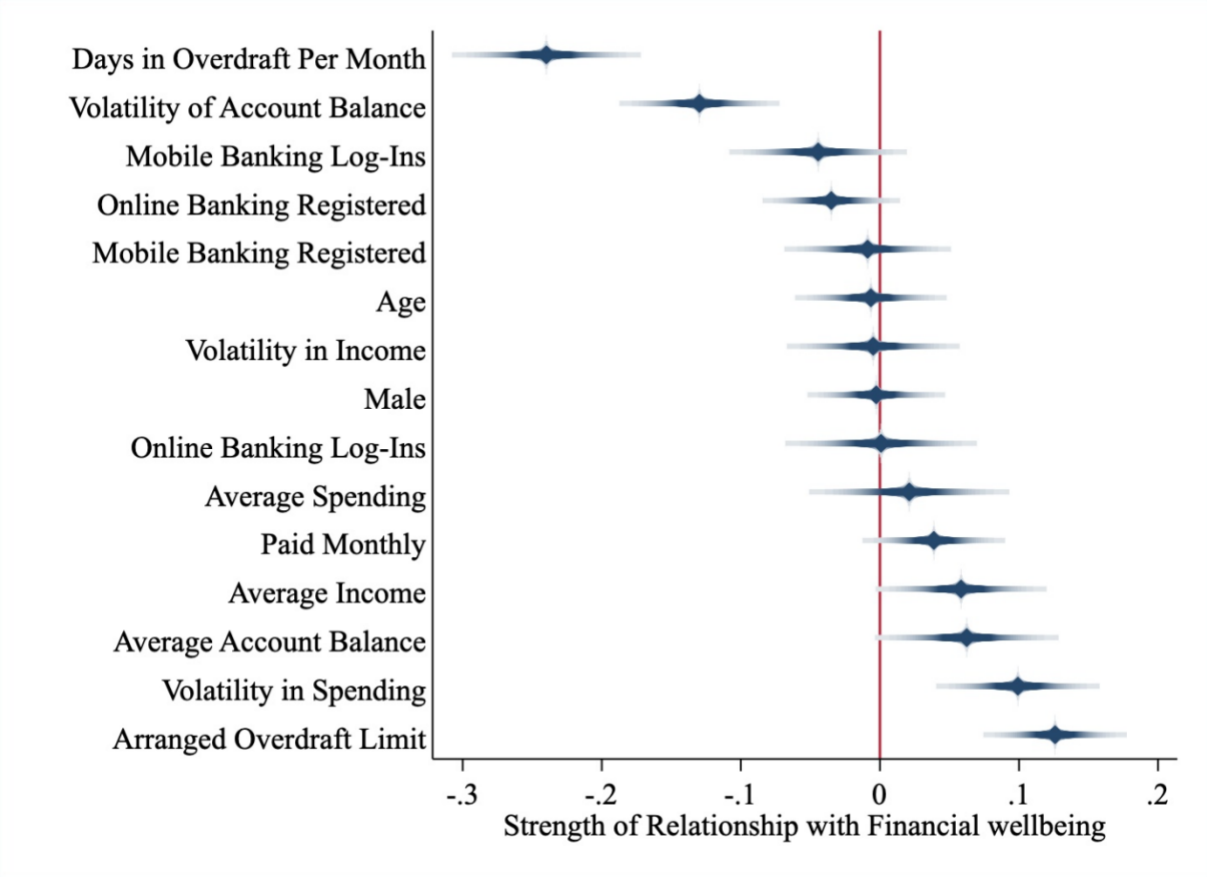
To understand the strength and direction of the relationship between activity on consumers' bank accounts and financial wellbeing, we predict financial wellbeing from each of the account variables using a multiple OLS regression model. We also include demographic variables to better isolate the unique contribution of the account data.

To more easily interpret the relative strength of each variable's association with financial wellbeing, we standardise coefficients as shown in Figure 3. Standardised coefficients are measured in units of standard deviation. For example, a beta (β) value of 1.5 indicates that a change of one standard deviation in the independent variable results in a 1.5 standard deviations increase in financial wellbeing. The coefficients in Figure 3 are ordered from the strongest negative association with financial wellbeing (top) to the strongest positive association (bottom).

The account variables most negatively associated with financial wellbeing are the number of days spent in overdraft per month (β = -.23), and volatility in account balance (β = -.11). The strongest positive associations are between the maximum limit of their arranged overdraft (β = .13), volatility in spending (β = .10), their average account balance (β = .10) and their monthly income (β = .06).

By contrast, demographic information, such as a person's age and gender, generally has weaker relationships with financial wellbeing. The result for age is surprising, as older people are typically found to have higher financial wellbeing, e.g. due to wealth building up over time (Netemeyer et al., 2018). That we do not find a similar result here is perhaps due to the survey's oversampling of consumers with lower account balances. It is also striking that use of online and mobile banking is not associated with differences in wellbeing, on average.

Figure 3: Coefficient plot of standardised beta coefficients predicting subjective wellbeing



Notes: The bands around the coefficients represent 99% confidence intervals. The further away they are from the zero line, the stronger the expected relationship with financial wellbeing is.

We next inspect the unstandardised coefficients *b* (Table 2). These describe how financial wellbeing is associated with the account variables in more meaningful units. For each additional £1000 in income a person earns, we expect an associated increase in their financial wellbeing of .04 standard deviation units. We also see higher financial wellbeing is associated with holding more liquid wealth (account balance) and greater available liquidity through arranged overdraft credit. It is striking that the coefficients for these two sources of liquidity are so similar - for every extra £1,000 in average account balance (arranged overdraft credit) there is an associated increase in financial wellbeing of .13 (.16) standard deviation units. Stability in liquid wealth also seems to be an important indicator of financial wellbeing, with those with higher volatility in their account balances over time also reporting lower levels of financial wellbeing.

Unlike the availability of pre-arranged overdraft credit, the *use* of credit is negatively associated with financial wellbeing: every extra day spent in overdraft per month is associated with a considerable decrease of .1 standard deviation units. Since the total days of overdraft per month comprises the use of both arranged and unarranged overdraft facilities, this result deserves further analysis. Later in the results section, we analyse both types of overdraft separately.

The pairwise correlations are listed in the final column of Table 2. These represent the simple zero-order relationships without controlling for the other variables in the model. The direction and strength of the associations are generally consistent with the standardized coefficients. The R^2 of the model shows that 11.9% of the variance in financial wellbeing was explained by the variables in the model. This suggests, unsurprisingly, that there are other explanatory factors of financial wellbeing that are not being captured by our model.

Table 2: OLS regression financial wellbeing (n= 2,481)

Variables	***b***	***SE***	**β**	**Pearson *r***	**R^2**
Balance	0.13***	0.03	0.10	.17	11.59
Income	0.04**	0.02	0.06	.08	3.53
Income paid monthly	0.08†	0.04	0.04	.07	2.48
Spending	-.01	.03	.02	.04	1.69
Volatility Account Balance	-0.47***	0.09	-0.11	-.15	16.08
Volatility Income	-.01	0.02	-.01	.05	0.7
Volatility Spending	.55***	.12	.10	.09	6.52
Gender (1=male)	0.00	0.04	0.00	.00	0.03
Age	0.00	0.00	-0.01	.02	0.2
Internet banking registration (1=Y)	-0.09*	0.04	-0.04	-.05	1.94
Mobile banking registration (1=Y)	-0.01	0.05	0.00	-.03	0.32
Internet Log-ins	0.00	0.00	0.00	-.01	0.16
Mobile Log-ins	0.00	0.00	-0.04	-.09	3.32
Overdraft Days per Month	-0.10***	0.01	-0.23	-.26	44.08
Arranged Overdraft Limit	0.16***	0.03	0.13	.05	7.38
Constant	.092	.10	-	-	-

Notes: Reported coefficients are from an Ordinary Least Squares (OLS) regression of financial wellbeing on the listed variables. Significance levels: *** p < .001, ** p < .01, * p < .05, † p < .1

One concern with our regression approach is the potential for multicollinearity, which refers to high intercorrelations among independent variables in a multiple regression model. If two or more variables are highly related (e.g., income and average account balance), this can lead to skewed or misleading results. To ensure the model is properly specified and functioning correctly, we calculated variance inflation factors (VIF) for each predictor variable, which measures the amount of multicollinearity in a set of multiple regression variables. The VIF scores were all below 2.25 (far below the generally

accepted cut-off of 10). Thus, multi-collinearity does not appear to be a cause for concern.

This issue of multicollinearity is also relevant when considering which variables contribute most to predicting financial wellbeing. When the predictors are correlated, it is difficult to separate the effects of individual predictors. We conduct a dominance analysis to calculate the relative importance of each predictor based on its contribution to the R^2 (Budescu & Azen, 2004). For each variable, the overall variance explained in the continuous dependent variable (R^2) was decomposed into the percentage attributed to each independent variable. This is done by running each possible subset of regression models, which was 32,767 in our case. The variable which explained the most variance was the average number of days per month in overdraft, at 44.08% of variance. Second was the level of volatility in consumers' account balances, explaining 16.08%. Third was the average balance of their account (11.59%), followed by arranged overdraft limit (7.38%).

Volatility and financial wellbeing

One of the goals of our research was to test whether our measures of volatility were significantly correlated with participants' subjective financial wellbeing. Our regression model indicated that some forms of financial volatility were reasonably strongly associated with financial wellbeing. As might be expected, a higher volatility in account balance was negatively related with financial wellbeing. This is consistent with the idea that stability is an important component of financial wellbeing: people need a financial buffer. Combined with our findings on sources of liquidity, this suggests an important role for liquid assets to play in budgeting. However, income volatility and spending volatility did not show the same negative relationship with financial wellbeing.

Instead our model estimates that, after controlling for the other covariates in the model, income volatility was not significantly associated with financial wellbeing. In other words, we cannot reliably distinguish the coefficient estimate from zero. One possibility is that this is due to the model also including account balance volatility, as the two of these may be closely related. The intuition here is that because lower-income households also tend to have fewer assets and less savings, income volatility leads to balance volatility. Although we find that income and account balance volatility are significantly correlated (r = .31), the correlation between income volatility and financial wellbeing (without controlling for account balance volatility) was small (r = .05) and explained only a small amount of the variance in financial wellbeing (.07%). Therefore, the weak relationship between income volatility and financial wellbeing is not explained by account balance volatility in our data.

We also found that spending volatility was positively related to financial wellbeing; those with more volatile month-to-month spending reported higher levels of financial wellbeing. This may reflect that those with greater spending volatility simply have more discretionary money to spend. However, the correlation between total spending and spending volatility was small (r = .014) and not significant.

One possible explanation for our findings on volatility is that they are driven by the extent to which incomings and outgoings fluctuate together. When ups and downs in expenditure closely track ups and downs in income, for example because the consumer

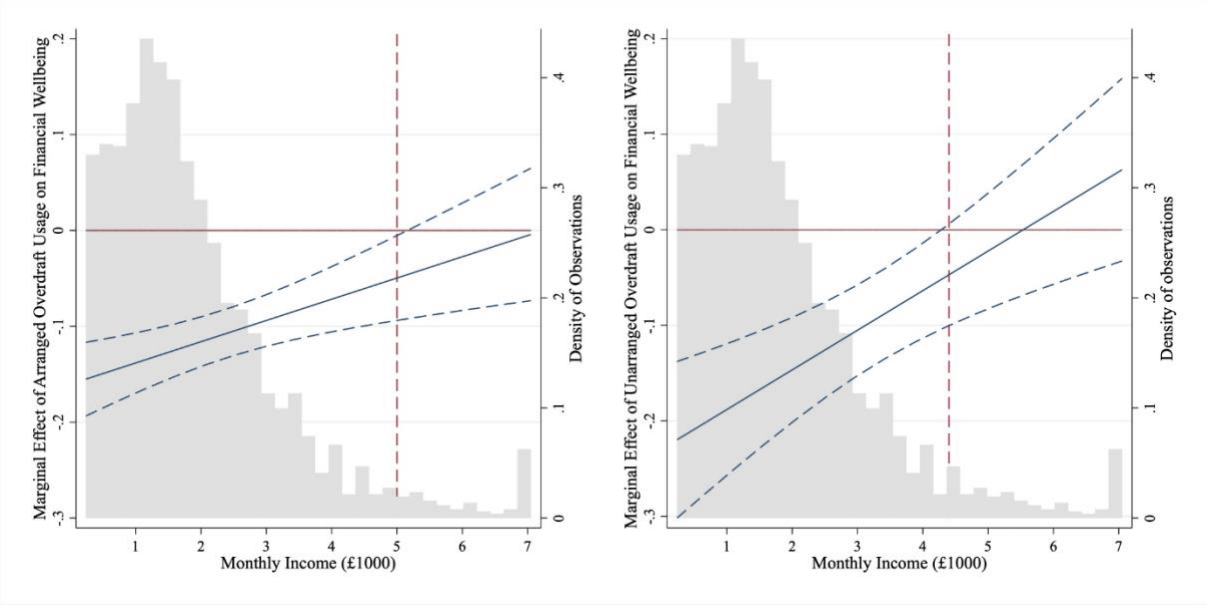
has a high marginal propensity to consume their income, account balance volatility will be low. But when there is a mismatch between expenditure and income cycles, the positive effect of expenditure volatility is offset by an increased volatility in account balance. This means that people with mismatched income and spending patterns have relatively lower financial wellbeing for the same level of expenditure volatility.

Effect of overdraft borrowing on financial wellbeing

We found overdraft use to be negatively associated with financial wellbeing, and to account for a large proportion of the explained variance (44%). However, this may be an over-simplification, both because there may be differences between unarranged and arranged overdraft use, and these effects might primarily affect those with low income levels. Higher income could act as a buffer against expenditure volatility and therefore overdraft use influences financial wellbeing less for those with higher incomes.

We run regression models based on the baseline regression reported in Table 2. This time, we include interaction effects between both arranged and unarranged overdrafts and income. We report the full regression results in Table 3, and to visualize these relationships, we plot the marginal effect of an additional overdraft day per month on financial wellbeing in Figure 4.

Figure 4: Marginal effect of overdraft use on financial wellbeing across income levels



Notes: Left panel shows arranged overdrafts, right panel shows unarranged overdrafts.

The graphs illustrate that overdraft usage has a negative relationship with financial wellbeing for both arranged and unarranged overdrafts. The upward-sloping line in both represents that this association is strongest for those with the lowest incomes. In fact,

for those with higher incomes, we cannot distinguish the overdraft use coefficient from zero. The line is steeper for unarranged overdraft use, suggesting a stronger association, although the difference in slope between the two overdraft types is not statistically significant. The vertical dashed line represents the point where the interaction is no longer significant (where the confidence interval crosses zero). For unarranged overdrafts, this is for those with incomes greater than £4400 per month. For arranged overdrafts, it is £5000 per month. A plausible interpretation is that going overdrawn has less impact on those with a high income, as they have the financial resources to cope with whatever shock leads them to become overdrawn. The figure also shows histograms of income (in grey) that show most incomes in our sample are on the left side of the diagram, such that for the majority of those in our sample there is a negative association between financial wellbeing and overdraft use.

Table 3. Regression models predicting financial wellbeing including interactions between overdraft usage and income

Variables	**Model 5**		**Model 6**	
	b	**SE**	**b**	**SE**
Balance (£1000)	0.14***	0.03	0.25***	0.05
Income (£1000)	0.02	0.04	0.04**	0.02
Income paid monthly	0.07†	0.04	0.07†	0.04
Arranged Overdraft Days	-0.16***	0.01	-0.22***	0.04
Unarranged Overdraft Days	-0.10***	0.01	-0.11***	0.01
Arranged Overdraft Days *x* Income	.02**	0.01	-	-
Unarranged Overdraft Days *x* Income	-	-	0.04***	0.01
Male	0.00	0.04	0.00	0.04
Age	0.00	0.00	0.00	0.00
Internet Banking	-0.09*	0.04	-0.09*	0.04
Mobile Banking	-0.01	0.05	-0.01	0.05
Internet Log-ins	0.00	0.00	0.00	0.00
Mobile Log-ins	0.00	0.00	0.00	0.00
Overdraft Limit (£1000)	0.16***	0.03	0.17***	0.03

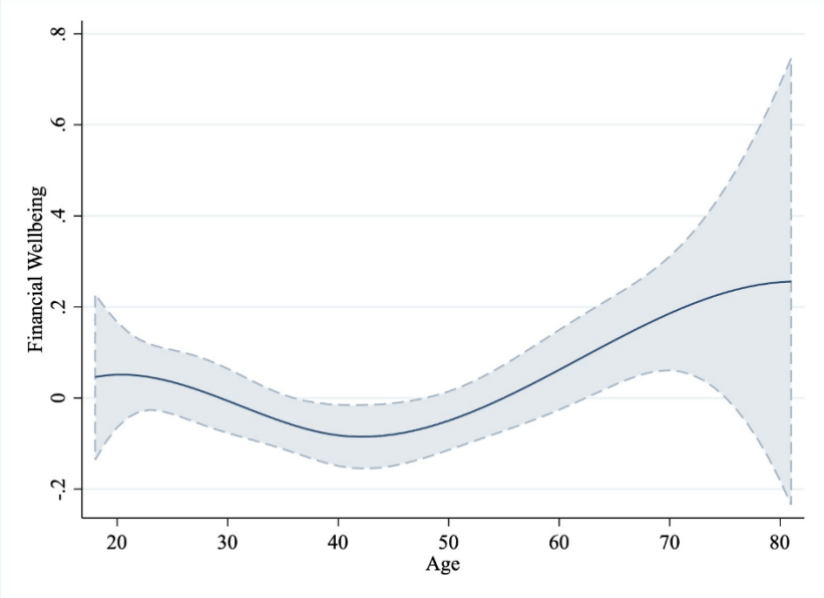
*** p < .001, ** p < .01, * p < .05, † p < .1. N = 2481. Arranged and unarranged overdraft days are per month. Standard errors are robust.

The shape of financial wellbeing

To understand how bank account records are related to subjective financial wellbeing, it is important to investigate not only whether these measures are positively or negatively correlated, but also to consider their shape. The regression models we have reported so far have assumed a linear relationship between financial wellbeing and objective account metrics. In other words, they assume that the amount of change in financial wellbeing associated with a unit increase in a variable like an arranged overdraft limit, holding all other variables constant, is the same regardless of the level of overdraft limit (e.g. increasing from the 10th to 20th decile, or from the 80th to 90th decile). To see how realistic this assumption is, we will visualise the true shapes of these relationships in this section.

If the relationships between objective account metrics and subjective wellbeing are non-linear, this can misrepresent the strength of an association when using tests which assume linearity. For example, if the relationship between financial wellbeing and digital records of income volatility are curvilinear, then income volatility may be more strongly associated with financial wellbeing than prior research suggests, and there may be a need to consider more closely the precise way in which income volatility influences financial wellbeing.

Figure 5. Estimated financial wellbeing and age (from nonparametric regression)

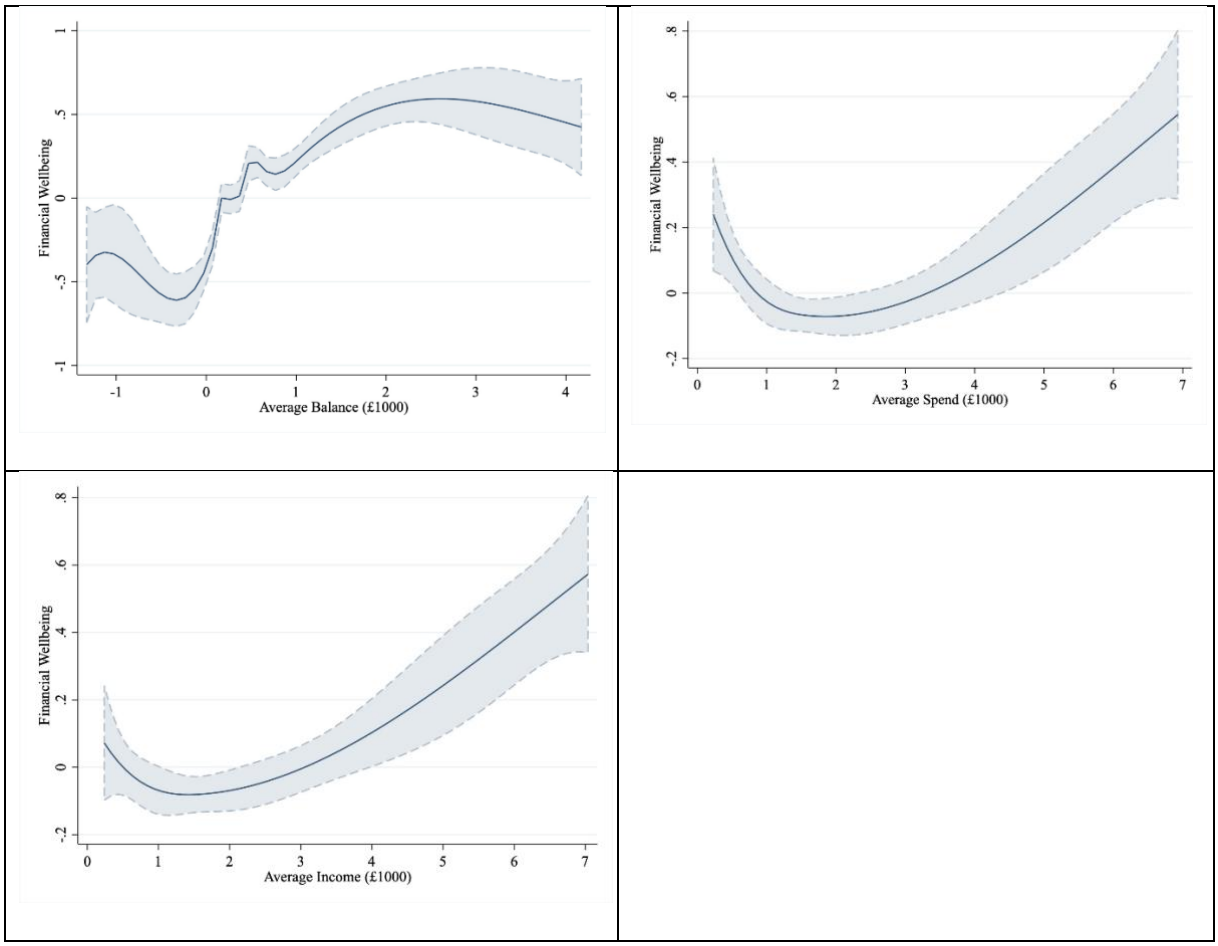


In the remainder of this section, we illustrate the relationship between financial wellbeing and our objective metrics using nonparametric regression models. This approach differs from our previous regression models in that it does not rely on strong assumptions regarding the shape of the relationship between the variables. Instead, the data are allowed to 'speak for themselves' in determining the form of the relationship. While several approaches exist, including kernel smoothing, local polynomial regression, and regression trees, we perform nonparametric series estimation using a B-spline. This

approach selects a basis function that includes the terms that minimise the mean squared error. We chose to use B-splines over other methods as they better approximate a smooth function by continuously connecting a set of low-order polynomials.

We begin by analysing how subjective financial wellbeing varies across age in our sample. We did not find a relationship with age in our earlier regression models, which may have been the result of non-linear associations with age. We plot the estimated level of financial wellbeing across the distribution of age in Figure 5. This shows a shallow U-shaped curve, with financial wellbeing lowest for those in middle age, and higher for those younger and older. This is consistent with research on life-stages, which shows financial stress is highest in middle age where financial demands are also greatest (Wrosch et al., 2000). This pattern is consistent with that found in studies of happiness and life satisfaction (Graham & Ruiz Pozuelo, 2017), including from studies using measures such as antidepressants rather than subjective survey measures (Blanchflower & Oswald, 2016). It is worth noting that the wide confidence intervals on the right-hand side of the graph partly reflect the relatively small sample we have in this older age group (5% of sample are over 68).

Figure 6. Estimated financial wellbeing and average account balance, spending and income (from nonparametric regression)



We next visualise financial wellbeing across income, spending and account balance (Figure 6). The figure which stands out as having the most clearly non-linear shape is

account balance. Here, we can see a jump in expected financial wellbeing for those with average balances going from below to above zero. In contrast, we see diminishing returns as average account balance goes above approximately £2,000. This may indicate that having positive account balances is psychologically reassuring (Ruberton et al., 2016), or reflect the stress of not knowing if sufficient credit will be available to fund expenditures once account balance drops below zero.

Income and spending show similar patterns: a strong positive relationship above £2,000 per month, but with U-shaped curves beneath this amount. While we can only speculate as to the cause of higher wellbeing at the lowest levels, it may reflect those with less complicated financial lives (e.g. relatively wealthy retirees or adult children still living at home – mirroring the U-shaped curve for age shown in Figure 5). It is worth noting that in neither case do we see diminishing returns with higher incomes and spending, but as our sample is drawn from less financially secure consumers, we may not be capturing enough wealthier consumers to draw inferences at the high end.

Figure 7. Estimated financial wellbeing and average account balance, spending and income volatility (from nonparametric regression)

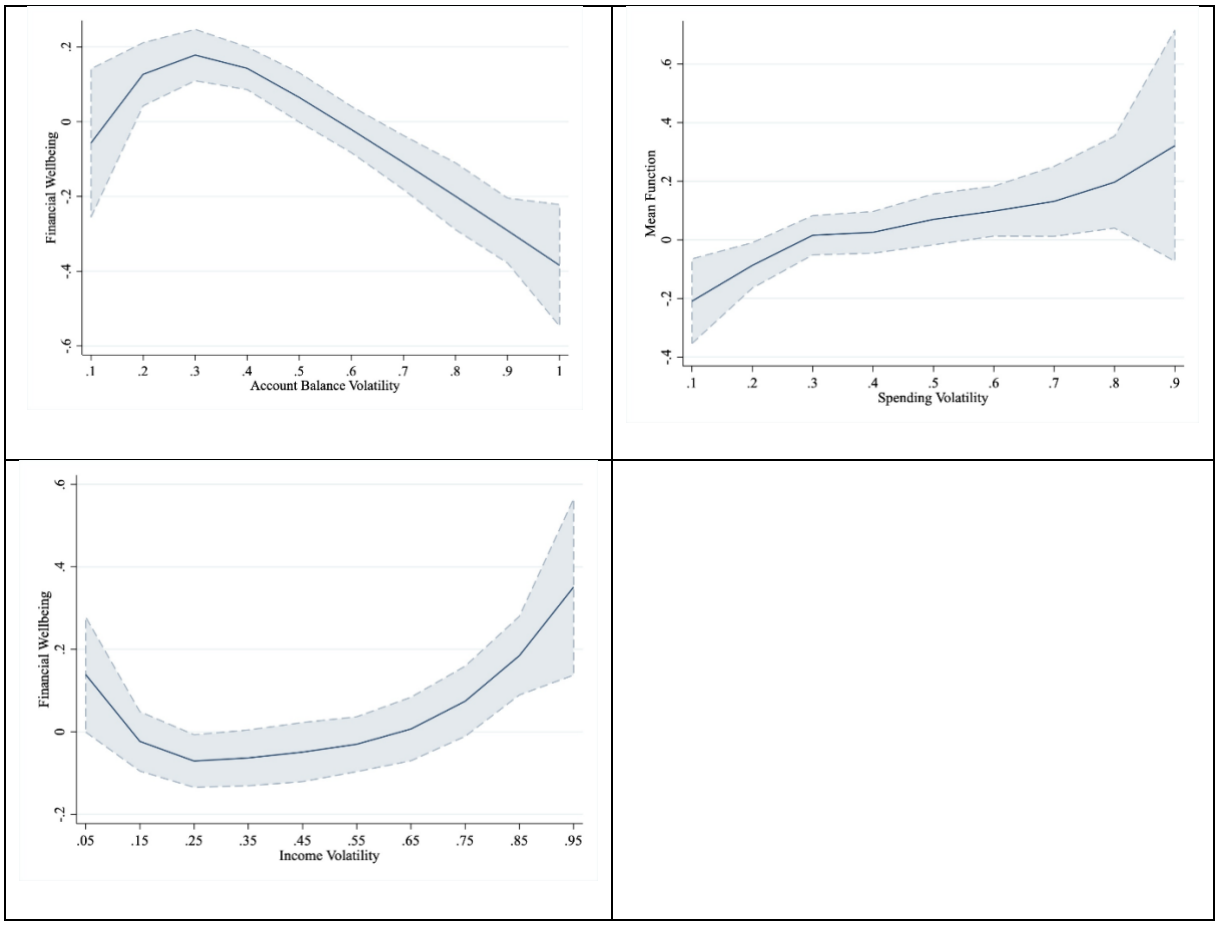
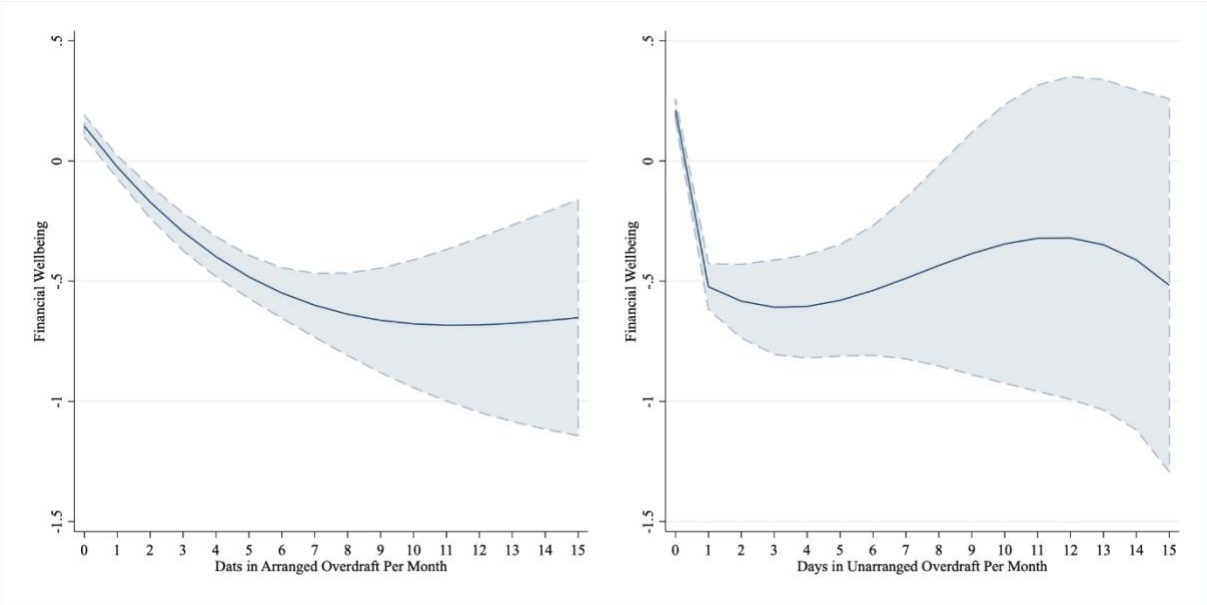


Figure 7 illustrates the relationship between financial wellbeing and measures of volatility. The earlier analyses showed volatility in account balance was negatively correlated with financial wellbeing (r = -.15), while spending volatility (r =.09), and

income volatility (r = .05) were positive but weaker. We can see these patterns in the plots below, albeit for different reasons. Those with the most volatile account balances had the lowest financial wellbeing, and this association was negative and monotonic from around -1. In contrast, income volatility showed a u-shaped pattern, which can help explain why the linear model indicated a weak relationship. This may be due to higher-income individuals being disproportionally better equipped to handle changes in income, for example due to greater wealth. Another explanation is that income volatility is correlated with other characteristics, such as riskier career choices, related with greater reported wellbeing.

Figure 8. Estimated financial wellbeing and number of days spent in overdraft (from nonparametric regression)



Finally, we look at the number of days consumers spent overdrawn on their account each month – see Figure 8. The graphs show a steep negative relationship; a person who spends on average 4 days overdrawn is substantially less financially well off on average than one who spends zero days overdrawn. This relationship also appears to be subject to diminishing returns as the number of days spent overdrawn increases. The pattern is consistent across both types of overdrafts, though is stronger for unarranged overdrafts. It should be noted that relatively few consumers had a high number of days spent overdrawn per month on average (only 10% had more than 4.7 days per month).

These non-linear relationships provide an alternative view on the data. By looking at non-linear relationships, our attention might be directed towards types of consumers that might require additional support. One interpretation of these findings is that specific groups of consumers might uniquely benefit from certain policy interventions. By understanding the 'shape' of the relationship of objective metrics and subjective wellbeing, we know much more about how to identify these groups of consumers.

Limitations and robustness checks

A major limitation of the current investigation is the reliance on data from a cross-section in time, providing only a snapshot of what are dynamic and complex processes. This precludes us from testing the causal direction between subjective financial wellbeing and account behaviours (i.e., does financial stress make people more likely to behave in certain ways, or vice-versa?). Future research would benefit from collecting repeated measures over time, including repeated measures of subjective financial wellbeing, which would make it possible to rule out alternative explanations by analysing within-person changes. However, even with longitudinal data, it is not possible to eliminate these problems entirely.

A further limitation is that while the records we use are a detailed source of information, we are only able to measure what was captured and shared by the two banks we partnered with. For reasons of privacy and data security, we chose not to request detailed metrics, such as online banking behavioural analytics data, and transaction details such as descriptions and merchant identifiers. Our data are therefore limited in the detail they cover. Additionally, if customers have accounts with other banking providers, we will be capturing fewer of their financial activities. This may limit our ability to generalise beyond the current sample. This is related to an additional concern, in that our sample is not nationally representative. The consumers in our sample had lower account balances and were more likely to run out of money than the average consumer, but do not report more difficulties in keeping up with payment commitments.

5 Discussion

Consumers vary in their subjective perceptions of their financial circumstances. In this paper, we developed a measure of subjective financial wellbeing and predicted these responses from people's financial bank records. While a large body of research has investigated the topic of financial wellbeing, we are one of the first to take advantage of linking data from customer financial records with self-reported information, providing richer insights into how these measures are related.

As might be expected, our findings indicate that those with the highest self-reported wellbeing had higher incomes, higher average account balances and were less likely to use their overdraft facility. More surprisingly, other significant predictors of financial wellbeing were whether someone had a large available overdraft limit and had greater month-to-month variability in both their balance (a negative correlation) and their spending (a positive correlation). An explanation that is consistent with these seemingly contradictory patterns is that lower subjective wellbeing stems from mismatches in income and expenditure – more volatile expenditure may simply be an indicator of being able to afford (at least in the short term) greater expenditure, whereas a volatile balance indicates that incomings and outgoings do not line up, creating stress. Especially when external sources of wealth and liquidity are available, fluctuations in expenditure can be covered and do not lead to large fluctuations in account balances.

We did not find a relationship between income volatility and wellbeing, in contrast to a policy and research literature that links income volatility to lower wellbeing. There could be several reasons for this discrepancy. It may be that our measure of subjective financial wellbeing, money management stress, does not fluctuate with income volatility whereas other wellbeing measures (e.g. happiness or life satisfaction) do. Another reason could be our choice of income volatility metric, variation in monthly income. Although this seems a natural interpretation of income volatility, and one that can be measured reliably for all our sample, it may not represent the kind of income volatility that is most disruptive. Income fluctuations on a weekly or fortnightly basis may impact those with shorter budgeting horizons. Some indication that the frequency of income receipts, not just the extent to which it fluctuates, also matters is the positive (and marginally significant) correlation between getting paid monthly and subjective wellbeing. Finally, it may be that disruptive income volatility does not show up in our account-based metric as households use flexibility in their labour supply to make up for temporary shortfalls.

Our results provide insights into which account behaviours could be used to predict people with low financial wellbeing. The strongest overall indicator of low financial wellbeing was the number of days spent overdrawn, which was responsible for almost half (44%) of the variance explained in our model. Other indicators that change with consumer behaviour, such as account balance volatility, spending volatility and frequency of income receipt, can also be used as indicators of lower financial wellbeing. An important question for further development of such indicators, and one which would require data collection over longer periods of time, is whether changes in any of these metrics for an individual consumer are indicative of changes in financial wellbeing.

It is also important to recognis that the relationship between the bank records and subjective responses to the survey items was not as strong as might be expected. Consumers' perceptions of how they are doing financially are not simply a reflection of their payslip or bank balance. The correlation coefficients between account behaviours and financial wellbeing ranged between 0-.26, indicating small-to-medium effect sizes (Cohen, 1988). This suggests that two people with similar account behaviours (e.g., similar income and assets) can thus have different perceptions of their subjective financial situations, and that different factors – many of which are missing from our current analyses – will contribute to these perceptions.

In today's increasingly digital world, data on financial behaviour are being captured at an unprecedented scale. Matching these records to subjective perceptions creates substantial opportunities to improve consumer welfare. Our research points towards the potential of predicting financial wellbeing from bank records. Using similar datasets to ours which also include a broader and more detailed set of variables, firms could use account data to predict the financial wellbeing of their clients. For example, firms can use machine learning algorithms (which can accommodate the kind of non-linearities we document) to determine those experiencing financial hardship – and implement measures to help these individuals.

In combination with tests of different support interventions and nudges towards these, firms can develop a tailored and effective suite of solutions to support financial wellbeing. The creation of such solutions starts with a better understanding of how bank record data reflects consumers' subjective experiences. Recent research by the Money and Mental Health Charity (2019) suggests that consumers are increasingly receptive of such tools and products.

One promising area of research is the divergence between subjective and objective measures of financial wellbeing. Data from consumer panels can be used to detect such differences, which may be explained by a combination of consumer characteristics, attitudes and circumstances. It may be, for example, that consumers with specific life experiences are better than others at handling economic shocks, meaning their subjective wellbeing does not respond as strongly to changes in objective financial wellbeing. In times of economic uncertainty, these findings could be important in targeting groups of consumers who would benefit most from extra support.

In closing, a note of caution. The growth of data collection on consumer behaviour and increasing sophistication of modelling techniques of consumers' state of mind also raise serious questions about protecting consumers from harm. Identifying potentially susceptible consumers through such means can allow bad actors to target individuals in ways that might not be in their best interests. This means that as the potential for inferring consumers financial wellbeing becomes more ubiquitous as financial behaviours are increasingly recorded digitally, there is an urgent need for policymakers to ensure that individuals are protected against potential abuse of such technologies.

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Appendix 1: Survey script

Below is the telephone script used for the survey. Only the sections relevant to this paper are shown.

INTRODUCTION

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

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

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

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

Thank you. Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society. I'd also like to inform you that this call will be recorded and may be monitored for the purposes of training and quality control.

IF NECESSARY:

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

IF NECESSARY:

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

IF NECESSARY:

If you have any questions about the project or would like to confirm that the FCA is commissioning this research, please call the FCA's Contact centre on [Phone number redacted]. If you would like to check the validity of this call or check we are a bona fide research agency, you can ring the Market Research Society freephone number on [Phone number redacted]. If you would like to contact [Agency name], please call [Phone number redacted].

IF RESPONDENT ASKS: [BANK NAME] passed details to [Agency name], based on a request from the FCA.

SECTION 1 – FINANCIAL WELL-BEING

I will read you three statements that could be used to describe a person's financial situation. Could you tell me how much each of these statements describes your current situation?

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

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

Thinking of any non-mortgage debts you may hold, e.g. credit cards, overdrafts, or personal loans, to what extent is keeping up with the repayment of them and any interest payments a financial burden to you? Would you say it was:

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

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

a. Keeping up with all of them without any difficulties	1
b. Keeping up with all of them, but it is a struggle from time to time	2
c. Keeping up with all of them, but it is a constant struggle	3
d. Falling behind with some of them	4
e. Having real financial	5

problems and have fallen behind with many of them	
f. Don't have any commitments	6
DO NOT READ OUT: Don't know	99

In the past 12 months, how often have you run out of money before the end of the week or month or needed to use a credit card or overdraft to get by? Would you say it was:

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

SECTION 5 - CONSENT TO MATCHING QUESTION

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

IF NECESSARY:

How will the linkage be done?

We'd like to link your survey with your credit file and current account transaction history, including information on your use of mobile and online banking. Your current account history includes information about when and how often you use your overdraft. Your credit file includes your credit

score as well as information on your borrowing on other products, for example credit cards. Importantly, the matching process will protect your personal data.

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

IF NECESSARY:

How will your data be used?

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

Appendix 2: Supplementary analysis

Table 4: Responses to survey wellbeing items.

Item	Scale and answers				
My financial situation controls my life.	1 = Describes you completely; 5 = Does not describe you at all.				
	10.1%	17.9%	40.8%	19.4%	11.1%
Whenever I feel in control of my finances, something happens that sets me back.	1 = Describes you completely; 5 = Does not describe you at all.				
	11.7%	15.0%	28.9%	27.2%	16.7%
I am unable to enjoy life because I worry too much about money.	1 = Describes you completely; 5 = Does not describe you at all.				
	7.5%	8.5%	20.7%	32.1%	31.0%
In the past 12 months, how often have you run out of money before the end of the week or month or needed to use a credit card or overdraft to get by?	1 = Always; 5 = Never.				
	7.8%	11.4%	28.7%	24.7%	27.2%
Are you keeping up with your bills and credit commitments at the moment?	1 = Keeping up without any difficulties; 5 = Having real financial problems and have fallen behind with many of them.				
	50.2%	34.1%	5.2%	3.2%	1.4%
Is keeping up with the repayment of non-mortgage debts and any interest payments a financial burden to you?	1 = A heavy burden; 3 = Not a problem at all.				
	7.4%		29.2%		52.7%

Notes: Percentages do not add up to 100% due to a small percentage of respondents answering "Don't know" - 0.7%, 0.5%, 0.1%, 0.2%, 0.3%, and 0.3%, respectively. For the fifth item, an additional 5.6% of respondents answered that they did not have any commitments. For the sixth item, an additional 10.3% of respondents answered that they did not hold any non-mortgage debt.

Appendix 3: Regression tables

Table 5: OLS regression predicting financial wellbeing (3 item version)

Bank Customer Variables	***b***	***SE***	**β**
Balance	0.08	0.05	0.04
Income	0.06†	0.03	0.05
Income paid monthly	0.01	0.04	0.01
Spending	0.15**	0.06	0.05
Volatility Account Balance	-0.46***	0.13	-0.08
Volatility Income	-0.01	0.14	0.00
Volatility Spending	0.62**	0.19	0.08
Gender (1=male)	0.01	0.06	0.00
Age	0.00	0.00	-0.01
Internet banking registration (1=Y)	-0.09	0.06	-0.03
Mobile banking registration (1=Y)	0.00	0.07	0.00
Internet Log-ins	0.00	0.00	-0.01
Mobile Log-ins	0.00	0.00	-0.04
Overdraft Days per Month	-0.08***	0.02	-0.13
Arranged Overdraft Limit	0.22***	0.04	0.12
Constant	-0.09	0.15	-

Notes: Reported coefficients are from an Ordinary Least Squares (OLS) regression of financial wellbeing on the listed variables. Significance levels: *** p < .001, ** p < .01, * p < .05, † p < .1. n= 2,481

Table 6: Regression model predicting financial wellbeing (3-item version) including interactions between overdraft usage and income

	b	SE
Balance (£1000)	0.064*	0.033
Income (£1000)	0.025	0.020
Income paid monthly	0.125**	0.041
Overdraft Days	-0.010***	0.002
Overdraft Days *x* Income	0.001†	0.001
Male	0.007	0.040
Age	-0.001	0.002
Internet Banking	-0.074†	0.043
Mobile Banking	0.017	0.050
Internet Log-ins	0.000	0.003
Mobile Log-ins	-0.001	0.001
Overdraft Limit (£1000)	0.167***	0.028

*** p < .001, ** p < .01, * p < .05, † p < .1. N = 2481. Overdraft days are per month. Standard errors are robust.

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