The link between digital skills and financial inclusion – Evidence from consumers survey data from low-income areas

Abstract

Financial and digital inclusion are key consumer policy agendas for governments globally. Yet, despite the importance of online interfaces to manage finances and make payments, the link between financial and digital inclusion remains under-researched. This study analyses the link between digital and financial inclusion drawing on data from a survey conducted of 922 adults in United Kingdom in 2018. The results suggest that the active use of banking services depends on digital skills. The level of self-rated internet proficiency predicts a variety of ways in which consumers use financial services in the management of their finances, including contactless payments, bank transfers and the use of multiple banking services. This holds even when controlling for socioeconomic and demographic characteristics. Conversely, household income is more important as a determinant than digital skills in checking account balance online. This possibly reflects that liquidity constrained consumers generally prefer to monitor their spending using cash as this provides more precise information on their spending and remaining balance.

Key words: financial inclusion; financial exclusion; digital inclusion; digital exclusion; digital skills

Financial and digital inclusion are key consumer policy agendas for governments globally. The access to and use of digital technology and financial services are associated with better consumer outcomes (Chen et al, 2022; Eisenberg-Guyot et al, 2018) and they ease or constrain access to most other goods and services (e.g., Anderson, 2018; Caselli & Somekh, 2021; Park & Humphry, 2019). Financial inclusion – the ownership and use of formal financial services (Allen et al., 2016) – can help consumers accumulate wealth by providing access to affordable credit and savings accounts (Barcellos & Zamarro, 2021) and in consumption smoothing (Ampudia & Ehrmann, 2017). It can stimulate economic growth by expanding the financial services sector, channelling increased savings into business activity and enabling a more efficient allocation of resources (Allen et al., 2016; Kablana & Chhikara, 2013; Nuzzo & Piermattei, 2020). Moreover, greater financial inclusion may reduce public expenditure through lower transaction costs for welfare payments (Anderson, 2018) and by

enabling households to cope with external shocks, cover life stage expenses and bridge temporary gaps between income and expenditure without relying on the welfare state (Berry, 2015).

In light of the ubiquity of information communication technology in modern society, digital inclusion – relating to access to, skills in, attitudes towards and engagement with the internet and related digital technologies (Helsper, 2012) – is of increasing importance. As one cannot participate in society without being able to access and use digital technology (Park & Humphry, 2019), including accessing information, basic services and employment opportunities, addressing digital exclusion is seen as an important policy goal to reduce inequalities (Lythreatis et al., 2022). Digital inclusion underpins a shift towards self-service solutions in the welfare state in an effort to reduce costs (Schou & Svejgaard Pors, 2019). It is also linked to the financial inclusion agenda, as governments have encouraged a shift from cash to digital payments to promote greater financial inclusion (Mouna & Jarboui, 2022).

There has been significant research into the determinants of digital and financial exclusion in the developed world. Numerous studies have found that people on low incomes, less wealthy, unemployed, ethnic minorities and the less well educated are less likely to own or have access to financial services (Barcellos & Zamarro, 2021; Bunyan et al., 2016; Coffinet & Jadeau, 2017). Similarly, there is a wealth of research on digital exclusion, which suggest that disabled, older, less well educated and people on lower income have lower digital skills and are less likely to use the internet (Blank et al., 2020; Helsper & Reisdorf, 2017; Scholz et al., 2017).

The relationship between digital and financial inclusion is significantly less well researched. A recent systematic review of the literature on financial exclusion concluded that there was a lack of research on the impact of the digital economy on financial exclusion (Fernández-Olit et al., 2020). There are two US studies explicitly focusing on the link between digital and financial exclusion. A report by McHenry et al (2017) looked at the relationship between banked status and level of internet activity in the US and found that unbanked households were less likely to have an internet connection. Another study found technology to be the most important determinant of financial inclusion, with mobile, internet and computer access increasing the likelihood of bank account ownership and use (Karp & Nash-Stacey, 2015). However, these studies only focused on internet access, omitting internet skills, which is an important determinant of effective internet use (Scheerder et al., 2017).

Although previous studies have largely neglected the relationship between digital and financial inclusion, it is hypothesised that they may well be strongly related and hence the

understanding of this relationship is important to understand financial exclusion in contemporary society for three reasons. Firstly, there is ample evidence that the ownership of financial services does not automatically lead to greater use of financial services, as other factors influence use of banking services, such as household income, wealth and education (Allen et al., 2016; Anderson et al., 2018; Greene & Stavins, 2021). Secondly, households are increasingly encouraged or required to use online and digital interfaces to make and receive payments. Thirdly, digital skills remain an important barrier for using the internet, as those with lower self-rated digital skills are less likely to use and make effective use of the internet for news, information, banking and social networking (Blank et al., 2020; Helsper & Reisdorf, 2017; van Deursen, 2020).

Our analysis draws on a survey conducted with 922 adults in the United Kingdom aged 18 to 96 in 2018. A unique feature of the data is that it enabled us to look at the varied specific uses of financial services and digital skills. This is significant because existing research on bank account use tends to focus on point-of-sale (POS) purchases (Greene & Stavins, 2021), unspecified online banking use (Blank et al., 2020) or the intention to use online banking services (Karjaluoto et al., 2019).

Background

Financial exclusion refers to households not owning or not being able to access the wide range of financial services necessary to manage their finances in a financialised society (Fernández-Olit et al., 2018), though most research has focused on bank account ownership (e.g., Allen et al., 2016; Ampudia & Ehrmann, 2017; Coffinet & Jadeau, 2017). There are several negative individual and societal consequences of financial exclusion. Households without a bank account pay more for services (Finney & Davies, 2020) and face larger fees per transaction (Long, 2020) compared with banked households. Financially excluded consumers are more likely to rely on informal loans (Biosca et al., 2020; Long, 2020), nonbank financial services (Birkenmaier & Zamarro, 2021) and commercial high-cost credit, such as payday lending (Financial Conduct Authority, 2019). Not owning and using a bank account also prevent these consumers from building up a formal credit footprint (Biosca et al., 2020).

The determinants of financial exclusion in Europe, US and the UK have been extensively researched (Caplan et al., 2021; Fernández-Olit et al., 2020). Financial exclusion has been found to be concentrated among less wealthy, lower income, unemployed or in

informal employment, ethnic minorities or immigrants, and those with lower educational attainment level (Ampudia & Ehrmann, 2017; Barcellos & Zamarro, 2021; Bunyan et al., 2016; Coffinet & Jadeau, 2017; Fernández-Olit et al., 2018). Research also points to the mistrust in financial institutions as a potential determinant of not being banked or using certain financial services (Barcellos & Zamaro, 2021; Collins et al, 2023). Yet, bank account ownership rates in Europe and the US have increased to near universal levels largely due to the shift to electronic payment of welfare benefit payments (Ampudia & Ehrmann, 2017; Anderson et al., 2018; Fitzpatrick, 2015), and the introduction of basic and low cost, limited functionality bank accounts (Fitzpatrick, 2015; Washington, 2006). Bank account ownership rates currently stand at 97.7% in the UK (Financial Conduct Authority, 2021), 95.5% in the US (Federal Deposit Insurance Corporation, 2020) and 96.5% in the EU (European Savings and Retail Banking Group, 2022).

Many of the benefits associated with bank account ownership are contingent on the use of banking and transaction services. Consumers often have to pay for energy, utility bills, insurance, internet and other services using direct debit or automated payments to benefit from lower payments and to build their credit score. Despite its importance, very few studies into financial exclusion address bank account use. Fernández-Olit et al (2018), Coffinet and Jeadeau (2017) and Bunyan et al (2016) all focus on ownership of various financial products in Europe. Corrado and Corrado (2015) and Fitzpatrick (2015) use access to bank credit as a proxy for bank account use. Nuzzo and Piermattei (2020) compare financial inclusion in Germany, Italy, France and Spain using data on debit and prepaid cards issued by providers rather than use. Lo Prete (2022) examines the country-level determinants of digital payments for 25 OECD countries, including financial literacy, digital skills and GDP per capita, but does not distinguish between paying bills, sending remittances or buying something using card, internet or mobile phone.

There are global country-level studies that examine frequency of use, usually measured as a dummy variable for three or more cash withdrawals a year (Allen et al., 2016). Using data covering 123 developing and emerging economy countries, Allen et al (2016) found that frequent bank account use was higher among older, richer, better educated and men. Further, they found that greater financial inclusion was associated with lower account costs, greater proximity to financial institutions, stronger legal rights and political stability. Drawing on the same dataset, Xu (2020) find that financial inclusion is positively associated with trust. The impact of is stronger in countries with weaker legal enforcement and lower educational levels, suggesting that trust acts as a substitute for formal financial institutions.

In the US, studies into financial exclusion often examine the use of nonbank financial services, such as cheque cashing, credit, and remittances, rather than bank account use (Barcellos & Zamarro, 2021; Birkenmaier & Fu, 2016b; Birkenmaier & Fu, 2018). Households that have a bank account but use alternative financial services are referred to as underbanked (Federal Deposit Insurance Corporation, 2020). This literature has found the use of nonbank services to be higher in areas with fewer bank branches and facilities (Blanco et al., 2022) and among ethnic minorities, low-income households and those with lower education (Birkenmaier & Fu, 2016b). However, the measurement of the use of alternative financial services does not distinguish between the use of non-bank transaction services (e.g., cheque cashing, remittances) from loans (e.g., payday loans, pawnshop loans) (see Federal Deposit Insurance Corporation, 2020). Moreover, using nonbank financial services does not preclude the use of banking and transaction services. Recent research has found that consumers often use multiple payment methods depending on type of bill (Greene & Stavins, 2021). In the UK, there are recent qualitative studies examining the lived experience of using informal and subprime loans (Appleyard et al., 2023; Biosca et al., 2020).

There is also a wealth of research on consumer payment method choices (Bagnall et al., 2016; Hernandez et al., 2017; Stavins, 2018). Generally, this research has found the use of cash to pay bills has declined significantly and is more prevalent among low-income consumers. Low-income households are more likely to rely on cash for budgeting purposes because it provides a greater sense of control (Hernandez et al., 2017). Further, payment method preferences vary by transaction value and type (Stavins, 2018). However, most of this research has focused on payment methods used at POS rather than the payment of bills and services (Greene & Stavins, 2021). As noted above, the use of a bank account to pay bills, especially automatic payments, is important to build a track record and benefit from discounts.

There are a few studies of bank account use in developed world economies. Greene and Stavins (2021) use daily diary surveys of payments made by 2,800 American consumers. They find that low-income and unbanked consumers were more likely to use cash and less likely to use automatic payments for bills. Low-income consumers were significantly more likely to use cash and less likely to set up automated online payments regardless of banked status (Greene & Stavins, 2021). Anderson et al (2018) examine the impact of the transition to electronic only payments of social security payments in the US in 2013 on bank account ownership and use. They find that the mandate increased account ownership but not use, as recipients used electronic payment cards rather than transfers. Research by the Competition

and Markets Authority (2016) found that around 16% of UK consumers used prepayment meters rather than pay for bills using direct debit. Households are more likely to use prepayment meters if they are on a low income, low educational attainment, disability and are a social housing tenant (Competition & Markets Authority, 2016).

The different ways in which consumers use financial services in the management of their finances are associated with different underlying behaviours. Checking bank account balance electronically is linked to the monitoring and tracking of expenses, which in turn is a type of self-control mechanism (Hernandez et al, 2017). Consumers on low incomes or those that are liquidity constrained tend to prefer cash to monitor spending as it provides an immediate and very precise indication of spend and remaining balance (Hernandez et al, 2017). Consumer recall of spend has been found to be less accurate with cards compared with cash (Gafeeva et al., 2018), as it requires spending limits to be set mentally (Hernandez et al., 2017).

The choice of payment method to make POS payments and purchases is linked to what in the literature is termed the salience or transparency of a payment method (Liu et al., 2021). Electronic payments are less transparent than cash and could make some consumers more vulnerable to make temptation purchases and overspend (Seldal & Nyhus, 2022; Liu et al., 2021). This is because the abstract nature of and delay to feeling the so-called pain of payments through electronic means (Liu et al., 2021). Low-income consumers tend to prefer cash as it increases control and reduces the chance of overspending (Hernandez et al., 2017). It should be noted that the degree of agency consumers have in choosing payment method is conditioned by the local opportunities to withdraw cash (e.g., bank branches, ATMs), and the payment methods accepted by retailers or recipients (i.e., may be card or cash only).

How consumers pay household bills, such as rent, and utility bills, depend on their need for flexibility and transparency. Because low-income households often have limited savings and discretionary income, they value the ability to vary when and how much they pay towards different bills (Collins et al., 2023). For this reason, low-income households are less likely to use automated bill payment methods (Greene & Stavins, 2021). Automated payments also leave the consumer at risk of incurring banking fees for going into their overdraft (Collins et al., 2023). More generally, low-income households are less likely to pay bills online (Greene & Stavins, 2021).

The use of banking services, in turn, increasingly involves using the internet. There is an increasing emphasis on paying for bills and services using online and remote banking. There has been a shift to paying social security or benefits electronically (Anderson et al.,

2018; Fitzpatrick, 2015) as well as closure of bank branches and discounts for paying bills electronically. Within the extensive digital exclusion literature, there is a wealth of research on the determinants of the use of the internet generally and online banking specifically (Helsper & Reisdorf, 2017; Karjaluoto et al., 2019; Oertzen & Odekerken-Schröder, 2019). Research in Europe has found disabled, older, women, people with lower educational and in poorer financial circumstances to be less likely to use the internet (Scholz et al., 2017). In the UK, internet use has increased but the rate of growth has slowed, and the use has intensified among those online (Blank et al., 2020). The main determinants are income, educational attainment and age, whilst gender is no longer affecting internet use in the UK (Blank et al., 2020). A comparative study of internet use in the UK and Sweden, found that non-users were older, less educated, more likely to be unemployed, disabled and socially isolated (Helsper & Reisdorf, 2017). Research has also found that motivational reasons are an increasingly important determinant of internet use (Helsper & Reisdorf, 2017; Reisdorf & Groselj, 2017; van Deursen, 2020).

The existing evidence also points to a significant increase in the use of online and mobile banking. In the UK, the latest Financial Lives Survey found that the use of online and mobile banking increased significantly across all age groups, though older people, especially those over the age of 75, were less likely to use online banking (Financial Conduct Authority, 2021). A study of 33 European countries found that internet access was a key determinant of the use of internet banking and that income influenced internet banking use through access (Takieddine & Sun, 2015). A recent German study of continued online banking use found that young people expressed more favourable attitudes and highest intention for continued use, but older people used it more (Oertzen & Odekerken-Schröder, 2019). Research has also found that perceived risks associated with security and privacy negatively affects the use or, more commonly, the intention to use internet banking (e.g., Merhi et al., 2019; Giovanis et al, 2019).

Digital skills are important because they enable effective use of internet for news, information, banking and social networking (Scholz et al., 2017; van Deursen, 2020). Digital skills are measured through objective skills-based performance tests and subjective self-assessed skills questions. Performance tests are more accurate, but they often involve smaller samples that are less representative because they are expensive and labour-intensive to conduct (Allmann & Blank, 2021). Notably, OECD's Survey of Adult Skills uses performance tests (see Lo Prete, 2022). Self-assessed skills measures are easy to collect and interpret and lend themselves to measuring skill levels in large populations but require careful

consideration to ensure external validity (Allmann & Blank, 2021). They are also more commonly used in the academic literature (van Laar et al, 2017; Allmann & Blank, 2021). Van Deursen et al (2016) distinguish between four types of digital skills: operational skills (basic technical skills), information navigation skills (finding, evaluating and selecting information sources), social skills (online communication and interactions) and creative (content creation).

A recent UK survey found that nearly one in five non-users do not use the internet because they do not know how to use the internet (Blank et al., 2020). Studies have found that people with higher self-rated skills are more likely to adopt new technology (Berkowsky et al, 2018 cf. Hunsaker & Hargittai, 2018). Digital skills have also been found to be associated with more effective use and better outcomes (Blank & Lutz, 2018; van Deursen, 2020). Different types of digital skills have been found to be sequential with a person lacking one type of skills also more likely to lack others (Van Deursen et al., 2017). Research has found that education and income are positively associated with internet skills (Hargittai et al., 2018). In the UK, the self-rated ability has remained stable since 2009 with retired people rating their skills the lowest (Blank et al., 2020).

As noted above, the lack of skills is one reason people do not actively use the internet (Blank et al., 2020). We therefore hypothesise that greater internet skills are linked to greater use of banking services:

> H: The level of internet proficiency is related to the use of various banking services. Individuals with higher levels of general internet proficiency are more likely to use banking services such as checking bank account online, transferring money using their account, and making contactless payments, as well as a broader spectrum of these services compared to those with lower levels of internet proficiency

By investigating the link between digital skills and banking use, this paper aims to contribute to the understanding of the relationship between digital and financial inclusion. Although consumers are increasingly reliant on digital technology to make and receive payments, the link between digital skills, and the use of financial services in money management remains underexplored. Firstly, there is little systematic evidence on the use of financial services beyond POS payment methods. Existing research is qualitative (e.g., Collins et al, 2023), focuses on the intention to use banking services (e.g., Karjaluoto et al., 2019), or is conducted in developing countries (e.g., Allen et al, 2016). As one of the few

exceptions, Greene and Stavins (2021) examine how American consumers pay household bills, rent or mortgage payments, and POS purchases, but they do not look at the use of financial services in money management (e.g., tracking expenses) more broadly.

Secondly, there is a dearth of studies that examine the link between digital and financial inclusion in the Developed world (Fernández-Olit et al., 2020). There are two US studies explicitly focusing on the link between digital and financial exclusion (McHenry et al, 2017; Karp & Nash-Stacey, 2015). However, one of these only look at account ownership and use of alternative financial services (McHenry et al., 2017), and neither study look at internet skills. This is an important omission, as research has shown that whilst internet access has become near universal, with nearly all UK adults under 50 having internet access (Blank & Lutz, 2018), the use and outcomes associated with internet use is highly varied (Blank & Lutz, 2018). Digital skills are one important determinant effective internet use (Hargittai et al., 2018; van Deursen, 2020).

The novelty and contribution of the paper is twofold. Firstly, it examines three dimensions of the use of financial services – individually and combined – as a monitoring tool, a POS payment method, and as a means of making wider payments. Each of these are associated with different consumer risks and outcomes. Secondly, it analyses the degree to which the different forms of use of banking services depend on self-rated operational digital skills (the ability to use the internet). To the best of our knowledge, no other paper has examined the link between digital skills and the use of financial services in monitoring *and* making payments. The resulting contribution is a more comprehensive understanding of the role of operational digital skills in enabling the use of a range of financial services.

Method and Data

We use data from a face-to-face survey conducted in the UK city of Leeds in early 2018. Leeds is the largest city in the northern English region of Yorkshire and the Humber with a population of around 800,000. The city has significant pockets of poverty and social deprivation with around 170,000 (or 21%) of its inhabitants living in relative poverty (Leeds City Council, 2018). Since 2004, Leeds City Council and partners have been working to address financial exclusion in the city. In recognition of the work to promote financial inclusion, the Government awarded the Council beacon status. The Council commissioned this survey as part of this work to understand the nature and extent of financial exclusion in the city and guide policy. The survey was focused on the experiences of people at risk of

financial exclusion and hence focused primarily on areas with higher concentration of low-income households. The sample consisted of 922 individuals aged 18 to 96, 55% of the women and was selected via quota sampling. The quotas were drawn based on the 2011 Census data, so that the key criteria in terms of age, gender, ethnic origin, and employment status for each of the LSOAs (Lower Super Output Areas) and MSOAs (Middle Super Output Areas) could be examined, meaning a sampling frame unique and reflective of each area was established.

The interviewers were directed to different parts of the LSOAs and MSOAs by the supervisors, were given individual quotas and recruited respondents by knocking on doors. When required to meet certain quota proportions, the interviewers used screening questions relating to respondent characteristics. The interviewers were instructed to interview adults in the household with responsibility for some or all of the household bills and involvement in financial decisions. The majority of the sample 65% (n=602) lived in 29 of the 10% most deprived LSOAs in England according to the 2015 Index of Multiple Deprivation, whilst 35% (n=320) lived in 5 MSOAs with average levels of deprivation. Aside from the level of deprivation, the areas were selected to represent a wide range of different types (e.g., inner city, terraced). 95% of the sample reported that either they or their spouse owned a bank account.

Outcome variables

The use of banking services was measured using four variables: 'Checking bank account online', 'Transferring money using their account', 'Making contactless payment' and 'Banking usage index'.

In the survey, the respondents were asked "Do you use any of the following…?" and provided with various banking service usage options to tick if they used them. For this paper, the responses for checking their bank account online and via smart phone or tablet banking app were combined into a single variable named '*Checking bank account online'* where '0' indicates neither method was used, and '1' indicates the use of one or both methods. Two other banking variables '*Transferring money using their account*' and '*Making contactless payment'* were also codes as '0' if the respondent did not choose the respective option and '1' if they did.

'Banking usage index' variable was also created by summing the values on all three variables, where the values of the index range from 0 (not using any of the three services) to

3 (using all three services). This variable measured a variety in different banking service usage.

Predictor variables

The level of internet proficiency was measured using the self-reported ability to use the internet by asking: "How would you rate your ability to use the internet?" with the answer options: 0- bad, 1- poor, 2-fair, 3-good, 4-excellent. This is a measure of operational skills, i.e., the technical skills needed to use the Internet (van Deursen et al., 2016). This is the same measure as the one used in the Oxford Internet Survey, the longest-running academic survey of internet use in the UK. We opted for this rather than a performance-based test because self-assessed skill measures are most commonly used in the digital inclusion literature (van Laar et al, 2017), are less costly and more feasible beyond fairly small samples (Allmann & Blank, 2021), and have been found to be closely correlated to more objective indicators of skills (Blank et al, 2020).

Control variables

In addition, a range of socio-demographic and household characteristics that have been established in previous studies as determinants of financial exclusion, namely age in years, sex, housing tenure, income levels, employment status, and receipt of means tested benefits, were controlled for. We did not control for the access to the Internet because 79% of the sample had the access to the Internet, and 75% of those who had access to the internet rated their ability to use it as excellent or good and 66% of those who did not have an access, rated their ability as poor. Moreover, only 12% (n=34) of the respondents who rated their ability to use as internet are fair or better had no Internet access, while only 25% (n=34) of those who rated their ability as bad, had an Internet access.

The relationship between the Internet access and self-related ability to use the Internet was statistically significant $X2(4, N=862) = 367.5$, $p < 0.001$, and Cramer's V test value of 0.65 indicated a very strong association between these two variables. Thus, including access to the Internet would create a problem of multicollinearity. Because of the widespread interconnectivity in the developed world and its reduced role as a barrier in benefiting from the internet, the digital inclusion literature has moved on to digital skills, use and outcomes of

internet use and skills (Scheerder et al., 2017). Descriptive statistics and response categories for all variables can be seen in Table 1 in Results section.

Data analysis methods

To test the hypothesis, several logistic regression analyses and ordinal logistic regression were performed. Logistic regression was chosen because the outcome variables were binary, and we had a set of predictor and control variables. As the banking index was an ordinal variable with four categories, ordinal logistic regression was employed to analyse its association with the predictor variables.

Results

Descriptive statistics and characteristics of the sample

Table 1 shows the characteristics of the sample and describes all the variables used in the analyses. In this sample, the most used online banking service was checking bank account online or via an app. The least used service was using telephone banking. More than half of the sample (61%) reported that their ability to use the Internet is either excellent or good but approximately one out of five rated their Internet proficiency as bad or poor. The average age of participants was 46, 55% of them were women and nearly every eight out of ten were White. Nearly half of the participants came from the households where the annual household income was under £15,000. Nearly half of the sample rented their housing from council but one in four owned their housing, with or without a mortgage.

There were wide variety of household composition types represented in the sample, with a couple with children being the most common. Nearly one third of the participants came from a household where at least one household member had a physical disability and one fifth from a household where at least one household member had a mental disability. Half of the sample were from a household where either the respondent or their partner (or both) was employed, one in every ten – from a household where there was at least one unemployed household member, and one in five where the respondent or they partner were looking after family. Only a small proportion of the sample where from a household where there was at least one person in an insecure job. The most reported benefits in the sample were housing benefits and child tax credits, the least reported- income support benefits and universal credit.

Missing values analysis

Table 1 indicates that missing values for outcome and predictor variables were at 5%, a range typically manageable in statistical analyses and unlikely to significantly bias results. Except for household income, all control variables had less than 5% missingness, minimizing potential analysis bias. However, household income showed 29% missingness.

Analysis of missingness patterns in household income yielded mixed results. Chi-square tests revealed no significant association between household income missingness and self-rated internet ability ($\chi^2(4) = 1.9481$, $p = .745$) or banking-related activities, including checking account online ($\chi^2(1) = 1.4297$, $p = .232$), transferring money ($\chi^2(1) = 0.2355$, $p = .627$), contactless payments ($\chi^2(1) = 0.1285$, $p = .720$), and overall banking usage index ($\chi^2(3) = 2.6001$, $p = .457$). This suggests the missingness of income data was not related to either the independent or dependent variables.

Furthermore, no significant links were found between household income missingness and most control variables, such as age, sex, housing tenure, employment status, and most forms of benefit support. However, significant associations were observed with ethnicity ($\chi^2(3) = 8.7485$, $p = .033$), household composition ($\chi^2(6) = 28.9780$, $p < .001$), and housing benefit receipt ($\chi^2(1) = 6.1502$, $p = .013$). Specifically, Asian (35%) and Black (40%) respondents were more likely to have missing household income values than White (27%) respondents. The highest proportion of missing household income values were among two adults (both under the age of 60) (39%), two adults at least one of age above 60 (41%) and three adults at least one older than 60 (39%) households. Respondents not receiving housing benefits (32%) were more likely to have missing household income than respondents who did receive these benefits (25%). These findings indicate a relationship between demographic and socioeconomic factors, and the likelihood of missing income data, possibly reflecting data collection patterns or reporting biases in certain subgroups.

Based on these results, it was decided to proceed with the analysis without imputing missing values for the following reasons: The missingness in household income was not systematically related to our primary variables of interest, household income was not central to our primary research objective, not imputing missing values maintains analytical simplicity and transparency, avoiding unnecessary complexity, and even after excluding cases with missing household income data, our remaining sample size remains sufficient for robust

statistical analysis. However, 'missing' category for the household income variable in all models has been included to account for the missing data's potential impact on the analysis.

[Table 1 around here]

According to Table 2, self-rated internet proficiency significantly predicts the use of all banking services included in this study. Positive regression coefficients in all models indicate that people who have higher internet proficiency are more likely to use these banking services than those who rate their proficiency lower. This is true even controlling for other variables in the model. Moreover, very large odds ratios indicate a large discrepancy in the likelihood of using banking services between those individuals who rated their ability as bad, compared to those who rated their internet use proficiency higher and especially those who rated it as excellent.

Table 2 also indicates that for transferring money and making contactless payments what matters is how high individuals rate their ability to use the internet rather than whether they are financially disadvantaged as for these to outcome the income variable was not a significant predictor. However, checking bank account online was an exception, as people in higher income categories were almost twice and three times as likely to check their bank account online than people with an annual income of £15,000 or less. Given the high level of non-responses for income, the analysis was also conducted without income. No substantial changes in the significance levels of the relationships between self-rated internet proficiency and banking usage were observed.

[Table 2 around here]

Discussion

This paper examined the relationship between digital and financial inclusion by analysing the association between self-rated internet proficiency and different uses of banking services. Overall, the results support our hypothesis that the use of banking services depends on digital skills.

The results confirm that account ownership does not automatically result in use of bank accounts. Although the vast majority of the sample owned a bank account, only around a quarter used the account to make transfers or make contactless payments. This is line with the

US evidence that low-income households are less likely to use online payments regardless of banked status than high- and middle-income households (Greene & Stavins, 2021) and that shifting to electronic transfer of social security payments increases bank account ownership but not use (Anderson et al., 2018). This underlines the importance of measuring the use and not just ownership of and access to financial services. Yet very few studies in developed countries focus on use (e.g., Coffinet & Jadeau, 2017; Fernández-Olit et al., 2018; Nuzzo & Piermattei, 2020).

The level of self-rated internet proficiency predicts the way in which consumers use financial services in the management of their finances, including making POS purchases with debit card or mobile phone (contactless payments), making transfers using a bank account and using multiple banking services (index combining contactless payments, making transfers and checking account balance online). This holds even when controlling for socioeconomic and demographic factors known to influence financial exclusion, such as age, sex, tenure, income, employment status and receipt of means-tested benefits. On the one hand, this echoes existing research, which suggests that digital skills are important for the effective use of internet, including for banking (Scholz et al., 2017; van Deursen, 2020; Blank & Lutz, 2018). Given the increasing ubiquity of online and digital interfaces, it is perhaps not surprising that abilities to use and operate the internet is important to enable people to use financial services.

On the other hand, it is surprising that self-rated digital skills are more important than income in the use of contactless payments and using the bank account to transfer money, given that existing research suggests that low-income consumers are much more likely to use cash and less likely to use online methods to make over-the-counter payments and pay bills (e.g., Greene & Stavins, 2021). Conversely, household income is more important as a determinant than digital skills in checking account balance online. This possibly reflects that people on lower incomes face greater liquidity constraints and therefore prefer to monitor their spending using cash as this provides more precise information on their spending and remaining balance (Hernandez et al., 2017).

There are some limitations of our study. Firstly, the dataset does not contain a variable for level of education. Yet, research has shown education to be correlated with internet use (Helsper & Reisdorf, 2017), digital skills (Hargittai et al., 2018), benefits from internet use (Blank & Lutz, 2018) and bank account use (Allen et al., 2016). Secondly, the sample has not been drawn using probability sampling. This means we cannot generalise reliably the univariate estimates to the population of Leeds or the UK. However, as Kolhler et al (2019)

have pointed out, nonprobability samples can be used to estimate reliable the relationships between different variables. Thirdly, the survey does not capture trust in financial institutions and perceptions around security and privacy, which we recognise may influence the use of financial services, perhaps especially online.

In conclusion, this paper finds that internet proficiency predicts the use of banking services, hence illuminating an under-researched link between financial and digital inclusion. Individuals with higher levels of internet proficiency are more likely to use banking services than those with lower levels of internet proficiency except for checking balance online where income is more important.

The findings have some potentially important implications for policymakers and regulators seeking to improve consumer outcomes in financial services markets. Firstly, the prevention of certain forms of customer detriments and the realisation of key consumer benefits, such as lower transaction costs, improved credit scores and greater protection of consumer funds (e.g., deposit protection), depend on the use of financial services by consumers in their money management (making payments etc.). Yet, the findings of this research suggests that ownership does not automatically translate into use, as many consumers have bank accounts without using them. It is recommended that regulators and policymakers place greater emphasis on understanding and addressing the barriers to and developing policies and interventions to support greater use of financial services. Such policies may include consumer education and information to help people use different financial services, and interventions to incentivise and require financial institutions to adjust the features and marketing of their products and services to how low-income consumers manage their finances (e.g., enabling greater control, providing greater transparency around fees). Secondly, digital skills and proficiency are important to enable consumers to use banking services, which has some potentially important implications for consumer policy and regulation in financial services. It underlines the importance of embedding operational digital skills into consumer financial education initiatives (not just financial knowledge). Financial service providers need to support their customers to acquire the appropriate technical skills needed to help them adopt digital payments and purchases. However, it also highlights the importance of providing alternative means of accessing and paying for goods and services for those with low levels of digital skills.

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Tables

Table 1 Descriptive statistics

Variable	n	%	Mean (SD)
Outcome variables			
Check bank account (yes)	520	56	
Use account to transfer money (yes)	235	25	
Make contactless payments (yes)	242	26	
Banking usage index:	874		1.14 (1)
-none	283	31	
-one	314	34	
-two	148	16	
-all three bank usage types	129	14	
Missing (for all above outcome variables)	48	5	
Predictor variables			
Ability to use Internet: bad			
- bad	135	15	
- poor	55	6	
- fair	116	13	
- good	240	26	
- excellent	327	35	
- missing	49	5	
Control variables			
Age	921		46 (18)
-<25	106	12	
-25-45	377	41	
-45-65	260	28	
-65+	179	19	
-missing	1	0.1	
Sex (female)	509	55	
-missing	0	0	
Ethnicity: White	708	77	
-Asian	79	9	
-Black	103	11	
-Other	31	3	
-missing	1	0.1	
Housing tenure (ownership)	222	24	
-rented from council	436	47	
-renting from a housing association	101	11	
-privately rented	157	17	
-missing	6	0.7	
Household composition: (one adults under 60)	125	14	
- one adult 60+	141	15	
- two adults, both under 60	92	10	
- two adults, at least one 60+	90	10	
- three + adults, at least one 60+	88	10	
- single parent with children under 16	139	15	

- couple with children under 16	208	12
- missing	39	4
Disability (at least one household member has a physical disability or long-term illness): yes	289	31
-missing	7	0.8
Disability (at least one household member has a mental disability or long-term illness): yes	173	19
-missing	12	1
Respondent or spouse is employed:yes	459	50
-missing	0	0
Respondent or spouse is unemployed:yes	94	10
-missing	0	0
Respondent or spouse is looking after family:yes	180	20
-missing	0	0
Respondent or spouse is insecure work:yes	72	8
-missing	43	5
Annual household income: <£15,000	419	45
-15,000-29,999	124	17
-£30,000+	77	8
-missing	270	29
Receives housing benefits (yes)	354	38
Receives income support benefit (yes)	86	9
Receives working tax credit (yes)	141	15
Receives child tax credit (yes)	304	33
Receives pension credit (yes)	74	8
Receives universal credit (yes)	16	2
- Missing for all benefit variables	0	0

Table 2 Self-perceived Internet use proficiency and use of banking services- logistic regression estimates

	Check bank account online (Model 1)			Use account to transfer money (Model 2)			Make contactless payments (Model 3)			Banking usage index (Model 4)		
	b	SE	Odds ratios	b	SE	Odds ratios	b	SE	Odds ratios	b	SE	Odds ratios
Age (<25)												
25-45	-0.42	(0.48)	0.66	-0.033	(0.39)	0.97	-1.12**	(0.38)	0.33	-0.54	(0.31)	0.59
45-65	-1.63**	(0.53)	0.20	-0.47	(0.44)	0.62	-0.85*	(0.42)	0.43	-0.91*	(0.35)	0.40
65+	-1.98**	(0.69)	0.14	-0.88	(0.65)	0.41	-1.42*	(0.62)	0.24	-1.51**	(0.52)	0.22
Sex (male)	-0.015	(0.26)	0.99	-0.056	(0.24)	0.95	0.090	(0.23)	1.09	-0.017	(0.19)	0.98
Ethnicity (White)											(.)	
Asian	-1.09*	(0.45)	0.33	-0.30	(0.44)	0.74	-0.58	(0.44)	0.56	-0.79*	(0.36)	0.45
Black	-0.015	(0.40)	0.99	-0.14	(0.36)	0.87	0.72*	(0.34)	2.06	0.23	(0.30)	1.26
Other	-0.51	(0.56)	0.60	-0.50	(0.55)	0.60	-0.46	(0.56)	0.63	-0.62	(0.43)	0.54
Housing status (Owned)											(.)	
Rented from council	0.76*	(0.37)	2.13	-0.51	(0.33)	0.60	-0.42	(0.33)	0.66	-0.081	(0.28)	0.92
Rented from HA	0.45	(0.47)	1.57	-0.32	(0.42)	0.72	-0.38	(0.42)	0.68	-0.13	(0.36)	0.88
Privately rented	-0.31	(0.44)	0.73	-1.62***	(0.45)	0.20	-1.28**	(0.42)	0.28	-1.09**	(0.34)	0.33
Household type (One adult under 60)											(.)	

One adult 60+	0.34	(0.52)	1.41	-0.32	(0.55)	0.73	-0.011	(0.51)	0.99	-0.099	(0.42)	0.91
Two adults both <60	-0.45	(0.50)	0.64	0.0052	(0.45)	1.01	-0.24	(0.45)	0.79	-0.32	(0.38)	0.73
Two adults at least one 60+	-0.063	(0.55)	0.94	0.17	(0.55)	1.19	0.31	(0.52)	1.36	0.15	(0.46)	1.16
Three+ adults at least one 60+	0.070	(0.51)	1.07	-0.22	(0.50)	0.80	-0.39	(0.47)	0.67	-0.15	(0.39)	0.86
Single parent with children	-0.69	(0.61)	0.50	-0.12	(0.54)	0.89	-0.42	(0.54)	0.66	-0.43	(0.44)	0.65
Couple with children	-0.069	(0.57)	0.93	-0.082	(0.49)	0.92	0.018	(0.48)	1.02	-0.059	(0.40)	0.94
Respondent or spouse is employed (no)	0.22	(0.33)	1.24	0.37	(0.32)	1.45	0.59	(0.31)	1.80	0.38	(0.25)	1.46
Respondent or spouse is unemployed (no)	-0.019	(0.43)	0.98	0.10	(0.41)	1.11	0.15	(0.40)	1.16	0.049	(0.32)	1.05
Respondent or spouse is looking after family (no)	-0.21	(0.36)	0.81	-0.35	(0.33)	0.70	0.27	(0.32)	1.31	-0.062	(0.26)	0.94
Insecure work (no)	-0.36	(0.43)	0.70	-0.13	(0.39)	0.87	0.21	(0.37)	1.24	-0.046	(0.31)	0.96
Income (<£15,000)											(.)	

£15,000 -29,999	0.63*	(0.31)	1.88	0.090	(0.27)	1.09	-0.20	(0.27)	0.82	0.12	(0.22)	1.13
£30,000 +	1.06*	(0.48)	2.88	-0.68	(0.44)	0.51	-0.95*	(0.44)	0.39	-0.29	(0.35)	0.75
Housing benefit (no)	-0.22	(0.31)	0.81	0.042	(0.30)	1.04	-0.043	(0.29)	0.96	-0.035	(0.23)	0.97
Income support (no)	0.46	(0.51)	1.59	0.29	(0.51)	1.33	0.28	(0.50)	1.33	0.28	(0.39)	1.32
Working tax credit (no)	0.57	(0.40)	1.77	0.17	(0.34)	1.19	0.49	(0.34)	1.64	0.40	(0.28)	1.49
Child Tax credit (no)	-0.14	(0.47)	0.87	-0.20	(0.41)	0.82	-0.42	(0.41)	0.66	-0.24	(0.33)	0.79
Pension credit (no)	0.014	(0.56)	1.01	1.10	(0.59)	3.01	0.021	(0.57)	1.02	0.44	(0.46)	1.55
Universal credit (no)	-0.54	(0.93)	0.58	-0.62	(0.90)	0.54	-0.080	(0.86)	0.92	-0.36	(0.74)	0.69
Self-rated ability to use Internet (bad)											(.)	
poor	1.61**	(0.62)	4.98	1.88*	(0.88)	6.58	1.35*	(0.63)	3.86	1.96**	(0.51)	7.08
fair	2.44***	(0.55)	11.52	2.56**	(0.80)	12.90	1.24*	(0.55)	3.47	2.63**	(0.45)	13.87
good	2.89***	(0.53)	17.97	2.66**	(0.79)	14.23	1.76**	(0.51)	5.78	3.11**	(0.43)	22.36
excellent	3.43***	(0.55)	30.74	2.68**	(0.79)	14.63	1.53**	(0.53)	4.63	3.20**	(0.44)	24.65
Constant	-1.46	(1.76)	0.23	-3.34	(1.79)	6.58	-1.41	(1.63)	3.86			
/cut1										0.96	(1.33)	
/cut 2										3.05	(1.34)	
/cut3										4.17	(1.33)	
Hosmer-Lemeshow	χ^2 = 460.27, df = 436, p			χ^2 = 477.93, df =			χ^2 = 465.36, df =					

goodness of fit	= 0.20	436, p = 0.08	436, p = 0.16	
LR chi-square	196.08 ***	66.23 ***	69.65 ***	181.7 ***
Pseudo-R2	0.28	0.11	0.10	0.13
Observations	531	531	531	531

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Residual analysis. Logistic model residuals for Model 1 show minimal mean deviation (Pearson: -0.00915, Deviance: -0.00919) and wide variation (Pearson: -3.962 to 4.141, Deviance: -3.997 to 4.190), suggesting overall model adequacy.

Residuals for logistic Model 2 show slight mean offsets (Pearson: -0.01107, Deviance: -0.01243) with a broad range (Pearson: -1.245 to 6.896, Deviance: -1.303 to 6.948), indicating acceptable model performance.

Residuals for logistic model 3 demonstrate negligible mean deviations (Pearson: 0.00021, Deviance: -0.00017) with considerable spread (Pearson: -1.598 to 4.464, Deviance: -1.671 to 4.532), reflecting adequate model fit.

Note: Given the high rate of non-responses for the income variable, we conducted sensitivity analyses by running models both with and without income included among control variables. Our findings indicated that excluding household income did not substantially affect the significance levels between self-rated internet proficiency and the outcome variables. Therefore, all models were reported with the income variable included.