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Consumer financial literacy and habitual behaviour as drivers of contactless payment ownership

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ABSTRACT

Historically, cash has been noted for its ease and convenience as a payment instrument; however, contactless payments now rival cash in this regard. Using UK survey data at a time when contactless payments were on the rise but not yet fully adopted, we examine the role of consumers' financial literacy and trait habitual behaviours as drivers of contactless payment ownership. This unique timing allows us to identify a segment of the population without contactless card ownership; a rare opportunity given the current widespread adoption of the technology. We find that consumers' financial literacy and proneness to routine behaviour are positively associated with ownership of contactless payment cards. Using propensity score matching techniques, we address the ex-ante heterogeneity between individuals exhibiting different levels of financial literacy, habitual behaviour, and non-random selection issues to show that our results are robust to potential endogeneity issues. Our findings can inform policymakers and banks about the adoption patterns of emerging payment technologies, providing insights that are particularly relevant for future technologies facing early-stage adoption challenges.

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1. Introduction

Near Field Communication (NFC) technologies have proven to be game-changers in the payment industry, allowing consumers to make everyday payments with a simple tap of a bank card. Contactless payment technologies have gained ground because of their underlying benefits in terms of convenience, speed, and ease of use, along with lower handling costs than cash payments.[1] The first contactless bank card was introduced in the UK in 2007, with regulation allowing individuals to pay for transactions up to £10. Over the years, this limit has gradually increased to accommodate growing consumer demand and confidence in contactless payment security. For instance, the limit has been raised several times, with the latest increase in 2021 bringing it to £100 per transaction.

This paper aims to examine the role of financial literacy and habitual behaviour in the decision to adopt a contactless card. A novel aspect of our research is its focus on capturing a segment of the population not yet engaged with contactless payment technology despite its growing prevalence.[2] This allows us to examine factors influencing the decision to adopt the technology during a period marked by increasing reliance on contactless payments. Taking advantage of the fact that widespread contactless adoption had not yet occurred at the time of the survey data collection, and ownership was concentrated in certain segments, our study provides insight into the adoption dynamics by those not initially engaged with the technology. Our data suggest that at the time our survey was conducted, 70.4% of the respondents owned a contactless debit card and 41.7% a contactless credit

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card, with 83.2% owning one form of contactless card. Further, ownership of contactless debit/credit cards varies geographically across the UK, with rates ranging from 74.5% (Northern Ireland) to 87% (East of England) and wider variation for their debit or credit card variants (See Figure A.1 in the Online Appendix). The fact that we are able to identify individuals without access to contactless payment instruments provides an ideal setting to understand the drivers of contactless payment adoption.

Behavioural research has long examined the influence of payment method choice on consumer behaviour, including in the context of pain of payment (e.g. Lo and Harvey 2011; Prelec and Loewenstein 1998; Prelec and Simester 2001; Soman 2001, 2003) and payment-consumption decoupling (Gourville and Soman 1998; Kamleitner and Kirchler 2006; Raghubir and Srivastava 2008; Shafir and Thaler 2006). More recently, studies begin to address how technological advances in payment methods influence consumer perceptions and behaviours, including accuracy of expenditure recall (Gafeeva, Hoelzl, and Roschk 2018), the pain of payment (Broekhoff and van der Cruijsen 2024) and willingness to pay (Falk et al. 2016; Liu, Luo, and Zhang 2021). In this paper, we extend this line of research to examine the behavioural drivers associated with the ownership of contactless payment instruments. Payment instrument ownership, of course, is an essential precursor to payment method choice at the checkout and, hence, consumer behaviour.

Research shows that financial, socio-demographic, and psychological factors are associated with consumer payment behaviour for traditional payment instruments, such as debit and credit cards (Borzekowski, Kiser, and Ahmed 2008; Koulayev et al. 2016; Van Der Cruijsen and Plooij 2018; Van Der Cruijsen and Van Der Horst 2019), but evidence for contactless payment technologies is limited. Such factors, including *inter alia* financial literacy, play an important role in financial well-being and can influence the adoption of emerging technologies (Panos and Wilson 2020). Our goal here is to improve understanding of the drivers associated with the ownership of contactless payment instruments, specifically exploring consumers' financial literacy and habitual behaviour in daily life (i.e. trait habit).[3] Our analysis relies on bespoke survey data collected in 2019 from UK consumers, which includes detailed socioeconomic and demographic information of consumers.[4] Our regression results suggest that financial literacy and trait habits are significant predictors of ownership of contactless payment technology. These findings are robust to the propensity score matching (PSM) method when we address the ex-ante heterogeneity between individuals exhibiting different levels of financial literacy and habitual behaviour and non-random selection issues.

This paper makes three main contributions to the literature. The first relates to the literature on consumer adoption of retail payment instruments (Koulayev et al. 2016; Schuh and Stavins 2013), which has largely overlooked the role of contactless payments.[5] Second, drawing on theoretical insights from consumer financial literacy and financial behaviour (Lusardi and Mitchell 2014), and employing the measure from Ranyard et al. (2020), we examine the role of financial literacy in contactless payment ownership. Third, drawing on theoretical insights from the Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003; Venkatesh, Thong, and Xu 2012), we provide novel evidence on the importance of an individual's propensity to habitual behaviour, in the form of routines, as a potential driver of contactless payment ownership, which complements recent literature on the role of *payment* habits (Van Der Cruijsen and Van Der Horst 2019), viewed as an important driver of growth in fintech payment service providers (Polasik et al. 2020).[6]

The rest of the paper is structured as follows. Section 2 outlines the theoretical framework and develops the hypothesis. Section 3 presents the data and methodology. Section 4 discusses the results and Section 5 concludes.

2. Theoretical framework and hypothesis development

The theoretical framework for this research integrates key concepts and theories from consumer financial literacy, habitual behaviour, and consumer payment behaviour to develop a comprehensive understanding of the adoption of contactless payment technologies. This paper focuses on how financial literacy and trait habitual behaviour, specifically routine behaviour in daily life, influence consumers' ownership of contactless payments, extending existing research in this domain.

Consumer financial literacy refers to individuals' ability to understand and effectively use various financial skills, including personal financial management, budgeting, and investing. Financial literacy impacts individuals' financial behaviour across a range of decisions (Lusardi and Mitchell 2014), including retirement planning

(Van Rooij, Lusardi, and Alessie 2011a), stockholdings (Van Rooij, Lusardi, and Alessie 2011b), debt and credit (Artavanis and Karra 2020; Galariotis and Monne 2023; McHugh, Ranyard, and Lewis 2011), savings (Cupák, Kolev, and Brokešová 2019; Deuflhard, Georgarakos, and Inderst 2019) and portfolio diversification (Gaudecker 2015). Low levels of financial literacy are associated with a limited general understanding of the functioning of the financial system (Kersting, Marley, and Mellon 2015).

Recent developments in the context of saving and consumption produce dynamic life cycle models in which consumer financial knowledge is an investment acquired at a cost, but which promotes better financial decisions (Lusardi and Mitchell 2014). Indeed, financially literate consumers are better equipped to navigate the complexities of financial products and services, including emerging payment technologies. Deuflhard, Georgarakos, and Inderst (2019) further demonstrate that financial literacy positively influences savings behaviour, supporting the notion that financially literate consumers are more likely to adopt beneficial financial tools such as saving accounts. Research has shown that financial literacy can impact consumer behaviour regarding new financial technologies. For example, Panos, Karkkainen, and Atkinson (2020) show that lower financial literacy is linked to a higher likelihood of cryptocurrency ownership, implying that less financially literate consumers may not fully understand the risks and rewards of such technologies. While Dionysopoulos, Marra, and Urquhart (2023) warn of potential negative consequences associated with the widespread adoption of digital payment solutions by consumers with low financial literacy, the relationship between financial literacy and the uptake of new payment technologies remains underexplored.

Based on the existing literature, we hypothesise that respondents with high levels of financial knowledge are more inclined to adopt new payment technologies (i.e. contactless cards) than less financially knowledgeable consumers. Financial knowledge equips consumers to find the most beneficial financial providers for their financial needs and allows for a better understanding of new technologies available in the market capable of fulfilling their needs (i.e. in terms of technologically advanced products or services). Building on this, we hypothesise that higher financial literacy levels among consumers lead to greater adoption of contactless payment technologies.

H1. Consumers showing high levels of financial literacy are more likely to own contactless payment technologies compared to their low-level counterparts.

The acceptance and adoption of financial innovations can be examined through the theoretical lens of the Unified Theory of Acceptance and Use of Technology (UTAT: Venkatesh et al. 2003; Venkatesh, Thong, and Xu 2012). Venkatesh, Thong, and Xu (2012) extend the original model in a number of ways, notably including the integration of habit as a critical construct in the intention to use technology. Motivated by this unified framework, we examine the role trait habitual behaviour plays in the adoption, specifically ownership, of contactless payment technologies.

Trait habitual behaviour involves actions performed automatically and regularly, often without conscious thought. Ersche et al. (2017) propose that habitual behaviour comprises two aspects: routine and automaticity. We focus on routine behaviour, which involves performing repetitive activities in similar situations without conscious awareness, as it best describes the potential intention to use payment cards. Loibl, Kraybill, and DeMay (2011) examine the role of habit in financial behaviours and find that habitual actions can significantly influence financial decisions.

Understanding how individuals' propensities for routine behaviour could affect ownership of new payment technologies is a largely unexplored area. Habits are difficult to break, which might have implications for the uptake of new technologies (e.g. contactless payments) by frequent users of 'traditional' technologies (e.g. cards without contactless functionality). We hypothesise that trait habitual behaviour influences the likelihood of owning contactless payment technologies, with variations across different levels of routine-oriented behaviour.

While the impact of general habitual behaviour on economic and financial decisions has been examined previously (e.g. Brooks et al. 2018, in the context of smoking and financial risk), along with specific financial habits too (e.g. Loibl, Kraybill, and DeMay 2011, in the context of saving habits), there is limited literature on the relationship between trait habitual behaviour and payments. A few studies come closest to our work, but these largely consider *payment* habits (e.g. consumers who pay mostly electronically show strong card habits) rather than habitual or routine behaviour generally (i.e. trait habit). For example, Van Der Cruijsen and Van Der

Horst (2019) find a positive relationship between payment habits and payment behaviour (e.g. consumers with strong cash habits are less likely to pay electronically at the checkout).

Drawing on insights from psychology, we anticipate that habitual behaviour, manifested as routine in daily life, is likely to impact contactless ownership. Individuals with low reliance on routines (i.e. those who do not favour routines) may be more inclined to experiment with new technologies and thus exhibit higher levels of contactless ownership. In contrast, individuals with a strong reliance on routines (i.e. those who prefer structure, predictability, and avoid novel situations) may be more likely to stick to familiar technologies and, therefore, exhibit lower levels of contactless ownership. However, evidence from psychology suggests that routines are 'maintained as long as they deliver the desired outcome' (Ersche et al. 2017, 78), hence the latter need not always be the case, with highly routine-oriented individuals prepared to change their routine if new technologies offer enhanced benefits. Indeed, if contactless payments are perceived as frictionless and seamlessly integrated into existing behaviours, even highly routine-oriented individuals may find adoption compatible with their preferences. In this sense, routine may function not only as a barrier but also as a potential enabler of technology use, depending on perceived fit and utility. As such, it remains an empirical question as to the direction of the influence of routine on contactless payment ownership and so we examine the following hypothesis:

H2. Trait habitual behaviour impacts ownership of contactless payment technologies, with the likelihood of ownership varying across different levels of proneness to routine-oriented behaviour.

Consumer payment behaviour encompasses the choices and actions of individuals regarding how they pay for goods and services. Research by Prelec and Loewenstein (1998) and Soman (2003) highlights how different payment methods influence consumer behaviour, spending, and perceptions of the pain associated with payments. By focusing on the ownership of contactless payment cards, this study addresses the initial step in payment behaviour, investigating the behavioural predictors of payment ownership as a precursor to understanding broader payment behaviours. Liu, Luo, and Zhang (2021) provide insights into how mobile payment technologies influence consumer behaviour, further supporting the relevance of examining contactless payment adoption.

The integration of financial literacy and habitual behaviour theories provides a comprehensive understanding of the adoption of contactless payment technologies. The interplay between financial literacy and trait habitual behaviour suggests that consumers with high financial literacy may be more open to altering their habitual behaviours to adopt beneficial new technologies. Insights from behavioural economics suggest that the ease and convenience offered by contactless payments can reduce the 'pain of payment' and decouple payment from consumption, thereby positively influencing consumer behaviour towards the adoption of such technologies. Using Dutch survey data, Broekhoff and van der Cruijsen (2024) report that contactless payments hurt less and are associated with increased spending. They find that contactless payments are negatively correlated with the relative pain of paying contactless suggesting that consumers try to avoid the pain of paying.

Hypotheses H1 and H2 propose that consumers with high financial literacy are more likely to adopt contactless payment technologies and that habitual behaviour significantly influences this adoption. These propositions are grounded in theoretical and empirical evidence from the literature, providing a strong rationale for the expected outcomes. The integration of these theories forms a framework for understanding the drivers of contactless payment adoption, offering valuable insights for both academic research and practical applications.

In conclusion, this research contributes to the literature by extending the understanding of consumer adoption of payment technologies, specifically focusing on contactless payments. It demonstrates the significant role of financial literacy and habitual behaviour in the adoption of new financial technologies and provides empirical evidence on the predictors of contactless payment ownership, thereby informing strategies for increasing the uptake of contactless payment methods.

3. Data and methodology

We use a bespoke online survey, hosted and administered via a third-party Market Data Service Provider, Dynata, with participants recruited from their UK-based panel of respondents. The survey was conducted in April 2019. Prior to participation, respondents were presented with an information sheet informing them of the

aim of the study and informed consent was obtained. On completion, respondents were paid by Dynata in line with their standard reward policy.

As socio-demographic factors have been shown to impact payment method preferences, including the decline in cash use (Ceeney 2019; UK Finance 2019), we employ a stratified sampling approach with interlocked quotas with respect to age, gender and income (84 sub-groups), so as to ensure a balanced sample across important socio-demographics. The final sample of 2,801 UK adults is well-distributed across these sub-groups (average n = 30.13) and compares favourably with other survey-based studies of economic and financial behaviour (e.g. Galariotis and Monne 2023; Van Der Cruijsen, Doll, and Van Hoenselaar 2019).[7]

Our baseline regressions are based on Probit models:

$$Pr(CP_i = 1) = \varphi(X_i, C_i + \varepsilon_i) \tag{1}$$

Our main binary dependent variable (CP_i) captures consumer's ownership of contactless payment technologies, including both debit and credit card variants.[8] Our survey allows us to construct two main individual-level independent variables (X_i): *(i)* financial literacy and *(ii)* habitual behaviour (routines).[9],[10] These variables are divided into quartiles based on the sample distribution to facilitate the interpretation of the results (See Figures A.2 and A.3 in the Online Appendix). Control variables (C_i) include several socio-demographic variables, including age, gender, marital status, employment/benefits status, education bands, income bands, rural/urban location, and consumer's place of residence based on NUTS1 UK geographical regions. For all regressions, standard errors are clustered at the geographical region where the consumer lives and are robust to heteroskedasticity. For each respondent, we compute an individual-level financial literacy score as the sum of correct responses to the 20 questions taken from Ranyard et al. (2020) and an individual-level habitual behaviour (routines) score as the average of the 16 questions (each on a 1–5 scale) in the Creature of Habit Scale (routine) taken from Ersche et al. (2017). Tables 1 and 2 provide an overview of all the variables used in the analysis. Given the quartile-based categorical nature of our two main individual-level independent variables, the Mean values reported in Table 2 represent the percentage of respondents in each quartile and approximate 25%. As can be seen, the survey data provides good representation across age, gender, employment status, education bands, income bands and geographical region. The respondents' average age is 47.7 years, ranging from 18 to 80 years; 46% are male and 54% are female.[11]

4. Results

4.1. Baseline analysis

Columns (1-2), (3-4) and (5-6) in Table 3 provide the results for the determinants of contactless payment ownership for debit and credit cards jointly, debit cards only, and credit cards only, respectively. For each group, we include two models: (i) a basic model including our behavioural variables of interest plus regional fixed effects capturing supply-side[12] characteristics which can be related to bank issuing strategies in specific geographical regions of the UK market or any other regional differences such as merchant acceptance of contactless technologies,[13] and (ii) a full model including a wide range of socio-demographic factors which could potentially explain differences in payment ownership rates to ensure our behavioural results are robust to a range of controls.

Relative to the base category of low financial literacy[14], results show a positive association between ownership of contactless payment instruments and both medium-high and high levels of consumer's financial literacy. Thus, higher levels of financial literacy are associated with a higher probability of contactless payment ownership. Interestingly, marginal effects of high financial literacy are higher for credit cards than for debit cards (21.3% vs. 12% higher probability of contactless payment ownership, respectively) relative to the base category of lowest financial literacy.

Results in Table 3 for habitual behaviour (routines) show that moderate level routine-oriented consumers are more likely to own contactless payments than their low-level routine-oriented counterparts. Examination of the results by card-type (columns 3–4 and 5-6) reveal the result is mainly driven by debit cards, where marginal effects show moderate level routine-oriented individuals have between 5.6-6.5% higher probability of owning a contactless debit card, relative to individuals with low levels of routines. This result could be explained by the fact

Table 1. Description of variables.

Variable	Description
INDEPENDENT VARIABLE	
Contactless	Binary dummy: 1 if respondent owns contactless cards, 0 otherwise
Contactless (debit)	Binary dummy: 1 if respondent owns contactless debit card only, 0 otherwise
Contactless (credit)	Binary dummy: 1 if respondent owns contactless credit card only, 0 otherwise
BEHAVIOURAL VARIABLES	
Financial Literacy – Quartiles of the distribution	Sum of correct responses in financial literacy scale across 20-items (Ranyard et al. 2020)
1st quarter – FL	Low (0-6)
2nd quarter – FL	Medium-low (7-10)
3rd quarter – FL	Medium-high (11-14)
4th quarter – FL	High (15-20)
COHS (routine) – Quartiles of the distribution	The average of 16 questions (1-5 scale) in the Creature of Habit Scale (routine) (Ersche et al. 2017)
1st quarter – COHS (routine)	Low (1–3.06)
2nd quarter – COHS (routine)	Medium-low (3.07–3.56)
3rd quarter – COHS (routine)	Medium-high (3.57–3.93)
4th quarter – COHS (routine)	High (3.94-5)
SOCIO-DEMOGRAPHICS VARIABLES	
Age	Age, measured in years
Gender (M/F)	Binary dummy: 0 for Female, 1 for Male.
Married	Binary dummy: 1 for Married, 0 otherwise
Employed (FT/Permanent)	Binary dummy: 1 if respondent is in full-time, permanent employment, 0 otherwise
Benefits	Binary dummy: 1 if respondent is receiving benefits, 0 otherwise
Qualification	Categorical variable: 0 for 'no qualifications', 1 for 'O-level/GCSE equivalent' and 'A-level of equivalent', and 2 for third level and postgraduate degree
Income	Ordinal dummy. 1: £0 to £500, 2: £501 to £1000, 3: £1001 to £1750, 4: £1751 to £2500, 5: £2501 to £3500, 6: £3501 to £5500, 7: over £5501
Rural	Binary dummy: 1 if respondent lives in rural area, 0 otherwise
White	Binary dummy: 1 if respondent is white, 0 otherwise
Place of residence (UK regions)	Location where individuals live: 1: North East, 2: North West, 3: Yorkshire Humberside, 4: East Midlands, 5: East of England, 6: London, 7: South East, 8: South West, 9: Scotland, 10: Wales, 11: Northern Ireland.
Financial constraints	Binary dummy: 1 if the respondent falls within the top 10% of the distribution for the number of financial dependants in our sample (i.e. respondents with 2 or more financial dependants).
Variety of payment instrument types	The number of types of cards they own, such as credit cards (contactless and non-contactless), debit cards (contactless and non-contactless), store cards, and pre-paid cards.

that debit and credit cards, while similar in appearance and usage, often serve different purposes for consumers and come with distinct behavioural patterns (Borzekowski, Kiser, and Ahmed 2008; Fusaro 2013; Zinman 2009). Debit cards might be more closely associated with routine behaviour compared to credit cards. One reason is the direct link to a consumer's bank account balance. Purchases made with a debit card are immediately deducted from available funds, making it a potential choice for those who want to monitor household finances (Hernandez, Jonker, and Kosse 2016) or as a tool of behavioural restraint (Borzekowski, Kiser, and Ahmed 2008; Fusaro 2013). Unlike credit cards, which permit borrowing and could lead to debt, debit cards restrict users to spending only what's in their bank account. The intrinsic simplicity of making payments with debit cards, combined with their convenience as a close substitute for cash (Bounie, François, and Waelbroeck 2016), might account for why consumers might prefer using debit cards for daily and routine transactions, like grocery shopping, but free from the risks associated with accruing debt.[15]

Also, the associated costs of debit and credit cards may also influence routine-oriented individuals towards debit cards. Credit cards entail complex charges like interest rates and late fees, potentially accumulating and creating financial debt. Debit cards, however, mainly involve overdraft fees, offering a simpler fee management system. This aligns with Zinman (2009)'s findings which highlight that credit cards tend to be costlier for those who carry a balance and pay interest, in contrast to debit cards that do not incur interest charges. For individuals with high levels of routine-oriented behaviour, the simple fee structure of debit cards makes them easier to

Table 2. Descriptive statistics.

Variable	Obs.	Mean	SD	Min	Max
Contactless	2,734	0.832	0.374	0	1
Contactless (debit)	2,734	0.704	0.456	0	1
Contactless (credit)	2,734	0.417	0.493	0	1
Financial Literacy – Quartiles of the distribution					
1st quarter – FL (base category)	2,734	0.273	0.446	0	1
2nd quarter – FL	2,734	0.274	0.446	0	1
3rd quarter – FL	2,734	0.237	0.426	0	1
4th quarter – FL	2,734	0.216	0.411	0	1
COHS – Quartiles of the distribution					
1st quarter – COHS (routine) (base category)	2,734	0.253	0.435	0	1
2nd quarter – COHS (routine)	2,734	0.284	0.451	0	1
3rd quarter – COHS (routine)	2,734	0.237	0.425	0	1
4th quarter – COHS (routine)	2,734	0.226	0.418	0	1
Age	2,734	47.661	17.262	18	80
Gender (M/F)	2,734	0.455	0.498	0	1
Married	2,734	0.486	0.500	0	1
Employed (FT/Permanent)	2,725	0.331	0.471	0	1
Benefits	2,652	0.262	0.440	0	1
Qualification					
No qualifications (base category)	2,702	0.053	0.225	0	1
O-level/GCSE / A-level	2,702	0.424	0.494	0	1
Third level and PG degree	2,702	0.523	0.500	0	1
Income					
$<$ £500 (base category)	2,476	0.092	0.289	0	1
£501 to £1000	2,476	0.135	0.342	0	1
£1001 to £1750	2,476	0.160	0.367	0	1
£1751 to £2500	2,476	0.168	0.374	0	1
£2501 to £3500	2,476	0.167	0.373	0	1
£3501 to £5500	2,476	0.174	0.380	0	1
$>$ £5501	2,476	0.104	0.305	0	1
Rural	2,721	0.338	0.473	0	1
White	2,707	0.838	0.369	0	1
Place of residence (UK regions)					
North-East	2,734	0.052	0.223	0	1
North-West	2,734	0.113	0.316	0	1
Yorkshire and the Humber	2,734	0.082	0.275	0	1
East Midlands	2,734	0.121	0.326	0	1
East of England	2,734	0.090	0.287	0	1
London (base category)	2,734	0.148	0.355	0	1
South-East	2,734	0.149	0.356	0	1
South-West	2,734	0.097	0.295	0	1
Scotland	2,734	0.076	0.266	0	1
Wales	2,734	0.051	0.220	0	1
Northern Ireland	2,734	0.020	0.140	0	1
Financial constraints	2,712	0.201	0.401	0	1
Variety of payment instrument types	2,701	2.096	1.007	1	6

manage for everyday transactions, making debit cards a more attractive choice. This is consistent with the results for credit cards, where routine-oriented behaviour has no influence on contactless ownership, with the income variable gaining relevance as a predictor of contactless ownership.

Results in Table 3 also suggest that the effect for individuals who are highly routine-oriented compared to their low routine-oriented counterparts is statistically and economically insignificant, suggesting that individuals with extreme routine-oriented behaviours (low or acute reliance on daily routines) are likely to have similar patterns of ownership of contactless technologies. Coefficients for gender and whether respondents live in rural areas are statistically insignificant across all regressions, suggesting that ownership of contactless payment technologies is not associated with these socio-demographic characteristics. We find that contactless ownership, specifically

Table 3. The effect of financial literacy and habits on ownership of contactless payment cards (average marginal effects).

	Contactless ownership (Debit and Credit)		Contactless ownership (Debit only)		Contactless ownership (Credit only)	
	(1)	(2)	(3)	(4)	(5)	(6)
Financial Literacy (FL)						
2nd quarter – (medium-low FL)	0.022	0.002	0.054	0.042	0.084***	0.047
	(0.94)	(0.10)	(1.21)	(1.07)	(3.20)	(1.58)
3rd quarter – (medium-high FL)	0.076***	0.060***	0.155***	0.144***	0.226***	0.165***
	(5.16)	(3.22)	(6.22)	(5.71)	(7.97)	(4.89)
4th quarter – (high FL)	0.107***	0.076***	0.142***	0.120***	0.320***	0.213***
	(6.09)	(4.71)	(3.18)	(3.52)	(15.75)	(6.53)
COHS (Routine)						
2nd quarter – COHS (Medium-low routine)	0.037**	0.033**	0.057***	0.065**	0.001	0.005
	(2.04)	(1.98)	(3.85)	(2.57)	(0.03)	(0.20)
3rd quarter – COHS (Medium-high routine)	0.044***	0.052***	0.063***	0.056**	−0.037	−0.041
	(2.61)	(2.72)	(3.45)	(2.32)	(−1.56)	(−1.39)
4th quarter – COHS (high routine)	0.028	0.033	0.014	0.018	−0.037	−0.030
	(1.05)	(1.36)	(0.61)	(0.69)	(−1.54)	(−1.07)
Place of residence (UK regions)						
North-East	−0.034***	0.003	0.008***	−0.006	−0.044***	−0.052***
	(−25.52)	(0.38)	(5.36)	(−0.38)	(−60.26)	(−4.37)
North-West	−0.066***	−0.023***	−0.018***	−0.022*	−0.075***	−0.050***
	(−61.22)	(−3.72)	(−14.16)	(−1.90)	(−41.00)	(−4.87)
Yorkshire Humberside	0.004	0.030***	0.052***	0.035**	−0.031***	0.000
	(1.35)	(4.23)	(24.27)	(2.54)	(−8.25)	(0.01)
East Midlands	−0.032***	−0.018**	0.005***	−0.001	−0.045***	−0.049***
	(−42.34)	(−2.42)	(3.49)	(−0.07)	(−17.74)	(−3.50)
East of England	0.015***	0.006	0.028***	−0.011	−0.049***	−0.064***
	(13.19)	(0.87)	(9.55)	(−0.76)	(−17.91)	(−4.53)
South-East	0.002	0.026***	0.050***	0.035**	0.008**	−0.011
	(1.23)	(3.55)	(17.35)	(2.53)	(2.12)	(−0.80)
South-West	−0.014***	0.020**	0.009***	0.004	−0.026***	0.003
	(−10.98)	(2.04)	(3.26)	(0.22)	(−9.01)	(0.18)
Scotland	−0.011***	0.036***	0.065***	0.082***	−0.025***	−0.007
	(−8.13)	(4.91)	(39.45)	(6.28)	(−10.82)	(−0.53)
Wales	−0.037***	−0.026**	0.054***	0.037**	−0.061***	−0.082***
	(−17.03)	(−2.28)	(19.04)	(2.07)	(−20.16)	(−4.85)
Northern Ireland	−0.083***	−0.062***	−0.108***	−0.118***	−0.147***	−0.148***
	(−33.39)	(−6.28)	(−29.38)	(−6.98)	(−52.22)	(−15.20)
Socio-demographics						
Age		0.000		0.001		0.003***
		(0.22)		(0.53)		(4.02)
Gender (M/F)		−0.007		−0.037		−0.000
		(−0.45)		(−1.42)		(−0.00)
Married		0.016		−0.004		0.023**
		(0.95)		(−0.20)		(2.11)
Employed (FT/Permanent)		0.057***		0.010		0.076***
		(3.18)		(0.43)		(4.05)
Benefits		−0.011		−0.013		−0.021
		(−0.71)		(−0.92)		(−0.85)
Qualifications						
O-level/GCSE / A-level		−0.041		−0.020		−0.003
		(−1.61)		(−0.73)		(−0.05)
Third level and PG degree		−0.030		0.001		0.016
		(−1.35)		(0.04)		(0.27)
Income						
£501 to £1000		0.030		0.033		0.053
		(0.62)		(0.50)		(1.53)
£1001 to £1750		0.019		0.015		0.031
		(0.35)		(0.27)		(1.28)

(*continued*).

Table 3. Continued.

	Contactless ownership (Debit and Credit)		Contactless ownership (Debit only)		Contactless ownership (Credit only)	
	(1)	(2)	(3)	(4)	(5)	(6)
£1751 to £2500		0.043		0.034		0.156***
		(1.30)		(0.95)		(5.37)
£2501 to £3500		0.095**		0.086		0.237***
		(2.05)		(1.64)		(8.08)
£3501 to £5500		0.101**		0.055		0.181***
		(2.22)		(1.15)		(6.17)
> £5501		0.120**		0.045		0.207***
		(2.57)		(0.75)		(4.69)
Rural		0.015		0.005		0.017
		(1.01)		(0.19)		(0.76)
White		−0.033**		0.008		−0.008
		(−2.02)		(0.27)		(−0.38)
Observations	2734	2368	2734	2368	2734	2368
Pseudo-R-squared	0.023	0.056	0.026	0.031	0.052	0.092
Log likelihood, constant-only model	−1238.784	−1033.009	−1659.636	−1415.260	−1857.529	−1620.493
Log likelihood	−1210.523	−974.766	−1617.199	−1371.595	−1761.383	−1470.972
AIC	2433.047	1969.533	3246.399	2763.190	3534.765	2961.944
BIC	2468.528	2027.231	3281.880	2820.888	3570.246	3019.642

Notes: This table reports average marginal effects of the determinants of contactless technology adoption based on probit models. Z statistics are reported in parentheses. Significance levels are denoted as * when $p < 0.10$, ** when $p < 0.05$ and *** when $p < 0.01$. The base category for financial literacy (FL) and Creature of Habit Scale (COHS) are 1st quarter, gender is female, qualifications is 'no qualification', income is £0-£500 and place of residence is London. All regressions include a constant term. Standard errors are clustered at the geographical region where people live.

contactless credit cards, is higher among the high-income and employed. These findings complement those in Broekhoff and van der Cruijsen (2024). They find that contactless payments tend to reduce the pain of payment compared to cash, especially for older adults. Our finding of higher contactless ownership among the high-income and employed suggests that individuals with a higher marginal value of income (i.e. those with less income) might impose self-control mechanisms to restrict spending by not owning contactless credit cards.[16]

4.2. Propensity score matching (PSM)

Assessing the causal effect of financial literacy and habitual behaviours on contactless payment ownership is potentially prone to endogeneity issues. If individuals exhibiting moderate/high levels of financial literacy and habitual behaviours (treatment group) are more likely ex-ante to own contactless payment instruments than their low-level counterparts (control group) with comparable characteristics, the results of the empirical analysis could be affected. Although the use of consumer attitudinal data has been found to be helpful to control for unobserved consumer heterogeneity and address endogeneity (Ching and Hayashi 2010; Harris and Keane 1999), we employ the Propensity Score Matching (PSM) technique to estimate the Average Treatment Effect on the Treated (ATET). Propensity Score Matching (PSM) is a widely used method for estimating causal effects in observational studies (Dehejia and Wahba 2002). PSM balances covariates between treatment and control groups by matching individuals with similar propensity scores, which represent the conditional probability of receiving treatment given observed covariates. PSM creates comparable groups for more accurate treatment effect estimation (Rosenbaum and Rubin 1983). By using this methodology, we are able to gauge the causal impact of financial literacy and routine behaviours on the ownership of contactless cards. More specifically, the ATET provides insights into the average difference in card ownership for individuals with high levels of financial literacy and routine behaviours, versus the expected outcomes had they possessed lower levels of these traits.

In order to compute credible counterfactuals, the treatment group was matched with the control group based on a propensity score, which is a function of observable characteristics available in the survey database. Propensity scores are estimated via a logit model using a wide range of individual-level characteristics (age, gender,

Table 4. Propensity score matching.

Panel A: Average treatment effect on the treated (ATET) of financial literacy on contactless ownership			
	Contactless ownership (Debit and Credit)	Contactless ownership (Debit only)	Contactless ownership (Credit only)
Panel A.1: One match per observation			
ATET	0.0830***	0.136***	0.0959**
	(3.36)	(4.10)	(2.10)
N	2,471	2,471	2,471
Panel A.2: Three matches per observation			
ATET	0.0699***	0.105***	0.158***
	(2.97)	(3.64)	(4.88)
N	2,471	2,471	2,471
Panel A.3: Five matches per observation			
ATET	0.0726***	0.108***	0.165***
	(2.75)	(3.49)	(5.83)
N	2,471	2,471	2,471
Panel B: average treatment effect on the treated (ATET) of habitual behaviour on contactless ownership			
Panel B.1: One match per observation			
ATET	0.0725***	0.0911***	−0.00785
	(2.99)	(3.12)	(−0.25)
N	2,471	2,471	2,471
Panel B.2: Three matches per observation			
ATET	0.0396**	0.0544**	−0.0151
	(2.00)	(2.23)	(−0.55)
N	2,471	2,471	2,471
Panel B.3: Five matches per observation			
ATET	0.0419**	0.0547**	−0.00810
	(2.19)	(2.34)	(−0.30)
N	2,471	2,471	2,471

Notes: This table shows the computation of the average treatment effect of the treated (ATET). That is for an individual, on average, the effect of having high financial literacy (Panel A) and high routine (Panel B) on the likelihood of owning a contactless payment instrument with one, three and five corresponding low financial literacy and low-routine individuals, respectively. Robust z-statistics are reported in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively.

marital status, employment status, income level, and NUTS1 regional area of residence) as independent variables. We match individuals with moderate/high-levels of financial literacy and habitual behaviours with one, three, and five corresponding (nearest neighbour) from their low-level counterparts (control group).[17] No observations were dropped due to lack of overlap. Figures A.4a and A.4b in the Online Appendix show good balance across the propensity score distribution, supporting the generalisability of the treatment effects to the full sample. Figures A.5a and A.5b in the Online Appendix show the distribution of the propensity score for both groups before and after matching and suggest that the matches are appropriate. As a sensitivity check, we re-estimate Model 2 using continuous measures and quadratic terms for financial literacy and routine behaviour. Results (Figures A.6a – A.6b) confirm a positive association for financial literacy and an inverted U-shaped pattern for routine, supporting the main hypothesis. We retain the quartile-based categorisation for clarity.

Table 4 presents the average treatment effect on the treated (ATET) for three groups of individuals: contactless owners (debit/credit), contactless debit card owners, and contactless credit card owners. The control group consist of individuals with a low level of financial literacy and habitual behaviour. Results reveal that ATETs for financial literacy (Table 4, Panel A) and habitual behaviour (Table 4, Panel B) are positive and statistically significant for almost all categories of contactless ownership, which is largely in line with the results reported in Table 3. Considering the results of Table 4, Panel A, it appears that for an individual, on average, the effect of having a moderate/high level of financial literacy increases the likelihood of contactless ownership in around 6.9% to 16.5% compared with what would have occurred if these individuals would have had a low level of financial literacy. In a similar way, results of Table 4, Panel B, suggest that for an individual, on average, the effect of having

Table 5. The effect of financial literacy and habits on ownership of contactless payment cards adding financial constraints as an additional control variable (average marginal effects).

	Contactless ownership (Debit and Credit)	Contactless ownership (Debit only)	Contactless ownership (Credit only)
Financial Literacy (FL)			
2nd quarter – (medium-low FL)	0.002	0.041	0.049
	(0.07)	(1.03)	(1.61)
3rd quarter – (medium-high FL)	0.061***	0.141***	0.166***
	(3.30)	(5.63)	(4.79)
4th quarter – (high FL)	0.078***	0.116***	0.214***
	(4.83)	(3.53)	(6.35)
COHS (Routine)			
2nd quarter – COHS (Medium-low routine)	0.031*	0.064**	0.005
	(1.80)	(2.49)	(0.21)
3rd quarter – COHS (Medium-high routine)	0.051***	0.055**	−0.040
	(2.65)	(2.32)	(−1.35)
4th quarter – COHS (high routine)	0.030	0.018	−0.028
	(1.29)	(0.68)	(−0.98)
Financial constraints	0.036**	−0.025	−0.002
	(2.26)	(−1.04)	(−0.08)
Full set of controls	YES	YES	YES
Observations	2361	2361	2361
Pseudo-R-squared	0.058	0.030	0.092
Log likelihood, constant-only model	−1030.132	−1410.151	−1615.175
Log likelihood	−970.818	−1367.243	−1466.164
AIC	1961.636	2754.487	2952.328
BIC	2019.305	2812.155	3009.996

Notes: This table reports average marginal effects of the determinants of contactless technology ownership based on probit models with a full set of controls as reported in Models 2,4 and 6 in Table 3 plus an additional proxy for financial constraints. Z statistics are reported in parentheses. Significance levels are denoted as * when $p < 0.10$, ** when $p < 0.05$ and *** when $p < 0.01$. The base category for financial literacy (FL) and Creature of Habit Scale (COHS) are 1st quarter. All regressions include a constant term. Standard errors are clustered at the geographical region where people live.

a moderate/high level of habitual behaviours increases the likelihood of contactless ownership in around 5.4% to 9.1% compared with what would have occurred if these individuals would have had a low level of habitual behaviours.[18] Similar to results reported in Table 3, the ATETs for credit cards are insignificant, which in turn suggests that the effect of routines on contactless ownership is mainly driven by debit card ownership.[19]

4.3. Robustness checks

In this Section, we carry out some additional robustness checks to provide further empirical support to our main findings. First, we have introduced an additional control variable to serve as a proxy for individuals who may face potential financial constraints ex-ante. This variable indicates whether the respondent is in the top 10% of the distribution for the number of financial dependants in our sample. This is consistent with Worthington (2006), who suggests that financial stress is higher in families with more children, indicating that the number of financial dependants in a household can increase the likelihood of financial stress. The results of regressions using this new variable are reported in Table 5. These results align well with the original findings shown in Tables 3 and 4, and provide further empirical support to our initial findings, even after accounting for potential income and wealth-related confounding factors.[20]

Second, it could be argued that respondents with more cards might be more likely to have at least one contactless card. Although our survey does not permit us to control for the exact number of cards each respondent has, we can still control for the number of types of cards they own, such as credit cards (contactless and non-contactless), debit cards (contactless and non-contactless), store cards, and pre-paid cards. By adding this new variable, in conjunction with the full list of control variables reported in Table 3 (models 2, 4, and 6), we can differentiate between the effects of merely having multiple payment instruments due to an established banking relationship and the effects of financial literacy or routine behaviour on contactless card ownership.

Table 6. The effect of financial literacy and habits on ownership of contactless payment cards adding ownership of multiple types of electronic payment instruments as an additional control variable (average marginal effects).

	Contactless ownership (Debit and Credit)	Contactless ownership (Debit only)	Contactless ownership (Credit only)
Financial Literacy (FL)			
2nd quarter – (medium-low FL)	−0.013	0.035	0.042
	(−0.56)	(0.88)	(1.39)
3rd quarter – (medium-high FL)	0.030**	0.139***	0.159***
	(2.01)	(5.11)	(4.76)
4th quarter – (high FL)	0.036***	0.121***	0.201***
	(3.06)	(3.49)	(6.39)
COHS (Routine)			
2nd quarter – COHS (Medium-low routine)	0.033**	0.066**	0.007
	(2.09)	(2.35)	(0.27)
3rd quarter – COHS (Medium-high routine)	0.044**	0.061***	−0.043
	(2.48)	(2.59)	(−1.45)
4th quarter – COHS (high routine)	0.028	0.027	−0.030
	(1.47)	(1.04)	(−1.08)
Variety of payment instrument types	0.096***	−0.077***	0.025
	(9.89)	(−7.19)	(1.35)
Full set of controls	YES	YES	YES
Observations	2351	2351	2351
Pseudo-R-squared	0.093	0.054	0.105
Log likelihood, constant-only model	−1610.779	−1393.769	−1001.303
Log likelihood	−1461.647	−1318.217	−895.684
AIC	2943.293	2656.435	1811.369
BIC	3000.919	2714.061	1868.995

Notes: This table reports average marginal effects of the determinants of contactless technology ownership based on probit models with a full set of controls as reported in Models 2,4 and 6 in Table 3 plus an additional proxy for Variety of payment instrument types. Z statistics are reported in parentheses. Significance levels are denoted as * when $p < 0.10$, ** when $p < 0.05$ and *** when $p < 0.01$. The base category for financial literacy (FL) and Creature of Habit Scale (COHS) are 1st quarter. All regressions include a constant term. Standard errors are clustered at the geographical region where people live.

The results of the regressions performed using this new variable are presented in Table 6. The results are in line with the findings presented in Table 3. This highlights their robustness, even when taking into account the potential for confounding factors related to the ownership of multiple electronic payment instruments. We acknowledge that the number of payment instruments may be endogenously related to unobserved financial innovation. This control addresses heterogeneity in access, but we caution against causal interpretation.

Third, it can also be posited that the sophistication of financial institutions is a significant factor contributing to the prevalence of contactless payment ownership. Although we have accounted for supply-side factors using geographic fixed effects, we attempt to capture the distinct banking preferences of urban and rural populations. It would be the case that urban residents are more inclined to utilise the services of larger national banks, as these institutions typically maintain branches in major urban centres. Conversely, rural residents may be more inclined to utilise the services of small and regional banks, as these institutions are often more prevalent in rural areas. Through the intersection of these demographics with income bands, we can more effectively identify and segment diverse consumer groups, and assess their access to payment solutions provided by their banks.

In light of the survey's omission of specific banking details, we introduce interaction terms between income and rural/urban location to address potential omitted variable bias. These interactions are theoretically grounded in the idea that access to financial services and adoption of payment technologies are jointly shaped by both income and geographic location. High-income consumers in urban areas are more likely to be served by major banks offering advanced payment technologies, whereas lower-income rural consumers may be more reliant on smaller regional banks with slower technology diffusion. By capturing these distinct consumer segments, the interaction terms allow us to control for unobserved heterogeneity linked to financial institution access and regional technological infrastructure. Our main results remain robust and are presented in Table 7.[21]

Table 7. The effect of financial literacy and habits on ownership of contactless payment cards adding the interaction of income bands and consumer location (urban/rural) as an additional control variable capturing bank's customer segments (average marginal effects).

	Contactless ownership (Debit and Credit)	Contactless ownership (Debit only)	Contactless ownership (Credit only)
Financial Literacy (FL)			
2nd quarter – (medium-low FL)	0.002	0.041	0.046
	(0.07)	(1.04)	(1.53)
3rd quarter – (medium-high FL)	0.060***	0.144***	0.167***
	(3.36)	(5.94)	(4.89)
4th quarter – (high FL)	0.076***	0.120***	0.216***
	(5.03)	(3.63)	(6.33)
COHS (Routine)			
2nd quarter – COHS (Medium-low routine)	0.033*	0.063**	0.001
	(1.94)	(2.38)	(0.05)
3rd quarter – COHS (Medium-high routine)	0.052***	0.053**	−0.044
	(2.69)	(2.32)	(−1.46)
4th quarter – COHS (high routine)	0.032	0.017	−0.031
	(1.32)	(0.63)	(−1.07)
AMEs of Income band for consumers located in urban and rural areas			
£501 to £1000 at urban area	0.034	0.052	0.014
	(0.49)	(0.62)	(0.33)
£501 to £1000 at rural area	0.019	−0.018	0.128*
	(0.67)	(−0.32)	(1.75)
£1001 to £1750 at urban area	0.041	0.060	0.042
	(0.70)	(1.00)	(1.45)
£1001 to £1750 at rural area	−0.025	−0.083	0.010
	(−0.40)	(−1.45)	(0.14)
£1751 to £2500 at urban area	0.049	0.037	0.158***
	(1.06)	(0.83)	(4.79)
£1751 to £2500 at rural area	0.030	0.014	0.153***
	(0.71)	(0.20)	(2.66)
£2501 to £3500 at urban area	0.103*	0.140**	0.278***
	(1.71)	(2.14)	(6.59)
£2501 to £3500 at rural area	0.077***	−0.026	0.166***
	(2.67)	(−0.46)	(2.99)
£3501 to £5500 at urban area	0.109*	0.076	0.190***
	(1.88)	(1.10)	(7.08)
£3501 to £5500 at rural area	0.083*	0.005	0.162***
	(1.78)	(0.09)	(3.23)
> £5501 at urban area	0.135**	0.081	0.225***
	(2.03)	(0.98)	(4.29)
> £5501 at rural area	0.088	−0.036	0.170***
	(1.50)	(−0.43)	(2.91)
Full set of controls	YES	YES	YES
Observations	2368	2368	2368
Pseudo-R-squared	0.121	0.049	0.095
Log likelihood, constant-only model	−1033.009	−1415.260	−1620.493
Log likelihood	−907.772	−1346.302	−1466.924
AIC	1835.545	2712.603	2953.849
BIC	1893.243	2770.301	3011.547

Notes: This table reports average marginal effects of the determinants of contactless technology ownership based on probit models with a full set of controls as reported in Models 2,4 and 6 in Table 3 plus an additional proxy for consumer segments (interaction terms between income band and rural/urban area dummy). Z statistics are reported in parentheses. Significance levels are denoted as * when $p < 0.10$, ** when $p < 0.05$ and *** when $p < 0.01$. The base category for financial literacy (FL) and Creature of Habit Scale (COHS) are 1st quarter, and income is £0-£500. All regressions include a constant term. Standard errors are clustered at the geographical region where people live.

5. Conclusions

Despite rapid developments in payment method technologies and the growing global trend towards cashless economies, research on the implications of cashless markets for payment method ownership and behaviour is in

its infancy (Anaza et al. 2022). We speak to this research agenda by examining behavioural drivers of ownership of contactless payment technologies during a period when contactless technology was on the rise, but market saturation was still to be recognised, thus allowing us to contrast behavioural characteristics across adopters and non-adopters. Motivated by theoretical insights from consumer financial literacy (Lusardi and Mitchell 2014) and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003; Venkatesh, Thong, and Xu 2012), we document the importance of consumer financial literacy and trait habitual behaviour on ownership of contactless payment cards. After ruling out the effect of unobserved supply-side factors in the areas where consumers live, we find that financial literacy and routine-oriented behaviour are significant predictors of contactless debit card ownership. Routines do not appear to affect ownership of contactless credit cards, which is mainly driven by consumers' financial literacy and income levels. Furthermore, after controlling for other sociodemographics, we find higher contactless ownership among the high income and employed, suggesting individuals with a higher marginal value of income (i.e. those with less income) might impose self-control mechanisms by not owning contactless credit cards.

Our findings provide valuable new insights into the under-researched role of consumers' behavioural characteristics, in the guise of financial literacy and trait habit, on the ownership of contactless payment technology, with ownership an essential precursor to use. Policymakers and financial institutions should focus on enhancing financial literacy as it plays a pivotal role in the adoption of new technologies that can significantly improve financial inclusion and well-being (Panos and Wilson 2020). While increasing financial literacy is not under the remit of financial providers, our findings suggest that broader public engagement with financial education programs could facilitate the uptake of new contactless payment technologies, which provide a convenient and efficient form of payment method. Furthermore, while banks and payment service providers have little influence over their customers' behavioural characteristics, our results suggest they might benefit from using customer data to identify routine-oriented behaviour (e.g. purchasing patterns in daily transaction data as opposed to payment methods per se) and to tailor specific campaigns for targeted customer segments in an attempt to facilitate the diffusion of new technologies. For pragmatic reasons, our work focuses on contactless technology in the form of payment cards. We leave it to future research to extend our work to non-card contactless devices.

As with any study, there are potential limitations and areas for future research. Our data were collected in 2019, when contactless payments were still in the early stages of adoption, which may affect the generalisability of our findings to more recent periods, given the rapid evolution of payment technologies. Future research could explore alternative operationalisations of financial literacy and habitual behaviour, such as continuous measures or payment-specific habit scales, to better capture the underlying constructs and address potential measurement error. It would also be valuable to examine non-linear relationships more systematically. Future studies with access to richer behavioural data of individual-level digital literacy, trust in technology, and prior experiences with fintech services could help further isolate the underlying mechanisms affecting technology adoption. Methodologically, while propensity score matching (PSM) helps address observed confounding, it cannot fully account for unobserved heterogeneity. Future research may consider the use of instrumental variables (IV) or structural equation modelling (SEM) to better isolate causal effects. Additionally, multilevel modelling may help capture localised variation in payment practices, particularly when fine-grained geographic data is available.

Notes

1. A general interest in cashless payment technologies gained considerable attention during the COVID-19 pandemic as a way to minimize physical contact during transactions (Kotkowski and Polasik 2021). In a recent paper, Jonker et al. (2022) show that the pandemic accelerated the use of debit cards and increased the use of contactless payments.
2. By 2024, contactless cards account for virtually all new cards issued in the UK – see https://www.ukfinance.org.uk/news-and-insight/press-release/uk-reaches-150-million-contactless-cards-in-issue
3. We draw on the notion of 'creature of habit' traits in Ersche et al. (2017) and it is to this that we refer whenever discussing habit, habitual behaviour, trait habit, etc., throughout. In doing so, we draw a distinction between the tendency to habitual behaviour in daily life in general (i.e. trait habit) and the more specific *payment* habits as per Van Der Cruijsen and Van Der Horst (2019).
4. The research project is an academic-industry collaboration funded by the National Westminster Bank, UK. Full academic freedom was retained throughout.
5. Recent exceptions include Trütsch (2020) and Brown et al. (2022) for the US and Switzerland, respectively.
6. Routine refers to 'familiar action patterns that involve regularity' (Ersche et al. 2017, 77).

7. We remove non-complete and non-serious attempts (i.e. those completing in a very short time or those entering random responses in free-text boxes). Individuals who didn't disclose their place of habitual residence (NUTS1 UK geographical regions) were also excluded from the estimation sample.
8. Although we cannot directly observe usage patterns from our dataset, ownership reflects a necessary precondition for use. As such, it serves as a meaningful indicator of access to and engagement with digital payment infrastructure.
9. Ersche et al. (2017) show that their COHS routine scale has high internal consistency and clear unidimensionality, confirmed through both confirmatory factor analysis and Mokken scale analysis, while construct validity is supported by significant negative correlations with sensation-seeking and modest positive associations with anxiety and compulsivity. They report high values for McDonald's omega and Cornbach's alpha ($\omega = 0.92, \alpha = 0.89$), supporting the scale's satisfactory reliability. Using a UK adult sample, Ranyard et al. (2020) employ item response theory (IRT) to produce a financial literacy scale with excellent psychometric properties, including high internal consistency and robust construct validity across four financial domains: everyday money transactions, the concept of money, borrowing, and saving and investment. Their 20-item in-depth scale which we use is shown to have satisfactory overall item reliability (Cronbach's alpha 0.86) and overall discriminability across a wide range of respondent ability (-2 to $+2$). The scale outperforms traditional brief measures in predicting financial well-being outcomes such as debt management, precautionary saving, and making ends meet (see Ranyard et al. 2020).
10. Our focus on trait habitual behaviour complements existing studies concerned with payment habits and avoids potential endogeneity concerns arising from reverse causality between payment habits and payment behaviours.
11. Our sample is drawn from a population that may not fully reflect the UK's diversity in terms of digital access, which may marginally affect generalisability. However, we are confident that our results remain robust, as key demographic drivers – such as age, gender, and income – are well represented in our sample.
12. Consumers self-select into contactless payment (Trütsch 2020); hence, while we control for supply-side effects, they are not our primary focus.
13. Jonker (2007) finds that geographical differences have a significant impact on payment behaviour. As Deungoue (2008) suggests, payment behaviours are influenced by the regulatory and technological environment in which consumers operate. The regional variation in contactless payment adoption across the UK likely reflects differences in regional infrastructure and merchant acceptance.
14. And, by implication, relative to medium-low levels which does not differ significantly from the base category.
15. Self-reported measures of habitual behaviour may be subject to social desirability bias (the tendency to present oneself in a favourable light) and recall bias (inaccuracies in remembering and reporting past events, experiences, or behaviours), which should be considered when interpreting the findings. We are confident, however, that the potential for such bias is small. Social desirability bias is unlikely to be a concern in our survey as participants completed the questionnaire privately and were informed their responses would remain confidential, while recall bias is unlikely to be a concern due to the nature of the questions comprising the COHS routine scale from Ersche et al. (2017) which do not explicitly require accurate recall.
16. Robustness checks using two-way clustering by region and location are reported in Table A.1 in the Online Appendix. Results remain robust across these specifications, providing additional confidence in our findings. Future work may consider multilevel modelling when more granular geographic information becomes available.
17. One assumption required to use treatment-effects estimators is the overlap assumption, which states that each observation has a positive probability of receiving each type of treatment. Consistent with the overlap assumption, the estimated density plots in Figures A.4a and A.4b in the Online Appendix show a considerable mass in the regions where they overlap. Thus, there is no evidence that the overlap assumption is violated.
18. We conducted sensitivity analyses using Mantel-Haenszel (MH) bounds (Rosenbaum and Rubin 1983) to assess the robustness of the results to potential unobserved confounders. These analyses are applicable only to nearest-neighbour 1-to-1 matching without replacement, limiting their generalizability. Although the critical value of Γ identified by the MH bounds indicates the threshold where our estimates become sensitive to unobserved factors, it does not directly confirm whether the Conditional Independence Assumption (CIA) has been violated. Detailed results are provided in Tables A.2 (Financial Literacy) and A.3 (Routine) in the Online Appendix.
19. We implement propensity score matching using 1, 3, and 5 nearest neighbours to address the bias-variance trade-off. Results are robust across specifications, including kernel matching (Table A.4, Online Appendix). Balance diagnostics (Tables A.5–A.6, Online Appendix) show satisfactory covariate balance, with standardised differences near zero and variance ratios close to one.
20. The financial constraints measure captures general difficulty in covering expenses but may not fully reflect broader aspects of financial stress, such as informal borrowing, asset depletion, or psychological strain. Future surveys could improve on this by incorporating more comprehensive indicators of financial hardship.
21. Future research could usefully explore how financial literacy interacts with other socio-demographic factors, such as education, to influence the adoption of financial technologies. While beyond the scope of the current analysis, such extensions may offer deeper insights into the behavioural and structural determinants of technology uptake.

Compliance with ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Ethical approval statement

Following Newcastle University's ethical approval procedure this project was deemed 'low risk' and hence ethical approval granted without further review by Research Ethics Committee.

Informed consent

Informed consent was obtained prior to participation in this project.

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No potential conflict of interest was reported by the author(s).

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Data availability statement

Data used in this study are available from the authors on reasonable request.

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