EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

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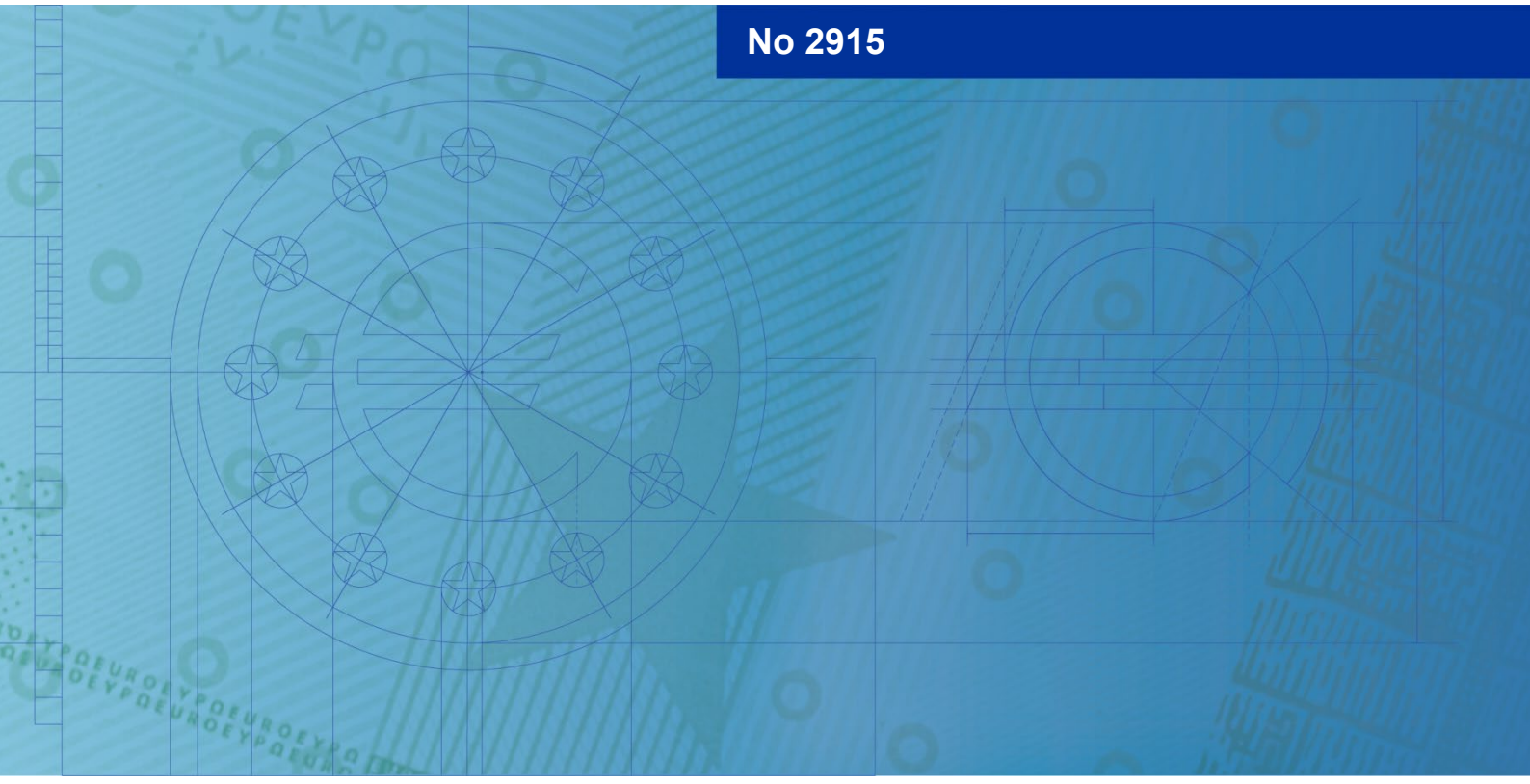
Consumers' payment preferences and banking digitalisation in the euro area

No 2915



Abstract

This paper contributes to understanding consumers' retail payment preferences and digitalisation in personal finances. We focus on the acceptance of cashless payments in everyday situations and the use of mobile banking apps in the euro area, where the payment services market has changed significantly in recent years. In particular, we study app-based tools for day-to-day (offline) purchases that involve small amounts of money as well as digital tools for managing personal finances. By looking at factors associated with using non-cash payment methods, and app-based financial services solutions, we shed light on the topic of financial inclusion in payment services that concern consumers' everyday choices. Using granular microdata from the European Central Bank's Consumer Expectations Survey, we find that most people prefer to use only one payment instrument. After the COVID-19 pandemic, it has mostly been cash and contactless cards. The use of cash is partly due to limited perceived acceptance of non-cash payments by merchants. We also find substantial cross-country heterogeneity and highlight the prominent role of demographic factors in choosing non-cash payment options and app-based tools when managing personal finances. While mobile banking is already popular amongst euro area consumers, the use of smart payment methods remains very limited. Our findings suggest that financial service providers should recognize the growing preference of the younger generations for alternative payment methods. Creating awareness among consumers might also lead to positive feedback effects by reducing consumers' reliance on cash through higher perceived availability of non-cash payment options.

Keywords: Payment Preferences, Cash, FinTech, Digitalisation, Consumer Expectations Survey (CES)

JEL-classifications: C13, D12, E42, O33

Non-technical summary

Making payments and choosing from different available payment methods is an everyday activity of consumer decision-making. This paper contributes to understanding consumers' payment preferences and digitalisation in personal finances. While being a common choice problem, how consumers make payments still widely differs across countries and different groups of consumers. Traditionally, cash has been the default option for many euro area consumers. Considering a rapidly changing payment landscape through digitalisation and the possible advent of central bank-issued digital currencies, we study individuals' payment preferences today, the role perceived acceptance of non-cash payments plays, and the use of mobile banking applications (apps) for consumers in the largest currency union, the euro area.

Exploring consumer payment preferences and behaviour matters beyond academic interest for central banks and policymakers. It furthers our understanding of how digitalisation changes individual day-to-day behaviour and to which extent payment patterns are heterogeneous within societies and across countries. It contributes to the discussion of financial inclusion in an ever-more digital payment landscape that might risk leaving certain groups of society behind.

Our empirical analysis is based on three waves of the ECB's Consumer Expectations Survey (CES), fielded in May 2020, December 2020, and August 2022. The CES is a novel web-based survey that collects since April 2020 data from more than 10,000 consumers from the six largest euro area countries (Belgium, Germany, Italy, France, Spain, and the Netherlands) at monthly frequency.

We find that most people prefer only one payment instrument, mostly cash or contactless cards. While mobile banking apps are widely used among consumers, smart payment methods remain at a low level after the COVID-19 pandemic. Perceived limits to the acceptance of electronic non-cash payments seem to be a relevant factor for cash preferences, even after controlling for demographic and socioeconomic characteristics.

We document substantial cross-country heterogeneity in payment preferences. Belgium and the Netherlands stand out as the countries with the highest fraction of respondents who prefer non-cash payment methods. In contrast, on the other end of the spectrum, Germany and Italy are countries where consumers rather prefer using cash.

Our results highlight the prominent role of demographic factors in choosing non-cash payment options and app-based tools in managing personal finances. Men, the young, and the high-earners are more likely to use payment options alternative to cash. We find no role of financial literacy in the preference for smart payments and using mobile banking applications, indicating that such tools might not feature significant entry costs.

"As our lives have suddenly gone digital, so have our payments: there has been a surge in online payments and a shift towards contactless payments in shops" (Christine Lagarde, 10 September 2020).

1. Introduction

The payment services market is changing rapidly with increasing digitalisation of payment services along with the advent of central bank issued digital money in many countries. The payment landscape for consumers changed significantly in recent years, particularly in the euro area. Electronic payments in the EU have grown constantly, reaching €240 trillion in value in 2021 (compared with €184.2 trillion in 2017) and consumers are increasingly interacting with online banking and financial technology firms (fintechs) in managing their personal finances.[2] Many market observers of the payment sector have recently hypothesised about cash eventually being marginalised by alternative digital payment options considering rapid technological change.[3] If anything, this public perception has only strengthened through the experience of the COVID-19 pandemic. While some research still finds that "*cash does not seem to be going away*" (Shy 2023), many central banks are preparing for such a market shift in financial services away from cash. Most central banks are rapidly working on complementing cash with a digital alternative, central bank digital currencies (CBDCs), according to a recent survey by Kosse and Mattei (2023).

This paper studies consumers' payment preferences with a focus on non-cash payment methods that can be seen as currently available substitutes and competitors for central bank digital currencies on the horizon. In particular, we study app-based tools for day-to-day (offline) purchases that involve small amounts of money as well as digital tools for managing personal finances. By looking at factors associated with using non-cash payment methods, and app-based financial services solutions, we shed light on the topic of financial inclusion in payment services that concern consumers' everyday choices. We address the two-sided market nature of payment markets by investigating the environment in which consumers form their payment preferences by assessing the role of consumers' perceived acceptance of non-cash payments by local shops.

Understanding consumer payment preferences and their use of digital tools in finance is relevant for researchers, service providers and policymakers in many respects. First, retail payments are central to commercial banks' activity. The rapidly growing role of new financial technology firms providing 'open

[2] See European Commission (2023).

[3] See, for instance, Financial Times "Cash is no longer king in Japan as use of coins drops sharply" on the 11th of July 2023 for Japan, similar headlines can be found in national newspapers for Euro Area countries. Similar claims were, however, already made three decades ago (Carow and Staten 1999).

banking' services has increased the competition with more traditional financial institutions in the payment field and posed new challenges to the banking sector in the supply of payment instruments. Payments are the main source of useful customer data used by banks to create value for businesses and customers, such as the development of cheaper and better services, increased efficiency and support for financial inclusion. In addition, more sophisticated types of fraud have also emerged, putting consumers at risk and affecting their trust. Second, making payments and managing personal finances is a substantial part of consumers' daily lives. The outbreak of the COVID-19 pandemic imposed unprecedented restrictions on people's mobility, while goods continued to be delivered at almost an almost normal pace. As a consequence, the COVID-19 pandemic has accelerated the increasing trend towards digital payments. In addition, the euro area is an interesting area to study as it includes countries with different languages, habits and cultural traditions that may reflect the heterogeneity in payment preferences. Third, monitoring payment behaviour matters for central banks, too, due to their role in providing access to money for citizens (ECB 2022). The relevance of consumer payment choices is confirmed by the maintenance of several payment surveys by major central banks[4], by ongoing debates about the issuance of central bank digital currencies or the decline of cash in circulation[5], and by the development of a single set of tools and standards that make cross-border payments in a particular currency as easy as national payments[6]. In addition, most central banks are currently actively exploring the option of issuing central bank digital currencies and thereby providing an additional means of payment for consumers (Auer *et al.* 2022).

We use data from the ECB Consumer Expectations Survey (hereinafter CES), a rich web-based and fully harmonised survey fielded in the six largest euro area countries (Belgium, Germany, Italy, France, Spain and the Netherlands). The CES collects information on demographic and personal characteristics including financial literacy and risk aversion. The data also allows us to explore the extent to which consumer preferences are associated with perceived local acceptance of electronic non-cash payment options. In addition, we exploit the time dimension of the survey to study how factors associated with the use of the most advanced payment methods (e.g. smart devices) have changed in recent years.

We find that most consumers prefer to use only one payment instrument, mostly cash or debit/credit cards. The perceived local acceptance of non-cash payments is another factor associated with cash usage,

[4] For instance, the ECB maintains a payment survey for consumers, the tudy on the payment attitudes of consumers in the euro area (SPACE), and a separate survey on the use of cash by companies in the euro area.

[5] See, for instance, Armelius *et al.* (2022) on the falling cash in circulation in Sweden and associated factors, and ECB (2023) on the opposite view to ensure that cash remains widely available and accepted as both a means of payment and a store of value.

[6] The EU SEPA or the US FED Now, among others.

even after controlling for demographic and socioeconomic characteristics. We also document substantial cross-country heterogeneity, in line with previous studies (e.g. Esselink and Hernández 2017; ECB 2022). Belgium and the Netherlands stand out as the two countries with the highest fraction of respondents who prefer non-cash payments, whereas at the other end of the spectrum, Germany and Italy lead the countries that use cash the most. In addition, our results corroborate prior studies' results by highlighting the prominent role of demographic factors in choosing non-cash payment options and app-based tools in managing personal finances. Men, the young and high-earners are more likely to use alternative payment options to cash. Finally, while mobile banking is already popular amongst euro area consumers, the use of smart payment methods is still minimal, although the recent COVID-19 pandemic has impacted the propensity to transition to these late-generation payment instruments. Some subgroups prefer not to use such new digital tools: the old, the low-educated and low-earners. We also document that demographic factors associated with preferring (or not preferring) smart payments and the use of mobile banking applications largely remained the same during and after the COVID-19 pandemic.

Our contribution to the existing literature on payment preferences and behaviour is threefold. First, we add to a still rather limited body of literature on the association between acceptance of non-cash methods and consumer payment preferences by directly eliciting consumers' perceived acceptance of electronic means of payment. Second, we provide novel insights into factors associated with the preference for smart payment methods and the use of mobile banking apps for the majority of euro area consumers using a rich set of individual-level as well as country-level characteristics which has been shown to be important for consumers financial behaviour. Third, we add to a recent and growing body of literature related to consumer behaviour in the post-COVID period as we document changes in preferences for smart payment methods between the pandemic and the post-pandemic.

The remainder of the paper is organised as follows. Section 2 reviews the literature most closely related to our paper. Section 3 presents the research questions, the dataset and the empirical methodology. Section 4 discusses the empirical results. Section 5 concludes the paper.

2. Related literature

This paper relates to three distinct strains of literature on consumer payment behaviour and new technology adoption in household finance. Reviewing this vast literature in its entirety is beyond its scope.[7] Instead, we focus on contributions most closely related to our contribution.

The first strain of the literature focuses on potential drivers of observed payment patterns at the point of sale and consumer payment preferences. These studies show that demographic factors and specific characteristics of a particular payment method play an important role in payment behaviour. On the one hand, cash usage increases with age and decreases with education and income levels, as well as with the transaction amounts involved (Jonker 2007; Klee 2008; Wang and Wolman 2016; Kajdi 2022). Similar factors are also related to being underbanked (Ampudia and Ehrmann 2017). On the other hand, prices, product features such as security, public campaigns, peer effects and financial incentives seem to have a steering effect on non-cash usage (Borzekowski *et al*. 2008; Bolt *et al.* 2010; Ching and Hayashi 2010; Carbó-Valverde and Liñares-Zegarra 2011; Jonker *et al.* 2017; Stavins 2018 and 2020; Kahn *et al.* 2017; Arango-Arango *et al.* 2018; Van der Cruijsen and Knoben 2021).

Moreover, the use of cards is enhanced by their features, such as user-friendliness (Jonker 2007; van der Cruijsen and Plooij 2018) and perceived safety (Kosse 2013). The contribution of our paper to this literature consists of further analysis regarding the role of perceived local acceptance of non-cash payment options for consumers' preferences between cash and non-cash payment methods.[8] We build on earlier work by Bagnall *et al.* (2016), who explore the role of reported acceptance of card payments in a study based on a diary survey conducted in seven countries in different years.[9] Also, Arango *et al.* (2015) document a lack of card acceptance at the point of sale as a factor for cash usage by Canadian consumers. We deviate from these studies as we look at a comparable measure of perceived non-cash acceptance across a large number of consumers in euro area countries and field the questions simultaneously in all countries. We also build on work by DNB (2020), which highlights a prominent role in declining non-cash acceptance in the Netherlands due to merchants' reactions during the outbreak of the COVID-19 pandemic. In recent work, Moracci (2023) illustrates in a calibrated model how limited acceptance of non-cash payment methods and uncertainty about the size of future purchases might

[7] For a recent comprehensive review of the economics of cash usage, see Shy (2023) and for a summary of recent work on euro area payment behaviour more generally, see Jonker *et al.* (2022).

[8] While especially during the COVID-19 pandemic perceived acceptance of cash in shops might have been an important topic (Tamele *et al.* 2021) we do not collect direct information on this. Instead, we infer from a survey run by the ECB in 2021 that during the then still ongoing COVID-19 pandemic acceptance of cash by merchants was 96 percent whereas it might not have been the preferred means of payment for customers (ECB 2022).

[9] The seven diary surveys were conducted in 2009 (Canada), 2010 (Australia), 2011 (Austria, France, Germany, and the Netherlands), and 2012 (the United States). Also, Bounie and Camara (2020) document positive spillover effects of card acceptance on contactless card sales in France.

explain consumers' cash holdings due to a precautionary motive. Our study further supports such a model-based rationale by highlighting the role of consumers' perceived acceptance of non-cash payments in their payment preferences. Our paper adds to this literature by assessing a rich set of individual characteristics associated with payment preferences and the role of perceived local acceptance of non-cash payment methods.

A second literature strain consists of contributions about the effect of large exogenous shocks on payment habits, such as the surge of the fintech/big-tech industry at large and the outbreak of the COVID-19 pandemic. Over the past few decades, fintech and big-tech companies have developed new technologies and devices (cloud technology, advanced data analytics tools and blockchain), enabling radical innovations in financial processes and leading to the development of various new (digital) financial products, such as mobile payments (Brits *et al.* 2021, amongst others). In emerging economies, the entry of fintech and big-tech companies seems to be driven by unmet demand from consumers and small enterprises for payments and other financial services provided by traditional banks. Consequently, they have started to offer (mobile) payment services to unbanked or underbanked people and small enterprises to boost financial inclusion (Demirguc-Kunt *et al.* 2022, amongst others).

More recently, the COVID-19 pandemic has abruptly impacted individual daily activities, including the way to shop and pay. This relatively recent literature shows that during the COVID-19 pandemic, consumer payment behaviour shifted towards cashless forms of payment (Kotkowski and Polasik 2021; Greene *et al.* 2023, amongst others). For the Netherlands, Jonker *et al.* (2022) document that the pandemic increased pre-existing trends to more contactless card usage. Carbó-Valverde *et al.* (2023) found that the effect of mobility restrictions on decreasing the use of cash in payments in Spain was more pronounced amongst lower-educated consumers. The impact of the pandemic on technologically advanced means of payment, namely smart payment methods such as smartphones, watches and digital wallets, is less clear. While Carbó-Valverde *et al.* (2023) find for Spanish consumers that mobility restrictions did not lead to more extensive adoption of smart payment, Fu and Mishra (2022) estimate that the spread of COVID-19 and related government lockdowns have led to a 24 and 32 percent increase in the relative rate of daily downloads of mobile finance applications in a sample of 74 countries. Auer *et al.* (2023a) find that effects on payment patterns might be temporary, reversing previous payment trends. Our paper adds to this literature by contrasting the role of different individual characteristics, which have previously been identified as affecting consumer payment preferences, during and after the COVID-19 pandemic.

The third strain of literature comprises studies on the process of payment digitalisation and the role of central bank issued digital currencies (CBDCs) as a payment instrument.[10] CBDCs are on the rise, with most central banks investigating or already testing such technologies (Auer *et al.* 2022 and 2023b). While this field is relatively new, surveys have been used to assess the potential uptake of CBDCs on the basis of self-reported intentions to use retail CBDCs as a new means of payment. Using Dutch data, Bijlsma *et al.* (2023) identify trust in banks as a critical factor in facilitating adoption. Subsequent work for Austria by Abramova *et al.* (2022) shows that technology-savviness increases consumers' willingness to adopt CBDCs. Indeed, Van der Cruijsen and Reijerink (2023) point out that there might be a "digital payment divide" arising, with some groups of the population relying on cash while the payment infrastructure moves increasingly to digital means of payment. In turn, analysing preferences for payment methods most closely resembling such future forms of digital central bank money, such as mobile payments, could be a relevant indicator of the potential adoption rate of CBDCs. Using this approach of revealed preferences for different existing payment technologies, Li (2023) uses a structural model to estimate CBDC demand based on US consumers' cash and demand deposit allocation. In a recent study, Nocciola and Zamora-Pérez (2023) model CBDC demand for the euro area and highlight the role of consumer preferences for existing payment methods and the role of mobile payments. Thus, understanding the role of demographic factors associated with using such payment technologies matters for the discussion on CBDCs. Our study contributes to this literature by enhancing the understanding of consumers' preferences for using smart mobile payment methods and smart technologies in managing personal finances. Studying consumers' preferences for existing payment methods also speaks to the financial inclusiveness of newly developing electronic payment methods. Like recent studies, we find that cash remains a widespread payment method amongst euro area consumers (ECB 2022) while smart payment options are still at an early stage. We address what type of consumers use non-cash payment methods and fintech (smart payments and banking apps), and who still refrains from using such tools thereby being at risk of financial exclusion in an ever more digitalised world.

3. Research questions, dataset and methodology

This paper poses three main research questions. First, we study the latest developments in the use of different payment methods for small amounts of day-to-day purchases, and the socioeconomic characteristics that are associated with the use of different payment methods. Second, we investigate

[10] See, for instance, Zamora-Pérez *et al.* (2022) for a review of the recent retail CBDC literature.

whether the perceived local acceptance of non-cash payment methods is related to consumer payment preferences. Third, we study whether factors associated with the preferences for the use of digital technologies have changed after the COVID-19 pandemic.

We use the ECB's Consumer Expectations Survey (CES) to address these questions. The CES has been conducted monthly since April 2020. ECB (2021) and Georgarakos and Kenny (2022) provide a detailed review of the survey's methodology. Notably, a large share of the respondents is recruited randomly from the euro area population of consumers older than 18. The survey's relatively large sample size, detailed individual and household background characteristics, and its overall representativeness make the CES particularly suitable for analysing changes in population preferences towards new technologies. Its online nature allowed us also to address topical issues, such as the changing landscape of payment methods in Europe during and after the COVID-19 pandemic.[11]

Our empirical analysis is based on two special-purpose questions fielded specifically in three waves of the survey (May and December 2020, as well as August 2022). About 30 percent of respondents provided answers in all three survey rounds, and about 40 percent responded to at least two of the three survey rounds.

To elicit consumers' self-reported behaviour when faced with different payment options, we ask consumers about their preferences for different payment methods in day-to-day retail transactions. Cash remains an essential means of payment in the euro area, with 96 percent of companies accepting cash (ECB 2022b). To ensure comparability across payment means, in May and December 2020, we limit the amount in the hypothetical scenario to €20. In addition, according to a survey conducted by the ECB (2020), the average transaction value was only marginally below a value of €20 before the outbreak of the COVID-19 pandemic. In the euro area, contactless card payment limits have traditionally been relatively low for most countries. In the six surveyed euro area countries, this limit ranged between €20 and €30 during 2019.[12] The €20 might thus be particularly relevant for consumers unaware of the broad-based increase to €50 in 2020. In August 2022, we amended the amount used to €50, taking particular account of the surge in retail prices and euro area-wide increases in contactless card payment ceilings to €50. Finally, using a rounded amount in both cases makes it arguably easier for consumers to conceptualise the scenario.

[11] Updates on the survey, sample questionnaires, further methodological details and recent results are available on the ECB webpage: https://www.ecb.europa.eu/stats/ecb_surveys/consumer_exp_survey/html/index.en.html.

[12] In particular, the limit for contactless card payments without pin in the euro area has been €30 in France; €25 in Belgium, Germany, Italy, the Netherlands and €20 in Spain. The latter serving as upper bound for the awareness in early 2020 about limits. While in 2020 this limit has been increased to €50 this increase has not happened synchronous across countries and payment card issuers. In August 2022, the payment limit for contactless card payments was in all countries €50.

For this purpose, the following question on payment choices was fielded: "*Which of the following payment options do you use to pay for an amount of €20/50 for a day-to-day transaction (e.g., at a supermarket)?*". The answer categories are cash, debit or credit card (excluding contactless); contactless debit or credit card; smartphone (mobile payment); retailer card with a payment function; bitcoin or other crypto asset; other (e.g. food voucher). Respondents may report multiple choices, so the payment options are not mutually exclusive. We consider the first four categories, as the last three categories amount to a small fraction of the overall sample.

Cash: Paper money and coins are the most common ways to pay for purchases. Cash has the advantage of being immediate but is likely neither the safest nor the cheapest form of payment. In our initial sample, cash is, on average, chosen by about 58 and 55 percent of consumers in 2020 and 2022, respectively.

Contactless and non-contactless debit/credit cards: Paying with a debit card means that the money is taken directly from the buyer's account; paying with a credit card temporarily defers the buyer's bill. In the case of a credit card, the buyer pays off their bill to the credit card company rather than paying the seller directly. Debit and credit cards can be used for online purchases and at physical retailers. They can be used by inserting a PIN code (non-contactless method) or tapping the card on a payment device (contactless method). In our sample, non-contactless methods are used by 33 and 40 percent of consumers in 2020 and 2022, respectively. In contrast, contactless debit/credit cards are used by 49 and 56 percent of consumers in 2020 and 2022, respectively.

Smart devices include banking apps, QR codes and digital wallets: payments are made for a product or service through a portable electronic device such as a tablet or a mobile phone. They do not require a PIN and might be considered easy to use, low-cost and convenient. Their main disadvantages could be limited availability, security and/or privacy concerns. In our sample, smart devices are used by 14 and 15 percent of consumers in 2020 and 2022, respectively.

In addition, to dive into the level of digitalisation in public payment habits, in each of the two survey rounds, we ask the followin question: "*Banks offer the possibility to arrange banking affairs by smartphone. You can manage your accounts and execute payments by using a special app provided by your bank. Do you use this type of app?*" Answer categories are "Every day", "At least once a week", "At least once a month", "Less often than once a month" and "Never".[13]

[13] The wording of the question has been adopted in large parts from the DNB Household Survey conducted by Centerdata.

3.1 The dependent variables

The questions described above provide the following dependent variables: the **number of payment methods** respondents prefer to use, and the **particular type of payment method** respondents prefer for a €20/€50 payment; **new financial technologies**, such as a preference for smart payment devices or using mobile banking apps.

The summary statistics for these variables for the pooled sample are reported in Table 1.

Table 1 about here

Number and type of payment options

The reported number of distinct payment methods ranges from one to four. Despite the increased availability of non-cash payment options through recent decades, the average respondent prefers fewer than two distinct payment methods in both years, with the median consumer preferring to use a single payment instrument. Throughout the paper, we distinguish between a consumer's preference for (i) cash-only, (ii) non-cash-only and (iii) indifference between cash and non-cash payment methods.

Cash is favoured by 58 and 55 percent of the respondents in 2020 and 2022, respectively (in combination with some other forms of payment) and by 24 and 16 percent of the sample in 2020 and 2022, respectively (as the sole payment method). Non-cash payment methods are reported by 42 and 45 percent of consumers in 2020 and 2022, respectively, as the only payment options (see Table 1 – Payment type). These findings are consistent with previous literature showing that consumers typically use only a few payment instruments (Bagnall *et al.* 2016). About one-third of the respondents are indifferent between cash and non-cash (33 percent in 2020 and 39 percent in 2022).

It is a well-known fact that payment habits and preferences differ substantially amongst countries in the euro area (see Esselink and Hernández 2017, amongst others). Our data show (see Figure 1) that in 2020 cash is the most used option in Germany and Italy (31 percent and 29 percent, respectively, both above the average of 24 percent for the pooled sample of countries) as well as in Spain (23 percent). In 2022, individual preferences for cash are still persistently higher than average in Germany (23 percent) and in Italy (17 percent) and increasing in the Netherlands (15 percent). Figure 1 also shows that the share of consumers who prefer non-cash-only is lowest in Germany (27 percent in both years). In contrast, the share of consumers who are indifferent between cash and non-cash is the highest in Germany (42 and

50 percent in 2020 and 2022, respectively). Belgium and the Netherlands stand out as the two countries with the highest fraction of individuals who prefer non-cash-only payment methods in both years, being six times as large as the fraction who prefer cash-only and twice as large as the fraction of individuals who are indifferent between cash and non-cash payment options.

Figure 1 about here

Interestingly, cash is negatively and significantly correlated with other payment forms, as depicted by the tetrachoric correlations in Figure 2, suggesting a substituting role of cash. This finding contrasts with Fujiki (2022), who documents that the frequency of cash payments is unlikely to decrease despite the use of cashless payment methods. In contrast, mobile apps are positively and significantly correlated with other non-cash payment methods, suggesting a complementarity role of this more recently introduced payment method. Some literature documents that the share of cash payments in many countries has decreased over recent years and more markedly during the COVID-19 pandemic (Coyle *et al.* 2021; Tamele *et al.* 2021, amongst others).

Figure 2 about here

New financial technologies

The third set of dependent variables considered in this paper consists of consumers' self-reported **preference for smart payment devices** (e.g., smartphones or wearables) in day-to-day transactions and the use of mobile **banking applications** for managing their finances. On average, 14 percent of consumers use smart devices and 60 percent use banking apps.[14]

We first document some cross-country heterogeneity in the use of new financial technologies. Table 2 documents the percentage of consumers using new financial technologies across countries. Consumers in euro area countries are relatively homogeneous in the use of mobile banking applications, which are already widespread amongst consumers today. In addition, the use of mobile banking by consumers has increased across all euro area countries since the COVID-19 pandemic (Spain and the Netherlands are leading with around 65 percent of consumers; France and Germany are at the end of the spectrum with

[14] We acknowledge that some differences in magnitudes could be partly due to a different question wording (multiple choice for payment methods vs. single choice for banking applications). We cross-validated our results for the Netherlands against data from the DNB Household Survey for the Netherlands and obtain comparable results for the year 2020 and 2022 in terms of the adoption of mobile banking applications.

about 55 percent). In contrast, preferences for smart payments remain at low levels and do not show a broad-based increase across euro area countries.

Table 2 about here

Exploiting the survey's time dimension allows us to trace individual preferences for smart payments and the use of mobile banking applications over time. Table 3 shows a significant degree of persistence in consumers' payment preferences between December 2020 and August 2022.[15] We observe a high degree of inertia in payment preferences, with most consumers exhibiting the same status over time. Possible explanations could be, for instance, habit persistence, cognitive barriers, and costs of devices (e.g. smartphones).

Table 3 about here

In our subsequent analysis, we use the time dimension by examining potential differences in factors associated with a **preference for smart payments** and the **use of mobile banking applications** between December 2020 and August 2022.

3.2 The explanatory variables

In our basic regressions, we include several socioeconomic characteristics, whose summary statistics are reported in Table A1 of Appendix A. In particular, we control for age (in class dummies), gender (female indicator), education level (university diploma indicator), households' financial situation, income and housing wealth (employed indicator; yearly net household income in quartiles; homeownership indicator), household composition and size (presence of partner indicator; the number of household members; the presence of children below 16 years, and between 16 and 25 years indicators), country of residence (Belgium, Germany, Spain, France, Italy and the Netherlands indicators) and degree of urbanisation (high, middle and low indicators).

[15] For a comparison between May 2020 and December 2020, see Table A3 in the appendix.

In addition, we control for financial literacy (dummy), hand-to-mouth consumption (dummy), trust in people (0-10 scale score), risk attitude (risk-loving, risk-averse and risk-neutral)[16] and households' COVID-19 health concerns (0-10 scale score). Financial literacy has been measured following the well-established concept of the "big 3" questions developed by Lusardi and Mitchell (2011) and one more advanced question (see Appendix 2 for details of the question wording).

An important aspect we want to explore is the perceived acceptance of non-cash payment methods, which might shed light on the circular relationship between consumers' adoption of payment technologies and merchants' acceptance (ECB 2022c). For this purpose, the following question was asked in December 2020:

> *Thinking about the stores where you shop most frequently, how many offer the possibility to pay by card or other electronic means?*

Respondents were able to choose from the following answer categories: "All stores", "Most stores", "Around half of the stores", "Few stores" and "None". In August 2022, we repeated that question with comparable wording.[17] The new question read as follows:

> *How many stores, restaurants and other businesses in the area where you currently live offer the option to pay by card or other electronic means?*

From these two questions, we construct an ordinal variable whose categories are "All", "Most", and "Half or less" stores accept non-cash payment methods. Figure 3 reports consumers' perceived acceptance of non-cash payment methods across countries.

Figure 3 about here

Somewhat surprisingly, given the rapidly progressing digitalisation, acceptance of non-cash payment methods seems far from ubiquitous according to the perceptions of euro area consumers. In August 2022, more than two out of three consumers report that not all stores in the area they currently live in accept non-cash payment methods such as cards or smart devices. Notably, the share of people answering that all stores accepted non-cash payment options decreased in all countries between

[16] The reason for including measures of trust amongst people and risk attitude is the idea that the choice of cash may be positively correlated with more defensive personality traits that prevent individuals adopting technological devices in view of their potential leak of personal data (by inserting a PIN or downloading an app on the personal mobile).

[17] The answer categories were the same as in December and their order was randomised to avoid primacy effects. We do not observe large ordering effects.

December 2020 and August 2022, possibly indicating a receding acceptance of non-cash payment methods after the COVID-19 pandemic. We also document persistent heterogeneity in the perceived acceptance of non-cash payment options across different euro area countries. Figure 3 shows that in August 2022 the Netherlands has the highest fraction of individuals who report that all stores accept non-cash payments (43 percent). The lowest percentage refers to Germany (16 percent), where the highest fraction of respondents reports that only half or fewer shops accept non-cash payments (30 percent).

Figure 4 about here

Perceived levels of non-cash payment acceptance might be lower than other payment diary surveys, such as the ECB's SPACE (ECB 2022) report since consumers are asked about their perception in the local area.[18] Nevertheless, consumers' perceptions might shape their payment preferences. For instance, consumers might prefer using cash in day-to-day transactions to avoid card or smart payments being declined. Looking at correlations between the degree of non-cash acceptance and the share of consumers preferring non-cash payment methods, we find a positive association, as depicted in Figure 4.

3.3 The empirical models

We start the empirical analysis by looking for the main factors associated with diversification in payment preferences. For this purpose, we estimate a Poisson model for the sum of payment options used:

$$\sum_j^N Y_{i,j,t} = exp(\alpha + \beta * X_i' + \nu * Z'_{i,t} + \delta_t + \gamma_c + \varepsilon_{i,t}), \quad (1)$$

where $Y_{j,i,t}$ denotes the preference of payment method j (cash, PIN debit/credit card, contactless debit/credit card, smart devices) reported by respondent i at time t (May 2020, December 2020, August 2022); X_i' is a vector of time-invariant demographic variables; $Z'_{i,t}$ is a vector of time-varying economic characteristics; δ_t is a fixed-effect vector of time dummies that allows accounting for shifts in the overall macroeconomic environment between May and August 2022; γ_c denotes a set of country fixed-effects that capture any country-specific factors; $\varepsilon_{i,t}$ is a residual component. Throughout, standard errors are clustered on the individual level.

[18] A recent survey of euro area firms finds that 87% of merchants accept cards but only 30% accept mobile payment methods (ECB, 2022b).

Next, we focus on each group of payment methods (indifference, cash-only, non-cash-only) and the preference for digital tools (smart, mobile banking apps) separately to characterise the "typical" users better and to examine how much these alternative options overlap. For this purpose, we estimate a linear probability model for each payment method and the use of banking applications as follows:

$$Payment\ Preference_{i,t} = \alpha + \beta * X_i' + \delta_t + \gamma_c + \varepsilon_{i,t}, (2)$$

where $Payment\ Preference_{i,t}$ denotes one of the following groups of payment methods: indifferent, cash-only or non-cash-only.[19] In particular, "indifferent", "cash-only" and "non-cash-only" are indicator variables that take the value one if, in May 2020, December 2020 or August 2022, the respondent reports a preference for using cash and non-cash, only cash, only non-cash payment methods, respectively.

We continue our empirical analysis by focusing on the most advanced technologies used, the complementarity between smart payments and the use of mobile banking applications, and the dynamics in preferences for smart payment methods. Beyond factors associated with such technologies, we study the switching in preferences for smart payment methods from December 2020, i.e. during the COVID-19 pandemic, to August 2022, i.e. after the pandemic. For this purpose, we use a bivariate probit model.[20] The bivariate probit takes the general form:

$$y_{1,i}^* = y_{1,i}' x_{1,i} + \epsilon_{1,i},;\ y_{1,i} = 1\left(y_{1,i}^* > 0\right), (3)$$

$$y_{2,i}^* = y_{2,i}' x_{2,i} + \epsilon_{2,i};\ y_{2,i} = 1(y_{2,i}^* > 0), (4)$$

$$\text{with: } E\left[\epsilon_{1,i}\middle|x_{1,i}, x_{2,i}\right] = E\left[\epsilon_{2,i}\middle|x_{1,i}, x_{2,i}\right] = 0, (5).$$

$$Var\left[\epsilon_{1,i}\middle|x_{1,i}, x_{2,i}\right] = Var\left[\epsilon_{2,i}\middle|x_{1,i}, x_{2,i}\right] = 1, (6).$$

$$Cov\left[\epsilon_{1,i}, \epsilon_{2,i}\middle|x_{1,i}, x_{2,i}\right] = \rho, (7)$$

where $y_{1,i}$ and $y_{2,i}$ are indicator variables and $x_{1,i}$and $x_{2,i}$ are vectors of observable variables.

The bivariate probit model allows unobserved heterogeneity amongst consumers to affect our outcome variables. For our case, we assume that some latent characteristics, such as tech-affinity, might jointly affect attitudes towards smart payment technologies and mobile banking applications. The strength of this influence of unobserved heterogeneity is estimated by ρ. We include the same set of covariates and

[19] For brevity, since the objective is not forecasting probabilities and for ease of interpretation, we only present results from the linear probability model. However, results from assuming a specific non-linear relationship and using a probit model are qualitatively comparable. Results of partial effects from the probit are available from the authors upon request.

[20] See Greene and Hensher (2010) for a detailed review of the bivariate probit model on which our equations are based.

country dummies used in earlier specifications in the bivariate probit in $x_{1,i}$ and $x_{2,i}$. Importantly, these observable characteristics included in the model can be associated differently with the two outcomes. In particular, marginal effects of the conditional mean function can be obtained from:

$$E(y_{1,i} \mid y_{2,i}, \mathrm{x}) = \frac{\Phi_2(x'_{1,i}\beta_1, x'_{2,i}\beta_2)}{\Phi(x'_{2,i}\beta_2)}, (8)$$

where Φ_2 and Φ refer to the bivariate and univariate normal cumulative density function, respectively.

The bivariate probit model has previously been used to model consumer behaviour, such as stock market investment (Christelis *et al.* 2011) or survey-taking behaviour (Jenkins *et al.* 2006). We employ the bivariate model in two specifications. First, we estimate a bivariate probit model that jointly models the probability of a household preferring to use smart payments ($y_{1,i}$) and using mobile banking applications ($y_{2,i}$). After estimating the model and testing for unobserved heterogeneity, we compute the marginal effects of a rich set of covariates for preferring smart payments conditional on using mobile banking apps to manage personal finances.

Subsequently, we use the panel dimension of the survey to assess whether key factors associated with preferences for smart payments and mobile banking applications have changed after the COVID-19 pandemic, i.e. in August 2022. We follow Bilias *et al.* (2010) in estimating a bivariate probit model for the preference to use smart payment methods and the use of mobile banking applications by period, respectively.

4. Empirical results

In this section, we review and discuss the main empirical results related to how diverse euro area payment preferences for daily purchases are (section 4.1), related to the type of payment instruments preferred, in particular cash versus non-cash (section 4.2), and related to the preference for smart payment methods and the use of new financial technologies to manage personal finances, namely mobile banking applications (section 4.3).

4.1 Payment diversification

The estimation results from model (1) are presented in Table 4, where the marginal effects and the 95% confidence intervals are reported. Demographic factors such as age, being female and having a spouse

are negatively and significantly associated with payment diversification. Being a homeowner and a hand-to-mouth consumer are also negatively and significantly associated with more payment instruments. In contrast, employment and higher incomes are positively and significantly associated with payment diversification. Also, financial literacy seems to be positively associated with using multiple payment options, which would be in line with lower entry costs of using non-cash technologies for the group of highly financially literate consumers.

Table 4 about here

We also observe significant country effects net of individual differences: Spain, France and Italy diversify less than Germany. One possible reason that we will revisit in section 4.2 could be that for consumers in Germany, on average, cash might serve as an additional payment option in case of limited acceptance of non-cash payments in shops.

4.2 Cash vs non-cash payment methods: the role of demographics and perceived acceptance

Next, we turn to the factors associated with types of payment preferences. Overall, cash and non-cash payments have roughly the same determinants, but with opposite signs indicating a certain degree of substitutability.

Payment preferences seem to be associated with key observable individual demographics and household-level socioeconomic characteristics. In particular, the data show a large and statistically significant (at the 1-percent level) age gradient: the preference for using only cash is increasing monotonically with age, with marginal effects going from some 3 percent for 35-49-year-olds to 5 percent for 65+-year-olds. Conversely, non-cash payment method use is less frequent in the older population compared to consumers under 50 years old. This result illustrates that elderly consumers might struggle with non-cash payment methods and prefer using only cash in regular day-to-day transactions.

Turning to variables associated with economic financial inclusion, we find highly educated respondents with a bachelor's degree or higher to be significantly (at the 1-percent level) more likely to adopt non-cash payment types for their daily purchases. Conversely, there is no significant difference in the use of

cash. In line with this result, the preference for using cash decreases monotonically with income. In contrast, a preference for non-cash payments is monotonically more likely for individuals in higher-income households. A plausible explanation for this finding is that low earners consider cash as a better monitoring and budgeting tool than non-cash payment channels (Hernández *et al.* 2017; van der Cruijsen *et al.* 2023). In turn, monitoring financial expenditures is more relevant for financially constrained consumers. We indeed observe hand-to-mouth respondents as significantly (at the 1-percent level) more likely to prefer cash, in line with Hernández *et al.* (2014), who document that those liquidity-constrained individuals use cash for budget control purposes. However, their preference for non-cash is not significantly different from those who do not face liquidity constraints. Similarly, being employed is significantly (at the 1-percent level) associated with a lower preference for cash but does not significantly affect the preference for non-cash.

Trust in others seems to play a limited role in consumer payment preferences. While cash is significantly (at the 1-percent level) less used by respondents with higher trust, this coefficient is small. Interestingly, consumers with a high level of financial literacy are less likely to prefer only cash and more likely to prefer using only non-cash payment options. However, these coefficients are relatively small in absolute size, casting doubt on any prominent role of financial literacy in day-to-day payment choices.

Our estimation results also confirm the previously documented heterogeneity in payment preferences across countries. Cash is significantly (at the 1-percent level) less likely to be used in any country other than Germany, and non-cash is significantly (at the 1-percent level) more likely to be used in any country other than Germany. Finally, the surge of the COVID-19 pandemic significantly (at the 1-percent level) reduced the use of cash in favour of non-cash payments more generally, as indicated by the August 2022 time effect. By including consumers' health-related concerns, we find these to be statistically significant but economically small, making it unlikely that such concerns about the safety of cash through a possible risk of infection (Tamele *et al*. 2021) were driving euro area wide changes in payment preferences.

Table 5 about here

Next, we turn to our primary variable of interest in this section: the perceived degree of acceptance of electronic non-cash payment methods. Accounting for all factors discussed before, Table 5 summarises the results.[21] A few points stand out. First, the presence of any limits to the local in-shop acceptance of

[21] The degree of acceptance of electronic non-cash payment methods is only elicited in December 2020 and August 2022 which naturally limits the sample size.

electronic non-cash payment methods is significant (at the 1-percent level) and positive for the use of cash-only. In particular, a respondent who perceives that only half of shops or fewer in their local area accept non-cash payments is about 15 percent more likely to prefer using only cash in their daily transactions. Importantly, this effect is economically significant and net of possibly confounding factors such as the degree of urbanisation or any demographic characteristics included in Table 4. As an additional robustness exercise, we use inverse propensity weighting with regression adjustment in columns (2), (4), (6), (8) and (10), allowing for non-linearity in the way covariates affect the dependent variable. We confirm our initial results under these conditions. In contrast to preferences for using cash, we find that limited acceptance is associated with a less likely preference for only non-cash methods and higher diversification in the payment methods that a consumer prefers.

Taken together, our results indicate that consumers faced with limits to the acceptance of electronic non-cash payments such as contactless cards also prefer to use cash as a fallback option or, if acceptance is low enough, as the default option. This finding is consistent with some literature showing that the decline in using cash as a payment instrument results from increased acceptance of non-cash payment channels (Arango-Arango and Suárez-Ariza 2020, amongst others).

4.3 New financial technologies: smart payment devices and mobile banking applications

In the past few years, the market for retail payments has witnessed a series of innovations through digitalisation. We now turn to two technologies: smart payments and mobile banking to manage personal finances. Columns (4) and (5) in Table 4 report the main individual characteristics associated with the use of such tools estimated by the linear probability model.

Two main findings stand out from Table 4. First, smart devices and banking applications largely share similar demographic and socioeconomic factors, indicating some degree of complementarity. Interestingly, neither higher education nor financial literacy seem to play a significant role in a preference for smart payment methods or the use of mobile banking applications. However, this absence of effects through education and financial literacy does not imply that digital tools are financially inclusive. Both payment methods are significantly (at the 1-percent level) less likely to be used in non-urban areas, by females, by the older population, and by hand-to-mouth respondents. Both preferences for smart payments and the use of mobile banking are significantly (at the 1-percent level) more likely to be held by respondents who report trusting other people, those with children, the employed, and those with higher income levels. Given the lower average prevalence of smart payment preferences compared

to mobile banking applications, marginal effects for mobile banking applications are sizable. These findings suggest that such new financial technologies might not be inclusive by design and may exacerbate the gap between specific population subgroups, particularly along the gender, age, and income dimensions. In the Netherlands, for instance, millions of people struggle to get to grips with digital payments (DNB 2023a, 2023b and 2023c). Ensuring financial inclusion might, therefore, require additional efforts by payment providers, merchants, and policymakers.

In addition, we find some evidence of positive within-household spillovers from younger generations, with the presence of young adults having a statistically significant, albeit small, positive effect on the use of new technologies net of any age effects. This finding hints at a role of younger members in the household leading older members to catch up with the technology developments, suggesting a possible motive for the elderly to "keep up with the young". In line with earlier research by Patacchini and Rainone (2017) and Van der Cruijsen and Knoben (2021), we find a role for network and peer effects in long-lasting relationships, in this case within households, with regard to the use of new payment methods.

We have previously documented the widespread use of mobile banking applications amongst euro area consumers to manage their banking affairs. In contrast, smart payment methods are not as broadly preferred by consumers. Nevertheless, the use of both technologies might be due to common unobservable factors such as technology affinity. Against this background, Figure 5 estimates a bivariate probit model to assess the marginal effects of key demographics on the preference for using smart payments conditional on mobile banking applications.

Figure 5 about here

We find the estimated common conditional marginal effects to be similar between users and non-users of mobile banking applications. However, the effects of key demographics, such as age and income, are much larger for users of mobile banking applications, indicating additional transition costs for most recent smart payment technologies.

To better understand the inertia in consumer preferences for smart payment methods and the use of mobile banking applications, we estimate a bivariate probit for each period using the balanced sample of respondents in the most recent survey waves. In other words, we estimate respondents' probability of using smart payments in December 2020 (first equation) and August 2022 (second equation). Figure 6

presents the marginal effects of the model for smart payments and mobile banking applications, respectively. In both cases, we find a positive correlation between unobserved factors influencing the exposure to new technologies in the form of the estimated correlations denoted by ρ at the bottom of the Figure.

Figure 6 about here

Estimated conditional probabilities for preferring to use smart payment methods are not markedly different during the height of the COVID-19 pandemic in December 2020 and August 2022. We find similar results for mobile banking applications. This finding indicates that preferences and the adoption of new technologies might not be particularly sensitive to temporary shocks, including mobility restrictions and temporarily increased acceptance of non-cash payment methods at the point of sale. In fact, in Table 5, we observed that the degree of non-cash acceptance seems not to affect consumer preferences for paying with smart devices.

5. Concluding remarks and future work

This paper focuses on three specific aspects of the digitalisation process in the payment landscape in the euro area. The first aspect is how much consumers diversify their payment instruments when dealing with daily purchases that involve small amounts. The paper, therefore, focuses on the market for retail payments that has been characterised by the entry of new financial firms in recent years and by the increasing competition with more traditional payment providers, namely the banking sector. The second aspect of the ongoing digitalisation process in consumers' payments addressed in this paper is the role of perceived acceptance of electronic non-cash payment methods in differences in consumers' payment preferences. Unable to match our survey data with administrative data from banks or stores, we collect information about perceived limits in local acceptance of electronic non-cash payment methods such as cards and smartphones from euro area consumers directly. In this way, we ultimately deal with consumer perceptions of such restrictions, which might affect their behaviour. Finally, we study the extent to which consumers use new financial technologies for retail payments by focusing on the self-reported use of smart devices and banking applications for managing personal finances.

Our main findings can be summarised as follows. Consumer payment behaviour remains heterogeneous across countries and amongst individuals. There is evidence of little diversification in preferences for how to conduct daily payments. The two major payment options consumers prefer are cash and cards

(both with PIN and contactless), often competing with each other but sometimes used jointly. Cash may no longer be an unchallenged "king" (Panetta 2021), especially in certain countries like the Netherlands, but it remains present in consumers' everyday offline purchases. Payment preferences are associated mostly with demographic and socioeconomic characteristics. These findings show that despite a lack of diversification on the individual-level, society as a whole has diverse payment preferences. It remains, therefore, important to offer multiple payment instruments as a choice in everyday offline payment situations to ensure inclusion and accessibility of the financial system. Our paper also documents that consumers still perceive imperfect acceptance of cashless payment options and this is associated with reticence in the use of such technologies, in turn, providing one additional possible explanation for the remaining widespread use of cash.

While mobile banking apps are by now widespread amongst euro area consumers, we document only limited preferences for using smart payment methods. Some subgroups prefer not to use such new digital tools: the old, the low-educated and low-earners. These results call for further work in assessing how financial service providers could make these payment methods more inclusive to avoid a widening digital divide between different groups in the society.

We also document that the demographic factors most prominently associated with preferring (or not preferring) smart payments and the use of mobile banking applications largely remained stable during and after the COVID-19 pandemic. This result casts some doubt on the role of the COVID-19 pandemic as a population-wide accelerator of modern technologies in consumer finances. Yet it is clear that younger generations show a strong preference for non-cash payment methods. Overall, our findings suggest that financial service providers should recognise the growing preference of the younger generations for alternative payment methods. Making electronic payment options available and creating awareness amongst consumers might also lead to positive feedback effects by reducing consumers' reliance on cash through higher perceived availability of non-cash payment options.

Several avenues for future research may be pursued in this area. First, the role of perceived acceptance of non-cash payment methods could be identified in an alternative way if transaction data from banks and stores became accessible to researchers and could be linked to consumer payment diaries. High-frequency transaction level data would allow the combination of payment choices with purchases, exploring heterogeneity in different market segments based on the amount of money involved and allowing empirical identification using, for instance, exogenous (regulatory) variation in payment limits at the point of sale or arguably exogenous events such as the temporary service interruption of specific electronic payment systems. Second, the possibility of repeating the questions used for this paper in

future survey waves would help us better understand the role of the COVID-19 pandemic on payment preferences in the longer term and its impact over time. It would also improve the dynamic analysis of using several payment options and factors associated with smart payment preferences. We could also better study the adoption of more digitalised forms of payments among heterogeneous groups of consumers in a rapidly changing technological environment. Third, collecting the same information for a larger number of countries would be beneficial in further pinning down country heterogeneity. At present, all these aspects can be partly addressed by using complementary studies like the SPACE survey, as it records payment diary information and acceptance levels at the point of sale for a specific period. These and other possible extensions are left for future research.

Tables and figures

Table 1: Description of key variables

		2020					2022				
Variable	**Description**	**Mean**	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**	**N**
Payment preferences											
Cash	Binary (1=cash payment; 0=else)	0.58	0.49	0	1	18,864	0.55	0.50	0	1	14,452
Contactless card	Binary (1=contactless card payment; 0=else)	0.49	0.50	0	1	18,864	0.56	0.50	0	1	14,452
PIN card	Binary (1=PIN card payment; 0=else)	0.33	0.47	0	1	18,864	0.40	0.49	0	1	14,452
Smartphone	Binary (1=smartphone payment; 0=else)	0.14	0.35	0	1	18,864	0.15	0.36	0	1	14,452
Payment type											
No. of payment methods	Count (# payment methods chosen)	1.54	0.75	1	4	18,864	1.66	0.79	1	4	14,452
Indifferent (cash and non-cash)	Binary (1=indifferent; 0=else)	0.33	0.47	0	1	18,864	0.39	0.49	0	1	14,452
Cash (only)	Binary (1=cash payment only; 0=else)	0.24	0.43	0	1	18,864	0.16	0.37	0	1	14,452
Non-cash (only)	Binary (1=non-cash payment only; 0=else)	0.42	0.49	0	1	18,864	0.45	0.50	0	1	14,452
Banking applications											
Banking app user	Binary (1= using mobile banking apps; 0=else)	0.59	0.49	0	1	18,692	0.64	0.48	0	1	14,451

Source: ECB – Consumer Expectations Survey authors' calculations.
Note: Population-weighted statistics. Data for 2020 represent the pooled May and December survey waves. The chart depicts responses by consumers to a hypothetical scenario of a day-to-day transaction (e.g. in shops, restaurants). Responses are grouped ex post into cash and non-cash (PIN card, contactless card or smart). Only a very small percentage (<5%) choose the "other" category, which is omitted from all analyses. Indifference captures all consumers who prefer to use both payment methods (cash and non-cash).

Table 2: Smart payments and banking applications across countries

	Self-reported use of mobile banking applications (share of consumers)		Preferring smart payments (share of consumers)	
	May-20/Dec-20	*Aug-22*	*May-20/Dec-20*	*Aug-22*
EA	0.59	0.64	0.14	0.15
BE	0.62	0.70	0.12	0.12
DE	0.53	0.59	0.17	0.14
ES	0.67	0.71	0.16	0.21
FR	0.53	0.57	0.11	0.11
IT	0.64	0.71	0.11	0.15
NL	0.67	0.72	0.15	0.19

Source: ECB – Consumer Expectations Survey authors' calculations.
Note: Population-weighted data. Data for 2020 represent the pooled May and December survey waves.

Table 3: Transitions in payment preferences from December 2020 to August 2022

		Dec-20 (percentage of consumers)									
		Cash		**PIN card**		**Contactless card**		**Smart**		**Banking app**	
		nonuser	*user*	*nonuser*	*user*	*nonuser*	*user*	*nonuser*	*user*	*nonuser*	*user*
Aug-22	*nonuser*	27.64	18.95	44.25	16.84	26.95	16.58	76.09	8.22	21.61	14.37
	user	13.60	39.81	22.69	16.21	22.63	33.85	9.70	5.99	19.00	45.02

Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Population-weighted data. Data are based on the balanced panel between the two depicted survey waves in each panel respectively. User and nonuser refer to consumers preferring to use a payment method or not, respectively.

Table 4: Factors associated with diverse payment preferences

Dep. Var.	Number of payment methods	Indifferent (cash and non-cash)	Cash (only)	Non-cash (only)	Smart payment (App)	Banking Apps
	(marginal effects from a linear probability model)					
	(1)	(2)	(3)	(4)	(5)	(6)
Risk averse	-0.04***	-0.03***	0.01	0.02***	0.00	-0.02**
	(0.014)	(0.009)	(0.007)	(0.009)	(0.007)	(0.009)
Risk loving	-0.01	-0.02*	0.01*	0.00	0.02**	0.01
	(0.015)	(0.009)	(0.008)	(0.010)	(0.008)	(0.009)
Trust in people (Z-Score)	0.02***	0.01*	-0.01***	0.01*	0.02***	0.03***
	(0.005)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
Financial literacy: high	0.03***	0.01	-0.03***	0.02***	-0.01	-0.01
	(0.012)	(0.007)	(0.006)	(0.008)	(0.006)	(0.007)
COVID-19 concerns (Z-Score)	0.00	-0.00	-0.01***	0.01***	0.00	0.00
	(0.005)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Urbanisation: Low	-0.07***	-0.03***	0.02**	0.01	-0.02***	-0.04***
	(0.014)	(0.008)	(0.007)	(0.009)	(0.006)	(0.009)
Urbanisation: High	0.02	0.01	-0.00	-0.00	0.02**	0.02**
	(0.012)	(0.007)	(0.006)	(0.008)	(0.006)	(0.008)
Women	-0.08***	-0.02***	0.01	0.01*	-0.05***	-0.05***
	(0.011)	(0.007)	(0.006)	(0.007)	(0.005)	(0.007)
Age: 35-49	0.00	0.00	0.03***	-0.03***	-0.04***	-0.08***
	(0.016)	(0.010)	(0.008)	(0.010)	(0.008)	(0.009)
Age: 50-64	-0.06***	-0.00	0.04***	-0.04***	-0.09***	-0.17***
	(0.017)	(0.010)	(0.008)	(0.011)	(0.008)	(0.010)
Age: 65+	-0.17***	-0.05***	0.05***	-0.01	-0.12***	-0.23***
	(0.021)	(0.014)	(0.012)	(0.015)	(0.010)	(0.014)
Education: bachelor and above	0.01	-0.01*	-0.02***	0.03***	0.00	-0.00
	(0.012)	(0.007)	(0.006)	(0.008)	(0.006)	(0.007)
Household size	-0.00	0.00	0.02***	-0.02***	-0.00	-0.00
	(0.007)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
Partner in household	-0.04***	-0.03***	-0.02***	0.05***	0.00	0.01
	(0.013)	(0.008)	(0.007)	(0.009)	(0.006)	(0.008)
Child: < 15 years	0.02	0.01	-0.05***	0.04***	0.01	0.04***
	(0.016)	(0.010)	(0.008)	(0.010)	(0.008)	(0.010)
Child: 16-25 years	0.00	-0.01	-0.03***	0.04***	0.01*	0.03***
	(0.017)	(0.010)	(0.009)	(0.011)	(0.008)	(0.011)
Homeowner	-0.03**	-0.02***	0.01	0.01	0.00	-0.02**
	(0.012)	(0.008)	(0.007)	(0.008)	(0.006)	(0.008)
Hand-to-mouth	-0.05***	-0.03***	0.04***	-0.02*	-0.01**	-0.02***
	(0.012)	(0.008)	(0.007)	(0.008)	(0.006)	(0.008)
Employed	0.06***	0.02***	-0.04***	0.01*	0.02***	0.06***
	(0.012)	(0.008)	(0.007)	(0.008)	(0.006)	(0.008)
Income: 2nd quintile	0.04***	0.02*	-0.05***	0.04***	0.02**	0.02*
	(0.015)	(0.010)	(0.009)	(0.010)	(0.007)	(0.010)
Income: 3rd quintile	0.08***	0.02**	-0.08***	0.05***	0.02***	0.03***
	(0.017)	(0.011)	(0.009)	(0.011)	(0.008)	(0.011)
Income: 4th quintile	0.10***	0.02	-0.10***	0.08***	0.04***	0.06***
	(0.018)	(0.011)	(0.009)	(0.012)	(0.008)	(0.011)
Income: 5th quintile	0.12***	-0.00	-0.11***	0.12***	0.08***	0.09***
	(0.019)	(0.012)	(0.010)	(0.013)	(0.009)	(0.012)
Belgium	-0.06**	-0.11***	-0.18***	0.30***	-0.02**	0.12***
	(0.023)	(0.014)	(0.010)	(0.014)	(0.010)	(0.015)
Spain	-0.12***	-0.10***	-0.08***	0.18***	0.03***	0.12***
	(0.018)	(0.011)	(0.010)	(0.011)	(0.009)	(0.011)
France	-0.14***	-0.09***	-0.12***	0.21***	-0.04***	-0.01
	(0.017)	(0.011)	(0.009)	(0.011)	(0.008)	(0.011)
Italy	-0.18***	-0.17***	-0.04***	0.20***	-0.00	0.13***
	(0.018)	(0.011)	(0.010)	(0.011)	(0.009)	(0.011)
Netherlands	-0.07***	-0.13***	-0.15***	0.28***	0.01	0.15***
	(0.024)	(0.014)	(0.011)	(0.015)	(0.011)	(0.014)
Survey-month						
Dec-20	0.01	0.00	-0.01**	0.01	-0.00	0.01*
	(0.011)	(0.007)	(0.005)	(0.007)	(0.005)	(0.006)
Aug-22	0.11***	0.04***	-0.08***	0.04***	0.02***	0.06***
	(0.011)	(0.007)	(0.006)	(0.007)	(0.005)	(0.007)
R-2	0.04	0.02	0.07	0.05	0.04	0.08
No. Obs. (NxT)	25,855	25,855	25,855	25,855	25,855	25,720
Joint significance (p-values)						
Age categories	<0.001	<0.021	<0.001	<0.001	<0.001	<0.001
Urbanisation categories	<0.001	<0.001	<0.021	<0.314	<0.001	<0.001
Income categories	<0.001	<0.018	<0.001	<0.001	<0.001	<0.001
Country dummies	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Source: ECB – Consumer Expectations Survey, authors' calculations.

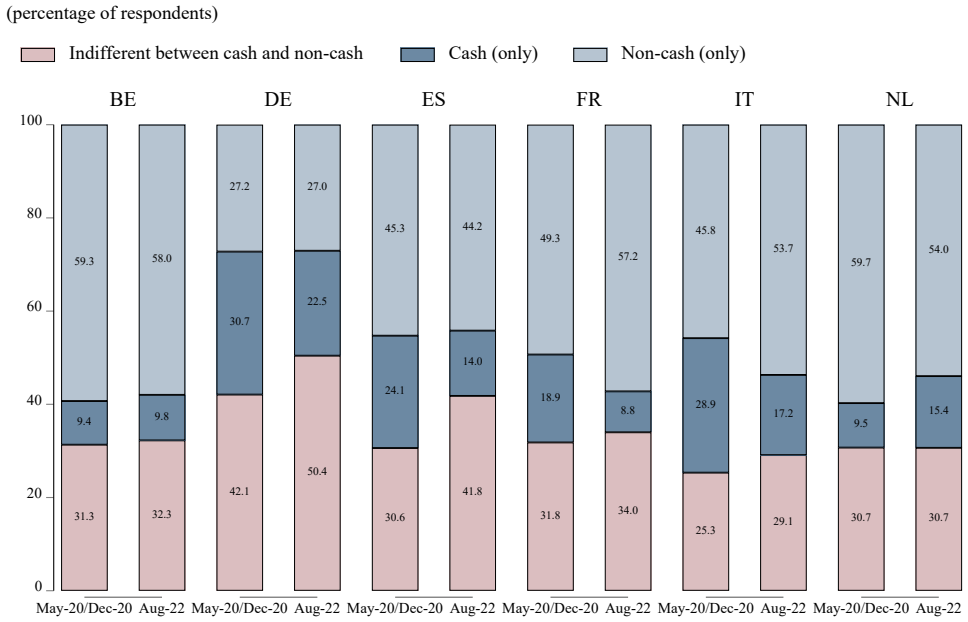
Notes: Pooled May 2020, December 2020, and August 2022 data. Standard errors are clustered at the individual level; significance levels are indicated as: *** p<.01, ** p<.05, * p<.1. The dependent variables are all binary. The depdendent variables of columns (1) to (5) refer to the payment preferences (the number of payment method a consumer prefers, preference for cash or non-cash methods, preference for only cash or only non-cash, or prefereing to use banking apps) while column (6) refers to the use of mobile baking applications for the management for personal finances. A constant was estimated but not reported. Household size is a continuous variable that captures the number of people living in the same residence. The level of urbanisation is defined as follows: low = *a village or rural area* (base category), middle = *a city with 100,000 to 500,000 inhabitants* or *a small city with fewer than 100,000 inhabitants,* high = *a big city with more than 500,000 inhabitants* or *a suburb or outskirts of a big city.* Other omitted base categories are risk neutral, low/medium financial literacy, men, age 18 to 34, primary/secondary education, no partner in household, no child in household, renter, non-hand-to-mouth, not employed (incl. unemployed, retired or student), income 1st quintile (bottom 20 percent), Germany as a base category for the country dummies and May-20 as first survey wave.

Table 5: Local acceptance of non-cash payment methods

Dependent variable:	Number of payment methods		Indifferent (cash and non-cash)		Cash (only)		Non-cash (only)		Smart (App) payment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	IPW+RA	OLS	IPW+RA	OLS	IPW+RA	OLS	IPW+RA	OLS	IPW+RA
Acceptance: most shops	0.04***	0.04***	0.03***	0.02***	0.03***	0.02***	-0.05***	-0.04***	0.00	0.00
	(0.013)	(0.013)	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)	(0.008)	(0.006)	(0.006)
Acceptance: half of shops (or fewer)	-0.15***	-0.11***	-0.08***	-0.05***	0.15***	0.15***	-0.07***	-0.10***	-0.01	-0.01
	(0.018)	(0.020)	(0.011)	(0.012)	(0.010)	(0.011)	(0.011)	(0.013)	(0.008)	(0.009)
R-2	0.05	-	0.04	-	0.08	-	0.07	-	0.04	-
No. Obs. (NxT)	18,982	18,982	18,982	18,982	18,982	18,982	18,982	18,982	18,982	18,982

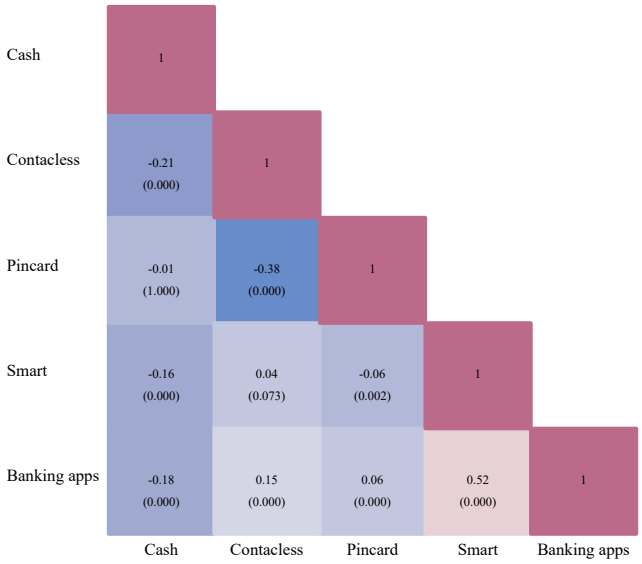
Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: All columns report marginal effects from a model including the same demographic and socioeconomic control variables as in Table 4. Standard errors are clustered at the individual level, significance levels indicated as: *** p<.01, ** p<.05, * p<.1. The dependent variables are all binary. The depdendent variables of columns (1) to (5) refer to the payment preferences (the number of payment method a consumer prefers, preference for cash or non-cash methods, preference for only cash or only non-cash, or prefereing to use banking apps). Full acceptance of non-cash payment methods in shops (incl. restaurants) of a respondent's area is used as base category. Columns using inverse propensity weighting (IPW) with regression adjustment (RA) report average treatment effects on the treated.

Figure 1: Payment preferences across countries



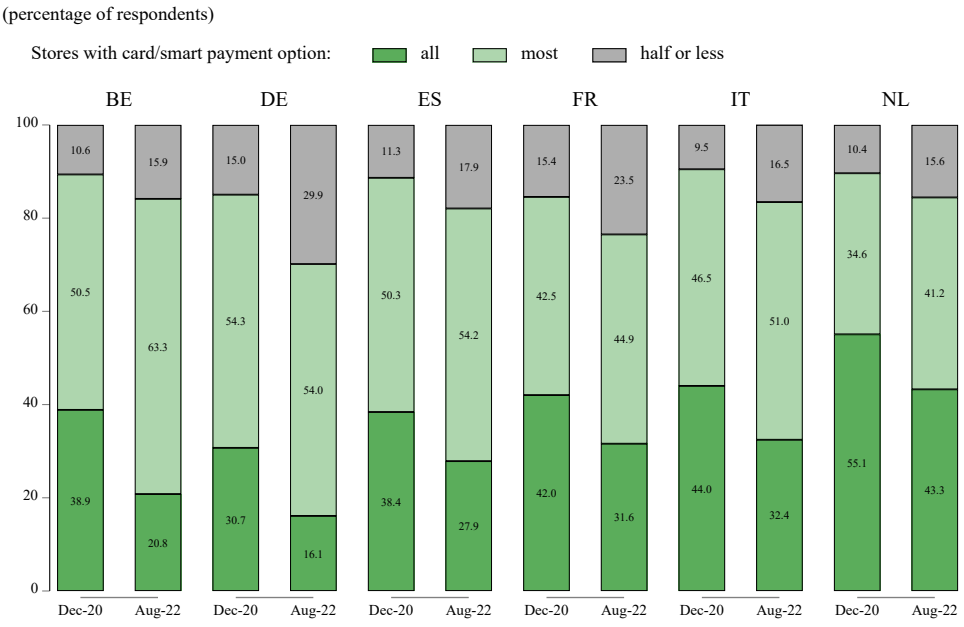
Source: ECB – Consumer Expectations Survey authors' calculations.
Note: Population-weighted statistics. Data for 2020 represents the pooled May and December survey waves. The chart depicts responses by consumers to a hypothetical scenario of a day-to-day transaction (e.g., in shops, restaurants). Responses are ex-post grouped in cash and non-cash (PIN card, contactless card or smart). Only a very small percentage (<5%) chooses the category "other" which is omitted from all analyses. Indifference captures all consumers who prefer to use both payment methods (cash and non-cash).

Figure 2: Correlation of payment methods and banking applications



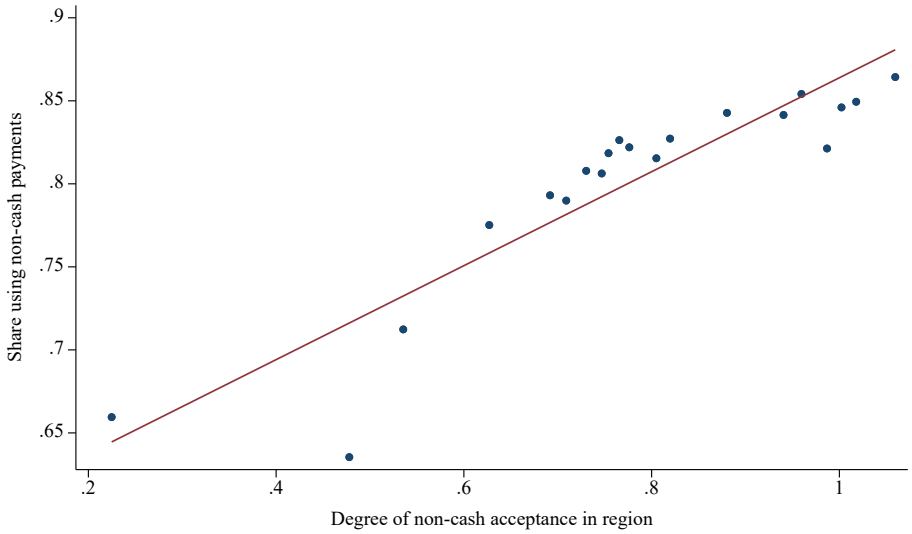
Source: ECB – Consumer Expectations Survey, authors' calculations.
Note: Data from August 2022. The figure depicts unweighted tetrachoric correlation coefficients. P-values with Bonferroni correction are in parentheses.

Figure 3: Perceived acceptance of non-cash payment option across countries



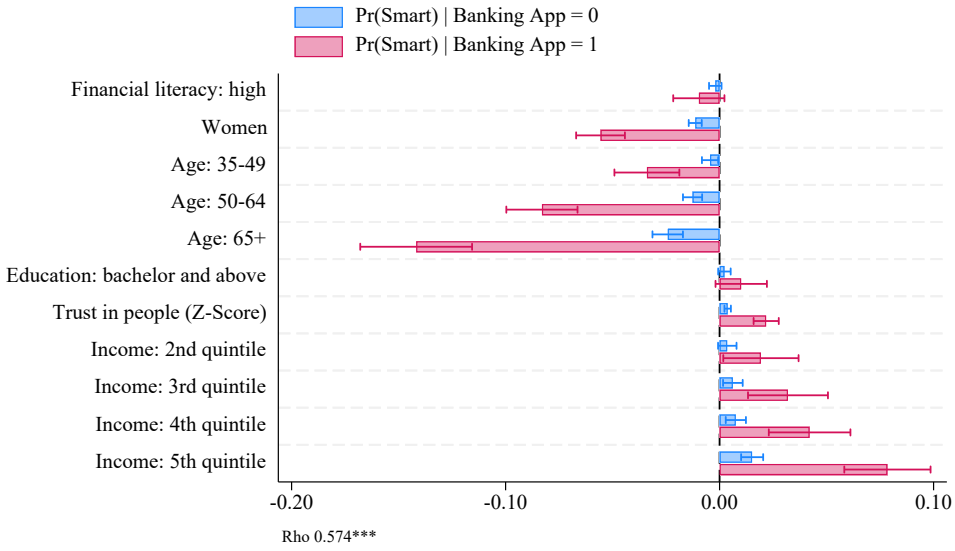
Source: ECB – Consumer Expectations Survey, authors' calculations.
Note: Population-weighted statistics. In December 2020 and August 2022, CES respondents were asked *how many stores, restaurants and other businesses in the area where* [they] *currently live offer the option to pay by card or other electronic means.* See Appendix A2 for the question wording.

Figure 4: Preferences and perceived acceptance of non-cash payments



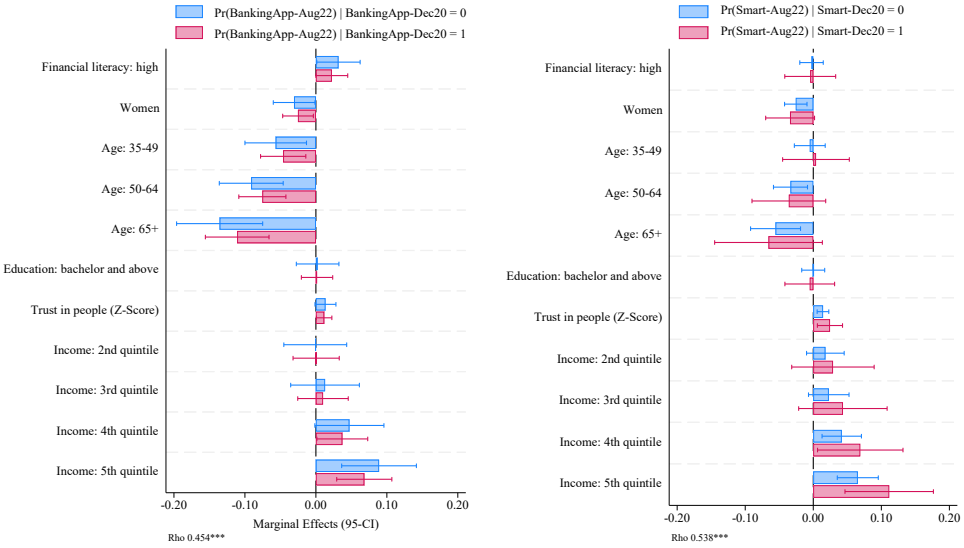
Source: ECB – Consumer Expectations Survey, authors' calculations.
Note: Population-weighted statistics. The figure shows a binscatter plot of the share of respondents who use non-cash payments (contactless card or smart device) on the y-axis and the degree of non-cash acceptance in local shops recoded at quarter-intervals from 0 (no shops accept non-cash payment methods) to 1 (all shops offer non-cash payment methods).

Figure 5: Preference for smart payment methods and use of mobile banking



Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: The panel depicts conditional marginal effects from a bivariate probit model and 95-% confidence intervals based on individual-level clustered standard errors. All estimations include a similar set of covariates as in Table 4 (including age, gender, education, income, financial literacy, degree of risk aversion, homeownership, employment situation, liquidity constraints, household composition and country dummies), apart from the non-cash acceptance dummies. Table A4 in the appendix provides the full set of regression results.

Figure 6: Preferences for smart payment technologies over time



Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Both panels depict conditional marginal effects from a bivariate probit model and 95-% confidence intervals based on individual-level clustered standard errors. All estimations include the same set of covariates as in Table 4 (including age, gender, education, income, financial literacy, degree of risk aversion, homeownership, employment situation, liquidity constraints, household composition and country dummies), apart from the non-cash acceptance dummies. Table A5 and A6 in the appendix provide the full set of regression results.

Bibliographic references

Abramova, S., Böhme, R., Elsinger, H., Stix, H., and Summer, M. (2022). What can CBDC designers learn from asking potential users? Results from a survey of Austrian residents. OeNB Working Paper No. 241.

Ampudia, M., Ehrmann, M. (2017). Financial inclusion: what it's worth?. ECB Working Paper Series, No 1990.

Arango, C., Huynh, K. P., and Sabetti, L. (2015). Consumer payment choice: Merchant card acceptance versus pricing incentives. *Journal of Banking and Finance*, 55, 130-141.

Arango-Arango, C., Bouhdaoui, Y., Bounie, D., Eschelbach, M. and Hernandez, L. (2018), Cash remains top-of-wallet! International evidence from payment diaries. *Economic Modelling*, 62, 38–48.

Arango-Arango, C. A. and Suárez-Ariza, N. (2020). Digital payments adoption and the demand for cash: New international evidence. *Journal of Payments Strategy Systems*, Vol. 14, No 4, pp. 392-410.

Armelius, H., Claussen, C. A., & Reslow, A. (2022). Withering Cash: Is Sweden Ahead of the Curve or Just Special?. *International Journal of Central Banking*, 18(4), 1-52.

Auer, R., Frost, J., Gambacorta, L., Monnet, C., Rice, T. and Shin, H.S., 2022. Central bank digital currencies: motives, economic implications, and the research frontier. *Annual review of economics*, 14, 697-721.

Auer, R., Cornelli, G., & Frost, J. (2023a). The pandemic, cash and retail payment behaviour: insights from the future of payments database (No. 18040) CEPR Discussion Papers.

Auer, R., Cornelli, G., and Frost, J. (2023b). Rise of the Central Bank Digital Currencies. *International Journal of Central Banking*, 19(4), 185-214.

Bagnall, J., Bounie, D., Huynh, K. P., Kosse, A., Schmidt, T., Schuh, S. D. and Stix, H. (2016). Consumer cash usage: A cross-country comparison with payment diary survey data. *International Journal of Central Banking*, Vol. 12, 1-62.

Bijlsma, M., van der Cruijsen, C., Jonker, N., & Reijerink, J. (2023). What triggers consumer adoption of central bank digital currency?. *Journal of Financial Services Research*, 1-40.

Bilias, Y., Georgarakos, D., & Haliassos, M. (2010). Portfolio inertia and stock market fluctuations. *Journal of Money, Credit and Banking*, 42(4), 715-742.

Bolt, W., Jonker, N. and van Renselaar, C. (2010). Incentives at the counter: An empirical analysis of surcharging card payments and payment behaviour in the Netherlands. *Journal of Banking and Finance*, 34, 1738–1744.

Bounie, D., and Camara, Y. (2020). Card-sales response to merchant contactless payment acceptance. *Journal of Banking and Finance*, 119, 105938.

Borzekowski, R., E. Kiser, and S. Ahmed (2008). Consumers' Use of Debit Cards: Patterns, Preferences, and Price Response. *Journal of Money, Credit, and Banking*, 40 (1), 149–172.

Brits, H., G. Cuijpers, N. Jonker, R Roerink, C. ter Wal and A. Zwemstra (2021). Changing Landscape, Changing Supervision: Developments in the Relationship between BigTechs and Financial Institutions. DNB report. Amsterdam: DNB

Carbó-Valverde, S. and J. Liñares-Zegarra (2011). How effective are rewards programs in promoting payment card usage? Empirical evidence. *Journal of Banking and Finance*, 35(12), 3275–3291.

Carbó-Valverde, S., Cuadros-Solas, P. J., Rodríguez-Fernández, F., and Sánchez-Béjar, J. J. (2023). Mobility restrictions and payment choices: The case of the Covid-19 pandemic. *Journal of Behavioral and Experimental Finance*, 40, 100850.

Ching, A. and F. Hayashi (2010) Payment Card Rewards Programs and Consumer Payment Choice, *Journal of Banking and Finance*, 34(8), 1773–1787.

Christelis, D., Georgarakos, D., and Haliassos, M. (2011). Stockholding: Participation, location, and spillovers. *Journal of Banking & Finance*, 35(8), 1918-1930.

Coyle, K., Kim, L. and O'Brien, S. (2021). 2021 Findings from the Diary of Consumer Payment Choice. San Francisco: Federal Reserve Bank of San Francisco.

Demirguc-Kunt, A., L. Klapper, D. Singer and S. Ansar (2022). The Global Findex database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. World Bank.

DNB (2020). DNB Factsheet. Point of sale payments during the COVID-19 pandemic. Available at: https://www.dnb.nl/media/tehjvslf/betalen-aan-kassa-uk.pdf.

DNB Bulletin (2023a). Millions of Dutch struggle to get to grips with digital payments. January.

DNB Bulletin (2023b). Digital banking is a struggle for many. January.

DNB Report (2023c). Digitalisation of the payment system: a solution for some, a challenge for others. January.

European Central Bank (ECB) (2021). ECB Consumer Expectations Survey: an overview and first evaluation. Occasional Paper Series, No 287, ECB, December.

European Central Bank (ECB) (2022a). Costs of retail payments – an overview of recent national studies in Europe, ECB Occasional Paper Series, No. 294.

European Central Bank (ECB) (2022b). Use of cash by companies in the euro area. Frankfurt am Main: ECB.

European Central Bank (ECB) (2022c). Study on the payment attitudes of consumers in the euro area (SPACE). Frankfurt am Main: ECB.

European Central Bank (ECB) (2023). The Eurosystem cash strategy (europa.eu).

European Commission (2023). Modernising payment services and opening financial services data: new opportunities for consumers and businesses, Press Release, Brussels, 28 June 2023.

Esselink, H., and Hernández, L. (2017). The use of cash by households in the euro area. ECB Occasional Paper.

Fu, J., and Mishra, M. (2022). Fintech in the time of COVID-19: Technological adoption during crises. *Journal of Financial Intermediation*, 50, 100945.

Fujiki, H. (2022). Will The Widespread Use of Cashless Payments Reduce the Frequency of the Use of Cash Payments? *Review of Economic Analysis*, 14(1). 1-175.

Georgarakos, D. and Kenny, G. (2022). Household spending and government support during the COVID-19 pandemic: Insights from a new consumer survey. *Journal of Monetary Economics*, Vol. 129, pp. S1-S14.

Greene, C., Merry, E. A., and Stavins, J. (2023). Changes in US payment behaviour during COVID-19: Differences by income and demographics. *Journal of Payments Strategy & Systems*, 17(3), 230-237.

Greene, W. H., & Hensher, D. A. (2010). Modeling ordered choices: A primer. Cambridge University Press.

Hernández, L., Jonker, N., and Kosse, A. (2017). Cash versus debit card: the role of budget control. *Journal of Consumer Affairs*, 51(1), 91-112.

Jenkins, S. P., Cappellari, L., Lynn, P., Jäckle, A., and Sala, E. (2006). Patterns of consent: evidence from a general household survey. *Journal of the Royal Statistical Society Series A: Statistics in Society*, 169(4), 701-722.

Jonker, N. (2007). Payment instruments as perceived by consumers: results from a household survey. *De Economist,* 155(3), 271–303.

Jonker, N., Plooij, M., and Verburg, J. (2017). Did a public campaign influence debit card usage? Evidence from the Netherlands. *Journal of Financial Services Research*, 52, 89-121.

Jonker, N., van der Cruijsen, C., Bijlsma, M., and Bolt, W. (2022). Pandemic payment patterns. *Journal of Banking and Finance*, 143, 106593.

Kahn, C. M., Liñares-Zegarra, J. M., and Stavins, J. (2017). Are there social spillovers in consumers' security assessments of payment instruments? *Journal of Financial Services Research*, 52, 5-34.

Kajdi, L. (2022). Consumer Payment Preferences in the Euro Area. ECB Working Paper No. 2729.

Klee, E. (2008). How people pay: Evidence from grocery store data. *Journal of Monetary Economics*, 55(3), 526-541.

Kosse, A. (2013). Do newspaper articles on card fraud affect debit card usage?. *Journal of Banking and Finance*, 37(12), 5382–5391.

Kosse, A., & Mattei, I. (2023). Making headway -- Results of the 2022 BIS survey on central bank digital currencies and crypto. BIS Papers.

Kotkowski, R., and Polasik, M. (2021). COVID-19 pandemic increases the divide between cash and cashless payment users in Europe. *Economics letters*, 209, 110-139.

Lagarde, C. (2020). Payments in a digital world. Speech at the Deutsche Bundesbank online conference on banking and payments in the digital world, September.

Lusardi, A., and Mitchell, O. S. (2011). Financial literacy around the world: an overview. *Journal of Pension Economics and Finance*, 10, 497–508.

Li, J. (2022). Predicting the demand for central bank digital currency: A structural analysis with survey data. *Journal of Monetary Economics*, forthcoming.

Moracci, E. (2023). Payments and Cash Management in the Euro Area Data, Theory and Quantitative Analysis. Working Paper.

Nocciola, L. and Zamora-Pérez A. (2023). Transactional demand for central bank digital currency. ECB Working Paper Series (forthcoming).

Patacchini, E., & Rainone, E. (2017). Social ties and the demand for financial services. *Journal of Financial Services Research*, 52, 35-88.

Shy, O. (2023). Cash is alive: How economists explain holding and use of cash. *Journal of Economic Literature*, 61(4), 1465-1520.

Stavins, J. (2018). Consumer preferences for payment methods: Role of discounts and surcharges. *Journal of Banking and Finance*, 94, 35-53.

Stavins, J. (2020). Credit card debt and consumer payment choice: what can we learn from credit bureau data?. *Journal of Financial Services Research*, 58(1), 59-90.

Tamele, B., Zamora-Pérez, A., Litardi, C., Howes, J., Steinmann, E., and Todt, D. (2021). Catch me (if you can): assessing the risk of SARS-CoV-2 transmission via euro cash. ECB Occasional Paper, (2021/259).

Van der Cruijsen, C., Hernandez, L., and Jonker, N. (2017). In love with the debit card but still married to cash. *Applied Economics*, 49(30), 2989-3004.

Van der Cruijsen, C., and Plooij, M. (2018). Drivers of payment patterns at the point of sale: stable or not?. *Contemporary Economic Policy*, 36(2), 363-380.

Van der Cruijsen, C., and van der Horst, F. (2019). Cash or card? Unravelling the role of socio-psychological factors. *De Economist*, 167(2), 145-175.

Van der Cruijsen, C., and Knoben, J. (2021). Ctrl+ C Ctrl+ pay: Do people mirror electronic payment behavior of their peers?. *Journal of Financial Services Research*, 59(1-2), 69-96.

Van der Cruijsen, C., and Reijerink, J. (2023). Uncovering the digital payment divide: understanding the importance of cash for groups at risk. DNB Working Paper 781.

Wang, Z., and Wolman, A. L. (2016). Payment choice and currency use: Insights from two billion retail transactions. *Journal of Monetary Economics*, 84, 94-115.

Zamora-Pérez, A., Coschignano, E., & Barreiro, L. (2022). Ensuring adoption of central bank digital currencies: An easy task or a Gordian knot? (No. 307). ECB Occasional Paper

Appendix A – Additional tables and figures

Table A1: Sample summary statistics for covariates

Variable	Description	Mean	SD	Min	Max	N
Age (in years)						
between 18 and 34	Binary (1=age between 18 and 34; 0=else)	0.25	0.43	0	1	33,316
between 35 and 49	Binary (1=age between 35 and 49; 0=else)	0.26	0.44	0	1	33,316
between 50 and 64	Binary (1=age between 50 and 64; 0=else)	0.27	0.44	0	1	33,316
65 and older	Binary (1=age 65 and older; 0=else)	0.22	0.42	0	1	33,316
Gender						
women	Binary (1=women; 0=men)	0.51	0.5	0	1	33,316
Education						
university education	Binary (1=university education, bachelor or above; 0=else)	0.53	0.5	0	1	33,316
Economic situation						
employed	Binary (1=employed; 0=else)	0.54	0.5	0	1	33,316
household (net) income	Quintiles (1 to 5; yearly net household income)					33,316
homeowner	Binary (1=owner of place of residence; 0=renter)	0.63	0.48	0	1	33,316
Household composition						
number of household members	Count (1 to 5; # of household members, censored at 5)	2.52	1.17	1	5	33,288
partner	Binary (1=partner living in household; 0=else)	0.63	0.48	0	1	33,316
dependent child	Binary (1=child up to age 15 in household; 0=else)	0.22	0.41	0	1	33,316
child in household	Binary (1=child between 16 and 25 in household; 0=else)	0.14	0.34	0	1	33,316
Degree of risk aversion						
Risk-averse	Binary (1=risk averse; 0=else)	0.47	0.5	0	1	32,696
Risk-neutral	Binary (1=risk neutral; 0=else)	0.22	0.42	0	1	32,696
Risk-loving	Binary (1=risk loving; 0=else)	0.31	0.46	0	1	32,696
Country						
Belgium	Binary (1=Belgium; 0=else)	0.04	0.19	0	1	33,316
Germany	Binary (1=Germany; 0=else)	0.29	0.46	0	1	33,316
Spain	Binary (1=Spain; 0=else)	0.17	0.37	0	1	33,316
France	Binary (1=France; 0=else)	0.22	0.41	0	1	33,316
Italy	Binary (1=Italy; 0=else)	0.22	0.41	0	1	33,316
Netherlands	Binary (1=Netherlands; 0=else)	0.06	0.24	0	1	33,316
Degree of urbanisation						
high	Binary (1=large city or suburb; 0=else)	0.32	0.47	0	1	26,991
middle	Binary (1=city or small city; 0=else)	0.46	0.5	0	1	26,991
low	Binary (1=village or rural area; 0=else)	0.22	0.42	0	1	26,991
Degree of local non-cash acceptance						
all shops	Binary (1=all shops offer cashless payments; 0=else)	0.33	0.47	0	1	24,515
most shops	Binary (1=most shops offer cashless payments; 0=else)	0.5	0.5	0	1	24,515
half of shops (or fewer)	Binary (1=half of shops (or fewer) offer cashless payments; 0=else)	0.18	0.38	0	1	24,515
Additional variables						
high financial literacy	Binary (1=3 or more correct responses; 0=else)	0.53	0.5	0	1	32,939
Hand-to-mouth consumer	Binary (1=self-reported liquidity constrained; 0=else)	0.28	0.45	0	1	33,316
trust in people	Ordinal (0=no trust; 10=complete trust)	5.41	2.4	0	10	33,316
COVID-19 health concerns	Ordinal (0=not concerned; 10=very concerned)	6.26	2.69	0	10	32,954

Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Population-weighted data. Based on pooled May 2020, December 2020 and August 2022 survey waves. Urbanisation and the degree of local non-cash acceptance were not included in all survey waves and therefore the relative sample size differs from the remaining covariates.

Respondents are asked a sequence of the following questions in which they are presented with choices at €10 increments. Imagine you are playing a game of chance by flipping a coin: "*If the coin comes up heads, you win €60, but if it comes up tails you win nothing. Would you rather play this game or alternatively receive the amount shown below for sure? (I would prefer to play the game; I would rather receive this amount for sure).*" We classify respondents who choose €10 or €20 as relatively risk-averse, those choosing €30 (the expected value) as risk-neutral and those choosing €40 or €50 or who would always play the game as rather risk-loving.

Table A2: Country-specific payment choices

(a) 2020 (pooled May and December)

Rank	1	2	3
Average	*Cash (21%)*	Contactless card (20%)	Contactless card & *cash* (13%)
BE	PIN card (25%)	Contactless card (20%)	PIN card & *Cash* (12%)
DE	*Cash* (29%)	Contactless card & *cash* (15%)	Contactless card (12%)
ES	*Cash* (23%)	Contactless card (18%)	PIN card (14%)
FR	Contactless card (25%)	*Cash* (18%)	Contactless & *cash* (13%)
IT	*Cash* (28%)	Contactless card (24%)	Contactless & *cash* (11%)
NL	Contactless card (27%)	PIN card (15%)	*Cash* (9%)

(b) August 2022

Rank	1	2	3
Average	Contactless card (20%)	*Cash (16%)*	Contactless card & *cash* (14%)
BE	Contactless card (22%)	PIN card (20%)	PIN card & *cash* (10%)
DE	*Cash* (22%)	Contactless card & *cash* (16%)	PIN card & Contactless card & *cash* (13%)
ES	*Cash* (16%)	Contactless card & *cash* (15%)	*Cash* (14%)
FR	Contactless card (29%)	Contactless & *cash* (14%)	PIN card (14%)
IT	Contactless card (28%)	*Cash* (17%)	Contactless & *cash* (12%)
NL	Contactless card (22%)	*Cash* (15%)	PIN card (14%)

Source: ECB – Consumer Expectations Survey, authors' calculations.
Note: Population-weighted data.

Table A3: Transitions in payment preferences and use of mobile banking
May to December 2020

		May-20 (percentage of consumers)									
		Cash		**PIN card**		**Contactless card**		**Smart**		**Banking app**	
		nonuser	*user*	*nonuser*	*user*	*nonuser*	*user*	*nonuser*	*user*	*nonuser*	*user*
Dec-20	*nonuser*	27.47	13.96	49.54	17.60	34.60	14.40	78.53	8.05	26.83	14.31
	user	15.00	43.57	17.02	15.84	18.42	32.57	7.45	5.97	14.49	44.36

Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Population weighted data. Data are based on the balanced panel between the two depicted survey waves in each panel respectively. User and nonuser refer to consumers preferring to use a payment method or not, respectively.

Table A4: Preference for smart payment methods and use of mobile banking, bivariate probit results

	Use mobile Banking App		**Prefer smart payment**	
	marginal effect	t-statistic	marginal effect	t-statistic
Financial literacy: high	-0.0225	-1.24	-0.038	-1.79
Women	-0.139***	-8.01	-0.221***	-10.89
Age: 35-49	-0.251***	-10.13	-0.178***	-6.64
Age: 50-64	-0.497***	-19.37	-0.404***	-13.72
Age: 65+	-0.672***	-19.40	-0.645***	-13.85
Education: bachelor and above	0.0116	0.64	0.0365	1.72
Household size	-0.00984	-0.95	-0.00295	-0.25
Partner in household	0.00207	0.10	-0.0168	-0.68
Child in household: < 15 years	0.113***	4.50	0.0545	1.91
Child in household: 16-25 years	0.0890***	3.34	0.0645*	2.11
Risk-averse	-0.0627**	-2.84	-0.0103	-0.4
Risk-loving	0.0332	1.40	0.0641*	2.35
Trust in people (Z-Score)	0.0992***	11.51	0.0980***	9.38
Homeowner	-0.0546**	-2.79	-0.0217	-0.94
Hand-to-mouth	-0.0465*	-2.44	-0.0282	-1.24
Employed	0.168***	8.63	0.102***	4.32
Income: 2nd quintile	0.0716**	2.92	0.0827**	2.71
Income: 3rd quintile	0.102***	3.82	0.132***	4.06
Income: 4th quintile	0.173***	6.21	0.184***	5.53
Income: 5th quintile	0.252***	8.34	0.325***	9.2
Belgium	0.335***	9.11	-0.0839*	-2.01
Spain	0.349***	12.82	0.115***	3.68
France	-0.0262	-1.02	-0.187***	-5.95
Italy	0.350***	12.81	-0.0213	-0.66
Netherlands	0.404***	10.89	0.0354	0.85
Dec-20	0.0133	0.80	-0.0124	-0.61
Aug-22	0.156***	9.04	0.0790***	3.86
Rho	0.653***	41.64	0.653***	41.64
N	32,142		32,142	

Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Results based on pooled May 2020, December 2020, and August 2022 data. Standard errors are clustered at the individual level; significance levels are indicated as: *** p<.01, ** p<.05, * p<.1.

Table A5: Preference for smart payment methods over time, bivariate probit results

	Prefer smart payments in Dec-20		**Prefer smart payments in Aug-22**	
	marginal effect	t-statistic	marginal effect	t-statistic
Financial literacy: high	-0.0126	-0.27	-0.0157	-0.35
Women	-0.260***	-5.94	-0.190***	-4.45
Age: 35-49	-0.185**	-3.14	-0.071	-1.2
Age: 50-64	-0.442***	-6.82	-0.274***	-4.22
Age: 65+	-0.654***	-6.33	-0.434***	-4.51
Education: bachelor and above	0.0613	1.35	0.0148	0.33
Household size	0.0016	0.06	0.00696	0.28
Partner in household	-0.019	-0.36	-0.0362	-0.7
Child in household: < 15 years	0.0233	0.38	-0.0136	-0.23
Child in household: 16-25 years	0.105	1.65	0.0898	1.47
Risk-averse	-0.00619	-0.11	0.0659	1.23
Risk-loving	0.0614	1.06	0.0551	0.96
Trust in people (Z-Score)	0.0748**	3.15	0.0883***	3.99
Homeowner	0.0349	0.7	0.00513	0.11
Hand-to-mouth	0.0578	1.08	-0.00847	-0.16
Employed	0.130*	2.45	0.0671	1.31
Income: 2nd quintile	0.113	1.57	0.115	1.62
Income: 3rd quintile	0.0651	0.84	0.127	1.67
Income: 4th quintile	0.253***	3.36	0.267***	3.58
Income: 5th quintile	0.352***	4.42	0.407***	5.21
Belgium	-0.225**	-2.61	-0.0928	-1.03
Spain	-0.0929	-1.43	0.285***	4.33
France	-0.275***	-4.06	-0.0989	-1.43
Italy	-0.246***	-3.62	0.135*	1.99
Netherlands	-0.0985	-1.1	0.0609	0.69
Rho	0.601***	18.66	0.601***	18.66
N	5,508		5,508	

Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Standard errors are clustered at the individual level; significance levels are indicated as: *** p<.01, ** p<.05, * p<.1.

Table A6: Use of mobile banking apps over time, bivariate probit results

	Use mobile banking app in Dec-20		**Use mobile banking app in Aug-22**	
	marginal effect	t-statistic	marginal effect	t-statistic
Financial literacy: high	-0.0697	-1.82	0.0536	1.39
Women	-0.183***	-4.97	-0.132***	-3.55
Age: 35-49	-0.310***	-5.71	-0.235***	-4.33
Age: 50-64	-0.589***	-10.43	-0.407***	-7.23
Age: 65+	-0.778***	-10.2	-0.574***	-7.57
Education: bachelor and above	-0.0126	-0.33	0.00182	0.05
Household size	-0.0123	-0.56	-0.0154	-0.71
Partner in household	0.0515	1.16	0.0639	1.43
Child in household: < 15 years	0.0865	1.6	0.0674	1.24
Child in household: 16-25 years	0.152**	2.79	0.0998	1.81
Risk-averse	-0.056	-1.21	-0.0627	-1.33
Risk-loving	0.125*	2.5	-0.0183	-0.36
Trust in people (Z-Score)	0.120***	6.34	0.0707***	3.74
Homeowner	-0.0439	-1.06	-0.0663	-1.58
Hand-to-mouth	0.00574	0.13	-0.0763	-1.73
Employed	0.144***	3.39	0.193***	4.49
Income: 2nd quintile	0.0711	1.26	0.0208	0.37
Income: 3rd quintile	0.0377	0.61	0.0429	0.7
Income: 4th quintile	0.176**	2.86	0.169**	2.74
Income: 5th quintile	0.192**	2.92	0.274***	4.12
Belgium	0.230**	3.12	0.361***	4.87
Spain	0.341***	5.94	0.325***	5.58
France	-0.00459	-0.08	-0.00161	-0.03
Italy	0.234***	4.06	0.392***	6.7
Netherlands	0.341***	4.47	0.331***	4.31
Rho	0.489***	19.87	0.489***	19.87
N	5,506		5,506	

Source: ECB – Consumer Expectations Survey, authors' calculations.
Notes: Standard errors are clustered at the individual level; significance levels are indicated as: *** p<.01, ** p<.05, * p<.1.

Appendix B – Selected Survey Questions

Financial literary

Respondents are asked the following financial literacy questions ("big 3") and one more advanced question (correct answers are highlighted in bold):

1) Suppose you had €100 in a savings account and the interest rate was 2% per year. After five years, how much do you think you would have in the account if you left the money to grow? **(more than 102€;** exactly 102€; less than 102€; Do Not Know).
2) Imagine that the interest rate on your savings account was 1 % per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? (more than today; exactly the same; **less than today;** Do Not Know).
3) Do you think the following statement is true or false? Buying shares in a single company usually provides a safer return than buying shares in a mutual fund. (True; **False**; Do Not Know).
4) Suppose you owe €1,000 on a loan and the interest rate you are charged is 20% per year, compounded annually. If you didn' t pay anything off, at this interest rate, how many years would it take for the amount you owe to double? (years: <2; **[2,5)**, [5,10), >=10; Do Not Know).

Hand-to-mouth (liquidity constraints)

Respondents who answer "no" to the below question are classified as hand-to-mouth consumers:

> Please think about your available financial resources, including access to credit, savings, loans from relatives or friends, etc. Suppose that you had to make an unexpected payment equal to one month of your household income. Would you have sufficient financial resources to pay for the entire amount?

Trust in people in general

Respondents are asked about their trust in people in general:

> Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please indicate your level of trust on a scale from 0 to 10, where 0 means that "you can't be too careful" and 10 means that "most people can be trusted".

Risk attitude

Respondents are asked a sequence of the following questions in which they are presented with choices at 10€ increments:

> Imagine you are playing a game of chance by flipping a coin. If the coin comes up heads, you win €60, but if it comes up tails you win nothing. Would you rather play this game or alternatively receive the amount shown below for sure? (I would prefer to play the game; I would rather receive this amount for sure)

We classify respondents who choose 10€ or 20€ as relatively risk-averse, those choosing 30€ (the expected value) as risk-neutral and those choosing 40€, 50€ or would always play the game as rather risk-loving.

COVID-19 health concerns

Respondents are asked the following question capturing their level of health concerns:

> How concerned are you about the impact of the coronavirus (COVID-19) on your own health or the health of the members of your household (scale from 0 – "Not concerned at all" to 10 – "Extremely concerned"; Do Not Know).

Acknowledgements

We thank Maurice Bun, Carin van der Cruijsen, Maarten Dossche, Dimitris Georgarakos, Geoff Kenny, Juha Honkkila and an anonymous referee for comments and suggestions. The paper has also benefited from helpful feedback from presentations and seminars at the European Central Bank, De Nederlandsche Bank and the 8th Luxembourg Workshop on Household Finance and Consumption. Any remaining errors are the authors' responsibility.
This paper should not be reported as representing the views of the European Central Bank (ECB) or the De Nederlandsche Bank (DNB). The views expressed are those of the authors and do not necessarily reflect those of the ECB or the DNB.

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PDF ISBN 978-92-899-6395-4 ISSN 1725-2806 doi:10.2866/4294 QB-AR-24-032-EN-N