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Contact to corresponding author: Jacek Pietrucha, jacek.pietrucha@ue.katowice.pl

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Jacek Pietrucha

University of Economics in Katowice, Poland

 orcid.org/0000-0001-5777-9666

Grzegorz Maciejewski

University of Economics in Katowice, Poland

 orcid.org/0000-0002-1318-0747

Precautionary cash holding by consumers making electronic payments and risk-taking behavior

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Abstract

Research background: The relative inertia in holding cash, despite the increasing importance of electronic payments, is one of the most fascinating puzzles of the current monetary system and a significant issue for central bank policy. In our study, we would like to extend the previous considerations regarding holding cash by consumers who have decided to make electronic payments but keep the cash despite this.

Purpose of the article: Recent literature mainly considers the trade-off between cash and electronic payments. We go beyond this dual framework and instead focus on the precautionary demand for cash. We study the relevance of several psychological factors behind cash holding by consumers who have decided to use electronic payments.

Methods: We employ factor analysis and logistic regression. We use data from a standardized online survey conducted among Polish consumers.

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Findings & value added: Our study's key determinants of holding cash include risk-taking behavior, perceived risk of the unavailability of the payment infrastructure and perceived attitudes towards cash (flexibility and cybersecurity related to the lack of exposure to cyberattacks). According to our research, consumers attach great importance to the flexibility that cash gives as an additional option to electronic payments. A better understanding of these motivations is crucial for public policymakers, who should strive to design payment systems that respond to the needs of all social groups. Therefore, in (at least) the short and medium term, cash will remain in circulation, even if it gradually loses its payment function.

Introduction

Although cash is losing its importance as a means of payment, it still constitutes a significant part of the total money supply. The relative inertia in holding cash, despite the increase in the importance of electronic payments, is one of the most interesting puzzles of the current monetary system and also a significant issue for central bank policy.

Extensive literature considers consumer preferences regarding the choice between electronic and cash payments (Shy, 2023). However, this research has focused on the payment function of money and sees cash holding only as the consequence of using cash as an alternative to electronic payments. Only a few studies have been interested in demand for cash for reasons other than transactional ones. This literature is mainly macroeconomic and discusses money as a store of value (Ashworth & Goodhart, 2020; Liñares-Zegarra & Willeson, 2021; Titova *et al.*, 2021). It emphasizes the role of cash hoarding and the interest rate as an opportunity cost. Literature dealing with why consumers hold cash despite choosing electronic payments for transactions is very rare.

We want to expand this research to include the perspective of the behavior of consumers who pay electronically but at the same time keep cash. We consider the impact of risky behavior but also other psychological aspects, such as the perception of risk of unavailability of infrastructure enabling payments and the attitude towards cash. We research consumers who have decided to make electronic payments, meaning that the consumer is both knowledgeable and willing to conduct such transactions. Despite this, the consumers also maintain cash reserves. In this case, factors such as digital or financial exclusion, financial literacy, age, education, and objective or perceived differences in the cost and ease of using individual payment instruments are probably less important. This is because, in principle, the consumer has already made the decision to make electronic payments and,

therefore, overcome any possible knowledge, skill, and mental barriers related to it.

In scenarios where individuals continue to hold cash alongside opting for electronic payments, further exploration into an array of potential underlying factors is warranted. It is posited that consumers engage in numerous and often unpredictable financial transactions, rendering them uncertain about the consistent availability of payment infrastructure. Consequently, they are compelled to retain various forms of currency, navigating under a veil of ignorance concerning the precise volume and type of transactions, as well as the reliability of technical infrastructure at the moment of transaction. Individuals may also maintain a cash reserve as a hedge against the perceived risk associated with the failure or unavailability of the infrastructure required for electronic payments. This cautionary stance could be further influenced by the perceived uncertainty of external events that might disrupt electronic payment methods, such as warfare or terrorist attacks targeting the technical infrastructure. Preferred behavior patterns, for example, taking risky activities, may also determine whether to keep cash (in addition to non-cash money/bank money).

The remainder of the paper is structured as follows. First, we review the existing literature on cash holding and present the research context, including the theoretical framework and current state of empirical research. In this context, we present our research procedure and research questions. Subsequently, we report our data collection methods and variable characteristics. The results of factor analysis and logistic regression follow this. In the last section, we discuss the results.

Literature review

The broad context of our research is defined by several strands of research, primarily empirical. Firstly, in the broadest sense, it is a discussion on the role of cash in an economy dominated by electronic payments. Secondly, considerations regarding the causes of inertia in holding cash from a macroeconomic perspective. Thirdly, diverse and multi-threaded research on the use of various forms of money. In this last area, the discussion takes place almost exclusively from the point of view of factors determining the choice of payment method. Only a few studies consider cultural or psychological factors regarding money holding. Below, these research areas are

briefly characterized, and then, against this background, the specificity of the research conducted is indicated.

1. The publication of Keneth Rogoff's book *The Curse of Cash* (Rogoff, 2016) is considered the high point of the argument for a cashless society. It summarizes the key arguments against a monetary system based on cash (in particular, facilitating illegal, criminal, and terrorist activities, enabling transactions to be transferred to the informal economy, thus depriving public authorities of part of tax revenues). However, further discussion (Dowd, 2019; Krueger & Seitz, 2018; Rösl & Seitz, 2022a; Shy, 2023) pointed to numerous weaknesses of Rogoff's ideas. They also showed significant arguments for maintaining cash (privacy, financial exclusion, systemic risk related to the fragility of the monetary system to terrorist attacks and armed conflicts). The stabilizing role of cash in the economy is also emphasized (Rösl & Seitz, 2022b). In the last few years, we have seen a gradual transition in central banks' attitude, increasingly emphasizing that cash is (at least in the medium term) a necessary element of the monetary system (ECB, 2024). Also, when preparing legal regulations regarding the digital euro, the European Commission is strengthening the provisions on accepting physical cash (EC, 2024). Similar efforts are being made in many countries to legally strengthen the acceptance of cash (France, Poland).

2. The empirical studies on the inertia (and even growth in many countries) in cash demand are mainly macroeconomic and have focused on holding cash due to the store of value motive. Liñares-Zegarra and Willeson (2021) indicated low interest rates as a key determinant. Jobst and Stix (2017) also reached similar conclusions. Additionally, Pietrucha (2021) concluded that the growing share of cash in GDP results from the downward trend in interest rates and the expansionary nature of monetary policy by central banks. Numerous works emphasize the potential importance of uncertainty. However, in empirical research, the importance of uncertainty is mainly confirmed in case studies of significant increases in uncertainty (Rösl & Seitz, 2022b; Pietrucha & Gulewicz, 2022; Kotkowski & Manikowski, 2023). Studies using longer time series remain inconclusive (Pietrucha, 2021).

3. The literature extensively reviews various determinants affecting the choice between electronic payments and cash, as explored by Shy (2023). Key factors include relative costs, transaction speed, convenience, security, anonymity, and the quality of electronic payment infrastructure at the point of sale. Demographic variables also influence the choice of payment

method; the propensity to utilize electronic payments decreases with age and increases with higher levels of education and income. The literature further emphasizes the role of financial literacy, though primarily in the context of choosing between payment methods rather than explaining why consumers retain cash alongside electronic options.

One of the factors discussed that determine the choice of payment method is the perception of the risk of the unavailability of the payment infrastructure. We also consider this risk important in the case discussed in our study. Broader risks related to electronic payments are considered in the works like those by Liébana-Cabanillas *et al.* (2013), Oney *et al.* (2017), Trinh *et al.* (2020). Specifically, Karoubi *et al.* (2016) explore risks of unavailability (difficulties in completing a transaction when the payment infrastructure is not present) and unacceptance (non-acceptance by sellers or due to technical issues), identifying unavailability as a particularly influential factor in payment method selection. However, all the above research mainly relates to the choice of e-payment and does not apply directly to why consumers hold cash even when they have opted for electronic payments.

Another strand of literature considers the psychological aspects of keeping money, including cash. An extensive empirical literature concerns the symbolic meaning of money (Fenton-O'Creevy & Furnham, 2020, 2021; Bruno & Faggini, 2022). However, the above literature constitutes the only broad context for our study. We mainly consider the psychological factors behind keeping cash despite making electronic payments. From the point of view of our study, however, the considerations of Sciortino *et al.* (1987) and Maison (2019) are particularly important.

Sciortino *et al.* (1987) proposed to integrate the economic and psychological issues intertwined in Keynes's precautionary demand for money. They employ a risk-taking scale to empirically investigate Keynes's precautionary demand for money.

Maison (2019) researched "love for cash": a positive and strong emotional attitude to cash. This affection for physical currency can be elucidated through four distinct dimensions:

- The tactile engagement with cash elicits a sense of joy for certain individuals, underscoring the intrinsic pleasure derived from handling physical money.

- Cash endows individuals with a sense of security, stemming from the belief in its universal acceptability as a means of payment, reassuring them of their ability to transact under virtually any circumstance.
- The use of cash enhances personal financial management and expenditure oversight, offering a tangible means to monitor and control spending habits effectively.
- Finally, cash symbolizes autonomy and independence, affording individuals the liberty to conduct transactions as they wish, unfettered by the potential constraints of technological disruptions or the impositions of external entities.

Similar conclusions were reached by Acedański *et al.* (2024). In this study, consumers' holding of cash as an additional option depends on three main factors: attitude toward cash, especially the freedom it offers; unusual purchasing situations; and perceived card or mobile payment risk, which moderates the role of the attitude toward cash.

Analytical framework

In our study, we would like to extend the previous considerations to include psychological issues, such as the risk-taking behavior. Sciortino *et al.* (1987) adopted a similar approach to studying money in a broad sense (not only cash). Contrary to Sciortino *et al.* (1987), in this study, we focus only on cash and use the risk-taking scale proposed by Studenski (2012). Additionally, we replicate the importance of other determinants of keeping cash proposed in later research, including attitude to cash from the article by Acedański *et al.* (2024).

Our study uses two concepts well established in the literature: precautionary holding of cash and risk-taking behavior.

Beginning with Keynes (1936), the literature distinguishes three motives of the demand for money: transactional, precautionary, and speculative. In the first case, the key determinant of the demand for money is the value of all transactions. This motive of demand for money, therefore, applies to the payment function of money. Speculative demand for money is the holding of money to avoid losses from holding other assets such as bonds. This is typically the case when the rates of return are expected to decline.

The last of the Keynesian motives for the demand for money is the precautionary one. The demand for money from the precautionary motive is

traditionally defined as the part of the demand for money that does not result from scheduled payments, but from uncertainty resulting from the scale of payments that will have to be made. Keynes defined precautionary demand as the following: “to provide for contingencies requiring sudden expenditure and for unforeseen opportunities of advantageous purchases” (Keynes, 1936). He emphasized the importance of uncertainty and the role of money as a protective device against unpredictable adverse events (Keynes, 1937; Cardim de Carvalho, 2010).

In our case, precautionary demand can also be interpreted as the part of the demand for money that (in the case of multiple payment methods) results from holding an additional cash balance for unpredictable cases where it is not possible to use the preferred form of payment. It can be assumed that the decision on the amount of the balance kept for this reason depends, *inter alia*, on the perception of the impossibility of making a payment by the preferred form of payment. The risks associated with this do not have to be constant over time, but may fluctuate significantly in times of crisis.

Our research assumes that holding cash partly depends on the precautionary motive (even if it does not necessarily constitute the most crucial factor). In this case, the importance of perceived uncertainty and risk increases, relating to both directly making electronic payments and events that may potentially harm the possibility of making electronic payments (e.g., failure of the electricity network due to war or a terrorist action). These issues, in the context of consumer behavior, have so far been the subject of systematic research only to a limited extent.

So far, research on risky behavior has been undertaken, most often in sociology, psychology, and medicine. Most studies concerned issues related to the cultural basis of risky behavior (Cestac & Assailly, 2015; Sheedy & Griffin, 2018), mental disorders (Buelow, 2020; Roland-Lévy *et al.*, 2023), youth risk behaviors (Bae *et al.*, 2010; Guedes & Lopes 2010) or socio-demographic differences in risky decision-making (Peplińska *et al.*, 2015). In economics, research on risky consumer behavior has tried to answer, among others, the following research questions: What psychological factors influence consumer risky behavior? (Ruggeri *et al.*, 2021; Liang *et al.*, 2023). How do individual personality traits contribute to consumer risky behavior? (Joseph & Zhang, 2021; Oehler *et al.*, 2023). What are the long-term consequences of consumer risky behavior on personal finances (Salisbury *et al.*, 2023)? To the best of our knowledge, no one has examined the relation-

ship between consumers' risky behavior in the context of keeping cash for precautionary reasons. When designing our study, we encountered difficulties in finding an appropriate measurement device. The literature is dominated by research descriptions that are based on original survey questionnaires prepared to solve a given research problem. We considered three tools tested by other researchers: questionnaire of the individual risk perception style (SIRI), proposed by T. Zaleśkiewicz (Znajmiecka-Sikora & Sałagacka, 2022); the psychometric scale DOSPERT that assesses general and domain-specific dimensions of risk preference: financial decisions (separately for investing versus gambling), health/safety, recreational, ethical, and social decisions (Blais & Weber, 2006) and the Risky Behaviors Questionnaire (RBQ). Of all of them, we have found the RBQ to be the most appropriate. It was developed by psychologist R. Studenski and based on the chronic self-destructiveness scale developed by Kelley *et al.* (1985). We present it in more detail in the next section.

We formulate the following research questions: RQ1 Does a risky consumer behavior style affect cash holding? RQ2 Does the perception of a risk associated with card and mobile payments affect the decision to hold cash? RQ3 Does the attitude towards cash as an alternative to e-payments affect cash holding?

Our paper contributes to the literature in two ways. First, we study the relevance of several factors behind cash holding by consumers who, as a rule, have decided to use electronic payments. The literature to date has been dominated by the cash versus e-payments discussion. Second, the literature considers mainly the payment function of cash and, in macroeconomic-oriented research, the store-of-value function of cash. As a complement to this existing literature, we instead focus on the demand for cash from the precautionary motive.

Data & methods

A standardized online survey was conducted among Polish consumers in 2021. We used a quota sampling method (quota in terms of gender and proportional in terms of age and place of residence) based on the characteristics of Polish consumers as reflected in the datasets of Statistics Poland (GUS, 2022) for the year 2020. As we were only interested in consumers who use electronic payments, we asked a filtering question "How do you

pay for purchases?" Nearly 95% of respondents always or sometimes used electronic payment (cards or phones) to pay for purchases. We eliminated the responses of consumers who only pay in cash from further analysis. Accordingly, our final sample was 1,040 consumers (Table 1).

In our study, we consider the determinants of the decision to maintain a cash reserve by consumers who have already decided to, in principle, make electronic payments. Therefore, our variable cash holding is a binary variable. This variable has two possible outcomes: 1 in the event of holding a cash reserve always or sometimes and 0 in the event that cash is not held.

One of our main research questions relates to how the holding of cash depends on risk-taking behavior (RB). We used the Risky Behaviors Questionnaire (RBQ), which is a tool proposed by R. Studenski (2012). According to Studenski (2012), the RBQ consists of statements that make up a 25-item, five-point ordinal scale, where the number 4 denotes the answer very often and the number 0 denotes very rarely or never. Thus, the maximum number of points for each statement is 4 and the minimum is 0. The range of results in the test can therefore be from 0 to 100 points. The individual measurement results of RB are calculated as the sum of the points obtained for all test questions. Sten scores were calculated to evaluate the test results. Sten 10 indicates a very strong preference for risky behavior and a very strong tendency to take risks. Stens 9–8 indicate a strong propensity to risk, stens 7–4 denote average, 3–2 denote low, and 1 denotes a very low propensity to risk. The reliability of the RBQ, estimated by R. Studenski using the Cronbach's α coefficient, was 0.93 (Studenski, 2012). The reliability of the RBQ estimated on the basis of the data collected in our study using the α coefficient was 0.98. Therefore, we considered the obtained value to be highly satisfactory. We thus confirmed the reliability of the tool developed by R. Studenski.

The second key explanatory variable relates to the perception of the risks associated with potential difficulties in making e-payments due to the lack or failure of appropriate infrastructure, or other technical problems (PR). We use scale from Acedański *et al.* (2024).

We also asked 17 questions that took into account various dimensions of the attitude towards cash (see Appendix). To reduce the number of variables and minimize the risk of a collinearity problem, we performed exploratory factor analyses (EFA). EFAs produce fewer variables, which, in turn, makes it possible to focus further analyses only on thus obtained, mutually independent factors. Detailed factor analysis results are shown in the Table

2–3 and Figure 1. Table 2 shows results of Kaiser–Meyer–Olkin (KMO) Test for Sampling Adequacy and Bartlett’s Test of Sphericity. Using the Kaiser criterion, we obtained two factors (Figure 1). However, the level of explained variability was insufficient. We conducted factor analysis using the explained variation criterion of 70%, which is recommended in the case of the number of original variables being less than 20 (Osborne *et al.*, 2008). Eventually, we obtained five factors. In the factor analysis the principal components method and the varimax transformation were used. Finally, we obtained the following five variables:

1. *Flexibility*. Holding cash as a way to ensure personal freedom and flexibility in making payments under all conditions. Consumers associate cash with freedom and certainty of payment in all conditions as well as liking to have banknotes in their wallets just in case.

2. *Comfort zone*. Having cash reduces various types of fears related to making electronic payments due to ignorance of the technology and lack of trust in entities participating in the transaction. We interpret this variable in the context of the concept of inertial use of cash resulting from habits.

3. *Cybersecurity*. Having cash reduces worries related to securing e-payment transactions, phishing, or loss of digital identity.

4. *Control*. Having cash allows for better control of expenses (in relation to e-payments) and sometimes allows a purchase to be bought cheaper.

5. *Shame avoiding*. Having cash reduces the fear of shame about the potential non-acceptance of electronic payment or a mistake in using the electronic payment instrument.

Our survey was conducted in 2021, i.e., during the COVID-19 pandemic. Therefore, we included a variable that aimed to illustrate consumer responses to the use of cash during a pandemic. Initial information about the possibility of transmission via banknotes (later unconfirmed) raised concerns among many consumers about the handling of cash (Auer *et al.*, 2020). Therefore, we asked a question related to this issue and introduced a *dirty cash* variable into the study to show opinions about the statement “cash is unsanitary.”

We supplemented our key explanatory variables with control variables resulting from the research on the choice of cash vs. e-payments. These were age, education (dummy variable higher education), and subjective assessment of level of wealth. The extensive literature shows that financial literacy is important for the use of cash. We have redefined this issue slightly by focusing on competencies related to e-payments. We decided that the

greater the knowledge of various electronic payment channels, the greater the competencies in this area. This is illustrated by the payment literacy variable created as a sum of positive responses regarding the effective knowledge of various e-payment channels.

For a detailed description of the variables, data characteristics (Table 1), and the autocorrelation table (Table 4).

Finally, to assess the determinants of holding cash, we ran a binary logistic regression and interpreted odds ratios (OR). We verified the goodness of fit with a Hosmer-Lemeshow test.

Results

In the first step, we verified the importance of risk perception (PR) and risky behaviors (RB) while controlling age, education, declared income level, payment literacy, and the effects of the pandemic (Table 5 Model I). Both PR and RB were statistically significant. The higher the perception of the risk related to unavailability or failure of technical infrastructure, the higher the chance of holding cash. At the same time, the more risky the behavior (lower RB value), the greater the probability of deciding to hold cash. The first result does not seem particularly surprising as growing concerns about not being able to make payments due to various types of technical problems may trigger the reaction of holding additional cash resources just in case (and therefore on a precautionary basis). The latter result seems less obvious and requires in-depth discussion, which follows in the next section.

In the next step, we took into account the dimensions of the attitude towards cash. Flexibility and cybersecurity turned out to be statistically significant (Table 6 Models II and III). Seeing cash as an extension of the scope of freedom and flexibility significantly increased the chances of maintaining a cash reserve. Also, the perception of cash as safer and not exposed to cyber-attacks was important for making decisions about maintaining cash reserves. Taking into account flexibility and cybersecurity together did not change their statistical significance (Table 7 Model IV). The other dimensions of the attitude to cash – comfort zone, shame avoidance, and control did not show a statistically significant influence on the decision to hold cash (Table 8 Models V-VII).

Ultimately, the main determinants of making a decision to hold cash in our study include:

- Flexibility and personal freedom related to having an alternative payment channel to e-payments.
- Cybersecurity related to the lack of exposure to cyber attacks.
- Preferring more risky behavior.
- Perception of the risk of technical problems with electronic payments.

The remaining variables were statistically insignificant at the standard level of <0.05 .

Considering the OR, we can see that the two dimensions of the attitude to cash (flexibility and cybersecurity) most strongly increased the chances of maintaining cash reserves. The strength of the RB and PR influence was smaller — but these variables still showed a statistically significant impact on the chances of deciding to hold cash. Two other variables may also be important for cash holding if the statistical significance criteria are slightly loosened. These were concerns about the possibility of virus transmission through banknotes (which is an artifact of research during the COVID-19 pandemic) and age. In both cases, however, the effect was not strong.

Discussion

In our study, keeping cash was preferred by risk-takers. In turn, people who preferred less risky behavior more often gave up holding additional cash reserves. This result requires more extensive discussion. It is worth emphasizing the context of our research once again. We did not ask about the consumers' preferences for making payments in cash or electronically. We asked whether consumers, who generally pay electronically, also hold a cash reserve.

The first of the possible interpretations is that, based on the assumption that risk-takers more often take unpredictable actions, they hold a cash reserve for cases in which they want to remain anonymous. They, therefore, may enter into transactions where cash is essential or prefer to remain anonymous concerning their activities. This interpretation is consistent with the key feature of cash as an anonymous means of payment (as opposed to electronic payments) and a popular view in the literature regarding the determinants of the use of payment methods (Dow, 2019).

The key to this interpretation is the understanding that the need for anonymity should not be seen solely from the perspective of illegal or unethical behavior. There is a whole group of reasons for reluctance to reveal one's preferences/behaviors/lifestyle. This reluctance should not be assessed negatively, even in liberal and democratic societies where fundamental rights are guaranteed. Its importance increases even more in closed societies where an oppressive government unifies values and lifestyles. In numerous studies, privacy has been declared one of the key features of the payment system. In a study conducted by Deutsche Bundesbank, privacy was the second most important key feature that entities expect from the payment system, after security (Deutsche Bundesbank, 2018). The importance of privacy is increasingly pointed out in recent studies (Kahn, 2018; Borgonovo *et al.*, 2021; Garratt & van Oordt, 2021).

The second possible interpretation is based on the assumption that people who prefer less risky behavior usually operate in a well-known, safe environment, where it is relatively easy to plan the method of payment and the actual risk from e-payments is low. Risk-takers are more often confronted with a new environment (often also less stable, less predictable) and new, unusual events. It is, therefore, more difficult for them to plan the method of payment, and the actual, broadly understood risk of e-payments is greater. Therefore, they are forced to hold cash reserves. In this case, the optimal decision strategy is to maintain more flexibility and have more options available (in this case, payment options). This interpretation is supported by the answer to the question about the strategy of dealing with the risk from card or phone payments. For most of the consumers in our study, this was holding cash.

This interpretation is also supported by the results on the role of perceived risk related to potential technical problems when making electronic payments. Consumers cannot be sure that the electronic payment infrastructure will always be available. They must, therefore, decide to hold the means of payment under conditions of uncertainty about the actual availability of the infrastructure when they wish to make the payment. Therefore, they can additionally hold a cash reserve as one of the additional/alternative payment methods in a risk minimization strategy. This behavior is similar to the risk minimization strategies undertaken by consumers in other areas (Maciejewski, 2012). In the group of people preferring less risky behaviors, such a strategy may not be necessary because they may less often be confronted with unusual situations due to their lifestyles.

Therefore, in their case, the consequences of uncertainty regarding the actual availability of infrastructure would be lower when they want to make a payment.

Our research shows that consumers attach great importance to the freedom and flexibility of holding cash as an additional means of payment in addition to non-cash money. These results replicate those from Acedański *et al.* (2024), using a different research methodology. The flexibility variable had by far the strongest influence on decisions about holding cash reserves in our study. The higher the importance attached to values, such as the flexibility and freedom that cash gives, the greater the probability of maintaining cash despite deciding to make electronic payments.

The second key variable was cybersecurity, i.e., the perception of cash holding as an activity to reduce concerns about securing e-payment transactions, loss of digital identity, and other concerns related to the cybersecurity of e-payments. The higher the rating of these threats, the greater the probability of maintaining additional reserves in the form of cash. This result is consistent with the literature on payment method decisions.

It is also worth paying attention to other variables. Payment competencies are not a significant factor in holding cash. The evidence for the importance of financial literacy provided in the literature refers to a different context — the choice of payment method. Our results do not deny this as they do not apply to the decision to choose a payment method (i.e., electronic vs. cash). As a reminder, the study considered cash holding by consumers who generally make electronic payments. It is, therefore, fair to assume that such consumers have basic payment competencies (because they stated they make e-payments).

From the results of our study, we can notice the effect of the pandemic in the form of a negative impact on the decision to hold cash from concerns related to the potential transmission of the virus through banknotes. This result is consistent with the conclusions of several recent studies (Cevik, 2020; Kotkowski & Polasik, 2021). In our study, this variable was only significant at the level of $0.1 > p > 0.05$. However, if it is considered significant, the strength of its influence is comparable to the importance of risky behaviors.

Financial status (self-assessment of financial status) and education (higher education) were statistically insignificant. These results differ from those suggested in the literature on the choice of e-payments versus cash — but once again the different context of our study should be emphasized.

There is evidence, albeit weak, of a role for age. This variable can be considered significant only at the level of $0.1 > p > 0.05$. The older the consumers, the more likely the decision to hold cash reserves. However, age only slightly increases the likelihood of deciding to hold cash.

In interpretations regarding the choice of payment methods (electronic vs. cash), it is often indicated that staying with cash is inertial and conservative. It is characterized by relatively older and less educated people. The importance of routine and copying the behavior observed in the environment is emphasized. Our research shows that the maintenance of cash by people who generally make electronic payments is partially determined by other variables, which is not surprising because the context of making decisions is different. There is a certain fraction of consumers for whom inertia or conservative attitudes towards new technological solutions may be significant (the variable age may be treated as significant). However, in our study cash is kept mainly by people who prefer riskier behaviors, see cash as an extension of the scale of personal freedom (understood as greater availability of alternatives), and see cash as a remedy for the perceived risk of unavailability or failure of technical infrastructure.

Our results should not be misinterpreted as an argument against the development of electronic payments. Once again, we would like to emphasize that we only surveyed consumers who decided to use e-payments, thus they decided that (from their point of view) electronic payments are a better solution than cash. However, these consumers feel that they need an alternative fallback solution in addition to e-payment. They do not want to give up e-payments, but they want to have access to an additional means of payment for precautionary reasons, taking into account uncertainty and perceived risk.

When presenting the results of our study, we are aware of its limitations. A key limitation of the study is its static nature. Therefore, we do not claim (and have no basis for doing so) that the agents' perception of the characteristics of cash that we have observed is permanent and will not change with the transition to an increasingly digital world. However, our results may constitute one of many factors to consider the role of cash in the current conditions, and this is how we understand the results of our study.

The second potential limitation concerns the fact that the study was conducted in one country. We decided to conduct research in Poland, a country with a relatively well-developed electronic payments sector. Data

show (ECB, 2022) Poland does not belong to the group of countries (in Europe) that are "cash lovers" like Germany or Switzerland. Other hand, Polish consumers, in general, are not leaders in the use of electronic payments (as e.g., Swedish consumers are). Poland also has an average, compared to other EU countries, developed electronic payment infrastructure.

Another potential limitation is related to the method used to obtain information. Despite its many advantages, survey research also has some disadvantages. It is based on the respondents' declarations and not on actually observed behavior. Therefore, a natural consequence of this limitation will be the need to conduct additional research using a different method — like experiment.

The above limitations also show potential directions for further research. First of all, it is necessary to replicate the results using other data sets (in terms of spatial or time dimension or divided into generations of consumers) and other methods (experiment). Looking more broadly, the issue of the role of cash in the modern world dominated by electronic payments is one of the intriguing areas of research. There are also other determinants of the demand for cash that could be examined on macroeconomic level — like perception of risk and uncertainty. It is also worth considering the existence of other stimuli, mediators and moderators of the relationships we found.

Conclusions

We considered the determinants of consumers holding cash despite their decision to make electronic payments. Thus, we did not consider preferences in terms of payment methods and the subjective or objective advantages of electronic payments and cash. We considered why consumers who, in principle, have decided to make electronic payments, hold cash in parallel.

In our study, we found that the likelihood of holding cash increased when consumers preferred more risky behavior. The factors that most strongly increased the probability of holding cash, however, were opinions about the characteristics of cash — as ensuring flexibility and cybersecurity.

Our results allow for a consistent interpretation. Consumers attach great importance to the freedom and flexibility that cash gives as an alternative to electronic payments. They want to feel that they are prepared for differ-

ent situations that are difficult to predict. People who prefer more risky behaviors are more often confronted with a new environment and new, unusual events, and thus it is more difficult for them to plan a payment method. Therefore, they are forced to maintain a cash. In this case, the optimal strategy decision is to maintain more flexibility and have more options available (in this case, payment options). Having cash also reduces concerns about securing e-payment transactions, losing digital identity, and other concerns about e-payment cybersecurity. This fear may arise in a variety of specific, unpredictable situations. In this sense, we interpret these behaviors as an expression of the demand for money from the precautionary motive. Holding cash for this reason is not directly motivated by the planned number of transactions or the storage of value but by uncertainty.

In the context of widespread changes in payment systems and the growing dominance of cashless transactions, analyzing the causes and consequences of attachment to physical currency takes on new importance. Attachment to cash can be analyzed through the prism of preferred behavioral patterns, autonomy, and flexibility. Having cash (in addition to other payment channels) gives people a greater sense of direct control over their payment option, which may be especially important in economic or social uncertainty situations. Cash allows transactions to be more flexible, which, for many people, is synonymous with personal freedom. A better understanding of these motivations is crucial not only for economists and psychologists but also for public policymakers, who should strive to design payment systems that respond to the needs of all social groups. In the era of digitalization of finances, it is crucial to take into account needs that, for many people, are inextricably linked to the physical possession of money. Transitioning to a cashless society requires a solution that fulfills functions similar to cash.

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Annex

Table 1. Characteristics of the research sample (N=1040)

Specification		Absolute number	Percentage of the tested sample
Gender	Female	549	52.8
	Male	491	47.2
Age	18–24	124	11.9
	25–39	306	29.4
	40–59	352	33.8
	60+	258	24.8
Place of residence by no. of inhabitants	Rural area	385	37.0
	City up 50 K	254	24.4
	City from 50 to 200 K	177	17.0
	City over 200 K	224	21.5
Education	Primary/lower secondary	22	2.1
	Vocational	87	8.4
	Secondary	490	47.7
	Higher	441	42.4
Subjective assessment of the financial status of own household	Very bad	12	1.2
	Bad	38	3.7
	Rather bad	88	8.5
	Average	427	41.1
	Rather good	285	27.4
	Good	172	16.5
Professional activity	Employed	664	63.8
	Unemployed	376	36.2

Table 2. Kaiser–Meyer–Olkin (KMO) Test for Sampling Adequacy and Bartlett’s Test of Sphericity

KMO		.951
Bartlett’s Test of Sphericity	Approximately Chi-Square	9953.071
	df	136
	p-value	.000

Table 3. Rotated Factor Matrix

	1	2	3	4	5
AC_1	.569	.458	.208	.277	-.008
AC_2	.585	.475	.055	.157	.091
AC_3	.347	.398	.466	.322	-.128
AC_4	.113	.111	.286	.796	.230
AC_5	.281	.232	.679	.135	.309
AC_6	.287	.194	.771	.139	.126
AC_7	.204	.338	.721	.221	.156
AC_8	.293	.329	.120	.702	.089
AC_9	.803	.057	.243	.077	.177
AC_10	.404	.438	.075	.326	.321
AC_11	.822	.154	.263	.134	.111
AC_12	.782	.269	.276	.181	.097
AC_13	.188	.195	.231	.213	.770
AC_14	.172	.652	.288	.151	.445
AC_15	.185	.752	.183	.114	.274
AC_16	.235	.760	.253	.162	.162
AC_17	.157	.685	.369	.200	-.128

Notes: Extraction Method: Principal component.

Rotation Method: Varimax with Kaiser Normalization.

Identified factors: 1. Flexibility. 2. Comfort zone. 3. Cybersecurity. 4. Control. 5. Shame avoiding.

Table 4. Correlations between the explanatory variables

	PR	RBQ	payment literacy	age	education	financial status	dirty cash	flexibility	comfort zone	cyber security	control
RBQ	-0.077										
payment literacy	-0.056	0.004									
age	0.040	0.106	-0.124								
education	-0.084	0.047	0.083	0.022							
financial status	-0.021	-0.038	0.081	-0.151	0.074						
dirty cash	0.099	0.032	0.100	0.133	0.055	0.015					
flexibility	0.114	-0.023	-0.095	0.015	-0.101	-0.018	-0.149				
comfort zone	0.157	-0.205	-0.165	-0.010	-0.065	-0.073	-0.033	0.026			
cybersecurity	0.294	0.023	-0.012	0.059	0.017	-0.028	0.115	0.052	0.018		
control	0.128	-0.072	-0.054	-0.043	0.025	-0.020	0.002	0.063	0.037	0.065	
shame avoiding	0.158	-0.040	-0.057	-0.093	-0.122	0.041	0.074	0.055	0.052	0.052	0.040

Table 5. Results (I)

Specification	Model I			
	β	SE	p	OR
PR	0.028	0.005	0.000	1.028
RB	-0.326	0.118	0.006	0.722
literacy	-0.094	0.042	0.027	0.910
dirty cash	-0.229	0.061	0.000	0.795
age	0.012	0.007	0.085	1.012
financial status	-0.019	0.096	0.841	0.981
education	-0.022	0.203	0.913	0.978
Hosmer-Lemeshow test				
Chi-sqr	13.199			
p-value	0.105			

Table 6. Results (II)

Specification	Model II				Model III			
	β	SE	p	OR	β	SE	p	OR
PR	0.025	0.005	0.000	1.025	0.022	0.005	0.000	1.022
RB	-0.264	0.124	0.033	0.768	-0.333	0.118	0.005	0.717
flexibility	1.048	0.132	0.000	2.853				
cybersecurity					0.308	0.116	0.008	1.360
literacy	-0.048	0.044	0.280	0.954	-0.086	0.043	0.043	0.917
dirty cash	-0.110	0.066	0.094	0.896	-0.246	0.062	0.000	0.782
age	0.012	0.007	0.093	1.012	0.012	0.007	0.079	1.012
financial status	0.024	0.101	0.810	1.025	-0.014	0.096	0.888	0.987
education	0.145	0.216	0.503	1.156	-0.065	0.205	0.750	0.937
Hosmer-Lemeshow test								
Chi-sqr	10.105				5.326			
p-value	0.258				0.722			

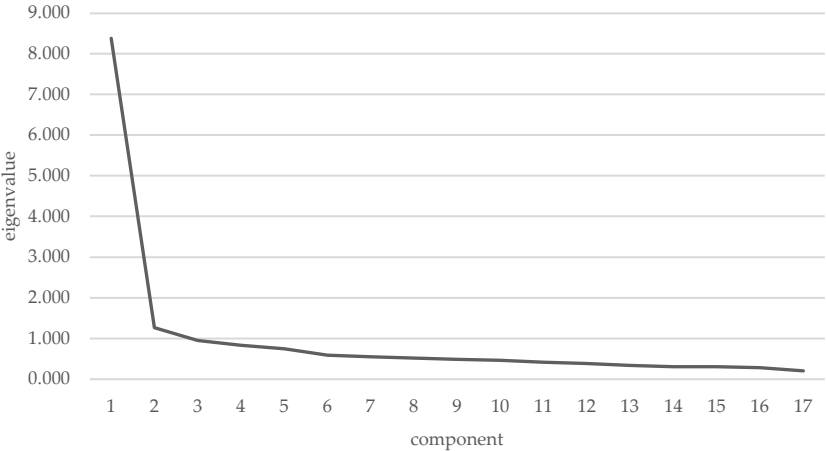
Table 7. Results (III)

Specification	Model IV			
	β	SE	p	OR
PR	0.018	0.006	0.002	1.018
RB	-0.274	0.124	0.027	0.761
flexibility	1.084	0.135	0,000	2.956
cybersecurity	0.360	0,118	0.002	1.433
literacy	-0.034	0.044	0.439	0.966
dirty cash	-0.128	0.067	0.057	0,880
age	0.012	0.007	0.095	1.012
financial status	0.041	0.102	0.687	1.042
education	0.095	0.219	0.664	1.100
Hosmer-Lemeshow test				
Chi-sqr	11.975			
p-value	0.152			

Table 8. Results (IV)

	Model V				Model VI				Model VII			
	b	SE	P	OR	b	SE	P	OR	b	SE	P	OR
PR	0.028	0.005	0.000	1.028	0.027	0.005	0.000	1.027	0.028	0.005	0.000	1.029
RBQ	-0.328	0.119	0.006	0.720	-0.326	0.118	0.006	0.722	-0.334	0.120	0.005	0.716
comfort zone control	-0.033	0.100	0.739	0.967					-0.047	0.115	0.685	0.955
shame					0.159	0.108	0.143	1.172				
payment literacy	-0.096	0.043	0.025	0.909	-0.086	0.043	0.043	0.917	-0.098	0.043	0.024	0.907
dirty cash	-0.230	0.061	0.000	0.795	-0.241	0.062	0.000	0.786	-0.232	0.062	0.000	0.793
age	0.011	0.007	0.092	1.012	0.014	0.007	0.048	1.014	0.012	0.007	0.086	1.012
financial status	-0.021	0.096	0.825	0.979	-0.025	0.095	0.792	0.975	-0.023	0.096	0.810	0.977
education	-0.019	0.204	0.927	0.982	0.021	0.206	0.920	1.021	-0.023	0.204	0.909	0.977

Figure 1. Scree plot



Appendix

Survey questions and variables construction

I. Risky Behaviors Questionnaire (RBQ)

We would like to find out about your attitude to difficult or dangerous tasks.

The questionnaire does not contain any good or bad statements. Your attitude to threats is your personal matter. You may prefer to take risks or value safety and caution. Please read each statement carefully and circle the number representing the frequency of your actions. The individual numbers mean: 4 = very often, 3 = often, 2 = sometimes, 1 = rarely, 0 = very rarely or never.

- RB_1 Sometimes I take dangerous shortcuts.
- RB_2 I take part in difficult and dangerous ventures.
- RB_3 I undertake behavior at the edge of risk.
- RB_4 I do dangerous things to experience the thrill.
- RB_5 I act riskier than others.
- RB_6 I participate in situations where my life or health is at risk.
- RB_7 I do things that I know are dangerous.
- RB_8 I undertake risky behaviors requiring high proficiency.
- RB_9 I deviate from the safety regulations if I can do something faster, cheaper, or with less effort.
- RB_10 Sometimes I take a risk even though it is not necessary.
- RB_11 I set risk-taking goals for myself.
- RB_12 I learn a lot by taking risks.
- RB_13 Even though I know what is harmful to me, I do not avoid it.
- RB_14 Sometimes I take risks to gain satisfactory experience.
- RB_15 If someone does something risky, I feel like doing something similar.
- RB_16 I pursue riskier goals than others.
- RB_17 I take a risk to test my fitness.
- RB_18 I prefer risky solutions to cautious ones.
- RB_19 I take a risk to enrich my experience.
- RB_20 I take a risk to show others that I am "lucky".
- RB_21 I feel the need to do something risky.
- RB_22 I take a risks when I want to improve my well-being.
- RB_23 My goals call for risky behavior.
- RB_24 I am not sure if my behavior will end in success or failure.
- RB_25 I choose risky solutions to give me a pleasant experience.

II. Attitude towards cash questionnaire

Attitude towards cash as an alternative to electronic payments.

To what extent do you agree with the following statements regarding the possible methods of payment:

Please mark your answer on a seven-point scale, where 1 = I disagree completely and 7 = I fully agree.

AC_1 Cash is the only real money.

AC_2 Paying in cash is easier.

AC_3 I want to remain anonymous and payment by card/phone leaves digital traces.

AC_4 When paying by card/phone, I will always spend more than planned.

AC_5 I am afraid that I will lose my card/phone or that my card/phone will be stolen.

AC_6 I am concerned about the phishing of data that would allow unauthorized persons to access my account.

AC_7 I am concerned about unauthorized charging of my account as a result of unknowing contactless transactions.

AC_8 It happens that when I pay in cash I can pay less than using a card/phone.

AC_9 I like to know that I have banknotes in my wallet.

AC_10 Possible return of the product is easier in the case of cash payment.

AC_11 I feel safer when I have cash.

AC_12 Having cash makes me feel free.

AC_13 I would be ashamed in front of the shop assistant and other people if it turned out that my card was not accepted.

AC_14 I am afraid that when paying by card/phone "I will do something wrong".

AC_15 I am afraid of paying by card/phone because I do not know about new technologies.

AC_16 I am afraid of card/phone payments as I do not trust banks.

AC_17 I am afraid of card/phone payments as I do not trust the government.

III. PR

We use scale from Acedański et al. (2024).

IV. Payment literacy

We use scale from Acedański et al. (2024).