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DISCUSSION PAPER

NO 435

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March 2026

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Universität Düsseldorf

IMPRINT

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Published by:
Heinrich-Heine-University Düsseldorf,
Düsseldorf Institute for Competition Economics (DICE),
Universitätsstraße 1, 40225 Düsseldorf, Germany
www.dice.hhu.de

Editor:
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ISSN 2190-9938 (online) / ISBN 978-3-86304-434-3

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Central Bank Digital Currency as a New Means of Payment: An Experimental Approach*

Jana Anjali Magin† Ulrike Neyer‡ Alexandra Stevens§

MARCH 2026

Abstract

Many Central banks around the world are considering the introduction of a Central Bank Digital Currency (CBDC) as a new means of payment. One of the reasons for introducing a CBDC is a change in payment behavior towards an increasing use of electronic forms of payment. This paper examines the introduction of a CBDC as a new means of payment. We conduct a controlled laboratory experiment to assess how adoption costs and anonymity affect the demand for CBDC compared to established means of payment such as cash and deposits. We use a 2x2 treatment design in which CBDCs differ in adoption costs and anonymity. We find that adoption costs play an important role in the decision to use CBDC as a new means of payment and that anonymity plays a role in the allocation of experimental money between different means of payment.

JEL classification: E41, E42, C92.

Keywords: Central bank digital currencies, experimental economics, payment methods, anonymity, adoption costs.

*We thank Katharina Erhardt, Sabrina Herzog, Hans-Theo Normann, Hannah Schildberg-Hörisch, Theresa Schmitz, Simon Schulten, Marco Schwarz and Olaf Stypa for their valuable comments and suggestions. We are grateful to members of the DICE Lab and, in particular, Robin Bitter, Leon Heidelbach and Jadine Rauh for their excellent research assistance. Additionally, we thank participants of the Scottish Economic Society Annual Conference, the Verein für Socialpolitik Annual Conference, the Behavioral Macroeconomics Workshop, the Annual Conference of the Money, Macro and Finance Society, DICE Winter School, the Center for European Studies Workshop on European Economics, and IMK Workshop, as well as seminar participants at DICE, Heinrich Heine University Düsseldorf and the MAGKS Colloquium for their helpful remarks and comments.

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1 Introduction

Payment behavior has undergone significant changes in recent years. The use of cash has decreased, while the use of electronic payment methods, such as cards or mobile payments, has increased.[1] Cash, being central bank money, does not allow for electronic payments. In response, central banks are exploring ways to make central bank money available in electronic form, ensuring its continued role as a widely used payment method.[2] Currently, only private money is available to the public in electronic form. In light of this, central banks worldwide are considering the introduction of Central Bank Digital Currencies (CBDCs) as a new electronic means of payment. In general, a CBDC is a digital form of money issued by a central bank. As such, it represents a direct claim against this central bank. It differs from existing forms of central bank money in two ways. First, a CBDC differs from cash in that it allows for electronic payments. Second, a Retail-CBDC is universally accessible and thus differs from existing forms of electronic central bank money, such as settlement account balances (Bank for International Settlements, 2018). A CBDC also differs from other forms of electronic money, such as deposits, as a CBDC is central bank money, i.e., public money. The purpose of introducing a CBDC is thus to extend the access to a digital form of central bank money to the general public, enabling digital payments using central bank money. In addition, a CBDC can facilitate transactions by reducing transaction costs, e.g., compared to handling cash or fees for credit cards (Bordo and Levin, 2017). However, the successful introduction of a CBDC requires not only technological feasibility, but also broad acceptance and use. Surveys indicate that for a CBDC to be widely adopted as a payment method, certain factors are crucial. Key among these are low costs, the protection of payment information privacy, and data security (Deutsche Bundesbank, 2021).

Against this background, we conduct a laboratory experiment to study the adoption of a new means of payment, CBDC, alongside the two existing means of payment, cash and deposits. We focus on two important properties of the potential new means of payment: Adoption costs on the payer side and anonymity in payment transactions. In the experiment, adoption costs are the costs that participants incur when adopting a new means of

[1] For the development of consumers' payment behavior in the euro area see European Central Bank (2024).

[2] Among the main reasons why central banks, such as the European Central Bank, consider introducing CBDCs are providing the public with access to an electronic form of public money and strengthening the European payment system. Other reasons include maintaining independence from private forms of money and geopolitical considerations (European Central Bank, 2025).

payment, in this case, CBDC. We distinguish between high and low adoption costs. In the real world, these adoption costs correspond, for example, to costs involved in searching and processing information, opening a bank account, or installing and becoming familiar with an app. In the experiment, we examine the role of privacy by distinguishing between two types of CBDC: A CBDC, which allows for anonymous transactions, and a CBDC, which does not. In reality, this is based on the planned design of the digital euro, with an offline and an online version with the former allowing for more anonymity.[3] Specifically, we address the following research questions. What role do adoption costs and anonymity play in an individual's decision to use a CBDC as a means of payment? And to what extent does the introduction of a CBDC impact the use of existing payment methods, such as cash and bank deposits?

Our main findings are as follows: (i) Adoption costs play a crucial role for the adoption of CBDC. CBDC adoption increases significantly with lower adoptions costs. (ii) Anonymity plays a role in the allocation of experimental money to CBDC, cash and deposits. The shift from a non-anonymous to an anonymous CBDC leads to a decline in deposit usage. (iii) Participants' beliefs about the CBDC adoption of other participants matter. In the experiment, sellers only accept CBDC as a means of payment if it is used at least by 50% of the buyers. Perceived CBDC adoption of other participants thus increases participants' adoption of CBDC as a means of payment.

We conduct a controlled laboratory experiment using a 2x2 treatment design. In the first treatment, named CBDC-adoption costs treatment, we vary these costs to examine their impact on the decision to adopt CBDC. In the second treatment, named CBDC-anonymity treatment, two versions of CBDC exist: A CBDC which offers anonymous transactions, and a CBDC that does not. The focus of the experiment is on the adoption of CBDC as a new payment method from the buyer's perspective. In this setup, buyers interact with computerized sellers. Each buyer is endowed with experimental money (EM) and must decide how to allocate it between cash, deposits, and CBDC. A transaction will only be successful if the means of payment chosen by the buyer is accepted by the seller. In this experiment, CBDC is a new means of payment. Its adoption requires a one-time fee, and participants' individual decisions to use it are influenced by their beliefs about the choices of other participants. If more than 50% of participants decide to

[3]For more information on the planned digital euro see "Proposal for a Regulation of the European Parliament and of the Council on the establishment of the digital euro COM/2023/369 final".

adopt CBDC, it will be accepted as a means of payment by sellers. Therefore, network adoption effects are important. In contrast, cash and deposits are considered established means of payment. We control for these network effects by asking participants about their expectations regarding the use of CBDC by other participants. After the experiment, participants answer a survey that covers questions on sociodemographics, preferences, CBDC, payment behavior, and financial literacy.

We contribute to the following strands of the literature. First, this paper refers to the literature on experiments concerning different means of payment. Relevant examples include Camera et al. (2016), Borgonovo et al. (2021), and Arifovic et al. (2023). The most closely related work is that of Arifovic et al. (2023), who assess the role of additional fixed adoption costs on the seller side in the introduction of a new means of payment and test for network adoption effects. The authors find that with low additional fixed costs, the new means of payment is quickly adopted, whereas higher fixed costs gradually lead to a decline in the use of the new means of payment. Our approach differs from theirs in that we specifically consider a CBDC as a new means of payment and the fixed adoption costs must be borne on the buyers' side. We contribute to this strand of literature by introducing CBDC as a new means of payment and investigating different properties of CBDC, in particular anonymity. Second, our paper relates to the literature on CBDC demand and substitution effects. The paper most closely related is Agur et al. (2022). The authors examine the role of anonymity and security in the demand for CBDC. The CBDC differs in these two attributes and households decide whether to use CBDC, cash, or deposits. The authors find that, depending on the role of the banking sector, an optimal CBDC could be one that is similar to cash, or one that differs from both cash and deposits. While the authors employ a Hotelling-style setup, we use a laboratory experiment and focus on different CBDC properties. Further examples of this strand of literature include Bijlsma et al. (2021), Choi et al. (2023), Gross and Letizia (2023), Huynh et al. (2020), Li (2023) and Nocciola and Zamora-Pérez (2024). Our paper also refers to the literature on demand for different means of payment as in Meyer and Teppa (2024). The authors conclude that payment preferences in the euro area remain heterogeneous and that perceived barriers to the acceptance of cashless payment instruments may explain the continued widespread use of cash. We contribute to this strand of the literature by analyzing substitution effects between different means of payment in a laboratory experiment. Third, we contribute to

the literature on anonymity and privacy in economic experiments. Relevant examples are Gary and Gneezy (2008), Benndorf and Normann (2018), Winking (2014), Thielmann et al. (2016), and Möser and Böhme (2017). We specifically analyze the role of anonymity in CBDC as a means of payment.

The paper is organized as follows. Section 2 provides an overview of the importance of different properties of CBDCs for consumers' decisions. Section 3 describes the experimental design. Section 4 describes the experimental procedure. Section 5 presents the hypotheses. The experimental results are analyzed in Section 6. Section 7 discusses the survey results. Section 8 summarizes.

2 The Importance of Different CBDC Properties from the Consumers' Perspective

The advantage of a CBDC for users is particularly evident when CBDC-design properties combine the advantages of cash and card payments with deposits, e.g., acceptance as a means of payment and anonymity for cash, and ease of use and transaction speed for card payments (Nocciola and Zamora-Pérez, 2024). Therefore, the following key factors are important for the widespread adoption of a CBDC: acceptance as a means of payment, the protection of payment information privacy, and costs (Bijlsma et al. (2021), Deutsche Bundesbank (2021), Huynh et al. (2020), Nocciola and Zamora-Pérez (2024)).

Acceptance reflects whether the payment instrument chosen by the buyer is accepted as a means of payment by the seller. In the real world, one distinguishes between central bank money and commercial bank money. Central bank money is issued by a public entity and is legal tender. This implies that central bank money has to be accepted as a medium of exchange in any transaction.[4] In contrast, commercial bank money is issued by a private entity and is not legal tender. This means that commercial bank money does not have to be accepted as a medium of exchange in all transactions. The acceptance of non-cash payment methods plays a decisive role. Meyer and Teppa (2024) show that if cashless payments are perceived as being associated with barriers to acceptance, people are more

[4]Legal tender means that unless the seller and the buyer have agreed in advance on another means of payment, sellers such as shops and restaurants may not refuse cash. This must be indicated by the seller beforehand, for example, by means of notices (see the European Commission recommendation of 22 March 2010, 2010/191/EU.

likely to resort to cash as a means of payment.[5] In reality, CBDC will be legal tender and thus generally has to be accepted. However, in our experiment, deposits and CBDCs are not always accepted by sellers, as we are considering the introductory phase, which is accompanied by the gradual acceptance of CBDC by the sellers.

With respect to privacy of payments, we follow the definition by the Bank for International Settlements (2025). Privacy means that personal payment information is not disclosed to other parties. This includes, but is not limited to, information such as the buyer's identity, the type and quantity of goods purchased, and the amount paid. In the euro area, the planned digital euro is to be available both offline and online. The planned offline digital euro offers cash-like anonymity, as there will be no record of the transaction details, whereas the planned online digital euro offers less privacy, resembling deposits (Cipollone, 2025; COM/2023/369 final). In the experiment, we model the CBDC as closely as possible to the planned digital euro design. For the sake of simplicity, the CBDC in the experiment is considered as either anonymous means of payment or non-anonymous means of payment.

In addition, costs vary by payment instruments. We focus on transaction costs and adoption costs. In the real world, transaction costs reflect, for example, the time costs at the checkout to pay for the purchase, the cost of withdrawing money or storage costs. Junius et al. (2022) show the costs of retail payments in nine EU countries. They offer an overview of individual and societal costs of using cash, debit cards, credit cards and mobile payments, for instance. In countries where a relatively high number of payments are made using debit cards, e.g. Denmark, unit costs are lowest for debit cards. Knümann et al. (2025) conduct a survey to assess the transaction costs incurred by German households when using different payment methods. The authors find that, relative to the transaction amount, cash incurs higher transaction costs than debit cards. For the purposes of the experiment, we consider it reasonable to assume that transaction costs for cash are higher than those for deposits and CBDC. Introducing a new means of payment incurs adoption costs, which must be covered by sellers, buyers or third parties. Examples of adoption costs associated with the introduction of a CBDC include information procurement costs and the setup of an app or wallet and getting familiar with it. Arifovic et al. (2023) assess

[5] Although the authors do not examine CBDC as it has not yet been introduced, the statements can be transferred to CBDC as it is an electronic means of payment.

the role of different additional adoption costs on the seller's side when introducing a new means of payment. However, we focus on the adoption costs incurred by the buyers.

3 Experimental Design

We study the adoption of a CBDC as a new means of payment in a laboratory experiment. This section describes the experimental design.

3.1 Experimental Setup

The experimental economy consists of buyers and sellers. Participants play the role of buyers. The focus of this experiment is on the adoption of CBDC as a new means of payment on the buyer's side, so the sellers are played by a computer. The experiment consists of 10 market rounds to allow for learning effects. The experimental setup is summarized in Table 1.

Table 1: Experimental Setup

Market Round 1	Stage 1: Payment choice → Buyers decide on adopting CBDC at a one-time fee → Buyers allocate experimental money between cash, deposits and CBDC
	Belief elicitation → Buyers state beliefs about the behavior of other buyers
	Stage 2: Trading → Each buyer meets one seller to trade
...	...
Market Round 10	Stage 1: Payment choice
	Belief elicitation
	Stage 2: Trading

In each market round, buyers play a two-stage game. In the first stage, buyers receive 10 units of experimental money (EM) at the beginning of the market round. Buyers decide how to allocate the 10 units of EM between cash, deposits and CBDC. Buyers also decide whether to adopt the CBDC, which incurs a one-time fee, the adoption costs. We keep the framing neutral, labeling cash as "means of payment 1", deposits as "means of payment 2" and CBDC as "means of payment 3". This allows us to better control for the information environment, thereby avoiding the influence of beliefs and payment preferences formed outside the laboratory on the results. The means of payment differ in three properties,

which are the sellers' acceptance as a medium of exchange, anonymity with respect to payment transactions, and cost efficiency (transaction and adoption costs).

Before the second stage begins, buyers are asked to state their beliefs about the behavior of other buyers. In particular, buyers forecast the units of EM other buyers will allocate to CBDC and whether CBDC is accepted by sellers as a new means of payment. These beliefs provide information on whether buyers use CBDC because they believe others will use it, thus identifying network effects. After belief elicitation, the second stage begins.

In the second stage, buyers and sellers interact to conduct transactions. Each buyer meets one seller. The buyer can purchase one unit of a good using cash, deposits, and/or CBDC as a medium of exchange. The transaction will only be successful if the seller accepts the buyer's chosen means of payment as a medium of exchange. The price of a good is normalized to 1 EM, i.e., buyers can buy up to 10 goods in each market round. Each transaction incurs transaction costs. For each successfully completed transaction, the buyer receives experimental income. This income is equal to the price of the good (1 EM) minus the transaction costs.

The buyer's payoff per market round depends on the number of successful transactions minus transaction costs and minus adoption costs if CBDC was selected and accepted in this market round. The total payoff consists of the sum of the payoffs per market round.

3.2 Means of Payment

In the experiment, we describe the three means of payment in terms of three properties. The first property is acceptance as a medium of exchange. In the experiment, both CBDC and cash represent central bank money, even though they are not explicitly referred to as such to participants due to neutral framing. In reality, both means of payment must therefore be accepted by every seller in every transaction. However, as in the experiment, we focus on the introduction phase, not every seller will accept CBDC in every market round. Acceptance of CBDC as a new means of payment in a market round depends on network effects, i.e., whether more than 50% of buyers in the group adopt it as a means of payment.

The second property is anonymity. In the real world, anonymity with respect to payment transactions describes whether information about a payment transaction is disclosed and stored. In the experiment, we focus on the amount paid, as information on the payoff of

participants using non-anonymous means of payment will be disclosed to other participants in the group.

The third property is cost efficiency. We consider transaction costs and adoption costs. In the real world, transaction costs reflect, for example, the time costs at the checkout to pay for the purchase, the cost of withdrawing money or storage costs. Adoption costs for a new means of payment reflect the cost of searching for and processing information, opening a bank account, or installing an app and getting familiar with it. In our experiment, buyers incur transaction costs with every successful transaction and fixed adoption costs once a new means of payment, namely CBDC, is adopted. The descriptions of the means of payment are summarized in Table 2.

Table 2: Summary Means of Payment

Means of Payment				
Property	Means of Payment 1 (Cash)	Means of Payment 2 (Deposits)	Means of Payment 3 (Anonymous CBDC)	Means of Payment 3 (Non-anonymous CBDC)
Acceptance	100%	81%	0 or 100%	0 or 100%
Anonymity	Yes	No	Yes	No
Transaction costs	0.60 EM	0.38 EM	0.10 EM	0.10 EM
Adoption costs	0.00 EM	0.00 EM	0.40, 0.50 EM	0.40, 0.50 EM

Cash, deposits and CBDC are described as follows. Cash is accepted as a means of payment by sellers for every transaction. The acceptance rate of cash is therefore 100%. In addition, transactions conducted with cash are anonymous. In terms of transaction costs, cash has the highest costs. Specifically, each successful transaction incurs transaction costs of 0.6 EM. Cash is an established means of payment. There are no adoption costs for buyers.

Deposits are not always accepted as a medium of exchange by sellers. Instead, the acceptance rate is 81% in the experiment. According to the European Central Bank (2022), it was possible to pay cashless in 81% of transactions at the point of sale in the euro area in 2022. In addition, transactions made with deposits are not anonymous, as information about the payment transaction is disclosed. In terms of transaction costs, deposits incur lower transaction costs than cash. Transaction costs amount to 0.38 EM. Similar to cash, deposits are an established means of payment, i.e., there are no adoption costs.

As we take a closer look at the introduction phase of a CBDC sellers do not have to accept CBDC until enough buyers adopt CBDC. The acceptance rate of CBDC is thus either 100% or 0% dependent on whether CBDC is adopted as a new means of payment or not.

The decision to adopt CBDC and thus the acceptance of CBDC as a medium of exchange depends on network adoption effects. Specifically, sellers will accept CBDC as a medium of exchange if the share of buyers using CBDC is at least 50%. Otherwise, sellers will not find it beneficial to introduce CBDC and the acceptance rate is 0%. In the experiment, there are two versions of CBDC, an anonymous CBDC and a non-anonymous CBDC. To avoid framing effects, we label them neutrally. With anonymous CBDC, transaction information is not disclosed and vice versa. In terms of transaction costs, CBDC incurs lower transaction costs than cash and deposits. Specifically, buyers incur transaction costs of 0.1 EM for each successful transaction. In reality, one of the motivational reasons for introducing CBDC as a new means of payment is that it facilitates transactions and thus reduces costs. However, CBDC is a new means of payment in the sense that buyers incur a fixed adoption fee of 0.4 EM or 0.5 EM, depending on the treatment.

3.3 Treatments

We use a 2x2 experimental design. In the first treatment, the CBDC-adoption costs treatment, we vary the one-time fee for adopting CBDC as a new means of payment on the buyer side (0.4 EM versus 0.5 EM). In the second treatment, the CBDC-anonymity treatment, the CBDC is either an anonymous or a non-anonymous means of payment. The fixed adoption costs are between-subjects, so participants play the same role throughout the experiment. In contrast, the CBDC-anonymity treatment is within-subjects, so participants play both treatments. This results in four randomized treatments, which are summarized in Table 3.

Table 3: Treatment Design

		CBDC Anonymity	
		Anonymous	Non-anonymous
CBDC Adoption Costs	0.4	Anonymous 0.4	Non-anonymous 0.4
	0.5	Anonymous 0.5	Non-anonymous 0.5

The order in which participants play the CBDC-anonymity treatments (anonymous vs. non-anonymous) is randomized. After five market rounds, the CBDC treatment is reversed. Subjects either start with the anonymous CBDC treatment and then change to the non-anonymous version or vice versa.

To identify subjects' preferences for anonymous payments, anonymity has real consequences: We publish information on payment transactions of subjects using non-anonymous means of payments, i.e., information on transactions conducted with deposits and non-anonymous CBDC. In general, participants' decisions remain anonymous throughout the experiment. However, if participants use non-anonymous means of payment during the experiment, the amount of their payoff achieved with non-anonymous means of payment (deposits, non-anonymous CBDC) will be made visible to all other participants within their group in the form of a table at the end of the experiment. If participants only use anonymous means of payment (cash, anonymous CBDC) in the experiment, the amount of their payoff will not be made visible at the end of the experiment. The table shows the number of the computer booth where they sit, and the amount of the payoff achieved using non-anonymous means of payment. Names and other personal data will not be made visible. A somewhat related approach can be found in Schram and Charness (2015). However, we deviate from this approach by not publishing other decisions made during the experiment or names and other personal data.

4 Experimental Procedure and Sample Characteristics

Before the experiment begins, the experimental instructions[6] are distributed. The instructions provide detailed information on the properties of the means of payment, the experimental setup, and the payoff function. After reading the instructions, participants are given several test questions about the three means of payments and the payoff consequences of different actions. This ensures that all participants have understood the procedures. This is followed by a test round, which is not relevant for the payoff. Participants are randomly and equally divided into treatments, as described in Table 3. Participants are informed of their treatment assignment. The experiment ends when the ten market rounds have been completed. All market rounds are relevant for payoff.

After the experiment, participants are asked to answer a survey[7] to elicit a number of control variables. These include measures of financial literacy and sociodemographics. To control for framing effects, we ask participants what they think the experiment is about (neutral framing test) and questions about CBDC. We also include questions about payment behavior and trust in the banking sector. In addition, participants play a lottery-

[6]The experimental instructions are available upon request from the corresponding author.

[7]The survey is available upon request from the corresponding author.

choice task to elicit their risk preferences regarding payment transactions. Participants are also asked about their preferences for anonymous payments.

The experiment was conducted from December 2024 to February 2025 at the DICE Lab at the University of Düsseldorf. The experiment was programmed with the software oTree (Chen et al., 2016). Participants were recruited through the online subject database Hroot (Bock et al., 2014). In the recruitment email, participants were informed that more participants would be invited than needed. If participants arrived on time, but their participation was no longer needed, they received the standard show-up fee of six euros and were invited to participate in a later session. In total, we had 160 participants, 40 participants in each treatment. On average, each session lasted 60 minutes. Upon arrival at the DICE Lab, participants were greeted and directed to individual computer booths. We used a randomizer to assign the computer booths. Once all participants were seated, they were given sufficient time to read the written instructions. In addition, they had the opportunity to ask the experimenter questions. Then, the actual experiment began with test questions and a test round. Regarding payments, all participants received a show-up fee of six euros. The belief elicitations were not incentivized. Moreover, surveys were not incentivized except for the lottery-choice task and questions on financial literacy. Participants received one euro for correct answers in the financial literacy questions and up to five euros depending on their choices in the lottery task. The average payoff is around 14 euro. The experiment is preregistered[8].

Table 4 shows the sample characteristics. The treatments CBDC adoption costs are balanced with respect to demographic variables, risk attitudes, anonymity preferences and educational composition. The share of participants with a background in economics or business administration is largely balanced.

[8]See the following link: https://aspredicted.org/sjgn-yxk2.pdf.

Table 4: Sample Characteristics by Treatment CBDC Adoption Costs

	Adoption Costs 0.4				Adoption Costs 0.5			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Age (in years)	23.65	7.29	18	61	23.79	6.44	18	67
Gender (1 female, 0 else)	0.56	0.50	0	1	0.59	0.49	0	1
Risk (0 risk averse, 10 risk loving)	5.73	2.37	0	10	5.96	2.55	0	10
Anonymity Concern (1 high, 4 low)	3.16	0.77	1	4	3.01	0.81	1	4
University Semester	4.56	3.56	1	16	4.15	3.76	1	17
University Grade	1.98	1.05	0	4	1.90	1.05	0	4
Student (1 yes, same for all variables)	0.94	0.33	0	1	0.94	0.24	0	1
Economics or business administration	10.63	0.31	0	1	8.13	0.27	0	1
Full-time employee	0.01	0.11	0	1	0.01	0.11	0	1
Part-time employee	0.15	0.36	0	1	0.16	0.37	0	1
Retired	0	0	0	0	0.01	0.11	0	1
Minor employment	0.06	0.24	0	1	0.06	0.24	0	1
Minijob	0.38	0.48	0	1	0.44	0.50	0	1
Self-employed	0.03	0.16	0	1	0.01	0.11	0	1
Unemployed, looking for work	0.06	0.24	0	1	0.03	0.16	0	1
Unemployed, not looking for work	0.08	0.26	0	1	0	0	0	0

Note: The table displays summary statistics of all demographic variables across the treatments CBDC adoption costs. For law students, grades were converted to align with the standard German grading system.

5 Hypotheses

The hypotheses are as follows.

1. The demand for CBDC is higher in the "anonymous treatment" than in "the non-anonymous treatment". Survey evidence suggests that the ability to make anonymous payments is an important characteristic of a CBDC for potential users: Nearly 80 percent of German households that responded to a survey conducted by the Deutsche Bundesbank stated that "Information about payments remains private" is "very important" (Deutsche Bundesbank, 2021). In a survey conducted by the ECB, a majority of 60 percent of responding households in the euro area said they are concerned about privacy when making digital payments (European Central Bank, 2024). Using structural models, Nocciola and Zamora-Pérez (2024), based on euro-area survey data, and Li (2023), using a Canadian survey, find that anonymity is a key design feature that matters for CBDC demand. In a theoretical model developed by Agur et al. (2022), the social value of a CBDC arises from its ability to introduce some of the anonymity of cash into digital payments. In addition, the results of laboratory experiments by Borgonovo et al. (2021) show that anonymity matters for the demand for CBDC.

To test this hypothesis, we estimate a multilevel logit (mixed-effects) regression model,

where the dependent variable is CBDC adoption (EM allocation). The key independent variable is the treatment dummy for CBDC anonymity. The specification includes round fixed effects, random intercepts at the group and participant levels, and standard errors clustered at the session level. The results are displayed in Tables 8 and 9, Columns (1)–(3).

2. Risk averse participants have a higher demand for cash than for deposits, and a higher demand for cash than for CBDC. This hypothesis refers to participants' risk preferences. Cash is public money and legal tender, i.e., it must be accepted by sellers (see Chapter 2). However, deposits are private money and not legal tender. Consequently, there is a risk that card payments, and thus payments based on bank deposits, may not be accepted. Although it is also planned that in the euro area CBDC will become legal tender (COM/2023/369 final), it does not necessarily have to be accepted by sellers during its introductory phase. Therefore, during this period, buyers face the risk that the CBDC may not be accepted as a means of payment. As a result, participants may choose to hold cash for precautionary reasons. This behavior is also supported by a study conducted by the Deutsche Bundesbank (2020). In a survey, participants were asked why they think people hold cash. 55 percent responded, "cash is the most common means of payment", which, in the context of our experiment, implies that it is the most widely accepted form of payment. The precautionary demand for cash is highlighted in the literature, for example, by Eschelbach and Schmidt (2013) and Pietrucha and Maciejewski (2020).

To test this hypothesis, we use participants' risk preferences elicited in the post-experimental survey and include this measure as a control variable in all regression models (see Appendix).

3. In the low-adoption cost treatment, the demand for CBDC is higher than in the high-adoption cost treatment. Furthermore, the switch from the high-adoption cost treatment to the low-adoption cost treatment implies that CBDC replaces cash and deposits. In our experiment, adoption costs describe the costs participants incur when adopting CBDC as a new means of payment. These costs are motivated by real-world costs, such as costs required to search for and process information about this new means of payment. Obviously, a reduction in these costs increases the

optimal transactions demand for CBDC.[9] This is supported by findings from the Deutsche Bundesbank (2021) survey, which highlights the importance of cost-free usage for a potential new means of payment. Moreover, lower adoption costs make paying with CBDC relatively cheaper. The optimal mix of means of payment requires that their marginal costs be equal. Consequently, a reduction in adoption costs should increase the demand for CBDC, at the expense of cash and deposits. In addition, Arifovic et al. (2023) show that with low fixed adoption costs, an equilibrium with low transaction costs can be reached and the new means of payment becomes established. However, with high fixed adoption costs, the equilibrium with low transaction costs will not be reached, meaning the new means of payment will not become established.

To test this hypothesis, we estimate a multilevel logit (mixed-effects) regression model, where the dependent variable is CBDC adoption (EM allocation). The key independent variable is the treatment dummy for CBDC adoption costs. The specification includes round fixed effects, random intercepts at the group and participant levels, and standard errors clustered at the session level. The results are displayed in Tables 6 and 7, Columns (1)–(3).

4. The probability that CBDC will be adopted by participants increases over market rounds, especially when adoption costs are low. This hypothesis refers to round effects. In the real world, people observe the payment behavior of other people at the checkout in a shop, for example. If they see that more and more people actually use a new means of payment, they are more willing to use it too, the innovation diffuses (Rogers, 2003). This kind of learning effect and herd behavior also occurs in other experiments as in, e.g. Carlsson et al. (2012). This is especially the case when adoption costs are low (see Hypothesis 3)

To test this hypothesis, we include the variable round and an interaction between the treatment variable and round in all regression models. Moreover, we plot the share of buyers adopting CBDC by treatment CBDC adoption costs over market rounds (see Figure 1). In a further analysis, we include the square of the round variable in the regressions to capture potential nonlinear trends over time.

[9] In his seminal paper, Baumol (1952) showed that the optimal transactions demand for cash decreases with the cost of holding cash. In his model, these costs are opportunity costs in the form of forgone interest income.

5. The adoption of CBDC increases sharply after round 1, the slope then flattens.

Once enough participants use the new means of payment, its adoption increases rapidly, as participants assume that it will also be accepted in the next market round. Arifovic et al. (2023) demonstrate this for the introduction of a new means of payment. In our experiment, participants receive information on the share of buyers adopting CBDC in the previous market round. Based on this information, participants form beliefs about the acceptance of CBDC by the seller starting from the first market round. Moreover, adoption is made easier when participants remain in the same groups during the experiment. This strategic cooperation within groups is demonstrated, for example, in Keser and van Winden (2000). To test this hypothesis, we plot the share of buyers adopting CBDC by treatment CBDC adoption costs over market rounds (see Figure 1). In a further analysis, we include a dummy variable for each of the ten market rounds and the square of the round variable in all regression models.

6. Network effects matter, i.e., participants will adopt CBDC as a new means of payment if they expect that other participants will also adopt CBDC. This is especially the case when adoption costs are low.

This hypothesis refers to the expected adoption of CBDC of other participants and therefore the perceived CBDC seller acceptance. This mainly refers to the fact that a critical mass must first be reached in order to achieve acceptance of a means of payment in two-sided markets. In our experiment, the critical mass is 50%. Network effects play an important role here, as described, for example, in Rochet and Tirole (2003), Evans and Schmalensee (2010) and Belleflamme and Peitz (2021). With regard to means of payment, network effects imply a critical mass is needed to introduce CBDC (Agur et al., 2022). To test this hypothesis, we elicit participants' perceived CBDC seller acceptance and include this measure as a control variable (*beliefs*) in Columns 2 of Tables 6 to 9. In a further analysis, we include participants' perceived CBDC adoption and an interaction between *beliefs* and the treatment variables.

6 Experimental Results

This section describes the descriptive statistics and presents the regression analysis, in which we refer to the CBDC-adoption costs and CBDC-anonymity treatments.

6.1 Descriptive Statistics

At statistically significant levels, the average share of buyers adopting CBDC, the number of transactions conducted with CBDC and the share of sellers accepting CBDC as a new means of payment is larger in the treatment with low CBDC adoption costs (Table 5). For the CBDC-anonymity treatment, there are no statistically significant differences between the anonymous and non-anonymous CBDC across any of the outcome variables.

Table 5: Summary statistics

Treatment		**CBDC Adoption Costs**			**CBDC Anonymity**		
Variables		0.4	0.5	p-value	Anonymous	Non-anonymous	p-value
Adoption CBDC	0.86	0.87	0.84	0.0850	0.86	0.86	1.0000
Cash Usage	0.31	0.30	0.33	0.2147	0.31	0.32	0.7874
Deposits Usage	0.39	0.37	0.41	0.1374	0.38	0.40	0.3304
EM CBDC	7.17	7.28	7.07	0.1041	7.21	7.14	0.5967
EM Cash	1.06	1.04	1.08	0.3788	1.05	1.07	0.8099
EM Deposits	1.77	1.68	1.85	0.2618	1.74	1.79	0.3862
Transactions CBDC	7.13	7.26	6.99	0.0607	7.15	7.10	0.6621
Transactions Cash	1.06	1.04	1.08	0.3788	1.05	1.07	0.8099
Transactions Deposits	1.36	1.29	1.42	0.1301	1.35	1.37	1.0000
Seller Acceptance CBDC	0.95	0.99	0.91	0.0000	0.95	0.95	0.3964
Observations	1,600	800	800		800	800	

Note: The table presents summary statistics by treatments averaged over market rounds. It reports the average share of buyers adopting CBDC, the share of buyers using cash and deposits, the units of EMs allocated to each means of payment, the number of transactions conducted with each means of payment, and the share of sellers accepting CBDC as a means of payment. The table also includes p-values from Wilcoxon rank-sum tests.

In both adoption-cost treatments, CBDC is accepted by the seller as a means of payment on average over all sessions (Figure 1). Moreover, buyers' adoption of a CBDC and the average units of EM allocated to CBDC increases over market rounds, while the units of EM allocated to cash and deposits decreases (Figures 1 and 2a). CBDC adoption increases sharply in the first market rounds and then flattens at a rather high level, which is in line with Hypothesis 5. Comparing the two adoption-cost treatments, more buyers adopt CBDC and more sellers accept CBDC as a means of payment in the treatment

with low adoption costs (Figure 1). Moreover, with low adoption costs, buyers allocate more EMs to CBDC and less to deposits (Figure 2a). For cash, the allocation of EM is similar across both treatments.

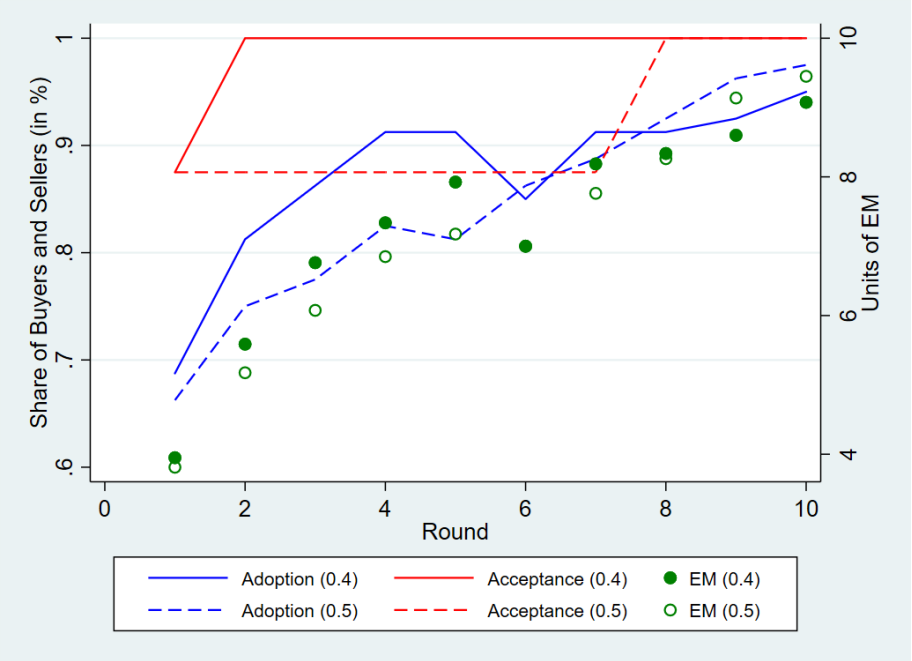
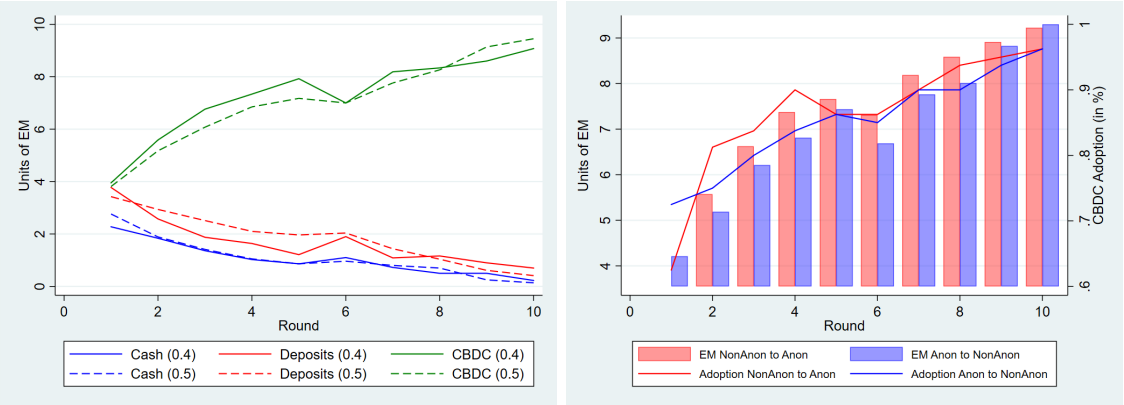


Figure 1: Share of Buyers Adopting CBDC, Sellers Accepting CBDC and EM Allocation to CBDC Across All Sessions by Market Round and Treatment CBDC Adoption Costs.

In both CBDC-anonymity treatments, CBDC adoption and the units of EM allocated to CBDC increase on average over market rounds (Figure 2b). In the first market round, CBDC adoption and EM allocation are higher when CBDC is anonymous. However, after the second market round, adoption and EM allocation to CBDC increase faster and remain higher when the CBDC treatment shifts from non-anonymous to anonymous.



(a) Average EM Allocation to the Means of Payment by Treatment Adoption Costs.

(b) Average EM Allocation to CBDC and CBDC Adoption by Treatment CBDC Anonymity.

Figure 2: Average EM Allocation to the Means of Payment Across All Sessions by Market Round and Treatments.

6.2 Regression Analysis

6.2.1 Effects of CBDC Adoption Costs on Payment Choice

A decrease in CBDC adoption costs is associated with an increase in CBDC adoption at the 10% significance level, controlling for buyers' beliefs on CBDC acceptance, as shown in Table 6, Column (2).[10] This finding is in line with Hypothesis 3. CBDC adoption increases with market rounds, but the positive effect of lower adoption costs on CBDC adoption decreases, which is in line with Hypothesis 4. Moreover, the belief that CBDC will be accepted by sellers in the next market round has a significant and positive effect on CBDC adoption, indicating that perceived seller acceptance is one key driver of CBDC adoption, supporting Hypothesis 6. With high adoption costs, the shift from a non-anonymous to an anonymous CBDC increases CBDC adoption at the 1% significance level, as shown in Table 6, Column (3). However, the positive effect of shifting to an anonymous CBDC decreases with lower adoption costs. Therefore, an anonymous CBDC increases CBDC adoption, but matters less when adoption costs are low. As shown in Table 6, Columns (4) and (5), a decrease in CBDC adoption costs decreases the use of cash and deposits, but the effects are not statistically significant. Moreover, a decrease in CBDC adoption costs increases the units of EM allocated to CBDC and decreases EM allocation to cash and deposits (see Table 7 and Hypothesis 3). However, these effects are not statistically significant. Overall, CBDC adoption costs matter for CBDC adoption, but not for EM allocation.

[10] See the Appendix for the full regression tables.

Table 6: Regression Estimates for CBDC Adoption as Means of Payment, and Cash and Deposits Usage.

	Dependent Variable				
Regressors	(1) CBDC	(2) CBDC	(3) CBDC	(4) Cash	(5) Deposits
Treatment (=1 if Adoption Costs = 0.4)	1.022	1.582*	1.293**	-0.666	-0.535
	(0.646)	(0.893)	(0.644)	(0.864)	(0.476)
Treatment x Round	-0.175*	-0.248*	-0.178*	0.050	-0.037
	(0.093)	(0.134)	(0.092)	(0.181)	(0.110)
Round	0.480***	0.380***	0.488***	-0.842***	-0.655***
	(0.054)	(0.096)	(0.053)	(0.193)	(0.079)
Beliefs		3.046***			
		(0.870)			
CBDC Anonymity (=1 if CBDC = Anonymous)			0.319***		
			(0.118)		
Treatment x CBDC Anonymity			-0.524**		
			(0.204)		
Constant	-1.335	-3.154	1.580	7.147***	4.907***
	(1.423)	(2.052)	(1.436)	(2.179)	(1.809)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Multilevel Logit regressions with clustered standard errors in parentheses. The treatment variable is CBDC adoption costs, and outcome variables are CBDC adoption, and cash and deposits usage. All specifications include controls for risk attitudes, anonymity preferences, income, age, and gender. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC anonymity to specification (1). Columns (4) and (5) repeat specification (1) for cash and deposits use. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Regression Estimates for EM Allocation to Cash, Deposits and CBDC.

	Dependent Variable				
Regressors	(1) CBDC	(2) CBDC	(3) CBDC	(4) Cash	(5) Deposits
Treatment (=1 if Adoption Costs = 0.4)	0.746	0.780	0.784	-0.230	-0.505
	(0.687)	(0.805)	(0.774)	(0.264)	(0.492)
Treatment x Round	-0.093***	-0.107	-0.093***	0.039	0.053
	(0.021)	(0.073)	(0.021)	(0.031)	(0.043)
Round	0.557***	0.370***	0.557***	-0.238***	-0.319***
	(0.011)	(0.056)	(0.011)	(0.024)	(0.034)
Beliefs		3.511***			
		(1.056)			
CBDC Anonymity (=1 if CBDC = Anonymous)			0.11		
			(0.215)		
Treatment x CBDC Anonymity			-0.078		
			(0.236)		
Constant	1.331	-0.366	1.276	4.847***	3.880***
	(1.554)	(1.918)	(1.627)	(1.016)	(1.299)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Mixed-effects regressions with clustered standard errors in parentheses. The treatment variable is CBDC adoption costs, and outcome variables are EM allocation to cash, deposits and CBDC. All specifications include controls for risk attitudes, anonymity preferences, income, age, and gender. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC anonymity to specification (1). Columns (4) and (5) repeat specification (1) for EM allocation to cash and deposits. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.2.2 Effects of CBDC-Anonymity on Payment Choice

The shift from a non-anonymous to an anonymous CBDC leads to an increase in CBDC adoption, controlling for CBDC adoption costs, but the effect is not statistically significant. This result is displayed in Table 8 Column (3) and is not in line with Hypothesis 1. In contrast, the shift to an anonymous CBDC leads to a significant decrease in the use of deposits at the 1% significance level, as shown in Table 8 Column (5). A possible explanation is that when the CBDC is non-anonymous, CBDC and deposits are complements as both means of payments have the same degree of anonymity (both are non-anonymous means of payment). However, when the CBDC switches to anonymous, buyers shift away from non-anonymous deposits to anonymous CBDC, leading to a significant decline in the use of deposits.

The shift from a non-anonymous to an anonymous CBDC is associated with an increase in EM allocation to CBDC at the 5% significance level, but the positive effect decreases over market rounds. This result is shown in Table 9, Column (1), and supports Hypothesis 1. Moreover, beliefs matter for EM allocation to CBDC (Column (2)), which is in line with

Hypothesis 6. The shift to an anonymous CBDC leads to a decrease in EM allocation to deposits at the 10% significance level, as shown in Table 9, Columns (4) and (5). Again, a possible explanation is that when the CBDC shifts to anonymous, buyers replace deposits with a CBDC. Overall, CBDC anonymity increases (decreases) EM allocation to CBDC (deposits). Table 10 summarizes the experimental results.

Table 8: Regression Estimates for CBDC Adoption as Means of Payment, and Cash and Deposits Usage.

	Dependent Variable				
Regressors	(1) CBDC	(2) CBDC	(3) CBDC	(4) Cash	(5) Deposits
Treatment (=1 if CBDC = Anonymous)	0.574	-0.877	0.864	-0.810	-1.444***
	(0.698)	(0.733)	(0.789)	(0.661)	(0.454)
Treatment x Round	-0.116	0.134	-0.123	0.135	0.235***
	(0.156)	(0.155)	(0.155)	(0.110)	(0.087)
Round	0.448***	0.181	0.459***	-0.888***	-0.757***
	(0.095)	(0.113)	(0.098)	(0.140)	(0.064)
Beliefs		3.182***			
		(0.916)			
CBDC Adoption Costs (=1 if Adoption Costs = 0.4)			0.634		
			(0.672)		
Treatment x CBDC Adoption Costs			-0.544**		
			(0.256)		
Constant	-1.177	-1.980	-1.582	7.377***	5.490***
	(1.555)	(2.025)	(1.730)	(1.896)	(1.929)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Multilevel Logit regressions with clustered standard errors in parentheses. The treatment variable is CBDC anonymity, and outcome variables are CBDC adoption, and cash and deposits usage. All specifications include controls for risk attitudes, anonymity preferences, income, age, and gender. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC adoption costs to specification (1). Columns (4) and (5) repeat specification (1) for cash and deposits use. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Regression Estimates for EM Allocation to Cash, Deposits and CBDC.

	Dependent Variable				
Regressors	(1) CBDC	(2) CBDC	(3) CBDC	(4) Cash	(5) Deposits
Treatment (=1 if CBDC = Anonymous)	0.842**	0.327	0.881**	-0.277	-0.584*
	(0.342)	(0.279)	(0.443)	(0.217)	(0.322)
Treatment x Round	-0.140***	-0.061	-0.140***	0.047	0.097*
	(0.156)	(0.048)	(0.049)	(0.029)	(0.050)
Round	0.581***	0.345***	0.581***	-0.242***	-0.341***
	(0.026)	(0.045)	(0.026)	(0.019)	(0.039)
Beliefs		3.567***			
		(1.098)			
CBDC Adoption Costs (=1 if Adoption Costs = 0.4)			0.279		
			(0.734)		
Treatment x CBDC Adoption Costs			-0.078		
			(0.236)		
Constant	1.231	-0.198	1.094	4.886***	3.957***
	(1.547)	(1.820)	(1.691)	(1.011)	(1.193)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Mixed-effects regressions with clustered standard errors in parentheses. The treatment variable is CBDC anonymity, and outcome variables are EM allocation to CBDC, cash and deposits. All specifications include controls for risk attitudes, anonymity preferences, income, age, and gender. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC adoption costs to specification (1). Columns (4) and (5) repeat specification (1) for cash and deposits use.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Summary Results

Hypothesis	**Prediction**	**Coefficient**	**Evidence**	**Result**
H1	CBDC EM allocation/ adoption ↑ if CBDC is anonymous	Treatment	Tables 8 and 9, (1)-(3)	Mixed (EM allocation ↑, no effect on adoption)
H2	Risk aversion: Cash > deposits, cash > CBDC	Controls (Risk)	Tables 6-9 (Appendix Tables 19-22)	Mixed (cash > CBDC, no effect cash > deposits)
H3	CBDC EM allocation/ adoption ↑ if low adoption costs; Cash/ deposits ↓	Treatment	Tables 6, 7	Mixed (EM allocation ↑, no effects on cash/ deposits)
H4	CBDC EM allocation/ adoption ↑ over rounds	Treatment x Round, Round	Tables 6-9, Figure 1	Supported
H5	Strong CBDC adoption ↑ in round 1		Figure 1	Supported
H6	CBDC Network effects	Beliefs	Tables 6-9, (3)	Supported

7 Survey

After the experiment, participants receive information about a CBDC and complete a survey. A total of 26.25% of participants report that they had previously heard of a CBDC, suggesting that most were introduced to this potential new means of payment for the first time during the experiment. This highlights the importance of reducing the adoption cost of CBDC for a successful introduction. Moreover, most participants report being likely or very likely to use a CBDC after its introduction (Table 11). This indicates generally positive attitudes toward CBDC adoption among participants.

Table 11: Survey Responses on CBDC Usage

How likely is it that you would use CBDC after its introduction?					
	Very Likely	Likely	Neutral	Unlikely	Very Unlikely
	15.63%	37.50%	26.88%	13.13%	6.88%
N	25	60	43	21	11

Participants associate CBDC slightly more with digital, cashless payment methods (like credit or debit card) than with cash (Figure 3). This is consistent with our experimental results: when CBDC shifts from non-anonymous to anonymous, the allocation of EM to (non-anonymous) deposits decreases, while EM allocation to CBDC increases (Table 9). Therefore, CBDC replaces deposits rather than cash, especially when the CBDC is anonymous.

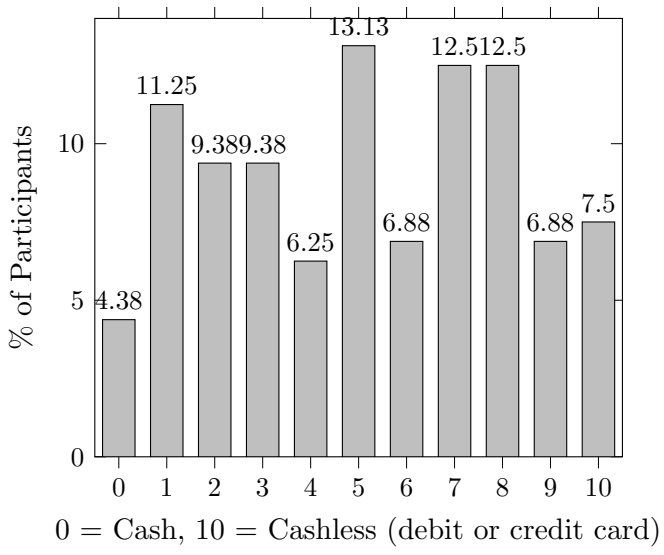


Figure 3: Participants' Perception of CBDC Compared to Cash and Cashless Payment Methods (Mean = 5.14).

In our survey, free usage and data security are most commonly selected as the most important CBDC characteristics, followed by ease of use (Figure 4). This is in line with the survey conducted by the Deutsche Bundesbank (2021), which identifies, among other factors, low costs and data security as key drivers for a CBDC to be adopted as a payment method. In our survey, anonymity is most frequently ranked as the least important CBDC characteristic, suggesting that privacy is less relevant (Figure 4). Moreover, we explain to participants that personal data is processed electronically whenever they use cashless payment methods (like bank transfer, payment by debit and credit card or smartphone) (Table 12). Most participants state that they are not concerned or only a little concerned about the disclosure of personal data when using cashless payment methods. Again, this suggests that anonymity and data protection do not appear to be primary concerns in the context of payment transactions for most participants. This is also reflected in participants' real-world preference for contactless and digital payment methods, which are typically non-anonymous (Table 13). These findings are not consistent with our experimental results (Tables 8 and 9). The discrepancy between participants' stated privacy preferences and their actual behavior is known in the experimental literature as the privacy paradox (Acquisti and Grossklags, 2005; Acquisti et al., 2015; Benndorf and Normann, 2018; Huberman et al., 2005). While the privacy paradox refers to participants claiming to value privacy but disclose personal information when provided with incentives, our results suggest a reversed version: participants indicate in survey responses weak preferences for anonymity, but allocate significantly more EM to the anonymous CBDC in experimental transactions. Although this reversal has received less attention in the experimental literature, it aligns with broader findings on hypothetical bias and context-dependent privacy preferences (John et al., 2011; List and Gallet, 2001; Loomis, 2011).

If CBDC was introduced, which characteristics would be most important to you?

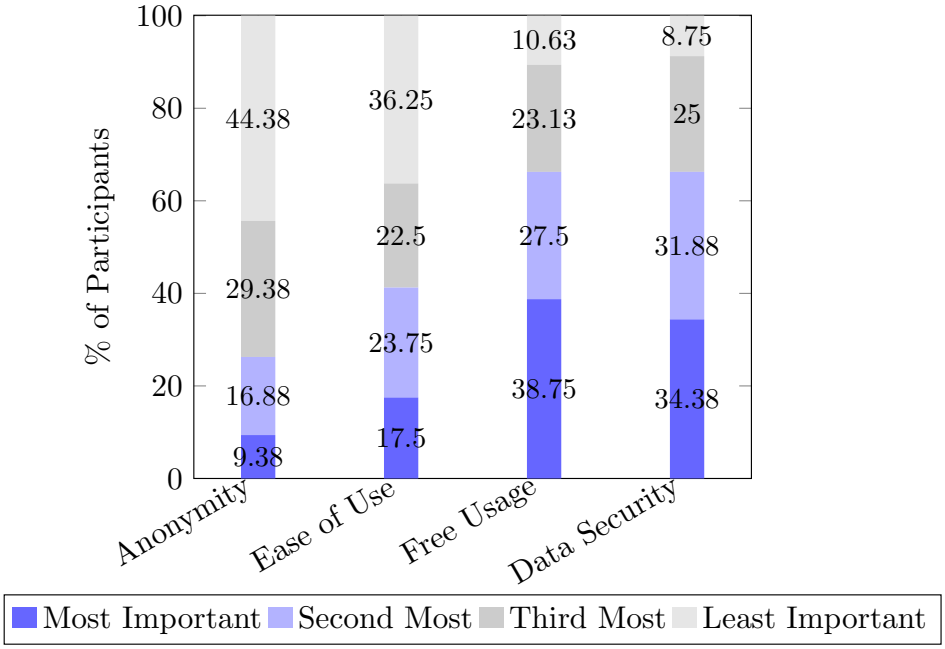


Figure 4: Participants' Ranking of Different CBDC Characteristics.

Table 12: Participants' Concerns About Disclosure of Personal Data

Are you concerned about the disclosure of your personal data?

	%	N
I am very concerned	5.63	9
I am concerned	10.63	17
I am a little concerned	53.13	85
I am not concerned	30.63	49

Table 13: Participants' Ranking of Different Payment Methods

Which payment method do you use most often to pay for everyday purchases (e.g., at the supermarket, bakery, or drugstore)?

Payment Method	First Most	Second Most	Third Most
Cash	18.13%	26.88%	38.75%
Smartphone	33.13%	12.50%	9.38%
Insert Girocard	1.88%	17.50%	28.75%
Insert Credit Card	0.63%	1.25%	3.75%
Contactless Girocard	43.75%	31.88%	12.50%
Contactless Credit Card	2.50%	10.00%	6.88%

The most preferred payment method for everyday purchases is contactless with Girocard, followed by Smartphone payments and cash (Table 13). This suggests a preference for contactless and digital payment methods, which is in line with our experimental results, as cash is the least used payment method (Table 5).

Participants have on average high self-reported financial knowledge (Table 15) and are familiar with all common payment methods (14). Specifically, cash is the most widely known payment method. Debit cards and direct debit follow closely. Similarly, credit cards and internet-based payment services (like PayPal or similar) are well known. Moreover, most participants undertake high search effort when selecting a financial product, while 12.5% indicate no effort (Table 16). To further assess financial literacy, participants are asked two additional questions [11]. 98% answered at least one of them correctly, while 67% answered both correctly, indicating rather high financial literacy. However, there are differences in financial literacy and in the effort to search for information. This needs to be considered when introducing a CBDC as a payment method. In particular, adoption or information costs should be kept low to ensure broad access to the potential new means of payment.

[11] The first question tests participants' understanding of interest rate calculations. The second question tests their familiarity with compound interest and the accumulation of returns over time.

Table 14: Participants' Awareness of Different Payment Methods

Which of the following payment methods are know to you?

Payment Method	%	N
Cash	99.38	159
Internet Payment (e.g. PayPal)	98.13	157
Mobile Payment (e.g. Apple Pay, Google Pay)	97.50	156
Credit Card	96.88	155
Debit Card	96.25	154
Direct Debit	96.25	154

Note: One participant stated that they were not familiar with cash as a means of payment. However, the participant also stated that cash was the third most commonly used payment method for everyday purchases. We can therefore treat cash as being familiar to all participants.

Table 15: Participants' Self-Reported Financial Literacy

How would you rate your financial literacy compared to the average in Germany?					
	Very Low	Low	Average	High	Very High
	1.88%	13.13%	57.50%	25.63%	1.88%
N	3	21	92	41	3

Table 16: Participants' Self-Reported Financial Literacy

When choosing a financial product,	%	N
I have not considered any other options at all,	12.50	20
I searched around, but no other options came into consideration,	8.13	13
I have considered several options from one provider	21.25	34
I have considered several options from different providers,	58.13	93
before reaching a decision.		

Only 23.13% of participants agree with the statement that their money is safe with a bank even in the event of bankruptcy, while a large share is undecided or disagree (Table 17). Participants have high trust in the European Central Bank (Table 18). Trust considerations could therefore play a key role in shaping the acceptance of a CBDC as a payment method.

Table 17: Participants' Trust in the Banking Sector

I am convinced my money is safe with a bank, even if the bank goes bankrupt			
	Disagree	Undecided	Agree
	37.50%	39.38%	23.13%
N	60	63	37

Table 18: Participants' Trust in the European Central Bank

How much trust do you have in the European Central Bank?					
	No Trust	Low Trust	Medium Trust	High Trust	Full Trust
	0.63%	6.88%	30.63%	59.38%	2.50%
N	1	11	49	95	4

8 Conclusion

In recent years, payment habits have changed: The use of cash has decreased and consumers increasingly prefer to use electronic forms of payment. In response, many central banks worldwide are considering the introduction of CBDCs as a new digital form of payment. This paper investigates the introduction period of a CBDC as a new means of payment focusing specifically on two key factors from the buyers' perspective: The amount of adoption costs and anonymity with respect to payment transactions.

We conduct a laboratory experiment with a 2x2 treatment design. In the first treatment, the CBDC-adoption treatment, we vary adoption costs to assess their impact on the individual decision to adopt CBDC as a payment method. In the second treatment, the CBDC-anonymity treatment, we use two versions of CBDC: An anonymous and a non-anonymous version. The experiment focuses on the adoption of CBDC from the buyer's perspective. Buyers are endowed with experimental money and decide how to allocate it between cash, deposits and CBDC. In this framework, cash, deposits, and CBDC differ in three key properties: Acceptance as a medium of exchange, anonymity, and cost efficiency, which includes transaction and adoption costs. Buyers meet computerized sellers to trade goods. Trading will only be successful if the means of payment chosen by the buyer is accepted as a medium of exchange by the seller.

The main findings are as follows: The amount of adoption costs is important for the introduction of CBDC. Lower adoption costs lead to a significant increase in CBDC adoption. Anonymity, however, plays a role in the allocation of experimental money to the different means of payment. When the CBDC-anonymity treatment shifts from non-anonymous to

anonymous, participants switch from non-anonymous deposits to anonymous CBDC. In addition, network effects are important, as expectations regarding the adoption of CBDC by other participants influence the adoption of CBDC by a participant. The results of the experiment and the survey indicate that adoption costs are crucial and sufficient information about CBDC is relevant for the success of CBDC as a new means of payment.

While this experiment provides insights regarding the adoption of CBDCs, it is subject to certain limitations, such as sample size and sample composition. Nevertheless, political implications can be derived. When introducing a CBDC, e.g. a digital euro, it is crucial to provide users with sufficient and comprehensive information. This information should be as accessible as possible. In particular, if technological progress reduces the relative advantage of CBDC over other means of payment. If offline payments also become possible with commercial bank money, for example, it is important to emphasise that CBDC provides a higher degree of anonymity, which is particularly relevant for individuals who place a high value on their anonymity. In addition, adoption costs for users should be kept as low as possible. Overall, to achieve acceptance as a means of payment, it is important that enough people use CBDC at the beginning of its introduction.

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Appendix

Table 19: Regression Estimates for CBDC Adoption as Means of Payment, and Cash and Deposits Usage.

	Dependent Variable				
	(1)	(2)	(3)	(4)	(5)
Regressors	CBDC	CBDC	CBDC	Cash	Deposits
Treatment (=1 if Adoption Costs = 0.4)	1.022	1.582*	1.293**	-0.666	-0.535
	(0.646)	(0.893)	(0.644)	(0.864)	(0.476)
Treatment x Round	-0.175*	-0.248*	-0.178*	0.050	-0.037
	(0.093)	(0.134)	(0.092)	(0.181)	(0.110)
Round	0.480***	0.380***	0.488***	-0.842***	-0.655***
	(0.054)	(0.096)	(0.053)	(0.193)	(0.079)
Risk	0.306***	0.373***	0.311***	-0.293*	-0.302***
	(0.042)	(0.048)	(0.041)	(0.150)	(0.092)
Income	0.076	-0.072	0.084	-0.025	0.436
	(0.249)	(0.280)	(0.248)	(0.360)	(0.361)
Age	0.021	0.045	0.021	-0.050	-0.062
	(0.040)	(0.066)	(0.040)	(0.051)	(0.055)
Gender	-0.119	-0.341	-0.128	2.174***	0.971*
	(0.386)	(0.409)	(0.384)	(0.584)	(0.547)
Anonymity	-0.105	-0.299	-0.097	-0.989*	-0.122
	(0.374)	(0.230)	(0.347)	(0.539)	(0.398)
Beliefs		3.046***			
		(0.870)			
CBDC Anonymity (=1 if CBDC = Anonymous)			0.319***		
			(0.118)		
Treatment x CBDC Anonymity			-0.524**		
			(0.204)		
Constant	-1.335	-3.154	1.580	7.147***	4.907***
	(1.423)	(2.052)	(1.436)	(2.179)	(1.809)
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Multilevel Logit regressions. Clustered standard errors in parentheses. The treatment variable is CBDC adoption costs, and outcome variables are CBDC adoption, and cash and deposits usage. All model specifications control for risk attitudes, anonymity preferences and demographics. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC anonymity to specification (1). Columns (4) and (5) repeat specification (1) for cash and deposits use. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 20: Regression Estimates for EM Allocation to Cash, Deposits and CBDC.

	Dependent Variable				
	(1)	(2)	(3)	(4)	(5)
Regressors	CBDC	CBDC	CBDC	Cash	Deposits
Treatment (=1 if Adoption Costs = 0.4)	0.746	0.780	0.784	-0.230	-0.505
	(0.687)	(0.805)	(0.774)	(0.264)	(0.492)
Treatment x Round	-0.093***	-0.107	-0.093***	0.039	0.053
	(0.021)	(0.073)	(0.021)	(0.031)	(0.043)
Round	0.557***	0.370***	0.557***	-0.238***	-0.319***
	(0.011)	(0.056)	(0.011)	(0.024)	(0.034)
Risk	0.330***	0.332***	0.330***	-0.159***	-0.155***
	(0.064)	(0.056)	(0.064)	(0.050)	(0.055)
Income	-0.210	-0.239	-0.210	0.012	0.210
	(0.246)	(0.031)	(0.064)	(0.102)	(0.238)
Age	0.038	0.033	0.038	-0.026*	-0.016
	(0.035)	(0.031)	(0.035)	(0.014)	(0.040)
Gender	-0.481	-0.456	-0.481	0.412*	0.078
	(0.367)	(0.304)	(0.367)	(0.238)	(0.283)
Anonymity	0.168	0.176	-0.168	-0.387*	0.183
	(0.311)	(0.223)	(0.311)	(0.221)	(0.182)
Beliefs		3.511***			
		(1.056)			
CBDC Anonymity (=1 if CBDC = Anonymous)			0.11		
			(0.215)		
Treatment x CBDC Anonymity			-0.078		
			(0.236)		
Constant	1.331	-0.366	1.276	4.847***	3.880***
	(1.554)	(1.918)	(1.627)	(1.016)	(1.299)
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Mixed-effects regressions. Clustered standard errors in parentheses. The treatment variable is CBDC adoption costs, and outcome variables are EM allocation to cash, deposits and CBDC. All model specifications control for risk attitudes, anonymity preferences and demographics. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC Anonymity to specification (1). Columns (4) and (5) repeat specification (1) for EM allocation to cash and deposits.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 21: Regression Estimates for CBDC Adoption as Means of Payment, and Cash and Deposits Usage.

	Dependent Variable				
	(1)	(2)	(3)	(4)	(5)
Regressors	CBDC	CBDC	CBDC	Cash	Deposits
Treatment (=1 if CBDC = Anonymous)	0.574	-0.877	0.864	-0.810	-1.444***
	(0.698)	(0.733)	(0.789)	(0.661)	(0.454)
Treatment x Round	-0.116	0.134	-0.123	0.135	0.235***
	(0.156)	(0.155)	(0.155)	(0.110)	(0.087)
Round	0.448***	0.181	0.459***	-0.888***	-0.757***
	(0.095)	(0.113)	(0.098)	(0.140)	(0.064)
Risk	0.316***	0.360***	0.322***	-0.302*	-0.324***
	(0.048)	(0.059)	(0.049)	(0.155)	(0.086)
Income	0.082	-0.053	0.092	-0.011	0.438
	(0.254)	(0.269)	(0.253)	(0.371)	(0.363)
Age	0.019	0.043	0.020	-0.052	-0.061
	(0.041)	(0.063)	(0.041)	(0.051)	(0.057)
Gender	-0.123	-0.366	-0.119	2.174***	1.011*
	(0.377)	(0.422)	(0.387)	(0.588)	(0.566)
Anonymity	-0.093	-0.282	-0.095	-1.018*	-0.133
	(0.337)	(0.223)	(0.345)	(0.539)	(0.405)
Beliefs		3.182***			
		(0.916)			
CBDC Adoption Costs (=1 if Adoption Costs = 0.4)			0.634		
			(0.672)		
Treatment x CBDC Adoption Costs			-0.544**		
			(0.256)		
Constant	-1.177	-1.980	-1.582	7.377***	5.490***
	(1.555)	(2.025)	(1.730)	(1.896)	(1.929)
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Multilevel Logit regressions. Clustered standard errors in parentheses. The treatment variable is CBDC-anonymity, and outcome variables are CBDC adoption, and cash and deposits usage. All model specifications control for risk attitudes, anonymity preferences and demographics. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC adoption costs to specification (1). Columns (4) and (5) repeat specification (1) for cash and deposits use.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 22: Regression Estimates for EM Allocation to Cash, Deposits and CBDC.

	Dependent Variable				
Regressors	(1) CBDC	(2) CBDC	(3) CBDC	(4) Cash	(5) Deposits
Treatment (=1 if CBDC = Anonymous)	0.842**	0.327	0.881**	-0.277	-0.584*
	(0.342)	(0.279)	(0.443)	(0.217)	(0.322)
Treatment x Round	-0.140***	-0.061	-0.140***	0.047	0.097*
	(0.156)	(0.048)	(0.049)	(0.029)	(0.050)
Round	0.581***	0.345***	0.581***	-0.242***	-0.341***
	(0.026)	(0.045)	(0.026)	(0.019)	(0.039)
Risk	0.342***	0.336***	0.342***	-0.163***	-0.163***
	(0.062)	(0.057)	(0.062)	(0.049)	(0.053)
Income	-0.214	-0.240	-0.214	0.013	0.214
	(0.246)	(0.204)	(0.244)	(0.101)	(0.241)
Age	0.038	0.033	0.038	-0.026**	-0.016
	(0.036)	(0.032)	(0.036)	(0.013)	(0.042)
Gender	-0.495	-0.462	-0.492	0.416*	0.089*
	(0.370)	(0.304)	(0.370)	(0.237)	(0.287)
Anonymity	0.168	0.176	0.164	-0.385*	0.182
	(0.305)	(0.216)	(0.309)	(0.216)	(0.185)
Beliefs		3.567***			
		(1.098)			
CBDC Adoption Costs (=1 if Adoption Costs = 0.4)			0.279		
			(0.734)		
Treatment x CBDC Adoption Costs			-0.078		
			(0.236)		
Constant	1.231	-0.198	1.094	4.886***	3.957***
	(1.547)	(1.820)	(1.691)	(1.011)	(1.193)
Observations	1,600	1,280	1,600	1,600	1,600
Groups	16	16	16	16	16

Note: Mixed-effects regressions. Clustered standard errors in parentheses. The treatment variable is CBDC-anonymity, and outcome variables are EM allocation to CBDC, cash and deposits. All model specifications control for risk attitudes, anonymity preferences and demographics. Column (2) adds buyers' beliefs about CBDC seller acceptance to specification (1). Column (3) adds CBDC adoption costs to specification (1). Columns (4) and (5) repeat specification (1) for cash and deposits use.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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ISSN 2190-992X (online)
ISBN 978-3-86304-434-3