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CBDC AND TRUST IN A CENTRAL BANK: TRANSITIVITY OF PREFERENCES VS. THE PRIVACY PARADOX

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Abstract

The privacy and anonymity of transactions are considered some of the biggest challenges when designing Central Bank Digital Currencies (CBDC). While many surveys show that people strongly prefer privacy in their transactions, behavioral theories suggest that human behaviour in digital spaces is more complex, a phenomenon known as the privacy paradox. The research aims to measure privacy preferences in specific situations and examine how these preferences influence choices between anonymous transactions versus the design of CBDC functionality. The study used the ANOVA method to determine if there were significant differences between groups based on privacy preferences. Survey data from respondents in emerging markets showed a mild form of the privacy paradox. The research measured privacy tendencies in three areas: general, digital, and financial environments, and found a statistically significant correlation between these measures. However, the respondents' privacy preferences did not consistently align with their choices between transaction anonymity and CBDC functionality, nor did they consistently relate to trust in central banks as privacy guarantors or the importance of central bank independence for ensuring privacy. The ANOVA test found no significant differences in privacy preferences between respondents who prioritized anonymity or functionality, or between those who trusted or did not trust central banks to guarantee privacy and their independence in doing so. This suggests that when faced with complex decisions, people may exhibit intricate patterns of preference, which is crucial for optimizing CBDC design.

JEL classification: E41, E42, E51, E58, G20

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Introduction

The closer central banks get to technological readiness to introduce digital currencies, the more questions of optimal demand-side design arise. The correct identification of use-cases will determine the extent to which central bank digital currency (CBDC) will be an effective tool aimed at satisfying client needs. But this is not enough. CBDC can have quite different designs. Use-cases will only partially reflect design issues. Privacy becomes a unique design challenge for CBDC (Agur et al., 2021). Economic agents will make a choice from among the available payment instruments; and therefore, they will certainly ask, why CBDC? It is thanks to the digital transformation of money that the problem of privacy/anonymity/confidentiality became has become obvious. This problem stems from the fact that economic agents, choosing the CBDC, ask whether they are guaranteed enough privacy, how much privacy should they should give up compared to cash, and how much will they will gain in terms of the central bank digital currency functionality by giving up alternative payment instruments? In turn, central banks face another dilemma: how compatible are the technological capabilities, demands of economic agents regarding the consumer properties of CBDC, institutional frameworks for privacy guarantees, financial monitoring procedures, etc.? One of the most striking challenges for central banks is that they should propose CBDC design under some supply-side limitations and demand-side expectations.

This raises the question of the extent to which revealed (rather than stated) privacy preferences determine preferences for CBDC anonymity and functionality, and to what extent such preferences correspond to trust in the independence of central banks as prerequisites for their ability to guarantee transaction privacy.

Literature review

Research concerning the analysis of CBDC preferences is actively developing. Analysis of the demand for CBDC is presented in a number of works. The focus on privacy of CBDC transactions is quite varied. In complex randomized surveys with elements of a behavioral experiment, respondents favor those payment instruments that offer a higher level of privacy (Choi et al., 2023). The probability of choosing a payment method with a higher level of privacy increases in the case of purchasing “sensitive” goods (Choi et al., 2023). Other research, built based on surveys, confirm that respondents are more prone to choose privacy. The choice in favor of it increases with age, trust in the central bank is quite stable, and there is a certain connection between it and the choice in favor of privacy (Choi et al., 2023; Bijlsma et al., 2021; Abramova et al., 2022; Jian, 2020).

The issues raised in the literature regarding the demand for CBDC are at the intersection of many research areas, most of to which this article is also relevant to.

Firstly, the theory of money has been significantly enriched recently due to the search for new approaches to explaining the nature of monetary functions under the influence of digitalization (Brunnermeier et al., 2019; Kahn et al., 2005; Suslenko et al., 2022; Zatonatska et al., 2022). The privacy of money is a public good because it allows non-discriminatory treatment of payers by those who have access to the accumulation of customer profile data (Garratt & van Oordt, 2021). Behavioral experiments confirm that economic agents value the privacy embodied in traditional money (Borgonovo et al., 2021). But the preference for privacy is not constant and may be subject to trade-offs in certain cases determined by reward and liquidity propensity (Masciandaro, 2018).

Secondly, privacy as an immanent property of money (Kahn et al., 2005) is not a given in technological and institutional realities. Cryptocurrencies are pseudo-anonymous. Monetary transactions leave a digital footprint. CBDC cannot be designed to provide the privacy, anonymity and untraceability of transactions as in the case of cash. The authors (Auer et al., 2023) show, based on a stakeholder analysis, that ensuring untraceability of transactions may not correspond to the public optimum even though the choice in favor of privacy appears to be consistent with public preferences. And so, the issue of technologically combining the request for privacy with the possibilities to ensure it, is a certain challenge (WEF, 2021; ECB, 2019; Bank of England, 2020; Garratt & van Oordt, 2021; Tsang et al., 2023). It doesn't mean that central banks are not looking for ways to implement public choice regarding privacy and limit abuse by interested parties in accessing an individual's payment profile (Auer et al., 2023; Ballaschk & Paulick, 2021). The design of CBDC, the problem of transaction privacy and the political choice of central banks have become immanent objects of the digital economy study (Ahnert et al., 2022a; Ahnert et al., 2022b). Risks of technological gaps abuse and the institutional capacity of central banks to guarantee privacy/anonymity of transactions with the help of CBDC exist, as shown in several works (Pfister & de Seze, 2023; Tsang et al., 2023). Nevertheless, the ECB is unequivocal that the privacy of CBDC transactions should be guaranteed in the Eurozone, which corresponds with public demands (ECB, 2019; ECB, 2021) and is confirmed by respondent surveys (Bijlsma et al., 2021; Abramova et al., 2022). Although some the results (Kantar Public Survey, 2022) do not show an exclusive priority of privacy, compared to other virtues expected from CBDC.

Thirdly, there was interest in analysing privacy and privacy preferences developed before CBDC design began to be actively debated. The emergence of technological capabilities to collect payment data and analyse consumer profiles based on this has spawned a whole class of literature (Acquisti et al., 2016). A key feature of relevant research is to find out to which extent economic agents behave in accordance with their stated preferences and how optimal the personal data protection policy is. Most researchers conclude that there is a privacy paradox. That is, most empirical studies show a discrepancy between what economic agents say about their preferences and how they actually behave (Acquisti, 2004; Acquisti & Grossklags, 2005; Norberg et al., 2007; Barnes, 2006; Athey et al., 2017; Chen et al., 2021). In several works, such conclusions are questioned (Kokolakis, 2017; Solove, 2021). One article (Solove, 2021) provides a critical review of the theory used to explain the privacy paradox and the methodology by which this paradox is empirically tested. The literature presents positions that explain and rationalize the privacy paradox (Kokolakis, 2017; Barth et al., 2017; Gerber et al., 2018).

On the other hand, the literature is represented by research, which emphasizes the importance of the context of the economic agent's behavior (Barth et al., 2017; Hirschprung, 2023). It is also pointed out that the behaviour of economic agents is determined not only by the context, but also by the extent to which they rationally weigh the losses and benefits of actions/inaction to protect/ignore privacy (Culnan & Armstrong, 1999). In a survey on attitudes towards financial apps, respondents demonstrated that their calculation of losses and benefits is conditioned by the context (Brits & Jonker, 2023). In other words, the privacy calculus is a specific model of behavior, the elements of which are calibrated by specific circumstances. This is well illustrated in (van der Cruijsen, 2020). The author shows that the willingness to share information about oneself depends on whom the respondent interacts with. Credibility to the one who accumulates data affects the willingness to disclose information, i.e. the original strict condition on absolute preference for privacy is weakened according to the context-driven privacy calculus. Authors (Rosati et al., 2022) emphasize that in addition to the context in which an individual finds himself/herself, when deciding whether to share data, expected outcomes and propensity for risk are also important. Research (Brits & Jonker, 2023) underline the fact that the behavior of respondents in the privacy calculus style dominates. Other authors (Barth et al., 2019) instead emphasize that the privacy paradox prevails. In their experiment, technically savvy respondents preferred functionality over privacy, even though the claimed level of privacy should have indicated the opposite. Researchers (Cloos et al., 2019), in turn, point to the importance of the behavioral aspects of the privacy paradox. Changing the nature of questions during experiments can significantly affect the statistical significance of the relationship between the declared individual propensity for privacy and actual actions under the influence of various types of stimuli.

Fourthly, the study of trust is equally important both in the case of central banks and in the case of the economic agents' behavior in a digital environment. As shown above, the privacy paradox is a rather persistent factor affecting the way economic agents behave in the digital world. At the same time, there is a functional relationship between privacy and trust (Waldman, 2018). Trust is conditioned by the confidence of economic agents that their privacy is ensured. The behavioral analysis also shows that trust is formed through interactions that are not discriminatory or opportunistic in nature (McKnight & Chervany, 2001). Cultural and institutional factors influence the nature of trust to behaviour and preferences (Ahmed & Salas, 2009). Empirical tests of demand for CBDC note a correlation between trust in the central bank and privacy preference (Bijlsma et al., 2021; Abramova et al., 2022).

Fifthly, the independence of the central bank as a CBDC issuer should be considered in the context of prospective demand and trust. Theoretically, such independence is a prerequisite for functional efficiency, which corresponds to established approaches to the analysis of the central bank institution (Dincer & Eichengreen, 2014) and the sources of trust formation according to the institutional approach. Authors (Bordo & Siklos, 2015) point out that trust in central banks is generated by the ability to fulfil the mandate, even regardless of significant shocks. In existing surveys, the correspondence between propensity for privacy and trust in the central bank has not been considered in the context of what exactly drives trust to the latter and why it is important for privacy protection reasons. At the same time, (Tsang et al., 2023) claim that CBDC issuers should be institutionally disciplined in understanding the possibilities of guaranteeing privacy in conditions where it is technologically difficult to do so. Authors (Pfister & de Seze, 2023) caution that the design of the e-yuan is an example of how a government can impose dominance over an individual in institutional settings lacking true central bank independence. In (Koziuk, 2021b; Koziuk et al., 2024) the author argues that the political regime matters when it comes to the ability of an independent central bank to issue credible CBDC.

Gap identified under literature review

At the same time, the literature does not consider the extent to which privacy preference corresponds to economic agents' choice between the anonymity of CBDC transactions or the functionality of their design, and how such a choice correlates with their trust in the central bank as a CBDC issuer and trust into the fact that the independence of the central bank is a prerequisite for the ability to ensure the anonymity of transactions with the help of CBDC. This angle of view on the problem is the basis of the article.

The aim of the research is to quantify privacy preferences in particular settings and verify how the obtained indexes related between each other and choice among options: anonymity of transactions vs. functionality design of CDBC; trust in a central bank's ability to guaranty privacy of transactions vs. non-trust; and trust in central bank independence as a precondition for such guaranty vs non-trust. Chosen The selected empirical test provides an identification of allow to identify sequence of preferences toward privacy and elements of the privacy paradox at the same time, contributing to the deeper knowledge of how preferences are revealed in the case of CBDC. The contribution of the paper related to deeper understanding of consumer choice in a complicated environment then preferences are not directly comparable. Also, the paper contributes to the "privacy paradox" discussion. The paper supports to optimal policy choice of CBDC design taking into account that privacy concerns may be overestimated and overshadowed by better functionality. At the same time, it is stressed that trust in a central bank's ability to preserve privacy is impossible to ignore while highlighting possible directions for central banks evolvement in a digital world.

Methodology

The research methodology assumes that the issue of privacy is a complex phenomenon. The literature review demonstrated that choice testing in favor of privacy/anonymity allows a theoretical bias in the interpretation of empirical results. The design of surveys/experiments often determines the result and confirms the proposed hypothesis in the way expected by the researchers. Because of this, a persistent propensity for privacy, the privacy paradox, the privacy calculus, and context-driven behavior should be considered together. This allows some agnosticism about the specific forms of relationships between respondents' recorded privacy preferences and choices in favor of aspects of CBDC design, as well as the corresponding trust in central banks.

Unlike (Choi et al., 2023; Bijlsma et al., 2021; Abramova et al., 2022), who conducted a survey within a single country, the paper is based on received answers from 156 respondents from 4 countries (Ukraine, Zimbabwe, Nigeria, Uzbekistan). These countries do not demonstrate athe high quality of institutions. And therefore, the impact of institutional trust in CBDC issues and the anonymity of transactions with their help can appear extremely important. Authors (Koziuk & Ivashuk, 2021) note that in the case, where trust in the central bank's ability to guarantee anonymity is low, the choice in favor of CBDC functionality may prevail. That is, the inclusion in the sample of several countries with imperfect institutions will allow a better understanding of the extent to which privacy preferences can influence respondents' choices regarding the anonymity or functionality of CBDC and trust to their issuers.

Respondents were directly asked to fulfil a relevant Google form that had been sent to them through e-mail. The age of respondents is ranging from 18 to 53 years old, male and female. Their occupation, education and level of income wasn't in the scope of the research design. The number of respondents is looked appeared sufficient. The survey contains elements of behavioral experiments, and such a group of respondents may provide valid results also because the calculated index of individual propensity to privacy is not expected to vary in to a large scale. Thus, the additional respondents were unlikely contribute to the variance of group characteristics.

The design of the survey has been constructed as follows. Firstly, respondents answer 3 groups of questions (10 questions in each group (Appendix A) to reveal their propensity for privacy). They then answer the question of whether they prefer the anonymity of CBDC transactions or the functionality of CBDC design. After that, they answer the question of whether they trust that the in the central bank will guarantee the anonymity of CBDC-based transactions; and also, the question of whether they believe that the independence of the central bank is a guarantee of its ability to ensure the anonymity of CBDC transactions. After quantifying the individual's propensity for privacy in three contexts, the relationship between the answers to the questions is assessed. This can be shown schematically in the Table 1.

Table 1: Schematic representation of the relationship among survey design elements

Questions in which propensity for privacy is determined	Nature of the variable (individual index)		Questions about CBDC design and credibility of the central bank	Nature of the variable
Identification of a general propensity for privacy	Index of a general propensity for privacy (GPP)	Empirical test	Preference of anonymity over CBDC functionality	Binary: 1 – anonymity 0 – functionality
Considering the digital context	Index of propensity for privacy in the digital environment (DEP)		Trust in the central bank as a guarantor of the CBDC transactions anonymity	Binary: 1 – yes 0 – no
Considering the financial context	Index of propensity for privacy in the financial environment (FEP)		Trust that the central bank's independence is a guarantee of its ability to ensure anonymity of CBDC transactions	Binary: 1 – yes 0 – no

Source: Author's own work.

Determination of three indices of individual propensity for privacy (Table 1) is carried out based on a 5-point Likert scale. In each of three groups of questions, the questions are constructed in such a way as to consider the particularity of the context. Survey questions, based on which the corresponding indices on the Likert scale are constructed, are contained in Appendix A. A Likert scale approach is relatively standard practice and represented in (Cloos et al., 2019).

The nature of the relationships between the obtained three indices of individual propensity for privacy is empirically tested to reveal the sequence of preferences. A strong relationship between all three indices will indicate the transitivity of preferences as well as the absence of the privacy paradox, and vice versa. For this test, the construction of the Pearson correlation coefficient matrix is used, which is compared with the Spearman rank correlation matrix.

Then respondents are grouped depending on the nature of their answer to the question about the preference of anonymity over functionality and trust in the central bank and its independence as a guarantee of the ability to ensure the anonymity of CBDC transactions. Here the 3 possible results could be expected:

1. Sequence of preferences. High score of indexes of propensity to privacy corresponds with preference of anonymity over functionality of CBDC, trust in the central bank and its independence.
2. Preferences toward privacy are not in correspondence with choice toward anonymity over functionality, trust in central banks and its independence.
3. There are more complicated patterns of relations between choices.

Based on this, three pairs of groups are formed. ANOVA method is used to assess the degree of statistical significance of the difference between the average values of the corresponding indices in the section of groups. Of particular interest is the question of the similarity degree of the indices level of individual propensity for privacy in a pair of groups, each of which is formed by respondents with opposite answers to the question about the preference of anonymity over functionality (A > F). In the case where the statistical significance of the difference in the average value of the individual privacy preference indices in the group preferring the anonymity of transactions with CBDC (A > F) compared to the group preferring the functionality (F > A) is observed, and this average value is higher, the assumption that the consistency of privacy preferences extends to choices regarding CBDC design elements will be confirmed. In the opposite case (absence of a statistically significant difference between groups A > F and F > A), there will be a reason to believe that a certain form of privacy paradox exists. A similar test is used to analyse answers to questions about trust in the central bank. If the choice in favour of trust corresponds to a higher propensity for privacy, the importance of institutional factors anchoring trust and the connection between the preference for privacy and respect for authorities persists. In the opposite case, it can be said that the propensity for privacy does not affect the degree of trust in the central bank. The same applies to the question of the role of central bank independence.

Taking into account the results of the correlation analysis, which proved the consistency of the respondents' preferences (a fairly tight relationship between three indices of individual propensity for privacy) and the results of the variance analysis, which demonstrated the absence of a statistically significant difference between the average values of the indices of individual propensity for privacy in the corresponding pairs of groups, an assumption was made about a more complex form of connections among respondents' answers.

Results

Analysis of relationships between individual indices of propensity for privacy

Based on respondents' answers to questions grouped into 3 blocks (Appendix A), a quantitative assessment of propensity for privacy was obtained. Three relevant indices were calculated for each respondent – GPP, DEP and FEP (Table 1). Each of the indices is the result of the summation of the quantitative values corresponding to one or another answer according to the Likert scale. Descriptive statistics of three indices data indicate the presence of certain differences in the distribution (Table 2).

Table 2: Descriptive statistics of propensity for privacy indices (valid number – 156)

Indicators of descriptive statistics	Index of general propensity for privacy (GPP)	Index of propensity for privacy in the digital environment (DEP)	Index of propensity for privacy in the financial environment (FEP)
Mean	32.00	33.10	27.50
Median	32.00	34.00	28.00
Min	15.00	18.00	17.00
Max	46.00	44.00	38.00
St. Dev.	5.31	4.71	4.01
Skewness	-0.49	-0.55	-0.19

Source: Author's own work.

From the Table 2 it can be seen that GPP is the most variable among three indices: the largest standard deviation, the highest and lowest maximum and minimum values. FEP, unlike GPP, is the least variable. However, propensity for financial privacy appears to be the lowest compared to overall propensity for privacy and propensity for privacy in the digital environment. DEP, in turn, occupies an intermediate position due to the variability of values, but has the highest mean and median. All indices have a leftward skewness. The FEP is the closest to the normal distribution due to minimal skewness.

Descriptive statistics to some extent point to a mild form of the privacy paradox. The propensity for privacy in the financial environment should intuitively be high. However, the data of the correlation analysis do not allow to assert the lack of consistency in the respondents' preferences. Table 3 demonstrates the existence of a clear picture regarding the fact that the transitivity of "general privacy – privacy in the digital environment – privacy in the financial environment" can be traced in the section of an individual respondent.

Table 3: Correlation matrix of Pearson and Spearman coefficients for individual indices of propensity for privacy

Variables	Pearson			Spearman		
	GPP	DEP	FEP	GPP	DEP	FEP
GPP	1.000	0.446*	0.427*	1.000	0.943**	0.943**
DEP		1.000	0.350*		1.000	0.886**
FEP			1.000			1.000

Note: * p = 0.000; ** p = 0.05

Source: Author's own work.

The calculation of the correlation coefficients of both Pearson and Spearman demonstrates the presence of a direct relationship. Respondents with a higher propensity for general privacy demonstrate a higher propensity for privacy in both digital and financial environments. The transitivity of preferences is obvious. There is also a symmetrical level of correlation between the three indices in terms of the calculated Pearson and Spearman coefficients. The DEP and FEP pair show the weakest relationship, the GPP and DEP pair shows the strongest one. A somewhat weaker relationship in the case of FEP corresponds to the data of descriptive statistics. The individual propensity for financial privacy is somewhat more deviant. In general, this does not give reason to believe that the argument about the transitivity of preferences is weakened and the privacy paradox takes place. Rather, it points to the importance of the context in which respondents' choices may be modified by specific factors. In this case, the propensity for financial privacy seems counter-intuitively lower, although not so much as to claim the existence of a privacy paradox.

Distribution analysis of individual indices of propensity for privacy by group and the results of the ANOVA test

After determining the relationships between individual privacy propensity indices, the research question is how their level corresponds to the choice between CBDC design elements and trust in the central bank. For this, grouping is carried out according to the criterion of answers to three questions of the questionnaire. Accordingly, three pairs of groups are formed. The first pair consists of groups in which respondents chose CBDC anonymity (A > F) and in which they chose CBDC design functionality (F > A). The second pair of groups consists of respondents who believe that the central bank can ensure anonymity of CBDC transactions, and who disagreed with this thesis. The third pair consists of a group in which respondents trust in the independence of the central bank as a guarantee that it can ensure the anonymity of transactions, and a group in which respondents do not share this position.

ANOVA method has been used for formal statistical assessment of how significant the difference between groups is. The model is univariate. The null hypothesis is the absence of a statistically significant difference between the average level of the GPP, DEP and FEP indices in the section of groups formed by opposite answers to the corresponding three questions of the questionnaire. The results of this statistical test are presented in the Table 4.

Table 4: ANOVA results for three indices of privacy

Effect	SS	Degree of freedom	MS	F	p
GPP dependent variable					
Choice between anonymity and functionality	0.612	1.000	0.612	0.610	0.4343
Error	154.388	155.000	0.996		
DEP dependent variable					
Choice between anonymity and functionality	0.570	1.000	0.570	0.570	0.4504
Error	154.430	155.000	0.996		
FEP dependent variable					
Choice between anonymity and functionality	2.761	1.000	2.761	2.810	0.0956
Error	152.239	155.000	0.982		
GPP dependent variable					
Choice between trust in the central bank as a guarantor of anonymity and incredibility	0.045	1.000	0.045	0.040	0.8323
Error	154.955	155.000	1.000		
DEP dependent variable					
Choice between trust in the central bank as a guarantor of anonymity and incredibility	3.560	1.000	3.560	3.640	0.0581
Error	151.440	155.000	0.977		
FEP dependent variable					
Choice between trust in the central bank as a guarantor of anonymity and incredibility	0.113	1.000	0.113	0.110	0.7365
Error	154.887	155.000	1.000		
GPP dependent variable					
Choice between agreeing that independence is a guarantee of the central bank's ability to provide anonymity, and disagreeing	3.653	1.000	3.653	3.740	0.0549
Error	151.347	155.000	0.976		
DEP dependent variable					
Choice between agreeing that independence is a guarantee of the central bank's ability to provide anonymity, and disagreeing	0.570	1.000	0.570	0.570	0.4504
Error	154.430	1.082	0.996		
FEP dependent variable					
Choice between agreeing that independence is a guarantee of the central bank's ability to provide anonymity, and disagreeing	0.751	1.000	0.752	0.760	0.3861
Error	154.248	155.000	0.995		

Source: Author's own work.

The results, presented in the Table 4, indicate confirmation of the null hypothesis. For all three indices of individual propensity for privacy, the p-level exceeds 0.05. That is, the respondents do not show a statistically significant difference in the propensity for privacy, measured with the help of the relevant indices, choosing the opposite answer options.

Firstly, these results contradict to previous tests where the choice in favour of privacy corresponded with trust in the central bank (Choi et al., 2023; Abramova et al., 2022). There is no convincing connection between the propensity for privacy and trust in the central bank as an institution that can ensure it. The same is true for central bank independence. Respondents may or may not trust in a central bank and may or may not perceive its status as a guarantee of its ability to provide such anonymity. At the same time, if respondents trust in a central bank's ability to maintain anonymity of transactions, they are confident that its independence makes this possible, regardless of the privacy preferences or how they choose between anonymity and functionality in the design of a digital currency.

Secondly, the lack of statistical significance of the difference in the average values of GPP, DEP and FEP in the section of the group of respondents choosing A > F and the group of respondents choosing F > A raises the question that the change in the class of the phenomenon is a barrier for transitivity of preferences. It would be logical to expect that respondents with a higher level of individual preference for privacy would prefer anonymity over functionality. However, the ANOVA test did not confirm this. If there was no clear direct relationship between three indices of individual propensity for privacy, this result could be qualified as an example of the privacy paradox. But the respondents demonstrated the transitivity of preferences, which proves a statistically significant level of correlation between GPP, DEP and FEP (Table 2). So, if the privacy paradox exists, it is confirmed in a mild form within the framework of this test. Instead, it is more evident that respondents may perceive the propensity for privacy in the relevant context and the choice between anonymity and functionality of CBDC design as separate classes of phenomena. This is more closely related to the theoretical approach of the privacy calculus.

Discussion

Provided The research has "opened the door" for comprehensive discussion.

Firstly, as can be seen from the results of empirical analysis, the strict opposition of privacy preference and privacy paradox is not convincing, even despite strong arguments in favour of the latter (Acquisti, 2004; Acquisti & Grossklags, 2005; Norberg et al., 2007; Barnes, 2006; Athey et al., 2017; Chen et al., 2021; Barth et al., 2019). As this research shows, economic agents are consistent in demonstrating propensity for privacy in the general, digital, and financial environments. But this sequence breaks down when the class of phenomena changes or another context appears, for instance, when it comes to choosing in favor of anonymity or functionality of CBDC specifically. This is hardly a denial of the privacy paradox in the spirit of (Solove, 2021). But it is much closer to the privacy calculus approach in the spirit of (Barth et al., 2019; Brits & Jonker, 2023; van der Cruijsen, 2020) and research, which emphasizes the importance of context (Rosati et al., 2022; Hirschprung, 2023). It is also much closer to the problem of behavioural analysis presented in (Cloos et al., 2019). In a broader methodological sense, it appears that each specific case of an individual's interaction with the phenomena of the digital world needs to be analysed separately. At the same time, the approach of (Solove, 2021) still looks radical, as it invalidates the relevant theoretical starting points.

Secondly, the conclusions about the heterogeneity of the "population of individuals" are significant for economic policy. This also applies to CBDC. Central banks will have to take on the unusual role of a "marketer" to study the various aspects of demand for digital money to make its adoption both successful and efficient. The (ECB, 2019) indicates the priority of privacy when it comes to respondents' preferences. And a more specific focus on the ranking of priority consumer characteristics of digital money during the survey of (Kantar Public Survey, 2022) no longer demonstrates such a pronounced priority of privacy, which corresponds to other research (Barth et al., 2019; Brits & Jonker, 2023; van der Cruijsen, 2020). In such a situation, it is extremely difficult to use only theoretical assumptions about the nature of privacy in the digital world. Instead, empirical methods can accommodate certain theoretical bias. Bringing behavioral distortions to the fore in researching behavioral issues in the digital environment is important (Cloos et al., 2019). But the scaling of behavioral anomalies through the accumulation of many works with the appropriate design of experiments can completely paralyse policy decisions regarding digital money and further complicate the choice of central banks, prompting them to sink deeper into an unusual "marketing" function.

Thirdly, the issue of privacy preferences and trust ofto issuers of digital money is also not reducible to a certain a priori theoretical scheme. Known theories of credibility drivers emphasize the importance of the functional efficiency of institutions, in particular central banks (Bordo & Siklos, 2015). In contrast, little is yet known about the functional efficiency of central banks

as CBDC issuers. That is, trust in to them is either extrapolated or formed under the influence of a certain behavioral stereotype based on the principle of trust into authority, etc. In most studies of the demand for CBDC, the relationship between privacy preference and trust in the central bank as a digital currency issuer is traced (Bijlsma et al., 2021; Abramova et al., 2022; Choi et al., 2023). In contrast, in (Koziuk & Ivashuk, 2021) authors show that institutional factors can distort the choice between anonymity and functionality when trust in the central bank is weak. From the results of the empirical analysis in this article, it follows that there is hardly a direct relationship between the preference for privacy and trust in the central bank. This is one option that does not exclude an alternative. Most likely, trust in central banks as issuers of CBDC will still be formed. But at the current stage, it cannot be derived from a certain a priori theoretical construction.

Fourthly, the absence of commercial motives for access to user profiles by payment services is not yet a reason to believe that the central bank is automatically the best institutional way to protect privacy. Authors (Tsang et al., 2023) demonstrate data privacy vulnerabilities from a technological perspective, pointing to the importance of central bank independence. It is evidence of readiness to see the central bank as an institution that will support certain virtues of money. In our research, the significant correlation between trust in the central bank and trust into its independence as a prerequisite for ensuring the anonymity of transactions is not solely a manifestation of the respondents' consistency toward privacy. Trust in the central bank as a CBDC issuer and its independence as a guarantee of CBDC transactions anonymity do not always correspond to privacy/anonymity preferences. However, this does not mean that the issue of independence of monetary authorities is important only for those who prefer privacy/anonymity. The digitalization of money will require an appropriate institutional perimeter to protect central banks, regardless of how much society prefers the privacy of transactions. This will create a strong case for sustainable demand for CBDC for those who value privacy, without being a hindrance to those who do not value privacy as much. But this will be a prerequisite for maintaining confidence in the stage of CBDC operation, thanks to which the demand for them will be sustainable.

Conclusion

Privacy/anonymity of transactions is one of the key factors that will determine the design of central bank digital currency and will affect the demand for it. At the same time revealed vs. stated privacy is an issue of strong academic debate. This has direct relation to CBDC design motivating us to investigate how revealed (rather than stated) privacy preferences determine preferences for CBDC anonymity and functionality. The same is true for how privacy preferences relate to trust in central bank ability to guaranty privacy and its independence as a precondition for their ability to guarantee transaction privacy.

Using the survey of respondents and Likert scale propensity to privacy in general terms was quantified, in the digital and in financial environment. It is found that all three quantitative dimensions of privacy are strongly correlated among each other, however, they distributed a bit differently. The semi-strong argument of sequence of choice toward privacy in different settings is possible to be done with some recognition of potential for privacy paradox speculation. At the same time, where sequence of preferences is weakening then respondents should choose among alternatives of another sort. It is found that respondents with similar propensity to privacy made opposite choices in regard to anonymity vs. functionality of CBDC design, trust and non-trust in central bank, or trust and non-trust in central bank independence as a precondition to guaranty privacy. The ANOVA test confirms that with strong statistical significance. This mean that there are no differences in level of privacy preferences across groups of respondents that choose between alternative options. Such results suggest that: privacy paradox may exist in mild form, changes in the nature of chosen alternatives may break up sequence of preferences, and preferences related to complicated options may be organised among complicated patterns.

The contribution of the paper relates to enriching the "privacy paradox" discussion from the analysis of consumer preferences toward CBDC. The results support the idea that economic agents demonstrate a complicated structure of preferences and central banks surveys related to CBDC demand analysis should be based on elements of a behavioral approach.

The results are important for CBDC design choice. This mean that central banks should pay stronger attention to payment preferences and how to affect them when introducing CBDC. The privacy of transactions may be overestimated in certain cases, which, however, does not reduce its importance. The functionality of the CBDC will be critical to demand. Constructing a socially optimal CBDC design will require the central bank to immerse itself in the marketing-based discovery of consumer preferences which is challenging for them as for policymakers. Promoting CBDC, central banks should stress more on functionality and be credible enough to not confront consumers with a privacy-functionality trade-off.

At the same time, it is clear that CBDC demand research should go forward. Replication of results highlighted in the paper on a larger group is one possible path for further analysis. Some improvements in quantification of the propensity to privacy and sophistication of experiment design also may contribute to improve a central bank's preparations for CBDC demand analysis.

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Appendix A

Structure of the questionnaire for determining the indices of individual privacy propensity: general, digital and financial

Table A1: General attitude to privacy

Question	Variant of answers	Score
Are you comfortable disclosing information about your wealth (property, cash) on a claim?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that to disclose information about wealth helps to improve public services?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that to disclose information about wealth helps to improve private services?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you prefer to meet with friends at your home?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that it is not necessary for kids to have separate room?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
While living in a hostel would you prefer a larger number of neighbors?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Are you ready to share your personal hygiene things?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you often talk about events from your life during a long trip?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Is it appropriate for you to discuss sharp political or social issues with little known people?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1

Question	Variant of answers	Score
Is it appropriate for you to share emotions or experiences from your private life with colleagues or not close friends?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1

Source: Own elaboration.

Table A2: Attitude to privacy in the digital environment

Question	Variant of answers	Score
Are you active in social media?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that it is better when a social media profile (account) is open?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you share information about your private life events (traveling, visiting interesting places / events, meeting with friends) in social media?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you try to provide information in your social media profile (account) properly and in a timely manner?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Are you comfortable completing on-line polls or registrations?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you provide information about you in on-line polls or registrations when it is possible not to do so?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you agree that it is appropriate to track web-sight visitors' personal data?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you allow sites to trace your personal data?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1

Question	Variant of answers	Score
Do you think that digital service activity regulations are a proper guaranty against commercial use of your personal data?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Is it appropriate for you that your personal data could be in commercial use without your permission even when it helps with quality of services that you can potentially consume?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1

Source: Own elaboration.

Table A3: Attitude to privacy in the financial environment

Question	Variant of answers	Score
Do you prefer digital (arm-length) form of money transactions even when it requires initial client identification?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that digital transactions guarantee the same level of anonymity as paper money?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Are you comfortable with client identification procedures in financial institutions?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that information about you as a client is better protected in state-owned financial institutions than in privately-owned?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you presume that financial institutions must share information about you as a client due to a claim of relevant authorities?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you presume that financial institutions invest considerable efforts (funds) to protect your personal data?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you think that financial authorities guarantee protection of your personal data (client information) against abuse of other authorities?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1

Question	Variant of answers	Score
Do you think that financial authorities accumulate and process information about personal transactions only for better regulations?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Do you agree that to share personal data is riskier when it's required by financial institution with monopolistic power?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1
Is it appropriate for you to think that traceability of money in (financial) transactions will be a social norm?	In no case	5
	Rather not	4
	I don't know	3
	Rather yes	2
	In any case	1

Source: Own elaboration.