

A qualitative study of Central Bank Digital Currencies and their impacts on European consumers.

Author: Bor Roelofs
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,

This thesis aims to understand Central Bank Digital Currencies (CBDCs) and the kind of effects this new form of currency could have on European consumers. This impact is reviewed by analysing the impacts of different design elements, the costs and benefits of CBDCs for consumers and consumer behaviour concerning the adoption of CBDCs. This was accomplished through a qualitative research approach using academic literature from monetary organisations and research from independent academic scholars. For the analysis of consumer adoption, 2 academic frameworks were used. The Technology Acceptance Model to analyse consumer's intentions towards using CBDCs, and Privacy Calculus Theory to analyse consumer's thought process towards disclosing personal information. The thesis indicates the significant effects of different design elements on consumers, costs and benefits, and key attributes for successful consumer adoption. All in all this thesis shows that CBDCs can have significant impacts on consumers, both positive and negative, which will be influenced by design elements.

Graduation Committee members:

Dr. Jörg Osterrieder

Dr. Vijay Marisetty

Keywords

CBDC, Central Bank Digital Currency, Consumers, Technology Acceptance Model, Privacy Calculus Theory, European CBDC

1. INTRODUCTION

The 2008 financial crisis has greatly altered how many people perceive today's financial landscape; additionally, it has greatly damaged people's trust in our current banking system. Due to these developments, the widespread popularity of cryptocurrencies might come as no surprise. These cryptocurrencies offer a unique way of storing value without centralised government controls (Ward & Rochemont, 2019). With these recent digital financial disruptions, central banks have started to notice. Central Bank Digital Currency (CBDC), is a new unique form of digital money. This form of digital money is stabilised by being pegged to another currency and is centrally distributed by central banks. (McKinsey, 2023) Around 100 countries are exploring the possibility of introducing CBDCs into their monetary system. (IMF, 2022) Introducing a brand-new payment infrastructure incorporating CBDCs can potentially change how transactions are performed. A question which remains largely unanswered due to the novelty of this currency is how this revolution will translate to consumers. How will this development influence consumers, and how might they react? These questions, amongst others, will be critically evaluated in this research.

1.1 Research Objective

This research aims to understand CBDCs and their impacts on European consumers properly. This research will explain and clarify the effects of CBDCs on European consumers and inform monetary policymakers about consumer needs and preferences regarding CBDC implementation. This research will help educate and inform consumers about CBDCs and narrow the information deficit between consumers and policymakers.

This paper starts with a brief discussion concerning the literature and key concepts surrounding CBDCs in section 2. Then the study design will be described and evaluated in section 3. Consequently, CBDC implementation will be discussed by looking at design choices, infrastructure and analysis of ongoing practical cases of CBDC trials in section 4. Next, there will be a cost-benefit analysis of CBDCs from a consumer-oriented perspective in section 5. Consumer acceptance will be analysed through the scope of the "Technology Acceptance Model", "Privacy Calculus Theory", and the analysis of key adopting factors in section 6.

1.2 Research Questions & Hypotheses

This research will revolve around a single main research question (MRQ) accompanied by 3 smaller specialised sub-research questions (SRQ).

MRQ: What are the potential impacts of CBDCs on European consumers?

MH1: CBDCs will have significant impacts on European consumers. First, on how they perform transactions, relying more and more on digitally centralised forms of payment. Second on the collection of consumer data, with more and more of this data being collected, stored, and utilised by the European Central Bank.

SRQ1: How might CBDCs be implemented, and which design elements are important?

SH1: The first important design element will be to which degree anonymity is integrated into a CBDC payments system. This anonymity largely depends on technical design elements, for example, a token vs account-based system. Additionally, anonymity vouchers for small transactions could be introduced in accordance with the proof of concept by the ECB (2019).

The second important design element is the efficiency of a CBDC retail payment system. This refers to which degree

CBDCs can lead to increased efficiency for payment systems, leading to cheaper and faster payments. When evaluating this difference in efficiency, it is important not solely to focus on efficiency differences but also to look at if and how this difference gets transferred to consumers.

The third important design element is the user experience. This user experience consists of the ease of use and the perceived benefits of CBDCs. For this, it is important to evaluate how easy it is for consumers to acquire the currency and how easy and convenient it is to use.

The question of how CBDCs will be implemented is difficult to answer since this is largely a politically motivated decision. As this is merely a literature review about CBDCs and their impacts on consumers, this is not a research question will be answered since this study lacks any academic basis to speculate on political decisions.

SRQ2: What are the benefits and drawbacks of CBDCs for consumers?

SH2: The first benefit is that CBDCs can be an especially efficient medium of exchange. Under an account-based CBDC payment system, CBDC payments could be practically instantaneous and costless. (Bordo & Levin, 2017) Furthermore, due to their centralised design CBDCs may be able to monitor transactions better and detect and prevent fraud more easily. (Ward & Rochemont, 2019) However, it remains to be seen to which degree these general advantages will transfer to explicit advantages for consumers and if this increased centralisation and data collection will be in the best interest of consumers.

The primary negative of the CBDC payment system is the risk of increased monitoring of financial transactions leading to a decline in financial anonymity. This decline in anonymity will transfer into a decrease in privacy for consumers.

SRQ3: How might European consumers view and come to accept CBDCs?

SH3: This depends, on the one hand, on how the CBDC implementation looks from a technical standpoint. Take, for example, account-based vs token-based CBDCs. More intrusive forms of implementation that damage financial anonymity might be viewed as less favourable and will be perceived as bearing a higher privacy cost. According to PCT, this will require greater use benefits to be accepted. Additionally important is how the implementation is handled from a public relations point of view. Factors such as trust and credibility were very important, according to Tronnier et al. (2022). If this public relations part is handled correctly with care, this will go to great lengths in limiting pushback from the general public.

2. LITERATURE & KEY CONCEPTS

When evaluating CBDCs and their effects on European consumers, value can be extracted from first having a brief discussion about the available literature and key concepts surrounding CBDCs.

2.1 Definition and Characteristics of CBDCs

Juškaitė et al. (2019) say CBDCs have no universally accepted definition. Instead, researchers often define the idea of CBDCs as reliant on specific technological implementation choices or based on a set group of users. The BIS (2018) comes to a similar definition and states that CBDCs are not a well-defined term, instead referring to a number of concepts. However, by most CBDCs are perceived as a new form of currency issued by the central bank, fulfilling both the roles as a medium of exchange and a store of value. Barrdear & Kumhof (2016) of the Bank of England give the following definition to CBDCs: "By CBDC, we refer to a central bank granting universal, electronic, 24x7,

national-currency-denominated and interest-bearing access to its balance sheet.”. The BIS (2021) states in its annual economic report, “CBDCs are a form of digital money, denominated in the national unit of account, which is a direct liability of the central bank”. In a staff discussion note published by the IMF by Griffoli et al. (2018), CBDCs are viewed as a new form of currency issued digitally by the central bank and meant to be used as legal tender.

2.2 Overlap & Differences Characteristics of Other E-currencies

Through the introduction of the internet and online banking, digital transactions have become increasingly popular. While online banking has become widely adopted, a more recent trend in the financial world is e-currencies. E-currency is an umbrella term for cryptocurrency, stablecoins, and CBDCs. The first, perhaps most widely known, are cryptocurrencies. Cryptocurrencies stem back to the introduction of the first successfully decentralised cryptocurrency in 2009; Bitcoin. Cryptocurrencies are decentralised digital assets issued by individuals rather than governments. They work fairly similarly to regular currency in enabling users to make virtual payments for goods and services but without involvement from a central trusted authority. When making payments, cryptocurrencies rely on the transmission of digital information. To ensure unique transactions, they rely on cryptographic methods. Cryptocurrencies first gained wide attention in 2011, and with that, various digital coins emerged. (Farell, 2015) The second digital currency is stablecoins. Stablecoins are designed to minimise volatility by tying their value to a national currency or commodity, collateralising to different cryptocurrencies, or using an algorithmic formula controlling the supply. (Groby et al., 2021) A relatively new financial phenomenon is CBDCs. CBDCs are a type of digital currency issued by a central bank digitally. (Chohan, 2022) CBDCs are centralised and controlled by banks in opposition to cryptocurrencies and stablecoins. Additionally, their value is tied to a specific currency. (McKinsey, 2023).

2.3 Retail vs Wholesale CBDC

Retail CBDCs are an electronic variant of digital central bank money different from other central bank reserves. The primary purpose of these retail CBDCs is to serve as a currency for retail transactions. Wholesale CBDCs are digital forms of fiat currency that are reserved for large financial institutions. This fiat money is reserved for large wholesale settlements, which are most common in settlement operations between the central bank and their counterparties, the settlement of securities transactions between financial institutions and interbank payments. (Athanasios, 2021) Since this research primarily revolves around the perceivable impacts of CBDC implementation on consumers, the research will primarily focus on retail CBDCs since these offer more relevance in general use for most consumers.

2.4 Account vs Token based CBDC

Additionally, when looking at CBDC design, there is a difference between token-based and account-based systems. Under a token-based system, CBDC tokens would circulate digitally among private individuals and companies. Like Bitcoin, this approach to CBDCs would utilise some type of distributed ledger technology for confirming the chain of ownership and verifying transactions without needing direct involvement from the central bank. Unlike Bitcoin, however, the central bank has total control over the supply of the tokens. The second system is account-based; here, the CBDCs would be held in digital CBDC accounts. Payments would be processed by deducing funds from one

account and adding these funds to the other account. (Bordo & Levin, 2017)

An advantage of the account-based system is that once the necessary systems are established, transactions can be processed cost-effectively and practically instantaneously. Additionally, with the account-based method, there is greater data collection capability, allowing for more effective monitoring of unusual activity and tracking down fraud. Verifying a token-based system would be relatively expensive since all tokens' ownership records have to be stored in an encrypted ledger via blockchain technology. (Bordo & Levin, 2017)

2.5 Privacy Within CBDC

In opposition to physical cash, which does not generate extensive data, digital payments do. (Ahnert et al., 2022) Privacy has always been a major concern within the digital space, which is also true in the digitisation of currency. Physical currencies offer the greatest degree of anonymity, while CBDC administrators can potentially gain access to personal transactions. (Kaushik et al., 2020) While the build-up of data frees up opportunities for efficiency gains, policymakers have become increasingly critical of the power of data-centric business models. These data-centric business models can drown out their competitors, circumvent creative destruction and participate in price discrimination. Furthermore, large public scandals like Facebook and Cambridge Analytica have raised public awareness and made the public more critical of digital privacy issues. (Ahnert et al., 2022) In a proof of concept developed by the ECB (2019), the need for some kind of central overview is discussed since there have to be certain fail-safes for money laundering and the financing of terrorism. However, despite combating these somewhat extreme scenarios, there should also be some kind of digital anonymity. The proof of concept demonstrates the possibility of building a simplified CBDC payment system that grants its customers some degree of anonymity for transactions of a low value while safeguarding that transactions of higher values still pass all the mandatory checks.

2.6 Literature Concerning CBDCs Impacts on Consumers

Reviewing available literature, there was limited research exclusively focusing on CBDCs direct impacts on consumers. This is not to say CBDCs have no impacts on consumers; however, in the literature, there tends to be a focus on the more high-level consequences that can be difficult to accurately translate to direct consumer impacts.

Ward & Rochemont look to CBDCs as a way of increasing the safety and efficiency of both retail and large value payments. Furthermore, Bordo and Levin (2017) state that CBDCs could serve as a secure store of value and a stable unit of account under certain conditions. Furthermore, under an account-based system CBDCs would be a particularly efficient medium of exchange with practically instantaneous and costless payments. According to Santaolalla Montoya (2017), CBDCs could reduce the costs of handling cash for low-income households and would therefore benefit financial inclusion. This ability to improve financial inclusion is reiterated by Mu & Mu (2022), who also discuss CBDC's ability to improve financial inclusion. Besides lowering the costs of handling payments, these CBDCs could also improve financial inclusion, helping to distribute funds to geographically difficult-to-reach locations and providing stable payment infrastructure to help in natural disasters. However, the relevance of these inclusionary financial benefits is not unanimously agreed upon. Terták and Kovács (2022) state that the need for improved financial inclusion in a European context is neither obvious nor urgent. They argue that although the European

financial conclusion is far from complete, no theoretical and practical obstacles to its achievement could be solely removed by introducing CBDCs. Bordo & Levin (2017) see that with the fitting accompanying monetary policy framework, CBDCs could offer true price stability. In this scenario, households and businesses could plan for the future, knowing that the average costs of goods would stay relatively stable in CBDCs. This could be particularly helpful to low-income families and small businesses that do not have the resources to invest in financial planning to combat these risks. Terták and Kovács (2022) also discuss CBDC's potential to increase lending costs. This could occur through a substitution effect where consumers reduce their capital holding in commercial banks and move this capital to CBDCs. The bank's decrease in capital warrants a decrease in lending capabilities, leading to higher lending costs. CBDC also may have impacts on the degree of payment privacy of consumers. According to Kaushik et al. (2020), CBDC administrators may potentially gain access to potential transactions. Mu & Mu (2022) additionally noted that the traceable nature of CBDCs has raised privacy concerns.

2.7 Alternative Impacts CBDC policy

Besides the more easily perceivable effects of CBDCs on consumers, there are also more general high-level impacts that CBDCs could cause. According to Dyson & Hodgson (2016), CBDCs allow for more monetary policy tools. If digital cash were to replace physical cash completely, this would enable the opportunity to lower interest rates below the zero lower bound. Alternatively, demand for goods could be increased by performing so-called "helicopter drops", where freshly created digital money is distributed to citizens to enforce targeted price stability more easily. Regarding price stability, Bordo & Levi (2017) state that CBDCs could offer a scenario with true price stability with the accompanying monetary policy framework. In addition to these impacts on the monetary systems, Dyson & Hodgson (2016) also discuss digital cash's ability to encourage competition and innovation within the payment ecosystem. If the regulatory frameworks were to be changed, this could leave the possibility to make it significantly easier for new entrants to offer payment accounts and offer significant competition to existing banks. CBDCs additionally affect the environment; according to Santaolalla Montoya (2017), CBDCs contribute to the environment because they are not printed on paper and thus consume fewer resources. Mu & Mu (2022) argue that CBDCs could potentially aid in combating illicit activities and decrease a country's informal economy.

2.8 Driving Forces for CBDC Implementation

Recent interest in CBDCs stems from some advantages that CBDCs hold over traditional forms of currency. First, an account-based CBDC system could be a particularly efficient medium of exchange. Under this system, CBDC payments could be practically instantaneous and costless. (Bordo & Levin, 2017) Currently, we live in times of rapid digitalisation. Additionally, recent phenomena such as the covid pandemic have led to cash shortages and hygiene concerns regarding physical currencies. This has shifted consumers away from physical currencies toward digital transactions. (ECB, 2023) Due to the combination of an increasingly digital landscape and administrative advantages over transactional currencies CBDCs have become a widely studied topic.

In a survey conducted by (Kosse & Mattei (2022) from the BIS, 81 central banks were interviewed. From the results, the primary driving force of CBDCs in advanced economies was domestic payment efficiency, payment safety and financial stability considerations.

3. METHODOLOGY

The research paper will comprise of an extensive literature review encompassing academic literature and applying scholarly theories. In order to establish a comprehensive understanding of CBDCs, primary sources from reputable institutions such as the European Central Bank (ECB), International Monetary Fund (IMF), and International Bank for Settlements (IBS) were consulted. Additionally, scholarly works from independent researchers were evaluated to gain a nuanced and critical perspective. A systematic search was conducted using online databases such as Google Scholar and Scopus, employing relevant keywords to identify relevant papers. The primary keywords used were "CBDC" and "Central Bank Digital Currency," supplemented with additional terms such as "privacy," "consumer acceptance," "advantages," and "disadvantages" to gather more specific and focused information. In addition to these conventional methods of literature gathering, ChatGPT-3, an AI-powered chatbot, was sought to provide pertinent academic articles.

4. CBDC IMPLEMENTATION

In this section of the paper, there will be a discussion about the implementation of CBDCs. This will be achieved by analysing design choices, infrastructure and ongoing CBDC trials in China and Sweden.

In analysing the possible impacts of CBDCs on consumers, it is essential to understand that CBDCs do not have a single universally accepted definition. Instead, researchers often define the idea of CBDCs as reliant on specific technological implementation choices or based on a set group of users. (Juškaitė et al. 2019) Therefore, when discussing the impacts of CBDCs on consumers, it is important to first index the variety of choices that can be made implementation-wise and how these choices contribute to impact.

4.1 CBDC Features and Policy Consideration

In a joint report from several central banks and the Bank for International Settlements written by the Bank of Canada et al. (2020), 3 different design choices for CBDC implementation are discussed: instrument, ledger and incentive. These design choices have impacts on the amount of control the central bank has over the economic system, on the way the system operates for consumers and on the risks consumers are exposed to. The design choices that will have to be made are not entirely independent since they all have some effect on each other. Therefore, in order to set up a functional system, a set of coherent, well-fitting design choices will have to be made. Based on the joint report by the Bank of Canada et al. (2020) each design element will be briefly explained, after which an analysis of this design choices impact will follow.

4.1.1 Instrument Design Explanation

According to the Bank of Canada et al. (2020), the first design choice is the instrument. Here there are 2 primary considerations; first, there is the matter of whether a CBDC should be interest bearing and second, whether there should be a capital limit on individual holdings of a CBDC. Central banks are currently exploring the possibility of a cash-like CBDC that does not offer interest.

4.1.2 Effects of Instrument Design

In research by the BIS (2018), it was noted that the interest rate of a CBDC could serve as a tool to control the demand for CBDCs and influence economic conditions. An alternative could be to design a CBDC that is more deposit-like; however, this could hasten disintermediation for existing bank customers.

Limiting the allowed holding of CBDCs could avoid a crisis in the form of a “run to CBDC”; however, it could limit the effectiveness of CBDCs as an interest-bearing asset.

4.1.3 Ledger Design Explanation

The first of these 5 factors is structure. Here there are multiple options. The first is a centralised structure with which an intermediary would be required between transactions. The second option is a decentralised design, which would function without an intermediary. The third final structure option would be a combination of the two. Then there is the second component, the design of the payment authentication. The payment authentication system could be identity-based, token-based or multifactor. The third component regards the functionality of the currency. The ledger could either serve as a simple record of central bank liabilities or incorporate more sophisticated functions in the design. The fourth component is the access requirements. These requirements would establish which parties could provide supporting services and settle payments. The fifth and final aspect of ledger design is governance. This concerns a rulebook of roles and responsibilities and sets in place power limitations.

4.1.4 Effects of Ledger Design

Regarding structure, a centralised structure would, due to the inclusion of an intermediary, make it easier to incorporate more extensive security and anti-fraud measures. A decentralised ledger could make peer-to-peer and offline transactions easier. Lastly, a combined structure would be possible; however, this would significantly drive up the complexity, which could, in turn, significantly hinder the system's proper functioning. Concerning payment authentication, different systems can offer differing levels of privacy. Additionally, authentication methods could vary across payments, for example, larger value payments being subject to more thorough validation. When looking at the functionality of the currency, a more sophisticated design could increase initial adoption rates but comes at the risk of significantly increasing costs and limiting differentiation across service providers. Regarding the access requirements for third parties, this would significantly affect the safety and efficiency of the entire ecosystem. When determining the access requirements, there should be a delicate balance between encouraging private parties to engage in the system and ensuring safe and well-regulated environments in which these parties operate. The governance aspect formalises the roles and responsibilities of operators, participants and other service providers or stakeholders. It would also cover aspects such as to which degree the central bank would be capable of altering system elements and how privacy aspects are set up.

4.1.5 Incentive Design Explanation

The third design choice is how incentives will be organised. As with regular cash, introducing a CBDC infrastructure would come with start-up costs and running costs for maintaining the system. Consequently, an important consideration is who should bear these costs, organised through the incentive design.

4.1.6 Effects of Incentive Design

One way would be to assign these costs to public users; however, this could be a disincentive for adoption. Another option would be for the central bank to cover or decrease these costs with their profits to reduce or eliminate the need for consumer charges. The last option would be to bill the costs to service providers. However, these would need to have viable business models in place to cover these costs.

4.2 CBDC Architecture

In the BIS quarterly review written by Auer and Böhme (2020), the architecture of a retail CBDC is discussed. These

architectural designs vary in the roles and relationships between central banks, commercial banks and consumers. Additionally, the infrastructures impact consumer risk exposure, the system's effectiveness and complexity. Understanding each of these architectures is important since the choice in architecture can significantly impact the consumer experience and the broader financial ecosystem. All infrastructures could work with both account and token-based CBDCs, and in all scenarios, the central bank is the only party to issue and redeem these CBDCs. Based on the work by Auer and Böhme (2020), each infrastructure possibility will be separately discussed in the following 3 paragraphs then, . Then will be a separate paragraph discussing the differences in terms of consumer impacts between the 3 architectures

4.2.1 Indirect CBDC Model

In the indirect model, an intermediary is interposed between the consumer and the central bank, solely responsible for managing wholesale accounts. Consequently, in this infrastructure, the central bank does not keep a record of individual claims; this task is reserved for the intermediaries. Additionally, consumers lack a direct claim on the central bank but instead have a claim on the intermediaries, which also handle payments. This system is somewhat similar to our current financial system, which also operates with intermediaries. An indirect system alleviates the central bank from dispute resolution and individual consumer identification obligations. However, under this system, the central bank cannot maintain records of individual claims; it can only keep track of the claims held by the intermediary as a collective entity.

4.2.2 Direct CBDC Model

The direct model establishes a direct connection between the central bank and the consumer, eliminating the need for an intermediary. In this setup, the central bank assumes the responsibility of maintaining records for all balances and regularly updating them with each transaction. In the direct model, the central bank operates the CBDC directly, exclusively handling payment services without involving other parties. Customer due diligence procedures may be conducted by the central bank or delegated to the private sector.

4.2.3 Hybrid CBDC Model

The final option entails a hybrid CBDC combining elements from direct and indirect CBDC models. In this hybrid model, individuals can hold direct claims on the central bank while intermediaries continue to play a role in payment handling. This allows for direct interactions with the central bank and the convenience of utilising intermediaries for payment transactions. This type of CBDC infrastructure has 2 crucial elements. First, a legal framework to prevent payment service providers from putting CBDCs on their balance sheet so that these CBDCs are protected in the event of the failure of the payment service provider. Moreover, the legal framework needs to enable consumers to transfer their funds from a failing Payment Service Provider (PSP) to a functioning one. This provision ensures that consumers can safeguard their funds and mitigate potential risks associated with the failure of a PSP. Second, technical measures should be implemented to ensure consumers can transfer CBDC holdings between PSPs so payments can still be made even if one PSP experiences technical difficulties.

4.2.4 Direct, Indirect, and Hybrid, what is the difference in impact?

All three of the beforementioned models have their implications for consumers and the overall financial system in general. Since with an indirect CBDC system, a consumers claim is on an intermediary, which also keeps the claim records and not with

the central bank, if said intermediary were to run into problems and come under pressure, this might incur difficulties in determining who is the owner of the CBDC. This could potentially lead to lengthy and costly legal battles that do not offer a certain outcome. The direct CBDC system, while attractive due to its simplicity and eliminating the need for intermediaries, compromises the payment system's reliability, speed and efficiency. The third and final option, the hybrid CBDC, might offer better resilience than the indirect model, but this comes at the cost of a more complex infrastructure for the central bank. Nevertheless, the hybrid CBDC model is considered simpler to operate than a direct CBDC. Because with the hybrid CBDC, the central bank does not entail direct interactions between the central bank and consumers, this arrangement enables the central bank to concentrate on core processes while intermediaries take on supplementary services, including instant payment verification.

4.3 CBDC Experimentation and Trials

Discussing how and under which condition a proper CBDC strategy is implemented can be complicated and technical. To create a more tangible understanding of CBDCs, 2 examples of CBDC implementation are discussed.

4.3.1 People's Bank of China Digital Currency/Electronic Payment

The first example of CBDC implementation discussed by Auer et al. (2020) is the People's Bank of China (PBC) with their CBDC project, the Digital Currency/Electronic Payment (DC/EP) which is currently the most advanced CBDC project. The development of a CBDC in China dates back to 2014. In 2019, a pilot study specifically focusing on retail CBDCs was conducted. China's highly digitised economy relies extensively on private digital payment services. Within this industry, a duopoly exists wherein AliPay and WeChat collectively control approximately 94% of the mobile payment market share. (FSB, 2019) If the PBC decides to go further than the pilot stage, this Chinese CBDC will not fully replace cash but instead work complementary to cash. The current architecture of the DC/EP in China comprises a hybrid CBDC model. Under this model, the DC/EP serves as a direct claim on the PBC, the central bank. However, the onboarding process and real-time payment services are operated by intermediaries. These intermediaries are vital in facilitating user onboarding, conducting transactions, and providing seamless payment services within the DC/EP ecosystem.

Fan (2020) states that the PBC provides the core infrastructure, while intermediaries like commercial banks provide services. With this measure, the PBC prevents enormous risk build-up at the central bank. The infrastructure would consist of a mixed system with a conventional database and distributed ledger technology. Regarding access to the CBDC, the PBC has opted for a hybrid payment instrument that combines value-based, semi-account-based, and account-based features. The researcher Xu (2022) of the Japan Center for Economic Research identifies some potential impacts of Chinese CBDCs on consumers. One of these impacts is that on financial monitoring, due to the PBOC increased capacity of tracing and recording transactions, they can use this to combat corruption, money laundering and tax evasion. A concrete example of this could be a measure being put in place where all public servants are required to use CBDCs to combat corruption. A measure like this could assist in popularising CBDCs and improving user-friendliness. The author also identifies the CBDC's ability to be a valuable tool in subsidy distribution. It often happens that subsidies for poor and old people take a long time to be distributed to the entitled group. With the CBDC, these payments could be directly issued to the

entitled group. After payment, this money could also be monitored to detect fake accounts and combat subsidy fraud.

4.3.2 Swedish Riksbank E-krona

The second example of CBDC implementation discussed by Auer et al. (2020) is the E-krona by the Riksbank, the world's oldest central bank. Sweden, a highly digitised economy, has witnessed a substantial decrease in cash utilisation. (Sveriges Riksbank, 2019) Currently, the Riksbank is developing a proof of concept of the "e-krona." (Sveriges Riksbank, 2020) Like in China, this CBDC is intended to complement regular cash. Regarding its architecture, the CBDC in Sweden is designed as a hybrid CBDC model, representing a direct claim on the Riksbank. Payment operations, on the other hand, are handled by payment service operators. As for the infrastructure, the project relies on distributed ledger technology and utilises R3's code as its foundation. The access technology is account-based however, an option for low-value prepaid cards that are token-based is being considered. Additionally, although this is an account-based system, the currency is designed to keep the consumer anonymous for the Riksbank since intermediaries are responsible for identifying consumers.

According to (Armeliu et al., 2020.), there is value in data, and many payment providers actively offer low or no fees where consumer data is the product. Due to the presence of difficult to read user terms, consumers may not consistently be always of this fact. Therefore, a public alternative lacking commercial interest could be important since there is increasingly difficult to consistently pay with cash. Ingves (2018) states that a Swedish E-krona must be designed inclusively. Besides the traditional term in this context, there is also the inclusion of demographic groups such as the elderly, those with disabilities, and those who find it generally difficult to operate digital solutions. It should be the responsibility of the state to assist these individuals, and the private market can not solely fulfil these responsibilities.

5. CONSUMER-ORIENTED COST-BENEFIT ANALYSIS OF CBDC

The value of a CBDC payment system can be evaluated from a diverse field of perspectives. Since the research goal of this paper is to evaluate CBDCs from a consumer standpoint, this paper constructs a consumer-oriented cost-benefit analysis of CBDCs. In this analysis, concrete everyday costs and benefits will be evaluated, as well as more abstract theoretical costs and benefits under the condition that they somehow translate to consumers.

5.1 Costs

This section will comprise of costs and risks for consumers associated with CBDCs.

5.1.1 Intermediary Risks

According to Baer (2021), under an account-based CBDC system, financial intermediaries would preserve access to the same purchasing data they currently do. In addition to this regular data collection, there is the risk that banks end up in a position where they are forced to harvest and monetise data in the ways some FinTechs currently do. The reason is that they would not earn any net interest on the CBDC like with regular deposits. Additionally, under an indirect CBDC system with intermediaries, if an intermediary were to fall, this could lead to a dispute over deposited funds. (Böhme, 2020)

5.1.2 Privacy-related and Operational Risks

According to Mu & Mu (2022), CBDC's traceable nature, in comparison to cash, has triggered privacy concerns. Additionally, these authors indicate possible operational risks for data security that retail CBDCs might bring. Additionally, according to Kaushik et al. (2020), CBDC administrators can

potentially gain access to personal transactions. A potential solution might be keeping anonymity in place for lower-value transactions while preserving control for larger transactions, like done in the proof of concept by the ECB (2019).

5.1.3 Financial Costs

When evaluating CBDC costs, a significant cost to explore is implementation costs. The costs of implementing a CBDC strategy are, however, still unknown. (Baer, 2021) Estimating the costs of CBDC implementation is difficult since there are currently no set guidelines and technical details about how such a CBDC strategy would look.

5.1.4 Interest Rate Risks

Banks primarily finance their loans by means of deposits from regular individuals. In the case of an interest-bearing CBDC, which could serve as a very viable substitute for commercial bank money. A substantial risk could be that of a substitution effect taking place. If CBDCs are attractive for consumers to store their money in, this might reduce the total amount of deposits stored in commercial banks. The decreased amount of capital might, in turn, lead to reduced lending capabilities for commercial banks and, in turn, increase the cost of money lending for consumers and businesses. A solution currently considered by the ECB could be a quantitative limit to the amount of money stored in a CBDC account. (Terták & Kovács, 2022)

5.2 Benefits

This section will encompass the various benefits that CBDC could potentially offer.

5.2.1 Financial Inclusion

According to Mu & Mu (2022), CBDC could improve financial inclusion and reduce a country's informal economy. Compared to cash or private digital money, CBDCs can allow for opportunities to distribute funds to geographically remote locations, thereby decreasing financial exclusion. Additionally, with CBDCs, an infrastructure could be created to help in natural disasters. For the Central Bank of the Bahamas, the central bank of the Eastern Caribbean currency union and the central bank of Nigeria, these geographical benefits leading to more financial inclusion were cited as the primary driving force for introducing a CBDC payment system. Additionally, according to Santaolalla Montoya (2017), CBDCs could lower cash handling costs for low-income households and thereby benefit financial inclusion. However, according to Terták and Kovács (2022), this need for financial inclusion is, from a European standpoint, not obvious or urgent. They argue that although financial inclusion in Europe is far from complete in some countries there are no theoretical and practical obstacles to its achievement that could be solely removed by introducing CBDCs.

5.2.2 Combating Illicit Activity

Due to the anonymity that cash provides and the fact that cash does not create a paper trail, this makes it attractive for those engaged in illicit activities. (FATF, 2015) A CBDC could potentially help in solving this problem. While anti-money laundering (AML) and combating the financing of terrorism (FoT) may not be the central bank's primary objectives or the main motivations behind the development of CBDCs, it is expected that central banks adhere to and comply with the guidelines and regulations related to AML and CFT. (Mu & Mu, 2022)

5.2.3 Financial Independence & Stability

Currently, large foreign tech companies like Visa or Alipay may acquire a large amount of influence in national payment markets (Terták & Kovács, 2022). These large multinationals may not

always handle consumer data with the most care; a public alternative could be CBDCs without direct commercial interests. (Armeliuss et al., 2020.)

Furthermore, according to Bordo and Levin (2017), the central bank could actively manage the supply of CBDC to ensure price stability and prevent inflationary pressures. Dyson & Hodgson (2016) state that price stability in a full CBDC economy could be more easily achieved through injecting money into the economy with CBDCs.

5.2.4 Environmental Factors

Due to their digital nature, CBDCs do not consume paper or wood, consuming fewer resources, thereby contributing to the environment. (Santaolalla Montoya, 2017)

6. CBDC ACCEPTANCE & ADOPTING

Besides the discussions concerning design elements and the balance between costs and benefits, another relevant discussion concerns consumer behaviour and attitudes towards CBDCs. Value can be extracted by exploring consumer perceptions and attitudes towards CBDCs since they would be the primary users.. With this knowledge, European policymakers can more effectively create CBDC policy according to the preferences of European consumers, which might lead CBDCs to be perceived as more favourable.

To accomplish this goal, 2 academic frameworks will be utilised. The first of these 2 frameworks is the Technology Acceptance Model. (TAM) which has evolved to become a key model that can be used to understand predictors of human behaviour, particularly acceptance or rejection of new technology. The TAM suggests that the combination of perceived usefulness and ease of use are variables in determining a user's attitude towards using a specific technology. (Marangunić and Granić, 2014) The second academic framework used to analyse consumer adoption of CBDCs would be Privacy Calculus Theory (PCT). According to the PCT, people weigh perceived privacy risks and benefits when disclosing their personal information (Krämer, 2022) Then, there will be an analysis of key factors for adoption based on 3 quantitative studies investigating CBDC adoption.

6.1 Application of Technology Acceptance Model

With the help of the TAM, consumer perceptions towards CBDCs will be mapped into the following 2 categories, perceived usefulness of CBDC and perceived ease of use of CBDCs. By identifying these 2 categories, a better understanding of how consumers might perceive CBDCs as a new technology can be formed.

6.1.1 Perceived Usefulness of CBDCs

Davis (1989), the original author of the TAM, defines perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance".

In research investigating consumer intentions to use CBDCs in China, the author Liu et al. (2022) came up with CBDC-specific traits for perceived usefulness based on research by Davis (1989) and Albayati, Kim, and Rho (2020). Here the perceived usefulness consists of the degree to which CBDCs would improve the effectiveness of payment transactions, decrease transaction fees, would make it easier to conduct payment transactions and would be able to facilitate quicker payment transactions.

Given these characteristics, let's look at the effectiveness and speed of a CBDC payment system. First, there are Ward & Rochemont, who see CBDCs as a way of increasing the safety and efficiency of both retail and wholesale payments. Bordo and

Levin (2017) state that, under an account-based system, CBDCs could serve as a particularly efficient medium of exchange with practically instantaneous and costless payments. Estimating the ease of making payment transactions is rather difficult since a European CBDC payment system has not been introduced to base this on.

Although cheap payments bring somewhat obvious usefulness from saving costs, it is still ambiguous to which degree this cost reduction would translate to consumers and to which degree they notice it and perceive it as significantly useful. Then there is the element of the speed of transactions. In a study by Mavri & Ioannou (2006), more than 90% of recipients considered speed a valuable attribute in the electronic financial industry. From this the value of fast payments can be identified.

6.1.2 Perceived Ease of Use of CBDCs

Davis (1989), the original author of the TAM, defines the perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort".

In the Chinese research performed by Liu et al. (2022), several CBDC-specific traits for the perceived ease of use are set up based on research by Davis (1989) and Shahzad et al. (2018). Here the perceived ease of use consists of the difficulty of learning to use CBDCs, the difficulty of using CBDCs, the degree to which interactions with CBDCs would be clear and understandable and the difficulty it would take to become skilful using CBDC.

Considering Davis's original definition and Liu's applied characteristics, this ease of use consists of 2 primary components. First, there is the ease of use regarding how difficult it is to operate CBDCs. This can range from activities such as making payments, transferring funds between accounts or setting up an account or wallet. How difficult this could vary per person or demographic since this somewhat depends on an individual's technological capabilities. Additionally, this aspect of the ease of use largely depends on the user interface and design choices.

Second, there is the ease of use in terms of using CBDC as a regular currency. This largely depends on how widely accepted CBDCs are. For example, if a consumer has to go out of their way to search for a store that accepts CBDCs, it might drive them to view CBDCs as an inconvenient payment method. These factors influence the convenience of using CBDCs as regular currency, influencing perceived ease of use.

6.1.3 Attitude Towards Use

According to the TAM, the factors of perceived usefulness and perceived ease of use should positively influence a consumer's attitude towards using a technology which would, in turn, positively influence the usage behaviour. (Marangunić and Granić, 2014) To accurately measure the perceived usefulness it is important to understand that the point of this paper is not to quantify the complete picture in terms of the usefulness of CBDCs but rather to measure to which degree CBDCs would most likely be perceived as useful by a consumer, this perceived usefulness could vary significantly across types of consumers. Then for the perceived ease of use, drawing conclusions on this is difficult since CBDCs are not in use within Europe. Therefore no comment can be made on whether they are widely accepted as an adequate payment system. Additionally, using CBDC due to being a digital currency would most likely require some level of digital knowledge, which can vary across consumers.

Since the thesis employs the application of the TAM on the speculative scenario of European CBDC implementation, it can not be concluded that perceived usefulness stemming from lower costs and almost instantaneous transaction lead to increased use of CBDCs. Additionally, since CBDCs are not in use in Europe

no formal conclusion can be drawn on the technical usability of the currency, nor measure whether it is a frequently accepted currency in (online) venues. Nevertheless, value can be extracted from mapping out the benefits and ease of use of CBDCs to better understand factors influencing consumer adoption through the TAM.

In the study by Liu et al. (2022), 344 Chinese CBDC users were surveyed. The data showed that both the perceived ease of and the perceived usefulness positively and directly affected an individual's behavioural intentions towards using CBDCs. Confirming the framework of the TAM within CBDCs. These results, however, must be interpreted somewhat cautionary since this is a study undertaken in China, and results might vary in Europe.

6.2 Application of Privacy Calculus Theory

The PCT will allow for a more nuanced understanding of how consumers experience and perceive privacy risks in opposition to the benefits they experience from CBDC use. Understanding how consumers experience privacy risks will allow for a better understanding of the balance between compromising some forms of privacy for optimal functionality.

6.2.1 Perceived Benefits

When analysing the perceived benefits of CBDCs it is important to look at the most concrete, easily perceivable benefits of CBDCs from a consumer standpoint. Examples of these perceivable benefits could be improvements in safety and efficiency in retail payments. (Ward & Rochemont, 2019) or introducing an account-based CBDC system with practically costless and instantaneous payments. (Bordo & Levin, 2017) Then there are the benefits CBDCs can bring in terms of financial inclusion (Mu & Mu, 2022), (Santaolalla Montoya, 2017) this can help give access to financial services to those who may have lacked access before.

A study undertaken by Jabbar et al. (2023) takes this privacy calculus and puts it into practice in the field of CBDCs with a quantitative study utilising an online survey. In this study, benefits and privacy concerns regarding CBDCs were evaluated. Here the benefits were made up of convenience and ease of use. According to the study's findings, convenience and ease of use significantly impacted the perceived benefits of CBDCs. Consequently, perceived benefits significantly impacted willingness to disclose personal information.

6.2.2 Perceived Privacy Risks

According to the study by Jabbar et al. (2023), perceived privacy risks significantly negatively impacted the willingness to disclose personal information. Looking at CBDCs there are some risks to consumers. According to Mu & Mu (2022), the traceable nature of CBDCs have triggered privacy concerns additionally, Kaushik et al. (2020) state that CBDC administrators can potentially gain access to personal transaction.

6.2.3 Willingness to Disclose Personal Information

According to PCT, individuals weigh perceived privacy risks and benefits when disclosing personal information (Meier & Krämer, 2022) Since both the advantages as well as the risks are somewhat subjective and individuals may vary in terms of risk aversion and preference, it remains difficult to estimate an individuals willingness to disclose their own personal information.

Results from the study by Jabbar et al. (2023) suggested that although participants originally had a negative perception towards disclosing personal if significant enough perceived benefits were present this could drive them to disclose this personal information.

6.3 Key Adopting Factors

In quantitative research by Bijlsma et al. (2021) written for “De Nederlandsche Bank,” the central bank of the Netherlands consumer acceptance of CBDCs is investigated through a survey among Dutch speakers. The study investigated the adoption of CBDC savings and current accounts and found that roughly half of the participants would be willing to open an account in either. The study showed the influence of personal factors; males, people under 35, people with high incomes and homeowners were more likely to adopt CBDCs. CBDC knowledge also proved significant. Those with more CBDC knowledge were more willing to open a CBDC savings or current account and were more willing to deposit larger amounts in a CBDC current account. Privacy also proved significant the degree participants valued privacy was positively related to their willingness to open a CBDC current account. Individuals with a higher degree of trust in their own bank, the central bank and banks, in general, were likelier to open a CBDC current account than others. When it came to the amount of money these users wanted to deposit, this related positively to their trust in the central bank and negatively to their trust in banks in general. When it came to the CBDC saving account only the trust an individual had in the central bank correlated positively to opening an account. The final discovery was that participants were more willing to store their money in a CBDC savings account if this account offered a higher interest rate than that of commercial banks. The final discovery was the influence of interest rates on participants’ willingness to store money in a CBDC savings account. Participants’ intention to store their money in a CBDC savings account was higher if the central bank offered a higher interest rate than commercial banks and lower if the central bank offered an interest rate lower than commercial banks. The exact degree to which these interest rates differed did not matter, only the sign that it was higher or lower.

A study undertaken by Tronnier et al. (2022) seeks to investigate privacy concerns and trust-related issues regarding CBDCs in Germany. The study draws multiple conclusions from an extensive quantitative study. The study investigated important factors for the adoption of CBDCs. In the study, multiple conditions for successful adoption by consumers were identified, first are the perceived benefits, which according to the study, positively influence the usage intention. Second, there are privacy concerns which, according to the study, negatively influence consumers’ willingness to use CBDCs. The third important factor is trust factors, here, the study differentiates between soft and hard trust factors. Soft trust factors can be identified as credibility and the central bank’s image. Hard trust factors refer to more technical elements such as liquidity and price stability. From these two trust factors, soft trust factors demonstrated a stronger influence on both privacy concerns and willingness to use the digital Euro. The hard trust factors showed to not significantly affect privacy concerns but did significantly affect a consumer’s willingness to use CBDCs. Then there was also the perceived vulnerability and control over personal data, respondents would only use the digital Euro if they remained in control over the sharing of their personal information. Also, those that felt their personal data might be misused by different actors showed greater privacy concerns than those who perceived that they could more easily deal with privacy threats.

A study conducted by Solberg Söilen and Benhayoun (2021) investigated household adoption of CBDCs, this was accomplished through a digital survey with participants from various continents but with 82% European participants. According to the research, households were quite knowledgeable about these currencies and were ready to adopt if this would assist them in increasing the efficiency of their financial

transactions. According to the research, the degree to which CBDCs met their expectations significantly affected consumer adoption. Second, social influence also had a significant influence, participants were more willing to adopt CBDCs if the perceptions and opinions of peers were favourable. Third was facilitating conditions which constitute the availability of resources, knowledge and skills facilitating CBDC use. Fourth there was trust which also proved important for adoption. Fifth, the study found that ease of use can foster CBDC adoption but under the condition that there is consumer trust in the currency.

6.4 Integration of Frameworks and Key Adopting Factors

With the help of the TAM, PCT and identifying key adopting factors, human behaviour towards adoptions of CBDC can be better understood.

With TAM 2, primary variables concerning consumer adoption can be better understood. Identified are the perceived usefulness stemming from quick, cheap and efficient payments. For ease of use, 2 subcategories are identified: the difficulty of using CBDCs in a technological sense and as a viable payment method. These 2 factors would theoretically positively influence the attitude towards use, according to Davis (1989) and do in the Chinese study by Liu et al. (2022).

The PCT seeks to investigate the balance between the benefits of CBDC use and privacy risks by analysing a consumer’s internal cost-benefit analysis. The benefits here constitute quick, cheap and efficient payments and the possible inclusion of more individuals into the financial system. Then there are privacy risks which are general concerns regarding the privacy of CBDCs and the potential for CBDC administrators to gain access to payment transactions. The benefits and privacy risks should theoretically form the basis of a consumer’s cost-benefit analysis when disclosing personal information (Meier & Krämer, 2022) In the study by Jabbar et al. (2023), individuals originally had a negative perception towards giving up their personal info however they were willing to if the perceived benefits were significant enough.

Serving to complement and add to the 2 frameworks is the quantitative research performed towards consumer adoption by Bijlsma et al. (2021), Tronnier et al. (2020) and Solberg Söilen and Benhayoun (2021).

This research investigates consumer adoption and identifies important conditions for successful adoption. According to the research by Solberg Söilen and Benhayoun (2021), households were already quite knowledgeable about CBDCs. They would be willing to adopt them if they could increase the efficiency of their payment transactions. According to Bijlsma et al. (2021), roughly half of the participants would be willing to open a CBDC payment or savings account. From these participants, personal factors were important; males, people under 35, those with high incomes and homeowners were more likely to adopt CBDCs than those not meeting these criteria. The significance of trust in CBDC adoption can also be identified from the research by Bijlsma et al. (2021), where it is divided into narrow-scope and generalised trust. Those with a higher narrow scope and generalised trust were more likely to open a CBDC current account. The amount of money deposited was positively related to trust in the central bank and negatively related to broad-scope trust in general. Regarding CBDC savings accounts, trust in the central bank correlated positively to the willingness to open savings accounts. Tronnier et al. (2020) also identify trust as significant but differentiate between soft and hard trust factors. The soft factors had the more significant impact and impacted both privacy concerns and willingness to use CBDCs. Hard trust

factors only influenced the willingness to use. In the work by Solberg Söilen and Benhayoun (2021), trust also comes back as relevant, being important for adoption and serving as a condition for the effect of ease of use to be significant towards adoption. Then Tronnier et al. (2020) identified perceived benefits as positively influencing willingness to adopt CBDC and privacy concerns as negative. Furthermore, the vulnerability in terms of privacy was seen as negative towards usage intention. Concludingly, Solberg Söilen and Benhayoun (2021) identified social influence as significant for adoption and whether CBDCs met performance expectations. Furthermore, interest rates played a role in whether individuals would be willing to deposit funds in a CBDC savings account. Participants were more willing to store their funds in CBDC's savings accounts if the interest rate was higher than that of commercial banks.

Combining the TAM and the PCT allows for an understanding of consumer perceptions regarding the trade-offs of adopting CBDCs. The TAM shapes the attitude towards use; however, this analysis is not complete without introducing some kind of cost-benefit analysis. Here the PCT comes into play as a tool for performing a consumer perspective risk-benefit analysis shaped by perceived benefits and privacy risks. To add further dimensions to these 2 qualitative frameworks, key adopting factors are introduced originating from quantitative research. These key adopting factors work independently but complement the models by identifying relevant factors for successful adoption from measurable results.

7. OVERVIEW OF FINDINGS & CONCLUSION

This section will comprise of an overview of the findings of the thesis and the conclusion.

7.1 Overview of Findings

This section will provide an overview of findings ordered by the sub-research questions,

7.1.1 Sub-research Question 1

The first sub-research question is *“How might CBDCs be implemented, and which design elements are important?”* this research question is investigated in section 4. As discussed in section 1.2, how CBDCs will be implemented will not be evaluated due to being largely politically motivated instead, there will be an analysis of relevant design elements and ongoing CBDC trials. Regarding design elements, the thesis primarily explores 2 design elements: the design choices consisting of the design of instrument, ledger and incentive and the CBDC architecture consisting of indirect, direct and hybrid models.

Starting with the design choices, the first is the instrument. With interest rates, this could control CBDC demand and change economic conditions. It could also possibly hasten disintermediation risks, this could be avoided by limiting allowed holding, but this could limit their effectiveness. Second, is ledger design, where a consideration should be made between more easily incorporating security measures and allowing easy peer-to-peer offline payments. This design element also sets up the handling of authentication, functionality, and access requirements for third parties and sets roles and responsibilities for operators and other service providers or stakeholders. Third is incentive design, which considers which parties will bear the start-up and operating costs of CBDCs.

Then there is the second design element, the CBDC infrastructure. In an indirect system with intermediaries, consumers are potentially exposed to the risk of the financial failure of an intermediary, which could potentially end with a dispute over their funds. A direct system could pose hindrances

to consumers since this would severely compromise the system's reliability, speed and efficiency. Although the hybrid system comes with better resilience than the indirect model, this comes at the cost of a more complex infrastructure, although still simpler to operate than a direct system. With this hybrid CBDC system, the central bank does not have to deal directly with consumers enabling the central bank to concentrate on the core processes.

Regarding SH1, when originally writing this hypothesis, I still had limited knowledge about how a CBDC would technically work and therefore presumed the outcomes in terms of effects as the design choices themselves, which with the knowledge of now, deems the hypothesis as irrelevant.

7.1.2 Sub-research Question 2

The second sub-research question is, *“What are the benefits and drawbacks of CBDCs for consumers?”* This research question is evaluated in section 5 with the help of the consumer-oriented cost-benefit analysis.

Regarding costs, first, there are privacy risks associated with CBDCs due to CBDCs' traceable nature and potential misuse of intermediaries. Second, there are potential operational risks for data security. Third, the costs of setting up and maintaining a CBDC payment system which are still unclear. Fourth there is the potential of a substitution effect drawing consumers away from commercial banks, decreasing their capital and thereby increasing lending costs for consumers.

Regarding benefits, first CBDCs could potentially improve safety, efficiency and costs of payments. Second CBDCs could potentially allow for improved price stability. Third CBDCs could potentially allow for more financial inclusion. Fourth CBDCs could aid in combatting illicit activity and decreasing the informal economy. Fifth, due decreased use of resources, they are beneficial for the environment.

Then regarding SH2, the benefits identified still hold up however, they lack some elements, these being inclusion, financial independence and stability and benefits to the environment. The drawback of potential privacy concerns also holds up but misses the elements of financial costs, interest rate risks, intermediary risks and operational risks.

7.1.3 Sub-research Question 3

The third sub-research question is: *“How might European consumers view and come to accept CBDCs?”* This research question is answered by applying the TAM, PCT and identifying several key adopting factors.

The application of the TAM allows for a fresh perspective to study the potential acceptance of a CBDC payment system. Here we view the perceived usefulness of CBDC, which stems from potentially fast, cheap and efficient payments. Then there is the perceived ease of use, which comprises the technical difficulty of operating the payment system as a consumer and the practicality of using CBDCs as a regular everyday payment system. Theoretically, these two factors should positively influence the attitude towards the use of consumers and the adoption rate. This is backed up, at least within a Chinese context, by the study by Liu et al. (2022).

The PCT allows for a consumer-oriented perspective on analysing the privacy risks of CBDCs. PCT assumes that these consumers make a rational cost-benefit analysis when disclosing their personal information. The first part of this equation is the perceived benefits, fast, cheap and efficient payments and increased financial inclusion. The other part of the equation is perceived privacy risks. This study is put into practice within the CBDC context by Jabbar et al. (2023), who discovered that

although individuals initially had a negative outlook towards disclosing their personal information, if the perceived benefits were significant enough they were willing to disclose this information.

In analysing key adopting factors, some variables proved especially significant for consumer adoption of CBDCs. Personal characteristics proved important; those with high income, homeowners, males, and people under 35 were more likely to adopt CBDCs than those that did not meet these criteria. Additionally, trust, perceived benefits, privacy concerns, social influence, meeting expectations, and interest rates compared to commercial banks played significant roles.

Then regarding SH3, the technical implementation strategy's connection to consumer acceptance was not researched due to a lack of literature discussing this connection. Regarding public relations, this proved significant from the quantitative studies where trust, privacy concerns and perceived vulnerability all played a role.

7.2 Conclusion

The conclusion will answer the main research question: "*What are the potential impacts of CBDCs on European consumers?*" and briefly reflect on the main hypothesis.

All in all, this research shows that CBDCs could potentially hold significant implications for consumers. These can be direct effects on consumers or more indirect effects through monetary policy.

The type of impact is, for a significant part, determined by how these CBDCs are implemented. First, there are varying types of instruments, ledger and incentive designs. Second are the indirect, direct and hybrid infrastructure models. The design choices have great bearing over how exactly the system would operate, what roles and responsibilities are for different stakeholders and which stakeholders would have to bear the costs for CBDCs.

Through the architecture, the inclusion of intermediaries can have significant effects. Cutting out intermediaries might sound attractive to the simplicity however, this comes with a very complicated infrastructure with compromised reliability, speed and efficiency. Interposing intermediaries might be a solution, but this can create risks for the deposited funds of consumers if these intermediaries were to run into financial troubles. A hybrid solution could offer a moderate approach.

CBDCs have benefits and drawbacks, which are not easily quantified and of which the weight is somewhat subjective. On the one hand, benefits such as inclusion, combatting illicit activity, safety, efficiency, financial independence, effectiveness as a currency, stability, and sustainability all paint CBDCs as a very attractive innovation. On the other hand, there are also potentially significant risks and drawbacks, such as intermediary risks, privacy and operation risks, financial costs and interest rate risks. The consideration of whether the benefits outweigh the risks is one that policymakers must consider with great consideration.

In terms of the perspectives of European consumers towards CBDCs, the perspectives of consumers can be better analysed using the TAM and PCT. Through the TAM, the acceptance of CBDC is analysed as a new payment technology, and with PCT, a consumer's internal cost-benefit analysis towards disclosing personal information is studied. Additionally, some key adoption factors can have big consequences in terms of consumer adoption. These factors show that individuals are more likely to adopt CBDCs if they are trusting and think CBDCs can benefit them. Privacy concerns and their perceived vulnerability negatively influenced them towards adopting CBDCs.

Additionally, demographic factors had an effect if participants were males, older than 35, had a high income and were homeowners; they were more likely to adopt CBDC.

Reflecting on the extensive body of research reviewed, CBDCs can be viewed as a significant innovation in the payment landscape with significant potential implications for the European consumer base. CBDCs bring significant direct and indirect benefits to consumers by allowing for potentially cheap, efficient and safe payments while at the same time providing benefits for a more inclusive and stable financial environment. In opposition to these benefits are the risks of such a system comprising risks in terms of privacy, interest rates, intermediaries, operation and potentially significant costs associated with the payment system's introduction and maintenance. However, these benefits and drawbacks are subject to fluctuation in part to how the implementation is handled. How consumers might come to perceive and eventually accept CBDC implementation will remain largely ambiguous and vary per person however, through the analysis combining the TAM and PCT as well as the integration of key adopting factors, human behaviour in terms of technology acceptance and tradeoffs of new technology can be better understood.

Reflecting on the main hypothesis formulated at the beginning of this thesis time will tell if or how CBDCs might be implemented. First, there will be the question to which degree consumers will start relying on CBDCs as a payment method and how centralised the system will be based on the design elements. Then there will be the degree to which CBDC data is collected by the central bank and how this data might be utilised. At this time, besides identifying significant impacts of CBDCs on consumers, no definitive conclusion can be made on how it would actually look in a European context.

8. LIMITATIONS & FUTURE RESEARCH

This research works with limited data since this is a quite recent topic with literature primarily based on hypothetical scenarios or individual countries. In identifying key adoption factors, some studies were used using data from digital surveys or data from non-European countries. Similar research into key adoption factors could be conducted for future studies that would benefit from a representative European sample population to more accurately assess how CBDCs might be successfully implemented in Europe. The academic frameworks provide a high-level overview of consumer acceptance of new technology and a consumer's internal cost-benefit analysis towards giving up digital information but lack a quantitative basis to reach objective conclusions. Future studies might benefit from reapplying these frameworks in a European context but through a quantitative analysis instead of a qualitative one. With this approach, more detailed conclusions could be made regarding accepting CBDCs as a new technology and into a consumer's internal cost-benefit analysis towards providing personal information.

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11. APPENDIX

The BIS (2021) provides the following 4 takeaways for CBDCs:

- 1) “Central bank digital currencies (CBDCs) offer in digital form the unique advantages of central bank money: settlement finality, liquidity and integrity. They are an advanced representation of money for the digital economy.”
- 2) “Digital money should be designed with the public interest in mind. Like the latest generation of instant retail payment

systems, retail CBDCs could ensure open payment platforms and a competitive level playing field that is conducive to innovation.”

3) “The ultimate benefits of adopting a new payment technology will depend on the competitive structure of the underlying payment system and data governance arrangements. The same technology that can encourage a virtuous circle of greater access, lower costs and better services might equally induce a vicious circle of data silos, market power and anti-competitive practices. CBDCs and open platforms are the most conducive to a virtuous circle.”

4) “CBDCs built on digital identification could improve cross-border payments, and limit the risks of currency substitution. Multi-CBDC arrangements could surmount the hurdles of sharing digital IDs across borders, but will require international cooperation.”