VILNIUS UNIVERSITY
FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

FINANCE AND BANKING MASTER PROGRAMME

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MASTER THESIS

VARTOTOJŲ POŽIŪRIS Į CENTRINIO BANKO SKAITMENINĖS VALIUTOS ĮVEDIMĄ	THE CONSUMER VIEW ON CENTRAL BANK DIGITAL CURRENCY ADOPTION

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Vilnius, 2023

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GLOSSARY

ACCA – Association of Chartered Certified Accountants

AEs – advanced economies

BIS – Bank for International Settlements

CBDC – Central Bank Digital Currency

CPMI – Committee on Payments and Market Infrastructures

DLT – distributed ledger technology

DNB – De Nederlandsche Bank

ECB – European Central Bank

EMDEs – emerging market and developing economies

IMF – International Monetary Fund

MAS – Monetary Authority of Singapore

MC – Markets Committee

P2P payments – peer-to-peer payments

INTRODUCTION

The technological progress brings novelties into the financial system almost daily. Businesses and consumers are getting more interested and engaged in the usage of new tools within the digital monetary transactions system. Digitalization of economies provides a new way to look at the traditional banking and payment systems, and therefore, fosters the development of a new environment where key market participants either have to adapt to a new reality and smoothly transfer their payment activities (transactions) in a remote mode through electronic means or left aside modern financial markets. With the appearance of private cryptocurrencies such as Bitcoin and Ethereum, central banks as the main money market regulators and overseers over the monetary policies within a particular country, understood that they could be left out of modern markets if they are not going to be part of the digitalization process. Central banks of various countries, developed and developing ones, realized that once being out of fashion for creating their own digital currencies, the private money market and digital platforms will be able to decrease their role. Therefore, they started researching and developing their own concept of a digital currency called central bank digital currency (CBDC). Many banks have already finished at least a research stage of CBDC and now are moving toward more advanced stages.

The topic of CBDC has been widely investigated by a group of researchers (Auer & Boehme, 2020; Barontini & Holden, 2019; Boar & Wadsworth, 2020; Cornelli & Frost, 2020) from the Bank for International Settlements (BIS) from an economic perspective, while from a legal perspective, the scientific papers on CBDC have been published by the researchers (Alwazir, Davidovic, Farias, Khan, Khiaonarong, Kiff, & Malaika, 2020; Bossu, Itatani, Margulis, Rossi, Weenink, & Yoshinaga, 2020) from the International Monetary Fund (IMF). On a par with those famous international financial institutions, the articles on CBDC have been released by the central banks' research groups around the globe. For example, the researchers (Bijlsma, van der Cruijsen, Jonker, & Reijerink, 2021) from De Nederlandsche Bank (DNB), the central bank of the Netherlands, have published a working paper on the triggers of consumer adoption of CBDC, while the researcher (Bindseil, 2020) from the European Central Bank (ECB) has studied the effect of CBDC launch on the financial system and the researchers (Kumhof & Noone, 2018) from the Bank of England have presented a scientific paper on CBDC design principles. Therefore, all those institutional researchers keep publishing a lot of data on assessing the risks of launching CBDC from a macroeconomic and legal perspectives or on prospective design features of CBDC.

However, the aspect of a consumer view on prospective CBDC adoption has not been clearly addressed in their scientific articles and reports. Only the reports on CBDC provided by independent research companies such as PureProfile and OMFIF Digital Monetary Institute have been primarily focused on studying consumer attitudes toward CBDC and how consumer concerns related to CBDC launch can be considered by policy-makers. Therefore, this master's thesis is aimed at filling the gap between a theoretical approach to CBDC studies and lack of analyzed data by providing prospective consumers' opinions on CBDC functions, potential benefits and challenges, overall consumers' willingness to explore the topic of CBDC and use this currency once it will be launched by central bank.

The object of the research. Consumers' opinions on potential CBDC launch in their country of residence in the near future.

The problem of the research. While CBDC has been widely explored from economic and legal perspectives in many scientific articles and reports, there is lack of data on consumer attitudes toward CBDC adoption from financial institutions and other independent research companies.

The aim of the research. The goal of this master's thesis is to assess the consumer view on CBDC adoption.

The main objectives of the research:

1. To analyze scientific literature that describes the concept of CBDC and provides an overview of consumer view on CBDC adoption.
2. To describe the methods that are used to systemize and analyze the findings about consumer attitudes toward CBDC adoption in their country of residence in the near future.
3. To analyze the obtained empirical results and compare them to the research findings published by financial institutions and independent research companies.
4. To assess the future of CBDC adoption from a consumer perspective.

Research method. To analyze the consumer view on CBDC adoption, a quantitative research method is employed within the following master's thesis. Two tests are used to analyze the data collected through a survey: the One-Proportion Z-test (for hypotheses testing) and the Chi-square test of independence (for correlation / association analysis). Based on these tests' results, all the necessary conclusions are drawn.

Structure of the research. The following thesis project consists of three main parts. The first part covers general information about CBDC design features, benefits as well as economic and legal challenges, and current CBDC developments as well as provides a brief overview of the consumer view on CBDC adoption. The research methodology part includes the description of five research questions and ten hypotheses to test these research questions as well as the description of a correlation / association analysis between the selected variables identified in each of ten hypotheses and demographic variables. This part also contains information about sample size estimation, data collection methods and questionnaire design, data analysis methods and assessment criteria, and limitations. The last part explains the results of hypotheses testing and association analysis, compares them to the results published in other reports by independent research companies on a similar matter, and provides the views of central banks' researchers on the research questions discussed. Finally, conclusions and recommendations are introduced.

1. SCIENTIFIC LITERATURE REVIEW FOR ASSESSING THE CONSUMER VIEW ON CBDC ADOPTION

This chapter establishes and examines the context for the study of CBDC. This part will introduce a short history of money, define digital currencies and their types, provide several definitions for CBDC and explain its design features, examine CBDC benefits as well as economic and legal challenges, include an overview of CBDC developments, and finally provide an overview of the consumer view on CBDC adoption.

1.1. Short History of Money

According to Graham (1940), money serves three main functions: a medium of exchange, a store of value, and a unit of account. The function of money as a medium of exchange allows people to "purchase goods and services to survive or satisfy the demand for specific desires" (Martens, 2021, p. 1). Another function of money as a store of value makes money's long-term value sustained in case no goods or services are bought (Martens, 2021). Lastly, the function of money as a unit of account in society is necessary to "price different goods and services, record debts, and make calculations using the same units (e.g., in euro)" (Martens, 2021, p. 1).

Money first appeared back in 770 B.C. According to Davies (2003), the conventional form of money is used by people to sell goods indirectly (a medium of exchange), store their long-term value (a store of value), and price goods in the same unit (a unit of account). The value of money is therefore determined by the mutual agreement regarding how much it is worth.

With the development of the financial system, there was a need for an intermediary called bank to account for the transactions on behalf of the buying and selling parties. In the past, a bank performed traditional functions such as accepting deposits, transferring funds, lending, exchanging money, and issuing debt. This allowed this financial intermediary to become very influential and expand the banking industry as such.

Currently, there is a new trend toward using alternatives to the traditional financial system with a bank as the main intermediary, and thus, the concept of decentralized finance has appeared and gained certain popularity in society. According to this new concept, there is no need for the established intermediary such as bank to record transactions, while decentralized finance offers a "peer-to-peer network of nodes" without any permissions from a regulatory body (Martens, 2021, p. 1). Decentralized finance applications vary from virtual money, or e-money (e.g., cryptocurrencies), to "unsecured credit via peer-to-peer lending platforms" (Martens, 2021, p. 1).

Coming back to the definition of money, decentralized finance applications certainly have a monetary value. And therefore, in the near future, there are quite high chances that decentralized virtual means of exchange, with all their advantageous features, will at least complement or even replace the conventional form of money with its less attractive features. That is why many researchers believe that the rise of private money projects such as decentralized finance applications, cryptocurrencies, and stablecoins has prompted central banks to consider launching their own digital currency called central bank digital currency (CBDC). However, there is not only a competition of central banks with tech giants such as Facebook (currently known as Meta) and its stablecoin called Diem, but central banks also compete among themselves fearing of currency substitution, for example, fearing of replacing their national currencies with the US dollar. Therefore, central banks more than any other financial institutions are interested in the successful development and launch of CBDC across their countries.

1.2. Digital Currencies and Their Types

Digital currency is a form of currency that is managed, stored, and exchanged only in a digital or electronic form. Nowadays there are a lot of digital currencies in the financial market such as cryptocurrencies, virtual currencies, and central bank digital currencies. Table 1 identifies the key differences between cryptocurrencies, stablecoins, and CBDCs.

Cryptocurrencies represent a digital currency in which the verification of transactions and maintenance of records are conducted through a decentralized system using cryptography rather than through a centralized system (ACCA, 2022). Therefore, the key feature of cryptocurrencies is in their decentralized nature. Cryptocurrencies function with the help of a blockchain technology. Based on this technology, every new transaction must be confirmed and agreed by the sender, the receiver, and a third party as well as recorded in a digital record called blockchain. Cryptocurrencies are usually stored in digital wallets on computer hard drives or smartphone applications and protected with passcodes (ACCA, 2022). One of the popular cryptocurrencies nowadays is Bitcoin. It is a decentralized digital currency that is neither represented in any physical form nor issued or backed by any private corporation or government (Bilotta, 2021). The demand for Bitcoin determines its value and thereby makes this digital currency very fluctuating: when people purchase more Bitcoins, their value increases; when they sell them, their value decreases respectively.

Stablecoins are another type of digital currencies. They represent digital tokens that have no physical form, are issued by a private corporation, and are tied to the value of a cryptocurrency, another currency (e.g., the US dollar), a basket of currencies, or exchange-traded commodities (e.g., gold). The value of the aforementioned assets determines the value of stablecoins, and this, in turn, provides a more secure digital currency. These features also allow to reduce price volatility when compared to cryptocurrencies. In 2019, there was an attempt by Meta (formerly known as Facebook) to launch its own stablecoin called Diem (formerly known as Libra). It was supposed to be backed by a basket of currencies, such as the US dollar and the euro, yet due to the ongoing criticism and regulatory concern, the project was abandoned in January 2022. Currently, there are two popular stablecoins in use: Tether and USCoin. They redeem at one to one for the US dollar and offer price stability that makes them a suitable means of payment. Stablecoins work with the help of the decentralized blockchain technology that allows them to conduct fast, cheap, and global transfers without any intermediaries (Adrian & Mancini-Griffoli, 2019).

Table 1 *Key Differences Between Cryptocurrencies, Stablecoins, and CBDCs*

Comparative Characteristics of Digital Currencies	Types of Digital Currencies		
	Cryptocurrencies	Stablecoins	CBDCs
Is this digital currency issued by a government?	No	No	Yes
Is this digital currency backed by a private company?	No	Yes	No
Is this digital currency's value linked to a country's monetary policy or other assets?	No	Yes	Yes
Is this digital currency centralized?	No	Yes/No	Yes

Source. Author's elaboration from Nicola Bilotta, "CBDCs for dummies: Everything you need to know about central bank digital currency (and why you shouldn't be afraid of it)," in *IAI Papers*, 2021, p. 6, https://www.iai.it/sites/default/files/iaip2124.pdf.

Central bank digital currencies (CBDCs) are also a type of digital currencies. They are digital versions of the physical coins and notes issued and guaranteed by central banks, and for now, they are intended to exist alongside physical money rather than replace it (ACCA, 2022). CBDCs can provide an efficient and low-cost payment system based on centralized or decentralized (blockchain) technology, facilitate financial inclusion by introducing a "safe and

liquid government-backed means of payment to the public," establish a "direct depository link between central banks, households, and companies," and offer safety in times of financial crisis (ACCA, 2022, p. 6). The definition and design features of CBDCs will be considered in more detail in the next sections of the following scientific work.

1.3. Definition of CBDC

CBDC represents a specific type of digital currencies. To be counted as a form of money, CBDC must perform primary monetary functions as a medium of exchange, store of value, unit of account, and standard of deferred payments. Thus, according to a general definition provided by the International Monetary Fund (IMF), CBDC is viewed as "legal tender in digital form" (Lee et al., 2021, p. 53). CBDC is also considered as the next evolutionary step in the process that started from metal currency to banknotes backed by metal and lastly to fiat money. Also, if CBDC incorporates all the desirable features in the future, it could become a replacement for the physical cash that is currently used. In addition, CBDC could serve as a complement to electronic money M1 and function in a similar manner as well as become a fully-backed reserve. Therefore, CBDC can be defined as a new form of electronic central bank liabilities that can be a means of payment and store of value, while having all the desirable features of M0 and M1.

However, currently researchers are facing certain issues while finding the precise definition of central bank digital currency (CBDC). Different articles define CBDC differently due to its varying stages of the financial development, different goals, and needs set by the countries' regulatory bodies and their prospective consumers. Therefore, for ease of understanding, Table 2 has been compiled by the author of the following master's thesis project to provide a summary for the most commonly used definitions of CBDC based on the reports from some prominent institutions that are currently involved in CBDC research.

Table 2 *Definition of CBDC*

Year	Author	Definition of CBDC
2018	Bank of England	An "electronic central bank money which is more widely accessible than reserves, is interest bearing, has functionality for retail transactions, has a different operational structure as compared to other forms of money" (Kumhof & Noone, 2018; Meaning et al., 2018).
2018	Bank of England	An "electronic, fiat liability of a central bank that can be used to settle payments or as a store of value" (Kumhof & Noone, 2018; Meaning et al., 2018).
2020	Committee on Payments and Market Infrastructures (CPMI)	A "new form of central bank money, a central bank liability, denominated in an existing unit of account, which serve both as a medium of exchange and a store of value" (Bossu et al., 2020).
2020	International Monetary Fund (IMF)	A "new form of money, issued digitally by the central bank and intended to serve as legal tender" (Bossu et al., 2020).
2020	International Monetary Fund (IMF)	A "digital representation of a sovereign currency issued by and as a liability of a jurisdiction's central bank or the monetary authority" (Kiff et al., 2020).
2020	European Central Bank (ECB)	A "form of central bank money which is managed through electronic means and is accessible to the larger public" (Bindseil, 2020).
2020	Bank for International Settlements (BIS)	A "digital form of central bank money that is different from balances in traditional reserves or settlement accounts" (Auer et al., 2020).

Source. Compiled by the author.

Therefore, various organizations define central bank digital currency differently based on the emerging theoretical developments and applications. Researchers are far from reaching a common understanding regarding this concept. In any case, CBDC can be designed to serve a specific sector of the society (retail versus wholesale) and perform certain functions. However, the definitions of CBDC will continue to expand, and it is unlikely that the debate on its definitions will end soon.

1.4. CBDC Design Features

Meanwhile, CBDC is viewed as a controversial topic in the researchers' community not only because of the difficulties with offering one concrete definition, but also because of the variety of CBDC types that could be distinguished based on its purpose, infrastructure, architecture, access, and status.

1.4.1. Retail and Wholesale CBDC

Based on the purpose, CBDC can be either retail or wholesale, or both. A retail CBDC is available to the general public for all transactions, while a wholesale CBDC is used only by financial institutions and for bank-to-bank transactions and settlements (Atlantic Council, 2022). Table 3 reflects a summary of the differences between retail and wholesale CBDC.

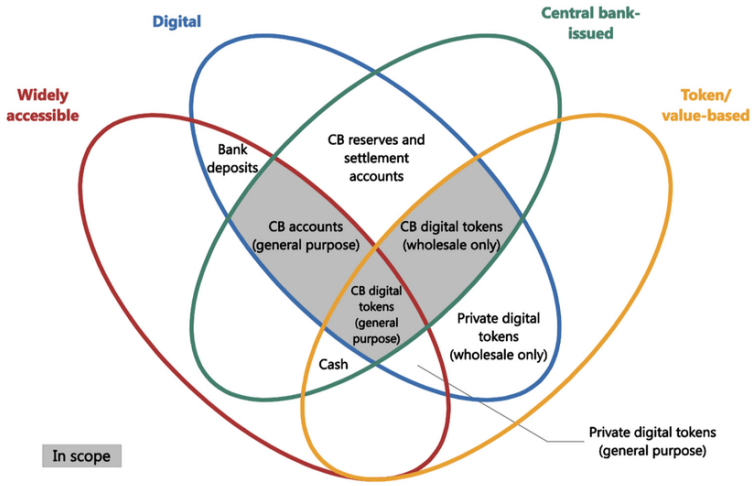
Table 3 *Summary of the Differences Between Retail and Wholesale CBDC*

Retail CBDC	Wholesale CBDC
Suitable for central banks in emerging economies	Suitable for central banks in advanced economies
Present potential threats to monetary policy and financial stability	Offer effective retail payments and settlement systems with real-time and highly available operations
Generally meant for general public and average consumers for conducting daily transactions	Suitable for exchanging and trading among central banks and private banks
Benefits of traceability, availability, and anonymity	Benefits of faster cross-border transactions
Retail CBDCs are responsible for taking away intermediary involvement and reducing the threats of criminal activities	Improve the speed and safety of existing wholesale financial systems with economic advantages

Source. Geroni, D., *What Are Retail and Wholesale Central Bank Digital Currencies (CBDCs)?*, 15 January 2021, https://101blockchains.com/central-bank-digital-currencies-cbdc/.

According to Bilotta's report (2021), the retail CBDC is viewed as a breakthrough within the researchers' community. The retail type of CBDC can be also called a "general-purpose" CBDC that is a digital currency that can be accessed by and available for retail clients (Bilotta, 2021, p. 7). The key feature that makes the retail type of CBDC more unique compared to the digitalized form of money that people have access to currently through debit and credit cards as well as mobile applications is a liability that is transferred from any financial institutions where clients have their bank accounts such as commercial banks to central banks. According to the CBDC tracker compiled by the Atlantic Council (2022), forty-four countries that had explored or are currently investigating the idea of launching CBDC chose to work on its retail type. This shows the novelty and interest of a global financial community to this type of digital currency. Figure 1 shows a taxonomy of money focused on the differences between retail and wholesale CBDC.

Figure 1 *BIS' Money Flower: A Taxonomy of Money*



Source. Bank for International Settlements, 16 January 2022, https://doi.org/10.1080/17538963.2020.1870279.

On a par with the retail CBDC, there is the wholesale CBDC. This type of CBDC already exists in the traditional financial system in a form of "digital money balances" that people own and in a form of "digital reserves" that central banks issue to banks (Bilotta, 2021, p. 7). Bilotta notes that modern users of various mobile payments systems, such Apply Pay and Google Pay, as well as card holders no longer deal with coins and bills as they use their digitalized forms (Bilotta, 2021, p. 6). Meanwhile, these digitalized forms of bills and coins are accessed only by financial institutions, and these institutions are in charge of "maintaining reserves and deposits to back [them] up" (Bilotta, 2021, p. 6). This evidence therefore allows many researchers to conclude that the wholesale CBDC that can be accessed only by certain financial institutions already exists "in many jurisdictions as a settlement asset in the interbank market" (Bilotta, 2021, p. 7). However, according to the data from the Atlantic Council, many central banks do not give up an idea to launch and perhaps improve or provide proper functioning of wholesale CBDCs: the United Arab Emirates, Saudi Arabia, Singapore, and Malaysia are interested in issuing wholesale CBDCs. At the same time, wholesale digital currencies are currently used by some countries that are testing wholesale cross-border payments projects. For instance, the central banks of Australia, Malaysia, Singapore, and South Africa joined the Project Dunbar led by the Bank for International Settlements (BIS) to test the usage of CBDCs in the international settlements (Atlantic Council, 2022, n. p.). The results of this project are planned to be published in 2023 (Atlantic Council, 2022,

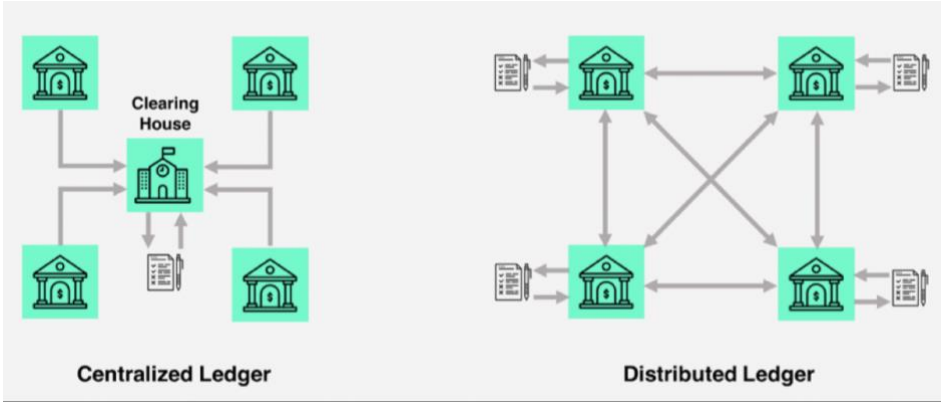
n. p). Therefore, although the wholesale CBDC does not seem to be a novelty in the financial industry, there is room for improvements and discoveries within the area of wholesale CBDCs.

1.4.2. CBDC Based on Conventional or DLT-Based Infrastructure

Based on the infrastructure, CBDC could function through a conventional centrally controlled database or through a distributed ledger technology (DLT) (Atlantic Council, 2022). The CBDC architecture is quite a debatable topic not only within the financial community, but also within the IT community. A conventional centrally controlled database functions in one particular location and is under control of a central authority. In other words, conventional databases are resilient due to the data storage over "multiple physical nodes that are controlled by one authoritative entity—the top node of a hierarchy" (Auer & Boehme, 2020, p. 92).

By contrast, DLT, with blockchain as one of DLT types, is a database that functions in different locations or within multiple participants and is not controlled by any central authority. Therefore, there is no one organization that processes, validates, or authenticates transactions, and therefore, the DLT-based infrastructure is more transparent and resilient (Zignuts Technolab, 2018). Also, according to Marco Polo Network (2018), the distributed ledger stores all the files in a timestamped form, with a unique cryptographic signature; all the participants can view all the questionable records; as well as this DLT provides a "verifiable and auditable history of all information stored in a particular dataset" (n. p.). The visual representation of the difference between centralized and decentralized ledgers is shown in Figure 2.

Figure 2 *Difference Between Centralized and Decentralized Ledgers*



Source. Bit2Me Academy, *What Is a Distributed Ledger (General Ledger)?*, 23 March 2022, https://academy.bit2me.com/en/which-is-ledger-distributed-ledger/.

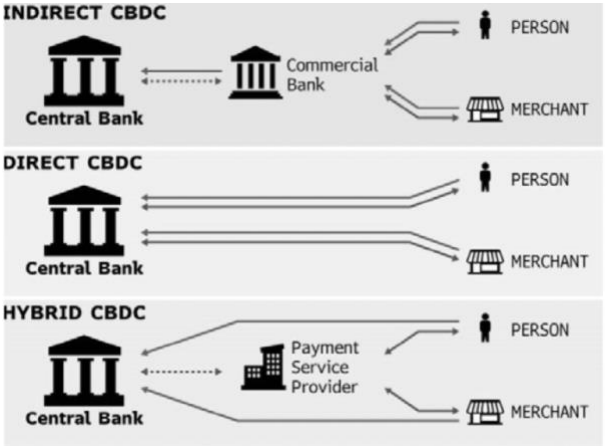
Thus, although there are two types of potentially working infrastructures, such as conventional and DLT-based infrastructures, most of the countries choose DLT for their CBDCs.

1.4.3. Indirect, Direct, and Hybrid CBDC

Based on the architecture (the legal structure of claims), CBDCs could be indirect (synthetic), direct, or hybrid. According to the Atlantic Council's report (2022) and the article by Auer and Böhme (2020), an indirect type of CBDC (also referred to as "synthetic CBDC" by the IMF) is not a direct claim on central banks. This type of CBDC represents a payment system operated by intermediaries, such as commercial banks or non-bank financial institutions (e.g., FinTech companies), where central banks "pass the digital currency token to [intermediaries], which then distribute the currency and also handle KYC and AML requirements" (Kayrouz, 2021, p. 5). According to this model, consumers have claims for the currency on these intermediaries, which operate all the retail payments, not on central banks (Auer & Böhme, 2020). These intermediaries need to "fully back all liabilities to retail clients with claims on central banks" (Auer & Böhme, 2020, p. 18).

According to the article by Auer and Böhme (2020), a direct type of CBDC is a direct claim on central banks that handle retail payments of consumers and record all the transactions. Additionally, according to PwC's report (2021), the direct CBDC is a model in which accounts at central banks are held by all the parties involved in the transactions. Based on this model, payments are conducted via a "transfer from one account to the other and all claims [are] backed by central banks" (Kayrouz, 2021, p. 4). Central banks are going to be responsible for the currency issuance and management of a "permission system to clear transactions" (Kayrouz, 2021, p. 4). Also, KYC and AML compliance requirements will be handled by central banks. Figure 3 provides a visual representation of the key differences between indirect, direct, and hybrid architectures.

Figure 3 *Key Differences Between Indirect, Direct, and Hybrid Architectures*



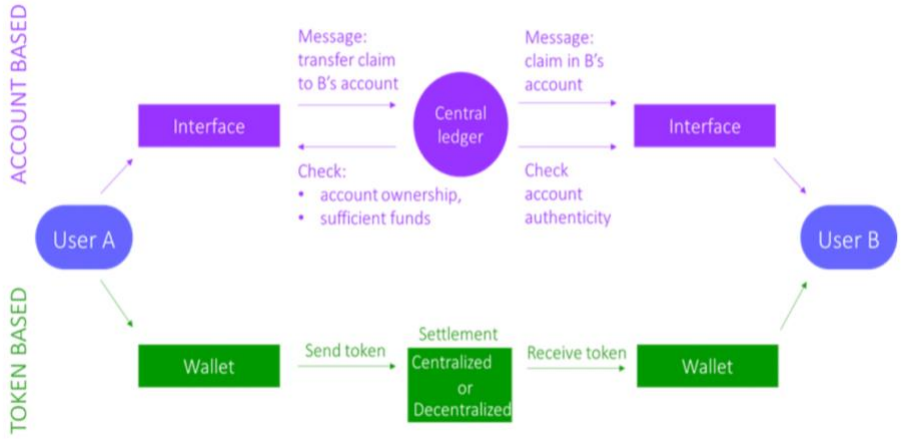
Source. PwC, June 2021, https://www.pwc.com/m1/en/media-centre/2021/documents/central-bank-digital-currencies-and-the-future-of-money-part1.pdf.

Lastly, the article by Auer and Böhme (2020) refers to the third type of CBDC, which is called a hybrid CBDC. According to PwC's report (2021), this type of CBDC is viewed as an intermediate solution where central banks distribute CBDC to regulated financial institutions-intermediaries, such as commercial banks or FinTech companies, that conduct all the retail payments and real-time transactions as well as handle the KYC and AML requirements. However, CBDC is also considered as a direct claim on central banks, "which also keep a central ledger of all transactions and operate a backup technical infrastructure allowing it to restart the payment system if intermediaries fail" (Auer & Böhme, 2020, p. 18). Currently, many central banks are thinking about the implementation of a hybrid model for their CBDCs.

1.4.4. Account-Based and Token-Based CBDC

Based on the access, researchers distinguish between an account-based and token-based CBDC. An account-based CBDC involves a claim transfer on an account (Mancini-Griffoli et al., 2018). A transaction in the account-based CBDC would be similar to today's transactions between commercial bank depositors, yet accounts would be held in central banks or any other "delegated entities such as commercial banks" (Lee et al., 2021, p. 54). The transaction of this type of CBDC should be performed in the following way: a payer would log in to an account at a central bank via a website or an application on his/her device and "request a transfer of funds to a recipient's account at a central bank" (Mancini-Griffoli et al., 2018, p. 8). This central bank in turn would have to verify the "payer's authority to use the account, sufficient funds, and authenticity of the recipient's account" and then would "ensure settlement by updating a master ledger" (Mancini-Griffoli et al., 2018, p. 8). As a result, there would be a substantial information exchange that would leave no room for proper anonymity. The basic mechanics of the account-based and token-based CBDC are shown in Figure 4.

Figure 4 *Basic Mechanics of Account- and Token-Based CBDC*



Source. International Monetary Fund, 2018, https://theblockchaintest.com/uploads/resources/file-313330466933.pdf.

On the other hand, a token-based CBDC involves a token transfer "between digital wallets through decentralized or centralized settlement systems" (Lee et al., 2021, p. 54). These decentralized or centralized systems would be used for the settlement and verification of tokens. Decentralized settlement could be ensured though the use of a distributed ledger technology (DLT). Yet, this technology has its drawback of not being scalable and energy sufficient as well as has certain issues with payment finality (He et al., 2017). At the same time, DLT could be utilized within a closed network under the supervision of a central bank. Centralized settlement could be presented in many forms that may seem to be more well-suited because they would validate serial numbers of these tokens and then change these numbers "once these tokens change wallets to avoid the risk of double spending" (Mancini-Griffoli et al., 2018, p. 9).

Transferring a token would require more steps than an ordinary cash exchange; however, it would also bring more advantages as well as some disadvantages. The main benefits of the token-based CBDC are its anonymity and a possibility to conduct offline transactions (Bilotta, 2021). Transferring the token-based CBDC would also be convenient as people would not have to meet in person. At the same time, the main disadvantages are difficulties related to distinguishing the token-based CBDC from its counterfeits by the parties involved in the transactions; therefore, external verification of the tokens would be required, which in turn makes transactions less anonymous (Mancini-Griffoli et al., 2018). In addition, central banks may also have problems "paying interests on their CBDC tokens as interests could alter the value of the token itself"

(Bilotta, 2021, p. 7). Although both account-based and token-based CBDCs have their advantages and disadvantages, according to the CBDC tracker by the Atlantic Council (2022), most countries and their central banks choose both types of CBDC for the further research, development, and final implementation.

1.4.5. CBDC Stages of Development

Based on the status, the Atlantic Council CBDC tracker divides CBDCs into six groups. The first group includes already researched CBDCs—at this stage, central banks in partnership with other technological companies establish working groups to explore the use cases, impact, and feasibility of CBDCs. There are thirty-nine countries that are now at the research stage—these are Chile, Mexico, Pakistan, Czech Republic, Hungary, and New Zealand to name a few. The second group incorporates CBDCs in development—at the following stage, central banks and other technological companies initiate technical build and early testing of CBDCs in controlled environments. There are already thirty-three countries at the development stage, such as Canada, the United States of America, Brazil, Turkey, and etc. CBDCs that are piloted, which means that they were tested in the real world in a small setting, with a limited number of participants, are included in the third group. Currently, only seventeen countries are at the pilot stage: China, Singapore, the United Arab Emirates, Saudi Arabia, Sweden, Australia, India, and etc. In the fourth category, there are launched CBDCs, which means that they are issued for widespread retail and/or wholesale use. Only eleven CBDCs are currently launched within some countries such as the Bahamas and Nigeria to name a few. Cancelled CBDCs constitute the fifth group, and by now, only Ecuador and Senegal cancelled their CBDCs' projects. The last group includes all other counties where no formal CBDC research is conducted, but an ongoing development of digital wallets and new payment infrastructure are observed. Additionally, there is a group of countries where the status of CBDCs is inactive—there are fifteen of them, with the Central Bank of Denmark that does not consider launching CBDC as it sees "significant legal, financial, and administrative challenges and no clear benefits for the Danish society" (Atlantic Council, 2022, n. p.). Therefore, although a few countries stopped researching and developing their own CBDCs; many countries are still interested in issuing CBDCs, exploring their potential benefits and drawbacks, as well as finding proper solutions in collaboration with advanced technological companies.

As the definitions of central bank digital currencies (CBDCs) and their key design features have been discussed, the next part of the master's thesis project will also cover CBDC benefits as well as economic and legal challenges.

1.5. CBDC Benefits and Economic and Legal Challenges

This section will be dedicated to the discussion of CBDC benefits as well as economic and legal challenges. This detailed discussion will provide a better understanding of CBDC as a theoretical concept and practical tool that has a huge impact on the consumer choice of this digital currency for their further use in the modern financial system.

1.5.1. Central Bank's Main Responsibilities

The central bank serves as a public institution and a monetary authority. Its main responsibilities include the preservation of the value of a national currency, maintenance of price stability and a stable financial system, and management of a monetary policy through monitoring and controlling the interest rate (Peluso, 2020). Central banks are also in charge of "managing gold and foreign currency reserves, issuing legal tender currency, and acting as treasurers and financial agents of public debt as well as accountants and lenders of private banks" (Peluso, 2020, p. 84). Additionally, central banks are the banks for private banks as they run their monetary policies through these private banks as well as lower or raise interest rates for liquidity provision.

As central banks have a lot of responsibilities within the financial system, no discoveries can be hidden from this overseeing institution. Thus, currently there is a growing trend in the decreasing use of cash as it seems to prevent the continuous criminal use of cash because its feature of anonymity and fungibility allows to avoid taxes and facilitates money laundering and illegal economic activities. Another reason for this trend is high costs of manufacturing new coins and bills. Also, liquidity provides limitations for central banks' monetary policies that are based on the negative interest rates, "as it provides a zero-rate alternative on deposit" (Peluso, 2020, p. 85). At the same time, with the occurrence of a COVID-19 pandemic, more consumers tended to use a digitized form of money through cards and mobile applications to stop the spread of COVID-19.

However, as more consumers choose to pay not in cash, cash as the only intermediary between consumers and central banks is gradually disappearing, while consumers' dependence on financial intermediaries such as commercial banks and private companies (e.g., FinTech companies) that work on providing modern mobile payment systems is only increasing. Thus,

central banks, while observing this situation, once realized that they must provide an alternative solution to cash transactions, so that they will not lose their consumers to other financial intermediaries.

1.5.2. CBDC Benefits and Challenges

Currently, many central banks are working on the development of their own CBDCs based on the needs of consumers and the financial system in every country. Those central banks that have already conducted extensive research admit that launching CBDCs provides a variety of economic benefits. For instance, CBDCs based on a distributed ledger technology, or blockchain, will make interbank payments faster and safer (Peluso, 2020). Issuing CBDCs will also promote financial integration, improve the efficiency and security of transactions, and decrease the cost of cross-border payments (MAS & Bank of Canada, 2019). When comparing the countries with a more stable and developed financial infrastructure to the countries that have a poorly developed financial infrastructure, the latter ones will gain more benefits if they introduce CBDCs to their consumers and economy because CBDCs could potentially reduce certain inefficiencies within those countries' financial systems. Additionally, those countries that suffer from increasing inflation or international sanctions will find CBDCs beneficial for their domestic economies (Lee et al., 2021). Counterfeiting can be also decreased or even fully eliminated with the issuance of CBDCs, and even if some sort of digital counterfeiting occurs, it could be easily traced with new technologies. CBDCs can also bring the transition to a "multi-polar reserve currency, which is an exit strategy for the current asset price inflation environment brought about by the global competitive quantitative easing policy" (Lee et al., 2021, p. 58). At the same time, launching CBDCs will allow central banks to conduct their monetary policies more effectively.

Also, CBDCs improve overall consumers' inclusiveness in the financial system as these digital currencies provide easy access to financial services to the unbanked in the rural area and the developing countries in general. With the help of inclusiveness, CBDCs can facilitate more precise and accurate measuring of countries' economic activities as many countries' statistics on GDP calculation does not present a full picture of current economic activities of those countries. Additionally, CBDCs' usage within the retail will "capture the payments associated with primary activities currently not reflected in the national accounts" (Lee et al., 2021, p. 59). Therefore, CBDCs' ability to provide the missing parts of statistics that measures the national economy will actually improve it and provide a ground for better policymaking and sustainable growth.

In addition, CBDCs may lead to the reduction of high costs of producing and circulating money in a traditional form. Furthermore, these digital currencies will contribute to the reduction of cross-border payment fees when conducting cross-border payments. Finally, the last benefit of issuing CBDCs is appropriate anonymity. Through CBDCs, central banks can have all the necessary data that allows to detect illegal activities such as tax evasion, terrorist financing, and money laundering easier (Lee et al., 2021). Also, if CBDCs are interest-bearing, they can function as a direct monetary policy tool and give central banks more direct control over money supply (Lee et al., 2021). In contrast, non-interest-bearing CBDCs will function as "digital public infrastructure to overcome friction in the financial space" (Lee et al., 2021, p. 59).

CBDC Economic Challenges

Although central bank digital currencies (CBDCs) have many benefits, they also bear many potential economic risks. One of the economic challenges is proper confidentiality provision and maintenance. For example, in the European Union (EU), issuing CBDC—a digital euro—would require the central bank to introduce innovations within its system, so that the overall security would not be compromised (Peluso, 2020). Also, access of central banks to sensitive information of the users poses a concern in the society. Some researchers state that with the rise of CBDCs, more users and investors are worried that central banks will be more prone to cyber risks because "creating a single centralized node increases the risk of system hacking" (Peluso, 2020, p. 86).

On a par with the general economic concerns, the experts from the European Central Bank (ECB) show concerns regarding the usage and function of CBDC in the investment area. These experts highlight that the "digital euro should be an alternative means of payment" and should not be used as "a form of investment" (Peluso, 2020, p. 96). More specifically, these experts worry that if CBDC is regarded as a form of investment, it could "encourage citizens to convert their deposits in commercial banks into CBDCs" and thereby "create instability and reduce the funds stored in private banks" (Peluso, 2020, p. 96). As a result of these operations, private banks' dependence on the central bank for funding will increase that would allow them to raise interest rates on bank loans and thereby reduce the volume of bank credit and stop consumption (Peluso, 2020).

Another challenge that the EU area and its central bank may face is the overall accessibility of CBDC across the euro area. According to Peluso (2020), a digital euro should be available through standardized solutions and easily accessible to everyone—including citizens who do not

directly participate in the financial system. In particular, if the retail type of CBDC, a retail digital euro, is going to be launched, there could be an issue with proper inclusion of this type of CBDC within the already existing payment system. Therefore, the retail digital euro must have a design that would only improve this payment system and contribute to maintaining confidence in the euro as well as promote an efficient market economy (Peluso, 2020).

Another problem that CBDC launch poses for the economies of various countries is a risk of wide CBDC accessibility to the public. Thus, "if the public can obtain the digital currency directly with no limitation, the demand for deposits or reserves of commercial banks will be reduced. The banks will face a liquidity shortage and trigger bank runs in case of market panic. A bank run is an imminent threat in financial crises and thus increases the risk of financial instability. The emergence of CBDC derivatives and engineered products triggers potential uncertainties and risks because of the speed of transaction and the volume involved" (Lee et al., 2021, pp. 59-60).

Also, with the rise of CBDCs, central banks may become even more monopolistic within the financial system. Under this scenario, central banks would have not only their traditional responsibilities as regulators of monetary policies, but they would also perform all the functions of financial service providers. This, in turn, could lead to poor service provision by central banks because everything would be concentrated within the single entity that would only increase the monopoly of central banks not only in terms of money issuance, but also in terms of money administration (Peluso, 2020).

Lastly, CBDC issuance could challenge individual privacy because as central banks, which could often be politically biased, gain full control over transactions and maintain full surveillance, "[their] censorship capacity would be greater than it is currently" (Peluso, 2020, p. 86). This happens oftentimes throughout the history, yet the recent example could be observed in Venezuela.

Therefore, CBDC issuance poses many economic risks for the overall financial system and thus leads to its fundamental change and even full transformation, especially in the area of money issuance and administration as well as payment provision.

CBDC Legal Challenges

While there are overall benefits and economic challenges to CBDC issuance, there are also legal challenges to its launch. Researchers admit that from a legal perspective, CBDC looks like a black hole. There is no proper legal and regulatory guidance on how CBDC must be treated within countries. There are also no proper articles on this issue: the only institution that brings relevance

and attempts to identify the key issues and solutions for a current CBDC place within the countries' legal systems is the International Monetary Fund (IMF) and its report that was published in 2020. The report focuses on central bank laws and monetary laws regarding CBDC and provides several conclusions in the form of recommendations on how best to grant a legal status to CBDC.

The IMF report identifies that one of the issues with CBDC is that depending on its type—if it is token-based or account-based CBDC—its legal treatment would be quite different. From a legal perspective, the token-based CBDC is "truly a new form of money," a "central bank liability incorporated in a digital token and transferred by transfer of that token" (Bossu et al., 2020, p. 41). While the account-based CBDC is "not a new form of money, but merely book money expressed in digital form" (Bossu et al., 2020, p. 41). This is only one example showing that the legal field behind CBDC is quite unclear and challenging and that there must be a concrete legal basis in the central bank law. In the absence of such a well-defined law, central banks would face many legal and political risks in case of CBDC issuance. For now, only few central bank laws hold this concrete legal basis.

Also, based on the type of CBDC—whether it is token-based or account-based—the issue of what organization is in charge of issuing CBDC arises. With the token-based CBDC, it is unclear if central banks are "legally authorized to issue a new type of liability incorporated in a digital token" because most of the central bank laws provide a right to issue the currency—banknotes in a paper or plastic form and coins in a metallic form, "not in the form of a digital token" (Bossu et al., 2020, p. 42). In contrast, the account-based CBDC is viewed as "book money" that can be offered by central banks only to those entities that have their authorization to offer cash current accounts (Bossu et al., 2020, p. 42). Currently, central bank laws do not authorize central banks to offer accounts to the general public as it is needed in case of the account-based CBDC. However, this issue can be solved if central bank laws are amended.

Another issue that arises from CBDC issuance is different treatment of CBDC under central bank laws and monetary laws (taking into consideration that monetary laws are more challenging). Importantly, neither token-based nor account-based CBDC would be treated as a "new monetary unit"; conversely, both types of CBDC would be a "form of a means of payment expressed in the official monetary unit" (Bossu et al., 2020, p. 42). However, there are certain issues related to the token-based CBDC because according to the current law, many countries would not treat the token-based CBDC as a currency as legally, the currency includes physical banknotes and metallic

coins. Theoretically, in case of the monetary law reform, the token-based CBDC would be treated as a currency in legal terms, yet this could be quite challenging. First of all, although the monetary law reform provides a legal status to the token-based CBDC, this change is not obvious in public "as long as broad layers in the population are not in a position to technically receive such a means of payment" (Bossu et al., 2020, p. 42). Secondly, the token-based CBDC has also no clear status in the private law, and therefore, it is "difficult to extend to it the private law privileges that legal systems attribute to currency with the aim to promote its circulation" (Bossu et al., 2020, p. 42). Thirdly, in case of CBDC issuance, if electronic counterfeiting is prevented by criminal law, there is an issue if electronic counterfeiting is a legal concept that fits into the broader criminal law system. Thus, the major problem with the token-based CBDC is that even if it is labelled "currency" in legal terms, it is unlikely that it will have a widely recognized legal status as the one that a traditional currency possesses in the broader legal system.

There is also an issue if the account-based CBDC is actually a currency. According to the IMF Working Papers' report (2020), the account-based CBDC is not a currency at all (Bossu et al., 2020). The IMF report states that there is no problem with this legal definition as the account-based CBDC would have the "same legal status as other central bank book money" (Bossu et al., 2020, p. 43). Also, because the account-based CBDC is a risk-free asset in this case, it plays an important role in the financial system. Therefore, no amendments to monetary laws are needed.

Lastly, the issue might also arise with interest-bearing tokens. According to the IMF, if the token-based CBDC is going to be interest-bearing, the first issue that might arise is that in order to have interest payments, legally, there has to be a loan (Bossu et al., 2020). Also, to be a means of payment (like cash), a payment amount needs to be the face value (Bossu et al., 2020). However, as soon as the token-based CBDC is interest-bearing (like bonds), its value is determined by the interest rate, not just by its face value (Bossu et al., 2020). This raises an issue of convertibility. In other words, a one-dollar interest-bearing CBDC is unlikely to be exchangeable one-to-one for a one-dollar bill (Bossu et al., 2020).

In summary, before the introduction of a particular type of CBDC within countries, these countries must carefully investigate the legal status of CBDC within their central bank laws and monetary laws as well as their legal systems. Of course, some of these countries may choose to provide a broader legal framework for their existing laws on currencies and their statuses, yet an extensive analysis of central bank laws and monetary laws is needed because it will provide a

better legal framework that will be codified in law and give more understanding to the public regarding the legal aspects of CBDC issuance, its further usage, and interpretation within the countries' legal systems.

1.6. CBDC in the Modern Financial System

This section will provide a brief overview of current CBDC developments in the Bahamas and Nigeria as well as worldwide from a perspective of the researchers' community.

CBDC Developments in the Bahamas and Nigeria

Although the COVID-19 pandemic has brought changes to CBDC studies and perhaps delayed its further research, development, and application, CBDC is still a widely discussed topic among financial professionals. Many countries, such as China, Sweden, and India, to name a few, are approaching the stage of application and introduction of their CBDCs to the public and allowing them to circulate within their national economies. Meanwhile, the Bahamas and Nigeria have become the pioneers in the non-cash transactions because they have already launched their digital currencies.

According to the Atlantic Council CBDC tracker (2022), the Central Bank of The Bahamas in partnership with NZIA Limited developed a retail token- and DLT-based digital currency called the Sand dollar, a digital form of the Bahamian dollar. In December 2019, they successfully completed the pilot study of the digital currency on the island of Exuma, and in October 2020, the central bank launched the Sand dollar across the whole country, making the Sand dollar the "first ever nationwide Central Bank Digital Currency in the world" (Atlantic Council, 2022). While access to the Sand dollar was provided to all the Bahamian citizens upon the currency release, the central bank is still working on its full integration with a commercial banking system because of the hybrid architecture of this digital currency, i.e., CBDC is a direct claim of the central bank, while transactions and payments are conducted by commercial banks. According to the Atlantic Council CBDC tracker (2022) and another CBDC tracker (2022), the main motivation for the Central Bank of The Bahamas to design and implement its digital currency is to improve financial inclusion and security against illegal economic activities such as money laundering as well as "reduce delivery costs, increase transactional efficiency, and finally modernize the country's financial system" ("CBDC Tracker," 2022). The results of the Sand dollar implementation across the Bahamas are still too early to summarize as the integration process is still in progress.

Another country that also pioneered in CBDC launching is Nigeria, the first African country to launch its own retail account- and DLT-based CBDC called e-Naira. The Central Bank of Nigeria in partnership with Bitt Inc. developed and further implemented e-Naira across Nigeria, and in October 2021, President Buhari finally launched this Africa's first digital currency. Interestingly, a few months before this launch, all other cryptocurrencies were banned in the country by the Nigerian government. The central bank governors note that the primary goals of e-Naira introduction are "increasing financial inclusion," improving money transfer, "reducing informality, and increasing the efficiency of the cross-border payments" ("CBDC Tracker," 2022). At the moment of e-Naira release, the governor of the Central Bank of Nigeria, Godwin Emefiele, stated that 500 million e-Naira ($1.21 million) had already been minted (Atlantic Council, 2022). Also, further usage of e-Naira implies that identity infrastructures (e.g., BVN, NIN, and TIN) will be applied to identify individuals and corporate entities to ensure its compliance with a KYC framework that will allow bank clients to have different account balance maximum and daily transactions limit. Currently, only bank account holders can access e-Naira by signing up with Nigeria's BVN bank identity, while the unbanked—accounted for 60 million sign-ups—are next to e-Naira access and distribution based on the usage of the Nigeria's national identity NIN (Atlantic Council, 2022). In summary, e-Naira is still under investigation by financial professionals as it is still in the process of the ongoing launch among different clients.

CBDC Worldwide Relevance

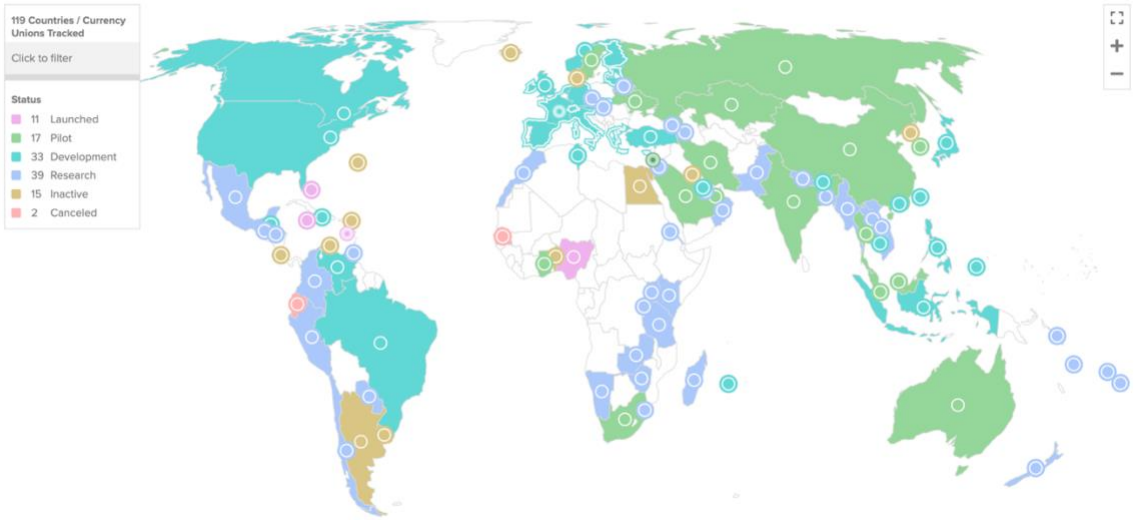
While the Bahamas and Nigeria are the pioneers in the field of non-cash payments, many other countries' central banks are reluctant to switch entirely from cash transactions to non-cash transactions. According to the 2018 G4S report, there is still an increase in cash demanded. According to the statistics, in 2011, the average amount of the circulated currency accounted for 8.1% of GDP in the world, while in 2016, this amount increased and constituted 9.6% of global GDP (Bilotta, 2021). According to the World Cash Report (2018), 79% of all transactions in Europe are cash transactions; globally, cash transactions account for 50%; while 2 billion people in the world still have no access to a bank account. Therefore, a tendency to use cash is still prevailing, especially in Europe, because cash provides an opportunity of better tracking, spending, and paying faster (Bilotta, 2021).

Nevertheless, as the process of digitalization takes over and merges e-commerce, online commercial banking, and development of non-cash payment instruments, a growing tendency to

use non-cash transactions is observed in the market. According to the World Payments Report (2020), there had been already 708.5 billion non-cash transactions in 2019 worldwide, and this trend is going to grow in the upcoming years as more people will use mobile payment systems (e-wallets) for their daily purchases (Roncancio, 2020). Interestingly, young people prefer making purchases through mobile payments applications rather than paying with debit or credit cards. This behavioral trend is observed in China where buyers favor non-cash transactions conducted through mobile payments applications over traditional cash transactions. In China, 49.6% of the population were the users of mobile payments in 2019, and this number will supposedly reach 60.5% by 2023 ("China is moving toward a cashless society," 2019, para. 1).

Therefore, as more people are using mobile payments, an opportunity for a new form of money, digital money, arises and sheds light on CBDC development nationwide and worldwide. The reasons for CBDC development differ across the countries. High costs of printing, transporting, and storing of cash are among the first reasons. However, Billota (2021) in his article on CBDC states that CBDC also involves high sunk costs that would be related to specific technological developments that would allow CBDC to work within a traditional banking system. Yet easy CBDC distribution among consumers would probably decrease any expenses in the future. In addition, CBDC could promote financial inclusion in the developing countries and emerging markets (Bilotta, 2021). Current popularity of mobile payments systems in Asia and Africa has provided a cheaper and easier means of payment for the unbanked; however, as the market of retail digital payments is currently fully managed by private companies only, it leaves central banks with no control over payment systems. Therefore, to regain a full control over the monetary system and outperform private companies, central banks started developing their own CBDCs that would give them a place within the market of digital payments systems. To keep up to date, 80% of sixty-six central banks are now researching CBDCs (Auer et al., 2020). Figure 5 shows this representation. However, when it comes to the actual CBDC implementation, according to the Bank for International Settlements (BIS) report (2020), only 10% of respondents stated that are currently ready to issue CBDC in the short term, while 20% mentioned that CBDC implementation can occur in the medium term, and 70% of respondents indicated that CBDC issuance is quite unlikely in the near future (Auer et al., 2020).

Figure 5 *Current CBDC Development*



Source. Atlantic Council Research, Bank of International Settlements, International Monetary Fund, John Kiff Database, 27 December 2022, https://www.atlanticcouncil.org/cbdctracker/.

Although there are different forecasts regarding the actual CBDC issuance and implementation, central banks continue researching CBDCs.

1.7. Consumer View on CBDC Adoption

Central banking and IT communities widely discuss possible design features, and there seem to be a consensus among them, yet there are benefits as well as economic and legal challenges that central banks observe when it comes to the actual CBDC implementation. Also, it is not clear what is a consumer view on CBDC issuance and implementation. This aspect has not been widely discussed and therefore assessed in the current studies on CBDC as most reports submitted by central banks' representatives overview only central banks' perspective on CBDC. The following section will shed light on the consumer view of CBDC in more detail.

Consumers' Needs and Strategies for CBDC Adoption

CBDC is supposed to support consumers' payment needs. As the economy becomes increasingly digital, consumers' needs must be assessed, and thus, their present and possible future demands must be considered.

According to the BIS report on CBDC user needs and adoption (2021), CBDC adoption would be driven by its future acceptance by merchants and usefulness to consumers (Auer et al., 2021). This report also states that merchants and consumers may favor CBDC over traditional

money because CBDC provides security, lower costs, offline payments, higher level of privacy, and multiple accessibility features. And as payments become part of digital living, CBDC could combine innovative features and be presented for a more convenient public use. In addition, not only adoption by merchants and consumers might drive CBDC adoption, but the use of CBDC by public sector authorities and imposition of a minimum level of acceptance at the country's level could also facilitate further CBDC adoption.

Merchants

In the context of the topic on the consumer view on CBDC, merchants will play a key role as they will drive CBDC acceptance and therefore make CBDC useful enough from the beginning, so that consumers would want to use it further. When merchants choose what payment instrument to accept, they are mainly concerned with the "breadth of adoption by consumers and the cost of acceptance (onboarding and ongoing)" (Auer et al., 2021, p. 6). Merchants want to accept that payment instrument that could "broaden their consumer base because it is used by an extensive pool of consumers or reduces their costs of transacting relative to payment methods currently accepted" (Auer et al., 2021, p. 6).

Consumers

In the context of the topic on the consumer view on CBDC, consumers will play the main role as they will decide if a new payment instrument such as CBDC is going to be adopted by central banks at the country's level or not. Consumers are mainly concerned with what unique features CBDC might offer to them. The main reasons outlined in the BIS report (2021) are "safety and security in a convenient form that could be integrated into innovative private sector products and services," a "lower cost to consumers and merchants, offline payments (useful during outages and in remote locations without connectivity), a higher level of privacy in comparison to commercial options, and a design with multiple accessibility features" (Auer et al., 2021, p. 5). Table 4 describes these reasons in more detail.

Table 4 *CBDC Features*

Safety of funds	In normal and crisis periods, this distinguishing feature of central bank money relative to other forms of money could make a difference for users' adoption. The physical nature of cash helps support the identified difference between central bank and private money.
Reduced costs	Consumers' utility is affected mostly by the transaction cost of the payment instrument. Although the overall cost of a CBDC system could increase with the complexity of its design, there should be little or no (explicit) cost to the CBDC end user.
Offline	A CBDC could allow users to maintain the cash-like experience they are familiar with, together with the additional benefit of participating in the digital economy. This feature might be particularly relevant in environments where internet availability is limited or unreliable.
Security	Several factors affect an end-user's overall perception of security: the reputation of (and trust in) the issuer, intermediaries, and the underlying technology; whether the involved entities are regulated; the level of fraud protection and end-user liability; and the quality of education and marketing campaigns. A CBDC might seek to adhere to a higher security standard to address these concerns.
Privacy	Protecting an individual's privacy from both commercial providers and governments has the attributes of a basic right (BIS, 2021). CBDC could be designed to offer more privacy to users because the central bank would not have incentives to monetize the data (for more see Group of Central Banks, 2021).
Accessibility	Accessible design is fundamental for both specific user groups (e.g., people with sensory, motor, and cognitive challenges) and the general population. CBDC end-user devices could be designed to improve on accessible digital interactions.

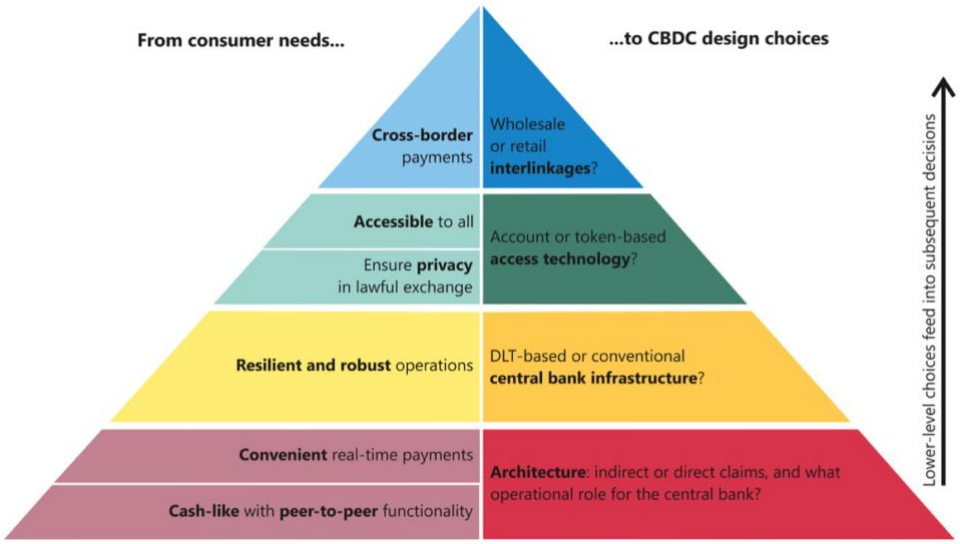
Source. Bank for International Settlements, September 2021, https://www.bis.org/publ/othp42_user_needs.pdf.

As the economy is getting more digitalized, consumers' present and future payments' needs will determine further CBDC adoption. For instance, according to the report prepared by the Bank of England (2020), CBDC might be useful for consumers if this currency is designed to facilitate programmability of payments and the use of micro-payments. This could provide new digital functions (e.g., programmability could support automatic routing of tax payments to tax authorities at point of sale) and business models (e.g., micro-payments might enable alternative revenue models for digital media) (Bank of England, 2020). According to the report by the Group of Central Banks (2021), as consumer needs evolve, an ecosystem of intermediaries is required to deliver innovation. Thus, CBDC flexibility and adaptability should support intermediaries in evolution of their services to meet future consumer requirements (Group of Central Banks, 2020).

From Consumer Needs to Design Choices: The CBDC Pyramid

Also, when it comes to the discussion of the consumer view on CBDC adoption, some researchers connect consumer needs to CBDC design choices that form a so-called CBDC pyramid (Figure 6). This pyramid shows what consumer needs CBDC could address. The left-hand side of the CBDC pyramid represents such consumer needs and six associated features that would make CBDC useful. These six features include cash-like peer-to-peer usability, convenient real-time payments, security, privacy, wide accessibility, and ease of use in cross-border payments. At the same time, the right-hand side of the CBDC pyramid indicates the associated CBDC design choices.

Figure 6 *The CBDC Pyramid*



Source. Bank for International Settlements, March 2020, https://www.bis.org/publ/qtrpdf/r_qt2003j.pdf.

Figure 6 shows that consumers want CBDC to be a cash-like claim on central bank, so that it could be transferred in peer-to-peer settings. The need for this arises from the fact that in case of financial turmoil, consumers want to be sure that they could shift their electronic money holdings into cash (Auer & Boehme, 2020). However, if cash were no longer accepted in the future, a severe financial crisis might lead to even more chaos by disrupting daily business and retail transactions. It is also true that consumers will not adopt CBDC if it is less convenient to use than today's electronic payments. Currently, banks and payment service providers use sophisticated infrastructures to handle peak demand, while intermediaries help them smooth the flow of payments by taking on risk (Auer & Boehme, 2020). Therefore, cash-like safety and convenience of use needs lead to the following CBDC design consideration: the choice of architecture, and how

it will balance the consumer's demand for a cash-like claim on central bank with the convenience that intermediaries provide to the payment system (Auer & Boehme, 2020). This choice is shaped by two questions: Is CBDC a direct or indirect claim on central bank? What is the operational role of central bank and of private sector intermediaries in daily payments? (Auer & Boehme, 2020)

Figure 6 also represents consumers' need for cash-like payment safety, which means that CBDC must be protected not only from the insolvency or technical failures of intermediaries, but also from disruptions in the work of central bank (Auer & Boehme, 2020). Thus, cash-like safety need leads to considering CBDC design: specifically, what infrastructure—a conventional centrally controlled database or DLT—must be chosen as a protective and efficient technology (Auer & Boehme, 2020). However, the choice of infrastructure must be made only once the architecture has been decided upon because DLT is feasible only for some operational setups.

Easy, universal access and privacy are the other two consumers' needs. According to Auer and Boehme (2020), there is a trade-off between ease of access and privacy on the one hand and ease of law enforcement on the other. These consumers' needs lead to another CBDC design consideration: whether access to CBDC must be tied to an identity system (an account-based technology) or via cryptographic schemes that do not require identification (an access technology based on digital tokens) (Auer & Boehme, 2020).

Finally, the need for CBDC use in cross-border payments is identified among consumers. This need is connected to the following CBDC design choice: whether CBDC must be wholesale or retail (allowing consumers to hold foreign digital currencies directly) (Auer & Boehme, 2020). However, again, the choice of interlinkage must be made only once the access technology has been decided upon.

Thus, the following scientific analysis of literature summarizes only general information about CBDC design features, benefits as well as economic and legal challenges, current CBDC developments, and a brief overview of the consumer view on CBDC adoption. Although the researchers' community makes attempts to identify consumer needs in CBDC, up until now, there has been little research into whether consumers are actually ready for CBDC adoption. The gap between central banks' representatives and consumers views is increasing, so that some policy-makers question whether central banks should be in the business of offering CBDC at all. That is why the goal of the following master's thesis is to find out what consumers around the world think about CBDC and how they would react to CBDC launch in their countries in the near future. In

attempt to identify the consumer view on CBDC adoption, a survey has been conducted and its results are presented in the subsequent sections of this master's thesis.

2. METHODOLOGY FOR ASSESSING THE CONSUMER VIEW ON CBDC ADOPTION

This chapter examines the methodology used to meet the thesis aim and specific objectives outlined in the introduction. This part will include an overview of issues related to the methodology development on the topic of assessing the consumer view on CBDC adoption and provide a solution to them in a form of a quantitative study by conducting a survey on the consumer view on CBDC adoption.

2.1. Selection of a Proper Research Method

Research methods are defined as strategies used for collecting data or evidence for the further analysis in attempt to provide a better understanding of a topic ("Research methods," 2019). For some research topics, it is easier to find a proper methodology than for the others. In case of the topic that is studied as part of the following master's thesis, a proper methodological approach is difficult to identify because of the complexity and lack of consensus on the topic of CBDC. For now, there is no one fully explained and widely accepted definition of CBDC provided by the researchers' community. Only CBDC design features seem to be identified and discussed. There is a limited number of sources available for CBDC research globally. Only a few organizations—the Bank for International Settlements (BIS) and the International Monetary Fund (IMF)—provide annual updates on CBDC research and launch. Perhaps the BIS is the only organization that conducts quantitative studies (runs surveys) on CBDC prospective launch and its economic implications, while the IMF is concentrated more on the legal issues related to CBDC adoption. Also, no central banks have actually issued and implemented fully-fledged CBDCs. Although the Bahamas and Nigeria have already launched their CBDCs, these digital currencies are not fully operatable within those counties' financial systems or widely used by consumers. Thus, most CBDCs across the world are still at the research stage and are studied from a theoretical perspective.

As a result, there is lack of numerical data on assessing CBDC adoption from a central banks' perspective, yet it is possible to assess CBDC adoption (its functions, potential benefits and challenges, overall consumers' willingness to explore the topic of CBDC and use of this currency once it will be launched by central bank) from a consumers' perspective via a survey. Thus, based on the survey design, consumers will be asked whether they want to explore the topic of CBDC further and start using this digital currency after its launch, what main benefit and challenge CBDC

possesses, and what functions it must primarily serve to encourage prospective consumers at least to try using CBDC in the near future. Thus, a quantitative research method (conducting a survey) seems to be suitable for researching the topic of CBDC because this method allows to assess the consumer attitude toward overall usability of CBDC, its prospective functions as well as advantages and disadvantages in the form of a survey.

Potential CBDC adoption will be assessed from a consumers' perspective using primary resources. At the same time, secondary resources will be also utilized to compare the obtained results with the ones that have been already received, analyzed, and published. Among the secondary resources, the reports by central banks' research groups and independent research companies such as PureProfile and OMFIF Digital Monetary Institute, BIS reports, IMF reports, and other scientific and practical reports will be used for analyzing CBDC adoption from a consumers' perspective and drawing conclusions about prospective CBDC launch.

Research questions:

1. Are prospective consumers willing to explore the topic of CBDC? (H1-H2)
2. What benefit determines a consumers' choice of CBDC adoption? (H3)
3. What challenge do consumers view as the main reason for not utilizing CBDC? (H4)
4. What money functions do consumers attribute to CBDC? (H5-H7)
5. Are prospective consumers willing to start using CBDC in the near future if their central bank launches it? (H8-H10)

2.2. Hypotheses Identification

To answer the defined research questions, a hypotheses identification strategy has been utilized. Ten preliminary hypotheses have been identified for further testing (see Table 5).

Table 5 *Hypotheses*

Hypotheses	Correlation / Association Analysis
H1 (single proportion): only 10% of respondents know something about central bank digital currency (CBDC) (H_0: p=.1; H_1: p≠.1).	Is there a relationship between consumers' knowledge of CBDC and an economic status of their country of residence?
H2 (single proportion): 90% of respondents are willing either to explore the topic of CBDC for the first time or improve their existing knowledge on it (H_0: p=.9; H_1: p≠.9).	Is there a relationship between consumers' willingness to explore / improve their knowledge on CBDC and their age?
H3 (single proportion): 50% of respondents choose security as the most important advantage of CBDC when deciding whether to adopt this digital currency or not (H_0: p=.5; H_1: p≠.5).	Is there a relationship between a consumers' choice of CBDC advantage and their educational level?
H4 (single proportion): 50% of respondents are concerned with a privacy issue and consider it as the main reason for not utilizing CBDC (H_0: p=.5; H_1: p≠.5).	Is there a relationship between a consumers' choice of CBDC disadvantage and their age?
H5 (single proportion): 60% of respondents accept CBDC as a new form of payment (H_0: p=.6; H_1: p≠.6).	Is there a relationship between a consumers' decision to accept CBDC as a new form of payment and an economic status of their country of residence?
H6 (single proportion): 40% of respondents agree to have their salary paid in CBDC (H_0: p=.4; H_1: p≠.4).	Is there a relationship between a consumers' decision to have their salary paid in CBDC and their monthly income?
H7 (single proportion): 60% of respondents are willing to use CBDC as an investment instrument if its interest rate is going to be higher than for a standard bank deposit (H_0: p=.6; H_1: p≠.6).	Is there a relationship between consumers' willingness to use CBDC as an investment instrument and their monthly income?
H8 (single proportion): in case of CBDC adoption, only 20% of respondents support the idea of completely replacing cash with CBDC (H_0: p=.2; H_1: p≠.2).	Is there a relationship between consumers' support for completely replacing cash with CBDC and an economic status of their country of residence?
H9 (single proportion): knowing that the pros of CBDC outweigh its cons, 80% of respondents are willing to use CBDC if their central bank launches it (H_0: p=.8; H_1: p≠.8).	Is there a relationship between consumers' willingness to use CBDC if their central bank launches it and an economic status of their country of residence?
H10 (single proportion): in case of the successful launch, only 30% of respondents are willing to start using CBDC within one year (H_0: p=.3; H_1: p≠.3).	Is there a relationship between a consumers' choice of a period to start using CBDC and their age?

Source. Compiled by the author.

The results of hypotheses testing will be presented in the section on empirical results analysis for assessing the consumer view on CBDC adoption. The evidence gathered from the primary resources (survey answers) as well as secondary resources will provide the basis for proving or refuting these ten preliminary hypotheses. Conclusions and recommendations based on the analysis of the survey results and secondary resources will be presented in the last section of the following master's thesis.

2.3. Sample Size Estimation

To estimate a sample size for the survey, a pilot study was conducted. Fifteen respondents were randomly selected, and their answers were used to determine the proportion of those respondents who know something or are not familiar with the topic of CBDC at all—they were asked the following question: "Do you know anything about central bank digital currency (CBDC)?" According to the findings of the conducted pilot study, thirteen (87%) out of fifteen (100%) respondents do not know anything about CBDC that makes p=.87 and p-1=.13. To calculate the sample size for the survey, the formula for a proportion was used. A confidence level that equals to 90% (z=1.645) and a margin of an error that equals to ±5% (e=.05) were chosen to find a sample size n for a proportion. Putting the values of p, p-1, z, and e in the formula for a proportion provides a result that equals to 125.1 (see Table 6).

Table 6 *Sample Size Estimation Calculations*

Number of randomly selected responses	15
p	.87
1-p	.13
z (c. l.=90%)	1.645
e (margin of error=±5%)	.05
n=z^2*p*(1-p)/e^2	
n	125.0784889
n	126

Source. Compiled by the author.

Therefore, after rounding off the result, the calculations suggest 126 respondents to be chosen for the survey sample size.

2.4. Data Collection Methods and Questionnaire Design

The project intends to explore the customer view on CBDC adoption. The data for the study was collected through a questionnaire. (See the questionnaire in Appendix) An online survey was

used for the data collection. A non-probability (convenient) sampling method was used. Random prospective consumers aged 18 and over who do not know anything about central bank digital currency but are willing to explore the topic of CBDC were selected for the primary data. The scope of the research was limited to prospective consumers who are eighteen years old and older because this age group represents more frequent conscious users of modern payment systems. The survey was completed by 150 respondents, yet the answers of only 126 real respondents were chosen for the assessment purposes.

The questionnaire consists of two sections: demographic questions section and main questions section. The questionnaire has a short paragraph that explains the goal of the survey in the beginning and then includes four demographic questions related to respondents' age, economic status of their country of residence, educational level, and monthly income and ten main questions related to gathering the respondents' opinion on CBDC adoption. Also, between the 2nd and 3rd questions in the main questions section, a definition of CBDC was included to provide a general understanding of this digital currency to those respondents who are still not familiar with the concept of CBDC and need this information to answer the subsequent questions about advantages and disadvantages, functions, and overall usability of this currency. Detailed information about questionnaire design is presented in Table 7.

Table 7 *Questionnaire Design*

Question	Type of Data and Measures	Explanation
	Demographic Questions	
1. Age 18-34 / 35-54 / 55 and over	Categorical data & ordinal scale	DQ1 is asked to know the age group of respondents. The age group might be one of the main factors determining the willingness of each age group to adopt CBDC. *Answer choices:* these age ranges have been chosen to divide prospective consumers into three user groups: young users aged 18-34, middle-aged users (35-54), or older users aged 55 and over.
2. Country of residence status (from an economic perspective) Advanced economies (AEs) / Emerging market and developing economies (EMDEs)	Categorical data & nominal scale	DQ2 is asked to know the economic status of the respondents' county of residence. The economic status of the country of residence might be one of the main factors determining the willingness of each country group to issue and adopt CBDC.

		Answer choices: respondents have been asked to choose between two categories which their country of residence belongs to from an economic perspective (AEs or EMDEs) because an economic development of a country might determine its residents' wish to accept changes within the financial system with the introduction of a new form of money.
3. Educational level (the highest level of education you have completed) Some high school / High school diploma / Bachelor's degree / Master's degree / Doctorate degree / Other	Categorical data & ordinal scale	DQ3 is asked to know the educational level of respondents. The level of education might be one of the main factors determining whether respondents with different educational levels want to adopt CBDC or not. *Answer choices:* these educational levels have been chosen to divide prospective consumers into at least five user groups: people with some school education, high school diploma, bachelor's degree, master's degree, doctorate degree, or any other education.
4. Monthly income (based on the economic situation in your country) Low / Medium / High	Categorical data & ordinal scale	DQ4 is asked to know the monthly income of respondents. The monthly income might be one of the main factors determining whether respondents with different monthly income would accept CBDC as a new form of money or not. *Answer choices:* these monthly income categories have been chosen to divide prospective consumers into three user groups: people with low, medium, or high monthly income, depending on the economic situation in their country.
Main Questions		
1. Do you know anything about central bank digital currency (CBDC)? Yes / No	Categorical data & nominal scale	Q1 will allow to understand if respondents are familiar with the concept of CBDC or not.
2. Are you willing to explore / improve your knowledge on the topic of CBDC? Yes / No	Categorical data & nominal scale	Q2 will allow to understand if respondents would like to explore the topic of CBDC (if they have no prior knowledge of CBDC) or improve their existing knowledge on this topic (if they have been already familiar with the concept of CBDC).
3. Please choose **one** advantage of CBDC you would find the most important when deciding	Categorical data & nominal scale	Q3 will allow to understand what advantage of CBDC will help respondents decide whether to adopt this digital currency or not.

whether to adopt this digital currency or not. CBDC offers more privacy to users than commercial digital currency providers / CBDC does not involve any additional costs / You can use CBDC internationally / Paying with CBDC does not require internet connection / CBDC is more secure than other digital currencies (e.g., cryptocurrencies) / Other		*Answer choices:* respondents are asked to choose one advantageous attribute of CBDC from at least five possible advantages. These advantages have been grouped into five explanatory sentences that are associated with five categories: privacy, cost-effectiveness, cross-borderness, easy and efficient usage, security, and etc.
4. Please choose **one** disadvantage of CBDC you would consider as the main reason for not utilizing this digital currency. I do not think it will be accepted everywhere (at online and offline market places) / I am afraid that my purchasing habits will be tracked / I do not think it is secure / Existing digital payments are sufficient / I am against all forms of digital money / Other	Categorical data & nominal scale	Q4 will allow to understand what disadvantage of CBDC will be considered by respondents as the main reason for not adopting this digital currency. *Answer choices:* respondents are asked to choose one disadvantageous attribute of CBDC from at least five disadvantages. These disadvantages have been grouped into five explanatory sentences that are associated with five categories: accessibility, privacy, security, general necessity, overall unwillingness to use, and etc.
5. Would you accept CBDC as a new form of payment? Yes / No / Do not know	Categorical data & nominal scale	Q5 will allow to understand if respondents are willing to accept CBDC as a new form of payment.
6. Would you agree to have your salary paid in CBDC? Yes / No / Do not know	Categorical data & nominal scale	Q6 will allow to understand if respondents are willing to have their salary paid in CBDC.
7. If CBDC is going to be interest-bearing and the interest rate is going to be higher than for a standard bank deposit, would you be willing to use CBDC as an investment instrument? Yes / No / Do not know	Categorical data & nominal scale	Q7 will allow to understand if respondents are willing to use CBDC as an investment instrument if both conditions are true: CBDC is interest-bearing, and the interest rate is higher for CBDC than for a standard bank deposit.
8. In case of CBDC adoption, would you support the idea of completely replacing cash with CBDC? Yes / No / Do not know	Categorical data & nominal scale	Q8 will allow to understand if respondents are going to support the idea of completely replacing cash with CBDC.

9. If you know the pros and cons of CBDC and if the pros outweigh the cons, would you be willing to use this digital currency if your central bank launches it? Yes / No / Do not know	Categorical data & nominal scale	Q9 will allow to understand if respondents are willing to use CBDC if their central bank launches it and both conditions are true: respondents know the pros and cons of CBDC, and the pros outweigh the cons.
10. Given the successful launch and proof that the digital currency is working well, when would you be willing to start using CBDC? Within one year / From one to three years / More than three years / I would never use it / Do not know	Categorical data & nominal scale	Q10 will allow to understand when respondents are willing to start using CBDC if both conditions are true: CBDC will be successfully launched, and it will work well after its launch. *Answer choices:* respondents are asked to choose between five time periods within which they would be ready to start using CBDC. These five time periods include a period within one year, a period from one to three years, a period after more than three years, never, and no decision on the usage date. The time periods do not include smaller periods because it always takes time for consumers to switch from one financial product to another one.

Source. Compiled by the author.

The data gathered with the help of this questionnaire will be analyzed in the subsequent section of the following master's thesis.

2.5. Data Analysis Methods and Assessment Criteria

To analyze the consumer view on CBDC adoption, two tests were used for analyzing the data collected through the survey. The first test used for the analysis is called One-Proportion Z-test. One-Proportion Z-test is a statistical test which is used to "determine if the proportions of categories in a single qualitative variable significantly differ from an expected or known population proportion" ("One-Proportion Z-Test," 2020, para. 1). To use it, one should have one group variable with only two options and there should be more than ten values in every cell ("One-Proportion Z-Test," 2020).

To test the hypotheses with the One-Proportion Z-test, the following assumptions should be met to ensure the accuracy of statistical method results: random sample, independence, large population, and mutually exclusive categories. The first assumption entails that the sample should be randomly selected, while the second one states that observations should be independent. Also, the assumption of a large population is important, so that the population of interest should be at

least ten times greater than a sample. The fourth assumption stresses an idea that no subject or participant should be included under both conditions; therefore, they should be mutually exclusive.

The One-Proportion Z-Test should also be used in the following scenario: the difference between two variables needs to be determined, the target variable is proportional or categorical, there are only two options, and each cell contains more than ten values. Therefore, the One-Proportion Z-Test can be applied to the hypotheses tested further in the next section of this thesis because the formulated hypotheses are aimed at answering the question if an actual sample has a different ratio for a certain variable than the population, categorical variables are used and have only two options, and more than ten observations are in each group.

On a par with meeting the assumptions and ensuring that the hypotheses are suitable for a particular test scenario, the next two steps in the process of performing the One-Proportion Z-Test performance include calculating a z-score, or z-statistic (with the appropriate confidence and significance levels being applied) and assessing this statistic with the help of a p-value that needs to be compared to a chosen significance level. Thus, the null hypothesis will not be rejected if a p-value based on a z-statistic is greater or equal to a chosen significance level; otherwise, the hypothesis will be rejected. The results of the One-Proportion Z-Test with an appropriate assessment method will be presented and interpreted in the subsequent section of this thesis.

The second test which is going to be used for the analysis of the consumer view on CBDC adoption is Chi-square test of independence (or the Pearson Chi-square test, or simply the Chi-square). It is one of the most useful statistics for testing hypotheses with the nominal variables that allows to "provide information not only on the significance of any observed differences, but also provides detailed information on exactly which categories account for any differences found" (McHugh, 2013, p. 143). Therefore, the amount and detail of information this statistic can provide make it one of the most useful tools for the researcher's analysis. Importantly, the Chi-square test of independence is a significance statistic and should be followed with a strength statistic. The Cramer's V is the "most common strength test used to test the data when a significant Chi-square result has been obtained" (McHugh, 2013, p. 143).

As with any statistic, there are assumptions that need to be met. The Chi-square test of independence includes the following assumptions: random sample, frequencies in cells, mutually exclusive variables, and nominal or ordinal variables. The first assumption entails that though the data should be obtained through random selection, it is "not uncommon to find inferential statistics

used when data are from convenience samples rather than random samples" (McHugh, 2013, p. 144). The second assumption states that frequencies (or counts of cases) should be included into cells as the data. The third and fourth assumptions proclaim that the categories of the variables should be mutually exclusive, and the variables should be categorical and measured at the nominal or ordinal scale. Therefore, the Chi-square test of independence can be performed for hypotheses testing in the next section of the following master's thesis because the assumptions listed above are met: a convenience sample is used, only frequencies are included as the data in the tables' cells, the variables are either nominal or ordinal and mutually exclusive.

On a par with meeting the assumptions, an actual calculation of the Chi-square (χ^2) needs to be performed, while using the following formula: $c^2 = \sum \frac{(f_o - f_e)^2}{f_e}$, where *fo* – observed frequency and *fe* – expected frequency. When the value for the Chi-square (χ^2) is calculated, this value should be followed with a strength statistic phi (φ) for 2x2 tables in the following formula: $j = \sqrt{\frac{c^2}{N}}$, where N – total number of observations. The result is assessed on a scale from 0 to 1 ($0 \leq \varphi \leq 1$): from no association to a perfect association. However, when the table contains either more than two rows or two columns, a strength statistic Cramer's V is used in the following formula: $V = \sqrt{\frac{c^2}{N(\min of(r-1, c-1)}}$, where *r* – number of rows and *c* - number of columns. The result is assessed based on the interpretation table by Cohen (1988), where the interpretation depends on the degrees of freedom, shown in Table 8.

Table 8 *Interpretations for Cramer's V*

df*	Negligible	Small/Weak	Medium/Moderate	Large/Strong
1	0 < .10	.10 < .30	.30 < .50	.50 or more
2	0 < .07	.07 < .21	.21 < .35	.35 or more
3	0 < .06	.06 < .17	.17 < .29	.29 or more
4	0 < .05	.05 < .15	.15 < .25	.25 or more
5	0 < .05	.05 < .13	.13 < .22	.22 or more

Source. Peter Statistics, 20 August 2022, https://peterstatistics.com/CrashCourse/3-TwoVarUnpair/NomNom/NomNom-2c-Effect-Size.html.

The results of the Chi-square test of independence followed by one of the strength statistics to determine the strength of association will be presented and interpreted in the subsequent section of the following master's thesis.

2.6. Limitations

Limitations of the used data analysis methods and assessment criteria include a type of sampling to be used and sample size requirements, issues with questionnaire design, difficulty of interpretation, reliability of the phi (φ) and Cramer's V strength statistics results, and sincerity of respondents. More explanations are detailed below:

1. Non-probability (convenient) sampling is used for this thesis; therefore, the sample might be not representative of the population.
2. The sample size might seem to be small; therefore, there is a question if the conclusions drawn from this sample could be applied to the population.
3. Usually, a particular region or country is chosen for this kind of the consumers' view studies. In the following study, a particular region or country is not chosen; therefore, there is a question if the conclusions drawn from this sample could be applied to the population due to the diversity of responses.
4. It is difficult to interpretate the data when there is a considerable number of categories (around 5 categories) in the independent or dependent variables.
5. The phi (φ) and Cramer's V tend to produce relative low correlation measures, even for highly significant results.
6. There is a chance that respondents did not answer sincerely, and therefore, the conclusions drawn might not be applicable to the population.

3. EMPIRICAL RESULTS ANALYSIS FOR ASSESSING THE CONSUMER VIEW ON CBDC ADOPTION

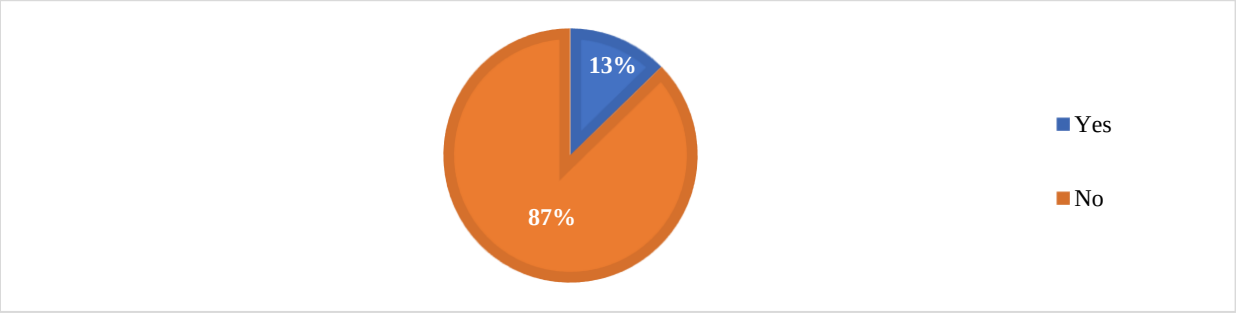
The following chapter discusses the empirical results collected in the process of the survey completion and hypotheses testing which also involves a correlation / association analysis. The analysis of the empirical results will allow to answer the research questions identified in the methodological part and conclude whether the hypotheses tested and the relationship identified between two variables confirm the primary assumptions about consumers' willingness to adopt CBDC in the near future or not.

3.1. Analysis of the Consumers' Willingness to Explore the Topic of CBDC

In the methodological section of the following master's thesis, the research question regarding the willingness of prospective consumers to explore the topic of CBDC has been identified. To test this research question, H1 and H2 have been formulated and articulated. Also, a correlation / association analysis has been performed to identify the relationship between the selected variables identified in H1 and H2 and demographic variables. The following analysis will present and explain the results of hypotheses testing and association analysis, compare them to the results published in other reports by independent research companies on a similar matter, and provide the views of central banks' researchers on the research question discussed to see how central banks are going to address the issues prospective consumers are currently concerned with.

The first research question identified in the methodological section relates to the willingness of prospective consumers to explore the topic of central bank digital currency. Thus, when respondents were asked if they know anything about central bank digital currency (CBDC), the results of the survey showed that out of 126 participants, only 16 consumers (13%) responded that they know something about central bank digital currency, while 110 consumers (87%) answered that they do not know anything about CBDC (see Figure 7).

Figure 7 *Do You Know Anything About Central Bank Digital Currency (CBDC)?*



Source. Compiled by the author.

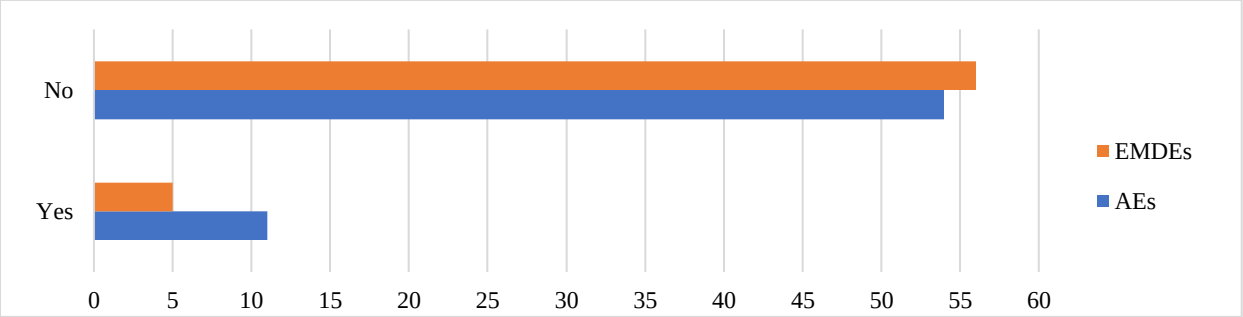
According to the primary (null) hypothesis, only 10% of respondents know something about central bank digital currency (CBDC): H_0: p=.1. To check if the primary assumption articulated in this hypothesis is true, H1 has been tested using the data obtained from the survey. To test this hypothesis, the One-Proportion Z-test has been selected and the following test assumptions have been met: there are two categorical outcomes (yes (0.1) / no (0.9)), and population follows binomial distribution. Further, the significance level (α) of .05 has been identified for a critical value to be selected. As the hypothesis formulated is two-tailed, two critical values (1.96 and -1.96) have been used. Using the following formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$, z-statistic has been calculated and resulted in 1.01. To interpret and assess this statistic, a p-value of .3124 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that only 10% of respondents know something about CBDC because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing show that the primary assumption is true and only around 10% respondents, or 13% according to the survey results, know something about CBDC for now. This finding means that although over the last few years, central banks have spent billions designing, building, and launching CBDC across the globe, they should not have assumed that if they worked on a new digital currency, consumers would be aware of the financial product they are working on. Therefore, little attention has been paid to the question of educating prospective consumers about CBDC from a central banks' perspective which means that central

banks should not only spend their resources on developing the currency itself, but also pay attention to the idea of educating people about CBDC before launching CBDC to the public.

On a par with revealing that prospective consumers are not educated about CBDC, the analysis of whether the economic status of a country where a consumer is residing is related to his / her knowledge of CBDC has been performed. To determine the relationship between these two variables—consumers' knowledge of CBDC and their country's economic status—the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) has been identified and it equals to the value of 2.16. However, as it has been noted in the methodological section, this value should be followed with a strength statistic phi (φ) for 2x2 tables because each variable contains only two categories, and the result should be assessed on a scale from 0 to 1 ($0 \leq \varphi \leq 1$): from no association to a perfect association. Thus, the strength statistic phi (φ) equals to .13 that makes the association between consumers' knowledge of CBDC and an economic status of their country of residence weak (see Figure 9).

Figure 8 *The Relationship Between Consumers' Knowledge of CBDC and Their Country's Economic Status*

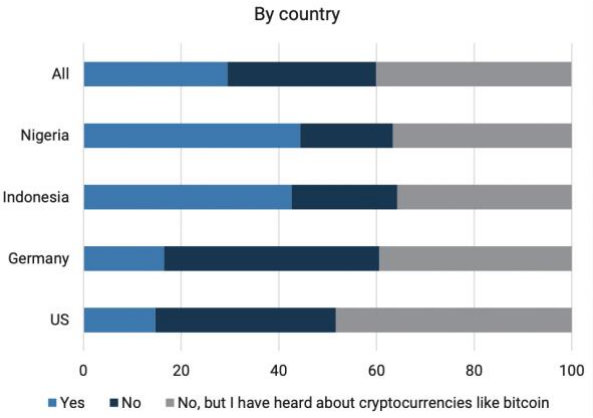


Source. Compiled by the author.

Although the association between the two variables is weak, Figure 8 shows that when answering "yes" to the question about CBDC knowledge, more respondents from the countries with advanced economies (AEs) are aware of CBDC as a concept compared to the number of respondents from the countries with emerging market and developing economies (EMDEs). This difference might be explained by the fact that the respondents from AEs countries are more educated about CBDC than the respondents from EMDEs countries. However, the report on consumer attitudes to CBDC by OMFIF Digital Monetary Institute and Giesecke+Devrient (G+D) published a different result and provided a different interpretation. This report summarizes the results of the "survey of 3,000 consumers across four jurisdictions: 1,000 in the US and 1,000 in

Germany, and 500 in Indonesia and 500 in Nigeria, conducted by Ipsos MORI," a market research company, and published in November 2021 (Grant et al., 2021, p. 4). The survey was designed to reveal how consumers from Germany, Indonesia, Nigeria, and the US feel about central bank digital currency. Therefore, when survey respondents were asked a question of whether they have heard of CBDCs or not, the survey results revealed that the respondents from EMDEs countries—Nigeria and Indonesia (more than 40%)—are more aware of CBDCs compared to the US and Germany (less than 20%) (Grant et al., 2021) (see Figure 9). The following results might be explained by the fact that people living in the countries with unstable economy tend to adopt new financial products hoping to improve their current living conditions, while people residing in the countries with stable economy are less willing to accept changes as they are satisfied with their current living conditions. Therefore, the authors of the report draw a conclusion that knowledge of CBDCs is higher in developing markets, while knowledge of bitcoin or other cryptocurrencies is higher in developed markets like the US (Grant et al., 2021).

Figure 9 *Have You Heard About CBDCs?*

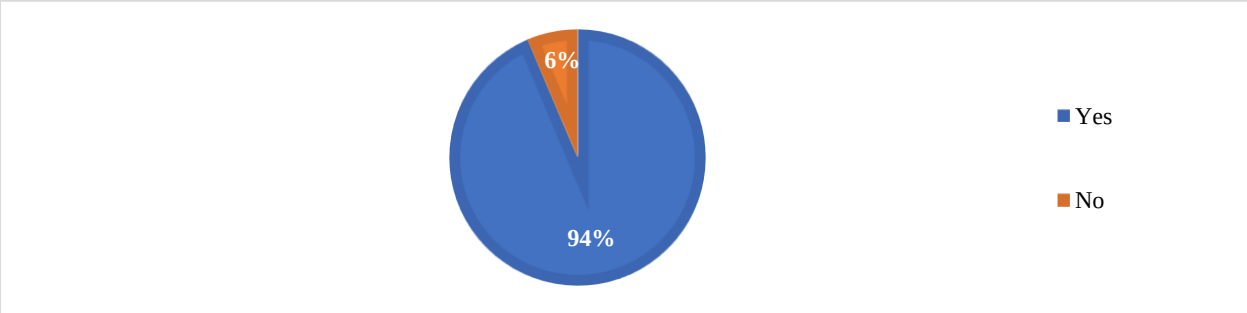


Source. Ipsos MORI, OMFIF analysis, November 2021, https://www.gi-de.com/corporate/Payment/Central_Bank_Digital_Currencies/G_D_2021_consumer_study.pdf.

Therefore, the comparison of the survey results gathered as part of the following master's thesis and the survey results published in the report reveals that a small number of prospective consumers are aware of CBDC, and yet depending on the survey results either the respondents from AEs or EMDEs countries are more knowledgeable about CBDC (the difference could be attributed to the sample size differences and countries being presented). However, anyway, these findings entail that central banks must spend more resources on educating prospective consumers from both AEs and EMDEs countries in order to launch CBDC successfully.

The first research question related to the willingness of prospective consumers to explore the topic of central bank digital currency also involves an aspect of studying consumers' willingness either to explore or improve their knowledge on the topic of CBDC. Thus, when respondents were asked if they are willing to explore / improve their knowledge on the topic of CBDC, the results of the survey showed that out of 126 participants, 118 consumers (94%) responded that they are ready to explore / improve their knowledge on central bank digital currency, while 8 consumers (6%) answered that they do not want to explore the topic of CBDC (see Figure 10).

Figure 10 *Are You Willing to Explore / Improve Your Knowledge on the Topic of CBDC?*



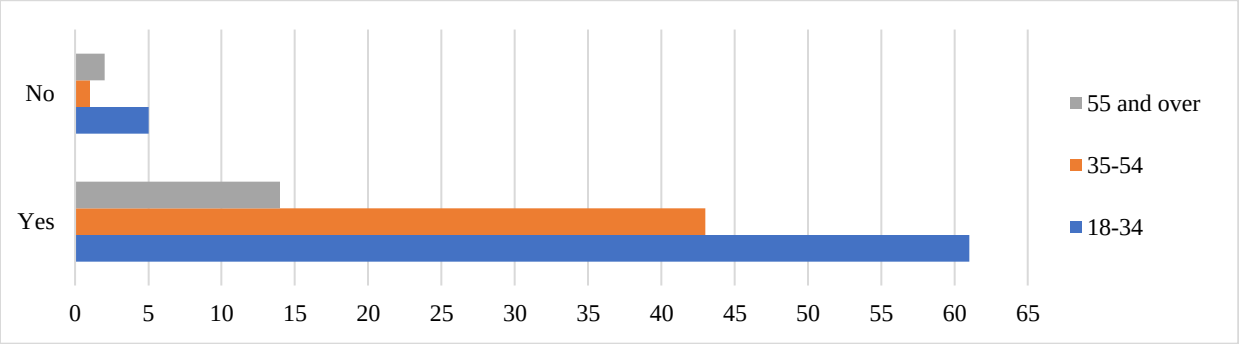
Source. Compiled by the author.

According to the primary (null) hypothesis, 90% of respondents are willing either to explore the topic of CBDC for the first time or improve their existing knowledge on CBDC: H_0: p=.9. To check if the primary assumption articulated in this hypothesis is true, H2 has been tested using the data obtained from the survey. To test this hypothesis, the One-Proportion Z-test has been chosen and the following test assumptions have been met: two categorical outcomes (yes (0.9) / no (0.1)), and population follows binomial distribution. Further, the significance level (α) of .05 has been identified for a critical value to be selected. As the hypothesis formulated is two-tailed, two critical values (1.96 and -1.96) have been used. Using the following formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$, z-statistic has been calculated and resulted in 1.37. To interpret and assess this statistic, a p-value of .1706 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that 90% of respondents are willing either to explore the topic of CBDC for the first time or improve their existing knowledge on it because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing reveal that the primary assumption is true and around 90% respondents, or 94% according to the survey results, are ready to explore the topic of CBDC for the first time for now. This finding means that although central banks do not spend enough resources on educating prospective consumers about CBDC, when these consumers hear about CBDC, many of them would like to explore this topic. Therefore, consumers have an interest in CBDC. At the same time, the BIS reports do not contain any information on consumers' willingness to explore CBDC. Recently, the Bank for International Settlements has conducted an extensive annual survey of central bankers' own views on CBDC, charting the dramatic growth in the number of central banks working on launching retail CBDC (Auer et al., 2021). Yet it gives little indication as to whether these CBDC projects will succeed with prospective consumers or not. Therefore, central banks should not only spend their resources on gathering central bankers' views on CBDC, but also pay attention to gathering prospective consumers' views on CBDC because otherwise no successful launch would happen.

On a par with revealing that prospective consumers wish to explore the topic of CBDC, yet central banks are not willing to study their opinions on CBDC, the analysis of whether the consumers' age is related to their willingness to explore CBDC has been done. To determine the relationship between these two variables—consumers' willingness to explore CBDC and their age—the Chi-square test of independence has been used. Following the calculations, the Chi-square (χ^2) has been identified and it equals to the value of 2.41. However, as it has been noted in the methodological section, this value should be followed with a strength statistic Cramer's V for a table with two rows and three columns because one of the variables contain more than two categories, and the result should be assessed based on the interpretation table by Cohen (1988), where the interpretation depends on the degrees of freedom. Thus, the strength statistic Cramer's V equals to .14 that makes the association between consumers' willingness to explore / improve their knowledge on CBDC and their age weak (see Figure 11).

Figure 11 *The Relationship Between Consumers' Willingness to Explore CBDC and Their Age*



Source. Compiled by the author.

Although the association between the two variables is weak, Figure 11 shows that when answering "yes" to the question about willingness to learn about CBDC, more respondents aged 18-34 wish to explore the topic of CBDC compared to the respondents aged 35-54, and the respondents aged 55 and over seem to be the ones who are unwilling to explore CBDC. This difference might be explained by the fact that younger respondents are more open to new financial discoveries, while older generation seems to trust their current financial products and not to dive deep into a new topic of digital currencies. Other reports do not focus on studying prospective consumers' willingness to explore / improve their knowledge of CBDC as well as on investigating if this decision to learn about CBDC is influenced by the age of consumers. Therefore, analyzing the survey results gathered as part of the following master's thesis, the following conclusions can be drawn: a big number of prospective consumers would like to learn more about the concept of CBDC or improve their existing knowledge on this topic, and the age of consumers might be a factor in determining whether they would be interested in diving deeper in the topic of CBDC or not. In any case, these findings entail that central banks must invest all the available resources into educating people about CBDC, its design features, functions, as well as advantages and disadvantages because the majority of prospective consumers have an interest in this digital currency, especially younger generation, and would like to find more detailed and understandable information on this topic.

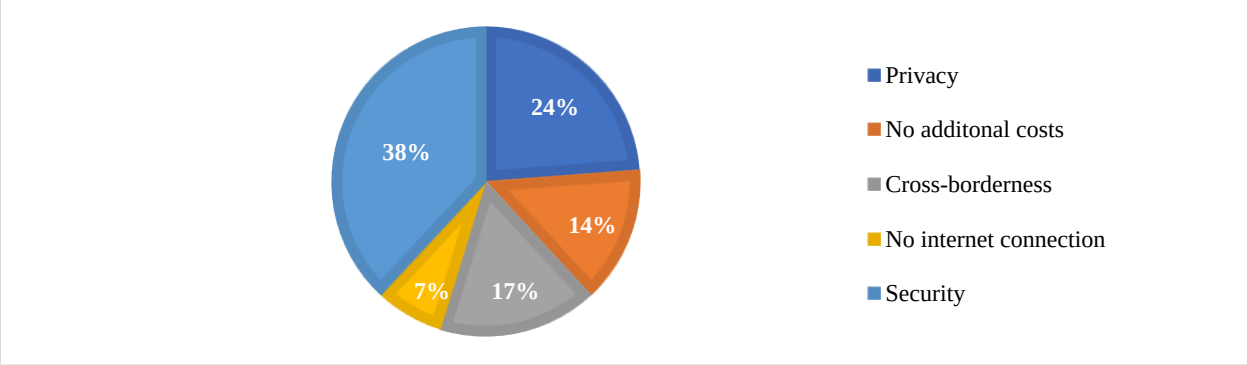
3.2. Analysis of the Benefits Determining a Consumers' Choice of CBDC Adoption

In the methodological section of the following master's thesis, the second research question regarding identifying the benefits determining a consumers' choice of whether to adopt CBDC or not has been identified. To test this research question, H3 has been formulated and articulated.

Also, a correlation / association analysis has been performed to identify the relationship between the selected variable identified in H3 and demographic variable. The following analysis will present and explain the results of hypothesis testing and association analysis, compare them to the results published in other reports by independent research companies on a similar matter, and provide the views of central banks' researchers on the research question discussed to see how central banks are going to address the issues prospective consumers are currently concerned with.

The second research question identified in the methodological section relates to the identification of CBDC benefits that might determine a prospective consumers' choice whether to adopt CBDC or not. Thus, when respondents were asked to choose one advantage of CBDC they would find the most important when deciding whether to adopt this digital currency or not, the results of the survey showed that out of 126 participants, only 48 consumers (38%) responded that security is an advantageous feature of CBDC, 30 consumers (24%) chose privacy as the main advantage of CBDC, 21 respondents (17%) selected a feature of cross-borderness as a CBDC advantage, 18 respondents (14%) selected an option of no additional costs associated with CBDC usage as the main advantage, while 9 participants (7%) chose an option of no internet connection associated with CBDC usage as the main advantage (see Figure 12).

Figure 12 *Consumers' Choice of CBDC Advantage*



Source. Compiled by the author.

According to the primary (null) hypothesis, only 50% of respondents would choose security as the most important advantage of CBDC when deciding whether to adopt this digital currency or not: H_0: p=.5. To check if the primary assumption articulated in this hypothesis is true, H3 has been tested using the data obtained from the survey. To test this hypothesis, the One-Proportion Z-test has been selected and the following test assumptions have been met: two categorical outcomes (security (0.5) / not security (0.5)), and population follows binomial distribution.

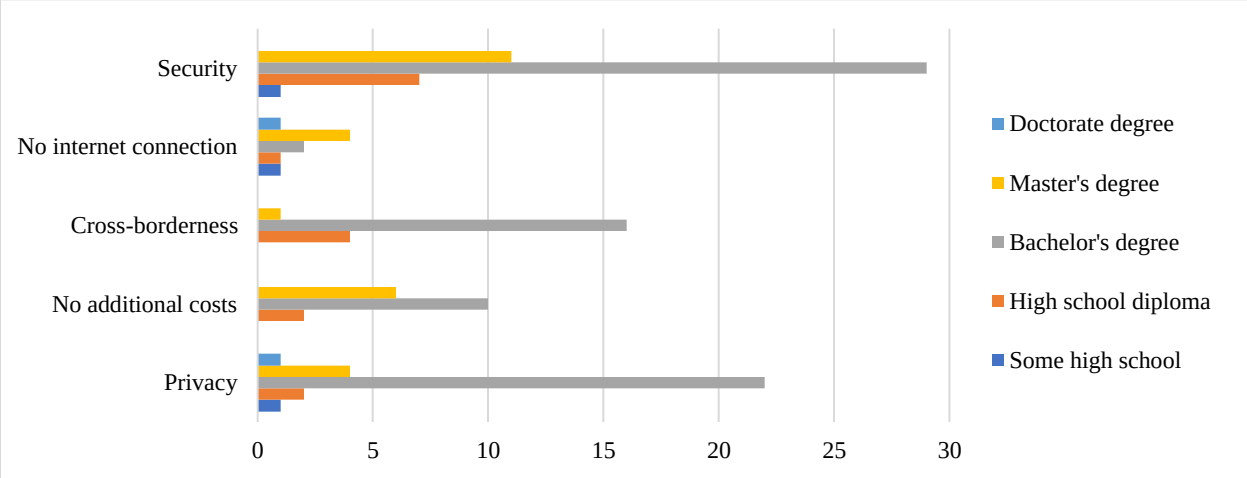
Further, the significance level (α) of .05 has been identified for a critical value to be selected. As the hypothesis formulated is two-tailed, two critical values (1.96 and -1.96) have been used. Using the following formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$, z-statistic has been calculated and resulted in -2.67. To interpret and assess this statistic, a p-value of .0076 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis is rejected at α=.05, i.e., there is sufficient evidence to reject the claim that 50% of respondents choose security as the most important advantage of CBDC when deciding whether to adopt this digital currency or not because the p-value is smaller than the significance level.

Therefore, the results of hypothesis testing show that the primary assumption is not true and only 38% respondents consider security as the most important CBDC advantage when deciding whether to adopt this digital currency or not. This finding means that security feature as well as privacy feature (24% of respondents chose this option) play a key role as CBDC advantages and are the primary factors determining whether to use CBDC or not. At the same time, the report on the consumer view on CBDCs by Guardtime and independent research company PureProfile published a similar result and provided a similar interpretation. This report summarizes the results of the interview of "902 adults aged 18-plus in Germany, Singapore, South Africa, the United Arab Emirates, the UK, the USA, France, Hong Kong, Sweden, and Norway using an online methodology in July 2021" (Guardtime, 2021, p. 2). When interview respondents were asked to "indicate what attributes of a CBDC they would find most important," the interview results revealed that the respondents chose "privacy on transactions as the most important attribute of CBDC, followed by ease of use" and CBDC not involving additional costs to use (Guardtime, 2021, p. 4). "Being able to use CBDC internationally and being able to use it when there is no internet connection were also seen as important" (Guardtime, 2021, p. 4). Importantly, when central bankers were interviewed, they named accessibility to the general public, security, and anonymity as the most important attributes of CBDC (Nugroho, 2018). Therefore, security and privacy are identified as the main advantages prospective consumers and central bankers are thinking of when deciding whether to adopt CBDC or not and what design features CBDC should have, so that consumers' demands would be satisfied.

On a par with revealing that security and privacy are considered to be the main advantages of CBDC, the analysis of whether the consumers' educational level is related to their choice of

CBDC advantage has been performed. To determine the relationship between these two variables—a consumers' choice of CBDC advantage and their educational level—the Chi-square test of independence has been used. Following the calculations, the Chi-square (χ^2) has been identified and it equals to the value of 23.78. However, as it has been noted in the methodological section, this value should be followed with a strength statistic Cramer's V for a table with five rows and five columns because both variables contain five categories each, and the result should be assessed based on the interpretation table by Cohen (1988), where the interpretation depends on the degrees of freedom. Thus, the strength statistic Cramer's V equals to .22 that makes the association between the consumers' choice of CBDC advantage and their educational level moderate (see Figure 13).

Figure 13 *The Relationship Between the Consumers' Choice of CBDC Advantage and Their Educational Level*



Source. Compiled by the author.

Although the association between the two variables is moderate, Figure 13 shows that the respondents who chose security and privacy attributes as the main factors determining whether to adopt CBDC or not have at least a bachelor's degree. This means that people with higher education understand overall concerns related to security and privacy issues in the financial sector. Therefore, they want to use CBDC in the near future only if central bankers make security and privacy part of CBDC design features.

Therefore, comparing the survey results gathered as part of the following master's thesis and the interview results published in the report, only 38% of consumers named security as the advantageous feature of CBDC, while 24% of consumers chose privacy as the main advantage of

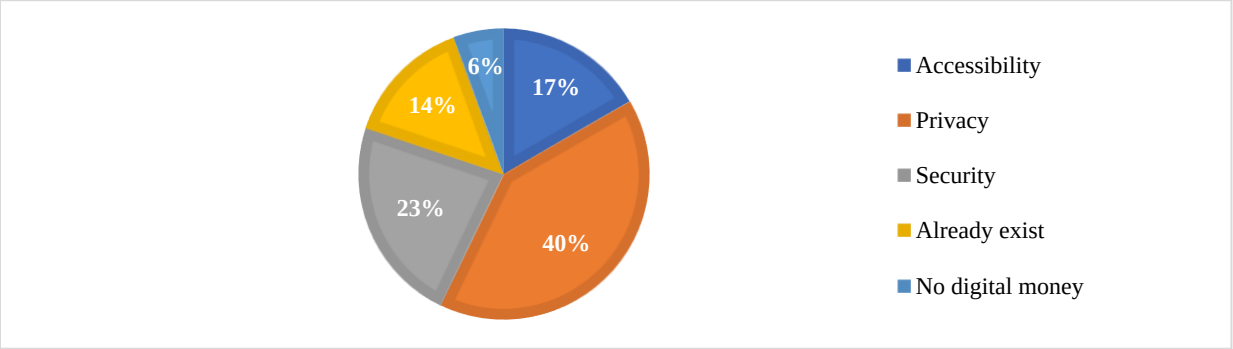
CBDC. At the same time, security is identified as the main feature of CBDC by central bankers that entails that although central bankers do not invest enough resources into educating prospective consumers about CBDC, they are still able to identify the main feature that would attract prospective users of CBDC and might signify a successful CBDC launch in the near future.

3.3. Analysis of the Challenges Preventing Consumers From Utilizing CBDC

In the methodological section of the following master's thesis, the third research question regarding identifying the challenges that might prevent consumers from utilizing CBDC has been identified. To test this research question, H4 has been formulated and articulated. Also, a correlation / association analysis has been performed to identify the relationship between the selected variable identified in H4 and demographic variable. The following analysis will present and explain the results of hypothesis testing and association analysis, compare them to the results published in other reports by independent research companies on a similar matter, and provide the views of central banks' researchers on the research question discussed to see how central banks are going to address the issues prospective consumers are currently concerned with.

The third research question identified in the methodological section relates to the identification of CBDC disadvantages that might be the main reasons for not utilizing this digital currency. Thus, when respondents were asked to choose one disadvantage of CBDC they would consider as the main reason for not utilizing this digital currency, the results of the survey revealed that out of 126 participants, only 51 consumers (40%) responded that they are concerned with a privacy issue CBDC might possess, 29 consumers (23%) chose a security issue as the main disadvantage of CBDC, 21 respondents (17%) are concerned with an accessibility issue, 18 respondents (14%) think that existing digital payments are sufficient, while a small group of respondents (6%) is against all forms of digital money (see Figure 14).

Figure 14 *Consumers' Choice of CBDC Disadvantage*



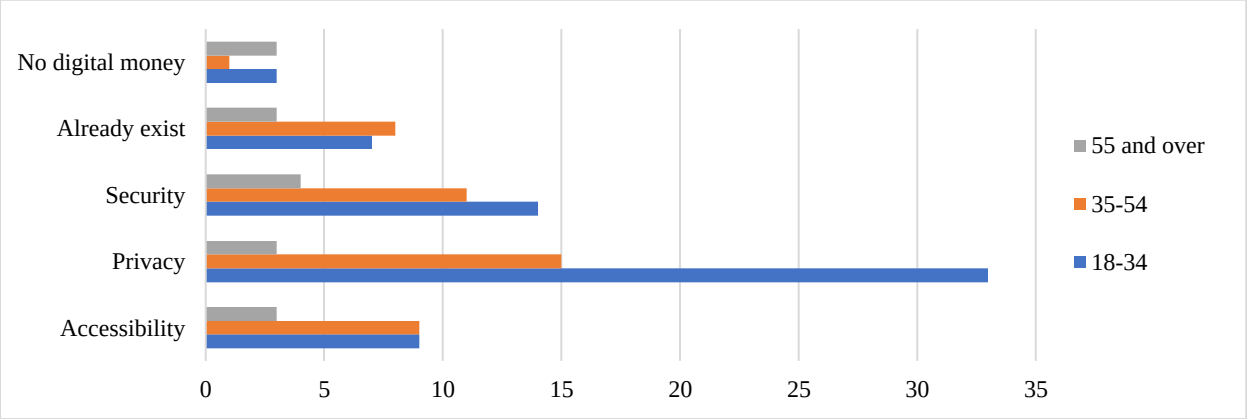
Source. Compiled by the author.

According to the primary (null) hypothesis, only 50% of respondents are concerned with a privacy issue and consider it as the main reason for not utilizing CBDC: H_0: p=.5. To check if the primary assumption articulated in this hypothesis is true, H4 has been tested using the data obtained from the survey. To test this hypothesis, the One-Proportion Z-test has been selected and the following test assumptions have been met: two categorical outcomes (privacy (0.5) / not privacy (0.5)), and population follows binomial distribution. Further, the significance level (α) of .05 has been identified for a critical value to be selected. As the hypothesis formulated is two-tailed, two critical values (1.96 and -1.96) have been used. Using the following formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$, z-statistic has been calculated and resulted in -2.14. To interpret and assess this statistic, a p-value of .0324 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis is rejected at α=.05, i.e., there is sufficient evidence to reject the claim that 50% of respondents are concerned with a privacy issue and consider it as the main reason for not utilizing CBDC because the p-value is smaller than the significance level.

Therefore, the results of hypothesis testing show that the primary assumption is not true and only 40% of respondents consider a privacy issue as the main disadvantage that concerns them most of all. This finding means that issues related to privacy and security are the key players in determining the consumers' choice of whether to adopt CBDC or not. Therefore, it does not matter if consumers are asked to name an advantage and a disadvantage of CBDC in separate questions, they will name the same features that might be an advantage or a disadvantage of the same digital currency. Thus, central bankers must consider these similar findings when designing CBDC that would be suitable for the general public.

On a par with revealing that issues related to privacy and security are considered to be the main challenges for CBDC adoption, the analysis of whether the consumers' age is related to their choice of CBDC disadvantage has been done. To determine the relationship between these two variables—consumers' choice of CBDC disadvantage and their age—the Chi-square test of independence has been used. Following the calculations, the Chi-square (χ^2) has been identified and it equals to the value of 12.07. However, as it has been noted in the methodological section, this value should be followed with a strength statistic Cramer's V for a table with five rows and three columns because both variables contain more than two categories each, and the result should be assessed based on the interpretation table by Cohen (1988), where the interpretation depends on the degrees of freedom. Thus, the strength statistic Cramer's V equals to .22 that makes the association between the consumers' choice of CBDC disadvantage and their age moderate (see Figure 15).

Figure 15 *The Relationship Between the Consumers' Choice of CBDC Disadvantage and Their Age*

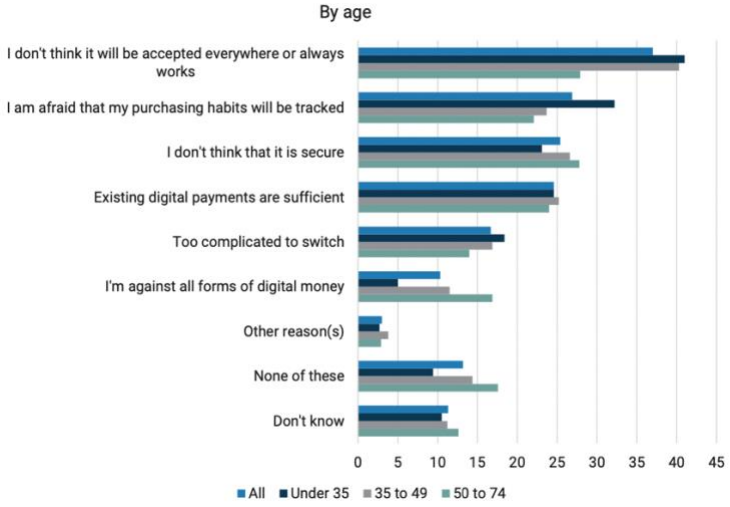


Source. Compiled by the author.

Although the association between the two variables is moderate, Figure 15 shows that the respondents who chose privacy and security issues as the main disadvantages that might prevent them from utilizing CBDC belong to a younger generation aged 18-34. This means that people aged 18-34 understand overall concerns related to privacy and security issues in the financial sector. Therefore, they want to use CBDC in the near future only if central bankers make them more private and secure compared to the existing fiat money or cryptocurrencies. The report on consumer attitudes to CBDC by OMFIF Digital Monetary Institute and Giesecke+Devrient (G+D) published a similar result and provided a similar interpretation. When survey respondents were

asked a question about which features might be viewed as CBDC disadvantages and would prevent them from using it, the survey results revealed that the respondents aged under 35 are mostly concerned with accessibility, privacy, and security issues of CBDC (Grant et al., 2021) (see Figure 16). The following answers might be explained by the fact that although a younger generation is open to new financial products, yet they realize that privacy and security issues will be present in CBDC design. At the same time, the authors of the report conclude that the issues raised by consumers around accessibility, privacy, and security are significant because these are the "principal characteristics of cash" (Grant et al., 2021, p. 17). Therefore, according to their opinion, "policy-makers should endeavor to make CBDC as close to cash as possible, especially focusing on widespread accessibility without the disclosure of personal data" (Grant et al., 2021, p. 17).

Figure 16 *Which of These—if Any—Are You Concerned About for Using a CBDC, and Which Might Mean You Would Not Use a CBDC?*



Source. Ipsos MORI, OMFIF analysis, November 2021, https://www.gi-de.com/corporate/Payment/Central_Bank_Digital_Currencies/G_D_2021_consumer_study.pdf.

Therefore, comparing the survey results gathered as part of the following master's thesis and the survey results published in the report, only 40% of consumers named a privacy issue as a potential disadvantageous feature of CBDC, while 23% of consumers chose a security issue as the main challenge to CBDC adoption. Many respondents who are concerned with these issues belong to a younger generation aged under 35, and according to the report, the potential disadvantages chosen by these prospective consumers entail that they want CBDC to be similar to cash, only in a digital form (Grant et al., 2021). Therefore, central banks might pay attention to privacy and

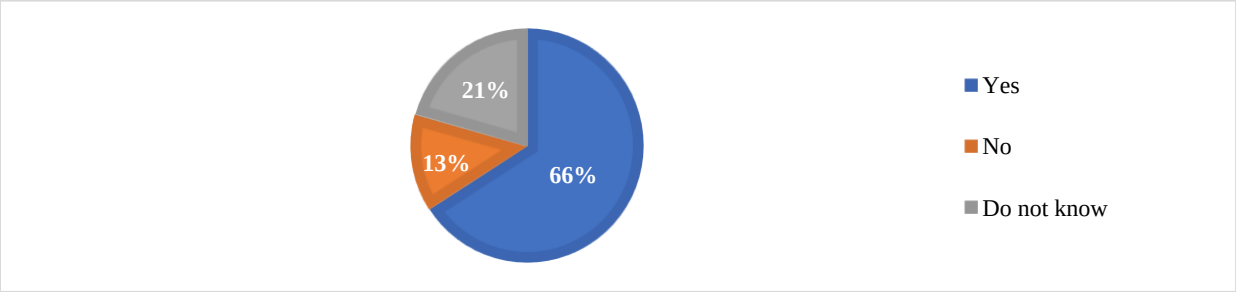
security features of CBDC because they can serve as an advantage or a disadvantage among a younger generation that represents their target audience.

3.4. Analysis of Money Functions Attributed by Consumers to CBDC

The fourth research question identified in the methodological section relates to identifying money functions consumers attribute to CBDC. To test this research question, H5-H7 have been formulated. Also, an association analysis has been performed to identify the relationship between the selected variables identified in H5-H7 and demographic variables. The following analysis will present and explain the results of hypotheses testing and association analysis, compare them to the results published in other reports by independent research companies on a similar matter, and provide the views of central banks' researchers on the research question discussed to see how central banks are going to address the issues prospective consumers are currently concerned with.

Thus, when respondents were asked if they would accept CBDC as a new form of payment, the results of the survey revealed that out of 126 participants, 83 consumers (66%) responded that they would accept CBDC as new form of payment, while 17 consumers (13%) and 26 consumers (21%) either do not want to use CBDC for the payment purposes at all or have not decided yet if they want to use it or not, respectively (see Figure 17).

Figure 17 *Would You Accept CBDC as a New Form of Payment?*



Source. Compiled by the author.

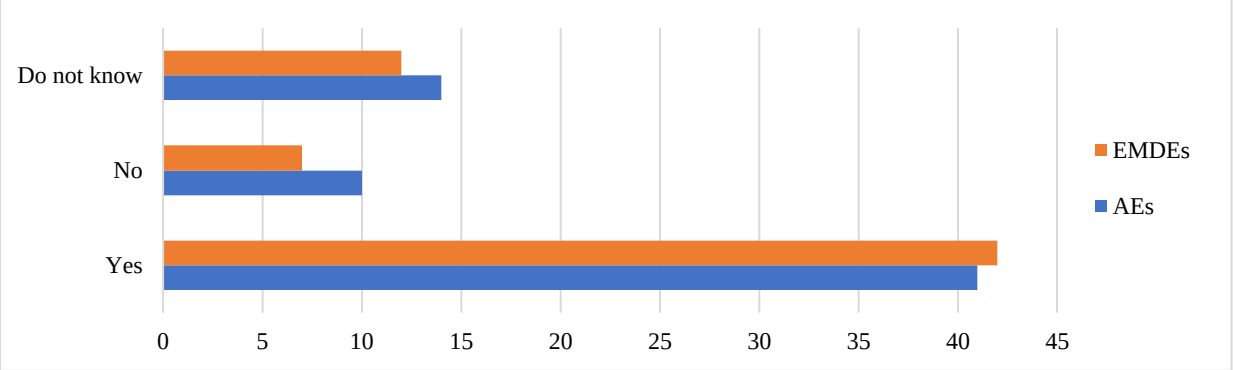
According to the primary (null) hypothesis, only 60% of respondents would accept CBDC as a new form of payment: H_0: p=.6. To test H5 hypothesis, the One-Proportion Z-test has been selected, and a significance level (α) of .05 has been chosen for the critical values to be 1.96 and -1.96 as the hypothesis formulated is two-tailed. Using the formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$ for calculating a z-statistic, the result of 1.35 has been received. To interpret and assess this statistic, a p-value of .1770 has been determined for a calculated z-statistic and compared to the selected significance

level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that 60% of respondents would accept CBDC as a new form of payment because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing show that the primary assumption is true and around 60% respondents, or 66% according to the survey results, are willing to accept CBDC as a new form of payment. This finding means that central banks may continue developing CBDC because more than half of respondents would like to accept it as a payment instrument in the near future.

On a par with revealing that more than half of consumers would like to accept CBDC as a means of payment, the analysis of whether the economic status of the country where a consumer is residing is related to his / her decision to accept CBDC as a new form of payment has been performed. To determine this relationship, the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) equals to .57. However, this value should be followed with a strength statistic Cramer's V that equals to .07 that makes the association between the consumers' decision to accept CBDC as a new form of payment and an economic status of their country of residence negligible (see Figure 18).

Figure 18 *The Relationship Between the Consumers' Decision to Accept CBDC as a New Form of Payment and Their Country's Economic Status*

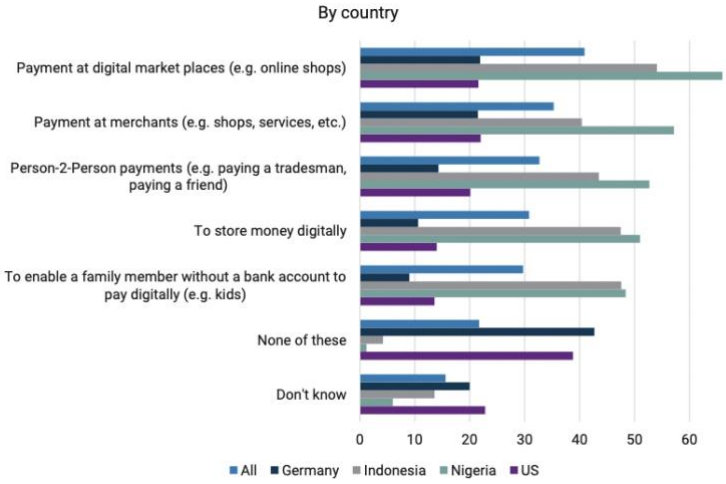


Source. Compiled by the author.

Although the association between the two variables can be neglected, the report on consumer attitudes to CBDC by OMFIF Digital Monetary Institute and Giesecke+Devrient (G+D) provides a different result and interpretation. When survey respondents were asked in which situations they would consider using a CBDC, emerging market consumers were more willing to

use CBDC as a new form of payment than their counterparts in developed markets (Grant et al., 2021). “More than 50% of respondents in Nigeria and Indonesia (EMDEs) would consider using CBDC as a form of payment in digital marketplaces, and more than 40% would use them for shopping at merchants, peer-to-peer payments, to pay for items without having a bank account” (Grant et al., 2021, p. 16) (see Figure 19). “Only around 40% of consumers in developed markets would be likely to use CBDC for any purpose, most likely shopping or P2P payments” (Grant et al., 2021, p. 16) (see Figure 19). This difference might be explained by the fact that EMDEs consumers are willing to use CBDC, while AEs consumers do not see any reason to replace their current fiat money with any new digital currency. Anyway, “policy-makers should bear in mind that CBDC should be a platform for innovation—they will need to be used for business models that don’t exist today” (Grant et al., 2021, p. 16). “The design of a CBDC must be future-proofed” (Grant et al., 2021, p. 16).

Figure 19 *In Which of the Following Situations Would You Consider Using a CBDC?*



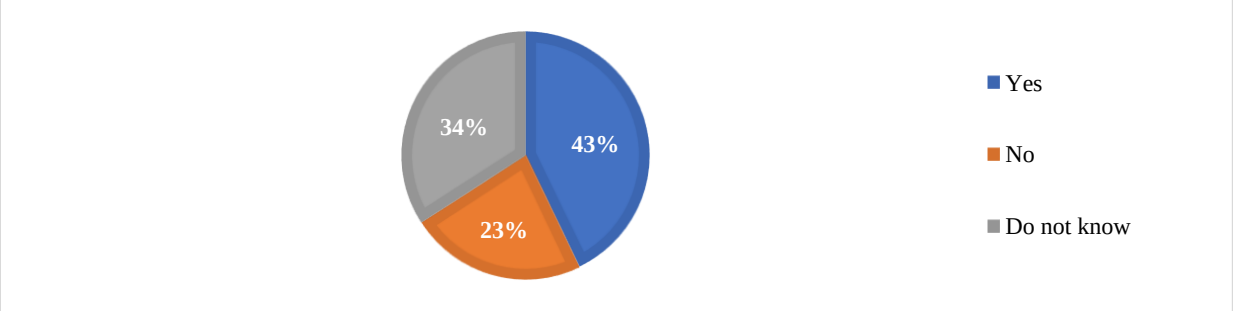
Source. Ipsos MORI, OMFIF analysis, November 2021, https://www.gi-de.com/corporate/Payment/Central_Bank_Digital_Currencies/G_D_2021_consumer_study.pdf.

Therefore, comparing the survey results of this master’s thesis and the survey results published in the report, more than half of consumers would like to accept CBDC as a means of payment, and although no correlation has been revealed between the consumers’ decision to accept CBDC as a means of payment and the economic status of their country of residence, other studies present this correlation and state that EMDEs consumers show more enthusiasm regarding the use of CBDC as a new form of payment compared to AEs consumers (the difference could be attributed to the sample size differences and countries being presented). However, these findings

entail that central banks must modify CBDC and at the same create a user-friendly environment for more consumers to accept CBDC as a new form of payment.

Once the respondents answered the question about whether they would accept CBDC as a new means of payment or not, they were also asked to provide their answers to the following question: Would you agree to have your salary paid in CBDC? According to the results of the survey, out of 126 participants, 54 consumers (43%) responded that they would agree to have their salary paid in CBDC, while 29 consumers (23%) and 43 consumers (34%) either do not want their salary to be paid in CBDC at all or have not decided yet if they want to have it in CBDC or not, respectively (see Figure 20).

Figure 20 *Would You Agree to Have Your Salary Paid in CBDC?*



Source. Compiled by the author.

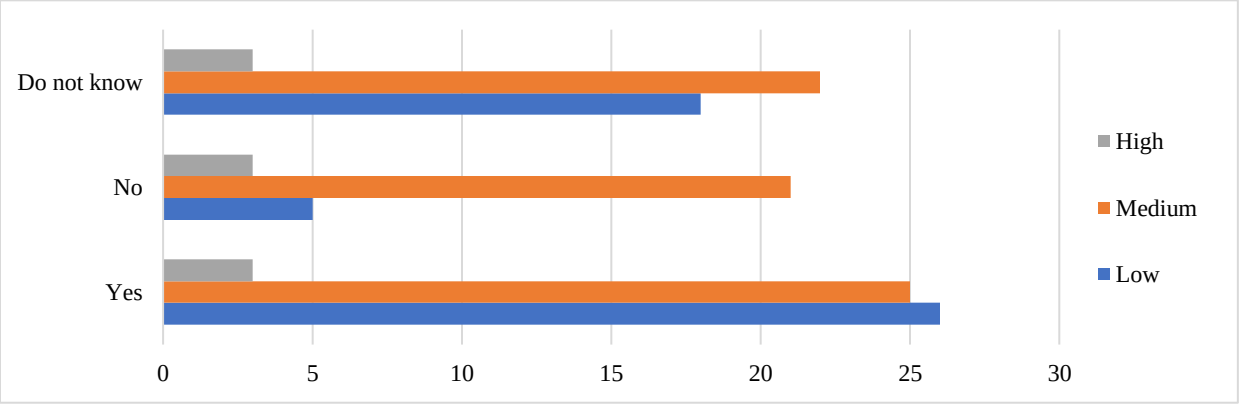
According to the primary (null) hypothesis, only 40% of respondents would agree to have their salary paid in CBDC: H_0: p=.4. To test H6 hypothesis, the One-Proportion Z-test has been selected, and a significance level (α) of .05 has been chosen for the critical values to be 1.96 and -1.96 as the hypothesis formulated is two-tailed. Using the formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$ for calculating a z-statistic, the result of .65 has been received. To interpret and assess this statistic, a p-value of .5156 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that 40% of respondents agree to have their salary paid in CBDC because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing reveal that the primary assumption is true and around 40% respondents, or 43% according to the survey results, are willing to have their salary paid in CBDC. This finding means although 40% of consumers are ready to have their salary paid in CBDC, still 34% of respondents have not decided about it, and the rest do not want their salary

to be paid in CBDC at all. This shows consumers' reluctance to accept their salary in CBDC, while 60% are ready to use CBDC for payment purposes. Similar results were discovered in the report on the consumer view on CBDCs by Guardtime and PureProfile. According to the survey results published in this report, "up to 30% would be happy to have their salary paid in CBDC within a month with another 40% following within one year (70% in total), while around 12% would never accept being paid in CBDC" (Guardtime, 2021, p. 3). These results show prospective consumers' lack of trust in CBDC and signify the need to provide a better understanding of CBDC from a central banks' perspective.

On a par with revealing that only 40% of respondents would agree to have their salary paid in CBDC, the analysis of whether consumers' monthly income is related to their decision to agree to have their salary paid in CBDC has been done. To determine this relationship, the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) equals to 7.87. However, this value should be followed with a strength statistic Cramer's V that equals to .18 that makes the association between the consumers' decision to have their salary paid in CBDC and their monthly income weak (see Figure 21).

Figure 21 *The Relationship Between the Consumers' Decision to Have Their Salary Paid in CBDC and Their Monthly Income*



Source. Compiled by the author.

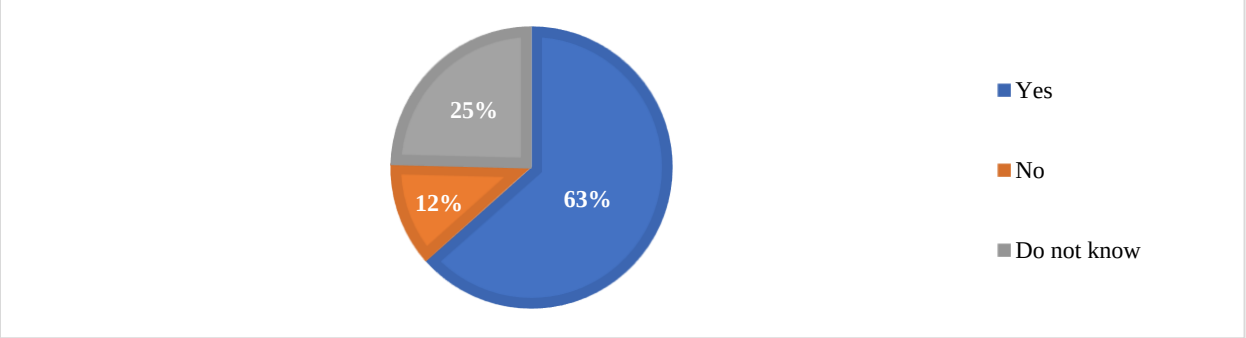
Although the association between the two variables is weak, Figure 21 shows that more respondents with medium monthly income chose not to have their salary paid in CBDC compared to respondents with low and high monthly income. This means that people with medium monthly income tend to trust less to CBDC than any other group perhaps because they are afraid of financial instability that might be caused by the switch from fiat money to CBDC. Therefore, central banks

must pay attention to this group of consumers and explain them more about the benefits of their salary paid in CBDC than in any other money.

Therefore, the analysis of the survey results of this thesis and findings presented in other reports shows that only 43% of consumers are willing to have their salary paid in CBDC, while many of them either have not decided yet or do not want to have their salary paid in CBDC at all. Therefore, this shows consumers' lack of trust in CBDC and a need to start an educational campaign by central banks for the future successful launch of CBDC.

After the respondents answered the question about their willingness to accept their salary paid in CBDC, they were also asked to answer the following question: If CBDC is going to be interest-bearing and the interest rate is going to be higher than for a standard bank deposit, would you be willing to use CBDC as an investment instrument? According to the results of the survey, out of 126 participants, 80 consumers (63%) responded that they would use CBDC as investment instrument, while 15 consumers (12%) and 31 consumers (25%) either do not consider CBDC as an investment instrument at all or have not decided yet if they want to use CBDC as an investment instrument or not, respectively (see Figure 22).

Figure 22 *CBDC as an Investment Instrument*



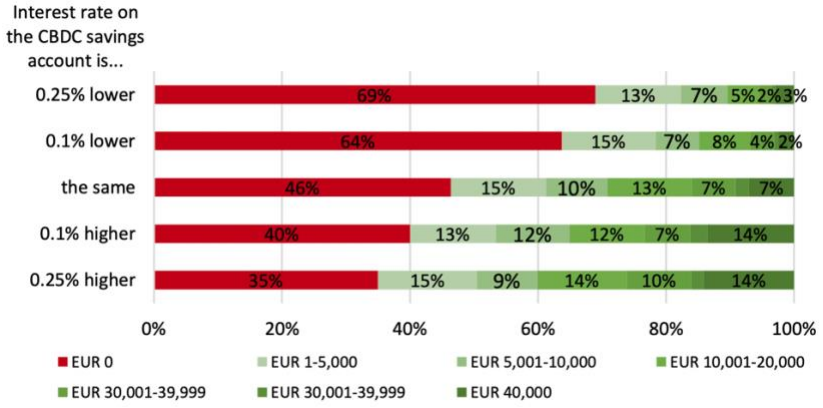
Source. Compiled by the author.

According to the primary (null) hypothesis, 60% of respondents are willing to use CBDC as an investment instrument if its interest rate is going to be higher than for a standard bank deposit: H_0: p=.6. To test H7 hypothesis, the One-Proportion Z-test has been selected, and a significance level (α) of .05 has been chosen for the critical values to be 1.96 and -1.96 as the hypothesis formulated is two-tailed. Using the formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$ for calculating a z-statistic, the result of .80 has been received. To interpret and assess this statistic, a p-value of .4238 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison

of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that 60% of respondents are willing to use CBDC as an investment instrument if its interest rate is going to be higher than for a standard bank deposit because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing reveal that the primary assumption is true and around 60% respondents, or 63% according to the survey results, are willing to use CBDC as an investment instrument if its interest rate is going to be higher than for a standard bank deposit. This finding means although 60% of consumers consider using CBDC as investment instrument if it is going to be interest-bearing, still 25% of respondents have not decided about it, and the rest do not want to use CBDC as an investment instrument at all. Similar results were discovered in the working paper on the triggers of consumer adoption of CBDC published by Michiel Bijlsma, Carin van der Cruijsen, Nicole Jonker, and Jelmer Reijerink (De Nederlandsche Bank) in April 2021. According to the survey results published in this paper, the respondents want to use CBDC as an investment instrument, and the amount these respondents want to deposit in a CBDC account depends on the interest rate offered (Bijlsma et al., 2021). Thus, when the respondents were asked to "allocate EUR 40,000 between a CBDC account and a standard account, 54% of respondents indicated they would be willing to put money in the CBDC account in the scenario where the interest rate is the same as for a standard account" (Bijlsma et al., 2021, p. 10). Therefore, "the interest rate offered on a CBDC account compared to the interest rate on a standard account has an effect on the extent to which people intend to use CBDC" (Bijlsma et al., 2021, p. 10) (see Figure 23). In general, "more respondents would be willing to transfer money to a CBDC account if the interest rate were higher than for the standard account" (Bijlsma et al., 2021, p. 10). Additionally, "the amount of money that respondents are willing to transfer in this scenario is higher" (Bijlsma et al., 2021, p. 10). "The opposite trends are found when the randomly assigned interest rate is lower compared to the interest rate on the standard account" (Bijlsma et al., 2021, p. 10).

Figure 23 *Adoption Rates and Intended Usage of CBDC Account, Broken Down by (Randomly Assigned) Interest Rate*



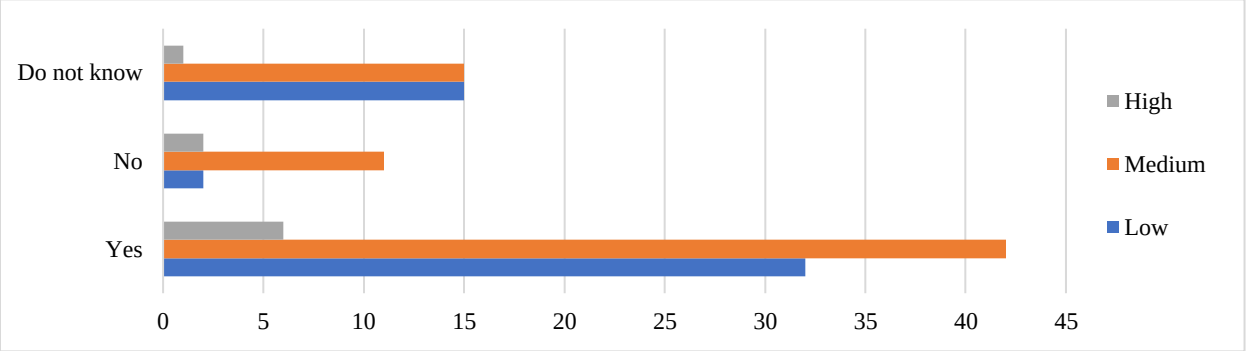
Source. CentERpanel, 30 April 2021, https://www.dnb.nl/media/amwfjgey/working_paper_no-_709.pdf. *Note*: 2,522 observations split into five random groups.

While the survey results of this thesis and working paper results suggest that prospective consumers would like CBDC to be interest-bearing, the central banks' perspective on this feature of CBDC varies. According to the results of the interview conducted among central bankers, there is no clearly stated position on whether CBDC should be interest-bearing or not because some of the experts suggested that CBDC should be interest-bearing, so that central banks would have additional tools to manage supply and demand of CBDC, while the others suggested it to be non-interest-bearing (Nugroho, 2018). Also, as it was mentioned in the scientific literature review, the experts from the European Central Bank (ECB) show concerns regarding the usage and function of CBDC in the investment area (Peluso, 2020). These experts highlight that the "digital euro should be an alternative means of payment" and should not be used as "a form of investment" (Peluso, 2020, p. 96). More specifically, these experts worry that if CBDC is regarded as a form of investment, it could "encourage citizens to convert their deposits in commercial banks into CBDCs" and thereby "create instability and reduce the funds stored in private banks" (Peluso, 2020, p. 96). Therefore, although prospective consumers show their interest to interest-bearing CBDC, central banks seem to be not ready to include this feature as part of CBDC design.

On a par with revealing that around 60% of respondents are willing to use CBDC as an investment instrument if its interest rate is going to be higher than for a standard bank deposit, the analysis of whether consumers' monthly income is related to their decision to use CBDC as an

investment instrument has been performed. To determine this relationship, the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) equals to 6.00. However, this value should be followed with a strength statistic Cramer's V that equals to .15 that makes the association between consumers' willingness to use CBDC as an investment instrument and their monthly income weak (see Figure 24).

Figure 24 *The Relationship Between Consumers' Willingness to Use CBDC as an Investment Instrument and Their Monthly Income*



Source. Compiled by the author.

Although the association between the two variables is weak, Figure 24 shows that more respondents with medium monthly income do not consider using CBDC as an investment instrument compared to the respondents with low and high monthly income. This means that people with medium monthly income tend to trust less to CBDC than any other group perhaps because they either trust standard bank deposits (i.e., conventional banking system) more or they do not accept any interest-bearing forms of money. Therefore, central banks might be unwilling to introduce interest-bearing CBDC because they assume that many consumers with average monthly income would never use CBDC as an investment instrument.

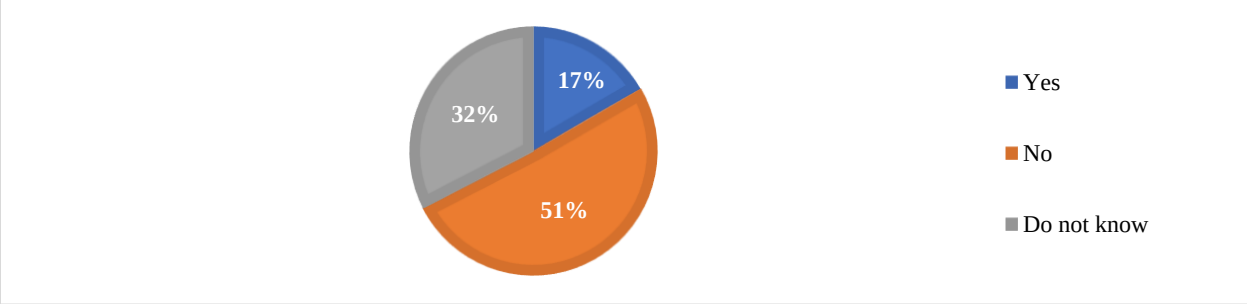
Therefore, the analysis of the survey results of this thesis and findings presented in other reports reveals that 60% of respondents are willing to use CBDC as an investment instrument if its interest rate is going to be higher than for a standard bank deposit, while the rest either have not decided yet or do not see any potential in interest-bearing CBDC. Meanwhile, central banks do not prioritize an interest-bearing feature of CBDC when conducting research, yet for the successful launch of CBDC, this is feature might be very beneficial.

3.5. Analysis of Consumers' Readiness to Start Using CBDC In Case of Its Imminent Launch by Their Central Bank

The fifth research question identified in the methodological section relates to assessing prospective consumers' willingness to start using CBDC in the near future if their central bank launches it. To test the last research question, H8-H10 have been formulated. Also, an association analysis has been performed to identify the relationship between the selected variables identified in H8-H10 and demographic variables. The following analysis will present and explain the results of hypotheses testing and association analysis, compare them to the results published in other reports by independent research companies on a similar matter, and provide the views of central banks' researchers on the research question discussed to see how central banks are going to address the issues prospective consumers are currently concerned with.

Thus, when respondents were asked if they would support the idea of completely replacing cash with CBDC in case of CBDC adoption, the results of the survey showed that out of 126 participants, 21 consumers (17%) agreed to completely replace cash with CBDC, while 64 consumers (51%) and 41 consumers (32%) either do not want cash to be completely replaced by CBDC or have not decided yet if they want to replace it or not, respectively (see Figure 25).

Figure 25 *In Case of CBDC Adoption, Would You Support the Idea of Completely Replacing Cash With CBDC?*



Source. Compiled by the author.

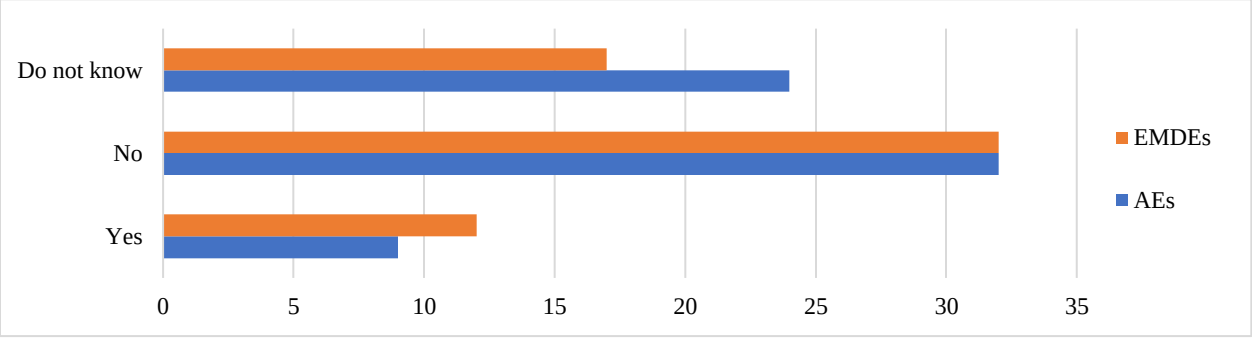
According to the primary (null) hypothesis, in case of CBDC adoption, only 20% of respondents would support the idea of completely replacing cash with CBDC: H_0: p=.2. To test H8 hypothesis, the One-Proportion Z-test has been selected, and a significance level (α) of .05 has been chosen for the critical values to be 1.96 and -1.96 as the hypothesis formulated is two-tailed. Using the formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$ for calculating a z-statistic, the result of -.94 has been received. To interpret and assess this statistic, a p-value of .3472 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient

evidence to reject the claim that in case of CBDC adoption, only 20% of respondents support the idea of completely replacing cash with CBDC because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing show that the primary assumption is true and around 20% respondents, or 17% according to the survey results, agree with the idea of replacing cash with CBDC. Similar results were discovered in the report on the consumer view on CBDCs by Guardtime and PureProfile. According to the survey results published in this report, "consumers would not necessarily ditch cash—however, 31% of adults said they would be willing to carry out more than half of their transactions through CBDCs within a month of a successful launch, with another 40% willing to do so within one to six months (71% in total)" (Guardtime, 2021, p. 3). These results show that prospective consumers are willing to use CBDC, yet they do not want CBDC to completely replace cash. On the contrary, they want CBDC to complement a conventional form of money. The same idea is supported by some central banks (Auer et al., 2021).

On a par with revealing that only 20% respondents agree with the idea of replacing cash with CBDC, the analysis of whether the economic status of a consumers' country of residence is related to their decision to agree to replace cash with CBDC has been done. To determine this relationship, the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) equals to 1.50. However, this value should be followed with a strength statistic Cramer's V that equals to .11 that makes the association between consumers' support for completely replacing cash with CBDC and their country's economic status weak (see Figure 26).

Figure 26 *The Relationship Between Consumers' Support for Completely Replacing Cash With CBDC and Their Country's Economic Status*



Source. Compiled by the author.

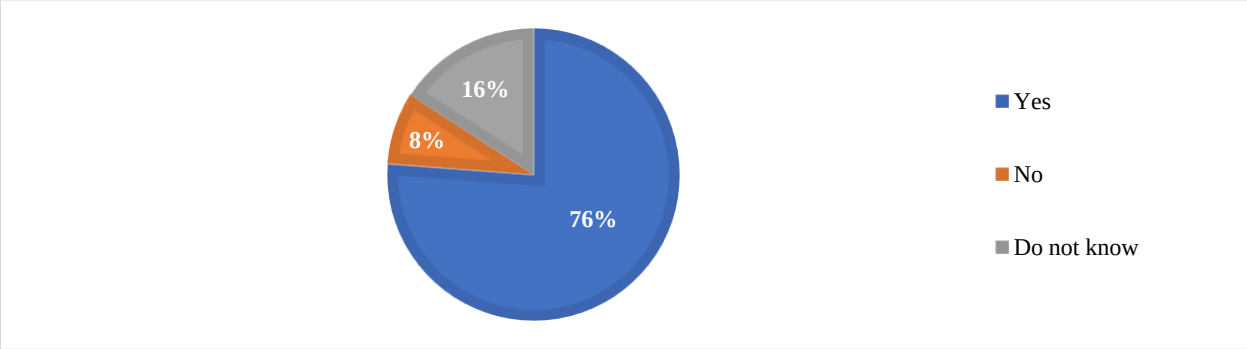
Although the association between the two variables is weak, Figure 26 shows that more respondents from EMDEs countries chose to completely replace CBDC with cash compared to the

respondents from AEs countries. This means that people from EMDEs countries are more willing to use CBDC only in case of its launch by their central bank because they do not trust their current currency, while people from AEs countries trust their current currency and consider an idea of starting using CBDC, but maybe as a complement to cash, not as a replacement to it.

Therefore, the analysis of the survey results of this thesis and findings presented in other reports reveals that only 17% of consumers support the idea of completely replacing cash with CBDC, while most of them either have not decided yet or do not want this replacement to happen at all. Therefore, this shows that consumers are willing to use CBDC, but they want it to use a complement rather than a replacement to cash. Therefore, this consumers' view should be carefully studied by central banks in order to provide better design options for central bank digital currency.

Once the respondents answered the question about whether they support the idea of completely replacing cash with CBDC, they were also asked to answer the following question: If you know the pros and cons of CBDC and if the pros outweigh the cons, would you be willing to use this digital currency if your central bank launches it? According to the results of the survey, out of 126 participants, 96 consumers (76%) responded that they will use CBDC if their central bank launches it, while 10 consumers (8%) and 20 consumers (16%) either are not willing to use CBDC or have not decided yet if they want to use it or not, respectively (see Figure 27).

Figure 27 *Consumers' Willingness to Use CBDC if Their Central Bank Launches It*



Source. Compiled by the author.

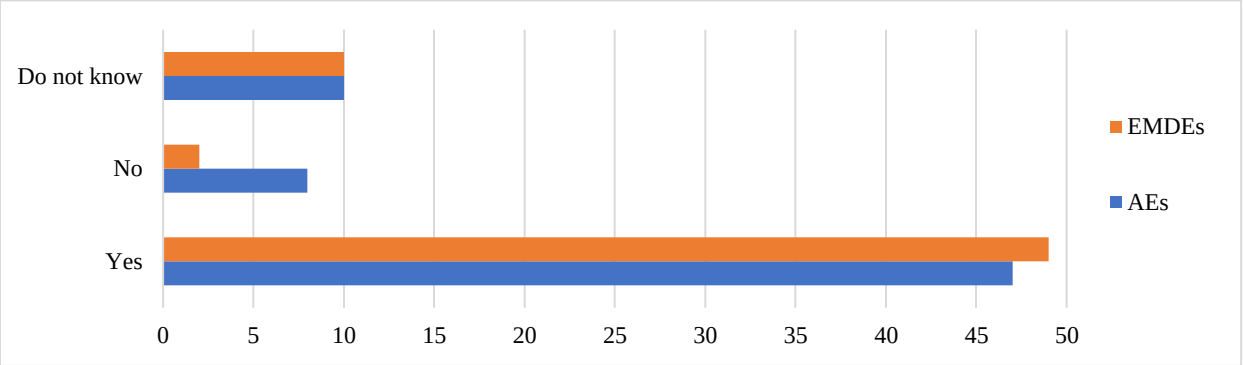
According to the primary (null) hypothesis, knowing that the pros of CBDC outweigh its cons, 80% of respondents are willing to use CBDC if their central bank launches it: H_0: p=.8. To test H9 hypothesis, the One-Proportion Z-test has been selected, and a significance level (α) of .05 has been chosen for the critical values to be 1.96 and -1.96 as the hypothesis formulated is two-tailed. Using the formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$ for calculating a z-statistic, the result of -1.07 has been received.

To interpret and assess this statistic, a p-value of .2846 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that knowing that the pros of CBDC outweigh its cons, 80% of respondents are willing to use CBDC if their central bank launches it because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing show that the primary assumption is true and around 80% respondents, or 76% according to the survey results, are willing to use CBDC if their central bank launches it. Similar results were discovered in the report on the consumer view on CBDCs by Guardtime and PureProfile. According to the survey results published in this report, when "consumers were asked to assess whether they would use a digital currency issued by their country, nearly two-thirds (64%) of adults said they would be likely to use CBDC at launch, with 33% saying they would be very likely to use one, while only 10% of those questioned said they would not use CBDC at launch" (Guardtime, 2021, p. 3). These results show that prospective consumers are willing to use CBDC in case of its launch by their central bank. Therefore, the demand for CBDC exists among consumers, and central banks should provide CBDC with appropriate design features to satisfy consumers' needs.

On a par with revealing that 80% respondents will use CBDC if their central bank launches it, the analysis of whether the economic status of a consumers' country of residence is related to their willingness to use CBDC has been performed. To determine this relationship, the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) equals to 3.52. However, this value should be followed with a strength statistic Cramer's V that equals to .17 that makes the association between consumers' willingness to use CBDC if their central bank launches it and their country's economic status weak (see Figure 28).

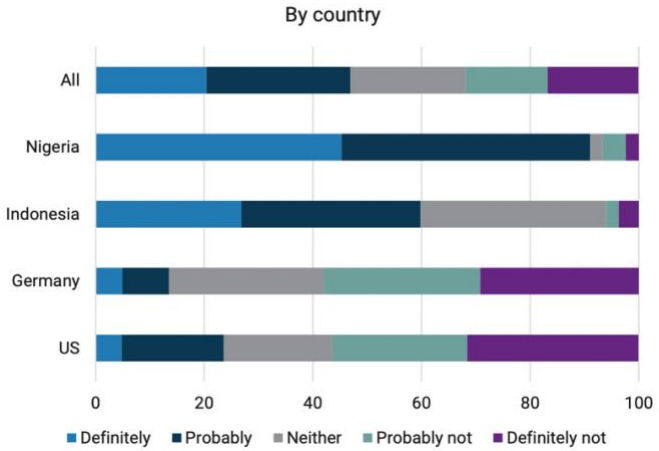
Figure 28 *The Relationship Between Consumers' Willingness to Use CBDC if Their Central Bank Launches It and Their Country's Economic Status*



Source. Compiled by the author.

Although the association between the two variables is weak, Figure 28 shows that more respondents from AEs countries are unwilling to use CBDC compared to the respondents from EMDEs countries. This might mean that the respondents from AEs countries are more satisfied with their current money circulated within their country's financial system, so they do not want to switch to unknown and unreliable CBDC. Similar results were discovered in the report on consumer attitudes to CBDC by OMFIF Digital Monetary Institute and Giesecke+Devrient (G+D). According to the survey results published in this report, "the differences in attitudes between AEs and EMDEs are at their most stark when consumers were asked about their likelihood to use CBDC" (Grant et al., 2021, p. 18). "More than 90% of consumers in Nigeria (EMDEs) would definitely or probably use a CBDC," while 60% of consumers in Indonesia (EMDEs) would do it (Grant et al., 2021, p. 18). "In both the US and Germany (AEs), nearly 60% of respondents say they would be unlikely to use CBDC, and just under one-third rule out using it altogether" (Grant et al., 2021, p. 18) (see Figure 29).

Figure 29 *If There Were CBDC in Your Country, How Likely Would You Be to Use It?*

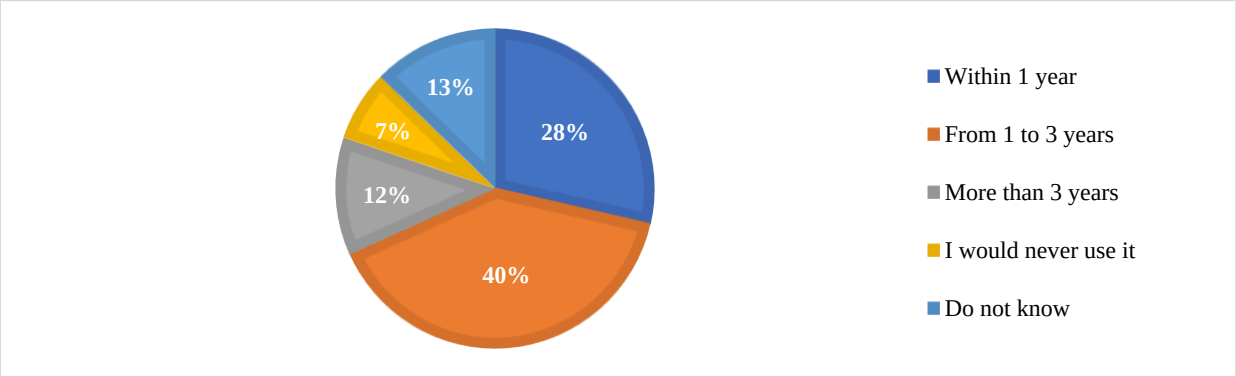


Source. Ipsos MORI, OMFIF analysis, November 2021, https://www.gi-de.com/corporate/Payment/Central_Bank_Digital_Currencies/G_D_2021_consumer_study.pdf.

"These findings arguably demonstrate that in EMDEs countries consumers are relatively unhappy with their current access to payments, and welcome a new option, whereas the skepticism of AEs consumers can be at least partially attributed to a degree of comfort about existing payment options" (Grant et al., 2021, p. 18). "If early adopter countries have positive experiences of CBDCs, then others will likely follow" (Grant et al., 2021, p. 18). "But there is clearly still a lot of groundwork to be done to make it attractive for consumers" (Grant et al., 2021, p. 18). "There needs to be more open discussion with the public about the benefits of CBDC" (Grant et al., 2021, p. 18).

Lastly, after the respondents answered the question about whether they are willing to use CBDC or not in case of its launch by their central bank, they were asked to answer the final question: Given the successful launch and proof that the digital currency is working well, when would you be willing to start using CBDC? According to the results of the survey, out of 126 participants, 36 consumers (28%) responded that they will start using CBDC within one year, 50 consumers (40%) will start using it in a period from one to three years, 15 consumers (12%) are planning to use CBDC more than three years after its launch, 9 consumers (7%) responded that they would never use CBDC, and 16 consumers (13%) have not decided yet about the period to start using CBDC (see Figure 30).

Figure 30 *Consumers' Choice of Time to Start Using CBDC*



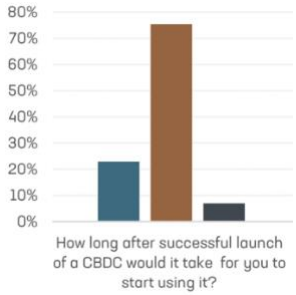
Source. Compiled by the author.

According to the primary (null) hypothesis, in case of the successful launch, only 30% of respondents are willing to start using CBDC within one year: H_0: p=.3. To test H10 hypothesis, the One-Proportion Z-test has been selected, and a significance level (α) of .05 has been chosen for the critical values to be 1.96 and -1.96 as the hypothesis formulated is two-tailed. Using the formula $Z \cong \frac{p_s - p}{\sqrt{\frac{p(1-p)}{n}}}$ for calculating a z-statistic, the result of -.35 has been received. To interpret and assess this statistic, a p-value of .7264 has been determined for a calculated z-statistic and compared to the selected significance level (α) of .05. The comparison of these two values leads to a conclusion that the null hypothesis cannot be rejected at α=.05, i.e., there is no sufficient evidence to reject the claim that in case of the successful launch, only 30% of respondents are willing to start using CBDC within one year because the p-value is greater than the significance level.

Therefore, the results of hypothesis testing reveal that the primary assumption is true and only 30% respondents, or 28% according to the survey results, are willing to start using CBDC within one year from its launch. Different results were stated in the report on the consumer view on CBDCs by Guardtime and PureProfile. According to the survey results published in this report, "given a successful launch and proof that CBDC is working well, three quarters (75%) of adults answered that they would start using CBDC within one year from its launch, while only 7% of adults said they would never use it" (Guardtime, 2021, p. 3) (see Figure 31). The difference in the results reported might be attributed to the differences in the sample size and countries being presented. However, these results show that prospective consumers are willing to use CBDC, yet the period within which they are willing to use it ranges from one to three years after its launch.

Therefore, central banks must expect that consumers will not start using CBDC immediately after its launch, yet it does not signify that CBDC designed is unsuccessful.

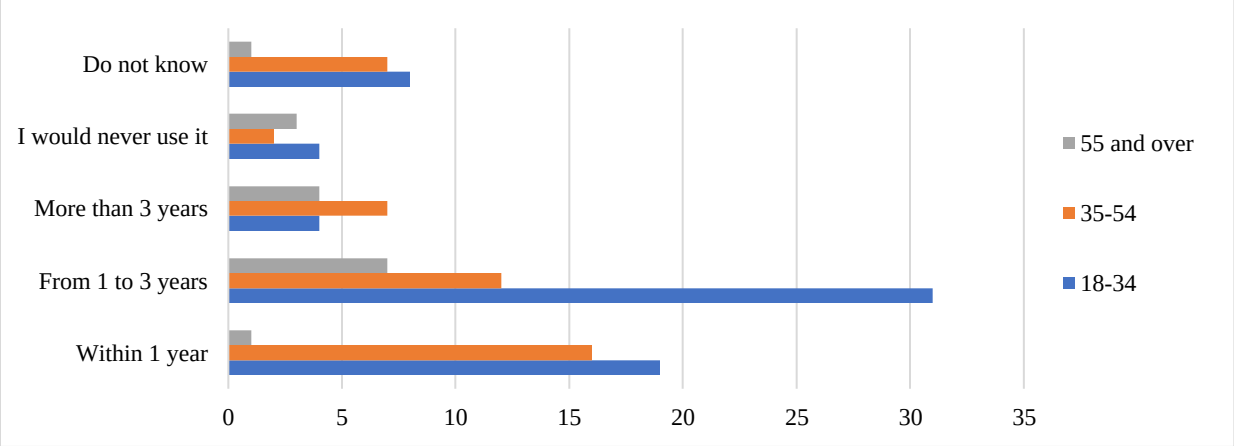
Figure 31 *Consumer Willingness to Use CBDC*



Source. Guardtime, PureProfile analysis, 2021, https://m.guardtime.com/files/CBDC_research.pdf. *Note:* blue column—within a week, brown column—within a year, black column—I would never use it.

On a par with revealing that only 30% respondents will start using CBDC within one year, the analysis of whether consumers' age is related to their choice of time to start using CBDC has been performed. To determine this relationship, the Chi-square test of independence has been utilized. Following the calculations, the Chi-square (χ^2) equals to 15.61. However, this value should be followed with a strength statistic Cramer's V that equals to .25 that makes the association between the consumers' choice of time to start using CBDC and their age moderate (see Figure 32).

Figure 32 *The Relationship Between the Consumers' Choice of a Period to Start Using CBDC and Their Age*



Source. Compiled by the author.

Although the association between the two variables is moderate, Figure 32 shows that more respondents aged 18-54 are willing to start using CBDC within one year compared to the respondents aged 55 and over. However, when the period from one to three years is considered, more consumers aged 18-34 are willing to start using CBDC from one to three years after its launch compared to the respondents aged 35 and over. This variation might be explained by the fact that not many consumers will start using CBDC during the first year because a lot of people are not fully familiar with CBDC, its benefits and challenges. Therefore, the successfulness of CBDC could be judged only from one to three years after its launch because this is the time period within which the majority of consumers would choose to start using CBDC.

Thus, the analysis of the survey results of this thesis and findings presented in other reports shows that only 28% of consumers are willing to start using CBDC within one year from its launch, while the majority prefers to wait from one to three years and only then try using CBDC. Therefore, this shows that CBDC is an interesting project developed by central banks to provide an alternative to cash which use has decreased drastically due to the pandemic. CBDC has the potential, yet central banks must invest more resources into educating prospective consumers about it and conducting more studies on the consumer opinions about CBDC adoption because there seems to be lack of communication between central bankers and prospective consumers for the CBDC project to be successful.

CONCLUSIONS AND RECOMMENDATIONS

With the introduction and subsequent implementation of the new forms of money and its various forms of delivery from one party to another one—from coins and banknotes to card payments, e-money, mobile payments, and cryptocurrencies—the financial and monetary systems have begun its transformation and continue developing up until now. In particular, an increase in the use of non-cash payments is a global trend and involves the spread of digitalization in the field of payments and economy in general. The process of digitalization has occurred due to the inputs of private companies and decentralized platforms through the introduction of other means of payment such as cryptocurrencies and stablecoins. These new means of payment are very popular among the public, yet they do not have a legal tender that reduces its influence and yet makes it still attractive for those who do not want their transactions to be traced by the monetary authorities. Therefore, private companies and decentralized platforms seem to gain power within the non-cash payments area of the financial market.

However, observing the rise of private companies and decentralized platforms as well as the growing popularity of cryptocurrencies and stablecoins, the world's central banks have realized that they need to provide an alternative—or let the future of money pass them by. More traditional financial institutions such as central banks for a long time had been standing aside from the current digitalization of the payment system and economy, yet soon they reconsidered their position. To be up-to-date, central banks all over the world began exploring the topic of central bank digital currencies (CBDCs), a digital version of cash, and their chances to launch their own CBDCs in the near future. Central banks realized that their own digital currency could compete with the private digital currencies and eventually replace them, while keeping the dominance of central banks within the financial system.

Therefore, the topic of CBDC launch is currently under extensive discussion among central banks' researchers. In particular, CBDC design features and its benefits as well as economic and legal challenges are widely researched by the central banks' researchers. However, little attention is paid to studying and assessing the consumer view on CBDC adoption by the central banks' research groups. The Bank for International Settlements (BIS) publishes only the results of central bankers' interviews or general reports and working papers on CBDC design features, yet it does not provide any information on the consumer view about CBDC launch. Only very few independent research companies such as PureProfile and OMFIF Digital Monetary Institute

publish the reports with the results of surveys completed by prospective consumers of CBDC and address consumers' concerns regarding CBDC launch for their further consideration by policy-makers. Therefore, there is certainly a gap in this area of CBDC research that can be filled with the results the following master's thesis.

Thus, it has been discovered that firstly, little attention is paid by central bankers to educating consumers about CBDC, its design features, as well as advantages and disadvantages because many respondents do not know anything about CBDC, yet they are willing to explore the topic of CBDC. According to the BIS report, many central banks realize that this problem exists and even have some form of financial education initiatives under way, yet it seems that in practice, little attention is paid to this issue although it could potentially prevent central bankers from the successful CBDC launch. Secondly, the results of the survey presented in this master's thesis reveal that consumers are concerned with security and privacy of CBDC and consider both attributes as an advantage and disadvantage at the same time. Therefore, central bankers must take this fact into consideration when designing CBDC, so that their CBDC design addresses consumers' concerns and is suitable for the general public. Thirdly, the results of the survey presented in this project also indicate consumers' willingness to use CBDC as a new form of payment and investment instrument, yet these findings represent their unwillingness to have their salary to be paid in CBDC as well as cash to be completely replaced with CBDC. Finally, the survey results show that consumers are willing to use CBDC in case of its launch by their central bank, yet they would like to start using it only from one to three years from its launch.

Looking at the analysis of the demographic variables, such as age, country's economic status, educational level, and monthly income, only two variables—age and the economic status of the country of residence (AEs or EMDEs)—showed an association to the target variables. One of the main conclusions drawn from that analysis is that consumers aged 18-34 from EMDEs countries are the most enthusiastic about prospective CBDC adoption because their demands are not met by the present financial system in their countries. Therefore, they are ready to try new financial products such as CBDC to improve their overall user experience within their country's financial system. Also, it should be expected that central banks from EMDEs countries will be the pioneers of CBDC projects, while central banks from AEs countries will launch their CBDCs only in case the overall CBDC success in EMDEs countries because prospective consumers in AEs countries are satisfied with their current money and financial system in general. However, still

central banks must gather more consumers' opinions about CBDC to deliver the best possible digital currency that would outperform other digital currencies, such as cryptocurrencies and stablecoins.

Recommendations. The research on assessing the consumer view on CBDC adoption has a lot of limitations, starting from lack of expert opinions from the central banking community on CBDC adoption to difficulties related to interpreting and drawing conclusions from the survey results because all the variables are categorical. Yet this research still brings certain benefits to the researchers' community and society if completed correctly. With the help of this research and its findings, central bank officials will find out that prospective consumers aged 18-34 from EMDEs countries are more enthusiastic about future CBDC adoption, and therefore, more efficient ways must be found in order to educate those consumers about the topic of CBDC. Central bank officials will also learn that prospective consumers are mainly concerned with security and privacy of CBDC, that they agree to use CBDC as a new form of payment and investment instrument, yet they do not want their salary to be paid in CBDC and want to see CBDC as a complement to cash. Most importantly, these consumers would like to start using CBDC from one to three years from its launch by their central bank. Thus, these findings will provide central bankers some ways to improve current CBDC design features, so that prospective consumers would be satisfied with the final version of this financial product. Lastly, this CBDC research may encourage central banks and independent research companies from EMDEs countries where CBDC has been already launched (Nigeria and the Bahamas) to conduct their own studies on consumers' opinions regarding already existent CBDC because although it is useful to study CBDC from a theoretical point of view, it is more important to know actual opinions of consumers regarding CBDC usability when it has been already issued in some EMDEs countries.

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THE CONSUMER VIEW ON CBDC ADOPTION

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Master Thesis

Finance and Banking Master Programme

Faculty of Economics and Business Administration, Vilnius University

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SUMMARY

91 puslapiai, 8 lentelės, 32 diagramos, 48 literatūros šaltiniai.

Magistrinio darbo pagrindinis tikslas yra nustatyti vartotojo požiūrį į CBDC priėmimą renkant ir vertinant nuomones apie funkcionalumą, galimą naudą, sunkumus, bendrą vartotojų norą pažinti CBDC temą ir galiausiai centriniui bankui išleidus šią valiutą. Magistrinis darbas sudarytas iš trijų dalių: literatūros analizės, tyrimų ir rezultatų, išvadų ir rekomendacijų. Literatūros analizė apibendrina informaciją apie CBDC funkcionalumą, naudą ir sunkumus, dabartinį CDBC kūrimo procesą ir galiausiai siaurą vartotojų požiūrį į CBDC priėmimą.

Sekant literatūros analizę autorė atliko tyrimą apie vartotojų požiūrį į CBDC ir galimą CBDC naudojimą po centrinio banko platinimo artimoje ateityje. Iš visų 126 galimų klientų pradedant 18 metų amžiumi norinčių dalyvauti apklausoje buvo pateikti keturi klausimai susiję su jų demografiniais aspektais, amžiumi, ekonominiu statusu, išsilavinimo lygiu, mėnesiniu atlyginimu, likusieji klausimai yra susiję su nuomonėmis apie CBDC priėmimą. Gauti rezultatai buvo lyginami su kita medžiaga surinkta nepriklausomų įmonių. Rezultatai buvo analizuojami naudojant Microsoft Excel programa. Du metodai buvo naudojami analizuoti šiems rezultatams: vienos proporcijos Z testas ir Pearsono Chi kvadratas apjungiant phi (φ) ir Kramerio V stiprumo statistikas.

Atlikti tyrimai parodė, jog 18-34 metų vartotojai iš EMDE šalių yra labiau susidomėję CBDC ateities pritaikymu, dėl šios priežasties centriniai bankai privalo rasti labiau efektyvius būdus kaip suteikti daugiau žinių apie CBDC temą. Iš tyrimo dar matoma, jog galimi vartotojai yra labiausiai susijaudinę dėl saugumo ir privatumo, kurį suteikia CBDC, jie sutinka naudotis šiuo produktu, tačiau kartu jie nurodo nenorėjimą gauti savo atlyginimų naudojant CBDC. Vartotojai mato CBDC kaip antrinę valiutą, jie labiausiai nori pradėti naudotis šiuo produktu tik po vienerių arba trijų metų po CBDC paleidimo. Išvados ir rekomendacijos apibendrina pagrindinius literatūros analizės konceptus, surinktus ir atliktus tyrimus bei pateikia rekomendacijas ateities tyrimams.

ANNEXES

Annex 1. Questionnaire on the Consumer View on CBDC Adoption

Questionnaire

The Consumer View on CBDC Adoption

Dear participant,

This survey is being done by a master's student of Finance and Banking program at Vilnius University in partial fulfillment of the requirements for obtaining a master's degree. The purpose of the survey is to collect consumers' opinions on CBDC adoption. The findings of this study will allow to assess the usefulness of CBDC introduction from a consumers' perspective and draw conclusions about prospective CBDC launch.

It will take approximately 10 minutes to complete the survey. You can take it only once. Your responses are completely anonymous.

Thank you very much for your time and participation.

I agree that the collected data would be used only for the scientific and academic purposes of the master's thesis.

- ❑ I agree
- ❑ I disagree (the end of the questionnaire)

Demographic Questions

*1. Age

- ❑ 18-34
- ❑ 35-54
- ❑ 55 and over

*2. Country of residence status (from an economic perspective)

- ❑ Advanced economies (AEs)
- ❑ Emerging market and developing economies (EMDEs)

*3. Educational level (the highest level of education you have completed)

- ❑ Some high school
- ❑ High school diploma
- ❑ Bachelor's degree
- ❑ Master's degree
- ❑ Doctorate degree

- ❑ Other_____

*4. Monthly income (based on the economic situation in your country)

- ❑ Low
- ❑ Medium
- ❑ High

Main Questions

*1. Do you know anything about central bank digital currency (CBDC)?

- ❑ Yes
- ❑ No

*2. Are you willing to explore / improve your knowledge on the topic of CBDC?

- ❑ Yes
- ❑ No

Definition of CBDC

Central bank digital currency (CBDC) is the digital form of a country's fiat currency which is issued and regulated by a nation's monetary authority or central bank.

*3. Please choose **one** advantage of CBDC you would find the most important when deciding whether to adopt this digital currency or not.

- ❑ CBDC offers more privacy to users than commercial digital currency providers
- ❑ CBDC does not involve any additional costs
- ❑ You can use CBDC internationally
- ❑ Paying with CBDC does not require internet connection
- ❑ CBDC is more secure than other digital currencies (e.g., cryptocurrencies)
- ❑ Other _____

*4. Please choose **one** disadvantage of CBDC you would consider as the main reason for not utilizing this digital currency.

- ❑ I do not think it will be accepted everywhere (at online and offline market places)
- ❑ I am afraid that my purchasing habits will be tracked
- ❑ I do not think it is secure
- ❑ Existing digital payments are sufficient

- ❑ I am against all forms of digital money
- ❑ Other_____

*5. Would you accept CBDC as a new form of payment?

- ❑ Yes
- ❑ No
- ❑ Do not know

*6. Would you agree to have your salary paid in CBDC?

- ❑ Yes
- ❑ No
- ❑ Do not know

*7. If CBDC is going to be interest-bearing and the interest rate is going to be higher than for a standard bank deposit, would you be willing to use CBDC as an investment instrument?

- ❑ Yes
- ❑ No
- ❑ Do not know

*8. In case of CBDC adoption, would you support the idea of completely replacing cash with CBDC?

- ❑ Yes
- ❑ No
- ❑ Do not know

*9. If you know the pros and cons of CBDC and if the pros outweigh the cons, would you be willing to use this digital currency if your central bank launches it?

- ❑ Yes
- ❑ No
- ❑ Do not know

*10. Given the successful launch and proof that the digital currency is working well, when would you be willing to start using CBDC?

- ❑ Within one year
- ❑ From one to three years

- ❑ More than three years
- ❑ I would never use it
- ❑ Do not know