

CBDC Diffusion in Asia: Insights from a Conjoint Analysis of the Indonesian Market*

Akbar Syahid Rabbani¹, Jongsu Lee²

[PRELIMINARY, PLEASE DO NOT CIRCULATE]

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Abstract

Even though the financial services industry has been developing some products to increase financial inclusion, more than 1.4 billion people are still unbanked worldwide. The fast adoption of blockchain technology in cryptocurrency has made central banks worldwide think about the potential adoption of this technology for central bank digital currency (CBDC). Currently, 86% of central banks engage in CBDC work, and 14% have already reached the pilot stage. As one of the emerging economies, Indonesia has a vast potential for the diffusion of CBDC, and it can be used as a tool to improve financial inclusion. Several previous studies explored the potential adoption of CBDC from a broader perspective, where only a few papers focused on the possible adoption while considering likely consumer preferences. This research used the conjoint analysis to determine CBDC adoption in the Indonesian market using four attributes: accessibility, privacy, transferability, and rate of return. The results from mixed logit regression showed that the central bank should utilize the growth of mobile banking to acquire broader consumers while improving its security standard. From the privacy perspective, consumers are aware of the negative impact of full privacy transactions and are willing to share some essential data related to the transactions. In addition, the transferability or exchange capability with bank accounts and electronic money will positively affect consumers' willingness to use the CBDC. Lastly, the research revealed the need for a competitive interest rate in the process of CBDC diffusion.

JEL Classification: C35, C51, E58, O33

Keywords: Central Bank Digital Currency, technology adoption, conjoint, mixed logit model

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¹ First Author: Interdisciplinary in Technology Management, Economics, and Policy Program, College of Engineering, Seoul National University, Seoul 08826, Akbar Syahid Rabbani (akbarsyahid11@snu.ac.kr).

² Corresponding Author: Interdisciplinary in Technology Management, Economics, and Policy Program, College of Engineering, Seoul National University, Seoul 08826, Jongsu Lee (jongsu.lee@snu.ac.kr).

1. Introduction

Financial technology (fintech) focuses on improving financial activities through technologies. It is also an innovative idea to improve financial services processes through technological innovation. Fintech requires a combination of finance, technology management, and innovation management subjects, where its applications can be divided into four categories: payment, advisory service, financing, and compliance (Leong, 2018). The fintech technology is projected to reach \$16.62 and \$10.44 trillion in digital payments and neo-banking transactions in 2028. The average transaction value per user is expected to continue growing to \$3.46 (digital payments) and \$27.02 (neo banking) thousand dollars (Statista Market Forecast, 2024). These vast amounts of potential transactions trigger firms worldwide to invest in this sector rapidly, resulting in business opportunities and potential risks. In this case, the government should create an infrastructure to support the business growth and protect consumers' privacy and security to create a suitable fintech environment.

Several digital products such as digital payments, online loans, crowdfunding, online brokers, and electronic transfer have been launched by the fintech industries utilizing the digitization and connection of devices. These technologies have successfully changed the current business processes and transformed the financial sector (Abad-Segura et al., 2020). However, the development of financial services products is not overcoming the considerable number of unbanked people worldwide. More than 1.4 billion people are still unbanked around the world, with the characteristics of being less educated, poor, and living in rural areas (World Bank, 2020). Unbanked people are a condition where the consumers do not have access to formal financial services, caused by three main reasons: it does not make economic sense due to the high cost or far bank branches, trust issues on bank services, and consumers are more

comfortable using informal financial sector (Djankov et al., 2008). In this case, improving financial inclusion would directly affect the decrease of unbanked people, increasing resource allocation efficiency, reducing the cost of capital, and transforming informal into formal financial services (Sarma & Pais, 2011). From the government's perspective, the increased financial inclusion rate is essential to close the gap between households and firms, increase consumption and investment, and improve economic activity (Omar & Inaba, 2020).

One of the emerging technologies in financial services is blockchain, which enables a more secure, reliable, and efficient transaction system for the market. The popularity of blockchain in the financial services industry started with the Bitcoin whitepaper by Satoshi Nakamoto in 2008 titled "Bitcoin: A Peer-to-Peer Electronic Cash System" (Ahram et al., 2017). The fast adoption of blockchain technology in cryptocurrency has made central banks worldwide think about the potential adoption of this technology for the Central Bank Digital Currency (CBDC). Currently, 86% of central banks engage in CBDC work, and 14% have already reached the pilot stage (BIS Innovation Hub Work on Central Bank Digital Currency (CBDC), 2021).

The Central Bank Digital Currency (CBDC) is a blockchain-based technology that can facilitate the direct transmission of monetary policy to households (Carapella & Flemming, 2020). This means that the central bank can extend its economic interventions to a broader range of citizens, particularly those residing in rural areas. The circulation of CBDC involves various stakeholders, including central banks, liquidity providers, commercial banks, clients, and large corporations. In the context of archipelago countries like Indonesia, this technology holds promise for enhancing financial inclusion, especially in remote areas. The Central Bank of Indonesia has already published a roadmap for developing the CBDC, with the retail and commercial sectors as their primary target market.

Indonesia's most popular payment options are electronic money (52%) and debit cards (34%) (Hasniawati et al., 2020). Electronic money has gained high popularity because of its wider availability and ease of registration compared to other payment options. It makes this product an intermediary before the consumer opens a bank account. In COVID-19, digital banking attracted many consumers, with transactions of 4.200 trillion rupiahs (Databoks Katadata, 2023). An easy onboarding process and a high interest rate are essential to driving this growth. Besides the vast growth of digital payments, is still essential in the Indonesian payment industry, with a 89.2% proportion compared to 10.8% of non-cash payments (Hasniawati et al., 2020).

Looking at the current condition of the financial services industry, digital payment products such as electronic money, mobile banking, and QR payment have become more prevalent in the Indonesian market. However, according to the number of unbanked people, the market's potential needs to be fully optimized, reaching 97.74 million or 48% of the population. Therefore, reliable technology like CBDC is still needed to acquire broader consumers. Determining the consumers' preferences would be essential as one of the stakeholders so the central bank can define suitable features and risk mitigation in the CBDC's circulation.

This study tries to answer three research questions related to the consumers' preferences in the Indonesian market to the CBDC's attributes and the factors that can affect it, the essential attributes based on the relative importance (RI) calculation, willingness to pay (WTP), and the policies implications related with CBDC diffusion optimization. The data was gathered by conducting conjoint analysis using four essential attributes according to previous literature, which are accessibility, privacy, interoperability, and interest rate. The conjoint analysis results will be explored using a mixed logit model that allows random taste variation, unrestricted

substitution patterns, and correlation in unobserved factors over time so the consumers' preferences can be shown appropriately (Train, 2009).

The results can empower the government and the central bank to provide a suitable CBDC design according to consumers' preferences, such as optimum consumer acquisition process, secure privacy requirements, most preferred transferability, and analysing the importance of financial benefits to the technology adoption. According to these results, the government and central bank can implement essential policies and regulations to overcome the technology diffusion challenges and optimize the adoption of CBDC.

This study is organized as follows: the next section explains the theoretical background, followed by the methodology and empirical model. Then, the empirical analysis will be discussed, including justification of attribute selection, data collection, estimation results and findings, and policy implications. Finally, this study concludes by presenting the limitations and proposing future research suggestions.

2. Literature Review

2.1 Limitations of electronic payment system

The development of the electronic payment system (EPS) started with the launching of credit cards in the late 19th century, followed by some other products such as digital wallets, quick responses (QR), electronic data capture (EDC), point of sales (POS), prepaid cards, and pay later. These products cannot only substitute the function of cash but also give vast amounts of data that can be utilized to create a modern surveillance economy (Lauer, 2020). It makes the electronic payment system one of the core technologies that support the growth of

electronic commerce (e-commerce), where its adoptions are affected by some essential factors such as advantages, convenience, complexity, costs, trust in service providers, and security risks (Bezhovski, 2016). Another research also mentioned three critical factors affecting consumers' perception: benefits, self-efficiency, and ease of use, including security and trust (Ming-Yen Teoh et al., 2013). In this case, all related stakeholders, including consumers, merchants, financial institutions, and infrastructure providers, are necessary to ensure successful operation and widespread adoption (Sangjo Oh, 2006).

Even though the industry has been developing some solutions to improve the quality of electronic payment, security, privacy, and system reliability problems still exist. The fundamental problems of digital payment systems are that they can be copied perfectly, and digital signatures can be duplicated by any other parties that know about the cryptographic key (Asokan et al., 1997). Previous work stated that the main concern of the current payment system is the settlement processes, which can trigger credit risk because the transaction is not realized at the full value. In addition, failed settlement can cause liquidity and operational risk. In the case of liquidity risk, the settlement is not executed at the desired time, which triggers the operational risk caused by the lag and failure of settlement (Rochet & Tirole, 1996). Issues in the current EPS can be divided into three areas: security statements related to the operation and security solution, transaction procedures that refer to the steps that are designed to eliminate the security fear of consumers, and technical protections to maintain the consumers' transaction security (Kim et al., 2010). Besides the potential of EPS, some limitations have continuously appeared, so more advanced technology like blockchain can be an option to overcome these problems.

2.2 Adoption of blockchain technology

Blockchain offers an innovative technique to save information, execute transactions, perform functions, and establish trust in an open environment. Some blockchain properties are consistency, tamper-resistance, resistance to a denial-of-service (DoS) attack, resistance to double-spending attacks, resistance to the majority (51%) consensus attack, and pseudonymity (R. Zhang et al., 2020). Two blockchain concepts have disrupted the payment and financial services sector: ledger and encryption processes. A single ledger is unavailable in the current ecosystem, complicating transactions between banks and other financial institutions. With the availability of a single ledger, all transactions can be centrally recorded, and all system participants trust it. Encryption has continuously improved in the last 30 years, with fundamental concepts such as Merkle trees and Byzantine fault tolerance (Narayanan & Clark, 2017).

As stated in its name, blockchain technology will be stored in a new block added to the transaction ledger and linked to the previous one after it is validated. Some concepts have been utilized in implementing blockchain, such as blockchain nodes, transactions, consensus, and smart contracts. Blockchain nodes is the point where all computing devices can connect to execute the transactions and maintain their data integrity. When the nodes are available, they can execute transactions that can be defined as an exchange or transfer of digital assets with information, goods, services, funds, or rules that can trigger other transactions. The blockchain has an agreement called consensus to reach an agreement on transactions between each node so the nodes can share the same data. Some consensus procedures exist, such as *Proof of Work* (PoW), *Proof of X-based algorithms*, and *Byzantine Fault Tolerant algorithms* (Belotti et al., 2019).

In the payment and financial services industry, blockchain technologies have been developing significantly, starting with the invention of Bitcoin in 2009. In the Bitcoin whitepaper, Satoshi Nakamoto argued that the current financial systems have weaknesses, such as incredibly high transaction costs, limited transaction size, and the unavailability of reversible transactions. He proposed a peer-to-peer electronic cash system using digital signatures as the primary security system, where the money can be sent without intermediaries such as banks or other financial institutions (Nakamoto, 2009). The launch of Bitcoin triggered other cryptocurrencies to provide solutions to solve unique problems. More than 9,321 cryptocurrencies have been issued in the global market (Statista, 2023), which means that the growth of cryptocurrency firms has increased by 14,023% in the last decade.

Blockchain technology can be implemented in more expansive fields than cryptocurrencies because it has more advanced characteristics than fiat or traditional currency, especially from a security perspective. In Korea, this technology has been applied in the authentication processes based on consumer equipment and closed (private) distributed ledgers that banks can use. This implementation will increase the reliability of the systems in essential processes such as payment, remittance, and stock exchange, which have vast business potential. A different case can also be implemented in the Distributed Ledger Technologies (DLT) concept by mentioning the important role of government and fundamental foundations of law framework to support blockchain development in financial services (Yoo, 2017; Cermeño, 2016).

2.3 Central Bank Digital Currency for financial inclusion improvement

The level of financial inclusion can be measured by using the Index of Financial Inclusion (IFI), which captures some related information such as banking penetration, availability of

banking services, and usage of the banking system. Some factors positively related to IFI are human development, GDP per capita, income inequality, adult literacy, and urbanization (Sarma & Pais, 2011). One of the challenges that the government and central bank face is determining the optimal level of financial inclusion because each country has different characteristics and backgrounds, so high financial inclusion can also generate some risks, such as fraud or system collapse (Ozili, 2021). In the case of Indonesia, only 48% of the adult population have any financial accounts, which is lower than other developing countries such as Malaysia (85%), Thailand (82%), India (80%), Kenya (82%), Sri Lanka (74%), and South Africa (69%). Low financial inclusion can happen because of three main reasons: insufficient funds (72.13%), unavailability of registration channels (32.96%), and unaffordable services (31.74%) (Hanivan & Nasrudin, 2019).

According to the data above, improving financial inclusion in Indonesia is required, where utilizing blockchain technology through issuing the Central Bank Digital Currency (CBDC) can be an option for the central bank. As stated in previous work, this solution can be a suitable option as countries with lower financial inclusion are more likely to adopt CBDC than more advanced countries (Maryaningsih et al., 2022). Several benefits of CBDC are efficient retail payments with its efficient, secure, and modern system, overcome the use of banknotes with the capability to anticipate money laundering and terrorist financing, and strengthened monetary policy since central banks can apply more flexibly monetary policy like negative interest rate, and improving financial stability with reducing the role of the banking system to creating money (Bindseil, 2020).

The central bank can implement two types of CBDC based on its consumer type in the implementation of CBDC: wholesale and retail. Wholesale CBDC (wCBDC) can be used by

commercial banks, clearing institutions, or other entities that have access to central bank reserves, whereas retail CBDC (rCBDC) will be used by corporations, small businesses, and individuals (Calle & Eidan, 2020). According to the previous pilot tests of rCBDC, some lessons learned are related to the scope, legal framework, features, ecosystem, establishing compliance and interoperability framework, and ensuring a resilient and reliable environment. In this case, the central bank needs a significant effort from the perspective of coordination and operational implementation (Morales-Resendiz et al., 2021).

The Central Bank of Indonesia has published the CBDC's white paper with project name "Garuda." The implementation of Indonesian CBDC will be divided into three phases: immediate, intermediate, and end-state. In the first phase, the development will focus on issuing, terminating, and transferring. Then, it will have more use cases that can support the daily transactions in the market. Lastly, improving the system architecture and design would be the focus of this project. In their report, The Central Bank of Indonesia also mentioned that the CBDC project has some risks that need to be mitigated, such as shadow banking, fraud, money laundering, terrorism funding, unfair business competition, and consumer privacy leaks (Bank Indonesia, 2022).

One of the key elements of CBDC is its design, which includes some core principles such as rate and quantity to ensure the balance between supply and demand while considering financial stability risks and relative costs and benefits (Kumhof & Noone, 2021). Previous work also mentioned that CBDC demand depends on attractiveness and includes features such as anonymity, security, transaction limits, and interest rate (Fujiki, 2023). Other work stated the importance of security features in the design of CBDC, such as preventing double-spending by utilizing a unique ID, avoiding replication/ forgeability by using anti-forging techniques,

standard verifiability technique applied by PSP, and the suitable privacy level that can ensure the validity of transactions (Li et al., 2021).

Even though some previous works mentioned frameworks in designing CBDC and essential factors that affect its potential adoption, only a few of them highlighted consumer preferences as the main factor for consideration, especially in the case of Indonesia's market. Previous work explored on the potential adoption of CBDC, which was affected by some financial variables, cross-border transactions, infrastructure, innovation, macroeconomics, and institutional variables, using probit estimation (Maryaningsih et al., 2022). Other work used a Delphi-analytic network process (ANP) that considers expert participation in evaluating the benefits, risks, opportunities, and costs of issuing CBDC (Zams et al., 2020). According to our knowledge, this is the first study that considers consumer preferences through a discrete-choice and mixed logit models to analyse and evaluate suitable attributes for CBDC Indonesia's market.

2.4 Discrete-choice models in technology adoption

In gathering data for further analysis using discrete-choice models, conjoint analysis can be an option to explore the consumer's trade-off with giving hypothetical products. The researchers can implement different conjoint analyses, such as full profile conjoint analysis, where the respondents should evaluate all product profiles consisting of some combination of the all-attribute levels. Other than that, there is a trade-off method that provides two attributes at a time to the respondents to reduce information overload received by the respondents. The researchers can also choose a hybrid conjoint analysis that can estimate each respondent's individual part-worth after evaluating a limited number of cards. Lastly, adaptive conjoint

analysis (ACA) can be another option to make the profiles more flexible according to the respondents' preference indications (Breidert et al., 2006).

Discrete choice models have been implemented to analyse various situations using an econometric approach. According to Train (2009), conducting a discrete-choice model aims to understand the behavioural process that leads to the consumer's choice. When measuring the consumers' choices, some factors can be observed (x), and others are unobserved (ε) by the researchers. These two factors can result in the behavioral function $y = h(x, \varepsilon)$, where the probability that an agent chooses a particular outcome from the set of all possible outcomes can be stated as Eq. (2.1).

$$P(y|x) = \text{Prob} (\varepsilon \text{ s. t. } h(x, \varepsilon) = y) \quad (2.1)$$

This probability can be stated in a more useable form by defining an indicator function in Eq. (2.2), where $I[\cdot] = 1$ if the combination value of ε and x influences the agent to choose an outcome y , and 0 if the combination value of ε and x makes the agent choose other outcomes.

$$I[h(x, \varepsilon) = y] \quad (2.2)$$

From Eq. (1) and (2), the probability of the agent choosing an outcome y is the expected value of the indicator function that can be stated in Eq. (2.3).

$$P(y|x) = \text{Prob} (I[h(x, \varepsilon) = y] = 1) = \int I[h(x, \varepsilon) = y] f(\varepsilon) d\varepsilon \quad (2.3)$$

In discrete choice models, researchers can apply some models and specifications; one of the most popular specifications is the multinomial logit model. This model provides a convenient closed form for the underlying choice probabilities without any requirement of multivariate integration, which provides an alternative specification for discrete choice models with the

independence of irrelevant alternatives assumption (IIA) (Hausman, 1981). The multinomial logit model has three essential advantages over other methods: (a) it is widely available in a typical statistical package; (b) the MLM estimation can be done when they have many categories; (c) the results of MLM is easy for interpretation purpose, providing convenient odds and probability measures (Kwak & Clayton-Matthews, 2002).

Alongside MLM estimation, other models such as nested logit, probit, and mixed logit offer a versatile toolkit for examining the factors that influence consumer choice. The nested logit, a generalized extreme values (GEV) model, is particularly useful when researchers face a set of alternatives that can be divided into subsets or “nests”. This model applies the independence from irrelevant alternatives (IIA) within each nest but not across nests. The probit model, on the other hand, overcomes the limitations of the logit model, such as random taste variation and substitution patterns, and is applicable in panel data. Lastly, the mixed logit model shares two key properties with probit, but it can handle correlation in unobserved factors over time and is not restricted to normal distributions (Train, 2009). The different characteristics of these models are explained in Table 1.

Some attributes of CBDC, such as transferability, storability, reliability, online/ offline transactions, security and privacy, transaction cost, affordability, convenience, and interest rate, were covered in previous works. However, there is no research exploring the accessibility or the registration process of the consumers before using the CBDC, which is essential to overcome the low financial inclusion challenge, especially in Indonesia. This study will explore the impact of different registration channels and the three most common CBDC attributes on consumer preferences using mixed logit.

Table 1. Comparison of discrete-choice models

Models	Random taste variation	Substitution patterns	Panel data application	Correlation of unobserved factors	Distributions
Multinomial logit model (MLM)	-	IIA holds, restrictive substitution patterns	Limited, primarily cross-sectional	-	Type I Extreme Value (Gumbel)
Nested logit model	-	Allows for some correlation within nests, partially relaxes IIA	Limited, primarily cross-sectional	√ Within nests only	Type I Extreme Value (Gumbel)
Probit	√	Flexible, allows for general substitutions patterns	Can be extended to panel data	√ Allows for general correlation	Multivariate Normal
Mixed logit	√	Highly flexible, allows for complex substitution patterns	Well-suited for panel data analysis	√ Allows for complex correlation structures	Customizable, often normal or lognormal

3. Methodology and Empirical Model

In designing CBDC, the central banks should consider several attributes affecting its potential adoption. Previous studies mentioned the essential attributes, mainly related to transferability, security and privacy, convenience, and interest rate. As Fujiki (2023) mentioned, the CBDC should have features like cash and other privately issued digital means of payment to prevent reluctance from consumers and merchants. In addition, some essential attributes such as ease of use, affordability, security, and transaction cost can also be differentiated from the current payment systems such as cash, credit cards, and debit cards (Huynh, 2020).

The cross-border transaction capability was also mentioned in previous study, stated that this capability could be one of the most crucial features, especially in implementing wholesale CBDC (Maryaningsih et al., 2022). Another work focused on the essential attributes of CBDC design: budgeting usefulness, anonymity, bundling of bank services, and rate of return (Li, 2023). Even though existing studies have covered some attributes that can be used in designing CBDC as shown in Table 1, accessibility has not yet been covered. As mentioned by Ozili (2021), the access to basic financial services in the formal financial system, especially for poor people, would be necessary in improving financial inclusion. This theory can be applied in the case of Indonesia, where the rate of financial inclusion rate still need to improved.

Table 2. CBDC attributes mentioned in previous works

Literatures	Attributes									
	Transferability	Storability	Reliability	Online or Offline Transaction	Security and Privacy	Transaction Cost	Affordability	Convenience	Interest Rate	Accessibility
Han et al. (2019)	√	√	-	√	√	-	-	-	-	-
Huynh (2020)	-	-	-	-	√	√	√	√	-	-
Kumhof & Noone (2021)	√	-	-	-	-	-	-	√	√	-
Dupuis et al. (2021)	√	-	√	-	√	-	-	-	√	-
Agur et al. (2022)	√	-	-	-	√	-	-	-	√	-
Maryaningsih et al. (2022)	√	-	-	-	-	-	-	-	-	-
Abramova et al. (2022)	-	-	-	√	√	-	-	√	-	-
Fujiki (2023)	√	-	-	-	√	-	-	√	√	-
Li (2023)	√	-	-	√	√	√	-	√	√	-

Following up on the previous works that used three main attributes, transferability, security and privacy, and interest rate, this study uses these attributes with accessibility to examine the most suitable acquisition channel that can optimize the adoption of CBDC in the Indonesian market. In the case of security and privacy, we focused on determining the privacy level that can maximize the consumer's utility and not exploring the security preferences of consumers further. Some adjustments on the attribute levels are made following the current payment and financial ecosystem conditions in Indonesia, as defined in Table (1). Each attribute will have some attribute levels based on the current ecosystem of electronic payment systems (EPS) with the following explanation:

1. *Accessibility* refers to the level of availability of CBDC from the perspective of all economic agents, including households and non-financial firms. The assumption that applied is that only banks and non-bank financial institutions (NBFIs) can trade CBDC directly with the central bank, where households and firms should buy/ sell CBDC in exchange for their deposits (Kumhof & Noone, 2021). Since the registration process would be an entry point for households and firms to use CBDC, four types of registration channels are defined based on the current best practices in the Indonesian market: agent, branch, mobile banking, and website.
2. *Privacy* become one of the most essential attributes in designing CBDC from the perspective of consumers, where it can be designed to blend intermediate levels of anonymity and security (Abramova et al., 2022; Agur et al., 2022). Other study mentioned that in designing CBDC, there is a trade-off to balance between adequate control by the government, privacy threats that appear because of designated privacy levels, and risks that can affect financial stability (Dupuis et al., 2021). Previous works also mentioned that

security and anonymity are two critical aspects central banks should consider in designing CBDC (Fujiki, 2023; Li, 2023). There are four types of privacy attributes in this research which are complete anonymity, significant transaction disclosure (more than 100 million rupiah or \$6,170), pseudonymous, and selective disclosure.

3. *Transferability* can be defined as the capability of CBDC to exchange or circulate its value in economic activities. Regarding actual payment, CBDC must maintain the zero-sum principle for more efficient and effective circulation. The security properties should also follow the transferable capability called no double-spending by utilizing a unique identifier (Han et al., 2019). Technically, the transferability would be operated by banks, existing NBFIs, or dedicated institutions for clarity purposes (Kumhof & Noone, 2021). In this study, transferability is defined as the exchange capability of CBDC with cash and non-cash payment options. Cash is still included because this payment option still dominates Indonesia's circulation of 42% compared to 28% of electronic wallet and 25% of debit, credit, and prepaid cards (Statista, 2024). Four types of financial services products for non-payment options are bank accounts, electronic money, foreign currencies, and cryptocurrencies.
4. *Interest rate* can be defined as the financial return, and it directly affects the convenience yield from the perspective of consumers. The implementation of interest rates can increase the CBDC demand, where the consumers can get the risk-free rate with no-arbitrage conditions (Kumhof & Noone, 2021). Other work also mentioned that the interest rate offered on the CBDC could impact the consumers' consideration with two other factors: heterogeneous preferences and the convenience of using a particular payment instrument (Agur et al., 2022). In 2022, the interest rate of Indonesian bank's deposits was 3.2%

(World Bank Open Data, 2022). However, some digital banks have an interest rate of 5% for their deposit products. In this research, the interest rate is divided into three types of interest rates, which are 0%, 3%, and 5%, based on the historical deposit interest rate and the current average interest rate implemented by traditional and digital banks.

Table 3. Variable definition for the CBDC

Variable name		Description	Definition	Distribution of parameters
Choice	Variable	Choice given by respondents	'1' if chosen, '0' otherwise	
Accessibility	AGENT	Agent registration (dummy variable for registration through offline agents)	'1' if available in the choice set, '0' otherwise	Normal
	BRANCH	Bank's branch (dummy variable for registration through branch)	'1' if available in the choice set, '0' otherwise	Normal
	MOBILE	Mobile application (dummy variable for registration through mobile application)	'1' if available in the choice set, '0' otherwise	Normal
	WEB	Website (dummy variable for registration through website)	'1' if available in the choice set, '0' otherwise	Normal
Privacy	ANONYM	Complete anonymity (dummy variable for complete anonymity)	'1' if available in the choice set, '0' otherwise	Normal
	LARGETRX	Disclosure for large transaction more than 100 million rupiah (dummy variable for large	'1' if available in the choice set, '0'	Normal

Variable name	Description	Definition	Distribution of parameters	
	transactions)	otherwise		
PSEUDO	Transaction using unique identifier (dummy variable for transaction using ID)	'1' if available in the choice set, '0' otherwise	Normal	
DISC	Selective disclosure for some transaction information (dummy variable for selective disclosure)	'1' if available in the choice set, '0' otherwise	Normal	
Transferability	CASH	Exchange capability of CBDC with cash (dummy variable for cash transferability)	'1' if available in the choice set, '0' otherwise	Normal
	BANKACC	Exchange capability of CBDC with bank accounts (dummy variable for bank account transferability)	'1' if available in the choice set, '0' otherwise	Normal
	EMONEY	Exchange capability of CBDC with electronic money (dummy variable for electronic money transferability)	'1' if available in the choice set, '0' otherwise	Normal
	FX	Exchange capability of CBDC with foreign currencies (dummy variable for foreign	'1' if available in the choice set, '0'	Normal

Variable name	Description	Definition	Distribution of parameters
	currencies transferability)	otherwise	
CRYPTO	Exchange capability of CBDC with cryptocurrencies such as Bitcoin and Ethereum (dummy variable for cryptocurrencies)	'1' if available in the choice set, '0' otherwise	Normal
Interest rate	RETURN	Return from interest rate of saving CBDC 0%, 3%, 5% interest rate per year	Log-normal

In this study, a Random Utility Model (RUM) was implemented to explore consumers' preferences using discrete choice models (McFadden, 1980). Its extension focused on creating a more flexible disturbance to cover a rich covariance and unobserved heterogeneity, latent variables to explain consumer behaviour, latent classes to capture different segmentation, and combining revealed and stated preferences. Regarding consumers' preferences related to Central Bank Digital Currency (CBDC), the assumption is that each consumer tries to optimize the utility of each attribute offered in the choice sets.

In RUM, the utilities can be assumed as the function of a set of *explanatory variables* X , which explains the *decision-maker* n and the *alternative* i . The utility equation can be stated as Eq. (3.1):

$$U_{in} = V(X_{in}; \beta) + \varepsilon_{in} \quad (3.1)$$

where U_{in} is the utility of alternative i [$i = 1, \dots, J_{in}$] for decision-maker n [$n = 1, \dots, N$] (U_n is the vector of utilities for decision-maker n); X_{in} is the vector of explanatory variables describing i and decision-maker n (X_n is a matrix of explanatory variables describing all alternatives and decision-maker n); β is a vector of unknown parameters; V (called the systematic utility) is a function of the explanatory variables and unknown parameters β ; and ε_{in} is a random disturbance for i and n (Walker & Ben-Akiva, 2002).

Three common attributes explored in previous literature are privacy, transferability, and interest rate. However, no literature explored accessibility in designing CBDC, essential in formulating appropriate channels for consumers' acquisition processes. With this background, four attributes—accessibility, privacy, transferability, and interest rate—were covered. As

Table 2 states, different levels of attributes were defined based on the current condition of the Indonesian market. All considered attribute levels can be stated in Eq. (3.2).

$$\begin{aligned}
U_{ijt} = & \beta_{Branch}BRANCH + \beta_{Agent}AGENT + \beta_{Web}WEB + \beta_{Mobile}MOBILE + \\
& \beta_{Anonym}ANONYM + \beta_{IDTrx}IDTRX + \beta_{LargeTRX}LARGETRX + \\
& \beta_{Disclosure}DISCLOSURE + \beta_{BankAccount}BANKACC + \beta_{Emoney}EMONEY + \\
& \beta_{Cash}CASH + \beta_{ForeignCurrency}FXCURRENCY + \beta_{Crypto}CRYPTO + \beta_{Return}RETURN + \\
& \varepsilon_{ijt} \quad (3.2)
\end{aligned}$$

To overcome three limitations of standard logit model which is allowing random taste variation, unrestricted substitution patterns, and correlation of unobserved factors over time, the mixed logit model was used in the estimation process. A mixed logit model can be expressed in the Eq. (3.3).

$$P_{ni} = \int L_{ni}(\beta)f(\beta)d\beta \quad (3.3)$$

where $L_{ni}(\beta)$ is the logit probability evaluated at parameters β stated in Eq. (3.4):

$$L_{ni} = \frac{e^{V_{ni}(\beta)}}{\sum_{j=1}^J e^{V_{ni}(\beta)}} \quad (3.4)$$

and $f(\beta)$ is a density function, $V_{ni}(\beta)$ is the observed portion of the utility, which depends on the parameters β . If utility is linear in (β) , the value of $V_{ni}(\beta) = \beta'x_{ni}$. In this case, the mixed logit probability can be stated as Eq. (3.5) (Train, 2009).

$$P_{ni} = \int \frac{e^{V_{ni}(\beta)}}{\sum_{j=1}^J e^{V_{ni}(\beta)}} f(\beta)d\beta \quad (3.5)$$

In mixed logit model, a sampled individual ($q = 1, \dots, Q$) faces a choice amongst I alternatives in each of T situations, where the individual is assumed to consider the full set of

offered alternatives in choice situation t and to choose the alternative with the highest utility as stated by this Eq. (3.6)

$$U_{itq} = \beta'_q x_{itq} + \varepsilon_{itq} \quad (3.6)$$

where x_{itq} is a vector of explanatory variables that are can be observed that considering attributes of the alternatives, socio-economic characteristics of the respondent and descriptors of the decision context and choice task itself (e.g. task complexity in stated choice experiments as defined by number of choice situation, number of alternatives, attribute ranges, data collection method etc.) in choice situation t . The components β_q and ε_{itq} are not observed, so these are treated as stochastic influences. In a logit context, the assumption of ε_{itq} independent and identically distributed (IID) extreme value type 1 is applied, so it does not allow for the error components of different alternatives to be correlated (Hensher & Greene, 2003).

To exploration of consumers' willingness to pay (WTP) can be divided into two types of approaches which is direct and indirect surveys. In direct survey, the respondents will be asked how much they would be willing to pay for some product. On the other hand, the indirect survey will require the respondents to create rating or ranking for different products. Two examples of indirect surveying methods to estimate WTP are conjoint analysis and discrete choice analysis (Breidert et al., 2006).

Other than direct and indirect surveys, the WTP can be measured using "models in preference space" and "models in WTP space." In preference space, the distribution is specified for the coefficients, and the parameters of this distribution (such as mean and variance) are estimated. On the other hand, convenient distribution is specified for the WTP's and the price coefficient in the WTP space. In this study, the WTP will be measured by using

"models in WTP space" using STATA following the specification in Eq. (3.7). In the implementation of the WTP space model, the price coefficient is given a log-normal distribution (Train, 2009).

$$U_{njt} = -\lambda_n p_{njt} + (\lambda_n w_n)' x_{njt} + \varepsilon_{njt} \quad (3.7)$$

To explore the level of importance of each attribute in CBDC design, Relative Importance (RI) was conducted. This approach is useful for comparing the most essential attributes that can affect consumers' preferences to other available attributes. In examining the attribute's RI, first, the part worth was determined using Eq. (3.9).

$$Partworth_{i,j} = |\beta_{i,j}| \cdot (Max_j - Min_j) \quad (3.9)$$

where: $\beta_{i,j}$ represents the coefficient (or utility) for the j -th attribute level of the i -th respondent; $|\beta_{i,j}|$ indicates the absolute value of the coefficient, ensuring that the part worth is always a positive value; and $(Max_j - Min_j)$ is the maximum and minimum values for the j -th attribute across all respondents or levels. The difference of this variable represents the range of that attribute.

Then, RI can be calculated by Eq. (3.10).

$$RI_j = \frac{partworth_j}{\sum_j partworth_j} * 100 \quad (3.10)$$

where $partworth_j$ is the part worth for the j -th attribute; $\frac{partworth_j}{\sum_j partworth_j}$ is the sum of part worth for all attributes to normalize the part worth to determine its relative contribution, and the multiplication by 100 converts the RI to percentage.

4. Empirical studies

4.1 Survey and Data

4.1.1 Conjoint experiment

The conjoint experiment was developed by using a website called conjointly.com. First, all desired attributes and attribute levels are inputted to the website. Four attributes and fourteen attribute levels are being used, all of which are defined in Table 1. After inputting the attribute and attribute levels, the website will create an experimental design automatically using twelve choice sets. Each choice set has three alternatives to ensure the respondents can optimally compare the available alternatives. The respondents are provided with information about all attributes and attribute levels to give them adequate information before choosing their preferences in the online survey.

Some features can be used in conjointly.com to maintain the reliability of the data, such as adding essential information related to the survey, checking the appropriate response inputted by the respondents according to an initial setting, disabling respondents from the same IP address, disabling respondents with the same cookie, terminate low-quality respondents according to their responses, and set up minimum review time. The conjointly home dashboard shown in Figure 1.

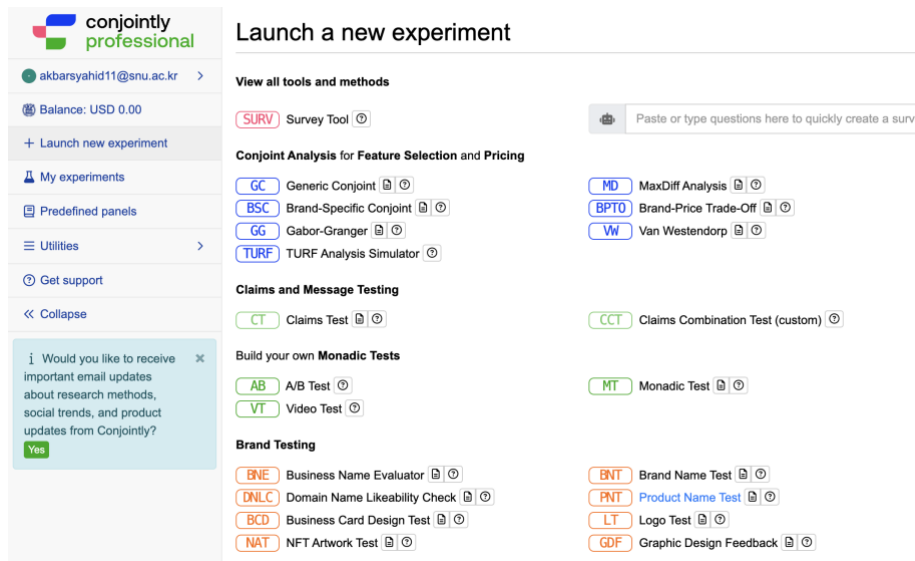


Figure 1. Conjointly home dashboard

Before sending the survey to all respondents, a trial session was held. Some feedback from seven respondents mainly highlighted the need for an explanation of attributes and attribute levels and information about how to fill out the questions in the survey. After improving the survey according to this feedback, the survey was blasted to Indonesian respondents using Bahasa Indonesia with the example of choice set shown in Figure 2.

	Product A	Product B	Product C
Rate of Returns	5% per year	0%	3% per year
Interoperability	Bank Accounts	Cryptocurrencies	Electronic Money
Privacy	Identity Verification for Large Transaction	Full Anonymity	Pseudonymous
Accessability	Branch	Website	Mobile Application

Figure 2. Example of choice set

4.1.2 Data collection

In this research, 203 Indonesian respondents aged 18 to 65 finished the online survey. The respondents' locations were not limited to some specific areas to mix the proportion of respondents and follow the spread from the conjointly. Six of 203 respondents randomly chose the choice sets without considering their preferences, which can be seen sequentially from the same choice for the whole choice sets. In this case, these respondents were excluded to ensure the data's reliability, resulting in 197 respondents.

Several demographic data were gathered from the respondents, including their gender, age, education, income, and job. In addition, respondent's payment and investment preferences were collected to get more information about their current behaviour. Finally, the respondents were asked about their knowledge of cryptocurrencies, knowledge of CBDC, and willingness to use CBDC to explore their knowledge about blockchain implementation in financial services.

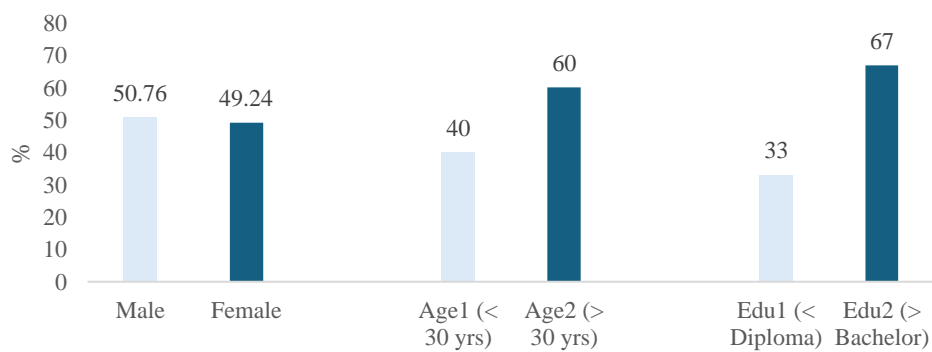


Figure 3. Respondent's gender, age, and education

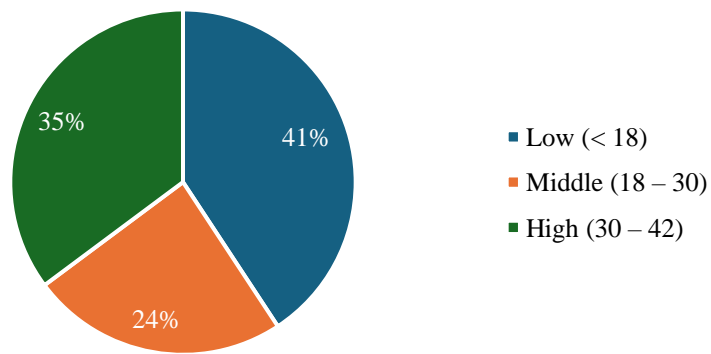


Figure 4. Respondent's income distribution

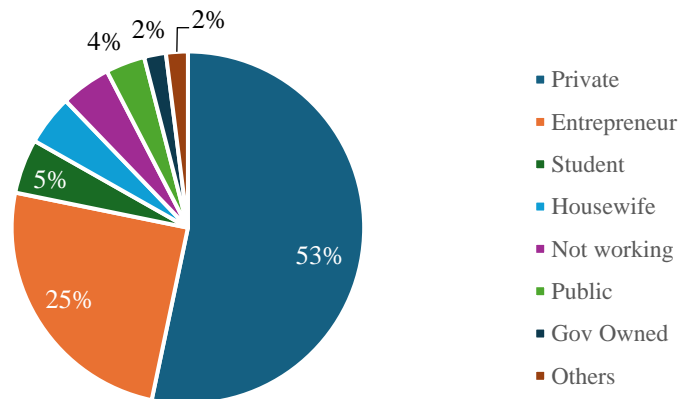


Figure 5. Respondent's occupation

The results of the demographic data show that 50,76% of respondents are male and 49,24% are female, which matches Indonesia's population proportion of 138,45 million males and 135,75 million females (Badan Pusat Statistik, 2022). Most respondents (60%) can be categorized as Age 2 (> 30 years) and 40% of them are in the range of 18-29 years. This

proportion is suitable for the fact that Indonesian people are at a productive age. From the education perspective, 67% of respondents have graduated with a diploma in education. This proportion is higher than the population, where only 10.15% of Indonesians graduated with a bachelor's degree (Databoks Katadata, 2023). The respondent's gender, age, and education proportion are shown in Figure 3.

Two socio-demographic information related to the respondents' income and occupation were collected. For the income distribution, the categorization defined by the statistical bureau is followed, where the income can be divided into four different levels: very high (more than 42 million), high (30 – 42 million), middle (18 – 30 million), and low (lower than 18 million) (Rakasiwi & Kautsar, 2021). The income distribution can be explained by Figure 4, where 41% of respondents have a low income or are lower than 18 million rupiah/ year. This proportion is slightly more significant than the overall population, which is 34.3% poor and low-income. Lastly, most respondents work as laborers/ employees in private (53%), entrepreneurs (25%), and students (5%), as shown in Figure 5.

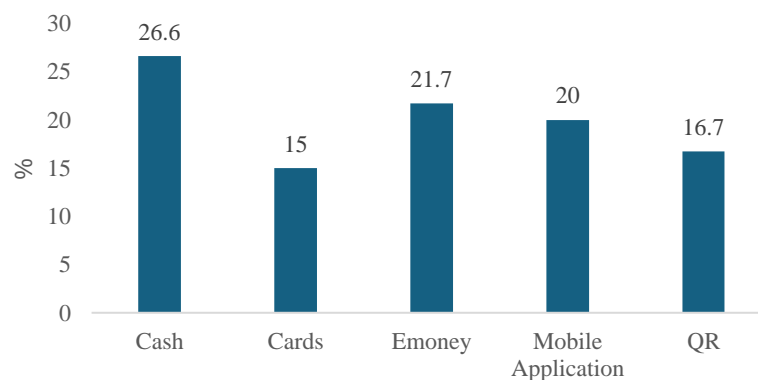


Figure 6. Payment preferences

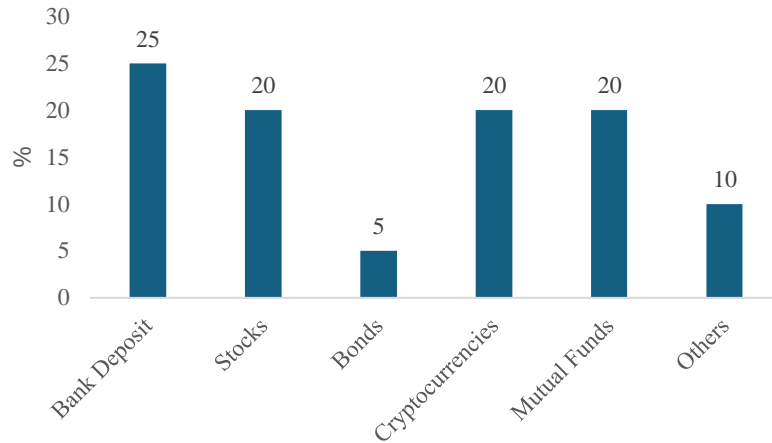


Figure 7. Investment preferences

Related to the respondent's payment preferences, their most preferred payment system is cash (26,6%), electronic money (21,7%), mobile application (20%), quick response (16,7%), and cards (15%), respectively as shown in Figure 4. This proportion is suitable with the current payment trends in Indonesia, where the popularity of electronic wallets and mobile applications continuously increases, affecting cash transactions' slowing down (Statista, 2024).

For the investment preferences, bank deposit (25%) is the most popular investment, followed by stocks (20%), cryptocurrencies (20%), and mutual funds (20%). The least preferred investment instrument is bonds (5%), where 10% of respondents choose other investments to maintain their wealth, as shown in Figure 5. The respondents' profiles matched with the most used financial products in Indonesia, where short-term and long-term saving accounts are used by 67% of Indonesian consumers (Statista, 2023). The unpopularity of cryptocurrencies happens for some reason, one of which is that consumers consider them a high-risk financial product (Themistocleous et al., 2023; T. Zhang & Huang, 2022).

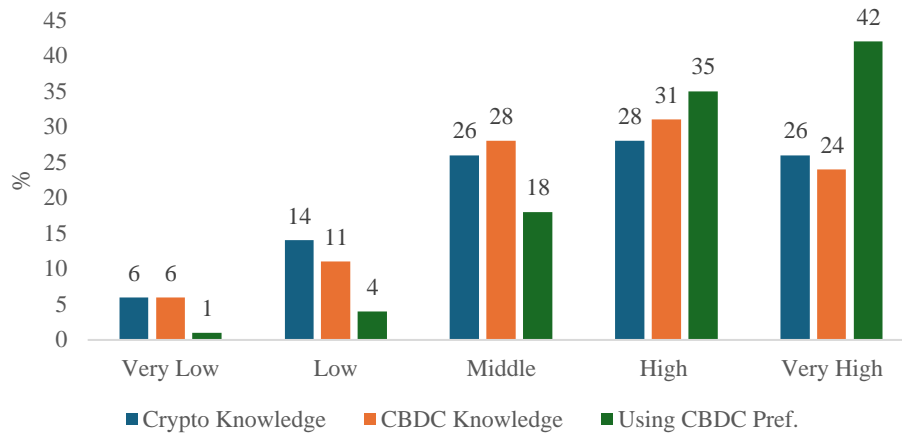


Figure 8. Cryptocurrencies knowledge, CBDC knowledge, and respondent’s preferences of using CBDC

Additional information related to respondents was also gathered to understand their exposure to cryptocurrencies and CBDC. Most respondents (54%) have a high understanding of cryptocurrencies, whereas 55% also know the urgency of CBDC implementation. Lastly, 77% of respondents will use CBDC if the central bank implements it in Indonesia’s market, as stated in Figure 8, representing the willingness to use CBDC. The socio-demographic, payment, and investment preferences, as well as the knowledge of cryptocurrencies and CBDC and their willingness to use CBDC, are also shown in Table 4.

Table 4. Demographic statistic

Characteristics of study subjects N = 197					
Characteristics	Percentage	Characteristics	Percentage	Characteristics	Percentage
Age range (18-65 years)		Payment preferences		CBDC Knowledge	
Age 1 (<30 years)	40	Cash	27	Very high	24
Age 2 (> 30 years)	60	Cards	15	High	31
Gender		Electronic money	21	Medium	28
Female	49	Mobile application	20	Low	11
Male	51	Quick responses (QR)	17	Very low	6
Education		Investment preferences		Willingness to use CBDC	
Edu 1 (\leq Diploma)	33	Bank deposit	25	Very high	42
Edu 2 (\geq Diploma)	67	Stocks	20	High	35
Income (rupiah)		Bonds	5	Medium	18
Low (< 18 million/ year)	22	Cryptocurrencies	20	Low	4
Middle (18-30 million/ year)	13	Mutual funds	20	Very low	1

Characteristics of study subjects N = 197

Characteristics	Percentage	Characteristics	Percentage	Characteristics	Percentage
High (> 30 million/ year)	65	Others	10		
Occupation		Cryptocurrencies knowledge			
Laborer/ employee (private, public services, government owned companies)	59	Very high	26		
Entrepreneur	25	High	28		
Housewife	5	Medium	26		
Student	5	Low	14		
Not working	4	Very low	6		
Others	2				

4.2 Estimation Results

The total observations calculated using the mixed logit model are 197 respondents. This research used STATA to estimate the relationship between the respondents' choices with four attributes: accessibility, privacy, transferability, and rate of return. All attributes besides the rate of return were calculated as a dummy variable and normal distribution. The attribute rate of return as a price variable was calculated as a continuous variable and log-normal to control the positive impact of rate return on the respondent's choice as implemented by Train & Weeks (2005). In implementing the mixed logit model, this study uses three references of attribute levels: branch for accessibility, pseudonymous for privacy, and cash for transferability. The calculation results using a mixed logit model with three different confidence levels, which are 90%, 95%, and 99%, are shown in Table 3.

4.2.1 Mixed logit regression

According to the results, consumers have a high utility for using mobile banking to register in CBDC using mobile banking (0.3755) compared to branches (reference attribute) and other registration channels like websites (-0.1554) and agents (-0.4178). This result aligns with Indonesia's mobile internet penetration rate, projected to reach 82.26% of the population in 2024 (Statista, 2024). The variance coefficient of mobile banking (0.6417) is the largest among the significant accessibility attributes, indicating that consumers' choices are more sensitive to mobile banking accessibility than other accessibility attributes.

Table 5. Mixed logit estimation results

Variable matching	Variable	Mean (b) of parameters			Variance (w) of parameters		
		Mean	Std. Error	p-value	Std. Div.	Std. Error	p-value
Agents	AGENT	-0.4178	0.0863	0.000***	-0.3579	0.1615	0.027**
Website	WEB	-0.1554	0.0812	0.056*	-0.3585	0.1644	0.029**
Mobile	MOBILE	0.3755	0.0888	0.000***	0.6417	0.1020	0.000***
Complete Anonymity	ANONYM	-0.4750	0.0949	0.000***	0.7013	0.1108	0.000***
Disclosure for large transactions	LARGETRX	-0.0360	0.0823	0.662	-0.4531	0.1175	0.000***
Selective disclosure	DISC	0.1015	0.0870	0.243	-0.5892	0.1018	0.000***
Bank account	BANKACC	0.2012	0.0906	0.026**	0.4401	0.1168	0.000**
Electronic money	EMONEY	0.2161	0.0894	0.016**	-0.355	0.1432	0.013**
Foreign currencies	FX	-0.3208	0.1016	0.002***	0.6834	0.1184	0.000***
Cryptocurrencies	CRYPTO	-0.5875	0.1211	0.000***	1.0577	0.1174	0.000***
Interest rate	RETURN ^a	0.9375	0.3851	0.015**	2.3997	0.2736	0.000***
N		197					
Chi-squared		349.02					
Log likelihood		-2304.7864					

Asterisk (*), (**), and (***) marks the significance at 90%, 95%, and 99%, respectively. ^aWillingness to pay (WTP) in interest rate (%)

The negative coefficients for websites (-0.1554) indicate that this channel is less attractive to consumers than the reference category. However, due to insignificant p-value, the null hypothesis could not be rejected. Even though consumers have heterogeneity when choosing websites as the acquisition channel, represented by a significant p-value of standard deviation (-0.3585) at the 95% confidence level, further study should be conducted to ensure its impact on consumers' adoption. One of the aspects that can be explored is exploring the specific consumer types websites can acquire for CBDC registration.

Our research indicates that agents (-0.4178) are generally viewed less favourably as an acquisition channel. The p-values of mean and standard deviation are significant at a 95% confidence level. In this case, the null hypothesis could be rejected, and the negative relation between the availability of agents and consumers can be confirmed. However, further study will be needed to ensure the effect of agents on consumers with specific profiles, especially those who live in rural areas. One of the products currently established in the Indonesian market is branchless banking, which has simple features to support small communities' economic growth (Kustina, 2019).

From the privacy perspective, complete anonymity (-0.475) produces the lowest utility for privacy attribute with a 99% confidence level. In addition, this attribute has the most extensive range with references and other attributes, indicating that most respondents can differentiate their choice and are aware of the negative effect of privacy. The p-value of the standard deviation for the anonymity variable is also significant, so the null hypothesis can be rejected and confirm that the consumers do not prefer to have fully anonymous transactions.

Selective disclosure (0.1015) produces the highest utility compared to other privacy attribute levels. However, the p-value of the mean is insignificant, so the null hypothesis could not be rejected. This result means that the impact of selective disclosure as one of the privacy levels

in the choice-set with consumers' adoption is equal to zero. Practically, the application of selective disclosure allows the exchange of transaction information such as amount, time, and terminal. With the insignificance of the p-value of the mean, further exploration is required to confirm the relation between selective disclosure and consumers' choice.

Another attribute is large transaction disclosure (-0.036), which produces a negative coefficient with an insignificant standard deviation p-value. The coefficient of this attribute does not have a big gap from the reference attribute (the pseudonymous/ transaction using ID), indicating that the consumers still do not have strong preferences related to the most appropriate privacy levels. Further exploration would be needed to ensure the relationship between large transaction disclosure and consumers' choice.

From the perspective of the p-value of mean and standard deviation, two privacy levels, which are selective disclosure and large transaction disclosure, have the same pattern of regression results, which is the insignificant mean with significant standard deviation. These results indicate the existence of heterogeneity in consumers' choices. However, since the null hypothesis could not be rejected, the effects of privacy levels other than completed anonymity could not be concluded. This underscores the significance and relevance of these findings, and the need for further exploration to fully understand the most appropriate privacy level that can optimizing the consumers' utility.

Related to transferability, consumers prefer to exchange their CBDC with electronic money (0.2161) and bank account (0.2012). The estimation results of mean value and standard deviation are statistically significant at 95% of the significance level so that the null hypothesis could be rejected. These results revealed a strong relationship between the bank account and electronic money transferability with the possibility of consumer adoption. In addition, the similar value of these two attributes' coefficients can be threatened by the same level of impact

on the consumers' utility. Since Indonesian consumers are familiar with these two financial products that can be used in the existing financial service environment, such as money transfer, withdrawal, and online and offline payments, the results adequately capture it.

On the other hand, foreign currency (-0.3208) and cryptocurrencies (-0.5875) produce the lowest utility compared to the reference attribute (cash) and other attributes (electronic money and bank account). The p-value of these two attributes is significant for both mean and standard deviation in 99% of the confidence level. This result indicates that consumers do not consider foreign currency and cryptocurrencies their desired CBDC transferability features. Some aspects, such as low circulation, high risk, and technical complexity, can be considered factors that reduce the consumers' utility level (Themistocleous et al., 2023; T. Zhang & Huang, 2022).

The last attribute explored is the interest rate with a coefficient of 0.9375, which is positive, indicating that the adoption of CBDC is positively affected by the interest rate. This financial attribute has a significant p-value in 95% of the confidence level, indicating the strong relation between a competitive interest rate and consumers' choice. In addition, the p-value for the standard deviation of the interest rate coefficient is statistically significant (2.399) at a 99% confidence level, indicating substantial variability in respondents' preferences regarding the interest rate. The variation might occur because respondents have different sensitivity levels to the interest rate levels presented in the choice set (0%, 3%, and 5%). Besides its relation with consumer adoption, the optimum level of interest rate is also essential to be explored.

4.2.2 Willingness to pay

The willingness to pay (WTP) can be measured directly and indirectly. Two examples of indirect surveying methods to estimate WTP are conjoint analysis and discrete choice analysis (Bredert et al., 2006). In this study, the WTP estimation used the data gathered through conjoint

analysis, where the WTP space of the mixed logit model was conducted in STATA. The results of WTP estimation in the form of interest rate value (%) are shown in Table 5. This method was chosen since it provided more reasonable distributions of WTP than the models in preference space (Train & Weeks, 2005).

Based on the WTP estimation results, it's crucial to note that mobile banking (0.0209) is the only attribute with a positive WTP in the accessibility category. This finding underscores the significant role of mobile banking in enhancing the accessibility of CBDC services. Conversely, other attributes such as agent (-0.0267) and website (-0.0054) show a negative WTP, indicating a lower preference among consumers. This result is consistent with the mixed logit estimation, which also highlights the strong preference for mobile banking. The significant p-value of the mobile banking standard deviation (0.0359) further supports this conclusion. For the website attribute, further investigation is warranted due to its insignificant gap to the reference WTP (branch) and insignificant p-value of mean.

Table 6. WTP estimation results

Variable matching	Variable	Mean (b) of WTP			Variance (w) of WTP		
		Mean	Std. Error	p-value	Std. Div.	Std. Error	p-value
Agents	AGENT	-0.0267	0.0059	0.000***	0.0269	0.0046	0.000***
Website	WEB	-0.0054	0.0043	0.215	-0.0149	0.0042	0.008***
Mobile	MOBILE	0.0209	0.0060	0.001***	0.0359	0.0076	0.000***
Complete Anonymity	ANONYM	-0.0361	0.0068	0.000***	0.0289	0.0050	0.000***
Disclosure for large transactions	LARGETRX	-0.0018	0.0042	0.666	0.0195	0.0062	0.002***
Selective disclosure	DISC	0.0064	0.0046	0.166	0.0372	0.0053	0.000***
Bank account	BANKACC	0.0059	0.0045	0.188	0.0179	0.0040	0.000***
Electronic money	EMONEY	0.0136	0.0048	0.005***	-0.0138	0.0051	0.007***
Foreign currencies	FX	-0.0239	0.0084	0.005***	0.0439	0.0083	0.000***
Cryptocurrencies	CRYPTO	-0.0568	0.0107	0.000***	0.0715	0.0122	0.000***
Interest rate	RETURN ^a	N/A	N/A	N/A	N/A	N/A	N/A
N		197					
Chi-squared		457.60					
Log likelihood		-2390.496					

Asterisk (*), (**), and (***) marks the significance at 90%, 95%, and 99%, respectively. ^a Willingness to pay (WTP)

Following up on the result of accessibility's WTP, the central bank can focus more on creating the diffusion of mobile application technology as a primary channel to acquire broader consumers. Financial institutions can also invest their capital in improving the reliability, usability, speed, and security of their mobile application channels. The central banks and financial institutions can also explore the most suitable acquisition process for different segments based on the consumers' demographic profile.

Regarding privacy, only selective disclosure (0.0064) of transactions shows a positive WTP, indicating that consumers are willing to pay a small premium for the ability to disclose their transaction details selectively. On the other hand, large transactions (-0.0018) result in negative WTP, indicating that consumers would require compensation to accept these privacy features. However, the p-values for the mean WTP of selective disclosure and large transactions are insignificant. This means that there is no substantial evidence that the average WTP for these attributes differs from zero, so the null hypothesis cannot be rejected. Further exploration is needed to understand the relationship between selective disclosure and large transactions with consumers' WTP. Moreover, the significant p-values for the standard deviations of these two attribute levels indicate significant heterogeneity in consumer preferences. This heterogeneity suggests that while the average WTP may not be significant, individual consumer responses vary widely, pointing to diverse preferences regarding these privacy attributes.

Only complete anonymity (-0.0361) in the privacy attribute has a significant mean and standard deviation WTP at a 99% confidence level. This result strengthens the previous discussion about consumer reluctance toward this type of privacy. In light of these findings, the central bank should avoid complete anonymity, as it can decrease potential adoption and lead to a negative WTP. If the central bank implements this option, consumers would expect some premium to compensate for the risk of executing completely anonymous transactions.

From the perspective of transferability, two attributes have a positive WTP: bank account (0.0059) and electronic money (0.0136) with different levels of significance. However, only electronic money has a significant mean and standard deviation at a level of 99%, whereas the mean of bank account is insignificant. This result indicates that consumers are willing to afford the transferability features of CBDC to electronic money, where further exploration of CBDC transferability WTP with bank account is required. The popularity of electronic money, where 107 millions of Indonesian consumers use this product (Statista, 2024), can be one of the reasons for the positive value of WTP.

Two other transferability attributes have a negative WTP: foreign currencies (-0.0239) and cryptocurrencies (-0.0568). This result indicates that consumers are unwilling to spend money on these capabilities for low circulation, high risk, and technical complexity (Themistocleous et al., 2023; T. Zhang & Huang, 2022). It strengthens the previous discussion, stating that the transferability of CBDC with foreign currencies and cryptocurrencies is less attractive than bank accounts and electronic money.

Looking at the standard deviation, three attribute levels of transferability are significant in 99% of confidence. According to these results, the null hypothesis can be rejected, and it can be confirmed that consumers have a positive WTP for electronic money transferability and a negative WTP for foreign currencies and cryptocurrencies. Following up on the results, the central bank can prioritize the transferability of CBDC with electronic money to facilitate the consumers' needs and consider its less complexity compared to foreign currencies and cryptocurrencies that involve stakeholders and central banks worldwide.

4.2.3 Relative importance

The relative importance (RI) would help define the attribute's level of importance between all available attributes (Mariani et al., 2019). In this study, the RI examined each attribute towards all attributes with the results shown in Table 4. According to the results of RI, the interest rate (70%) can be seen as the most influential attribute that can drive the potential adoption of CBDC in Indonesia's market. However, a suitable interest rate should be determined by the central bank to balance to needs of financial benefits from the consumers side with stability of macroeconomic conditions. As stated by Carapella & Flemming (2020) that exploring the impact of interest rates on consumers' choices will help the central bank choose the appropriate interest rate.

Table 7. Relative importance of attributes

Attributes	Relative importance (%)
Interest Rate	70%
Transferability	20%
Accessibility	9%
Privacy	2%

Other attributes, such as transferability (20%) and accessibility (9%), are also seen as two essential attributes from consumers' perspective. These can represent the need for advanced features provided by CBDC. As discussed in the previous chapter, fulfilling some consumer's basic needs, such as mobile registration and transferability to popular financial products such as bank accounts and electronic money, will drive CBDC adoption positively. Furthermore, some advanced blockchain technologies, such as distributed ledger, encryption processes, and transaction consensus (Belotti et al., 2019; Narayanan & Clark, 2017), can be implemented to give valuable benefits and convenience to consumers.

Lastly, the RI of privacy (2%) has the lowest value, indicating that consumers are still aware of the importance of security but do not see it as the main driving factor to use the CBDC. According to the mixed logit model, the consumers could only clearly identify the negative effect of complete anonymity, where they do not have any significant preferences for any other privacy level. These results indicate that the privacy design would rely more on the design of the central bank as the primary stakeholder that issue and maintain the circulation of CBDC.

4.3 Policy Implications

4.3.1 Accessibility

The mixed logit estimation result reveals that mobile banking (0.3755) surpasses other registration channels such as websites (-0.1554) and agents (-0.4178) in terms of utility. This finding holds crucial policy implications for the central bank, banks, and non-bank financial institutions (NBFIs) in the context of Indonesia. The central bank, for instance, will oversee the issuing, circulation, and termination process (Bayhakah & Wicaksana, 2022). Banks and NBFIs, on the other hand, will play a direct role in interacting with households and firms, providing services like deposits, loans, and exchanges to support the circulation of CBDC (Kumhof & Noone, 2021).

Ensuring optimal mobile banking penetration necessitates the provision of reliable telecommunication, particularly in remote areas. In this regard, the government's role becomes pivotal. It should formulate policies that prioritize infrastructure development, such as 5G, to address the lack of physical and informational infrastructure that deters financial service providers from offering products tailored to the needs of low-income individuals. The involvement of private sectors, including telecom service providers and financial institutions, is also crucial in this endeavour (Dermish et al., 2011; Mishra & Singh Bisht, 2013; Wonglimpiyarat, 2014).

From a technological perspective, the central bank, banks, and NBFIs should have a strategic plan for implementing mobile applications as one of the CBDC registration channels. The central bank should encourage the banks and NBFIs to continue the development of mobile banking by creating regulations and national standards that can cover the CBDC registration business process. Even though the registration process through a mobile application is still in the exploration phase by the central banks worldwide, as stated by Steblyanskaya et al. (2019), developing some blockchain features that can ensure reliability, security, and accessibility to optimize the consumers' acquisition would be beneficial for all related stakeholders. Some features that can be explored are the consistency of the ledger across institutions, integrity of transactions, availability of system and data, prevention of double-spending, confidentiality of transactions, anonymity of users' identity, and unlikability of transactions principles (R. Zhang et al., 2020).

The development of CBDC is primarily aimed at enhancing the financial inclusion rate, with mobile banking serving as the most accessible channel for consumer registration. This finding is reinforced by the p-value of mean and standard deviation, both of which are statistically significant, allowing us to reject the null hypothesis. It implies that the availability of mobile banking as a registration channel for CBDC significantly influences consumer choice. The result is consistent with previous research, which stated that the mobile banking revolution could improve financial inclusion and reduce dependency on new physical branch penetration (King, 2012). To ensure a balanced approach to mobile banking penetration for CBDC consumer acquisition, the central bank must also establish regulations concerning national security standards, particularly for the encryption process using algorithms like Rivest-Shamir-Adleman (RSA), Triple Data Encryption Standard (3DES), and Advanced Encryption Standard (AES) (Narendiran et al., 2009). This underscores the importance of maintaining a secure environment for CBDC transactions, even as mobile banking becomes more prevalent.

Even though agents and websites resulting in negative coefficients can decrease consumers' utility, exploring these options for specific types of consumers would benefit the government and central bank. For agents, implementing branchless banking in rural areas in the Indonesian market could be leveraged for CBDC consumer acquisition. This strategy would be beneficial in accelerating the potential diffusion of CBDC since the cost of establishing it is cheaper than that of traditional banking channels. This statement is supported by previous work stating that CBDC has great potential to reach many low-income, unbanked people at affordable prices with a wide range of products to meet their financial needs (Dermish et al., 2011).

In designing CBDC acquisition through the agents, the central bank should have an appropriate design due to its limitations, especially for financial institutions. Several challenges appeared in implementing agents to execute current payments and financial transactions, where the agent banking implementation did not significantly increase the number of third-party funds and bank profits (Kustina, 2019). Further exploration of the current agent banking's business process and strategy to improve its challenges would be necessary to be explored by the central bank to mitigate these challenges. One exploration that would be beneficial is understanding the diffusion of phone banking technology called M-Pesa³, which has millions of consumers in Kenya (King, 2012).

4.3.2 Privacy

Related to the privacy attribute, complete anonymity (-0.475) produces the lowest utility for the privacy attribute compared to other attribute levels, such as large transaction disclosure (-0.036) and selective disclosure (0.1015). This means that the consumers understand the adverse effects of complete anonymity and are willing to share their data related to the transactions.

³ M-Pesa is a mobile money service that provide financial services to the people who have mobile phones, but do not have bank accounts in Africa.

This result can be explained by previous results stating that privacy and anonymity preferences are related to cultural patterns, where 71% of Asian people are willing to allow the privacy of transactions for the public interest. This rate is higher than in Africa (63%) and Eastern Europe (59%) (Koziuk & Ivashuk, 2022).

According to the result, the central bank can consider other privacy levels besides complete anonymity in designing CBDC since it cannot comply with anti-money laundering (AML) and countering the financing of terrorism (CFT), know your customer (KYC), and record-keeping requirements regulation, which have been regulated by the central banks (Koziuk & Ivashuk, 2022; Wenker, 2022). One of the possibilities that the central bank can consider is combining large transactions, pseudonymous/ transactions using ID (reference attribute), and selective disclosure. Even though selective disclosure and large transactions produce different effects on utility, since the mean p-value is insignificant, the null hypothesis could not be rejected. In this case, combining these two privacy levels can be beneficial to increase the convenience that can increase consumers' convenience and benefits, so they are more likely to disclose their personal information (Jabbar et al., 2023). However, this approach warrants additional investigation and exploration by the central bank.

Combining some privacy levels was explained in a previous study by Gross et al. (2021) stating that the level of payment privacy can be divided into three levels to support complete privacy while addressing constraints related to AML and CFT regulation by imposing limits on anonymous payments:

1. Fully private: Hidden identities and transaction amounts of both involved parties.
2. Semi-private: The amount of the transfer to the Payment Service Providers (PSP) and the central bank is revealed, but only the identity of the holder of the transparent CBDC account is revealed to the involved PSPs and central bank.

3. Fully transparent transfer: The Sender's PSP, the receiver's PSP, and the central bank know the identities and the transaction amount (like current electronic payments via commercial banks).

According to the mixed logit model and WTP results, the central bank should avoid the fully private option because the consumers would be reluctant to do it. The central bank can choose the other two options: semi-private and fully transparent transfer. However, semi-private transactions can be the most suitable option because they can balance the security and privacy of transactions according to consumers' preferences. The flexibility is higher than that of a fully private and transparent transfer in this case. Besides these three options, the managed anonymous CBDC can also be an option to adjust the CBDC's anonymity to change the mechanisms and specific effects of CBDC affecting the economy according to the central banks' needs (Ren et al., 2023).

4.3.3 Transferability

From the perspective of transferability, consumers prefer the capability of changing CBDC with electronic money (0.2161) and bank accounts (0.2012) compared to foreign currencies (-0.3208) and cryptocurrencies (-0.5875). Electronic money and bank accounts have a similar impact on utility, which aligns with the current payment trends in Indonesia, where e-money and bank accounts dominate digital transactions. The mean and standard deviation p-values are significant in 95% of the confidence level so that the null hypothesis can be rejected.

The last two transferability levels, foreign currencies, and cryptocurrencies, result in negative coefficients, so the null hypothesis can be rejected at a 99% confidence level. The results supported by previous research mentioned that interoperability issues in blockchain could benefit CBDCs' capabilities (Sethaput & Innet, 2023). In addition, the negative

coefficients can also happen because of their low circulation, so consumer demand is not as high as the existing EPS, which is bank accounts and electronic money. In addition, consumers' perception of foreign currencies and cryptocurrencies as new financial products with high risk also impacts their preferences. Even though the foreign currency in implementing CBDC would be beneficial, its technical complexity and suitable regulations between central banks worldwide still need further exploration.

According to Themistocleous et al. (2023), the CBDC interoperability capability still needs further research related to its framework, design, and risk assessment. This statement, also supported by T. Zhang & Huang (2022) mentioned that cross-chain interoperability among blockchains is a big challenge for blockchain and blockchain-based CBDC schemes. The central bank can first focus on the bank account and electronic money transferability before expanding to foreign currency and cryptocurrencies. Looking at the potential of the cryptocurrency market in Indonesia, which achieved IDR 17.09 trillion (\$1.1 billion) in November 2023 (Statista, 2024), the transferability of CBDC with cryptocurrencies would have a significant impact in the future. Further exploration of this feature is essential to ensure that the central bank can utilize the vast cryptocurrency market.

In designing CBDC transferability, the central banks should also create the CBDC model interaction that involves all related stakeholders such as banks, non-bank financial institutions (NBFIs), and consumers (households and firms). According to Kumhof & Noone (2021), the central bank would need to maintain the reserves of CBDC balance, where banks and NBFIs will interact with consumers to provide loans and deposits. In this case, defining the most suitable CBDC architecture that considers both existing electronic payment system (EPS) and blockchain design principles would be necessary.

4.3.4 Interest rate

The interest rate (0.9375) resulted in a positive coefficient sign, indicating its positive effect on the consumers' choice. Since the p-value of the mean interest is significant, the null hypothesis could be rejected, and the relation between interest rate and consumers' choice can be confirmed. Some previous works also mention the positive relationship between interest rates and CBDC adoption and its impact on the monetary condition. Carapella & Flemming (2020) explained that the central bank can respond to the economic condition more effectively by appropriately choosing the interest rate on CBDC.

Other work also mentioned that an interest rate on CBDC can also improve monetary policy's effectiveness by stimulating aggregate investment and consumption (Davoodalhosseini et al., 2020), where the flexibility of monetary policy also can be executed by the central banks since they can implement positive and negative interest rates responding to the economic condition (Wang & Hausken, 2022). Further exploration is also required to explore the impact of interest rates on technology diffusion, where financial products like M-Pesa can get millions of consumers without applying any interest rate and focusing on convenience services (King, 2012). In this case, exploring some scenarios of interest rates and their impact on the Indonesian economic condition would benefit the Central Bank of Indonesia in determining suitable policies and regulations related to CBDC.

4.3 Impact of CBDC to the payment ecosystem

The existence of CBDC will directly affect the current payment ecosystem since it has the potential to create a synergy of payment solutions by providing more innovative and advanced features, such as secure cross-border payments. A wider adoption of CBDC can improve financial inclusion, especially if the cooperation between all stakeholders, including consumers, central banks, and financial institutions, can be smoothly established (Foster et al., 2021). A previous study also revealed that the

introduction of CBDC will improve the financial stability (Keister & Monnet, 2022). In Table 8, the study examined the possible impact of CBDC on other electronic payment systems (EPS) from the perspective of registration, transfer and transactions, privacy and security, and circulation. Five EPS were assessed: electronic money, credit cards, bank transfers, digital banking, and cryptocurrencies, considering their popularity in the Indonesian market.

From the perspective of registration, the existence of CBDC will positively affect other EPS since the registration process of CBDC will be similar to other products. In the existence of CBDC, ISO/IEC 1179, related to metadata registry (MDR), can be implemented to maintain consumers' data, including creation, registration, and management. This international standard also explains how data circulation between different types of products: digital currency, CBDC, non-CBDC Token, and other accounts are managed (Jung & Jeong, 2021). Consumers' data from those who have been registering for one of the EPS or CBDCs can be utilized for other products so that the payment ecosystems can benefit from the existence of CBDCs.

Table 8. The impact of CBDC to other EPS

Products	Registration	Transfer and Transactions				Privacy and Security			Consumers' Benefit		Circulation	
		Transfer		Transactions		Costs	Storability	Reliability	Privacy Level	Convenience		Interest Rate
		Local	FX ⁴	Offline	Online							
Electronic Money	+	+	+	+	+	+	+	+	+	-	-	
Bank Transfer	+	+	+	-	+	+	+	+	+	+	-	-
Digital Banking	+	+	+	+	+	+	+	+	+	+	+	-
Credit Cards	+	-	-	-	-	-	+	+	+	+	-	+
Cryptocurrencies	+	+	+	+	+	+	+	+	+	+	+	-

Notes:

- The (+) and (-) mean that the existence of CBDC is predicted to have a significant and a not significant impact to the EPS, respectively.

⁴ FX: Foreign Exchange

To optimize consumer acquisition, The Central Bank of Indonesia can adopt the approach implemented by The People's Bank of China (POBC), which integrates the CBDC services called e-CNY to other electronic money providers such as WeChat, JD.com, and Didi Taxi. In addition, the POBC also did the pilot test during the Winter Olympics, with some features such as payment, withdrawals, and transfers tested using e-CNY's mobile application (Allen et al., 2022). In this case, integrating CBDC with some market leaders in the electronic money business, such as Gopay, Dana, OVO, and Shopee Pay, which have a significant market share (Statista, 2022), can optimize the CBDC's adoption. These strategies align with the result of this study since electronic money can improve the consumer's utility, and they are also willing to spend some money to use this feature.

From the perspective of transfer and transactions, the existence of CBDC can be analysed using two major transaction types: transfer (local and foreign exchange) and transactions (offline and online). The existence of CBDC can benefit both local and foreign exchange since its transferability can be applied to these two types of transfer. In the case of local transfer to bank accounts and electronic money, the implementation of CBDC would be smooth because it has been implemented previously.

One of the critical challenges is executing the cross-border payment between CBDCs issued by different central banks worldwide. Some challenges are different opening hours, varying communications standards, multiple intermediaries, high costs of compliance across borders, and limited transparency on the status of payments. The central banks should cooperate to handle these challenges, including the design, technical infrastructure standards, and information-sharing rules (Auer et al., 2021).

To ensure the transferability of CBDC can be executed smoothly, The Central Bank of Indonesia can start cooperation with other central banks in the Southeast Asian (SEA) region

first before expanding to other countries. Currently, some of the central banks in the SEA region have been establishing bilateral agreements for Quick Response (QR) payment, such as the cooperation of payment linkage between Bank Negara Malaysia (BNM) with Bank of Thailand in 2021 and Bank Indonesia with Bank of Thailand in 2022 (Boston Consulting Group & ASEAN Business Advisory Council, 2023). Leveraging the interoperability cooperation of Quick Response (QR) between Indonesia and other SEA countries in exploring the CBDC agreement will benefit and improve cross-border transactions' efficiency.

Another feature that CBDC can provide is offline payment, which can be executed without a network connection and established without the existence of a third party as an arbitrator. According to this definition, some payment products, such as near-field communication (NFC), quick response (QR) codes, and Bluetooth, can fulfil the requirement of offline transactions. The implementation of offline transactions in CBDC can be done through the offline payment system (OPS) protocol using encryption technology based on a trusted execution environment (TEE) (Chu et al., 2022).

CBDC's features in executing offline transactions could benefit the EPS integrated with QR code, which was implemented as Quick Response Indonesian Standard (QRIS) in the Indonesian market. Currently, two EPS have been integrated into QRIS: electronic money and digital banking, where these products provide payment, transfer, and deposit utilizing QRIS. Cryptocurrency can also benefit from the capability of CBDC's offline transactions, with further consideration of policies and regulations.

On the other hand, the online transactions of CBDC can give a benefit for electronic money, bank transfers, digital banking, and cryptocurrencies. Leveraging CBDC in online transactions can overcome settlement problems of current EPS (Rochet & Tirole, 1996), which frequently

happen in the Indonesian market. In addition, the cost of transactions can also be reduced by the existence of CBDC since the transaction verification can be automated.

Another significant aspect that CBDC can consider is privacy and security, such as storability, reliability, and privacy level. Storability is the CBDC's capability to store the transaction history in electronic data stored in an organization or user's electronic device (Han et al., 2019). This capability can positively impact all EPS since it provides more secure data protection than any other EPS. In addition, the data captured by CBDC can also be utilized for another purpose, such as providing “point-to-point” credit support and determining a proper interest rate (Yang & Zhou, 2022).

The reliability of CBDC can be defined as its constant availability to provide transactions all the time without exception (Dupuis et al., 2021). The latest transfer system developed by The Central Bank of Indonesia is Bank Indonesia Fast Payment (BI-FAST), which provides secure, efficient, and 24/7 operation. However, the cost charged to the consumers is 2,500 rupiah (\$0.15) per transaction, which can be reduced with the existence of CBDC. In this case, the existence of CBDC can overcome the limitation of current EPS by becoming a substitute product when other products are unavailable due to technical problems. It can also provide consumers with affordable transactions.

The last aspect that is considered essential in privacy and security is the flexibility of managing privacy levels, where CBDC can provide flexible adjustments. An example is the implementation of managed anonymity that POBC has implemented in e-CNY, where the central bank allows anonymity for small transactions. However, they can access the consumer's and transaction data in certain situations to prevent illegal transactions (Ren et al., 2023). The Central Bank of Indonesia can benefit from implementing CBDC by utilizing its storability,

reliability, and flexible privacy levels to provide consumers with more advanced payment and transaction features.

The introduction of CBDC, if appropriately designed, can significantly enhance consumers' utility. With more advanced features, consumers perceive CBDC as a better proportion of current and savings accounts offered by traditional banks. The perception is affected by the respondents' knowledge of CBDC, price incentives, and privacy and security (Bijlsma et al., 2021). Another study also revealed that the design of CBDC, which includes ease of access, would be an essential factor that affects the number of potential consumers (Keister & Monnet, 2022). This study also confirmed this statement, where features such as mobile application registration, avoiding complete anonymity, transferability to electronic money and bank accounts, and the availability of interest rates can improve the consumers' utility.

Another aspect that needs to be considered is the role of the Central Bank of Indonesia in promoting the CBDC by providing potential financial benefits, such as interest rates, special discounts, and promotional programs that can further incentivize consumers to use CBDC in cooperation with other financial institutions. In terms of benefits for bank and non-bank financial institutions (NBFI), the capability of data sharing will also determine the improvement in their utility since the success of CBDC could be determined by this capability (European Central Bank., 2022).

Lastly, from the perspective of current EPS circulation, the existence of CBDC can change the structure of money demand (Yang & Zhou, 2022), which can possibly decrease the transactions of electronic money, bank transfers, digital banking, and cryptocurrencies. This can happen because of the similar features that CBDC can provide to consumers. In this case, the central bank should consider some essential factors that can support the diffusion of CBDC,

which are perceived ease of use, cost, security of the payment method, transaction costs, and merchant acceptance (Huynh, 2020).

One of the strategies that The Central Bank of Indonesia can apply is integrating CBDC features into the current EPS, such as digital banking and electronic money. An example is integrating electronic money for registration channels as implemented in e-CNY. However, credit card circulation is predicted to remain the same because of the different characteristics of products, and the CBDC can become a complementary product for improving the credit score for credit card applications.

5. Conclusion

In this study, four main attributes- accessibility, privacy, transferability, and interest rate- were used to explore the factors that can affect the potential adoption of CBDC in Indonesia's market. The results give us some related insights on optimizing the potential adoption, such as utilizing mobile banking to acquire a wider audience. Currently, Indonesian people, especially those living in big cities, are familiar with using mobile applications to maintain their financial activities so that mobile application would be a suitable channel for these consumers. Consumer acquisition through branches can be an option to reach the people who live in rural areas. However, the central bank still needs to explore the effectiveness and efficiency of agents and websites in the CBDC registration process.

From a privacy perspective, consumers are aware of the negative impact of complete anonymity on CBDC implementation, as represented by the negative estimation results. In this attribute, selective disclosure related to their transactions is the preferred option, resulting in positive utility. However, since the p-value of selective disclosure is insignificant, further exploration is required to formulate the most appropriate security level. Through this result, the

central bank should avoid implementing complete anonymity that negatively affects the consumer's potential adoption.

For the transferability attribute, the capability of transferring CBDC balance to bank accounts and electronic money results in a positive utility for consumers. Since the p-values of these two attribute levels are also significant, their impact on the consumer's choice can be confirmed. On the other hand, the result confirms the negative effect of foreign currencies and cryptocurrencies on the consumers' utility with significant p-values. It means that these two attribute levels are less attractive to consumers. So, the central bank can develop these two transferability features after the CBDC balance can be transferred to the bank account and electronic money.

The last attribute is interest rate, which is of positive utility to consumers. Since the p-value of the mean interest is significant, the null hypothesis could be rejected, and the relation between interest rate and consumers' choice can be confirmed. From the willingness to pay (WTP) perspective, the interest rate results in the most significant value compared to other WTPs with significant p-values. This means consumers are willing to pay for the CBDC service if there is a financial benefit, such as the interest rate applied to the platform. According to the results, the central bank should consider the interest rate as an essential attribute in optimizing the potential adoption of CBDC in the Indonesian market.

Other than analysing four essential attributes, this study also assessed the impact of CBDC existence on five Electronic Payment Systems (EPS): electronic money, bank transfer, digital banking, credit cards, and cryptocurrencies are examined from five aspects, which is consumers' registration, transfer and transactions, privacy and security, consumers' benefit, and circulation. This assessment determined the practical strategy that The Central Bank of

Indonesia can implement to optimize the CBDC diffusion based on the results of this study and previous studies.

Overall, the existence of CBDC positively affects other EPS consumers' registration, adding more reliable and affordable payment options for local and foreign transfers, providing the most complete online and offline transactions, and giving more secure and flexible privacy and security features. Related to the consumers' benefit, the CBDC can improve it if appropriately designed. Finally, the existence of CBDC can decrease other EPS circulation due to similar features. The Central Bank of Indonesia can develop some strategies to create policies and regulations mainly related to system integration and security standards, promoting CBDC through financial benefits such as interest rates, discounts, special programs, and international cooperation to establish cross-border transactions.

This study contributes to defining the essential attributes in developing CBDC, especially in the case of the Indonesian market, where only a few studies discuss it using quantitative methodologies like the mixed logit model. From the results of this study, some essential insights were revealed: mobile banking can increase the potential adoption of CBDC because it positively affects the consumers' utility, complete anonymity should be avoided in the implementation of CBDC because it cannot comply with the anti-money laundering (AML), countering the financing of terrorism (CFT) and know your customer (KYC) regulations, more exploration about the transferability features of CBDC to bank accounts and electronic money would be necessary to cover consumers' needs, and the implementation of competitive financial benefits can trigger wider adoption of CBDC. The study also determined the strategy that The Central Bank of Indonesia can implement to optimize the adoption of CBDC.

Some limitations can be found in this study that offers the opportunity for additional research: First, due to the small number of respondents, the result of this research can cause a

bias that affects the accuracy of policies and regulations implications. Leveraging the number of respondents involved in the study will strengthen the existing results and implications. In addition, the online survey can cause misunderstandings about attribute definitions and how to fill out the survey, so considering a face-to-face survey can ensure that all the respondents understand the content. Second, evaluating the four attributes and considering other essential attributes mentioned in this study will give new insights to help design CBDC. Lastly, the implications of the policies and regulations are derived according to the mixed logit model, so exploring the results using other methodologies might help produce implications that can improve the CBDC diffusion in Indonesia's market.

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