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Digital Money: Opportunities, Challenges and the Future Outlook

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Abstract

Purpose: This study explores the opportunities, challenges, and the future outlook of emerging digital currencies in the like of central bank digital currencies (CBDCs), cryptocurrencies, and stablecoins. The aim is to understand how these digital monetary forms are shaping the global digital currency ecosystem.

Methodology: A systematic literature review of 281 studies on digital currencies, published between 2010 and 2024, was conducted. The review focused on identifying key themes such as the regulatory landscape for cryptocurrencies, privacy and anonymity concerns, and technological risks associated with digital currencies.

Findings: The review unraveled several dominant themes, including increasing efforts by regulatory authorities to develop comprehensive frameworks to provide legal clarity, enhance consumer protection, and foster innovation in the digital finance sector. However, a significant gap was identified in the integration of regulatory frameworks with Behavioral Economic principles. To address this, the study proposes an integrated regulatory-behavioral framework to influence user behaviour and promote the secure and stable adoption of digital currencies.

Unique Contribution to Theory, Policy and Practice: The proposed regulatory-behavioral framework offers an innovative approach to digital currency regulation by integrating insights from Behavioral Economics. This contribution highlights the need for collaborative efforts among policymakers to ensure regulations evolve in tandem with advancements in digital financial technologies. The study envisions a future where CBDCs, cryptocurrencies, and stable coins coexist, with CBDCs playing a central role in establishing a stable, accessible, and efficient digital monetary system.

JEL Classification Codes: E42, G20, O16

Keywords: *Cryptocurrency, Central Bank Digital Currencies, Stable Coins, Digital Monetary Systems, Behavioral Economics*

1. Introduction

This study explores the opportunities, challenges and the future outlook of emerging digital currencies or digital money. The study specifically focuses on central bank digital currencies (CBDCs)[1], stablecoins and cryptocurrencies. The shift away from cash, once the dominant currency, reflects a rapidly evolving global financial environment (Prasad, 2021; Carstens, 2021). The shift away from cash is both a result and a consequence of significant changes in the global financial sector, poised to disrupt the global financial landscape and impact households, businesses, investors, banks, and governments. Recent years have seen remarkable changes in how individuals in both developed nations and developing economies conduct transactions, largely due to the rise of smartphones. In the early 2000s, advanced economies witnessed substantial advancements in financial markets that were expected to enhance safety and efficiency. However, the dysfunction within both domestic and international capital and financial markets ultimately led to the global financial crisis of 2008. This was followed by the eurozone debt crisis a few years later. The onset of the COVID-19 pandemic in 2020 severely impacted global economies and placed immense pressure on financial systems. This period also witnessed the emergence of innovative products designed to enhance the functionality of financial markets. In the aftermath of the COVID-19 pandemic, it appears that the evolution of the financial landscape is increasingly driven by new financial technologies and digital monetary forms (Prasad, 2021; Agrrawal & Waggle, 2024). These digital monetary forms present novel avenues for enhancing financial inclusion, streamlining payment processes, and promoting technological advancement. Nonetheless, their adoption introduces a range of challenges, including regulatory ambiguities, potential financial instability, and various cyber vulnerabilities (International Monetary Fund, IMF, 2021).

Recent developments in financial technology, particularly cryptocurrencies like Bitcoin, are enhancing accessibility, speeding up transaction processing, and reducing costs in the financial landscape. Both national and global payment systems are poised for significant transformation, promising greater efficiency. However, these advancements may come with trade-offs. Decentralized digital payment frameworks can improve efficiency and stability, provided market power is not concentrated among a few players. Conversely, declining trust in private payment systems during financial downturns could harm businesses and consumers, increasing counterparty risk and potentially triggering widespread failures. Traditional financial institutions, especially commercial banks, may struggle as new technologies enable online platforms to connect savers and borrowers, potentially diminishing their ability to generate excessive profits (economic rents) in areas like loan distribution and international payments. While some quarters may welcome the decline of commercial banks, it is worth noting that the decline of these financial institutions poses its own set of risks, considering their

[1] Despite the cautious stance, Central Banks across the world are exploring the idea of adopting their own digital currencies called central bank digital currencies (CBDCs) as block chain-based versions of existing reserve currencies. The CBDCs are not initiated as third-party stablecoins such as tether (USDT), Frax (FRAX) or Dai (DAI). CBDCs are envisioned as eventual replacements of national reserve money systems that will allow businesses and households to make direct electronic payments. For details, see Table 1 for the survey results of CBDC adoption by Central Banks as of 2024.

crucial roles in contemporary economies, particularly in the realm of credit creation (Bullmann et al., 2019; Prasad, 2021).

Table 1 reports the survey of CBDC adoption by central Banks worldwide. The key drivers behind CBDC adoption are financial inclusion, reducing reliance on cash, and enhancing monetary policy tools (Mancini-Griffoli et al., 2018; IMF, 2021).

Table 1: CBDC Adoption by Central Banks Across the World, 2010-2024.

Region/Country	CBDC Name	Implementation Year	Details
The Bahamas	Sand Dollar	2020	The first country to fully launch a national digital currency.
China	Digital Yuan (e-CNY)	Pilot: 2020	Extensive pilot tests across major cities in China.
Eastern Caribbean Central Bank	DCash	2021	Digital currency initiative involving multiple member states in the Eastern Caribbean.
Nigeria	eNaira	2021	Launched to drive financial inclusion in Nigeria.
European Central Bank (ECB)	Digital Euro	Research: 2021, Pilot: 2023	Focused on privacy, safety, and innovation in digital payments.
Bank of England	Digital Pound (Bitcoin)	Research: 2020	Exploring the integration of a digital pound into the UK financial system.
Sweden	e-Krona	Pilot: 2020	The trial aimed at ensuring inclusion and efficiency in a cashless society.
Canada	Digital Canadian Dollar	Research: 2021	Studying risks and benefits of CBDC implementation.
India	Digital Rupee	Expected: 2024	Modernizing payments and enhancing transparency in transactions.
Brazil	Digital Real	Expected: 2024	Research and testing for financial modernization and inclusion.
United States	Digital Dollar	Research: Ongoing	Exploring a secure, efficient, and inclusive digital dollar.
Japan	Digital Yen	Pilot: 2021	Potential domestic payment enhancement through digital yen.

Source: Authors' elaboration from Various Sources[2]

The systematic literature review on digital currency-related literature unraveled some key themes, including, among others, the regulatory landscape for cryptocurrencies, privacy and anonymity in digital currencies, technological risks in digital currencies, the future of cryptocurrencies and CBDCs, and adoption and user behaviour in CBDCs and cryptocurrencies. It is important to mention that among the key themes related to digital currency, there seems to be a significant gap in the existing discourse regarding the integration of regulatory frameworks for digital money with the principles of Behavioral Economics. Behavioral Economics, which examines the psychological factors influencing individuals' economic decisions, offers valuable insights into how people interact with money, make financial choices, and respond to incentives. However, the current regulatory frameworks governing digital currencies[3] often fail to take these insights into account. This disconnect can lead to regulations that do not effectively address the unique behaviours and motivations of users in the digital currency ecosystem. For instance, traditional regulatory approaches may not fully consider how cognitive biases, such as overconfidence or loss aversion, can impact users' engagement with digital money. Without a framework that incorporates these behavioural insights, regulations may inadvertently stifle innovation or fail to adequately protect consumers. A framework that aligns regulatory measures with the principles of Behavioral economics could facilitate a better understanding of user behaviour, leading to more effective policies that promote responsible usage while fostering innovation in the digital currency sector. This study, which proposes an integrated regulatory and behavioural economics framework, is therefore necessary to fill the gap. It is envisioned that the integrated framework could enhance consumer protection, encourage responsible financial behaviour, and ultimately contribute to the sustainable growth of the digital currency ecosystem.

2. Literature Review

2.1 Theoretical Underpinnings

This section outlines pertinent theories that underpin the emerging digital money or digital currency.

2.1.1 Hayek's Monetary Theory of Competitive Currencies

Friedrich Hayek's advocacy for competitive currencies, articulated in 1976, stems from his thorough critique of state control over monetary systems and his belief in the effectiveness of free markets. He argued that government monopolies on currency issuance often led to inflation, economic instability, and inadequate monetary management. To mitigate these problems, Hayek (1976) proposed that private entities should be allowed to issue their own currencies, fostering competition for public acceptance. He asserted that government

[2] The sources are Bank of Canada (2021), Central Bank of Nigeria (2021), Bank of England (2021), Bank for International Settlements (2020), Central Bank of The Bahamas (2020), Central Bank of Brazil (2024), European Central Bank (2021), Federal Reserve (2022), People's Bank of China (2020), Reserve Bank of India. (2024) and Sveriges Riksbank (2020).

[3] In this study, the term 'digital currencies' is used interchangeably with digital money.

monopolies tend to generate inflation, as political motivations may overshadow the need for long-term monetary stability. In contrast, private currency issues, motivated by profit motive, would encourage the private sector to create stable currencies to remain competitive. Hayek (1976) also opposed legal tender laws that require the acceptance of a single government-issued currency, claiming that their removal would enhance competition and innovation within the monetary system. Critics caution that competitive issuance of currencies might result in disorder, marked by fluctuating exchange rates and increased transaction costs. However, proponents regard Hayek (1976) theories as foundational to modern developments such as digital money. Hayek's (1976) support for competitive currencies is intrinsically linked to his belief in the ability of free markets to promote stability and his scepticism towards government intervention, aligning with his broader economic and philosophical principles.

Hayek's (1976) testable theory can be reduced to predictions about features of trading institutions that increase the likelihood of the occurrence of efficient trades. This study follows the model in Friedman & Ostroy (1995), which is simple but can be applied to general equilibrium principles. The model assumes that there are two goods: money and a traded good. Preferences are such that each individual's demand curve for the traded good (in this case, digital currencies) is a step function.

Let $I = B \cup S$ be the set of players, the players representing the buyers and sellers of digital money. For each $i \in I$, the preferences can be described by two k-vectors, $(r_1^i, \dots, r_k^i)$ and $(q_1^i, \dots, q_k^i)$. The two vectors are reservation values and quantities respectively. For each buyer, $i \in B$, reservation values decrease with the quantity and for each seller,$i \in S$ the reservation values increase with the quantity.

For a player i with parameters (r_j^i) and (q_j^i), denote the number/quantity of trades by $Y^i \in (q_{j-1}^i, q_j^i)$ for some $1 \leq j \leq k$. Normalizing the utility for zero trade to be zero, implying that $v^i(0) = 0$. Normalizing $q_0^i = 0$, then the total utility of y^i can be expressed as:

$$v^i(y^i) = \sum_{i=1}^{j-1} r_1^i \left(q_1^i - q_{1-1}^i\right) + r_j^i\left(y^i - q_{j-1}^i\right) \quad (1)$$

The total payoff to each market player is the utility received from the traded good (in this case, digital money), $v^i(y^i)$ less the money paid or plus the money received.

Let $V^{i^{2k}}$ be the set of all utility functions with the utmost 2k parameters. It follows that an economy, v, can be defined as:

$$v \in V^{2k} = X_i V^{i^{2k}} \quad (2)$$

A Walrasian (competitive) equilibrium for $v \in V^k$ comprises a price p and quantities traded (y^i), such that:

i) Economic agents maximize utility for each i, $v^i(y^i) - py^i \geq v^i(x^i) - px^i$

Where $0 \leq x^i \leq q_k^i$ if $i \in B$ and $0 \geq x^i \geq q_k^i$ if $i \in S$ and

ii) Markets clear: $\sum y^i = 0$ (3)

The set of prices is denoted as p and the set of allocations (y^i) that form part of the Walrasian equilibrium by $P(v)$ and $Y(v)$ respectively. Assuming the quasi-linear preferences, it is well known that the set of pairs of prices and allocations that make a Walrasian equilibrium for an economy, v, is $P(v)$ x $Y(v)$.

2.1.2 Modern Portfolio Theory

Modern Portfolio Theory (MPT), formulated by Harry Markowitz in 1952, constitutes a foundational paradigm in finance for constructing investment portfolios that seek to optimize expected returns while effectively managing risk. A key tenet of MPT is the concept of diversification, which, along with risk management and the strategic allocation of assets, facilitates the creation of efficient portfolios. The incorporation of digital assets into investment strategies has the potential to reshape the efficient frontier. Markowitz's (1952) theory, applied to emerging digital currencies under consideration, entails employing the mean-variance framework as described by Huni and Sibindi (2020). Portfolio optimization is crucial in finance, aiming to maximize returns while managing risk through the diversification of financial instruments. This includes various assets, such as stocks and digital currencies, which are evaluated for potential returns. With technological advancements and changing investor sentiments, it's important to assess the relevance of MPT and mean-variance optimization (MVO) for these new digital assets. MPT asserts that increasing the number of assets in a portfolio reduces overall risk, provided the assets respond differently to market events, a concept known as "correlation." Effective diversification can be achieved by selecting uncorrelated assets, allowing investors to maximize returns while minimizing variance, as indicated by the law of large numbers. Ultimately, this principle supports the existence of a portfolio that optimizes returns with minimal risk. Its computation comprises finding the weighted average return of assets included in a portfolio by multiplying individual assets by their respective weights:

$$E(r_p) = \sum_{i=1}^{n} w_i E(r_i) \qquad (4)$$

Where $E(r_p)$ is the expected (or mean) portfolio return, n is the number of assets, w_i is the proportion of the funds invested in the asset, r_i, r_p refers to the ith asset and portfolio, p. The portfolio variance (risk) is a measure of how returns of a set of assets constituting a portfolio fluctuate and deviate from the expected rate of return. In other words, it is the chance of unfavourable events happening. Standard deviations and correlations of each individual security in a portfolio are typically used to calculate the portfolio variance. Portfolio variance can be expressed as:

$$\sigma_\rho^2 = (w_A\sigma_\rho)^2 + (w_B\sigma_B)^2 + (w_3\sigma_3)^2 + 2(w_A w_B \rho_{AB}\sigma_A\sigma_B) + 2w_A w_C \rho_{AC}\sigma_A\sigma_c + 2w_B w_C \rho_{BC}\sigma_B\sigma_c$$

(5)

Where; $\rho_{AB}, \rho_{AC}, \rho_{BC}$ denote the correlation coefficient between the return on assets AB, AC and AC; $\rho_A \rho_B \rho_C$ refers to the standard deviations of returns of assets, A, B and C; and ; $W_A W_B W_C$ refers to the weight of each asset. Using computing power technology, the magnitude of all feasible portfolios can be derived by a critical line, as depicted in Figure 1.

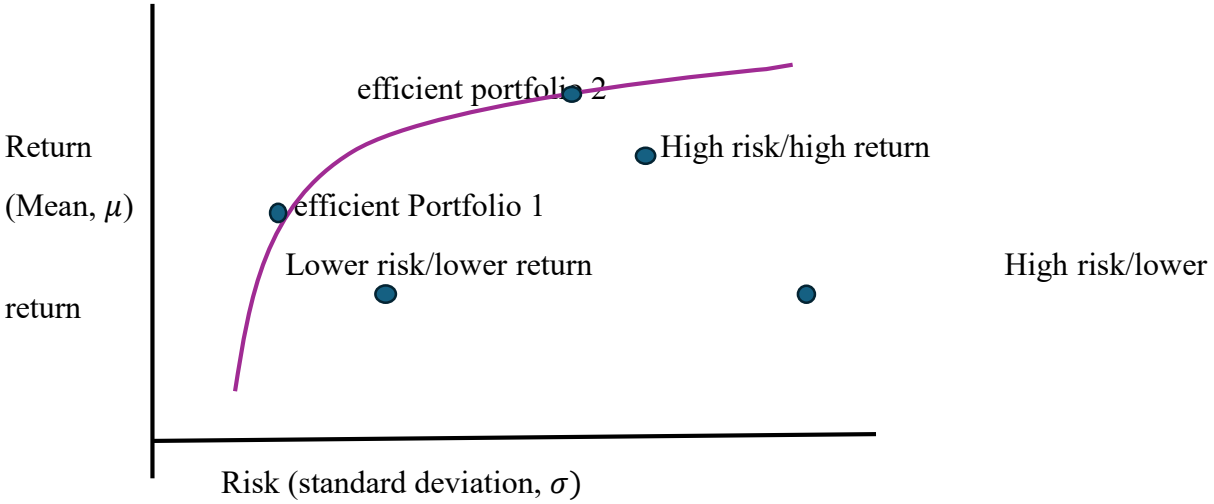

Figure 1: Graphical depiction of Mean-Variance Optimization Framework

Adapted from Huni and Sibindi (2020)

2.2 Review of Related Literature

While there are a variety of views regarding cryptocurrencies as investments and as potential global mediums of exchange (See, for example, Huni and Sibindi, 2020) some economists consider them to be the future of money, while others consider them to be a short-term investment bubble or inherently unable to eventually meet the world's money supply (See, for example, Agrrawal and Waggle, 2024; Xiang et al., 2024)

Andolfatto (2021) explored the effects of a Central Bank Digital Currency (CBDC) in a monopolistic banking environment. Using theoretical models, the study analyzed the interaction between CBDC and traditional banking, focusing on deposit competition and financial intermediation. Findings indicate that a well-designed CBDC can enhance lending rather than disrupt it, promote financial inclusion, and increase competition, potentially raising deposit rates while reducing monopolistic banks' profits. The research suggests that CBDC may broaden the deposit base and does not pose significant risks to financial stability, challenging common concerns about banking disruptions. The author calls for future empirical studies and regulatory framework assessments to address banking sector stability risks, noting that the reliance on theoretical models limits the exploration of long-term CBDC effects in various economic contexts, especially in smaller developing markets.

Auer, Cornelli and Frost (2021) examined the motivations behind central banks' interest in digital currencies (CBDCs), their development status, and associated technical designs. It highlights the varied drivers and approaches to CBDC development globally, emphasizing how

digitized and innovative economies lead the effort. Researchers analysed over 16,000 central bank speeches and reports to assess motivations, technical designs, and policy stances. The paper provides insights into three CBDC initiatives—China's DC/EP, Sweden's e-krona, and Canada's contingency plan—and outlines current design frameworks and technological choices. Findings indicate that CBDC projects are driven by the need for financial inclusion, payment efficiency, and countering private cryptocurrencies. The study identified several open questions, including the macroeconomic impact of CBDCs on bank lending and financial intermediation, effective strategies for cross-border CBDC integration and addressing privacy concerns while ensuring regulatory compliance. The authors suggest a cautious and collaborative approach to CBDC adoption. They recommend further research on the economic implications of CBDCs and international cooperation to harmonize standards for cross-border interoperability.

Brunnermeier and Niepelt (2019) investigated the conditions under which private and public money can be considered equivalent in terms of their macroeconomic effects. Using a theoretical framework, the authors analyze monetary swaps (e.g., between CBDCs and bank deposits) and propose sufficient conditions for equivalence in equilibrium allocations and price systems. The study employs general equilibrium theory to assess the neutrality of public and private liquidity under symmetric costs of liquidity creation. Findings in this study show that if central banks adopt pass-through policies (e.g., redistributing funds to banks during depositor shifts), CBDCs can coexist with private deposits without undermining financial stability. The study recommends that policymakers should implement pass-through mechanisms to mitigate risks during transitions to CBDCs adoption. In terms of gaps, given the assumption of the model symmetric social costs of liquidity creation for public and private monies, this assumption may not fully capture real-world scenarios, especially for unregulated or resource-intensive systems like digital money.

Carstens (2021) explores the increasing importance of CBDCs in shaping the global financial landscape, highlighting their potential to improve payment systems, enhance financial inclusion, and maintain monetary stability amid the rise of stable coins and decentralized finance. The study combined conceptual analysis with policy recommendations, examining real-world CBDC initiatives like China's e-CNY and the European digital euro to illustrate various strategies and challenges. Key issues addressed include privacy, consumer protection, and cross-border payment interoperability. The findings identify motivations for CBDC development, such as preserving monetary sovereignty and countering private digital currencies. Carstens (2021) argues that CBDCs could complement commercial banks by providing a secure digital asset and improving financial access. Despite advocating for CBDC adoption, the Carstens (2021) acknowledges ongoing uncertainties regarding their design and impact on traditional banking systems.

The Financial Stability Board (FSB) 2020 report outlines a regulatory framework for global stable coins (GSCs), which could significantly impact the global financial system. Designed to maintain a stable value linked to various assets, including fiat currencies, GSCs require uniform international regulations to mitigate risks to financial stability as they expand

across jurisdictions. The report, based on consultations with regulatory authorities and financial institutions, recommends that GSCs follow the principle of "same business, same risk, same rules," ensuring they meet regulatory standards similar to other financial instruments. Key findings suggest that widespread adoption of GSCs could affect payment system stability and monetary policy. It also notes that current regulatory frameworks are insufficient to address challenges related to cross-border payments and digital asset oversight. Enhanced international cooperation and consistent regulatory practices are essential to prevent regulatory arbitrage and strengthen global financial stability.

The International Monetary Fund, IMF (2021) report on digital money highlights the increasing adoption of digital currencies, both public (such as CBDCs) and private (like stablecoins and cryptocurrencies). It explores their implications on global and domestic monetary systems, financial stability, and economic inclusion. The IMF (2021) acknowledges that while digital money offers significant benefits, such as enhanced financial inclusion, lower transaction costs, and easier cross-border payments, it also presents challenges related to regulatory frameworks, privacy, competition, and security risks. Additionally, the IMF (2021) concedes that there are concerns that remain to be resolved about currency substitution, especially in countries with high inflation, which could undermine national monetary policies.

Xiang et al (2024) investigated the impact of Central Bank Digital Currency (CBDC) on macroeconomic fluctuations under various external shocks, expanding the research on the macroeconomic effects of CBDC issuance. This paper explores the influence of introducing a CBDC on macroeconomic stability by assessing the efficacy of three scenarios: the absence of a CBDC, an interest-bearing CBDC, and a non-interest-bearing CBDC, in managing fluctuations caused by external shocks in an environment without traditional monetary policies. The findings reveal that, compared to the scenarios of no CBDC issuance or a non-interest-bearing CBDC, the interest-bearing CBDC more effectively mitigates macroeconomic volatility stemming from external shocks. This underscores the potential of interest-bearing CBDC as crucial monetary policy instruments for stabilizing macroeconomic disturbances.

Agrrawal and Waggle (2024) explored the integration of Digital Assets (DAs), especially cryptocurrencies, into traditional multi-asset class (MAC) portfolios, creating a DA-MAC framework. Their research uses established portfolio construction methods to address market efficiency and price discovery issues. By applying Modern Portfolio Theory (MPT) metrics, they find that well-structured DA-MAC portfolios can offer significant diversification and improved returns compared to traditional portfolios of equities, bonds, commodities, and real estate. However, due to the high volatility of digital assets, they recommend limiting their allocation and adoption. The authors also discussed the growing role of CBDCs suggesting that CBDCs could lead to increased regulation in the digital money ecosystem and drive innovation in blockchain technology. Agrrawal and Waggle (2024) contend that while CBDCs may offer more stability than cryptocurrencies, they could also compete in remittances and international payments, potentially reducing privacy but allowing integration into Decentralized Finance (DeFi) protocols.

3. Methodology

The study uses a systematic literature review (SLR) methodology as described by De Freitas Netto et al (2020), allowing researchers to position their work within existing knowledge. This approach ensures the thorough identification of relevant studies and reduces bias and subjectivity in literature selection and evaluation (Higgins et al., 2021). The review followed the PRISMA guidelines (Page et al., 2021) and explored digital currency globally using a Boolean Proximity search to identify related terms such as "digital currency," "cryptocurrencies," "central bank digital currency or money", and "stablecoins." A mapping approach with VOS viewer software was used to create bibliometric networks based on citation metrics (Moya-Clemente et al., 2021). The research examined databases like Web of Science, Scopus, Google Scholar, Central Bank websites, Bank of International Financial Settlement (BIS), the International Monetary Fund (IMF), the Financial Stability Board (FSB) and the World Bank (WB) publication from 2010 to 2024. The search and analysis occurred between February and November 2024.

The search yielded a total of 307 articles. Specifically, 65 articles were identified from the Web of Science (WOS), 24 from SCOPUS, and Google Scholar emerged as the leading source with 111 peer-reviewed articles related to digital currencies. Additionally, central banks from around the world contributed 38 papers on the subject within the 14-year timeframe from 2010 to 2024. The search also revealed 22 publications from the BIS, 13 from FSB, 16 from IMF and 7 from the World Bank Publications. During the screening phase, it was noted that 11 publications were duplicates found across various academic databases, while 6 articles were found to be abridged, and 9 articles addressed the digital economy and its impact on economic growth. Consequently, the total number of excluded articles, which included duplicates, abridged works, and those focused on the general digital economy and economic growth-related themes, amounted to 26. This resulted in a final sample of 296. Figure 2 shows the flow chart of the article or publication identification and selection processes.

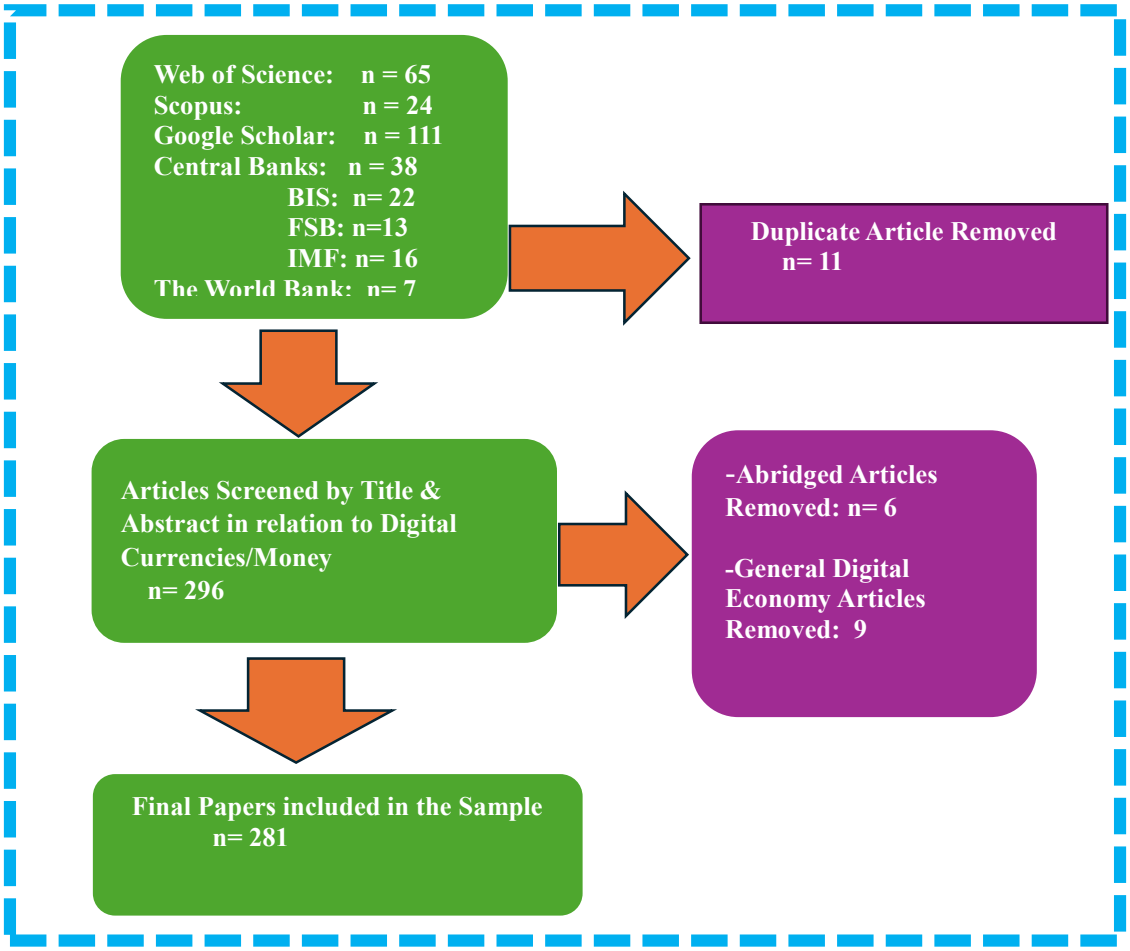

Figure 2: PRISMA 2021 Flow Diagram:

Article Identification and Selection Processes

*Notes: **BIS** denotes the Bank of International Settlement, **FSB** denotes the Financial Stability Board, and **IMF** denotes the International Monetary Fund.*

4. Findings and Discussions

4.1 Cost-Benefit Analysis of various Forms of Digital Money

The emergence of Central Bank Digital Currencies (CBDCs), cryptocurrencies, and stablecoins signifies a revolutionary transformation within the global financial landscape. These digital monetary forms present novel prospects for enhancing financial inclusion, boosting payment efficiency, and promoting innovation. Nevertheless, their widespread adoption introduces challenges, including regulatory ambiguity, potential financial instability, and various technological risks. Conducting a thorough cost-benefit analysis is essential to grasp the ramifications of these digital assets for the future landscape of money.

4.1.1 Benefits

Financial Inclusion

Central Bank Digital Currencies (CBDCs) promote financial inclusion by providing direct access to central bank funds through digital wallets, particularly benefiting unbanked populations in developing regions (Auer & Böhme, 2021). They can reduce transaction costs and lower barriers to financial services, broadening access to the financial system (Carstens, 2021). Similarly, cryptocurrencies like Bitcoin and Ethereum enable individuals to engage with decentralized financial systems, facilitating payments and remittances at lower costs than traditional methods (Narula, 2018).

Increased Payment Efficiency

Digital currencies can improve payment system efficiency, especially for international transactions, by reducing delays, costs, and reliance on intermediaries. Central Bank Digital Currencies (CBDCs), along with cryptocurrencies and stablecoins, can streamline operations and lower transaction costs (Auer et al., 2021). CBDCs may significantly speed up transaction settlements in real-time retail payments. Stablecoins, tied to stable assets like the U.S. dollar, offer price stability, making them suitable for everyday transactions and addressing concerns about value fluctuations (Bullmann et al., 2019).

Financial Innovation

Cryptocurrencies have initiated a significant transformation in the financial landscape, particularly through the emergence of decentralized finance (DeFi). DeFi platforms, which are constructed on blockchain technology, empower users to participate in various financial activities such as lending, borrowing, and trading without relying on conventional financial intermediaries (Gensler, 2021). This shift towards democratized financial services has the potential to reduce costs, enhance accessibility, and stimulate innovation within financial markets. Central Bank Digital Currencies (CBDCs), despite being more centrally governed, can also drive innovation by facilitating programmable money. The integration of smart contracts and automated transactions may become increasingly prevalent, leading to novel applications of currency that extend beyond the limitations of traditional cash (Arner et al., 2020).

4.1.2 Costs

Regulatory and Legal Challenges

One significant cost or downside linked to the rise of digital currencies is the regulatory ambiguity that envelops them. Cryptocurrencies, owing to their decentralized characteristics, frequently function beyond conventional regulatory structures, which heightens risks regarding unlawful activities such as money laundering and financing of terrorism (Gensler, 2021). It is imperative for governments and regulatory agencies to formulate explicit guidelines for the regulation of these assets; however, achieving a balance that encourages innovation while curbing illegal activities presents a formidable challenge. Although stablecoins provide a degree of stability, they have also sparked concerns regarding the adequacy of their reserve

backing. There have been cases where issuers of stablecoins did not offer sufficient transparency regarding the assets that support their tokens, raising doubts about their capacity to sustain stability during turbulent market conditions (Financial Stability Board, FSB, 2020). It is essential to develop a regulatory framework that guarantees transparency and accountability without hindering innovation**.**

Financial Stability Risks

The introduction and adoption of Central Bank Digital Currencies (CBDCs) and other digital currencies presents significant challenges to the conventional banking framework. A widespread implementation of CBDCs may result in disintermediation, wherein both individuals and enterprises redirect their financial resources from commercial banks to central bank digital wallets. This shift could compromise the capacity of commercial banks to generate credit, thereby posing a risk to the stability of the financial system (Brunnermeier & Niepelt, 2019). Furthermore, cryptocurrencies, particularly those characterized by high volatility such as Bitcoin, introduce additional threats to financial stability. The substantial fluctuations in cryptocurrency values can have repercussions on traditional financial markets, especially as institutional investors increase their involvement with these digital assets (Baur & Dimpfl, 2021). Although stable coins exhibit lower volatility, they are not exempt from financial stability risks if they lack adequate reserve backing, which could trigger market turmoil in the event of redemption failures.

Cybersecurity and Technological Risks

The inherent digital characteristics of Central Bank Digital Currencies (CBDCs), cryptocurrencies, and stable coins render them susceptible to cybersecurity threats. Incidents of hacking targeting cryptocurrency exchanges and decentralized platforms have led to considerable financial losses, thereby heightening concerns regarding the security of these digital assets (Bullmann et al., 2019). As national digital currencies, CBDCs must incorporate comprehensive cybersecurity measures to safeguard against fraud, hacking, and operational failures (Andolfatto, 2021). Furthermore, beyond the risks associated with hacking, technological malfunctions within digital currency systems could pose significant threats to the financial infrastructure. For example, failure within a CBDC system could erode public confidence in the currency and potentially trigger extensive economic turmoil. Table 2 summarizes the costs and benefits of CBDCs, Cryptocurrencies and Stablecoins

Table 2: Summary of Costs and Benefits of CBDCs, Cryptocurrencies and Stablecoins

Feature	CBDCs	Cryptocurrencies	Stablecoins
Benefits	Financial inclusion, reduced transaction costs, improved monetary policy	Decentralization, security, financial innovation	Stability, reduced volatility, potential for wider adoption
Costs	Privacy concerns, the potential for, disintermediation, financial stability risks	Volatility, energy consumption, regulatory challenges	Underlying asset risks, regulatory oversight, systemic risks

Source: Author's Elaboration

Table 3 summarizes some of the main themes gleaned from the systematic literature review. The themes include the regulatory landscape for cryptocurrencies, privacy and anonymity in digital currencies, technological risks in digital currencies, the future of cryptocurrencies and CBDCs, adoption and user behaviour in CBDCs and cryptocurrencies, among others.

Table 3: Main Themes Elucidated from the Literature Review

Theme	Brief Thematic Discussions	Representative Sources
Regulatory Challenges of CBDCs and Cryptocurrencies	- The regulatory landscape for cryptocurrencies and its influence on innovation. -How different countries are developing regulatory frameworks for CBDCs	Narula & Ritchie, 2022; Zohar, 2023
Privacy and Anonymity in Digital Currencies	-Differences in privacy features between CBDCs, Cryptocurrencies and stablecoins. - Cybersecurity threats and the risks of technological	Zohar, 2023

Technological Risks in Digital Currencies	-Cybersecurity threats and the risks of technological failures in CBDCs, stablecoins, and cryptocurrencies	Auer & Böhme, 2021
The Future of Cryptocurrencies and CBDCs	-Long-term forecasts and the potential for CBDCs to coexist with decentralized cryptocurrencies	Bech & Garratt, 2022; Pattison et al., 2023
Volatility and Risk in Cryptocurrencies	-The role of stable coins in reducing volatilities in the digital asset market	Auer & Böhme, 2021
Adoption and User Behavior in CBDCs and Cryptocurrencies	-Factors influencing public trust and willingness to use digital currencies	Narula & Ritchie, 2022
The Environmental Impact of Cryptocurrencies	-The carbon footprint of cryptocurrency mining and its environmental implications	Catalini & Gans, 2020
The Role of Digital Currencies in Investment Portfolios	-How institutional investors perceive and engage with cryptocurrencies	Pattison et al., 2023
Impact of Digital Currencies on Financial Inclusion	-How can CBDCs promote financial inclusion and provide access to banking services in underserved regions? -Case studies on the adoption of CBDCs in developing countries and their effects on the financial system	Bech & Garratt, 2022; Auer & Böhme, 2021

It is worth highlighting that, among the pervasive key themes of digital money or digital currencies brought to the fore through the literature review, there seems to be a gap in terms of the framework for integrating digital money regulatory frameworks and the principles of Behavioral Economics. This gap forms the basis for proposing the integrated regulatory-behavioural economics framework.

Digital Money and Regulatory Frameworks

Digital currency encompasses all varieties of electronic currencies that enable transactions within the digital realm, including cryptocurrencies and Central Bank Digital Currencies (CBDCs). The digital money regulatory frameworks aim to tackle several issues, such as:

i) *Security and Consumer Protection*: Safeguarding users against fraud, hacking, and cybercrime.

ii). *Market Integrity*: Promoting transparency and preventing market manipulation, including practices like pump-and-dump schemes in cryptocurrency markets.

iii). *Anti-Money Laundering (AML)* and Countering the Financing of Terrorism (CFT): Averting illegal activities.

iv). *Financial Stability*: Ensuring that digital currencies do not undermine the financial system or replace traditional monetary frameworks (Arner et al., 2020; Gensler, 2021; IMF, 2022)

The IMF (2022) asserts that the current regulatory frameworks, such as those established by the Financial Action Task Force (FATF), the Bank for International Settlements (BIS), and the International Monetary Fund (IMF), offer foundational guidelines but require modifications to keep pace with the swiftly evolving landscape of digital currencies (IMF, 2022). The modifications should include the integration of principles of behavioural economics.

The next section focuses on how behavioural economics principles can be integrated with the regulatory framework to augment the adoption of emerging digital money and mitigate the risks associated with the three types of digital money explored in this study.

Principles of Behavioural Economics

The integration of digital currencies, such as cryptocurrencies and central bank digital currencies, into the financial landscape presents numerous regulatory challenges, especially as these systems develop and impact economic activities. The transformative nature of digital money calls for the creation of robust regulatory frameworks designed to uphold stability, protect consumers, and ensure market integrity. At the same time, insights from behavioural economics can enhance our understanding of individual financial decision-making, informing the creation of regulatory measures. This approach supports a holistic strategy that aligns digital currency regulations with user behaviour, ensuring that regulations not only address risks of market manipulation and fraud but also align with human behaviour to foster financial inclusion and stability. Behavioral economics focuses on the effect of psychological, emotional, and social influences on decision-making processes, often resulting in departures from conventional rational economic models. The foundational concepts of behavioural economics encompass:

i). *Bounded Rationality*: Individuals operate with limited cognitive capabilities, frequently relying on heuristics instead of optimal decision-making strategies (Kahneman, 2011).

ii). *Loss Aversion*: Individuals exhibit a stronger aversion to losses compared to the pleasure derived from equivalent gains, which can significantly influence their financial choices, including those related to digital currencies (Kahneman & Tversky, 1979).

iii). *Framing Effect*: The presentation of information can shape decision-making, particularly in how risks associated with digital currencies are communicated (Tversky & Kahneman, 1981).

iv). *Nudging*: Minor modifications in the decision-making environment can promote choices that are more aligned with individuals' long-term objectives (Thaler & Sunstein, 2008).

These concepts can be leveraged to formulate regulatory frameworks that steer users towards more informed, secure, and beneficial interactions with digital currencies, such as encouraging the use of safer platforms or more prudent investment options.

The Integrated Regulatory and Behavioural Economics Framework

Integrating the principles of behavioural economics into the regulatory framework can significantly improve the efficacy of these regulations by considering the actual decision-making processes of individuals in digital financial contexts. Table 4 presents essential regulatory domains and integrates actionable behavioural insights from Behavioural Economics principles.

Table 3: **The Integrated Regulatory and Behavioural Economics Framework**

Domains	Regulatory Insight	Behavioural Insight	Example
Consumer Protection and Fraud Prevention	Digital currency platforms, including cryptocurrencies and CBDCs, expose users to fraud and cyber threats. A robust regulatory framework is essential to ensure these platforms protect user information and secure transactions. Regulations should require stringent security measures, such as two-factor authentication (2FA) and data encryption. (Arner et al., 2020).	**Nudging for Security** -Individuals often neglect optimal security practices despite knowing the risks, as shown by behavioural economics. Regulators can require platforms to automatically enable security measures like two-factor authentication (2FA) for all users, promoting safer behaviours without requiring extensive thought (Thaler & Sunstein, 2008). -Using reward-based structures can nudge individuals toward complying with regulatory requirements.	**Behavioral Nudging for Compliance** -Regulators might consider implementing default configurations for digital wallets or platforms that emphasize security measures, including two-factor authentication, as a means of safeguarding against fraudulent activities (Thaler & Sunstein, 2008). -For example, platforms could offer rewards for completing identity verification steps (Benartzi & Thaler, 2013).

Market Integrity and Consumer Education	Preserving integrity in digital currency markets is crucial to preventing manipulation, such as pump-and-dump schemes. Regulatory frameworks must promote transparency, ban deceptive advertising, and establish clear pricing mechanisms (Kahneman, 2011).	**Framing Effect** The presentation of information greatly impacts individuals' financial decision-making (Tversky & Kahneman, 1981). Regulations should require that all marketing communications be transparent, clear, and free from misleading or overly optimistic claims about digital asset profitability (encourages safe investments)	In 2020, the U.S. Securities and Exchange Commission (SEC) issued guidelines for crypto exchanges to ensure that they disclose risks clearly. Regulators can further ensure that educational materials about the risks of digital assets emphasize potential losses rather than just speculative gains, addressing overconfidence in crypto investments.
Promoting Financial Inclusion Through Design	Regulatory frameworks should focus on preventing digital currency from worsening financial exclusion (International Monetary Fund, IMF, 2022).	**Default Settings and Accessibility** Insights from behavioural economics indicate streamlined and user-friendly systems. Regulators can improve onboarding for those with limited digital literacy by simplifying processes and setting defaults that encourage responsible financial behaviour, such as default savings options and user-friendly wallet interfaces, to enhance financial inclusion (Bech & Garratt, 2022)	In developing countries, CBDCs should be designed with user-friendly interfaces and low barriers to entry, including mobile apps that simplify the process of sending and receiving digital money. This reduces the complexity of digital money for less tech-savvy users and promotes financial inclusion (Mersch, 2021)
Addressing Cognitive Biases in Digital Money Markets	Digital money markets are prone to the influence of cognitive biases, such as overconfidence or herd behaviour. Regulations should account for these biases to protect consumers and ensure fair markets (Financial Conduct Authority, FCA, 2020)	**Leveraging Loss Aversion** Behavioural economics suggests that people choose protective measures when facing potential losses. Regulators can use this insight to enhance consumer protection by creating disclosure regulations that highlight the risks of investing in volatile digital currencies, potentially reducing speculative	In the case of digital currencies, regulators might impose limits on leveraged trading, encouraging users to trade responsibly and avoid highly risky investments. In Japan, regulators have limited margin trading on crypto exchanges to curb excessive risk-taking (Financial Conduct Authority, FCA, 2020)

		behaviour (Kahneman & Tversky, 1979).	

Integrating behavioural economics principles into the regulatory frameworks for digital currencies offers a forward-thinking innovative approach to shaping user behaviour, ultimately fostering the safe and stable adoption of digital money. By acknowledging the psychological and emotional influences on decision-making, regulators can establish an environment that bolsters consumer protection and motivates individuals to make informed and beneficial financial decisions. This strategy requires ongoing collaboration among policymakers, economists, and behavioural scientists to ensure that regulations evolve alongside advancements in digital financial technologies.

The Future Outlook for Digital Money

Regulatory authorities worldwide are increasingly prioritizing the development of comprehensive frameworks to oversee digital currencies, recognizing their potential to fundamentally transform the landscape of international finance. This shift in focus is driven by the rapid evolution of digital assets, which have gained significant traction among consumers, investors, and businesses alike. As a result, governments are actively pursuing regulations for various forms of digital currencies, including cryptocurrencies and stablecoins, while simultaneously striving to harness the benefits presented by Central Bank Digital Currencies (CBDCs). The rise of cryptocurrencies has prompted concerns regarding their volatility, potential for illicit use, and implications for financial stability. In response, regulatory bodies worldwide are working to establish guidelines that ensure consumer protection, promote market integrity, and mitigate systemic risks (IMF, 2022, Financial Stability Board, FSB, 2020). Stablecoins, which are designed to maintain a stable value by pegging them to traditional assets, have also come under scrutiny, as their widespread adoption could pose challenges to monetary policy and financial stability. In this context, prominent international organizations, such as the International Monetary Fund (IMF, 2022) and the Financial Stability Board (FSB, 2020), are advocating for harmonized regulatory strategies that can effectively address the cross-border risks associated with digital currencies. These organizations emphasize the need for a coordinated global approach to regulation, which would help prevent regulatory arbitrage and ensure that all jurisdictions are equipped to manage the challenges posed by digital assets. The IMF (2021), in particular, has highlighted the importance of international cooperation in developing regulatory frameworks that can adapt to the rapidly changing digital finance landscape.

A number of countries around the world are responding to these challenges by formulating legislative measures aimed at regulating digital currencies (IMF, 2022). For instance, the United States is exploring various regulatory options, with agencies such as the Securities and Exchange Commission (Federal Reserve, 2022) and the Commodity Futures Trading Commission (CFTC) taking steps to clarify the legal status of cryptocurrencies and enforce compliance with existing financial regulations. Meanwhile, members of the European Union are advancing their regulatory efforts through initiatives like the Markets in Crypto-

Assets (MiCA) regulation, which seeks to create a comprehensive regulatory framework for digital assets within the EU (European Central Bank, 2021). As the global financial landscape continues to evolve, the development of robust regulatory frameworks for digital currencies will be crucial in ensuring that the benefits of these innovations can be realized while minimizing potential risks. The ongoing collaboration between governments, international organizations, and industry stakeholders will play a vital role in shaping the future of digital finance. This study suggests that integrating behavioural economics principles into the regulatory frameworks for digital currencies offers a forward-thinking approach to shaping user behaviour, ultimately fostering the safe and stable adoption of digital currencies.

Conclusion

This study aims to explore the opportunities, challenges, and future outlook of emerging digital currencies, specifically central bank digital currencies (CBDCs), cryptocurrencies, and stablecoins. Its aim is to understand how these digital monetary forms are shaping the global digital currency ecosystem. The methodology employed in this study is the systematic literature review of 281 studies on digital currencies, published between 2010 and 2024, which was conducted. The review focused on identifying key themes such as the regulatory landscape for cryptocurrencies, privacy and anonymity concerns, and technological risks associated with digital currencies. The findings of the review revealed several key themes, including increasing efforts by regulatory authorities to develop comprehensive frameworks to provide legal clarity, enhance consumer protection, and foster innovation in the digital finance sector. However, a significant gap was identified in the integration of regulatory frameworks with Behavioral Economic principles. To address this, the study proposes an integrated regulatory-behavioural framework to influence user behaviour and promote the secure and stable adoption of digital currencies. The unique contribution to theory, policy and practice of this study is the proposed regulatory-behavioral framework offers an innovative approach to digital currency regulation by integrating insights from Behavioral Economics. This contribution highlights the need for collaborative efforts among policymakers to ensure regulations evolve in tandem with advancements in digital financial technologies. The study envisions a future where CBDCs, cryptocurrencies, and stable coins coexist, with CBDCs playing a central role in establishing a stable, accessible, and efficient digital monetary system.

Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could influence the work reported in this paper.

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