Centralized Bank Digital Currencies, Decentralized Finance, and its impact in Emerging Markets

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Dissertation written under the supervision of Professor Rute Xavier

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ENGLISH ABSTRACT

Title: Centralized Bank Digital Currencies, Decentralized Finance and its impact in Emerging Markets

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The following dissertation explores Central Bank Digital Currency (CBDC), Decentralized Finance (DeFi). The research presented unfolds the implementation of Crypto, CBDC's, and DeFi within the current economies and the impact it might bring to emerging markets,

Ultimately, implementing the specified financial services or products within economies depends on each country's government and regulatory bodies.

Parallel to the dissertation, a consulting project for Montepio Bank was developed.To answer how Montepio can be involved in Decentralized Finance (DeFi) and further understand Cryptocurrencies and the leading players, varied literature on the matter was collected and analyzed along with the thematic analysis and conclusion from the following dissertation.

PORTUGUESE ABSTRACT

Título: Moedas Digitais de Banco Centralizado, Finanças Descentralizadas e seu impacto nos Mercados Emergentes

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A dissertação a seguir explora a Moeda Digital do Banco Central (CBDC), Finanças Descentralizadas (DeFi). A pesquisa apresentada desdobra a implementação de Crypto, CBDC's e DeFi dentro das economias atuais e o impacto que ela pode trazer para os mercados emergentes,

Em última análise, a implementação dos serviços ou produtos financeiros especificados dentro das economias depende do governo e dos órgãos reguladores de cada país.

Paralelamente à dissertação, foi desenvolvido um projeto de consultoria para o Banco Montepio. Para responder como Montepio pode estar envolvido em Finanças Descentralizadas (DeFi) e entender melhor as Criptomoedas e os principais atores, a literatura variada sobre o assunto foi coletada e analisada juntamente com a análise temática e conclusão da dissertação seguinte.

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1. INTRODUCTION

1.1 Background

Since 2008 with the release of Bitcoin (BTC), our economies have become increasingly more digital and decentralized, user needs are rapidly evolving, and innovation is reshaping financial services. Many countries have seen falling cash transactions and new digital financial services and forms of currency. Today there are nearly six thousand digital currencies (Best 2021) available to the public, of which twenty hold ninety percent market share.

Governments do not want to lose the technology race and have started theorizing about Central Bank Digital Currency (CBDC) which are different from independently mined currencies such as Bitcoin or Ethereum they are issued by a central bank, with similar guarantees as national

currency, equivalent to cash and designed for everyday transactions. Private cryptocurrencies are mined independently to take away the economic power from one institution. Most cryptocurrency prices are determined by the market based on demand and events, similar to stocks, making them far more volatile than traditional money. They have been utilized mostly as investment vehicles rather than as a kind of cash in regular trade. Nevertheless, there is a growing acceptance of crypto among merchants and new options like "crypto cards, crypto atm" which allow for the conversion of crypto into currency to points of sale or withdrawal cash.

Banks and financial institutions are exploring how they can continue to deliver their products while ensuring they can respond to a future system that appears to be changing rapidly.

1.2 Problem statement

Even though Cryptocurrency, Central Bank Digital Currency and a movement towards a decentralized financial system have been part of our economy for more than a decade it is important to understand the opportunities or threats it has on already established financial systems. The idea and execution of Central Bank Digital Currency and a decentralized financial system ranges from developing countries such as Nigeria to developed economies such as China. However, lack of access to the internet, infrastructure or other socio-economic factors may limit accessibility or understanding in Emerging Markets.

Q1: What characterizes an emerging market prone to adapting Cryptocurrency or Digital Assets in their economy?

Q2: What is the foreseeable future for Central Digital Bank Currencies & DeFi in Emerging Markets?

Q3: How imminent is the adoption of Crypto & DeFi?

1.3 Scope

This dissertation focuses on Central Bank Digital Currency (CBDC), Decentralized Finance (DeFi), and Crypto assets/currencies (Crypto) and the benefit that they may bring to emerging markets. The primary analysis of this dissertation focuses on understanding where have Crypto, DeFi, and CBDC's come from. Further research on current pilot programs in developed and emerging countries implementing these tools or services in the 21st Century Financial system was crucial to comprehend the future of Crypto, DeFi, and CBDC might lead.

The purpose of the linear layout of information within this dissertation is to lay the foundation for the proposed thesis.

1.4 Research Methodology

To address the proposed problem statement it is necessary to develop a specific research methodology that allows us to understand what the future of Central Digital Bank Currency and DeFi holds, both of which are dependent on the success or failure of Cryptocurrencies and Digital Assets. The implemented research methodology throughout the dissertation divides into the literature review, benchmark analysis, and thematic interview analysis.

1.5 Relevance

1.5.1 Academic Relevance

The research outlined in this thesis will serve as relevant information to further understand and develop Central Bank Digital Currency and Decentralized finance in academia in emerging markets. Technology has become an essential part of us through the way we use it in our personal and professional lives to the purpose it has served to develop our economies and humanity. Since the introduction of cryptocurrencies in 2008, there has been an unmatchable technological growth and the market. In addition, cryptocurrencies have had an imminent implementation in different economies, which has made different governments and regulating bodies theorize about Central Digital Bank Currency. We no longer live in the space era. However, we live in the tech race era.

1.5.2 Business Relevance

Considering many projects under development between central banks, government institutions, and private entities regarding Central Bank Digital Currencies and DeFi, along with Montepios' consulting project. Throughout this thesis, it will be analyzed and explained in detail how businesses such as Montepio and many others can take advantage of the new digital market to further differentiate from their competitors.

2. LITERATURE REVIEW

In the second chapter is presented the literature review, namely a detailed description of the key concepts which were discussed throughout this study.

2.1 Blockchain Technology

In 1998, Leslie Lamport provided the foundation for Blockchain with the Paxos Protocol in her paper The Part-Time Parliament (Lamport 1998, 133-169). Paxos is an algorithm for selecting a

single value from a set of options. The term "choosing" here refers to the fact that all members will see the same chosen value, and that a client will actually request the chosen value. In her paper, Lamport introduces Paxos as a Greek Island which thrived from commerce and mercantile activities. However, civic duty was the least of qualities that government officials possessed, especially those in parliament wandering in and out of their chambers.

The Paxos protocol is explained in a lengthy and cryptic language that very few with non-computer systems knowledge would understand. It was introduced for accountability, and record keeping of law(s) approved within the parliament. Each legislator held a ledger in which they would record the session(s), and law(s) passed with indelible ink and no changes could be made to the entries (Lamport 1998, 133-169). No two ledgers could be different; however, when legislators were not present, their ledgers would be empty until they were all caught up.

A newly elected parliament president could only introduce new decrees when they had revised all previous decrees, confirmed that all previous decrees had been voted by at least one member in a session, and that no decree was filling any gap. The president had to simply follow this protocol "If decrees (A) and (B) are important and decree (A) was passed before decree (B) was proposed, then A has a lower decree number than B" (Lamport 1998, 133-169). New decrees were introduced by representing the number of decrees in the president's ledger; a decree was said to be passed when it was written for the first time in a ledger.

Today Blockchain is a nice buzzword with very little understanding of what it does or how it works. Before introducing cryptocurrencies back in 2008, digital transactions and other digital activities required record-keeping. However, such transaction(s)/activities faced the risk of double-spending (Mazonka 2016). Double spending is a sequence of digital transaction(s)/activities that repeats itself. The development of Blockchain technology was to disrupt the system and be an autonomous financial alternative (Yaga et al. 2018) without having to trust a financial institution.

A cryptographic Hash Function (HF) is an algorithm that takes as input a predefined length of the message (0, 1 *) and outputs a fixed-length result (0, 1 n) (sometimes called an imprint, digital fingerprint, hash code, hash result, hash value, or hash). Digital signatures, timestamps, message authentication codes (MAC), public-key encryption, file tamper detection, and other current cryptography practical applications rely heavily on cryptographic hash functions (AlAhmad and Alshaikhli 2013) . In its paper ``Broad View of Cryptographic Hash Functions,

Alahmad & Alshaikli refer to (HF) as the “Swiss army knife of cryptography” (AlAhmad and Alshaikhli 2013).

Hash Functions were introduced after the realization that encryption such as a block chipper in Electronic Code Book (ECB) (Preneel, Govaerts, and Vandewalle 1993) is not secure enough to prevent actions such as double-spending in electronic transactions. However, each block in ECB is independently encrypted and easily modifiable. In contrast, all Hash functions depend on the previous result and cannot be modified or reverted.

Only the person with the public key is authorized to create a new blockchain. Keys in cryptography are known as (PKC), a set of encrypted keys, private and public. Private keys allow for change and decryption of the hash chain and must be kept secret. Public keys are used to encrypt data/messages. Hash chain(s) with PKC authorization can perform a function for the secure transfer of digital objects, called tokens. For example, suppose that one hash chain represents a token. It may be something to which the real world assigns a value. The owner of the last block is the owner of this value because only he can pass it to somebody else. However, this kind of hash chain implemented as-is would require a central place where the blocks are created, stored, and verified. We come back to the concept of a bank that requires trust.

Blockchain technology is the representation of data blocks with values that are placed in a global hash chain. New external blocks cannot appear in older internal blocks (Mazonka 2016).

Bitcoin (BTC) is a valuable representative token of the internal hash chain(s). The creation of new internal blocks is referred to as transactions because they represent a change of ownership. To create new blocks, significant computational effort and energy are required (Mazonka 2016). External hash chain(s) are global; they store portions, and bits of internal has chain(s) by binding the tokens with their owners and making double-spending impossible. Independent holders of external hash chain(s) do not trust each other, making it hard to regulate the blockchain community.

In conclusion Blockchain(s) is the organization of external hash chain(s) inside global hash chain(s). The external hash chain must follow usability, simplicity, incentive, and trust and authority rules. The purpose is to minimize human error and be an autonomous verification system. Internal hash chain(s) must have an authorization mechanism so one party can own something of value.

2.2 Cryptocurrency

Cryptocurrencies are digital financial assets that hold a specific value and exchange for banknotes. Ideally, cryptocurrencies effectively gain substantial traction even after being viewed as disrupting financial institutions and traditional banking systems. DeVries affirms that a cryptocurrency is a digitized currency formulated and stored on electronic systems (2016). Unlike traditional currency, any authority or central bank does not supply cryptocurrencies, and the network is effectively decentralized. Cryptocurrencies do not face the same risk as financial institutions of a likely security breach or human error (Guidici, Milne, and Vinogrado 2019).

Similarly, in their paper "A critical investigation of cryptocurrency data and analysis" Alexander & Michael view cryptocurrency as a digitized asset formulated to work as a platform on an exchange that incorporates cryptography to achieve secured transactions, verify the assets transfers and manage the formulation of extra units (Alexander and Dakos 2019). Thus, they are a sort of digitized currency, virtual currency, and alternative. Cryptocurrencies employ decentralized control contrary to the usual central banks and electronic monetary systems. Cryptocurrency functions on a decentralized public exchange catalog for distribution, also known as a blockchain.

Before Bitcoin's launch and popularization, the theory behind digital currencies had already been introduced, such as Hashcash, B-Money, and Bit Gold. Hascash was a proof-of-work system introduced by Adam Black in 1997 (Chohan 2017). Its purpose was to combat and control email spam(s). Today Hashcash is used as a mining algorithm for Bitcoin and other cryptocurrencies. In 1998 Wei Dai proposed the theory of B-Money's. Wei Dai intended to provide a medium for exchanging and enforcing contracts in online economies without government regulations or laws. B-Money intended to grant a true feeling of financial freedom. Today, B-Money is recognized as a milestone in Blockchain History (Dai 1998). Nick Szabo introduced Bit Gold with the intention that money had always been trusted to third parties and emphasized the insecurity that comes with doing so. Nick Szabo was determined to create a tool that would take away the trust put in third parties to control our financial assets and resources and let computers do the jobs (Szabo 2005). In 2008 Satoshi Nakamoto (a pseudonym for an individual or group of people to this day unknown) publish a paper "Bitcoin: A Peer-to-Peer Electronic Cash System," (Nakamoto 2008) laying out its purpose of providing a digital currency that would

remove the trust laid upon third parties and allow for its users to control it without regulations (Chohan 2017).

In her paper Dyhrberg states, the market for computer-generated currencies has grown and the players in it, since the introduction of Bitcoin (Dyhrberg 2015). Historically money has served the following economic functions as a value holder, medium of exchange, and unit of account; when cryptocurrencies were first introduced, they did not meet any of the previously mentioned functions of money. Cryptocurrencies can be used as an alternative to fiat currencies and banking systems, government-led economic redistribution, and public participation (Feinstein and Werbach 2021). Cryptocurrencies are gaining substantial popularity as they give privacy protection, explicit source methodology, minimal entry barriers, and cost-effectiveness. Digital assets have transformed into a unique market where many players enter and compete (Dyhrberg 2015). In March 2020, it was estimated that there were ≈ 5,100 different cryptocurrencies worth ≈ $231B (Perkins 2020).

Despite the myriad advantages and user-friendly procedures, there is a significant array of evidence indicating risks associated with cryptocurrencies. Lack of liquidity and security concerns are among the predominant challenges highlighted in several studies. According to Schaupp and Festa (2018), many countries continuously denounce cryptocurrencies due to their incorporation in black and grey markets (Schaupp and Festa 2018). Ideally, there are two sets of interconnected threats: one enveloping the risks posed to the security of the state and the users and the other being the expansion and growth of these media within the uncertain policy environment (Farell, Dwork, and Naor 2014). Also, they create a platform where illicit trading and criminal conduct would progress through the support of terrorism financing and issues of evading taxes.

The cryptocurrency's acceptance as a legal tool presently differs from country to country; while some nations are creating policies and measures, other countries are yet to respond to the currency changes causing disruption. Similarly Devries emphasizes the burgeoning incorporation of cryptocurrency in ramson wares, terror financing, arms trades, cybercrimes, and organized illicit drugs has effectively raised reflux among law enforcement and security agencies. Thus, they may require displacing the exciting economic schemes that accommodate electronic money flow across varied political segments (DeVries 2016, #).

Slowly, the active cryptocurrencies are coming underneath the control net to check misuse. For example, Japan is one of the countries which regulate cryptocurrencies, while America is engaging in laying down policy guidelines for regulation (Feinstein and Werbach 2021). Australia and the U.K. continue to engage in the formalities while countries like China have engaged in the baring of Initial Coin Offerings (ICO). Due to a variety of reasons, including global scams related to the ICO.

The Indian Reserve Bank has maintained a tab on the elevating cryptocurrencies usage and has advised on the same matters in 2013, cautioning holders and traders using virtual currencies regarding its anticipated threats and financial issues. Additionally, the Finance Ministry engaged in a public consultation practice focused on regulating virtual currencies. The finance minister, Arun Jaitly, stated that the government would ensure that cryptocurrency is eliminated in illegitimate actions in India.

Controlled cryptocurrencies will preserve powerful consumer shield supplies. In regards to benefits, this acts as a force elevator in India's appeal for economic inclusion, corresponding to the electronic payment modes such as Adhaar Enabled Payment System and digital wallets (Rahman and Dawood 2021). Moreover, this could further minimize remittances expenditures, enveloping over ≈ $60B to India. Also, this will actively attract business entrepreneurs, resulting in innovative platforms, wealth creation, and generation of job opportunities in the due procedures of payments processing, taxation, and e-commerce (Rahman and Dawood 2021).

While India is eager for a transparent, high and quick revenue currency, it is limited by the unstable nature of cryptocurrencies and understanding and practical use. The Indian government will take a unique stance that explores and learns more about cryptocurrency.

In summary, the future and progressive success of cryptocurrencies depend on the nature of existing regulations and further changes to be formulated by policymakers, mainly on control frameworks. According to Feinstein, different countries continue to approach regulation in various ways, thus making the regulatory environment unpredictable (Feinstein and Werbach 2021). Therefore, the government will have to take significant steps to gain insight into probable risks expected in using cryptocurrencies in money laundering actions, terror financing, and tax evasion (DeVries 2016).

2.3 Decentralized Finance

Decentralized Finance (DeFi) encompasses various categories such as Financial Technology (FinTech), Regulatory Technology (RegTech), cryptocurrencies, and digital assets. Decentralized Finance (DeFi) is one of the most emerging technological evolutions in finance. However, we know very little about it as it is still in its early stages and must understand its legal implications and policy consequences. Decentralized Finance (DeFi) requires careful regulatory attention. In situations where Decentralized Finance (DeFi) produces new forms of technological reliance, regulation needs to focus on the reconcentrated portion of the value chain to ensure adequate oversight and risk control. In this framework, regulation is necessary in order to support decentralization, in much the same way that regulation is at the core of securities markets and other financial services. In other situations, regulation will be necessary to protect markets and participants from predation by a non-decentralized system, for instance when a participant in a market seeks to take advantage of technology for regulatory arbitrage.

DeFi emerges from three important patterns in technological evolution: Moore's law,Kryder's law (Zetzche, Arner, and Buckley 2020). Moore's law refers to the assumption that the amount of data processing power grows exponentially (Moore 1965) . Kryder's law posits the same for data storage capacity (Walter 2005). The combination of ever-increasing processing power and ever-increasing data storage capacity leads to ever-lower costs for both. The third factor making DeFi possible is the tremendous growth we have seen in communications bandwidth combined with decreasing costs—a phenomenon which has been discussed since the late 1990.

DeFi platforms provide an alternative system rather than merely a plug-in for existing institutions. Because access to important information is not dependent on centralized processing or a prior connection, transaction onboarding and market-based risk assessments are easier to scale throughout a business's larger system. Prior to DeFi, a company would have to do anti-money laundering and "know your customer" checks on every source of capital, as well as persuade their counterparts to join the same transaction banking programs. They would also be unable to provide evidence of performance on their debt or payables other than financial statements.

DeFi enables the flow of trustworthy data across a system, hence lowering the barriers to corporate financial services. However, because of the volatility of crypto-assets, regulatory ambiguity, and the immature nature of the technology involved, most organizations did not see

DeFi as a viable alternative to their bank's services until recently. Even Tesla's $1.5 billion bitcoin acquisition was prompted by the asset's immediate financial worth rather than the companys' needs (Kovach 2021). DeFi's concept for the future of digital banking lacks two critical components for success: interoperability across multiple blockchains and one-to-one exchange with fiat money. Interoperability is critical for large-scale transactions in the fragmented blockchain landscape. While DeFi has handled the challenging needs for portable digital ID for companies, it has yet to fulfill the need for a reliable store of value that may be used as cash.

DeFi-based transaction banking reinforces the current trend of atomization of services and financial management relying more on technology, workflow management, and risk arbitrage for credit opportunities. The most important elements that DeFi brings to these developments are permissionless access and a stronger emphasis on interoperability. Non-DeFi decentralized systems lack the user-friendliness that fosters adoption. We introduce Decentralized Finance and put it in the context of the traditional financial economy, connect Decentralized Finance to open banking, and end with some policy considerations. In regular finance, there are financial institutions (e.g., public banks, stock exchange) who serve as intermediaries between lenders (e.g., investors, lenders) and borrowers (e.g., bank account holders, everyday people). Financial institutions operate under policies and regulations set by the government to install confidence and trust in the public. Financial institutions oversee the interactions between lenders and borrowers. Any financial activity must be under the parameters set by the regulations and policies to have a fair market, hence centralizing the control to one party, the government, under the idea that money is sovereign. Market-based financial systems are often seen as unstable, with constant regulatory adaptations and other forms of market failures being addressed, such as the government's intervention in the 2008 housing crisis. In addition, Decentralized Finance seeks to challenge traditional governing and regulatory systems. Finally, it proposes a world in which technology replaces human error and the institutions they lead, thus attracting many who have suffered under the regulatory system. However, over time, it has moved from a utopian vision to a simple idea in which technology can potentially eliminate the risks inherent in the concentrated systems central to traditional finance.

2.3.1 Decentralized Exchange (DeX)

Decentralized exchanges are increasingly becoming an integral aspect of financial services. Typically, a decentralized exchange is a transaction without failure platforms such as a person, institution, or server running and controlling the exchanges. Therefore, decentralized exchange omits the concepts of trusting authorities, thus becoming an effective trustless service (Sobol 2020). Also, it creates some myriad benefits that are beyond decentralization.

A decentralized exchange is a universal service with no borders available to members using the internet. Servers running from many global sectors ensure that the exchanges are smooth at any time and settlements occur within seconds (Shapiro 2018). Further software development ensures that the system becomes more user-friendly than other systems (Wang et al., 2021).

Moreover, the traditional schemes require individuals to give their credentials such as identity cards, credit cards, statistics, and even keys and passwords to colleagues and other individuals within the economic sectors (Malamud and Rostek 2017) . However, cryptography ensures that such necessities are not essential since each individual may keep their identification cards and credit card information after proving they possess the needed credentials.

Notably, everything within the internet becomes explicit; hence, developed corporations need to sustain privacy. The power beyond technology permits everything to be transparent and open for everyone without causing any uncertainties and security compromises (Lo and Medda 2021). The traditional system allows the developed organizations to incorporate security to retain all their statistical information and client's data, privately backed and locked by its unique authority. Also, there is an absence of reasons for preventing the unbanked and poor individuals from participating within the universal economic sectors. Indeed, capitalist-minded financial service providers and corrupt regimes have nothing much to play that will incur measurable effects on their liberty of participating in transacting on cryptocurrency platforms (Wang et al., 2021). Thus decentralized transactions allow individuals, regardless of their social class or influence, to transfer and store wealth at almost zero cost and in any segment of the world.

According to the " Decentralized Exchange" paper presented by Malamud and Marzena , many decentralized transaction protocols work with tokens featuring a similar technical execution and a similar ledger platform for distribution (Malamud and Rostek 2017). For description, EtherDelta, AirSwap, and OX are among the predominant protocols working with homogenous ERC-20 tokens within the Ethereum blockchain. Stellar's decentralized transactions operate,

beyond Ethereum, with issued tokens on the Stellar network, and OpenLedger Dex of BitShares' runs only with the issued token on the BitShares blockchain scheme. A few decentralized exchanges are currently starting to incorporate atomic swaps to allow users to automatically trade cryptocurrencies existing on a variety of blockchain networks (Wegrzyn and Wang 2021). Though, atomic swaps necessitates that the exchanged cryptocurrencies maintain and adhere to designated technical standards.

2.4 Central Bank Digital Currencies

Globally, the value of cashless payments has skyrocketed. The COVID-19 epidemic may have also accelerated the cashless megatrend. Currently, cryptocurrencies do not meet these requirements, so Central Bank Digital Currencies are created, designed on a hybrid model supported by cash, facilitating the record-keeping of claims and privacy by private entities. Central Bank Digital Currencies is a bridge for the ongoing competition between public and private players for digital currencies and their use in the economy (CBDC WG and Center for Latin American Monetary Studies 2020) . Central Bank Digital Currencies would not rely on the soundness of commercial banks and could serve as an anchor for as cash does today. However, the value of money is better safeguarded by institutions accounted to the public rather than private investors and focusing on establishing the monetary system and nothing else. Market Solutions drive Private investors, a result of local knowledge associated with analyzing and determining individual clients' risk.

Understanding the Central Bank Digital Currency architecture is crucial to understand that digital wallets are required to conduct transactions with digital currencies. A digital wallet is a software program composed of different public and private keys that allow the use of digital between two or more parties, balance, and record keeping. Recent price movements have sparked a public debate that the cryptocurrency market is a bubble with no underlying worth and worries about regulatory and legal avoidance. However, the consequences of risks, benefits, and possible costs of Central Bank Digital Currencies must be better understood. These ramifications, ranging from privacy issues to macroeconomic impacts, blur the borders of the payment and financial systems. Developing new digital currencies requires safeguarding privacy and maintaining the two-tier financial system.

Technological progression, particularly in the previous decade, has resulted in an advancing number of electronic modes for payments that are effective and fast during transactions. Typically, this has rapidly raised questions for policymakers regarding the duties of the public sector in the generation of digitized instruments for paying suitable for the modern economy (Kumhof and Noone 2018). From a philosophical view, central bank digital currency (CBDC) provokes various responses and questions relating to the provision of private and public money and the central bank's ability to incorporate the CBDC as a monetary transaction means to households.

2.4.1 CBDC'S Impacts on Commercial Banks

Primarily, one of the roles of the CBDC is bearing interest substitutes which is beneficial to retail bank deposits. The presence of these substitutes allows the commercial bank to effectively respond by altering the deposits rates' nature offered to savers and the loan term provided to the borrowers (Fung and Halaburda 2016). Consequently, the introduction of CBDC alters bank-intermediate lending volume and the bank deposits' quantity. Therefore, this sheds light on the idea and concerns of policymakers that CBDC substantially replaces primary sources of funding for banks and results in commercial banks' disintermediation, thus resulting in a decline in lending.

The paper "Designing Central Bank Digital Currencies" analyzes these impacts upon a monopolistic bank (Agur, Ari, and Dell'Ariccia 2021). Typically, when the CBDC is bearing interest, the bank making positive revenues in equilibrium elevates the equilibrium deposit charges to a level that equalizes with the CBDC interest rates. An integral outcome is that since CBDC encourages more suitable contractual policies for depositors, it elevates their demand through an extensive and intensive margin. Thus, the banks' depositors base could be expanded effectively due to the competitive pressure applied by CBDC. However, there is a possibility that CBDC remuneration erodes profits though this does not typically result in the elevation of loans. In their paper Fung and Halaburda argue that banks can still make loans avoiding dissemination if they acquire the central bank's reserves (Fung and Halaburda 2016).

In their paper Kumhof and Noone further develop concepts proposed by Fung and Halaburda by studying the CBDC model as an asset which bears interest hence competing with bank's deposit and causes significant effects on the lending activities for banks. From a theoretical perspective that goes beyond Fungs' and Halaburda by analyzing how the bank can actively hold CBDC to

meet their reserve needs and CBDC enterprises that deliberate policy tools different from setting the interest rates it pays (Auer, Cornelli, and Frost 2020) . However, the specific lending changes depend on the parameter space' region. There is no impact on bank activities if the checkable deposits are higher than the CBDC interest rates (Barrdear and Kumhof 2021). The bank responds by elevating lending and deposit rates if the stakes are lower than the interest rates of CBDC- increased rates of deposits consequences to increased deposit base. Though, if the CBDC interest rates are high, the commercial banks significantly scale down their loans and deposits.

2.4.2 CBDC's Impacts on Financial Stability and Monetary Policy

The second strand focuses on assessing the effect of CBDC on the existing economic stabilities and monetary policies and the generated welfare consequences. CBDC, as a new money form for the central bank, encapsulates the capacity to affect the central bank's larger aims, whether through its effects on household portfolio choices and bank run probability or as a new monetary policy instrument. Fung and Halaburda formulated a "Dynamic Stochastic General Equilibrium" model with costs adjustments and stuck charges to study the cycle- and long-run impacts of CBDC towards the microeconomy sectors (Fung and Halaburda 2016). Notably, the introduction of the CBDC minimizes the distortionary expenses and rates of interest, thus resulting in the long-run elevation of the GDP. Over the financial cycle, CBDC issuing can result in a slight GDP fall as a response mechanism to a liquidity petition shock. The demand shock results in a considerable flight to safety where the household actively requires more CBDC (Barrdear and Kumhof 2021). Suppose the demand is satisfied by the central bank by raising the CBDC quantity. In that case, the decrease in actual financial activities is less severe, thus attenuating the waning in expenditure and so welfare.

Agur et al. (2021) highlight CBDC's as deposits held at the central bank (Agur, Ari, and Dell'Ariccia 2021,). The framework demonstrates a necessary trade-off: if a CBDC run happens, the central bank internalizes the effect on charges, and therefore actual consumption, from the significant asset liquidating to pay depositors (Barrdear and Kumhof 2021). The central bank can, thus, effectively reduce the actual withdrawal values by elevating the price level when a run happens, hence preventing occurrences of bank runs. Moreover, the price level increase introduces challenges of preceding inflation targeting (Auer, Cornelli, and Frost 2020).

2.4.3 Threats Facing CBDC in the Modern Era.

Ideally, the innovative sectors introduce significant cyberterrorism threats, which may reduce the effectiveness of CBDC. For illustration, ultimately, quantum computers affect all financial services due to their compromising of cryptographic primitives and primary data encryption methods incorporated for accessibility protection, data integrity when transmitted and stored, and confidentiality (Auer, Cornelli, and Frost 2020). Therefore, quantum computing must be cindered during technological designs to avoid compromising security systems safeguarding CBDC accounts. (Barrdear and Kumhof 2021, #)Foy description, central banks must consider specific primitives' vulnerability to the forthcoming quantum computing system. Moreover, there is an elevated likelihood of quantum computers accessing the CBDC accounts in the future without any detection, thus introducing untraceable theft cases.

3. METHODOLOGY

Following on from the previous chapters regarding the literature review, this following chapter will discuss the methodology utilized in this dissertation. Introducing the methodology implemented allows concluding the proposed research questions more efficiently. Secondary research uses benchmarking analysis divided into Crypto, DeFi, The Bitcoin Index, and CBDC trials to present a more complete picture of how and when implementing some of these services or products might happen in different economies. Ultimately, the analysis of interview data through coded themes will be performed.

3.1 Secondary Research

3.1.1 Benchmark

The following section will analyze data and information acquired throughout research. It will be divided into cryptocurrency and decentralized finance to understand how the market behaves. CBCD Project intends to compare how different countries implement pilot programs and see the viability of introducing central bank digital currencies in their economies. Primary Research

3.1.2 Interviews

To achieve so, the current research used a qualitative technique. Unlike quantitative research, which offers statistical relevance of how frequently an event occurs and generalizes its conclusions, qualitative research allows you to study the phenomena and establish its significance both while it is happening and after it has occurred (Williams and Moser 2019). The interviews were conducted via video call or email to acquire qualitative data throughout semi-structured. Semi-structured interviews allow participants to discuss rather than yes or no responses (Cope et al. 2016). The interview questions can be found in the Appendix.

4. SECONDARY RESEARCH

This chapter covers the analysis data gathered through industry research.

4.1 Benchmarking Analysis

This chapter aims at defining the stages in which many CBDC programs and its counterparts, Cryptoassets and DeFi, hold in different economies. Currently, many developed and emerging countries are testing hypotheses of how to either implement cryptocurrencies or assets in their economies, such as Bolivia and the exchange of CBDC's between countries such as China and France. Many of the different programs laid out in this chapter will serve as a blueprint for the future development of crypto-regulations and the implementation of cryptocurrencies or assets in other economies, being developed or emerging.

4.1.1 Cryptocurrency and Decentralized Finance Analysis

By adopting digital currencies, decentralized finance (DeFi) continues to develop and increases its demand for implementation in certain economies. According to a Goldman Sachs report, since mid-202, the Decentralized Finance market has seen a 10x expansion (Muroff et al. 2021). DeFi is created on the Ethereum Base. In 2020 Ethereum reached ≈$1.5 trillion in transactions, and only in Q1 of 2021 Ethereum transactions surpassed its previous year (Njuguna 2021). To put things into perspective, Ethereum transactions represent ≈ 83% VISAs' volume in 2020 (Visa 2020). The increase of Bitcoins' value and relative consistency and the increased demand of NFT's and ETH have boosted the entire Decentralized Finance market (Yield 2020). To date, Decentralized Finance total value locked (TVL) reached ≈ $257.29 billion (DeFi Llama, n.d.)with the development of new apps and coins surging.

According to Defi Lama segment leaders (DeFi Llama, n.d.) are Curve (CRV) and MarkerDAO (MKR) protocols, which account for ≈14.8% of the total market. Mid 2021 summer, Goldman Sachs applied to the SEC to create an ETF foundation in DeFi. In mid 2021 Goldman Sachs conducted research on DeFi & the Ethereum network, mainly to provide their hedge fund clients exclusive understanding and analysis on DeFi and digital currencies (Son 2021). Along with Goldman Sachs, Morgan Stanley & Bank of America have announced that they will allocate manpower for research purposes of digital assets. The move by Goldman Sachs and its competitors shows the imminent adoption and demand for DeFi.

According to the 2021 Geography of Cryptocurrency Report by Chainalysis (Chainanalysis Inc. 2021) data shows that the increase in the volume of transaction for centralized services and DeFi promote cryptocurrency usage in the developed countries and those who already experience substantial adoption, while peer-to-peer platforms are driving new adoption in emerging markets.

Many emerging markets such as the South African Rand, Mexican Peso or Brazilian Real face significant currency devaluation (Smith 2020), which leads to citizens to look for another way in which their savings and lives can be preserved, thus buying cryptocurrencies through peer-to-peer platforms. Others in these areas use cryptocurrency to carry out international transactions, either for individual remittances or for commercial use cases, such as purchasing goods to import and sell. Many emerging markets represented here limit the amount of the national currency that residents can move out of the country. Cryptocurrency gives those residents a way to circumvent those limits so that they can meet their financial needs.

This contributes to an interesting dynamic whereby peer-to-peer platforms have a greater share of total transaction volume made up of smaller, retail-sized payments under ≈$10,000 worth of cryptocurrency.

In an interview with The Entrepreneur Alex Lemberg , the CEO of Nimbus (Lee 2021), mentioned that for several years the Asian community has been enthusiastic about Crypto use is widespread in the area, with key economic cities such as Singapore, Beijing, and Seong having a sizable Crypto user base. Lember further adds how the private sector's continuous support (Insert Citation) is a clear illustration of how Decentralized Finance and Crypto will benefit the traditional economy in significant ways. The deregulated aspect of Crypto and Decentralized Finance is an avenue for those in lower socio-economic classes to increase their income.

This contrasts sharply with traditional markets, where asset diversification might be difficult or impossible for someone in, instance, a lower economic level. Market support will be more limited, as in Korea, or driven underground in more state-controlled territories, such as the People's Republic of China. While the global economy continues to rebuild as the worldwide epidemic fades, cryptocurrencies remain one of the world's most sought-after assets. It became evident that the governments of these large economies did not want uncontrollable currency flowing through their borders. With previous economic crises exposing the flaws of traditional economies, many people are looking for new methods to diversify. The addition of a virtual wallet to the platform means that it has access to the DeFi market without the need for a third party. It is apparent that these additional rules have removed some, but not all, Crypto users in the Asian area. Similar experiences from South Korea and Hong Kong demonstrate that stronger rules are insufficient to deter individuals from investing more in cryptocurrency. Naturally, there was a dip in Crypto value as many of the main currencies saw their value plummet as a result of the seeming loss of these markets. Despite the governments' blanket prohibitions and stricter regulations, the same excitement for Crypto exists in these countries.Obviously, the more powerful areas do not want significant currencies to emerge that they do not control. "While DeFi may not replace the bank as an intermediary required to conduct transactions, it may replace it as a source of permissionless funding." Others, though, argue that this is excessively heavy-handed and harms the DeFi market's independence. These regulations aren't so much targeted at destroying bitcoin as they are at eradicating cryptocurrency-related frauds. Asset diversification is something that more forward-thinking people strongly believe in. Similarly, amid mixed reactions, South Korea's newly constituted regulatory organizations have destroyed several of the al-coin trade sites.

In recent years, many economic and technical factors have aided the exponential rise of Decentralized Finance. As a result, Decentralized Finance is rapidly changing and expanding to replicate the traditional financial services ecosystem, whether through decentralized exchanges, lending, and borrowing of various asset kinds of insurance products. This new type of decentralized financial technology may eventually influence the future of centralized finance companies, with Decentralized Finance perhaps perceived as a cheaper, faster, and more relevant alternative.

4.1.2 The Bitcoin Market Penetration Index

The Bitcoin Market Potential Index (BPMI), established by Garrick Hileman of the London School of Economics, conceptualizes, and rates the potential utility of bitcoin across 178 nations to determine which countries have the most potential for bitcoin adoption. The BMPI tries to assess bitcoin's overall potential utility. Hence, it incorporates factors relating to bitcoin's function as both a store of value and a medium of exchange and the block chain's ability to serve as a technological platform for non-monetary applications (e.g., notary timestamp). However, because bitcoin is now mainly used as an alternate way of storing and transferring wealth, the index includes additional characteristics that focus on bitcoin's currency and payment capabilities. For example, the index uses a data collection containing 40 characteristics linked to bitcoin's function of preserving value, exchange, and a technological platform (Hileman, n.d.).

The factors are divided into seven equally weighted subindices of the index: technological penetration, international remittances, inflation, the extent of the informal sector, financial repression, previous financial crises, and bitcoin penetration. In addition, the Bitcoin Market Potential Index (BPMI) can serve to understand cryptocurrencies' future acceptance and where its adoption is most likely to occur.

The Bitcoin Market Potential Index (BPMI) concludes that Argentina, Venezuela, and Zimbabwe are the top three nations that show potential of high Bitcoin use.

Based on the BMPI's criteria, Argentina is unsurprisingly placed first. The country has chronically high inflation, a significant informal sector, and financial crises occur on a regular basis. Furthermore, Argentina has a relatively high level of technological penetration and capital-movement regulations. Argentina has also just declared a sovereign debt default for the second time in 13 years. While external sovereign defaults have a modest weighting in the BMPI, this new trend is reflected in the rankings.

Number two-ranked Venezuela, like Argentina, experiences relatively high inflation and periodic financial crises (Hilmola 2021), while number three-ranked Zimbabwe thrives on informal sector (black market) (IPS Correspondents 2008).

4.1.3 CBDC Trials

The Peoples Bank of China has started experimental projects. More trials are planned, notably for the Beijing Winter Olympics in February 2022 (Kharpal 2021). As of June 30, 2021, the e-CNY has been utilized in more than ≈1.32 million transactions, with a total transaction volume of ≈70.75 million and a transaction value of RMB ≈34.5 billion (Hee 2021). The Peoples Bank of China is also looking into pilot programs for cross-border payments with other central banks and monetary authorities. As the Chinese economy transitions from high-speed growth to high-quality development, technological innovation, as symbolized by the digital economy, has emerged as a key growth engine. Covid-19 has accelerated the digital transformation of people's jobs and lives, increasing online buying, remote working, and e-learning. As a result, the digital economy has extended geographically, and there is a growing need for online financial services in less developed and distant locations (People's Bank of China 2021).

The Hong Kong Monetary Authority has been collaborating with the Bank for International Settlements on Project Aurum's Innovation Hub Hong Kong Centre, which will focus on the technical elements of issuing retail CBDCs and potential architectural designs through commercial banks and payment service providers (Lim 2021). The Hong Kong Monetary Authority has formed an internal cross-departmental working group to investigate the pertinent technological, policy, and legal concerns to publish the first report by June 2022 (Hong Kong Monetary Authority and The Bank of Thailand 2020). The "e-HKD" research intends to understand its use cases, advantages better, and associated dangers to strengthen Hong Kong's technological preparedness to issue e-HKD (Central Banking Newsdesk 2021).

In 2021, the Indian government discussed the adoption of CBDCs. Now The Reserve Bank of India is designing a deployment strategy and cases for its use. The criteria followed by the Reserve Bank of India are the following: Should CBDC's be used in retail and wholesale payments? Should the ledger be centralized or distributed? Token or wallet-based for verification purposes? Should the Reserve Bank of India be the one to distribute directly to users or use private banks as intermediaries? How anonymous should it be? Risks associated with it? (Reserve Bank of India 2021)

In 2020, the Bank of Japan, the European Central Bank, and other major central banks had formed a committee to evaluate the possible use of CBDCs (The Bank of Japan 2020). The Bank of Japan has started the first phase of a proof of concept by creating a test environment for the

CBDC system and conducting trials on the basic operations necessary for CBDC to be considered payment. It is expected for the first phase to last until Q3 2022 (Gunning et al. 2021).

PARTIES INVOLVED	STATUS	OBJECTIVE
The People's Bank of China	In-progress	Mass implementation of e-CNY
The Hong Kong Monetary Authority	In-progress	Research intends to understand its use cases, advantages better, and associated dangers to strengthen Hong Kong's technological preparedness to issue e-HKD
The Reserve Bank of India	In-progress	Analyze how/where/when and why should CBDC's implemented in the economy and risks associated
The Bank of Japan, European Central Bank	In-progress	Proof of concept by creating a test environment for the CBDC system
The Monetray Authority of Singapore	Complete	Completed in 2015 it investigated the use and distribution ledger of CBDC in an experimental stage
The Bank of Korea	In-progress	Architecture and functionality of CBDC's
The Bank of Thailand	In-progress	Investigates wholesale CBDC and distribution
The Hong Kong Monetary Authority & The Bank of Thailand	Complete	Finalized in 2020 the project aimed at the test of cross-border exchange of CBDC's
The Reserve Bank of New Zealand	In-progress	Feedback on CBDC and its potential as currency alongside current government backed currency
The Central Bank of Nigeria	Complete	In 2021 launched their CBDC "eNarrowa"
Government of El Salvador	Complete	First country in South America to recognize Bitcoin as a currency

Table 1: Summary of CBDC Trials

In 2020 The Monetary Authority of Singapore completed Project Ubin, which started back in 2015. Project Ubin was a digital currency initiative and investigated the use and distribution ledger of CBDC in an experimental stage (MAS 2020). Throughout the project, a payments network prototype was created for the development of next-generation cross-border payments infrastructure. Technical details for the prototype network's capabilities and connecting interfaces have been made public to promote innovation (MAS 2020). Furthermore, in July 2021,

the Monetary Authority of Singapore and Banque de France completed a wholesale cross-border payment and settlement experiment involving various CBDC's (Banque De France and MAS 2021). In Mid-2021, The Monetary Authority of Singapore and the International Monetary Fund, the World Bank, and others collaborated to launch the "Global CBDC Challenge" (MAS 2021). In addition, the Challenge focused on finding new retail CBDC solutions worldwide to improve payment efficiency and promote financial inclusion.

In the summer of 2021, The Bank of Korea launched a CBDC simulation split into two phases. The first phase will be the architecture phase to build a cloud-based simulation environment and test the fundamentals of CBDC (issuance and circulation). The second phase will focus on functionality, cross-border transfers, and ownership of digital assets (So-yeon 2021).

The Bank of Thailand has been actively involved in CBDC research since its inception, beginning with the investigation of wholesale CBDC through Project Inthanon. The project was divided into two phases. Phase one focused on creating a prototype of a decentralized real-time gross settlement system with important payment features, such as the tokenization of cash and bonds. Phase two looked at applying distributed ledger technology to increasingly complicated use cases, including smart contracts (Chananun Supadulya et al. 2021).

The Hong Kong Monetary Authority and the Bank of Thailand jointly conducted a project known as Inthanon-LionRock, which concluded in 2020. As part of the project, a prototype of the Hong Kong Monetary Authority and the Bank of Thailand cross-border corridor network was created, allowing member banks in Hong Kong and Thailand to undertake cash transfers and foreign currency operations (Hong Kong Monetary Authority and The Bank of Thailand 2020). The Bank of Thailand wants to concentrate its efforts on the study and construction of a retail CBDC between 2021 and 2022 (The Bank Of Thailand 2021).

In September 2021 The Reserve Bank of New Zealand created a paper for its public providing feedback on CBDC and its potential as currency alongside current government backed currency. The paper showed cons and pros, costs and rewards, and risks and possibilities that come along with the idea of CBDC. It also stated four principles for it to be valuable, create uniformity, it is universal, cash-like and it is innovative (Reserve Bank of New Zealand 2021).

The Reserve Bank of New Zealand wants input on the document by December 6, 2021. However, the Reserve Bank of New Zealand estimates that we are still a long way ahead of CBDCs actual

implementation in the economy due to complex, design, usability protocols that need to be created along with it (PYMNTS 2021).

As part of a trial plan being tested in Australia, Singapore, Malaysia, and South Africa, digital currencies may soon be used to settle cross-border payments between nations. The project aims to determine if adopting alternative central bank digital currencies may reduce transaction costs and improve company efficiency (John 2021).

In October, 2021, Nigeria's president, Muhammadu Buhari, publicly introduced the Nigerian Central Bank Digital Currency, referred to as "eNarrowa" (SWFI 2021). The Central Bank of Nigeria created the digital currency, which was launched on that day, after a series of discussions with important parties such as the banking community, fintech operators, merchants, and, indeed, a cross-section of Nigerians. The eNarrowa is designed to make financial transactions easier and more seamless for people from all walks of life. However, there are still results to be expected from previous implemented measures in response to the slow GDP rebound rather than inflation and the question remains “can it deliver?” (Zalles 2021).

In the summer of 2021, El Salvadorans became the first country in Latin America to use Bitcoin as a way of wealth storage and payment. The conversion to legal money removes capital gains from the equation, allowing users to transfer and exchange Bitcoin without fear of taxation (Renteria and Esposito 2021). Politicians in several Latin American nations have begun to advocate for the use of Bitcoin as legal money. Inflation, dependency on the dollar, and a mechanism to promote IT entrepreneurship are a few factors that drive interest in Bitcoin (Wilkins 2021). Congressman Carlitos Rejala of Paraguay urged the country to progress with its young people (Burnett 2021).

According to Panamanian Congressman Gabriel Silva, they cannot be left behind and aims to introduce similar legislation as El Salvador (Quiroz 2021). Currently, El Salvador is the guinea pig of the Bitcoin experiment in the region, and all eyes are on them to see the outcome.

5. PRIMARY RESEARCH

The primary research focused on interviewing different industry experts to P1 (André Padrão) is a software engineer at Banco Montepio who focuses on emerging trends., P2 (Paulo Cardoso do Amaral) Paulo Cardoso do Amaral is a Professor of Economics at Católica Lisbon SBE and a renowned academic in Portugal whose expertise is sought by influential papers such as Jornal

Economico, Portugal's number one Economic Newspaper, P3 (Hailey Lennon) Haley Lennon is a partner at Anderson Kill, a nationally recognized law firm in the United States. She. is the founder and president of CryptoConnect non-profit that spreads education in the crypto industry. She is also a legal analyst at Forbes Magazine and a former Coinbase associate General Counsel Regulator. P4 (Nilsen G. Arias Sandoval) is the former International Trade Manager for Ecuador's Oil Company (EP Petroecuador) between 2010 and 2017, during his time at EP Petroecuador Mr. Arias and his team negotiated $100Billion worth of crude oil on behalf of Ecuador. P5 (Horacio Cruz) is the former Director for Banco Internacional do Funchal S.A and a serial entrepreneur with over 15 years of experience in Finance. Mr. Cruz has gained experience in multiple industries, with ventures in real estate to developing a new crypto wallet and exchange platform. Each and every one of the interviewees possesses a particular experience beneficial to this thesis. From technical to financial professionals, their answers hold a certain value when talking about the crypto industry. The interview method was semi-structure which focuses on providing a set of guidelines and allowing the interviewee(s) to provide open answers. Thematic analysis will be used elaborate on the qualitative data attained.

5.1 Thematic Interview Analysis

Qualitative research must be performed rigorously and methodically as it becomes more widely acknowledged and respected to provide meaningful and valuable results. Qualitative researchers must show that data analysis was carried out in a precise, consistent, and exhaustive manner by documenting, systematizing, and exposing the analysis techniques in sufficient detail to allow the reader to judge whether the process is credible. Researchers can implement thematic analysis as a tool to display an auditable decision trail, directing the interpretation and representation of collected data (Maguire and Delahunt 2017).

Thematic Analysis (TA) aims at identifying and analyzing patterns of meaning in a dataset, in this case interviews (Braun and Clarke 2008). It highlights the themes studied in the proposed thesis.

The term "themes" refers to a certain pattern of meaning discovered in the data in this example. It can have manifest content, which is something that is directly or indirectly visible.

(Braun and Clarke 2008) present two types of themes, semantic and latent.

Semantic refers to an analysis of the dataset which does not look further from what was said. In contrast, latent analyses the core idea behind what was said; it is then deconstructed and further explored.

Braun & Clarke introduce a six-step framework to conduct thematic analysis; (1) Become familiar with the data, (2) Generate initial codes, (3) Search for themes, (4) Review themes, (5) Define themes, and (6) Write-up.

Reading and familiarizing yourself with the data is the initial stage in any qualitative analysis (i.e., all the interviews and other data used). Following this, data needs to be organized in a meaningful and systematic way. For example, coding reduces information into small chunks of meaning. However, coding will vary depending on perspective and research questions.

The analysis of the data collected was more latent than semantic. Firstly the use of open code in the form of sentences and quotes from each respondent conveyed the message of the respective answer; pre-set codes were not used but developed and modified throughout the coding process. Searching for themes involves examining the codes and identifying which fit into a theme. In this particular TA, the preliminary themes were Implementation, Evolution, Value, Education, Risk, Regulatory Framework, Golden Opportunity, Implementation. However, after further review of the themes, it was clear that some were similar and would have to merge for the information to be more concise. Figure 3 below shows the phrases from each interview with its respective code. Implementation refers to the way in which Crypto, CBDCs and DeFi can be introduced in today's financial system, some of the points discussed are the fear of its illegal use due to the principle of anonymity. Regulatory Framework raises the questions and concerns over the limitation which CBDCs, DeFI and Crypto phase today which are mainly Political due to governmental interest in restricting its formal use as a way of protecting fiat currencies.

Interviewee	Open Codes "Interview Quotes"	Closed Codes "Themes"
Nilsen	Volatile	**Implementation**
Cardoso	Tremendous evolution of the ecosystem self-execution supported by Blockchain	**Implementation**
André Padrão	I think banks will inevitably have to adopt it sooner or later.	**Implementation**
Hailey	Concerns over cryptocurrency being used for money laundering and terrorist financing	**Implementation**

Cardoso	Tremendous evolution of the ecosystem self-execution supported by Blockchain	**Implementation**
Hailey	Concerns overcryptocurrency being used for money laundering and terrorist financing	**Implementation**
Horacio	Concerns overcryptocurrency being used for money laundering and terrorist financing	**Implementation**
Horacio	Extremely risky	**Implementation**
Cardoso	Current regulation is wrongly fitting the new reality	**Regulatory Framework**
André Padrão	Extremely risky	**Regulatory Framework**
Nilsen	Lack of Regulatory Framework	**Regulatory Framework**
Horacio	Government needs to intervene	**Regulatory Framework**
Hailey	Without the need of intermediaries like banks, and with less government surveillance/control	**Golden Opportunity**

Figure 1: Sample of Theme Code Analysis

Similarly to any other industry there is an opportunity of being the first adopters or movers, referred in this thesis as "Golden Opportunity," the key takeaway is the opportunity that banks and private intermediaries gain by adopting and allowing for the distribution of Digital assets in today's financial system. Demand is present in today's market, however it is at a halt due to the lack of regulations and acceptance by each government.

Interviewee	**Open Codes "Interview Quotes"**	**Closed Codes "Themes"**
Horacio	By Government and banks intervening they can only benefit from the demand	**Golden Opportunity**
André Padrão	Cryptocurrencies market is a threat to fiat money	**Golden Opportunity**
Hailey	Fear based narratives about bitcoin	**Golden Opportunity**
Nilsen	Does not see it as an opportunity due to the risk and informality	**Golden Opportunity**
Horacio	Fiat Currency & Crypto can coexist based on different scenarios	**Golden Opportunity**
Horacio	More server consumption,	**Golden Opportunity**
Horacio	Apple Pay,Paypal and similar platforms are only means of payment, they do not change the system	**Golden Opportunity**

Horacio	Soon crypto will be backed by projects such as Real State. Allowing them to be trusted by the public	**Intent**
Horacio	Put the decision in hands of the people	**Intent**
André Padrão	Getting rid of some of the "rubbish" that the financial system naturally produces, namely intermediaries	**Intent**
André Padrão	Everyone with the internet can participate in this decentralized financial system.	**Intent**
Nilsen	To hold value and hedge against uncertainty	**Intent**
Hailey	Peer-to-peer medium of exchange and store of value.	**Intent**
Hailey	Remove the friction that comes with cross–border payments	**Intent**

Figure 1: Sample of Theme Code Analysis

Intent refers to the underlying purpose with which it can be implemented, similarly to a mission and a vision in a company. There has to be an end goal, in the case of Crypto, DeFi and CBDCs is to put trust back in the hands of the people and allow them to take control over the financial system. However this poses a dilemma between CBDCs, a country's digital currency and the principle of removing intermediaries by many of the cryptocurrencies already in the market.

CONCLUSION

Through literature analysis and research of the thesis presented it was possible to comprehend definitions, concepts, key functions, advantages, and disadvantages of Crypto, DeFi, and CBDC's. Due to the topic's technical complexity, it was key to revert back to its foundations of cryptography as a ledger method which served the purpose of effectively eliminating intermediaries, lowering costs and increasing security. Throughout the development of the thesis access to information was limited as many of the companies in the industry are privately held. Project Results are still in process. It was very challenging to obtain qualified interviews to be part of the thesis, many of the interviews requested were unresponsive as most of the individuals are public figures and hard to reach. Out of the initial 30 interview requests sent out only 16% (5) people agreed to be interviewed. As explained throughout the following thesis Crypto is an industry that is just in its early stage, in 2020 it reached more than 83% of VISA's transaction value. In 2020 Bitcoin was recognized by the government of El Salvador as a means to store wealth and complete payments throughout the country, Nigeria has introduced its own CBDC to

combat a devalued currency and a continuous growth of its informal markets which challenge the authority of a government. Developed countries such as Japan, Korea, China to name a few are not staying behind in terms of preparing for the future and will lay the foundation and construct the blueprint that many emerging markets may follow because of devalued currencies and crumbled economies as is the case for Venezuela and Argentina. Far gone are the times to hold gold or mineral reserves to provide value to independent currencies. However, the main concern that needs to be faced is lack of regulatory framework and skepticism by the public. All the interviewees agreed that for the industry to move forward it is important to establish a clear regulatory framework that allow banks and intermediaries to hande Crypot and tap into the DeFi space, by doing so consumers will be more willing to trust it and move from just as means of storing value to an actual fiat currency. The adoption of Cryto & DeFi is imminent, a clear example is the Metaverse introduced by Meta in 2021 (Milmo 2021) which has created a whole new landscape of the virtual world in which the opportunities are endless.

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APPENDICES

APPENDIX I: Interview Questionnaire

Main Set of Questions

1. What is your opinion on digital currencies?
2. In your point of view, what are particular uses of crypto, nowadays?
3. Should the average Person be handling/investing in crypto?
4. In your point of view what is the biggest concern with crypto
5. Do you believe that offering digital currencies is risky regarding banking.
6. How do you think crypto or digital currencies have benefited the economy?
    a. How do you think it will benefit it in the future?
7. In your opinion what role does the gov currently play in crypto
    a. If Yes, how?
    b. If No, Do you think regulations should be put into place?
8. How do you think developing countries can benefit from it
9. Do you believe education can limit the use of crypto
10. What is your opinion in CBDC's
11. Do you believe that central banks should adopt cryptocurrencies?
12. Do you think the Portuguese banking system is ready to incorporate digital currencies?

Extension for Montepio

6. How do you see your bank differentiates from its competitors?
7. What currently technological advancements have you developed in your bank
8. Where is the bank heading?
9. What is the bank's interest in digital currencies and cbdcs

9.1 How do you see digital currencies helping the bank to grow

APPENDIX II: Interview André Padrão

André Padro is a software engineer at Banco Montepio who focuses on emerging trends. Mr. Padro's answer only represents personal opinion and not Montepios'.

Mr. Padro believes that cryptocurrencies and DeFi should be implemented in the economy for various purposes, such as financial speculation, liquidity, protocols, lending, and borrowing, and highlights their current use in non-fungible tokens (NFTs). Mr. Padro said that despite the extremely high risks of cryptocurrencies and digital assets, "ordinary people" must aspire to be financially educated and invest informally, noting that education helps promote cryptocurrencies and digital assets. At the same time, It also highlights that the market is not ready for widespread adoption without regulation. Additionally, Mr. Padro believes that the lack of regulation is one of the main concerns regarding the limited retail adoption of cryptocurrencies due to the lack of investor protection.

Due to the risks associated with misinformation and the protection that third parties must provide to their stakeholders, the digital money supply for central and private banks has yet to be determined.

The digital currency supply of central and private banks is yet to be determined due to the risks associated with misinformation and the protections that third parties must provide to their stakeholders.

However, Mr. Padrow believes that most banks will eventually offer digital currencies and assets, albeit perhaps not in the mass market sense. For example, an early stage might be to create an exchange-traded fund (ETF) to monitor the performance of a token, in this case, Bitcoin. With the help of smart contracts, he believes that DeFi is paving the way for a more transparent, less costly financial system and has fewer third parties, but he acknowledges that anti-money laundering and counter-terrorism laws are significant hurdles. DeFis' slogan is "Banking the Unbanked," so it can help minimize barriers to entry for financial instruments or services by allowing everyone with an internet connection to join a decentralized financial system economy of developing countries.

In the case of CBDCs, he sees them as inevitable for banks, as the rise of cryptocurrencies poses a threat to fiat currencies and requires central banks to regulate the financial system. He

also believes that any government that does not regulate its financial system puts itself at risk, so its role is crucial. Furthermore, he noted that the most developed and democratic countries would try to regulate and establish a CBDC for their financial systems, as regulation or prohibition is the only option. As far as the Portuguese financial market is concerned, he believes it is ready to embrace digital currencies and has been relying on the European Central Bank.

Montepio's technological differentiation is made possible by the creativity to harness business opportunities and technological challenges. For example, we recently integrated a large amount of data into a multi-cloud environment with the help of Microsoft and IBM. As a result, DeFi solutions help banks grow from a technical and financial perspective. For example, a product that enables deposits at twice the industry's rate of return benefits both customers and banks.

APPENDIX III: Interview Paulo Cardoso do Amaral

Paulo Cardoso do Amaral is a Professor of Economics at Católica Lisbon SBE and a renowned academic in Portugal whose expertise is sought by influential papers such as Jornal Economico, Portugal's number one Economic Newspaper. When questioned about DeFi in cryptocurrencies, Professor Cardoso referred us to an opinion piece in "Jornal Económico". In his piece "**A final as criptomoedas vieram mesmo para ficar**" Professor Cardoso points out that the durability of cryptocurrencies is irreversible, as digital assets' value lies in the powerful economic impulse they present. When it comes to problems regarding anonymity due to lack of identity verification, Professor Cardoso mentioned that this matter had been addressed by using decentralized identifiers (DIDs) and is being built using the European blockchain services Legal Section Infrastructure (EBSI) project. "Using DID, digital identification is complete in two steps: the token points are sent to another properly authenticated token when needed. Just as digital signatures are generated from a certificate stored in citizen cards, These new identifiers will also work. However, instead of storing the certificate in the citizen card, it will be enforced on a token in the EBSI blockchain," he added. As long as digital assets are not regulated, Investing in them is risky for "ordinary" people, one of the main concerns is that most people do not yet understand the subject. Digital currencies and future economies have benefitted by supporting emerging economies and creating economic value for such currencies. Education on digital currencies can only positively impact economies that already implement them.

Professor Cardoso does not believe there is a risk associated with banks implementing CBDCs. It can be seen as a method of managing the monetary masses that will benefit the economy by allowing independent transactions in an already established digital economy. Therefore central banks can only gain by adopting digital assets. Professor Cardoso adds that the latter interest of governments will not diminish interest in other digital currencies, warning that once money becomes fully digital, it will no longer pass through banks, thus endangering the current payment system and the liquidity of the banks themselves. Therefore, the value to the economy of cryptocurrencies and central bank digital currencies goes beyond just means of payment; instead, the ecosystem for them to be used. The role of governments in CBDCS and digital currencies is to ensure that laws and regulations are enforced. Professor Cardoso believes that the laws and regulators are not yet ready for the Portuguese banking system, but if setting it up means selling crypto assets, it makes perfect sense.

APPENDIX IV: Interview Hailey Lennon

Hailey Lennon is a partner at Anderson Kill, a nationally recognized law firm in the United States. She. is the founder and president of CryptoConnect non-profit that spreads education in the crypto industry. She is also a legal analyst at Forbes Magazine and a former Coinbase associate general counsel regulator. Hailey views cryptocurrencies as a new way to participate in the financial system with less government control and oversight or intermediaries. Taking, for example, Bitcoin, Hailey states that technology can change the world like the invention of the Internet in the past.

There are new ways to participate in the financial system in today's world without the need for intermediaries, less control, and government oversight. As an example, Bitcoin's technology is able to change the world as the Internet once did. The lack of regulations and oversight raises concerns regarding the illegal use of digital currencies. Hailey quickly mentions that most companies in the industry have programs in place or under development that can prevent illegal activities. Not only are private companies preventing illegal activities from happening, but government entities as we. Hailey provides a vast example of how the United States already regulates digital assets. Financial Crimes Enforcement Network (FinCEN)view cryptocurrencies as money, which allows them to implement already well-established regulations in the industry. The Office of Foreign Assets Control (OFAC) views them as assets. The Internal Revenue

Service (IRS) views them as property. It requires anyone who has acquired or sold crypto assets to report them in their quarterly tax forms, the U. S. Securities and Exchange Commission (SEC) admitting cryptocurrencies can be a security, and the Commodity Futures Trading Commission (CFTC) as a commodity. Many people invest in cryptocurrencies merely for speculative reasons, when the primary intent of digital currencies is peer-to-peer as a medium of exchange and store of value. Hailey mentions that everyone should be part of DeFi, but such complexity scares them off.

DeFi and cryptocurrencies benefit the economy is by allowing individuals to diversify their portfolios and hedge against inflation. The friction in cross-border payments is removed by making them more efficient and cheaper than traditional financial ways. Developing countries can benefit from cryptocurrencies as they fight inflation by being limited assets, and the fact that most developing countries lack trust in the government puts the power in the hands of citizens and lets them choose how to participate in the economy, even those unbanked.

CBDCs, are a form of virtual fiat currency issued and regulated by each country's central banks; Hailey argues that they will improve the traditional financial system, even with the oversight of governments and banks. The United States was left behind in what concerns CBDCs since they are still in the research phase while 39 countries are developing, piloting programs, or launching CBDCs. Moreover, central banks would make a mistake by not adopting cryptocurrencies as the traditional banking model needs improvements in infrastructure and technology.

APPENDIX V: Interview Nilsen Giordano Arias Sandoval

Nilsen G. AriasSandoval, the former International Trade Manager for Ecuador's Oil Company EP Petroecuador between 2010 and 2017, agreed to interview and provide his opinion on DeFI and CBDCs.

Nilsen states that digital currencies do not give him any confidence due to their volatility and risk without a proper regulatory framework. A quick example is a speculation on tokens such as Dogecoin, which over a short period increased its value drastically and after its crash has stayed stagnant. Crypto use is informal nowadays; its worth is still valued in dollars or euros; central banks, stock exchanges, and every day retailers have yet to implement it into their economies.

The lack of education and complexity around crypto increases its risk dramatically. People can invest and handle it; however, it is riskier than investing in other forms of storing value.

Crypto & DeFi do not directly benefit the economy as they are not factored in any country's GDP or generate jobs. The only way in which it. The future can benefit from government oversight, intermediaries, and regulatory frameworks.

The Portuguese Banking system is not ready to implement digital currencies to the bureaucracy and is part of the European Central Bank.

APPENDIX VI: Interview Horacio

Horacio Cruz is the former Director for Banco Internacional do Funchal S.A and a serial entrepreneur with over 15 years of experience in Finance. Mr. Cruz has gained experience in multiple industries, with ventures in real estate to developing a new crypto wallet and exchange platform with licenses from the government of Dubai and waiting for the license in Estonia. The new token's initial coin offering (ICO) is expected for April 2022. This Interview only represents Mr. Cruz's individual opinion and it is independent from the companies of which Mr. Cruz is part of.

Digital currencies are an alternative to the standard fiat currencies and are a part of the decentralization of finance as we used to know it. The finance world is adapting to new technologies, and everything from banking to the way we make purchases are changing - for example, Apple Pay, Google Pay, and similar nowadays are no more than platforms that still use traditional fiat currencies credit cards to make payments online and/or on the street (restaurants, brick and mortar stores, etc). Mr. Cruz believes that a day will come when these platforms will also serve as wallets for cryptocurrencies, and payments with these digital coins will also be possible on these "classic" platforms. At BRExchange are positioning ourselves to be at the forefront of this change by offering the platform to serve as a wallet and exchange for different fiat and digital currencies, not only its token. Digital currencies will be a significant part of finance decentralization and will be more and more used. Having said this, society is at the beginning of this transformation, and we still have a way to go before everyone understands how it works and how best to use these new digital currencies.

Moreover, as with all innovations, some digital coins are worthless, and others have intrinsic value. BRECoin will have liquidity and will be invested in branded real estate projects, so the owners of our tokens will have participated in several branded real estate projects worldwide. BRExchange has an underlying asset to its digital currency, much like the tokenization of assets

that will also be part of the finance decentralization transformation. It will happen with real estate and with companies that are now going public via IPO but that will be able to go public via ICO of a token-related currency in the future. So the transformation will be at all levels of the finance industry, from currencies to payment methods to corporate finance to real estate investments, etc. There will be the need for regulation, and the governments and central banks are starting to look at these alternatives seriously - first to collect taxes on profits and second to prevent these digital currencies from being used for money laundering, tax evasion, terrorism finance, etc. Compliance will play a crucial part in the regulatory environment.

Nowadays crypto is not being used to its full potential, first because there's a lot of misinformation and lack of knowledge as to how it works for most of the population, and second because there's no clear understanding from governments and central Banks as to how to approach it (and also because there are very powerful lobbies that are trying to keep the established status of the traditional system). For example, when Uber first started doing business, taxi lobbyists everywhere tried everything to prevent Uber from doing business because it would reduce their market share, and Uber is here to stay because there is a significant demand for their services due to convenience and price. However, it does not mean that the taxis are extinct - sure, there is a significant reduction in demand for taxis, but they still operate - they had to adjust to the new reality. Mr. Cruz believes that the Uber example is a clear blueprint of what will happen with cryptocurrencies. Due to its convenience, it will be more and more used, but it does not mean that it will replace fiat currencies. Instead, they will coexist and be part of the same industry and used in different scenarios depending on demand.

Nowadays, crypto is mainly used as an investment class of assets due to its current limitations. Even though it can be used as an investment product, crypto will mainly be used to make payments in the future much like any other currency. There is demand for that, and once the regulatory landscape is established, people will trust and use crypto more not only as an investment asset on its own but also as any other investment class like investing in real estate, equities, commodities, debt, whichever the underlying fungible asset is used for each digital coin. So once the average person understands the full potential of crypto and has confidence in them (and for this, there needs to be regulation from governments and central Banks), Mr. Cruz is confident that more and more people and companies will start trading and making/receiving payments in crypto. Mr.Cruz's opinion is that some digital coins are worth it and others are

worthless, and the average person should be cautious when making long-term investments in this type of asset class.

Mr. Cruz believes that the lack of a regulatory landscape is the primary concern for crypto. Governments and central Banks must define the rules for this new transformation and use it as an opportunity to simplify the financial industry for the average person, making it accessible and understandable to them and at the same time for companies to start making and receiving payments in digital currency. Furthermore, it is known that the lobbying industry will try to delay the process for as long as they can (Uber example). Mr. Cruz believes the demand is present, and a transformation is inevitable with certain transparency to illegal activities.

The Banks are already losing ground - look at the payment methods. Apple Pay, Google Pay, Transferwise for international wires, private lending companies, etc. These companies disrupted the Banking status in recent years in one way or another. This is even more obvious in the US than in Europe for cultural reasons (most of these innovative companies originated in the US - but that is another academic thesis on its own). Banking will survive, but it will have to adjust like the taxi industry when Uber started their business. Mr. Cruz believes that Banks will be smaller and more efficient and will have to start offering investments in crypto like any other asset class nowadays (equities, commodities & fixed income). Banks should look at this transformation as an opportunity rather than a threat, and the first Banks to understand this will be the winners (of course, after the regulation is established, as previously mentioned).

Crypto has not had the impact yet that it will undoubtedly have due to lack of regulation and supervision, as previously mentioned, so nowadays, the impact is minor but will undoubtedly increase in the future. The change is reluctant, as with any transformation, but it will happen sooner or later, and the demand will force that change. Governments will also want to understand better, and of course, they will want more transparency (for compliance reasons) and tax collections once crypto is used in transactions to buy and sell all sorts of assets, not only as an investment tool as it is being perceived today. The macroeconomic aspect will play an essential part in the future. Mr. Cruz's opinion is stated above once the governments start looking at crypto as an opportunity to 1) increase transparency and 2) increase tax collections, then, together with the increasing demand from persons and companies, they will be almost compelled to put a regulatory landscape in place. Some governments are already starting, Mr. Cruz believes there will be a lot more regulation in two years, and people and companies will have more confidence

in using crypto and the traditional fiat currencies for all types of financial needs. We at BREH (our Holding company for the crypto) are one of two companies that have signed an agreement with the government of Dubai to help them create this regulatory landscape, giving us the privilege of being at the first seat of this transformation. Some countries have already jumped into the crypto wagon - El Salvador being the first, but the truth is that there is not much information, and together with some tech issues, the rollout was not that successful.

Nevertheless, this was to use Bitcoin as another currency. Mr.Cruz states that the developing countries can benefit from crypto by creating their crypto-like they use their fiat currency today but making it available to all citizens and at the same time using it as a way of tokenization of their national assets like a big national company, or a government building, or anything that has a value, and selling those tokens thus getting additional funds for their national budget. Information is crucial so that the average person understands crypto and can use it as they use fiat currency today, the only difference being that crypto is 100% digital. There are no physical coins nor $20 bills to own. Everything will be in their digital wallets. This will be one of the most critical aspects of the transformation. There is crypto already linked to the USD, and it is a stablecoin not meant to give profit but rather to serve as a stable currency in the market. However, it is private (issued by BitFinex), and therefore it is not a CBDC by itself. Mr. Cruz believes Central Banks should have their cryptocurrencies equivalent and linked to their fiat currencies, and people would use them as digital currency in their digital wallets to make payments as they do with the traditional payment systems (bills, coins, credit and debit cards, checks, etc). Sooner or later, because the demand is there and the decentralization of finance will cause it to happen with all the technological evolutions at an ever-increasing pace. This will benefit from bringing stability to the crypto market, and citizens will use it for their daily use as they do today with fiat currency, with the advantage that it is digital. Globally speaking, Banks are still very attached to the traditional banking system, and it is going to take some time to make the change to digital currencies. However, with everything, if there is a will, there is a way - these days, it only depends on the banking system and the central Banks to make this change. From a technological perspective, Mr.Cruz do not think it will not be straightforward to adjust all data centers and systems to incorporate another currency in the Banks' internal systems as they do today with FX in foreign currencies. Maybe there will be more server consumption, creating the need for a more

robust and faster information database. This also applies to the Portuguese Banking system, of course.