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What is Preventing the Wider Use of Digital Currencies?

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Abstract — **The aim of this paper is to broaden the discussion on the main barriers to the use of digital currencies. The main problem of the research conducted arises from the fact that trust in digital currencies is highly dependent on public opinion, legal regulations and understanding of the technical aspects. Although they offer significant advantages such as transparency, traceability and low transaction costs, the markets for cryptocurrencies are highly volatile and therefore too risky for broad social acceptance. In this paper, topological data analysis (TDA) is used to investigate multiple currencies. TDA is primarily used to gain more insight into market activity, volatility and the connection between coins or tokens, as well as information about the market itself. Given the growing interest in cryptocurrencies and investing in recent years, the paper addresses the need for informed decision making in an evolving market. Vulnerabilities in exchanges, private wallets and trading wallets are examined and analyzed.**

Keywords - cryptocurrecy; currency; digital; investor; trading

I. INTRODUCTION

Blockchain refers to blocks of data connected in a one-way chain where each new link or block depends on the value of the previous older link. In other words, it is an immutable database with secure access in which transactions can record transactions, which are verifiable between parties. Decentralization is a key feature of blockchain that can improve transparency, traceability and low transaction costs. Transactions must go through so-called "blockchain confirmations" to be recorded in the blockchain, and once they have been validated by other nodes, they can no longer be changed. Therefore, there are a number of websites that provide transactions and timestamps of the transaction depending on the network that the transaction passes through [1]. Blocks are the data containers that define a piece of digital information and consist of a header and a list of transactions. The block header contains metadata that includes the hash of the previous block and is identified by either the block hash or the block height. Consensus mechanisms form the backbone of any blockchain-based application. The decentralized nature of blockchain requires a set of rules to find a way for users to agree on a particular state. There are a variety of consensus algorithms, the most well-known being Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, Practical Byzantine Fault Tolerance (pBFT), Proof of Activity (PoACT), Proof of Burn (PoB),

Proof of Capacity (PoC) [2]. Blockchain is a key innovation in the field of decentralized currencies as it enables peer-to-peer value transfers between parties without a trusted third party. There are a few factors that may impact blockchain on the development of the payments industry and CBDCs themselves. Cost is the first factor, and these payment systems can offer lower transaction costs, especially for cross-border payments, currency exchanges and other payment scenarios. A second factor is ease of use, and it is said that blockchain technology makes the transaction process more intuitive and easier to integrate with other services. Last but not least, anonymity is a third factor, allowing users to carry out transactions without providing their own real credentials [3].

A. Blockchain types

In the past, there were mainly three blockchain networks. The public blockchain is a permissionless distributed ledger technology that allows anyone to interact and transact. In simple terms, this means that anyone with access to the internet can explore the public blockchain. Ethereum and Bitcoin are two of the most well-known examples of a public blockchain. A private blockchain operates in a closed network. It is also a blockchain with permissions that are managed by an organization. Private blockchains are fantastic if a private company or organization wants to use a blockchain for personal purposes. Also, the company can set various network parameters, such as authorization, accessibility, etc. A hybrid blockchain is a mixture of private and public blockchain. Some transactions can remain private, while others can be transparent. Its main advantage is that certain rules can be changed if necessary. Hybrid blockchains can reduce costs in healthcare (they allow selected medical research data to be transparent), retail (some records such as the description of a product or service can be transparent, while others such as the customer's name can remain private), logistics (they show where the product was manufactured and hide sensitive information about the price at which it was purchased), the Internet of Things (they publicly show which group of users used the device, but do not reveal the user's name), etc.

Although the first scientific research paper on cryptography appeared in the early 1990s, the blockchain as we know it today was described and defined in 2008. At that time, "someone" under the pseudonym Satoshi Nakamoto set up the website bitcoin.org and published a

white paper called "Bitcoin: A Peer-to-Peer Electronic Cash System". In the same year, the white paper was sent to one of the popular mailing lists among cryptographers, where it met with great interest [4].

B. Smart contracts

Nick Szabo first described smart contracts in the 1990s, putting contracts into a code that could be both trustless and self-enforcing, thereby increasing efficiency and eliminating the ambiguity of contractual relationships [5]. The general goals of smart contract design are to satisfy common contract terms such as payment terms, liens, confidentiality, and even enforcement, and to minimize bad faith and accidental exceptions. The economic goals include reducing fraud losses, enforcement costs and arbitration proceedings [6]. Some good examples of smart contracts are digital money protocols. Few technologies that exist today can be considered as simple smart contracts, e.g. POS terminals and cards, EDI and algorithmic allocation of bandwidth in public networks.

Smart contracts have the potential to significantly reduce the fraud and enforcement costs of many commercial transactions. An important role of smart contracts is to communicate the semantics of the transaction to the parties involved. In [7], an example was discussed where grocery store POS machines don't tell customers whether or not their names will be linked to their purchases in a database. The clerks don't even know, and they have processed thousands of such transactions under their noses. So, through a hidden action of the software, the customer reveals information that they might consider valuable or confidential, but the contract and transaction are designed to keep these important parts of the transaction hidden from the customer [8].

II. DIGITAL CURRENCIES

Central Bank Digital Currency (CBDC) is a new form of money that only exists in digital form. Instead of printing money, the central bank issues widely accessible digital coins that facilitate digital transactions and transfers. They are similar to cryptocurrencies, except that their value is set by the central bank and corresponds to the country's fiat currency. Many countries are in the process of developing digital currencies and some have already introduced them [9]. A report by [10] shows that the impact of CBDCs on financial stability as a whole and on the banking sector is not well studied. Most studies are based on simulations and theoretical models without empirical support. Data from 86 countries and 1176 banks from 2010 to 2021 show that the introduction of a CBDC contributes to financial stability. It is important to understand that a CBDC currency works differently from traditional currencies, where fiat money is not backed by a physical commodity such as gold or silver. Physical currencies are still widely exchanged and accepted, but their use has declined in some developed countries, and this trend has intensified during the pandemic [11].

According to [12], a CBDC should have four basic functions of a currency: medium of exchange, store of value, unit of account and means of payment. CBDCs can be divided into two categories: the first category is retail CBDCs, the second category is wholesale CBDCs. Retail CBDCs are designed to be directly accessible to the public, businesses and individuals. They are digital forms of currency that mimic traditional cash and provide individuals with a direct claim against the central bank. They enable peer-to-peer transactions, online purchases and in-store payments and offer an alternative to traditional payment methods. The main goals of CBDCs for retail are accessibility, privacy and anonymity, financial inclusion and customer protection. Some of these challenges are the reason why retail CBDCs lag behind wholesale CBDCs in testing and adoption. Wholesale CBDCs are aimed at financial institutions and facilitate the processing of high-value interbank transactions and other financial transactions. They primarily serve to improve the efficiency of the financial system and enable real-time settlement. Key benefits of wholesale CBDCs include streamlined interbank settlement, greater market efficiency and improved regulatory oversight [13].

So what is the difference between stablecoins in cryptocurrencies and the CBDC itself? Stablecoins are a type of private, stabilized cryptocurrency that is pegged to another currency, commodity or financial instrument with the goal of maintaining a relatively stable value over time. Stablecoins or cryptocurrencies are an encrypted form of digital currency that is not dependent on a government or financial institution, which is a key difference between digital currencies and cryptocurrencies. These stablecoins, which are supposedly convertible one-to-one with the dollar, have also been discussed as an alternative to traditional payments. However, stablecoins are less secure, less stable and less regulated than traditional forms of money, and their structures and frameworks are opaque. To the extent that stablecoins are widely used in everyday payments, these characteristics could raise significant concerns. Unlike cryptocurrencies, which are decentralized, CBDCs are issued and operated by the state [14]. The research conducted by [15] has shown that the CBDC framework based on the blockchain consists of three layers, namely the regulatory layer, the network layer and the user layer. The regulatory layer is mainly used to control and manage the entire lifecycle and includes the central bank, public key infrastructure with identity authentication and other regulatory bodies. The network layer is the bridge between the top-level regulators and the normal users. The user layer consists of the ordinary users and their transactions, which are not only the regulation objects of the regulation layer, but also the main data source for the verification and processing of the network layer currency with a focus on social adaptation and education.

A. Digital euro

A digital euro would be an electronic means of payment that would be available to everyone free of charge. Like today's cash, it could be used anywhere in the euro area, and it would be secure and private. As mentioned earlier in the text, the use of digital currencies is quite broad, and the European Central Bank talks about them being used for everyday purchases, payments between friends, travel abroad and online purchases with additional features. Recurring payments would be something that citizens could use, even though they

already exist in some digital banks [16]. The Eurosystem would work to ensure that payment service providers across the euro area can offer a harmonized and secure service, available to hundreds of millions of end users and meeting high IT and cybersecurity requirements [17]. The digitalization of the economy is affecting all aspects of people's daily lives, including the way we pay for certain products or services. To better understand how consumers are changing their habits, the ECB has conducted several surveys to investigate the payment attitudes and behavior of euro area citizens. It examines trends in payment habits, payment behavior by value range and purpose, recurrent payments, preferences for and benefits of cash and cashless payments, cash in wallets and cash reserves, and consumer access to payment instruments.
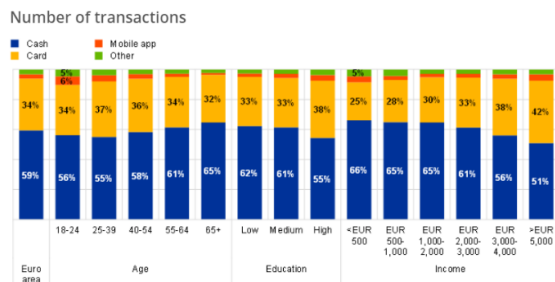

Figure 1. Popularity of different means of payment in the EU according to age, education and income status

The survey has its own results, which reveal common and unusual findings based on the citizens of the countries surveyed. Figure 1 shows that cash is the most commonly used payment method at POS in the Eurozone, accounting for 59% of total payments. The survey suggests that people are holding more cash reserves today than in the past. This information collected and analyzed by the ECB is helpful in monitoring trends in the use of payment instruments, as it can track changes and trends in the retail payments landscape [18].

B. Usage and features

Table 1 shows the differences between CBDCs and cryptocurrencies. While CBDCs are always widely accepted as legal tender, cryptocurrency is only accepted by a small number of retailers. For example, one retailer that accepts cryptocurrency payments is Ford Croatia. The main difference is that CBDCs are centralized, while cryptocurrencies are usually decentralized. CBDCs as a store of value are stable and in line with the central bank's price stability mandate, while cryptocurrencies are more volatile and can cause gains or losses in the portfolio. One of the main problems of centralization is that a person or company is always tracked if they make multiple large transactions, while decentralized transactions are hidden and anonymous if they are not disclosed. As mentioned in [19], the CBDC would likely monitor transactions to prevent fraud due to centralization, unlike cash payments. Issuing a CBDC may require additional monitoring and compliance with anti-money laundering and combating the financing of terrorism (AML/CFT) laws. Given the special characteristics and potential risks of CBDCs, some countries may decide to introduce laws and regulations

specifically for them. Issues such as customer due diligence (CDD), transaction monitoring, reporting obligations and compliance requirements for CBDC actors may be covered by these regulations. On the other hand, other countries may decide to change their current AML frameworks to incorporate CBDCs into their legal system. This strategy utilizes established AML rules and methodologies to integrate CBDCs into the current legal and regulatory framework. It ensures that CBDC stakeholders, such as central banks, financial institutions and technology suppliers, are subject to the same AML rules and obligations. There are some difficulties and things to consider when implementing CBDCs and AML frameworks, including the role of AML solutions for banks. Protecting individuals' sensitive data while identifying and preventing illicit activity requires a balance between data protection concerns and AML objectives. Effective cross-border anti-money laundering with CBDCs requires global cooperation, harmonization of regulations and information sharing platforms. In addition, the implementation of CBDCs brings with it cyber security threats and technological vulnerabilities that must be effectively addressed to maintain trust and system integrity. There will be awkward situations where individuals or a company are monitored by a single source. The degree of anonymity will depend on the technology and features chosen and may vary from country to country. If CBDC is made more anonymous, this would allay people's concerns about the security of internet transactions, which could lead to an increase in illegal transactions or tax evasion. These negative externalities would create additional social costs.

TABLE I. MAIN DIFFERENCES BETWEEN CBDC AND CRYPTOCURRENCIES

ATTRIBUTE	CBDC	CRYPTOCURRENCY
Means of payment	Universally accepted, legal tender	Accepted by a small number of retailers
Store of value	Stable, consistent with central bank price stability mandate	Tend to be volatile, depends on the market price, excluding stablecoins
Unit of account	Fiat currency (e.g., United States Dollar)	Own unit of account (e.g., token or coin)
Governance	Centralized	Typically decentralized, relies on consensus between large number of entities
Transaction verification	Small number of trusted entities	Many competing entities

The most important question is whether banks should be allowed to issue their own digital currency. This way, according to [20], the government could easily track how much a person owns and what they spend it on without the judiciary having to seize the information. For this reason, people prefer physical cash. Even though the cost of producing physical cash does not completely limit the government's ability to devalue a currency, a central bank could, without printing dollars or minting coins, create hyperinflation at no cost by simply adding more zeros to accounts. Theoretically, a country's currency law could

establish a new, second currency unit in which CBDC would be expressed. However, such a law would also have to specify the mechanism for determining the exchange rate to the country's existing monetary unit. Many central bank laws grant the central bank a legal monopoly on the issuance of banknotes. Whether a central bank monopoly for digital currencies is desirable or appropriate is ultimately a matter of political and policy decision. That being said, the issuance of private digital tokens similar to CBDC could lead to very similar problems, including a serious disruption of the monetary system caused in the 19th century by the issuance of banknotes by private banks that were subsequently unable to meet their obligations to exchange these bills for real currency [21].

III. VULNERABILITIES AND RISKS

To trade successfully in the cryptocurrency market, specific knowledge is required, such as knowledge about cryptocurrencies, how to buy, how to find a suitable exchange, how to own a wallet and how to open an account with a centralized exchange with identity confirmation. In practice, there are different types of investment, depending on the technical and fundamental analysis or the information provided by the institutions and the economic situation. There are many options, from staking, mining, affiliate programs, surveys, learning and earning programs, referral bonuses, yield farming, dividends, lending, to the recently popular airdrops. Airdrops usually require several tasks to help the project itself and earn the right to receive an airdrop. In general, airdrops have recently proven to be very rewarding as users can earn a significant portion of their initial investment or the tasks they perform [22].

A. CBDC critical barriers

Not everyone has the same level of digital literacy, and it is important to understand what users actually know and how they interact with digital technology, in this case CBDCs. The user experience is mainly determined by the simplicity of the website and the interactions between the user and the website. In a book by [23], we can see that digital literacy has been divided into three eras: 80s, 90s and the present time. Most of them show the same result in technological development where each era has almost the same knowledge about technology. In the current era, the older population is far behind due to the rapidly developing technology, which might affect their knowledge about the upcoming CBDCs. Financial inclusion is an important policy objective that central banks, especially in emerging and low-income countries, are considering for retail CBDCs. If properly designed to remove barriers to financial inclusion, CBDS have the opportunity to gain the acceptance of the financially excluded for digital payments. It is important to identify complementary policy measures that could accompany the introduction of a CBDC to improve financial inclusion, such as: Digital literacy programs, digital and electrical infrastructure development, and improving access to cell phones. In addition, the laws and jurisdiction of the individual countries and their laws must be taken into account. Overall, CBDC is not a panacea for financial inclusion and more experience is needed to fully

understand its potential impact [24]. CBDC and similar measures can remove several barriers to financial inclusion, but the other barriers remain. These barriers include low financial literacy, cultural factors, and low trust in formal financial institutions. El Salvador, for example, is the first country to introduce a so-called "Bitcoin law" and make Bitcoin legal tender. The environmental impact of digital currencies or cryptocurrencies is still high in terms of electricity consumption and a solution needs to be found in the near future, especially because of Bitcoin mining.

B. Exchange risk

Cryptocurrency exchanges are private platforms that facilitate the trading of cryptocurrencies against other crypto assets, including digital and fiat currencies and NFTs. There are two types of exchanges: centralized and decentralized exchanges.

Centralized cryptocurrency exchanges act as an intermediary between a buyer and a seller and earn money through commissions and transaction fees. Popular crypto exchanges today are Binance, Coinbase, Kraken and KuCoin. CEXs work with an order book system, which means that buy and sell orders are listed and sorted according to the intended buy or sell price. CEXs can offer features such as advanced trading tools, support for fiat currencies, simplified account management and customer support. Disadvantages of CEXs include the risk of hacking, transaction fees and custody of digital assets, as well as the risk of fraud. Transaction fees can be extremely high in some cases [25]. Digital asset custody and the risk of fraud emerged last year when stablecoin TerraUSD collapsed, causing the bankruptcies of Celsius Network, Voyager Digital and the sudden collapse of FTX.

A decentralized cryptocurrency exchange is another type of exchange that enables peer-to-peer transactions directly from your digital wallet without involving an intermediary. Examples of DEXs include Uniswap, PancakeSwap, SushiSwap and many others. These exchanges are based on smart contracts that allow for more privacy and less slippage or in other words less transaction fees. The disadvantages of DEXs are complexity, lack of fiat payments and liquidity constraints. Such exchanges are mainly used for exchanging one digital asset for another. DEX platforms have become a viable alternative for investors who want to overcome the failures of centralized exchanges and trade digital tokens in a more reliable, secure and decentralized way. According to recent estimates, trading on DEX platforms exceeded USD 150 billion in May 2021, far outpacing the growth of competing centralized exchanges [26].

C. Risks of Crypto Wallets

Crypto wallets store private keys that make cryptocurrencies secure and available and also enable cryptocurrencies to be sent and received. Unlike ordinary wallets where real money can be stored, these wallets are technically not stored but displayed on the blockchain, which can be accessed with a specific key phrase that belongs to the owner of the wallet. The wallet key phrase

Figure 2. MarketCap from 2019 to 2023

Rank	2019 Symbol	2019 Name	2020 Symbol	2020 Name	2021 Symbol	2021 Name	2022 Symbol	2022 Name	2023 Symbol	2023 Name
1	BTC	Bitcoin	BTC	Bitcoin	BTC	Bitcoin	BTC	Bitcoin	BTC	Bitcoin
2	ETH	Ethereum	ETH	Ethereum	ETH	Ethereum	ETH	Ethereum	ETH	Ethereum
3	XRP	XRP	USDT	Tether	BNB	Binance Coin	USDT	Tether	USDT	Tether
4	USDT	Tether	XRP	XRP	USDT	Tether	BNB	Binance Coin	BNB	Binance Coin
5	BCH	Bitcoin Cash	LTC	Litecoin	XRP	XRP	XRP	XRP	XRP	XRP
6	LTC	Litecoin	BCH	Bitcoin Cash	LTC	Litecoin	LTC	Litecoin	LTC	Litecoin
7	EOS	EOS	BNB	Binance Coin	BCH	Bitcoin Cash	BCH	Bitcoin Cash	BCH	Bitcoin Cash
8	BNB	Binance Coin	XLM	Stellar	XLM	Stellar	XLM	Stellar	XLM	Stellar
9	BSV	Bitcoin SV	BSV	Bitcoin SV	EOS	EOS	EOS	EOS	BSV	Bitcoin SV
10	XLM	Stellar	EOS	EOS	BSV	Bitcoin SV	BSV	Bitcoin SV	EOS	EOS

proves ownership of digital assets and enables transactions; if the private key is lost, access to the money is lost. A distinction can be made between hot and cold wallets. Hot wallets are connected to the internet. As it has been proven that nothing on the internet is 100% secure, funds stored in a hot wallet are always at a small risk. A cold wallet is a wallet that is secure offline and cannot be intentionally or accidentally compromised over the internet [27].

The tests conducted by [28] of attacks and countermeasures on crypto wallets that can be downloaded from the Google Play Store have shown that apps with certain permissions can read or write to the external storage and modify the data in the storage. Researchers targeted one of the largest wallets available, such as Blockchain Wallet, Bitcoin.com Wallet, BitPay, Coinbase Wallet, Trust Wallet and others. To prevent accidental loss of application data due to device corruption, the Android operating system has an application backup service that can back up the data to a local file or to a cloud server for recovery.

IV. DECISION-MAKING IN AN EVOLVING MARKET

Investors come to a point where they have to decide whether it is better to invest in cryptocurrency markets or stock markets or not to invest at all, taking into account all the risks. When it comes to trading cryptocurrencies and deciding which coin or token to invest in, it is important to know how to analyze cryptocurrencies [29]. Fear and uncertainty in the markets are rife, and investors are looking for ways to protect themselves from losing their funds when trading. An analysis of Bitcoin's hedging capabilities has shown that BTC can serve as a safe haven against stocks and the dollar [30]. There are some rules of thumb that every investor should follow. The first and most important step is to read the white paper, which defines the objectives and technical details of the blockchain and the role of cryptocurrency. Secondly, it is important to find out who is behind the individual projects. This may involve checking LinkedIn profiles or the "About" page on the cryptocurrency website. The biggest warning sign is an anonymous team or developers who do not want to reveal their identity. Once an investor has done all the above steps, they should also try to understand the technology and vision, review the roadmap and learn tokenomics. Tokenomics refers to the circulation, distribution and overall supply of a particular cryptocurrency. However, none of this means that it will help the project grow. According to [31] almost 75% of comments on targeted coins are neutral and positivity is higher than negativity. It is important to emphasize that this research was only conducted on a social platform called Reddit. According to the charts created from the collected results, the price has an impact on the social activity of cryptocurrency. For most coins, there were price spikes up or down depending on the number of comments made during that period.

Figure 3 contains a ranking of 10 selected cryptocurrencies, although it should be noted that these are not yet the largest in terms of market capitalization in general since the data was first taken in December 2019 where these 10 currencies were largest and taken as an example during 4 years of data. The use of ranking sites such as Coinmarketcap.com for this paper is then a means to ensure highly accurate data. The data was collected every year from 2019 to 2023 in December on specific days in the last week of the month. Figure 4 shows that the market capitalization has not changed significantly after the bull run in 2021 and the ranking shows the strength of the top coins and their popularity. Figure 4 shows a correlation matrix with Pearson correlation coefficients below the diagonal. The table shows that all correlations are predominantly positive, with the strongest pair at 0.9 and the least correlated at 0.1.

	Bitcoin	Ethereum	Tether	Binance Coin	XRP	Litecoin	Bitcoin Cash	Stellar	Bitcoin SV	EOS
Bitcoin	1									
Ethereum	0,91325	1								
Tether	-0,5168	-0,430018908	1							
Binance Coin	0,8001	0,969585967	-0,4347	1						
XRP	0,93016	0,996102149	-0,3824	0,949003877	1					
Litecoin	0,69667	0,65997058	-0,6133	0,567669204	0,64191	1				
Bitcoin Cash	0,67719	0,614538319	-0,1838	0,458984945	0,63505	0,86966	1			
Stellar	0,85188	0,81346633	-0,3086	0,678013675	0,83024	0,87517	0,955989774	1		
Bitcoin SV	0,10307	-0,014798648	-0,0578	-0,155705532	-0,0059	0,66725	0,756651268	0,5433	1	
EOS	0,08281	0,127994185	0,25908	0,032674421	0,14047	0,56171	0,779605505	0,59095	0,872158496	1

Figure 4. Pearson correlation coefficient between selected cryptocurrencies

V. CONCLUSION

Blockchain technology has been on the rise the past couple of years and it's most likely to be used more in the near future with its promising technology. With smart contract implementation we have the potential to significantly reduce the fraud and enforcement costs of many commercial transactions. Before CBDCs are officially introduced, numerous security measures must be taken to ensure the privacy and protection of users and institutions. The digital euro is a good start for the abolition of physical cash and the acceleration of transactions between intermediaries. In the future, wholesale central securities depositories could be a viable option for the settlement of certain financial market transactions and the processing of international payments. In terms of some of the broader design and policy issues, particularly in relation to consumer privacy and the impact on the banking system, it is difficult to envision a world where the trade-off between benefits and unintended consequences could justify a

direct access to CBDC for purposes other than interbank and wholesale transactions. It is important that we carefully consider the evolving money and payments landscape and digital innovation in general, including a potential European CBDC. Therefore, the most important task is to invest time to find the safest way to manage trades and portfolios and make this information available to other users to avoid worst-case scenarios.

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