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INTRODUCTION

Before the 2008 financial crisis, the term "crypto assets" was primarily the preserve of a minority of computer scientists and engineers experimenting with new technologies as a means of decentralizing finance. They subsequently launched the first projects involving blockchain, but it was the white paper on Bitcoin by Satoshi Nakamoto in 2008 that introduced crypto assets as an area of interest for investors and financial institutions with higher risk appetites. The wider public followed shortly afterward and, later, regulators.

Crypto assets reached a market capitalization of $3 trillion by the end of 2021. Their interrelationship with global financial markets is increasing, the profile of investors in crypto-asset markets is diversifying, and the applications and nature of the crypto-asset market are also expanding rapidly; from cryptocurrencies to decentralized finance (DeFi) ecosystems enabled by smart contracts to Non-Fungible Tokens (NFTs), the Metaverse, Web 3.0, the list goes on.

However, their contribution to social value is questionable and overdue for further investigation. The main proponents of crypto assets argue that their increasing interdependence with the real economy and partial substitution of some systems of the current financial and economic model has made them irreplaceable and therefore their long-term sustainability, inevitable. In addition to reducing the necessity of intermediaries, they believe that the crypto economy enables financial inclusion whilst increasing the efficiencies of financial markets.

Detractors, on the other hand, regard crypto as little more than a speculative bubble driven primarily by greed and by those seeking to circumvent the formal system to finance criminal activities or avoid paying taxes. Not only, they argue, does the crypto economy tend to attract less seasoned and therefore *more vulnerable investors* (leading to greater indebtedness) but there are also environmental concerns that have been widely raised and the belief that the increasing prevalence of crypto assets will lead to the further financialization of the economy.

To date, however, there has been little comprehensive analysis of the *net social value* between the contrasting impacts of crypto assets and their contribution to the broader economy and society.

Our paper attempts to fill this gap and to present a novel contribution to the existing literature by analyzing the net social value of crypto assets and their impacts on society more broadly. We use Phills, Deiglmeier, and Miller's definition of social value, which establishes that a certain product or service generates social value when it creates "benefits or reductions of costs for society - through efforts to address societal needs and problems - in ways that go beyond the private gains and general benefits of market

activity". Therefore, to evaluate whether there is social value in crypto assets and crypto economics, externalities "beyond (…) market activity"[1] need to be considered.

We conclude that, thus far, the crypto economy does not add substantive social value to our societies, although this does not mean that it might not do so in the future.

The paper is structured as follows: the next section provides an overview of the current state of play of the crypto-asset market; how it works, what crypto assets are, and a brief overview of governance structures. Secondly, we examine four core claims made by crypto proponents; that it promotes democratization, transparency, trust, and inclusiveness. Lastly, we outline our concerns and conclude with several policy recommendations.

THE FRAMEWORK OF THE CRYPTO ECONOMY

The crypto economy[2] which has the blockchain as a central component has grown exponentially in the last years and most notably since the Global Financial Crisis (GFC) of 2008. Crypto assets were brought to mainstream consciousness by a white paper[3] from Satoshi Nakamoto in 2008, a pseudonym (representing a person or a group) behind the development of Bitcoin, which over time has become the oldest and most popular of thousands of crypto assets.

The Bank of England Deputy Governor for Financial Stability Jon Cunliffe noted in a speech in October 2021[4] that crypto assets were at the time worth $2.3 trillion (€2 trillion)[5], an increase of 200 percent since the start of 2021 and twice the size of the $1.2 trillion sub-prime real estate debt market in 2008 (vs $258.9 trillion in assets in financial institutions in 2008).

He remarked in the same speech that: "When something in the financial system is growing very fast, and growing in a largely unregulated space, financial stability authorities have to sit up and take notice. They have to think very carefully about what could happen and whether they or other regulatory authorities, need to act…" and that "…you don't have to account for a large proportion of the financial sector to trigger

[1] Phills, Deiglmeier, and Miller (2008)
[2] For this paper, the term 'crypto economy' is used to describe an environment in which the blockchain digital ledger forms the backbone of the offering in question be it a DeFi solution, a crypto currency, an NFT or related to Web 3.0 (Metaverse).
[3] Nakamoto (2008)
[4] Cunliffe (2021)
[5] By the end of 2021 crypto assets reached a market capitalization of over $3 trillion.

financial stability problems"[6]; we should not forget that sub-prime real estate debt represented only 0.46% of assets in 2008.

In 2021, global financial assets amounted to $468.7 trillion[7] (€424 trillion) and crypto assets represented roughly 1% of this volume. In the words of the ECB executive responsible for this area, Fabio Panetta, echoing the words of Cunliffe, this is a "larger market than subprime mortgages had before the global financial crisis started. We cannot afford to ignore them." The regulatory goal must, therefore, be to find the delicate balance between the protection and security of the *stakeholders* involved in these assets without stifling the innovative development of the technology. But to achieve this, it is essential to analyze in detail what crypto assets consist of, the technology behind them, their governance models, and their risks.

DEFINING CRYPTO ASSETS

Crypto assets do not have a standard definition but are characterized by the use of blockchain technology (blockchain) for the decentralized accounting record (distributed ledger) of the asset; they are private in that they are not issued or guaranteed by a public authority and their function is to be a payment or investment medium.[8] Although popularly referred to as cryptocurrencies, it is more appropriate to speak of crypto assets because, contrary to popular belief, cryptocurrencies *are not money* for several reasons. Money has three basic functions: means of payment, store of value, and unit of account. But Bitcoin, the most popular cryptocurrency, has limitations in all three. Its payment use is limited, volatility in its price makes it an insecure store of value, and very few contracts are issued and invoiced in Bitcoin. The unit of account used to give it value is the dollar, a sovereign money.

Furthermore, there are different types of crypto assets, which are generally described as *tokens* and amongst which payment tokens and investment or utility tokens are most prominent. Payment tokens are user-to-user versions of traditional bank transfers since they are not intermediated by financial institutions. The given network records transactions in blocks using cryptographic methods, and via computational validation mechanisms such as *proof-of-work* (through what is known as *mining*), new crypto assets are generated.

[6] Cunliffe (2021)
[7] Statista (2022, May 31)
[8] Arnal Martínez et al. (2021)

Payment tokens can have the backing of another, more stable asset, collateral, or claim on an identified user (backed tokens) or have no such backing (non-backed tokens). Backed tokens, which are known as *stablecoins*, have three stabilization mechanisms: backing by a sovereign currency such as the dollar (for example *USDCoin*), backing from another crypto asset (for example *Wrapped Bitcoin*), or in the absence of other assets as collateral, the use of algorithms to create or destroy tokens to ensure that the total "monetary" mass adjusts to their value.[9]

Non-backed tokens, lacking a relationship to other assets, tend towards greater volatility in their value; this, in turn, hinders their performance as a means of payment and store of value.

Lastly, there are investment or utility tokens. These are a digital representation of rights and give the holder the right to participate in the profits of a certain actor, entity, or company and include, for example, Initial Coin Offerings (ICOs) of certain start-ups or Non-Fungible Tokens (NFTs). NFTs, moreover, accredit digital property.[10]

TECHNOLOGY AND THE CRYPTO ECONOMY

A key element that characterizes all crypto assets is their use of decentralized ledger technology (DLT). DLT is based on three older technologies: 1) Napster-like peer-to-peer networks; 2) cryptography to prevent third parties from being able to read or manipulate the message; 3) consensual algorithms that validate new transactions and create a new block in the chain of the log.[11]

There are DLTs *with or without permission*. DLTs that require permissions, like conventional payment systems, are updated by "trusted" actors, only by those who are selected and subject to the supervision of a central authority. In this way, all users have access to the registry, but only a few users can update and validate it.[12]

There are also *permissionless* DLTs. These allow any user to access the DLT, notify participants of the existence of an update, and through consensus algorithms, allow all nodes to jointly validate the transaction. Blockchain is the main tool for this: it allows each node or terminal to be connected and verifies the validity of transactions. Users perform checks against movements already collected on the existing blockchain to ensure

[9] An example is Dai, a stablecoin which is backed by Ether and USDCoin and adjusts its value algorithmically.
[10] Arnal Martínez et al. (2021)
[11] Romero Ugarte (2018)
[12] Many private DLTs, especially in the banking sector, operate with permissions.

that the token (money) has not been previously used and in this way act as a replacement for banks in their role of certifying transactions. Bitcoin runs on a public DLT without permission.

PROOF-OF-WORK VS PROOF-OF-STAKE

What sets blockchain apart is the ease with which actors who do not know each other and therefore have little reason to trust each other can still conduct secure transactions without a central authority.[13]

As previously discussed, the crypto economy is based on human cooperation through incentives; the system has miners validate users' transactions and reward them with crypto assets. The most successful public blockchain, Ethereum, operates on this basis as does Bitcoin. Ethereum has a native cryptocurrency *"ether"* and works as a kind of operating system (Windows-like) on which multiple applications, and contracts, can be created.[14]

There are two core mechanisms for processing and validating blockchain transactions (also known as 'mining'): *proof-of-work (PoW)* and *proof-of-stake (PoS)*.

Proof-of-work operates akin to a lottery; the validation of transactions is assigned to whoever manages to solve a mathematical problem. The more computers and computational power a validator has, the greater the probability of solving the problem and being assigned the validation.[15] To increase this probability, the miner will seek to acquire more computer power to solve more mathematical problems simultaneously. Other miners in the network will follow the same logic and so on. Specifically, Bitcoin uses proof-of-work, which explains the cryptocurrency's high power consumption and the associated cost of mining a single bitcoin.[16]

Proof-of-stake, on the other hand, is more efficient; instead of a reliance on computer power and the consequent high electricity consumption, the process requires making cryptocurrencies available to the blockchain to be considered a validator. The more

[13] Blockchain is a theoretically secure technology, but recent hacking events have evidenced it is not totally immune to hacking.
[14] Such as other cryptocurrencies to digital bank accounts, investment operations and smart contracts without the need for intermediaries.
[15] In other words, the more lottery tickets a miner has bought and, therefore, the greater the probability of winning the lottery.
[16] A report from the UK financial website Moneysupermarket.com cites states that each Bitcoin transaction consumes 1,173 kilowatt hours of electricity. The Bitcoin mining that enables a purchase, sale or transfer, it posits, uses a slug of electricity that costs $176. That number is based on an average worldwide cost per kWh of 9.0 cents over the past 12 months (Tully, 2021).

cryptocurrencies a validator has concerning the rest of the network (the stake), the more likely she is to receive the task assignment. Similarly, the earnings from the validation of transactions are proportional to the amount of the stake. The stake is also referred to as a wager (or investment) because if the validation is not done correctly, the miner will lose the money wagered.[17]

In terms of the practicalities of proof-of-stake, the mechanism supports greater flexibility in cryptocurrency design than proof-of-work, allowing the processing of many more transactions per second. In the next few years, most cryptocurrencies and blockchain applications are expected to migrate to proof-of-stake. Even so, a large-scale operational deployment over an extended period is needed to accurately understand its advantages and disadvantages.[18] The first major test will be Ethereum's announced move to proof-of-stake.[19]

Proof-of-stake, in principle, also addresses the problems of *node collusion*, i.e., that most nodes associate to validate malicious transactions. It does this through the loss of stake if a validated transaction is subsequently identified as malicious. However, beyond theoretical security, proof-of-stake exacerbates the problem of inequality and concentration of cryptocurrencies. By assigning a higher probability of processing a transaction as a function of cryptocurrency stake, it favours centralization in pools of miners, and the greater the centralization of transaction processing, the greater the possibility of collusion.

DEFI AND NFTs

An extensive variety of products and services known as DeFi (Decentralized Finance)[20] have emerged and are based on the DLT and the principles of decentralization. DeFi aims to replicate the structures of traditional financial systems without intermediation.

The DeFi sector is composed of decentralized financial ecosystems and allows, for example, the use of automated lending products, fully collateralized with

[17] The higher the stake, the higher the probability of receiving the assignment. Consequently, power consumption is substantially reduced and any miner holding cryptocurrencies is allowed to participate in the bet and receive more coins in return. As in proof-of-work miners with more resources are more likely to validate, but the barriers to entry are lower in proof-of-stake.

[18] BIS (2018) and Beaumier & Kalomeni (2021)

[19] Bitcoin only processes 7 transactions per second and Ethereum 15. Solana, a proof-of-stake based blockchain (in combination with proof-of-history), though more modern, is still small in scale and processes 400 transactions per millisecond. This puts it on a par with the VISA payment system.

[20] DeFi is defined as a set of finance protocols built with smart contracts, which are trustless and developed on permissionless, public blockchains.The use cases of DeFi range the substitution of stock exchanges, new decentralized financial products (combinations of bonds, stocks, derivatives…), flash loans.

cryptocurrencies. DeFi uses smart contracts, which are mutual agreements that automate the execution of transactions and financial activities without the need for intermediaries once the conditions stipulated in the contract are met. [21] In a low-interest rate environment, many high-risk investors have embarked on *yield farming*[22] via DeFi.[23]

Similarly, the blockchain is also used in NFTs, which are typically part of the Ethereum blockchain and are unique and irreplaceable digital assets. In comparison, a bitcoin is easily replaceable by another bitcoin, so they are fungible, while an NFT, is not. NFTs are digital property rights that are bought and sold in exchange for cryptocurrencies and can be applied to intellectual property, physical objects, or digital objects. Each NFT has a digital signature that cannot be exchanged and whose ownership is verified through that signature.

A CONCEPT OF GOVERNANCE BOUND BY 'DECENTRALIZATION' CONSTRAINTS

At the philosophical core of crypto assets is the notion of decentralization and, as discussed previously, a key component to Bitcoin as the first model was to create a decentralized system that could replace some of the functions performed by central banks and other financial institutions, which, in the aftermath of the GFC had suffered an enormous erosion of trust. A further aim was to reduce the costs of international transfers. From these motivations came the development of peer-to-peer consensus mechanisms.

However, this governance model has revealed challenges and indeed, centralizing tendencies. Platforms such as Bitcoin can evolve, with proposed modifications to the system's code and documentation base. Anyone can make proposals and implement them in the validation of future transactions. When this happens, not all nodes accept the modification at the same time; some update the DLT according to the new proposal, while others continue with the old model. In this way, two parallel Bitcoin chains appear. This process is called *forking* and it is through this phenomenon that crypto assets such as Bitcoin Cash or Ethereum Classic have appeared.[24]

[21] Kaplan (2021)
[22] Yield farming is the process of using decentralized finance (DeFi) to maximize returns. Users lend or borrow crypto on a DeFi platform and earn cryptocurrency in return for their services. Yield farmers who want to increase their yield output can employ more complex tactics.
[23] Rapoza (2021)
[24] The degree of adoption of the new chain determines which branch of the project is the "winner" and establishes itself as dominant in the future.

However, it is *not* the community that ultimately decides whether to accept the new proposal as final, but rather the core developers.[25] They decide the future of the project based on which Bitcoin chain seems most suitable to them. In this way, the Bitcoin network's ambition to create a decentralized, public currency in which anyone could participate with equal voting power is not fulfilled, as only a few "technocrats" have control over its design, development, and maintenance.[26]

The centralization of the blockchain applies not only to its governance, but also to the increasing concentration of miners, users, and exchange platforms (see below). The longer the blockchain chain, i.e., the more transactions need to be processed, the more computational power is required to have the ability to process a transaction. This excludes smaller miners and favours the creation of cryptocurrency mining (either PoW and PoS) pools. As mentioned, in the long run, this dynamic can foster the collusion of pools to overcome the 51% consensus barrier.[27]

SOCIAL VALUE OF THE CRYPTO ECONOMY

As previously highlighted, crypto supporters tend to argue that the crypto economy generates social value via four main principles: *democratization* through decentralization, *transparency* through open access, *trust* by avoiding human discretion, and *economic inclusiveness*.[28] This section is an attempt to further identify why and asks whether such assertions can indeed be substantively supported, based on the findings from our research.

Before proceeding further, however, it is important to note that decentralization is arguably the core tenet of the crypto economy. Value is essentially derived from the elimination of intermediaries and central authorities which over the past two decades have lost legitimacy in the eyes of many. Libertarian and progressive principles merge here and are central to the arguments put forward by crypto proponents.

DEMOCRATIZATION THROUGH DECENTRALIZATION

The theory posited is that the elimination of intermediaries and central authorities

[25] In 2011, Satoshi Nakamoto ceded control of the Bitcoin code repository to Gavin Andersen, who in turn appointed several core developers.
[26] Fillipi and Loveluck (2016)
[27] In 2018, it was already discovered that it was only a small number of players that controlled 60% to 75% of cryptocurrency mining, putting them in a position of power.
[28] Prasad (2021) and expert interviews.

(decentralization) results in lower transaction costs which in turn leads to increased financial participation (inclusion). The lower costs and distribution of power over a network (without central authorities controlling and monitoring outcomes) support the argument that the crypto economy is democratizing the financial sector.

This apparent democratization has led to the entry and empowerment of new groups who, through the crypto economy, have gained ownership of their work which they can directly monetize, and with that comes an enhanced sense of identity. An example is the content moderators operating in the wider Web 3.0 environment who can now enjoy a larger proportion of the profits generated by their work. That is to say, the aim is to create a digital environment that is no longer dominated by states, the big banks, and 'big tech'.

However, our findings suggest that decentralization is not happening to the extent that crypto advocates argue and, consequently, there is a gap in the democratization discourse around crypto. The nature of the technology on which crypto is built (blockchain), inevitably leads to the pursuit of economies of scale, which has resulted in a concentration of power in many areas: crypto asset ownership, platforms, protocols, protocol decisions, and validation of transactions.

Firstly, at the level of users and exchange platforms concentration is widespread. The analysis conducted by Nature magazine on Coinchain, a platform dedicated to trading crypto assets, reveals that only 1% of cryptocurrency users are institutional investors, but that they generate 60% of the operations and own 50% of the assets in circulation. In the case of Bitcoin, a study from the National Bureau of Economic Research (NBER) shows that 0.01% of crypto-asset holders control 27% of the Bitcoins in circulation.[29] Other research suggests that 2% of digital accounts hoard 95% of the available Bitcoins (currently around 19 million mined, and more than 4 million lost in unrecoverable digital wallets).

Something similar happens with NFTs, where 10% of the operators manage 85% of the movements and own 96% of the assets.[30] These vested interests of large investors have led to increasing lobbying activities; ECB Executive Board member Fabio Panetta referred to crypto firms spending around USD 5 million in the US Senate in the first nine months of 2021 alone.[31]

Secondly, services and transactions are increasingly being offered and undertaken on a small number of platforms. By April 2022 for example, Binance, the largest

[29] Makarov and Schoar (2021)
[30] Peirano (2022)
[31] Panetta (2022)

cryptocurrency exchange, controlled 17% of global volumes. Meanwhile, most of its peers did not exceed the 5% threshold.[32] This amounts to nothing less than the creation of newly centralized intermediaries while still relying on the old ones to transform cash into crypto and vice-versa (the entry and exit legs of the crypto economy). This is usually done through traditional bank accounts.

Thirdly, there is a concentration on *protocols*. Almost all DeFi projects are built on Ethereum. As of June 2022, 65% of the total value locked on all chains was concentrated on Ethereum,[33] yet a further demonstration of a concentration of power in the hands of Ethereum's leadership but also exposure to significant operational risks given the immense reliance on a single blockchain protocol.

Fourthly, protocol decisions are taken by a small number of vetted and select "technocratic" actors. This occurs in the two major cryptosystems: Bitcoin and Ethereum. In Bitcoin, several core developers can decide on the future of the Bitcoin project whenever there are *forking* events.[34] Meanwhile, the Ethereum leadership decided to reverse the hacking of one of its most active DeFi applications. The hard *fork* was imposed because the hacking effectively took out of circulation 15% of outstanding ether in 2016, and it was done in the context of this attack because it was too big to ignore. Therefore, Ethereum leadership used their power to intervene in a discretionary fashion.[35]

Lastly, there is concentration on the validation of transactions (mining), with potential for the collusion of nodes, which applies to both PoW and PoS. The same NBER study shows that 10% of miners control 90% of mining capacity in Bitcoin.[36] In PoW, the expensive equipment needed, and high electricity consumption incentivize the creation of mining pools to concentrate costs, which also promotes collusion in decision making. Similarly, in PoS, the dynamic of assigning transaction validation to those with a higher stake enlarges the stake of those who are already in a privileged position and makes collusion easier.

Our interviews revealed that industry experts and practitioners are aware of the lack of decentralization in DeFi and crypto projects that claim to be decentralized even though "half of them are not".

[32] De Best (2022, May 17)
[33] DeFi Llama (2022)
[34] De Fillippi and Loveluck (2016)
[35] Carter and Jeng (2021)
[36] Makarov and Schoar (2021)

Furthermore, the crypto economy is tied to the traditional financial system and financial intermediaries that it intends to substitute. The connection to legacy finance and sovereign monies is the most visible in its entry and exit legs. This means that cryptocurrencies and DeFi services need to be exchanged into dollars, euros, or other sovereign money to transfer value from the crypto economy to the real world.

This is particularly true for stablecoins, which are backed by commercial bank currencies and depend on the value of fiat and the collateral mobilized in banks: by mid-2021, 95.2% of stablecoin value circulating on public blockchains was backed by sovereign currencies in commercial banks.[37] The dependence is sometimes extremely high and concentrated in a few institutions, like Silvergate. Silvergate is one of the few banks in the US that has specialized in the provision of critical financial services for cryptocurrency businesses. Disruptions in banks like Silvergate can severely compromise a large portion of cryptocurrency participants due to the high concentration in crypto service provision. The interconnectedness with the financial system extends to the increased convergence of consumer fintech apps and DeFi, and heightened corporate exposure to crypto (or planned exposure) in their balance sheets.[38]

Lastly, one of the most negative externalities of decentralization is the environmental impact of decentralized ledgers. This problem is inherent to the technology on which the crypto economy is built: blockchain. The "append-only" logic of blockchain for the validation and record of transactions, requires a high level and intensity of energy consumption. Regardless of the use of side chains, layers, and other methods to limit the length of the chain and the number of updates to perform across the whole chain, blockchain will require more computational power. By definition, this increases the environmental impact. Bitcoin, which is by far the most extended cryptocurrency, consumed more electricity than Denmark, Chile, or the Netherlands in 2021. Meanwhile, Ethereum is expected to migrate to PoS soon (although this has been in discussion for many years and has not yet happened), which would significantly lower its energy needs. However, the energy consumption of the entire DeFi ecosystem built on top of the Ethereum protocol will follow the same append-only logic.[39]

In sum, decentralization through blockchain is highly questionable, and it has negative side effects.

TRANSPARENCY THROUGH OPEN ACCESS

[37] Carter and Jeng (2021)
[38] Carter and Jeng (2021)
[39] Kaplan (2021), Pazzanese (2021), Tabuchi et al. (2021)

Publicly distributed ledgers allow for the full oversight of information stored in the blockchain, including information on the crypto economy. Open access is supposedly guaranteed at all times, which differs from the opacity of the traditional financial system where a few players control the information. For crypto enthusiasts, blockchain offers both transparency and privacy. Through crypto-pseudonymity, privacy, which is a key source of value for crypto proponents, is assured (in principle) but they accept that, if there is substantiated reason to investigate who is performing activities that might be considered illicit, there are ways to determine the identities of those behind crypto addresses.

Nevertheless, the lack of true decentralization and the creation of new intermediaries in the crypto economy raises new barriers to transparency and access to information. The fact that information is publicly stored in the ledger (which can be corrupted) does not entail there is transparency: it requires technical knowledge, and strong social and political will to police the blockchain and the transactions included. This is very similar to what happens in the traditional financial system. There is no added value here.

Technical knowledge also has its limitations because it is not easily accessible to the entire population. The lack of an initially sound technical background and time constraints, among others, make increasingly difficult the scrutiny of the ledger by the public. Additionally, there are ways to obscure transactions and identities even in the event of full public oversight and strong political will. Several platforms offer "tumbler" services, which are often used by entities and individuals to obfuscate their identity and the transactions performed. Therefore, they increase anonymity and make identification and traceability much harder.

In the investment leg of the crypto economy, there are also transparency issues. Traditional finance requires disclosure of information on the nature of the business, performance, governance, and reporting structure of investment recipients. This information allows current and potential investors to make informed decisions. However, investment tokens in the crypto economy act as equivalents to securities without public disclosure of investment and business information.

Lastly, governance structures of crypto assets do not match transparency expectations. Some examples are the existence of relatively unknown governance control systems in most DeFi protocols and smart contracts (e.g., kill switches), and the lack of delegation of decision-making power from initial and core development teams to the participating community.[40]

[40] Carter and Jeng (2021)

TRUST BY AVOIDING HUMAN DISCRETION

Insofar as to how the notion of trust is perceived within the crypto economy environment and by its main proponents, trust is regarded as the product of democratization and transparency. Trust results from the democratic consensus of multiple nodes across the globe and the elimination of political hierarchies. Human agency, and discretion, are eliminated and replaced by technology. In an era where trust in the political authorities and related institutions is questioned, blockchain technology can generate a new ecosystem where trust between different actors is regained. This is perceived in developing countries with weak or highly corrupt governments and institutions.[41]

Our research reveals that the human components of decision-making and power, supposedly removed through technology, remain. On the one hand, protocols need human involvement for their development, maintenance, governance, and upgrade. On the other hand, protocols require human involvement to solve issues that can compromise the viability and sustainability of those same protocols. In many cases, the vulnerabilities encoded into smart contracts have been countered through human consensus whenever a certain vulnerability was relevant enough to be reversed.

A clear example, of what was understood by the part of the Ethereum community as a betrayal of core blockchain principles, was The DAO. In 2016, a DeFi application known as The DAO was hacked. The Ethereum leadership deemed the hack critical enough to be reversed and forced a hard fork on the blockchain, which created two parallel chains. The intervention created unrest as it countered the principles that the crypto economy holds as the core.[42]

Similarly, Bitcoin also gives strong decision-making power to a group of core developers designated by Gavin Andersen, to whom Satoshi Nakamoto ceded the control of Bitcoin in 2011.[43] Tech insiders believe that in Bitcoin "about 20-30 people are responsible for most of the decision-making with a long tail of smaller participants into the hundreds".[44]

There are also questions about security that undermine the trust generated by blockchain-based systems. The Blockchain Trilemma stipulates that any blockchain system needs to choose two of three characteristics that cannot be simultaneously

[41] Alnasaa, et al. (2022)
[42] Carter and Jeng (2021)
[43] De Filippi & Loveluck (2016)
[44] Ryan Research (2021)

attained: decentralization, scalability, and security. When blockchain protocols favour decentralization (which is questionable in many cases) and scalability, security is left behind. Crypto scams and security breaches have grown at a slower rate than the overall crypto market (79% and 550%, respectively) but the amounts scammed are not negligible: in DeFi markets, scams cost $2.8 billion, while thefts cost $2.2 billion.[45]

According to people familiar with the intelligence units dedicated to prosecuting cyber-crime, the number of fraud cases and financing of criminal or illegal activity through crypto is likely to be much higher. Panetta, drawing on several works, estimates that "as much as $72 billion per year, or about 23% of all transactions, is associated with criminal activities." The identities of the individuals behind such activities are also hard to trace in many cases due to the current incompatibility of many DeFi services with AML and KYC regulation, and lack of user identification.

Furthermore, the lack of consumer and investment protection and ever-increasing speculation is a serious challenge to stakeholders and the overall ability of the crypto economy to generate trust. Small investors are particularly exposed to scams, fraud, and market manipulations. This only diminishes trust in the overall system and its democratic component, as it makes it harder for smaller investors to participate on an equal footing.

Another trust issue comes from the lack of sovereign, central authorities. The absence of a sovereign authority to back crypto assets makes the crypto economy vulnerable to panic. It also makes on-chain results of on-chain agreements difficult to enforce in the off-line world, with no authority to solve contractual disputes either, undermining trust in the system. As James Madison acknowledged long ago: "If Men were angels, no government would be necessary". It happens that this is so for both the "real" and "crypto" worlds.

ECONOMIC INCLUSIVENESS

The last social value potential of the crypto economy is inclusiveness. By reducing the intense intermediation of the legacy financial system, which excludes millions of people from access to finance through high costs and barriers to entry, crypto, in principle, allows for anyone to participate in finance. This includes lower transaction fees, cheaper and faster cross-border transfers, and the diversification of financial services, which makes crypto more inclusive.

[45] Szalay (2022)

Nevertheless, on a very basic level, the crypto economy creates new intermediaries, which will always charge for their services. The case of Ethereum, the go-to blockchain platform due to the number of DeFi applications and crypto projects built on it, is illustrative: in March 2022, gas fees (price for validating transactions) were $14. Not only is this a relevant price, but there is also huge volatility impacting gas fees.[46] Sophisticated validators do not only charge considerable amounts, but they have also access to privileged information (they know which transactions will take place) and this has led to increased market frontrunning episodes.[47]

At the same time, smart contracts are relatively expensive about other costs in blockchain-based systems. The more demanding smart contract use-cases are, the higher the requirement for performant equipment, and the fees for smart contract execution. Similarly, there is an issue with block space. Higher adoption of one use case leads to fee hikes. These represent higher barriers for other use-cases which are not as popular, which might be of particular interest for smaller transacting parties participating in the crypto economy, and who now find them too costly to use.[48]

Another issue with the inclusiveness argument is that it assumes that financial exclusion is a technical problem, rather than a social one. There is part of the population that can be brought into the financial system by providing them with access to finance through, for example, their mobile phones. Nevertheless, this does not mean that they are financially included, and it does not apply to all groups. In many cases, other variables impact the financial exclusion of groups, such as marginalization and lack of education. Studies have shown how financial exclusion and financial problems are related to a lack of financial education and money management skills, which makes some groups more vulnerable to "financial abuse, fraud, and debt".[49]

The inclusiveness argument is also rejected by looking at the geography of the crypto economy. A Chainalysis report reveals that ~$3 trillion and ~$1 trillion of transaction volume in cryptocurrency and DeFi respectively, were concentrated in the countries with the largest professional and institutional markets (wealthier countries). For all other groups of countries, transaction volumes did not surpass the ~$0.5 trillion thresholds. In terms of the cryptocurrency value received by region from July 2020 to June 2021, Central and Western Europe, and North America generated 43%.[50] Here again, the crypto economy resembles the traditional one.

[46] BitInfoCharts (2022)
[47] Dutta (2021)
[48] Carter and Jeng (2021)
[49] Halfon (2022)
[50] Chainalysis (2021)

Lastly, a look into investor profiles reveals the false appearance of inclusiveness assigned to the crypto economy. Crypto investors have changed. From the original tech-savvy, financially educated, middle-aged, white investors that put their money into crypto out of the sincere belief in and understanding of the project, newcomers are retail investors who have been seduced by the popularization and infantilization of finance and crypto. Some of them are joining crypto, rather late, by taking out loans to generate returns faster in a context of a low-interest rate environment and amidst global uncertainty[51] in moments of high risks. A very recent example is the May 2022 crypto sell-off, after the collapse of the Terra blockchain.

FOMO (Fear of Missing Out), and the allure of being part of a new transgressive "community", are also playing a role for younger investors who rush into the crypto economy partly due to social pressure, induced by social networks and mass advertising (the 2022 Superbowl featured several crypto ads)[52]. These new profiles are vulnerable to the strong speculative activity hosted in the crypto economy since they cannot mitigate risks. Indeed, 90% of the transactions in Bitcoin have no links to meaningful economic activity and only 5% of daily transactions occur between individuals. The rest of the activity happens in exchanges and speculative activities.[53] Crypto is the environment where new complex financial products are being marketed to the public because they can circumvent consumer and investment protection regulations (as was the case of Spanish *preferentes* and SPACs back in the day). But the net social value here is highly questionable, again.

CONCLUSION

All in all, our analysis has shown that – hitherto – there is limited net positive social value in many of the crypto applications because of the non-negligible negative externalities. The technology so far has not evolved and met the expectations of founders and many of the early adopters. Crypto seems to entail the enlargement and deepening of the problems already identified in Web 2.0. There are important risks that need to be acknowledged and addressed by policymakers, crypto stakeholders, and society as a whole in the development of the new crypto economy. If the crypto economy keeps on expanding without control or regulation, there will be significant negative consequences

[51] FCA (2021a, 2021b) and Kale (2021)
[52] Klein (2022)
[53] Makarov & Schoar (2021)

for the environment, the hyper-financialization of society, financial stability (with disastrous consequences, as witnessed in 2008), and security, among others.

However, blockchain and smart contracts can positively disrupt existing sectors and accelerate the development of new ones.[54] Therefore, policymakers should be aware of their potential and not over-regulate to restrain innovation in the sector. If technology is understood to be developed as value-neutral, it is humans who later load technology with values, social constructs, and applications that raise social challenges. It is here where policymakers need to come in and regulate, without compromising future innovation.

POLICY RECOMMENDATIONS

Although we have been critical of some of the more optimistic arguments in favour of crypto, the crypto economy is still emerging and some of its social value might still be in the making. Banning would be a mistake. Thus, to successfully regulate the new crypto economy, we propose four general policy recommendations, and some more specific recommendations on the four areas previously described: democratization, transparency, trust, and inclusiveness.

GENERAL POLICY RECOMMENDATIONS

1. Regulatory Sandboxes and Crypto Sprints

In May of this year the UK's Financial Conduct Authority (FCA) hosted what it termed a two-day "CryptoSprint", a creative idea "focused on informing regulatory policy changes based on evolving technologies". What is novel about the FCA's initiative is the demand that participants should be a diverse mixture of "innovators, academics, regulators, technologists and subject matter experts who will collaborate intensively to help inform policy decisions safely and inclusively". This is the kind of approach that is needed to ensure that proportionate regulation is introduced and one that other regulators could learn from to find the right balance between allowing for innovation whilst protecting investors and consumers. In addition to crypto sprints, regulatory sandboxes can also be a helpful tool for testing technology-based regulatory solutions in a controlled environment under a regulator's supervision. In the current case, it could be useful to test the successful incorporation of blockchain into the traditional financial industry, where players are facing challenges, through sandboxes.

2. Consider the environmental impact of the crypto economy

[54] CBInsights (2022)

The environmental impact of the crypto economy must not be a secondary consideration when assessing the social value of crypto. The "append-only" logic of blockchain requires any new transaction or piece of information to be added as a new block to the chain. Therefore, regardless of the type of validation mechanism, which can be more or less energy-consuming, as the adoption of the crypto economy scales, blockchain-related energy consumption will increase as well. The European Parliament has already agreed on extending EU taxonomy to include the activity related to crypto assets. Nevertheless, taxonomy is not enough for an industry that consumes the same amount of electricity as small European countries. Further measures such as green taxation of crypto activities should be considered.

3. Strive for a formal agreement on global coordination

A recent op-ed by the EU Commissioner for Financial Services, Financial Stability, and Capital Markets Union, Mairead McGuinness calls for a global approach to regulating cryptocurrencies. The Commissioner is correct to call for this. Global regulatory cooperation is not as common as one might think in many sectors, and it often takes a series of scandals or a major crisis – consider the GFC – for advances toward global regulatory agreements to be taken. At an EU level, we also have the example of poor coordination and information sharing in anti-money laundering (AML) governance and supervision. Only recently following what became the largest money-laundering scandal in Europe involving Denmark's Danske Bank has the EU moved towards implementing a policy to strengthen AML across the Single Market. Furthermore, coordination and information sharing must be between a wide variety of agencies and bodies across sectors and include, amongst others AML agencies, criminal enforcement agencies, macro-prudential regulatory institutions, consumer protection bodies, and many others.

4. Ensure continuity of services in Ethereum and other systemic blockchains

This paper has introduced concepts such as non-backed crypto assets like Ether, backed crypto assets like Tether stablecoins, and Defi platforms. The prevalence of Ethereum in all three is significant. As the use of stable coins increases, what are the systemic risks given their increasing interconnectedness to the traditional financial system? Their additional function as a safe "parking space" for crypto volatility means they act as a bridge between fiat currencies and crypto assets and their functions within the ecosystem have multiplied. They are also used for trading - in September 2021 around 75% of all trading on crypto trading platforms involved a stable coin, according to a recent paper from the European Central Bank.[55] As part of global coordination efforts to ascertain a

[55] ECB (2021)

coherent approach to regulation of the crypto economy, the reliance on the Ethereum blockchain also merits particular scrutiny to better understand its connectedness with the traditional financial system and the risks arising thereof.

OTHER POLICY RECOMMENDATIONS

To mitigate the impact of decentralization and **democratization** claims that result in the concentration of power, (key) players in the system must be identified and regulated (in line with current work in the European Parliament). This does not necessarily require the development and design of new regulations, but the application of existing regulations to new digital assets if they perform the same functions and behave similarly. In other industries, monopolies are discouraged, and competition promoted. This should be the case also in crypto. The existing regulation should apply beyond cryptocurrency service providers only, but to market players in DeFi, NFTs, etc., which are less under scrutiny and can be used for money laundering activities. Decentralization claims also hide the interlink between the traditional financial and the DeFi systems, which needs to be monitored closely. Spill-over effects and risks have become increasingly visible and, rightly so, worthy of attention.

Transparency is another questionable claim. To avoid the problems arising from tumbler services and the obscurity of identities, a public financial assets registry is needed. This will also support the effort to tax those engaged in crypto activities and profiting from the crypto economy. Tumbler services that are designed to obfuscate transactions and identities rather than to add to the security and privacy of user transactions should be scrutinized and regulated. Additionally, increased cooperation between cross-border intelligence authorities and finance ministries could support transparency goals without compromising some of the core principles of operation. Lastly, the organizations that issue tokens publicly as a means of investment must disclose relevant information. Investors and participants need public and clear information on the ventures they are financing and using, and information should be reliable and easily understandable.

The crisis of **trust** in the existing institutions is evident. Policymakers need to acknowledge this legitimacy crisis of the current authorities and power structures. Therefore, they need to reflect on the drivers behind the crisis that have resulted in the crypto economy becoming a viable alternative for many. This reflection needs to be accompanied by an increase in public awareness (through campaigns, specific training, etc) of the benefits and potential of the crypto economy, as well as risks and myths. Regaining the trust of the public will be a key endeavor if one day the ECB decides to launch a digital euro.

Lastly, **financial exclusion** (especially in developed countries) needs to be acknowledged as a social problem that cannot be solved with a technical solution only. Access to technology will not reduce the poverty, education, and exclusion gaps: it may even accentuate them. Thus, it is important to find a social remedy for the complex social problem of economic and financial exclusion. To prevent even greater exclusion from the risks of crypto, the development of public information campaigns targeted at retail investors is crucial. Banks and other financial intermediaries, including crypto service providers, should have a key informational role. Furthermore, as the crypto economy grows, the necessity to monitor and prosecute fraud and abuse will increase and new capabilities, and political will, will be necessary to combat it, as well as coordination between units and countries. However, innovation should not be discouraged. The crypto economy serves as a good playground (experimentation space) to see how modern (digital) finance can evolve with its upsides and downsides.

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