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The Shared Frontiers of Economic and Civil Society:

Toward Optimal Political Context for Distributed Ledger Technology in Finance

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A Thesis in the Field of International Relations

for the Degree of Master of Liberal Arts in Extension Studies

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Abstract

Distributed ledger technology (DLT) facilitates a new chapter for the internet, one known as Web3. It is a back-end upgrade (Voshmgir, 2020, p. 28) that drives particularly rapid innovation in the finance industry. Its trajectory will be in part determined by the role of developer communities, innovators, and technology companies. It will be shaped by government supervisors and decisions by policymakers on how to foster innovation, control risk, or compete internationally.

It is no secret that the ideals of DLT developers regarding decentralization and democratization are partly social in nature; indeed, their efforts have been recognized as the ultimate form of protest (Russo, 2020). Despite this, discussion of DLT developers as belonging to social movements or civil society is a research gap in the academic literature. In seeking a better political context for the social efforts of DLT developers, the first contribution of this thesis is a definitional distinction between DLT Automation and DLT Activism. The null hypothesis that DLT activism must exist as a theme in DLT narratives, presented by the mainstream written media, is then developed. This is done by tying together interdisciplinary literature on DLT, banking, environmental and social governance, as well as civil society, and social movements.

The importance of decision framing in the media is discussed in the research methods section, along with natural language processing techniques used to test the hypothesis. The research methodology begins with a multi-label classification prediction model built using machine-learning packages available in Python. Predicted descriptive

labels for a large sample of articles from *The Economist* magazine suggest the null hypothesis should be rejected. This outcome is subsequently validated more comprehensively using ProQuest command-line queries and a larger sample, which suggests that at a 5% confidence level there is evidence to accept the expanded hypothesis; that DLT activism exists as a minor theme in mainstream DLT narratives.

The thesis concludes with discussion about the risk of divided partisan views about DLT. Technology is used to create decentralized organizations and facilitate widespread contractual cooperation. One could say that political polarization regarding DLT could result in extreme collective organization within, rather than across, group lines thereby exacerbating social cleavages.

As democracy faces the growing challenge of political polarization, the inclusive and open ecosystems that DLT communities have nurtured so far should be studied more deeply with a view to strengthening cross-cutting ties. DLT communities should not be left to develop in an isolated and insular manner.

Dedication

For my fiancée, who surrendered brunches, hikes, and weekend getaways with me so I could pursue scholarly activities.

Acknowledgments

For their encouragement, expert guidance, and time, many thanks to my Research Advisor, Dr. Doug Bond, and my Thesis Director, Dr. Michael Miner.

I began this ALM degree with hopes of studying Distributed Ledger Technology through a new lens. I found my final direction thanks in large part to Dr. George Soroka's 2021 Summer School course titled *Democracy's Century: Democratic Transitions in Comparative Perspective*. A 2020 HES course by Dr. Miner, titled *Intelligence and International Security,* really helped me think about a policy-maker audience.

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Glossary of Acronyms

AUM	assets under management
CBDC	central bank digital currency
CSR	Corporate Social Responsibility
DeFi	decentralized finance
DLT	distributed ledger technology
ESG	Environmental and Social Governance
ETH	the native value token of the Ethereum network
EVM	Ethereum Virtual Machine
ICMA	International Capital Market Association
ICO	initial coin offerings
NLP	Natural Language Processing
PoS	proof-of-stake
PoW	proof-of-work
PWG	Presidents Working Group
SCS	Social Credit System (in China)
SDG	Sustainable Development Goal
SRI	Socially Responsible Investing
TFIDF	Term Frequency—Inverse Document Frequency
TradFi	traditional finance
URL	Uniform Resource Locator
WWW	World Wide Web or Web1

Chapter I

Research Problem, Definitions, and Language

Distributed ledger technology (DLT) facilitates a new chapter for the internet known as Web3 (Web3 Foundation, n.d.). It is a back-end upgrade (Voshmgir, 2020, p.28) that has been brewing since the 1990s. Web3 promises to have infinite complexity and size but its positive value to society is not a foregone conclusion. Its trajectory will be in part determined by the role of developer communities, innovators, and technology companies. It will be shaped by government supervisors and decisions by policymakers on how to foster innovation, control risk or compete internationally.

Although still in its infancy, this worldwide "internet of value" (Internet of Value, 2021) is already driving particularly rapid change within the finance industry. U.S. policy decisions on how to regulate decentralized finance impact more than the ability of U.S. firms to compete in the decentralized finance (DeFi) arena. As the quick march toward digitization and decentralization continues, such decisions may also impact the future prestige of the U.S. dollar internationally (U.S. House Committee on Financial Services, 2021a, 1:42:20). Further, as this thesis argues, failure to consider that sections of the DeFi ecosystem might constitute civil society or social movements could exacerbate social cleavages.

Research Problem

As financial institutions from democratic-capitalist systems find themselves in new competitive tangles with those from authoritarian-capitalist systems, decision makers will benefit from a nuanced understanding of compromise. This thesis holds that one must goes beyond issues such as financial inclusion, citizen protection from fraud or market manipulation, the efficacy of monetary policy or fostering innovation. Consider also the transnational financial operations of foreign tech giants that are already underway. One could argue that such activity might distort the perceived competitive landscape of both the tech and finance industries, thereby changing the backdrop against which decisions by U.S. policy makers or leaders of industry are made. Does this constitute the creep of authoritarian capitalism flagged by the Senate Select Committee on Intelligence (2019, p.25)? If so, how should it factor into decisions about how to enable or reign-in internationally dominant U.S. firms? What will be the cultural cost at home? This thesis hopes to contribute toward answering such questions.

Currently, DeFi projects are considered peripheral to the financial system and as instances of innovation by economic entities. One can argue however that sections of the DeFi community also possess characteristics like those of civil society or social movements and therefore seek a different type of political context. While the use of DLT has been recognized as an instance of capitalist institutional evolution (Davidson, et al., 2018), details have not been fleshed out.

Financial inclusion of the “unbanked” (U.S. House Committee, 2021b, p.4) through DeFi is championed as a benefit to society and democracy, but the wider impact of this DLT driven capitalist evolution on the democratic process has not been

investigated. Consider that blockchain's emergence engendered ideals of decentralization and disintermediation, which are now at complete odds with the prospect of retail central bank digital currency (CBDC) or the prospect of big-tech dominated stablecoins.

Retail CBDC could give rise to a level of financial centralization never seen before and programmable money could be used to further social or environmental agendas. Consider also that DeFi is a movement that began with ideas about addressing the failures of banking oligopolies whose members were "too big to fail" (Sorkin, 2009). Big banks were denounced after the Great Recession, yet if the worlds of banking and big tech collide, the finance industry could consolidate further (McFarland, 2021, Ch.3).

The implications of finance industry transformation are particularly important to monitor from an international relations standpoint because any evolution to the architecture of market capitalism has implications for democracy. During the 2021 BIS Innovation Summit, Chairman Powell's view was that to move forward on issues such as introducing a CBDC would "need buy-in from Congress, from the administration, from broad elements of the public" (BIS, 2021, p. 34). Given the breadth, novelty, and complexity of such topics, not to mention their interdisciplinary nature, making an informed decision on whether to "buy in" would require high levels of insight and understanding.

In support of such education, the research here explains how seemingly novel DLT issues can be embedded in well-known literature on capitalism, democracy, as well as environmental and social governance. After defining key terms and describing language that is unique to this thesis, a literature review discusses the complicated relationship between capitalism and democracy. This provides a platform from which old

ideas about narrow banking, brought back to the fore by the prospect of retail CBDCs (White, 2021; *Economist*, 2021b), are discussed. The literature review then analyses the dichotomy between CBDCs and stablecoins, which gives rise to speculation about how DLT-enabled programmable money might one day be used to implement social agendas via the evolving financial system. The literature review continues with consideration of the long history and recent growth of social responsibility in the finance industry. Throughout these sections, the literature review distinguishes between instances of economic optimization using DLT and activism using DLT. The literature review closes with consideration of whether components of the DeFi ecosystem need to be considered as civil society or as social movements.

Definition of Terms

This multidisciplinary thesis provides a bridge from the realm of DLT to the realms of regulatory decision making and academic discourse on democracy. To understand DLT discussions at a high level requires understanding numerous technical terms and some jargon, all of which are closely interrelated. Definitions are therefore most efficiently produced in groups. The following paragraphs are long definitions, but they cover more than three terms each. To isolate single terms would be less cohesive and a larger undertaking for the reader. Definitions for many of these terms are consistent across many sources. Voshmgir (2020) provides a particularly cohesive summary which guided the definitions and organization here.

Blockchain and Distributed Ledger Technology

Terms covered: Blockchain, Bitcoin, Proof-of-Work (PoW), brief Ethereum introduction.

Blockchain was originally used for the peer-to-peer computer network that underpins Bitcoin (Nakamoto, 2008). Bitcoin has been described as digital currency, virtual currency, crypto currency, a digital asset, a commodity—the list goes on. For now, it is sufficient to know that Bitcoin represents a digital store of value and the Bitcoin Blockchain records an immutable list of Bitcoin transactions and details about them. Notably, the Bitcoin network has limited programmability (Russo, 2020, p.44-59) and there is a limited supply of Bitcoin; to ultimately reach a predetermined number of coins was a design factor to avoid inflation (Nakamoto, 2008, p.4).

This publicly and freely accessible network is characterized by a universal ledger of transactions that is collectively maintained by anyone who wants to participate, thereby avoiding the need for centralized intermediaries to manage data on their own servers. The terms “public,” “permissionless,” and “decentralized” are often used interchangeably to describe this peer-to-peer network design.

Crucially, Bitcoin provided an automated solution to the “double-spending” problem (Nakamoto, 2008, p. 1), which has been the historical reason why society needs clearing intermediaries, such as banks, to settle financial transactions. This was done by sequentially connecting records of transactions together using cryptographic functions and a “proof-of-work” consensus mechanism (Nakamoto, 2008, p. 3). Network participants compete to solve cryptographic problems that link new records to an existing chain of records. The process is called “mining” because the participant whose

computational work solves the problem is rewarded with newly minted Bitcoin—a gold-mining analogy (Nakamoto, 2008, p. 4; Auer, 2019). The public network then verifies the solution, the chain gets longer, and reproducing it to manipulate a record becomes harder, thereby making it more secure.

The chain represents a single state (Voshmgir, 2020, p.29) or configuration of information that is witnessed and agreed by members of the network. Data about transactions are grouped together in 1Mb "blocks" before being chained together, hence the name Blockchain (Auer, 2019, p.7). Notably, the Bitcoin network has not been down for any period since 2013 (Bitcoin Uptime Tracker, n.d.) but as it has grown, so has its use of energy, so much so that it uses more energy than many countries (Gulli, 2020, p. 96).

Proof-of-Work (PoW) design means that as more network participants work on the cryptographic functions that secure the network, the problems get harder. In addition, the energy required to solve them increases (BIS, 2018, p. 99). Although the invention of Blockchain was the culmination of decades of cryptographic development, it is considered a watershed event, partially due to its timing at the height of global financial crisis. This thesis argues that Blockchain catalyzed a movement that needs to be analyzed using existing knowledge about civil society and social movements.

After the inception of the original Bitcoin blockchain, efforts quickly got underway to build more functionality on top of it, to represent different assets as tokens and facilitate more complex transactions. Having worked on a variety of projects seeking to add features to the limited-purpose Bitcoin network, a young Canadian-Russian developer by the name of Vitalik Buterin saw the need for a more flexible network with

facilities to support unlimited creation on top of it (Russo, 2020, p. 44–59). In 2014 he published a white paper on Ethereum (Buterin, 2014) and with the help of a founding team, the Ethereum public blockchain network was launched in 2015 (Tual, 2015).

Permissioned versus Permissionless

Terms covered: Private Blockchain, Public Blockchain, Permissioned Network, Permissionless Network, Traditional Finance (TradFi), Distributed Ledger Technology (DLT), brief mention of Ethereum and Proof-of-Stake (PoS)

Shortly after Ethereum surfaced, serious efforts began to understand how incumbent finance industry entities might benefit from the Blockchain concept (R3, 2021b). Commentators describe incumbent finance industry entities as belonging to the realm of traditional finance (sometimes shortened to TradFi) (Mathew & Jagdev, 2021). To maintain close control of network activity, consortiums of traditional finance stakeholders utilized private blockchains (R3, 2021a).

Activity in private networks (e.g., R3's Corda) is permissioned, meaning that participants need to be identified and granted access. While permissioned private blockchains involve peer-to-peer maintenance, they are ultimately governed by a central authority or group (Voshmgir, 2020, p. 60). For this reason, they cannot be described as decentralized and do not fall under the banner of Decentralized Finance (DeFi). Private blockchains that retain some of the features of public blockchains are sometimes referred to as hybrid chains (Pana & Gangal, 2021) but that distinction is not meaningful here.

One can argue that the public permissionless nature of the original blockchain is one of its defining characteristics. Similarly, one can argue that the proof-of-work

mechanism is another. Use of the term "blockchain" has become contentious partly because of the public versus private distinction. Adding complexity, Ethereum will transition from a proof-of-work consensus protocol to a "proof-of-stake" (PoS) mechanism in 2022 (Ethereum, n.d.-b). Further, there are now new forms of distributed ledger systems that do not involve sequential chains of records. (See Voshmgir, 2020, p. 54 for mention of networks using directed acyclic graphs.) This thesis discusses the family of related technologies that were derived from bitcoin at a high level. An umbrella term that unambiguously encompasses it all is therefore needed—Distributed Ledger Technology (DLT) is that term.

Ethereum, Smart Contracts, and Decentralized Finance

Terms Covered: Ethereum, ETH, Smart Contracts, Decentralized Finance (DeFi), Proof-of-Stake (PoS).

This section summarizes key points from the Ethereum project's development documentation (Intro to Ethereum, n.d.) published by the Ethereum Foundation, a non-profit dedicated to supporting the project and related technologies. Ethereum is a public blockchain that allows any type of transaction to be customized, executed, and recorded.

The state of the Ethereum network is computed by the Turing complete Ethereum Virtual Machine (EVM) which is used to execute smart contracts that are written using object-oriented programming languages. In other words, Ethereum is a computer that exists on a decentralized network. It allows users to develop applications that record data of any kind on the immutable Ethereum blockchain. Users can define the terms of contracts to facilitate and record customized exchanges of value. Such exchanges can

involve data about anything ranging from financial securities to the environment (Voshmigir, 2020, p. 105–112). These programmable and automated contracts are called Smart Contracts.

While smart contracts exist in vending machines and are therefore not new (Szabo, 1997; Voshmigir, 2020, p. 115), DLT smart contracts were a remarkable development. Ledger entries can now be programmed to record complex transaction agreements between remotely connected peers.

ETH is the native value token to the Ethereum network, it is currently issued via a block mining process like that used for the maintenance of the bitcoin network but serves an additional purpose beyond being a form of digital currency. To punish inefficient code and to avoid infinite loops being run on the Ethereum computer, there is a charge for executing code known as gas which is paid using ETH. While DLT smart contracts are not unique to Ethereum, the Ethereum network has attracted, by a long way, the most developers (Statista, 2022). It is therefore home to the largest and most sophisticated collection of smart contracts or protocols. Those projects using smart contracts on public blockchains that pertain to financial services are collectively described as Decentralized Finance (DeFi).

At present, the Ethereum network uses a similar energy intensive Proof-of-Work (PoW) consensus mechanism to the Bitcoin network but will attempt to go live with a Proof-of-Stake (PoS) methodology in 2022 (ConsenSys, 2021). PoW makes malicious attempts to manipulate a distributed ledger “impractical” (Nakamoto, 2008, p. 8) due to the amount of computational power required to rival that of network participants who are collectively maintaining its integrity. In a PoS design, rather than having network

participants compete at solving computational problems, network participants are randomly chosen to record or check ledger entries, but to do so, they are first required to pay, or stake, a deposit. Any evidence of incompetence or attempted manipulation results in the stake being lost (Ethereum, n.d.-b).

Web3 and Digitization

Terms covered: World Wide Web (WWW, Web1), internet, Web2, Web3, data-sovereignty, "back end", digitization

The World Wide Web (WWW, also known as Web1) emerged in the 1990s and began as a network of static web pages located at unique URLs (Uniform Resource Locators), e.g., https://extension.harvard.edu/. The internet is the global network of computers and other devices that facilitate the WWW. Voshmgir conveniently recaps this well-known history in her book on DLT (2020, p. 29). The internet uses client-server architecture governed by a set of protocols known as TCP/IP. These rules allow devices to communicate. Importantly, this architecture means that much of society's data is maintained by the servers of large institutions or corporations that are responsible for preserving the accuracy of that data, looking after private information, and protecting it from unethical or malicious use. Data that is kept on a server can be thought of as a data monopoly while data on a peer-to-peer distributed network can be thought of as data sovereignty (Voshmgir, 2020, p. 31).

The rise of interactive websites, e-commerce, and social media in the late 1990s and early 2000s marked the beginning of Web2 which is characterized as a "front-end" (Voshmgir, 2020, p. 28) revolution. This means that social and economic interactions

became dramatically more sophisticated for Web clients or users. Web2 leveraged the underlying architecture of the original internet and therefore back-end data management remained centralized.

Use of the term Web3, and broad speculation about what it might look like, has arguably existed since Web 2.0 discussions began in 1999 (DiNucci, 1999; O'Reilly, 2005). However, many believe that Ethereum's 2015 introduction of smart contracts actually marked its beginning. The term "Web3" is now specifically used to describe DLT networks and was notably used in this context by members of the U.S. Congress during their hearing on digital assets in December 2021. Use of Web3 in this context, to describe DLT networks and ecosystems, was suggested by Gavin Wood (Wood, 2014 [tweet]; Web3 Foundation, n.d.) who helped co-found the Ethereum concept after it was conceived by Buterin.

With Ethereum, it became increasingly clear that peer-to-peer distributed ledgers would be used to overhaul client-server-based data structures that have shaped the competitive landscape of not only the tech industry, but the finance industry and beyond since the advent of the internet. Web3 can be described as a "back-end" (Voshmgir, 2020, p. 28) internet revolution that will not necessarily change the way users interact with the internet, as Web2 did, but instead re-shape and hopefully optimize the way data is managed behind the scenes. With this in mind, references to digitization, digital currency or digital assets make more sense. Clearly society has been able to make payments and view their bank balances or stock portfolios in a digital online environment for a long time, so the term digitization is sometimes confusing. Use of the term *digital* in a DLT context refers to a step toward more digitization through back-end optimization,

this may not result in any visible changes for the end user of an application on their computer or phone.

The Internet of Value and the Token Economy

Terms covered: internet of value, token economy, virtual token

The terms "internet of value" and "token economy" describe changes to the internet landscape that DLT is expected to bring. Smart contracts and DLT are innovations that change the management of internet data and facilitate sophisticated transactions involving value exchange without the need for trusted intermediaries, hence the name internet of value. Such value exchange is done using virtual tokens which represent value on blockchains, hence the term token economy.

More on DLT Language, Structure, and Definitions

DLT use cases for finance related projects or products are extremely diverse. At one extreme, some DeFi advocates strive toward the complete disintermediation of traditional banking institutions. These ideals might seem either unrealistic or unnecessary from a standpoint in the U.S. or Western Europe, but crypto savvy Argentinians may have different perspectives; some used DeFi to escape inflation in 2013 after losing trust in their banking system (Russo, 2020, p. 20).

To discuss DLT use cases within the finance industry in terms of capitalism and democracy, it is helpful to include a language dimension that describes the case relative to its economic or political environment. Existing literature provides a taxonomy relating to political affiliation and the use of technology, but it is complex. Proponents or

supporters of techno liberalism, techno libertarianism (Borsook, 2000), techno populism or even crypto anarchism for example, might engage in media activism, internet activism, "hacktivism" (Soderberg, 2015), or simply the development of software to enable social change in a particular direction. They might do this via social justice or open-source technology movements. Further complicating DLT taxonomy is jargon, such as DeFi, CeFi and TradFi, that has emerged from DLT projects and media commentators.

With the aim of contributing to language that is both forward-looking and compatible with academic discourse about capitalism and democracy, this thesis uses the following umbrella terms to organize discussion of DLT's political and economic environment: DeFi ideals, systemic DLT, DLT automation, DLT activism, fringe DLT. Each is described below in greater detail.

DeFi Ideals

The term "DeFi ideals" describes the vision toward which DeFi participants are striving. In some jurisdictions such ideals seem feasible, in others, impossible. Regardless of how quixotic they may be, it is useful to consider whether idealizing DeFi objectives and pushing toward them is adaptive or not. This can be done by considering them alongside notions of democracy and libertarianism or *laissez-faire* economics, each of which involve ideals to which society moves closer toward or further from, on a continuum.

Cryptographers have been working to solve the problem of private peer-to-peer digital currency since the 1980s. Proof-of-work was invented in 1993, and 1990s projects such as Hashcash, B-money and Bit-Gold gave rise to Bitcoin (Russo, 2020, p. 14).

Subsequently, Bitcoin's blockchain gave rise to the decentralized finance movement and the idea of Web3. The anonymous founder(s) of bitcoin specifically referenced failures of the finance industry in 2009 thereby charging the project socially and politically from its outset, as well as reviving a well-established underlying movement.

The long history of cryptographic development and cryptography's historic role as a tool for social and political change during early days of the internet, immediately gave Blockchain enthusiasts a social and political banner under which many still operate. Leaders of the global DeFi movement have distilled a vision that centers on the operation of a financial system without intermediaries or central authorities (Ethereum, n.d.-a). Achievement of this vision involves public blockchain protocols that govern all financial transactions (Aave, n.d.), but as tech developers run into problems that the traditional finance industry has been managing for a long time (Frangella, 2020), they are realizing that complete disintermediation is tricky, maybe impossible. New forms of DLT dwelling centralized intermediary such as Coinbase have emerged, banking regulation designed for public protection is difficult to navigate and retail central bank digital currency could change the playing field completely.

Systemic DLT

Systemic DLT describes distributed ledger technology that is important for a functioning financial system whether that be now or in the future. As of late 2021, there is arguably no systemic DLT, but R3 Corda and Ethereum are quickly approaching this status. It is also clear that stablecoins are a DLT product with growing systemic importance and are therefore described as systemic DLT in this thesis.

As DLT products, protocols, platforms, and vendors grow in sophistication and approach an institutional grade, it seems likely that TradFi entities will also innovate and use the technology to a significant degree. The DeFi versus TradFi dichotomy therefore seems likely to become more obscure and of less importance than a distinction between entities using DLT who are deploying it with financial systemic importance and those who are not.

DLT Automation and/or DLT Activism

The distinction between DLT automation and DLT activism in this thesis can be explained by a high-level distinction between public and private blockchains. In short, both are instances of DLT technology that can be used to improve the efficiency of financial transactions. Private blockchains are administered by a single entity or consortium and their use does not shift industry norms toward the DeFi ideals described above, they deploy DLT for efficiency through automation. Public blockchains are administered by anybody who wishes to contribute to their maintenance. This level of decentralization makes them immutable because network consensus about the state of data cannot be manipulated. Use of public blockchain DLT may involve efficiency through automation but also represents a movement toward DeFi Ideals. DLT projects motivated by efficiency through automation will be described as instances of DLT automation in this thesis. DLT projects motivated by social or political change will be described as DLT activism. The two are not mutually exclusive.

The term “DLT activism” is needed in addition to DeFi ideals because a project might push for social change through DLT activism and use of a public blockchain but

consider disintermediation of certain entities as too risky. Further, the public-private blockchain dichotomy, although useful in explaining the distinction between DLT automation and DLT activism, is limited. Most obviously, it does not help explain differences between two public blockchain projects.

Fringe DLT

This thesis focuses on DLT used for financial services and its impact on democracy and capitalism. Any instance of DLT that is considered to have little or no meaningful influence, directly or indirectly, on the course of finance industry evolution is described as Fringe DLT.

Chapter II

Literature Review

> *Democracy and market-capitalism are like two persons bound in a tempestuous marriage that is riven by conflict and yet endures because neither partner wishes to separate.*
> —Dahl, 2015, p.166

Financial technology innovations since 2008 have consequences that extend far beyond the financial services. Foremost, the use of DLT within the finance industry is recognized as an instance of capitalist institutional evolution (Davidson, et al., 2018). Further, there is an inextricable link between capitalism and democracy and therefore the impact of DLT on democracy must also be considered.

Background: Democracy, Capitalism, and DLT

Dahl (2015) provides a roadmap for discussion about the relationship between democracy and capitalism. While Dahl has written extensively on the topic, a quick overview of key points in chapters 13 and 14 of his book *On Democracy* serves to orient analysis and discussion throughout the rest of this literature review. He highlights the "amazingly unambiguous" fact that modern representative democracy has "endured only in countries with a predominantly market-capitalist economy; and it has never endured in a country with a predominantly non-market economy" (p. 166). Dahl describes the features of market capitalism that make it both favorable for democratic institutions, but harmful for further democratic prospects (pp. 173–179). In summary, market capitalist

economic entities are generally considered self-interested, privately owned, and concerned with making optimal economic decisions for themselves. They can make such decisions independently and without central direction because all required information is available in the market, and selfish economic choices are not obscured by "lofty" (p. 167) and ambiguous topics like general welfare and the public good. The result of "innumerable independent but competing actors" (p. 167) of this kind is unparalleled efficiency and regularity in the production of goods and services which leads to economic growth (p. 167).

Economic growth is conducive to democracy for a multitude of reasons ranging from reduced conflict, increased living standards, literacy, and education but there are important challenges to consider, such as the abundance of natural resources and a nation's reliance on tax income (Teorell, 2010, Chap. 3). In his comprehensive 2010 literature review, Teorell concludes that "democratic achievements are better sustained at higher levels of socioeconomic modernization," and cites media proliferation as an important factor deterring or derailing coups (Teorell, 2010, p. 76). That the capitalist process directly impacts economic growth brings structural determinants of democracy to the fore, but the agency of strategic decision makers is also essential to consider. One could argue the speed at which society is charging headfirst into social and industrial revolution (Baweja, et al., 2016) might increase demand for elite technical leaders who can navigate such uncertainty, thereby amplifying individual ability to guide institutional change.

Dahl's point that the decentralization of economic decision-making favors democracy because it avoids the need for a powerful central government, is more

nuanced still. Market-capitalist economies do not exist in democratic countries "without extensive government regulation and intervention to alter its harmful effects" (Dahl, 2015, p. 176). Such harmful effects range from environmental damage to abuse of the working class or to inadequate capital reserves held by commercial banks. While economic decision making may be decentralized in modern representative democracies, the central government still requires power to intervene. The optimal extent of this power in the economic realm is the subject of debate between *laissez-faire* ideologists and proponents of more government intervention.

In terms of the oversimplified U.S. left-right political spectrum, liberals (reform liberals) and progressives are associated more with pro-government economic intervention policies. Conservatives and libertarians (classic liberals) are associated more with laissez-faire policies. Regarding the latter, narrow banking has been a long-time recurring topic of focus and is particularly relevant to the study of DLT in the finance industry. The concept, also known as 100% reserve banking, has complicated implications for the institutions of capitalism which have been brought to the fore by ideas about Central Bank Digital Currency (White, 2021; *Economist,* 2021). In the following section, this literature review analyzes how retail CBDC and updated views on narrow banking impact the conversation about government economic intervention.

Dahl concludes his summary of how market capitalism harms democracy by talking about how market capitalism "affects the operation of democratic political institutions" (2015, p. 177). In short, market capitalism creates economic inequality which generates inequality in terms of political resources. This limits the extent to which modern representative democracies, which Dahl calls polyarchies, can further

democratize. Dahl says market capitalism supports the development of democracy "up to the level of polyarchal democracy. But because of its adverse consequences for political equality, it is unfavorable to the development of democracy beyond the level of polyarchy" (p. 178). The constraints on democracy that inequality creates for modern U.S. representative democracy has received significant attention, notably in Shapiro (2002) and Ferejohn (2009).

CBDCs and narrow banking are explored in the following section with a view to understanding the impact of DLT on long-run conversations about economic intervention. Then, looking to provide insight into how DLT development might impact economic inequality, this literature review discusses the programmability of DLT as it pertains to environmental and social governance (ESG) standards. Before concluding, and with a view to assessing government responsiveness, this thesis considers whether the DeFi communities that are driving DLT innovation have characteristics of civil society or social movements.

The impact of DLT on capitalism and democracy in the U.S. cannot be fully perceived without a deep look at big tech's presence in the finance industry. To better understand the international landscape, literature on authoritarian capitalism and international trade will also require review. However, these two topics are beyond the scope of this research.

Narrow Banking and Retail CBDC

Narrow banking (also known as 100% reserve banking, or full reserve banking) was most famously presented in 1936 (Fisher) as a response to the Great Depression. It was part of a monetary reform proposal known as the Chicago Plan. Calls for reform are

recurring, particularly in the wake of financial crises, and there has been a resurgent interest in narrow banking since the 2008 Great Recession. This interest has been further fueled in recent years by discussion about retail central bank digital currencies. Note that while industry-wide narrow banking reforms have not been imposed anywhere to date, narrow banks have existed throughout history and continue to do so (Pennacchi, 2012).

Given the long and relatively high-profile history of narrow banking, there is a wealth of literature available on the subject. To avoid repetition, this literature review flags only key publications that have notably shaped current discourse, and focus on the new relationship between narrow banking and retail central bank digital currency. No prior understanding of narrow banking is assumed, so the next few paragraphs provide an introduction.

The fractional reserve banking system is used worldwide, nearly exclusively. Its key characteristic is that private-sector commercial banks create money by lending. Such banks take deposits from the public, which can withdraw funds at any time without notice. These kinds of deposits are known as demand deposits. Simultaneously, the same banks provide risky loans at various maturities to other customers, using these deposits. The process of taking short-term demand deposits and converting them into longer-term loans is called maturity transformation. The *Economist* magazine aptly paraphrased Joseph Schumpeter, who viewed this as "not mere technique . . . [but] part of the core capitalist process." The *Economist* article also said: "Banks liberate innovation and investment, the engines of Schumpeter's creative destruction, from the 'voluntary abstinence routine of savers.'" (*Economist*, 2021b).

Depositors do not see their bank balances go down, but borrowers receive money, and therefore the money supply increases. This works because depositors generally do not all come to withdraw all their funds at the same time. Therefore the bank needs only a small reserve on hand to service depositors who do want their money back at a given moment. In the event of a shortfall, commercial banks can borrow from each other. In a crisis, they can borrow from the central bank that is their lender of last resort. While the fractional reserve banking system puts idle funds to work in the economy by transforming short-term demand deposits into longer-term loans, the system is vulnerable to bank runs. When depositors lose confidence in their bank, or the system, and attempt to withdraw their deposits en masse, financial crises ensue.

Interestingly, apparent advocates for finance industry upgrades within the DeFi community have essentially recreated fractional reserve banking entities using blockchain protocols (see Appendix 1 for DeFi banking case studies). AAVE and BlockFi effectively take deposits which are then used to create a loan market. These entities are not fully licensed banks, and they skirt banking regulation through the use of cryptocurrency. They can offer higher yields than commercial bank deposit accounts for this reason, and while they cannot officially take deposits, they present yield opportunities comparable to commercial bank savings accounts. Loans are automated without need for credit checks through overcollateralization with digital assets. While smart contracts can be used in conjunction with entities known as oracles (Voshmgir, 2020, p. 112) to automatically liquidate collateral in the event of default or adverse market moves, market risk however is not eliminated. This was seen on 12 March 2020 now known as crypto's Black Thursday (Frangella, 2020). Arguably, this is an instance of DLT automation, not DLT

activism despite such projects being praised as champions of the DeFi movement which has social and political roots. A recent BIS interpretation of DeFi was that it "differs from traditional finance not so much in terms of the types of service it seeks to provide, but rather in how it performs them" (Aramonte, et al., 2021)

Many DeFi companies do not appear to be changing the nature of finance as a response to the financial crisis, they appear to be developing a technology upgrade for fractional reserve banking. While they are moving closer to direct competition with commercial banks, the crypto ecosystem seems mostly sandboxed from the economy.

The SEC's recent response to Coinbase seems like evidence that unregulated entities, mimicking fractional reserve banks, will not be allowed to attract mainstream depositors until their risk frameworks and reserve protocols are better understood. That Aave and BlockFi have established lending programs and bank-like activity without repercussions to date, suggests one of the following: (a) either their innovation is considered constructive for the industry and DeFi markets do not yet pose systemic economic risk because user bases have not extended to the mainstream, or (b) government agencies and regulatory bodies cannot keep up. The former conclusion was communicated by the BIS in December 2021 when it said:

> In principle, DeFi has the potential to complement traditional financial activities. At present, however, it has few real-economy uses and, for the most part, supports speculation and arbitrage across multiple crypto-assets. Given this self-contained nature, the potential for DeFi-driven disruptions in the broader financial system and the real economy seems limited for now. (Aramonte, et al., 2021, p. 1)

In contrast to fractional reserve banking and the apparent operations of DeFi bank-like entities, narrow banks remove the risk of fractional reserve banking by not lending deposits at all. All deposits, hence the alternative names 100% or full reserve

banking, are kept on hand and ready for when depositors want them. While in theory this helps ensure that depositors maintain confidence in the system thereby reducing the severity of a financial crisis, it also takes away the capitalist engine that is maturity transformation.

The IMF produced a comprehensive history and description of narrow banking in its publicly available 2012 working paper, "The Chicago Plan Revisited" (Benes & Kumhof, 2012). Notably, the IMF's stance on narrow banking changed in 2012 from its previous review in 2001—a theme that seemed to appear across academia. In addition to the IMF in 2012, Grasselli & Lipton (2019), Rodriguez (2020), and Wilmarth (2012) each concluded that narrow banking as a policy option should receive more attention. Furthermore, for the first time since the 1930s, narrow banking policy was seriously considered in a 2018 Swiss citizens' initiative known as *Vollgeld* (Assenmacher & Brand, 2018).

Politically, narrow banking would have constituted a move toward *laissez-faire* capitalism because a safer and more simplistic banking system would warrant less regulatory oversight from the government. The prospect of retail CBDC, however, changes those politics because DLT provides a means for central banks to disintermediate commercial banks and then directly provide narrow banking to the public. Narrow banking historically provided a libertarian pathway to less government intervention; now it also provides a pathway in the opposite direction. The direction of discourse on narrow banking will be key to understanding the range of potential impacts that retail central bank digital currencies or stable coins might bring.

Analyzing the broad economic of impact of narrow banking reform such as the separation of deposit taking and lending institutions, or the implications for monetary policy, are far beyond the scope of this study. Here, a knowledge of narrow banking simply helps understand the consequences of central banks sucking deposits out of the fractional reserve banking system through pursuit of a retail CBDC. Such understanding is essential for policy makers when weighing the pros and cons of stablecoins as they did during the December congressional hearing on digital assets.

Stablecoins versus CBDC

Digital currencies are generally not practical as a means of value exchange (Bode, et al., 2021; PWG, et al., 2021). Bitcoin, the most well-known example, is seen by many as a speculative investment, its price is extremely volatile, and transaction confirmation times are slow. Others, ETH included, have strong price correlation to bitcoin in addition to these characteristics (Bode, et al., 2021). Stablecoins were the market's response to demand for a functional means of exchange within the various DLT ecosystems. Their creators also see them as a viable mainstream form of payment.

Stablecoins are DLT tokens whose values are pegged to non-digital assets with stable prices. Circle maintains an audited reserve of cash and short-term U.S. treasury securities to back the value of their stablecoin known as USDC or U.S.D Coin (U.S. House Committee, 2021a, 0:15:59). During the December 12th congressional hearing, Circle's CEO highlighted the success of U.S.D stablecoins internationally and stressed their importance in maintaining the prestige of the U.S. dollar as nations continue to further digitize going forward (U.S. House Committee, 2021a, 1:42:20).

According to McKinsey (Bode, et al., 2021), close to 3 trillion in stablecoins were transacted in the first half of 2021 compared to 70 million in China's CBDC. This comparison was also highlighted during the Congressional hearing. It is worth noting, however, that "the e-CNY is not interest-bearing . . . [which] makes it a less desirable form of money in which to park savings relative to government-insured, interest-bearing commercial bank deposits" (Greene, 2021, para. 9). Until stablecoins are embraced as a mainstream form of payment they will largely serve only to facilitate access to the realm of DeFi which is somewhat prohibited in China (Reuters, 2021). Stablecoins and CBDC have similar future aspirations, that is to facilitate mainstream payments, but as of now they serve different functions.

On the one hand, pilot CBDCs are currently being tested for their use in retail payments and on the other, the use of stablecoins has grown rapidly to facilitate innovation in the DeFi space. It would be useful to see stablecoin statistics that differentiate between transactions relating to retail payments or money transfers versus participation in DeFi protocols. While McKinsey point out that stablecoins were intended, in part, to enhance liquidity and simplify settlement across DLT projects they do not provide further insight into the nature of transactions. The President's Working Group on Financial Markets in their report prepared in conjunction with the FDIC and the OCC do point out that "stablecoins are predominantly used in the United States to facilitate trading, lending, and borrowing of other digital assets" (PWG, p. 8) but detailed statistics are not readily accessible.

After introducing Stablecoins, Bode, et al. (2021) describe CBDC as a response to their apparent success:

> Some efforts to create CBDCs have been born out of reservations about the impact of privately issued stablecoins on financial stability and traditional monetary policy, and with the goal of improving access to central bank money for private citizens, creating greater financial inclusion and reducing payment friction. (para. 5)
>
> Various public statements indicate that central banks envision CBDCs as more than simply a digital-native version of traditional notes and coins. Beyond addressing the challenge of greater financial inclusion, some government's view CBDCs as programmable money – vehicles for monetary and social policy that could restrict their use to necessities, specific locations, or defined periods of time. (para 6)

The tension between stablecoin use and ideas about CBDC clearly requires the attention of policy makers. Informed regulatory decisions will require sophisticated views on how to best foster U.S. innovation, conduct monetary policy in more digital world, ensure the prestige of the U.S. dollar internationally, represent the efforts of economic and civil society, and much more. By analyzing instances of DLT automation versus DLT activism, this thesis hopes to contribute toward refining such views.

Lawrence White (2021) provided important input to the stablecoin versus CBDC dichotomy in his recent article in the *Cato Journal*. He considered the question of whether the state or the market should provide digital currency and elaborated on ideas about pass-through funding from Markus Brunnermeier and Dirk Niepelt (2019). The latter two proposed that a swap between private and public money, engendered by retail CBDC, need not impact the system in terms of credit allocation and price. This is possible via pass-through funding, which involves a central bank automatically lending "all the funds it gains by the migration of commercial bank deposits into CBDC" to commercial banks (White, 2021, p. 240).

Central banks might do this if they recognized that "financial intermediation would be less efficient in the hands of a state monopoly than in a competitive private

market" (White, 2021, p. 240). Should commercial banks be disintermediated, there are several issues that White raises, ranging from taxpayer costs to inefficient or even politicized credit allocation. These issues would result from the State's lacking experience and infrastructure when it comes to facilitating retail payments and because it is "wishful thinking to imagine that the Fed would agree (or be allowed to) intermediate its new liabilities into loans to commercial banks without strings attached." (White, 2021, p. 243) White goes on to speculate on the nature of conditions that might be imposed by congress and their record regarding neutrality. White's view is that the allocation of credit would likely be further politicized should the State attract deposits through retail CBDC.

While White sheds light on important issues that retail CBDC might give rise to, he presents a dichotomy between retail CBDC offered by the state or digital money offered by "a plurality of profit-seeking competing banks and other private firms" (White, 2021, p. 244). If the U.S. big-tech landscape is to look anything like China's however, with payments facilitated by social media or e-commerce giants, then for the U.S. it could very well be a dichotomy between state CBDC and private monopoly, i.e., stablecoin payments facilitated by a tech giant such as Meta (Facebook).

"Programmable money" using DLT is the reason government might one day attach conditions or strings to retail CBDC or pass-through funding, it is the reason private firms might one day enable access to more sophisticated financial products using stablecoins. Programmable money is introduced in the next section followed by an analysis of ESG within the finance industry. At first look, ESG factors look to be prime

candidates for introducing conditionality to financial products or transactions using DLT but literature on this topic is scarce.

DLT Programmability and ESG

The term "programmable money" is widely used but also somewhat of a DLT buzzword. Not only is the term technologically "ill-defined" (Lee, 2021), the scope of data points or conditionality features that might be used for programming money is so vast that the term recalls very different ideas about what it might mean for society.

The term generally refers to all possible use cases for DLT smart contracts involving money. However, neither digital money nor the ability to programmatically define criteria for how such money can function are necessarily unique to DLT. According to the Federal Reserve, the innovation is that DLT-based digital money can now be made inseparable from software that defines its conditions. The Fed calls this a "coherence guarantee" (Lee, 2021, para 1). While the Fed has shed some light on how to isolate the novelty of DLT based programmable money from non-DLT-based "programmability as a service," much is still left to the imagination in terms of societal implications.

The range of possible financial and non-financial data points used to define conditions when programming money or financial contracts, the accuracy and integrity of the data, the way it is mined, modeled, and aggregated, will all have societal implications. Such data points might include personal, social, environmental, or even political information. China's Social Credit System (SCS) is a real example of such non-financial data being used to inform credit allocation decisions, but while China's SCS has attracted

significant academic attention, extracting lessons that inform Western policy is convoluted.

One could speculate that Meta's use of Pax Dollars to facilitate WhatsApp payments constitutes a step toward a financial system in which payments might one day be as easily moderated as tweets. From that first step, though, one must make large leaps when thinking through why subsequent steps lead to a deterioration of economic freedoms. Consider that credit card companies can already censor payments (*Economist*, 2021a) but do not widely do so, also that it is unclear whether technology companies with commercial interests will ever be granted banking licenses. It is unclear whether they would ever be positioned to make credit allocation decisions.

To avoid broad-brush speculation and to proceed with evidence, this section focuses specifically on the use of ESG factors in DLT financial transactions organized by U.S. or Western European entities. While the quality of ESG data used to inform socially responsible capital allocation leaves a lot to be desired, it has existed at the shared frontiers of the finance and social decision making for a long time. While big-tech companies could one day blend their mass of social data with financial data for a new breed of politicized financial product or programmed money, they seem to be outsider candidates for doing so at this stage. The President's Working Group recommended in 2021 the introduction of legislation to "require stablecoin issuers to comply with activities restrictions that limit affiliation with commercial entities" (p. 3).

The blending of financial and social data is already being facilitated by the market through ESG so one could argue that DLT upgrades for the ESG movement will be a key arena to watch in the near term. After providing a brief history of social responsibility in

finance, subsequent paragraphs highlight notable ESG transactions using DLT and then consider opportunities and threats associated with ESG innovation on DLT.

Socially responsible finance involves two parties—corporations and investors. Corporate social responsibility (CSR), which has roots in stakeholder theory, is a management concept that incorporates social and environmental factors into the decisions of business leaders. On the investor side, socially responsible investing (SRI) describes investment decisions that consider social and environmental factors in addition to financial returns. (Baker & Nofsinger, 2012, ch.1). There is a wealth of literature on the long history of both, and while religious organizations have incorporated social considerations into investment decisions for hundreds of years, modern social responsibility in finance can be traced back to 1960s social movements (Schueth, 2003). Presidential candidate Robert F. Kennedy (1968) offered a memorable glimpse at late 1960s Democratic Party rhetoric during a speech in which he called for a reassessment of economic progress:

> Even if we act to erase material poverty, there is another greater task: it is to confront the poverty of satisfaction, purpose, and dignity that afflicts us all. Too much and for too long, we seemed to have surrendered personal excellence and community values in the mere accumulation of material things. Our Gross National Product now is over 800 billion dollars a year. But that Gross National Product—if we judge the United States of America by that—that Gross National Product counts air pollution and cigarette advertising and ambulances to clear our highways of carnage. It counts special locks for our doors and the jails for the people who break them. It counts the destruction of the redwoods and the loss of our natural wonder in chaotic sprawl. It counts napalm and it counts nuclear warheads and armored cars for the police to fight the riots in our cities. It counts Whitman's rifle and Speck's knife and the television programs which glorify violence in order to sell toys to our children. Yet the Gross National Product does not allow for the health of our children, the quality of their education, or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit

> nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile. And it can tell us everything about America except why we are proud that we are Americans. (p. 347)

SRI is further rooted in 1970s labor movements and anti-nuclear efforts, as well as financial efforts to dismantle apartheid in the 1980s and to address the aftermath of Chernobyl. Beyond that, information about global warming and events ranging from oil spills to school shootings have all created momentum for socially responsible finance (Eccles & Stroehle, 2020; Schueth, 2003).

The United Nations identified ESG in 2004 as part of a joint effort with financial institutions to develop guidelines for better social responsibility in the investment industry. The UN went on to help launch Principles for Responsible Investment in 2006. The PRIs exist to help industry stakeholders understand the investment implications of ESG factors and to support an international network of investor signatories in incorporating ESG factors into their investment and ownership decisions ("About the PRI", n.d). In terms of size, influence and growth, total assets under management (AUM) by PRI signatories grew steadily from U.S.$6.5 trillion in 2006 to U.S.$45 trillion in 2014, and thereafter grew exponentially to U.S.$120 trillion in 2021 ("PRI growth 2006-2021", n.d.-b).

In 2007, the European Investment Bank "issued its inaugural Climate Awareness Bond, the world's first green bond" ("Climate Awareness Bonds", n.d). Between 2016 and 2018, the International Capital Market Association (ICMA), a self-regulatory body, created a Global Green Finance Council and published guiding principles for the issuance of Green Bonds, Social Bonds, and Sustainability Bonds. These bonds refer to debt

securities that raise funds for projects with environmental benefits and that seek to address social issues. They often involve tax incentives for either investors or issuers. In the first half of 2021, global issuance of sustainable debt doubled year-on-year and year 2021 issuance was on track to hit U.S.$1 trillion.

Beyond the rapidly growing support for better management of ESG factors within the investment industry, ESG factors topped agendas at the 2020 and 2021 World Economic Forum annual meetings. Despite investment into ESG issues and their visibility, however, compromise and cooperation at the 26th UN Climate Change Conference of the Parties (COP26) was not enough to set global society on a track anywhere close to meeting the Sustainable Development Goals (SDGs) of the 2015 Paris Agreement.

The modern ESG focus within the asset management industry is nothing short of a credible social movement (Arjalies, 2010). Along with growing ESG prominence in the finance industry, and the possible spurring effect of shortcomings regarding climate change efforts and other ESG related failures in recent years, consider that disheartened advocates of change may see DLT as an opportunity to refresh the ESG movement.

Regarding ESG bonds, Pana and Gangal (2021) note that limited evidence is available about blockchain bond issuance in general and identify this as a "critical research gap since blockchain technology is expected to yield significant benefits by transforming the global bond market" (p. 217). Evidence about the DLT intentions of ESG actors is more limited. As of December 2021, there were 23 bond issuances using DLT, two of which were green projects (see Table 1). Beyond short press releases about green issuance projects and speculation about the programmability of ESG factors using

DLT, there is currently little evidence that can be used to develop an informed view on how the purely financial realm might further coalesce with the ESG movement through DLT. It is clear, however, that DLT-based ESG projects are underway. Given that ESG adoption can be considered a social movement, one can therefore argue environmental or social bonds are instances of DLT activism.

Table 1. Summary of Bond Market DLT Developments.

Date	Issuers/ Issuance Team	Description
Jan 17	Commonwealth Bank and QTC	Working DLT bond prototype with automatic coupon payments. Private, permissioned blockchain.
Jun 17	Daimler and Landesbank Baden-Württemberg	€100m 1-year corporate Schuldschein. The entire transaction was reportedly carried out via blockchain technology.
Sep 17	Commerzbank, KfW and MEAG	Euro Commercial Paper, €100K, 5-day term transaction replicated and simulated on the private R3 Corda platform without need for a paying agent or clearing system.
Nov 17	LuxDeco, Nivaura and Allen & Overy	Reportedly the first fully automated cryptocurrency-denominated bond issuance. Cleared, settled, and registered on public blockchain infrastructure.
Feb 18	Telefónica Deutschland Holding AG, LBBW, DZ BANK	€250m Schuldschein issuance with 1 year term, of which €50m was a tranche reportedly based entirely on blockchain technology. Tranche size increased to €75m following oversubscription.
Apr 18	National Bank of Canada and J.P. Morgan	Test Exercise. Parallel DLT simulation of U.S.$150m 1yr floating-rate Yankee certificate of deposit issuance. Quorum Blockchain Service (open-sourced variant of the Ethereum blockchain).
Aug 18	Bank of Montreal	Pilot. CAD$250m 1-year floating rate deposit note issuance mirrored to demonstrate viability of blockchain platforms and smart contracts. Transaction booked as a traditional Canadian Depository for Securities issuance and successfully paralleled using DLT.
Aug 18	World Bank and Commonwealth Bank of Australia	New blockchain based bond instrument (“bond-i”) launched. 2yr AUD$110m Kangaroo bond with a 2.20% coupon. Reportedly created, allocated, transferred, and managed through its life cycle using DLT.

Date	Issuers/ Issuance Team	Description
Feb 19	BBVA Group	Blockchain-supported structured green bond issuance. Private placement of a €35m 6yr term bond linked to the 5yr euro swap rate. DLT for access to the transaction, reduced issuance time, traceable and immutable negotiations and agreements thereby supporting regulation compliance. Notably, the platform allowed the client to choose between numerous product configuration options when designing the bond to best suit their needs.
Feb 19	Continental, Commerzbank and GSK Stockmann	Pilot project to process a money-market security using R3 Corda under Luxembourg law. Euro-denominated electronic commercial paper. €100K volume, 3-day term.
Apr 19	Societe Generale	€100m covered bond issued as a security token on Ethereum by way of SG's FORGE. This was the first FORGE issuance. AAA rated.
Jul 19	Yes Bank and MonetaGo	Asia's First Commercial Paper Issuance on R3's Corda. INR100 Crores (~U.S.$15m)
Aug 19	World Bank, CommBank, RBC, TD	Bond tap to expand market participation with the Bond-i platform. Additional AUD50m raised for the Kangaroo bond.
Sep 19	Banco Santander	Intercompany issuance, U.S.$20m bond, 1.98% quarterly coupon, 1yr maturity. Bond existed only on the Ethereum public blockchain but was reportedly tokenized securely and registered in a permissioned manner. Santander was tokenization agent and custodian of cryptographic keys. Cash and coupons were tokenized.
May 20	Banque de France and Societe Generale	First CBDC settled transaction. €40m covered bond issued as security tokens directly registered on Ethereum. Rated AAA. Tokens were fully subscribed by SG which paid the issuer in digitally issued EUR. The experiment used FORGE to demonstrate securities being digitally settled and delivered in CBDC.
Sep 20	Bank of Thailand	Launch of a new DLT platform for Government Savings Bond issuance.
Nov 20	China Construction Bank and Fusang Exchange	listed DLT debt security providing investors access to bank-secured deposits at an annualized rate of LIBOR +50bps (~0.70%). Tradable on Fusang Exchange prior to maturity, in U.S.$ and Bitcoin, with a total program target size of U.S.$3bn. Available to retail investors.
Dec 20	Union Bank of the Philippines and Standard Chartered	Proof of concept for the issuance of a DLT-enabled retail bond in the Philippines. 3 and 5.25-year dual tranche issuance totaling PHP 9bn was successfully mirrored.
Jan 21	Vonovia	First fully digital note via online marketplace firstwire. €20m, 3-year term. Security tokens were used for the transfer of ownership of the bond using the Stellar blockchain.

Date	Issuers/ Issuance Team	Description
Apr 21	Societe Generale	€5m structured product DLT issuance by way of SG FORGE and the Tezos public blockchain. Security tokens directly integrated to conventional banking systems interfaced with SWIFT format.
Apr 21	EIB and Banque de France	Digital bond issuance using DLT for registration and settlement. Payments from underwriters to the EIB were on the Ethereum blockchain using CBDC. Investor payments used traditional fiat currency.
Nov 21	SIX Digital Exchange	Senior unsecured digital bond issuance. CHF150m total volume, 0.125% coupon, 2026 maturity. First DLT issuance in a fully regulated environment. It involved two exchangeable parts, one listed and administered traditionally, one fully digital.
Dec 21	Vasakronan AB using the Firstwire Marketplace	The Firstwire Marketplace was used to self-arrange a Digital Registered Green Note issuance in the European market. €50 m issuance was placed directly with DekaBank.

Sources: International Capital Market Association (n.d); Pana & Gangal (2021).

Government Responsiveness

If one overcomes the sector-specific understanding of civil society and the identification of the economy with profit-oriented capitalism on the basis of private property, a variety of connecting lines can be observed.
—Adloff, 2020, p.157

It is evident that aspects of the DeFi ecosystem, as well as certain SRI-motivated DLT projects, constitute DLT activism as it is defined in the context of this thesis. It is also evident that international organizations and governments have been responsive, whether that be in terms of licensing, CBDC experiments, guidance from the BIS, funding of government task forces, or recent congressional hearings.

This section considers whether framing DLT activism as a social movement or as civil society, rather than simply innovation by economic entities, has implications for the nature, urgency, or adequacy of government responsiveness. The argument that follows

holds DLT automation as the work of economic society but that DLT activism as being at the shared frontiers of economic and civil society; this blurry intersection requires more attention.

Conceptions of civil society go as far back as Aristotle's concept of *Societas Civilis* or the contributions of Enlightenment- period philosophers. With a view to orienting discussion of whether DLT activism exists in the domain of civil society or not, it is useful to begin by noting the following evolution. Marxist or Gramscian conceptions of civil society, influenced by industrialism and capitalism during the 19th century, do not necessarily produce net positive outcomes for society because, for example, they reinforce class divisions through false consciousness or give rise to rebellion (Soroka, 2021). Neo-Tocquevillian conceptions of civil society, however, generally do produce positive outcomes, and they have established dominance in the literature. From the 1990s, writers like Robert Putnam and Francis Fukuyama revived de Tocqueville's early 19th century idealistic views about civil society's necessity for democracy. Importantly and more recently, further depth and critique has been added by Berman (1997), Foley and Edwards (1996), and Higley and Burton (1989), to mention a few.

The following paragraph maps the DeFi community to a neo-Tocquevillian definition of civil society. From there, important and well-known qualifications regarding the benefits of civil society are noted before introducing Adloff's 2020 case that "civic practices can also be identified in the economy and offer a reform approach that is largely overlooked and underestimated in social scientific and political debates" (p. 149). The notion that DeFi projects or communities might belong to civil society group is then reconsidered.

Schmitter's (1993) definition of civil society is "a set or system of self-organized intermediary groups" (p. 4) that exist in the space between domestic life and the state or public sphere. Schmitter describes these groups as "relatively independent of both public and private units of production and reproduction, i.e., firms and families" (p. 4). This arguably excludes DeFi companies such as BlockFi from the definition as they produce financial services for profit. Such exclusion of economic entities is common to most neo-Tocquevillian definitions. Schmitter then states that the intermediary groups in his definition "are capable of deliberating about and taking collective actions in defense/promotion of their interests/passions" (p. 4). This condition does not rule out DeFi entities, but he goes on to say that they "do not seek to replace either State agents or private (re)producers or to accept responsibility for governing the polity as a whole" (p. 4). Some DeFi projects are explicitly working to replace financial institutions with blockchain protocols that govern financial interactions.

Finally, Schmitter's groups "agree to act within pre-established rules of a civil or legal nature" (p. 4). This final condition prompts an initial thought that areas of DeFi will require new rules and regulatory frameworks but, as with each of Schmitter's statements, it will require further analysis. Already, it seems evident that of Schmitter's four conditions for defining a group as civil society (dual autonomy, collective action, non-usurpation, civility), one or more will likely not be met by groups within the DeFi community who therefore do not fit the definition.

Regarding the benefits of civil society, Berman's 1997 analysis of the Weimar Republic, albeit an extreme example, highlights the necessity of political context, political institutionalization, and the inclusiveness of civil society groups. In short, rich,

extensive, and vigorous German civil society in the 1930s did not give rise to democracy and therefore did not conform to Neo-Tocquevillian theories of civil society. This was because "weak and poorly designed political institutions" (Berman, 1997, p. 424) exacerbated social cleavages by blocking participation in public life rather than responding to demands from civil society.

Berman explains why this resulted in private associational activities "generally organized within rather than across group boundaries" (pp. 424-425), which ultimately contributed to an opening for totalitarianism. Comparing 1930s German civil society to modern DeFi communities is dramatic, but disregarding DeFi communities as civil society does risk an inadequate political context. Totalitarianism in the U.S. or Western Europe is beyond comprehension, but it is not difficult to imagine that social cleavages could be further exacerbated.

Techno-libertarian blockchain developers rejecting ideas about retail CBDC while moving an insular world of DeFi toward systemic economic importance could have such an effect—particularly if DeFi versus TradFi narratives become politicized and yet another bi-partisan battleground. Aspects of the DLT ecosystem strike chords on either side of the political spectrum.

On the one hand, DeFi ideals about decentralization, disintermediation or a "Bankless nation" (Bankless, 2021), in addition to having roots in movements from early days of the internet, can also be rooted in the movement of laissez-faire partisans. The community's energy therefore is not surprising. One could go as far as to speculate that "Occupy Wall Street" movements (which were largely without clear political direction in 2014 but generally against inequality and reduction of liberty resulting from the Great

Recession) were examples of this same political energy in a latent form. Accordingly, one could argue that some idealistic DeFi developers, the cyberpunks who provided their platform, as well as wider segments of society such as occupy activists could all be aligned with the "perennial anti-government constituency" (Spragens, 2021, p. 4) that is common to all liberal societies.

On the other hand, DeFi projects focused on programming non-financial data points into smart contracts might open the door to social agendas. Such an outcome is conceivable through conditional pass-through funding for commercial banks, through the involvement of social platforms in the finance industry, through cultural evolution toward more socially responsible finance, or other unforeseen routes. As with ESG, such projects can be rooted in social movements from the 1960s.

Recognizing DeFi communities as organized groups, using advanced forms of cooperation and governance to deliberate and take collective action toward not only economic but also social and perhaps environmental objectives, is essential. Failing to recognize that not all efforts in the DeFi domain are purely economic, and that there are numerous distinct social aspects possibly requiring political representation, could conceivably give rise to growing social cleavages. This is particularly important as the confrontation between proponents of *laissez-faire* economics and partisans of welfare state regulatory policies returns to "front and center of the American political arena" (Spragens, 2021, p. 4).

That dominant literature on civil society has historically defined it as a distinct sphere of associational activity, separate from the economy and the state, means the task of extracting guidance about responding to collective action within the realm of DeFi is

convoluted. Two avenues for cutting through this complexity are used here. First, one can acknowledge that "sweeping, mutually exclusive ideal types like 'political society' and 'economic society . . . are unlikely to capture the range of associational forms that prepare citizens to engage in collective action for mutual benefit." By doing so, one can argue that "economies are not only embedded in civil society . . . [but] can also be organized according to civil society principles" (Adloff, 2020, p. 149). Without such acknowledgement, how does one explain socially responsible investment? Social responsibility in finance is direct evidence of different value spheres colliding, spheres that are pervasively viewed in isolation within the social sciences (Adloff, p. 153).

Second, one can argue that not all social movements "represent an armed and paranoic vision of civic responsibility" (Foley & Edwards, p. 7) then recognize the overlap between civil society discourse and social movement studies. These two approaches can be used to connect the realms of civil society, economic society and political society (see Figure 1) which are largely separated in the civil society literature.

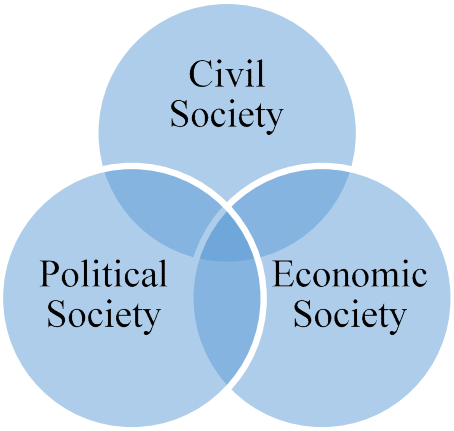

Figure 1: The Shared Frontiers of Political, Economic, and Civil Society.

Source: Soroka, 2021, p. 5

Della Porta (2014) discusses where social movement studies and civil society studies intersect. While the two fields have each specialized and therefore grown apart, they still overlap (p. 137). Della Porta references Kaldor to point out:

> Empirically, civil society organizations have often been conceptualized as the product of the "taming" of social movements. Where social movements privilege protest, civil society organizations are said to use less disruptive forms. While social movements put forward radical claims, civil society organizations are presented as moderate and reasonable. (p. 138)

DeFi projects might not meet the specialized criteria for a neo-Tocquevillian conception of civil society, but it is feasible that crypto revolutionaries have operated at the intersection between civil society and social movements. Through proactively building alternative technology infrastructure for the financial system without permission, rather than seeking change through political agents, such developers have been described as engaging in the "ultimate form of protest" (Russo, p. 70). At the same time, some DeFi projects are designing governance systems and participatory democracy using blockchain; they are incredibly well organized. Their wake of disruption is difficult to detect because their activism is civil in nature, yet it is also radical because they are challenging the foundation of long-standing institutions.

DeFi advocates pushing toward ideals that are unattainable or unrealistic creates conflict, which is the hallmark of social movements. At the same time, by leaving DeFi communities free of regulation to support economic innovation, government creates spheres of social autonomy where DeFi communities can experiment with new ways of connecting, organizing, and transacting. Social movements are still acceptably defined as "networks of informal interactions between a plurality of individuals, groups and/or organizations, engaged in political or cultural conflicts, on the basis of shared collective

identities" (Diani, 1992, p. 1). If one accepts social change is among the motivations of some DeFi developers, then their challenge to economic institutions should not just be viewed as economic competition but as a form of cultural conflict.

This leaves collective identity, discussed in the next section, as the only criterion to be fulfilled before one can accept that social movements occur within the realm of DeFi. Accepting that DeFi developers exist at the tamer, more civil end of the social movement spectrum then allows one to agree they are also at the intersection of civil society and social movements.

The Fourth Industrial Revolution, Crowd Culture, and Collective Identity

Society is in the middle of the fourth industrial revolution, which is characterized in part by extreme connectivity through communication technology (Baweja, et al., 2016). This thesis uses the term "crowd culture" to describe how this modern connectivity has shaped activity within the financial markets that is not purely economic in nature.

The following paragraphs make the claim that DeFi ideals and an online crowd culture both provide a common identity through championing accessibility to financial services, financial inclusion, and therefore democratization. With reference to real examples, this section describes how modern connectivity enables strangers across the globe to collectively organize around objectives related to ideals of democratization. In short, communication technology, crowd culture, and DLT ideals give rise to collective identity centered on notions of democracy.

"Crowdfunding" describes ways to raise money from many people. Conversely, it is also a way for many people to participate in a funding project without needing to contribute large amounts and for this reason it is a way to democratize financial processes. This kind of activity dates to the 1700s, but modern-day crowdfunding began in the 1990s when the internet was used to raise funds for art projects. The funding of creative projects is still facilitated by websites such as Indiegogo and Kickstarter, which have been active since 2007 and 2009, respectively. Crowdfunding-related activity has expanded dramatically over the last decade resulting from separate developments in the areas of law, communication technology and DLT.

In 2012, President Barack Obama signed the Jumpstart Our Business Startups (JOBS) Act into U.S. law, which made it legal for entrepreneurs to raise equity capital for startups through crowdfunding. This gave rise to licensed online funding portals (SEC, 2017). Separately, in 2013, entrepreneurs began crowdfunding projects through Initial Coin Offerings (ICO) using blockchain technology. Such funding processes existed outside the remit of regulation until July 2017 when the SEC required compliance with federal securities laws (Franklin, 2020). ICOs were a major factor in propelling DLT into the mainstream. The largest of such campaigns was in 2017 when FileCoin raised U.S.$257 million through a crowdfunded ICO (Higgins, 2017).

In late 2020, an instance of crowd activity became a cultural phenomenon. A group of amateur retail investors took to the financial markets using mobile phone applications such as RobinHood to trade GameStop stock. Through collective organization using the online social media platform Reddit, this group competed against well-established hedge funds by purchasing the failing retailer's stock to contradict the

hedge funds' short positions and push up its share price. This social price manipulation was purportedly aimed at saving GameStop, but was misguided (Manskar, 2021) because an inflated share-price was not necessarily a good thing for the company possibly causing it to miss merger opportunities (Galloway, 2021). Such opportunities might have been the only sustainable future for GameStop. However, the event confirmed that the financial markets are an arena in which groups of individuals with a common goal can collectively exert their will by using modern communication platforms. The GameStop debacle was not crowdfunding because the secondary trading of shares did not provide GameStop with capital, but it was a cultural offshoot. It was certainly an instance of online crowd culture.

As DLT has been developed since 2008, so has accessibility to capital through crowdfunding activity. At the same time, unprecedented levels of communication and connectivity facilitate widespread organization around common goals. They have all grown up together and are intertwined. Online crowd culture is becoming mainstream because beyond crowdfunding art projects, or medical bills and such, society now collectively pools its savings to achieve diversification in investment portfolios; it makes unaffordable investments such as real estate properties available to the masses through crowdfunding. Society has witnessed events such as GameStop and engaged in ICOs. The public square that is Twitter means anyone can tune into crowd chatter at any time.

Notions of online crowd culture and DeFi community are distinct but both are associated with claims of democratization and therefore have an aspect of their identities in common and it is not purely economic. For this reason, media sentiment about one might have framing implications for the other.

Chapter III

Hypothesis

Elements of the DeFi ecosystem, described as instances of DLT activism throughout this study, should be perceived as civil society. Treating such communities otherwise risks a suboptimal political context. To support this perception, it is important that the mainstream media frames DLT activism as such.

Null hypothesis: DLT activism, as defined in this thesis, exists as a theme in DeFi narratives presented by the mainstream written media.

After introducing the importance of decision framing, the following section describes how the above hypothesis was statistically tested before discussing results.

Chapter IV

Research Methods

The psychological notion of decision frames can be used to connect economic, financial, technological, and political environments with a methodology for empirically studying their influence on individual decision making. One could argue that decision framing within the media contributes to perceptions of what is politically acceptable or desirable at a particular point in time. Subsequently, one could claim that such framing has a direct influence on the decisions of corporate leaders, policy makers, or even diplomats. If that seems far-fetched, one could certainly claim that media decision framing might influence public opinion about the outcome of such negotiations and their choices at the polling station.

Framing Theory

Decision frames have been extensively studied and offer a wealth of methodological knowledge. They provide a framework for understanding decisions made with a particular context and can help build a structured understanding of the media backdrop. According to Tenbrunsel and Smith-Crowe (2008, pp. 561–563), decision frames refer to "the type of decision that individuals believe that they are making - how it is that they have coded or categorized the decision." The type of situation in which decision makers see themselves is a product of their framing. Katherina Glac (2012) considers the economy as a decision frame and investigates ways in which investors

frame the financial markets for investment decisions. When comparing decisions framed as moral versus those framed as simply financial, Glac shows that perceived decision types influence behavior significantly (p. 194). Kramer, et al. (2010) summarized social decision making as it pertains to social dilemmas. Krishnamurthy and Nagpal (2010, pp. 37–51) studied conflicts in decision making which gives structure to the analysis of financial versus cultural decisions. It seems that decision frames are yet to be used for the direct study of Identity Economics—a topic that might help connect the influence of media narratives about democracy and financial technology to a variety of different types of decision.

Walsh's (2011) article in *American Psychologist* artfully communicates the prominence of the digital environment in decision making: "So powerful and pervasive is today's multimedia reality that for philosophers such as Jean Baudrillard, it constitutes a hyperreality—a simulated lifeworld that seems more real than reality" (p. 584). Walsh cites Tiffin and Terashima (2001) while emphasizing that "so omnipresent are media-manufactured images and narratives, and so divorced are we from the direct events they portray, that we largely live in, believe in, and respond to this artificial hyperreal world rather than the natural world itself" (p. 584). Moreover, this persuasive philosophical stance is validated by media statistics (e.g., Mitchell, et al., 2020).

It is clear that decision frames provide meaningful context to decision making. It is also clear that economic, business and finance media is highly pervasive and difficult to escape (Mitchell, et al., 2020), yet the ways in which it influences different kinds of decisions (social, cultural, political) is not well understood. Furthermore, the foundation for adequately exploring this topic in 2022 has not yet been laid. Given the speed at

which intertwined economic, political, and technological environments are evolving, and the theatrics with which they are described and presented (video, audio, blogs, tweets), a sustainable methodology for interpreting decision framing within media narratives will be valuable. Studying such a fast paced and evolving subject will be essential for policy makers in the coming years. It is addressed in this thesis through automated textual analytics.

Natural Language Processing in Python

It is possible to test this hypothesis by entirely using command line queries to download articles from the ProQuest database, then programmatically coding and categorizing them. However, this thesis aims to build a foundation for future studies, not just in terms of conclusions about the optimal political context for DLT but also in terms of methodology design. Therefore, Natural Language Processing (NLP) using machine-learning in Python was chosen, for two reasons:

1. *Scalability*. To systematically analyze five labels using ProQuest alone requires 32 different queries because each label is a binary value—it is either assigned or it is not. Considering this numerically, a label value is either 1 or 0, and therefore the number of possible combinations for 5 binary digits is $2^5 = 32$. Additionally, ProQuest limits student users to downloading 500 articles at a time. If each of the 32 queries returned 1,000 articles, then this would have required 64 separate downloads. Articles need to be downloaded so they can be organized and aggregated by date to facilitate analysis. The more download files that need to be collated programmatically, the more complex and prone to human error this

process becomes. This methodology is highly manual, not scalable, and therefore not conducive to building a good foundation for future study. The machine learning methodology still required 32 queries to build a training/testing data set, but no more than 500 articles were used for each label combination and therefore the manual work for training was capped at 32 separate downloads. Once trained, the model can then be reused and is therefore scalable. After training the model, all articles requiring its prediction can be collated into a single file and programmatically processed in one go, thereby removing much complexity from the process.

2. While mainstream articles from *The Economist*, *Financial Times,* and *Wall Street Journal* are readily available via ProQuest, this methodology design also considers that future studies will need to consider DeFi community narratives which cannot currently be systematically sourced and organized using an academic database. Articles by CoinDesk.com or Cointelegraph.com, for instance, are not available in ProQuest. Neither are transcripts of DeFi podcasts or YouTube videos like those produced by Bankless (2021). NLP packages in Python facilitate an assessment of the written media that can be kept consistent, regardless of the data source.

Multi-Label Classification

This thesis focuses on DLT innovation in the finance industry, particularly that which will impact the deposit-taking and lending activities of commercial banks. To recap the literature review:

- DLT is reshaping the landscape of capitalism, which is inextricably linked to the landscape of democracy.
- In the U.S. or Western Europe, government-administered retail CBDC, depending on design features, could result in more centralization and government economic involvement than there is today. Research on narrow banking and ideas about pass-through funding for commercial banks will be integral to any retail CBDC design decisions.
- Private-sector USD stablecoins are an alternative to retail CBDC but full analysis of retail CBDC versus stablecoins would require fully covering the subject of payments, which is beyond the scope of this study.
- While DLT is being used to solve environmental and social governance issues, policy discussion about DLT in the finance industry has largely overlooked ESG related innovation.
- Narratives about DLT technology do not adequately distinguish between instances of automation and instances of activism.
- Certain projects, developers, and segments of DLT communities should be considered as existing where civil society, social movements and economic society intersect. This is not a focus in the academic literature.
- An inadequate political context for civil society can exacerbate social cleavages.

To gain insight into how these topics are framed in the economic media, supervised machine learning facilitated by the Scikit-Learn Python library was used to assign multiple descriptive labels to articles from the Economist magazine. These labels

are analyzed as decision frames in the discussion and analysis section. They correspond to five key subjects highlighted by the literature recap above and are summarized below in Table 2. Full definitions can be found in Table 3.

Table 2. NLP Label Summary.

	Label/Decision Frame	Summary
1	DLT	The DLT label flags general discussion of distributed ledger technology and associated key terms. It is assigned to any article covering topics such as smart contracts, blockchain, decentralized finance or digital currencies. The DLT label does not cover discussion of CBDC or Stablecoins, see below.
2	Activism	The activism label flags discussion about civil society, social movements, and associated terms.
3	Crowd	The crowd label attempts to flag discussion about crowd culture which refers to instances of collective organization using communication technology or DLT.
4	CBDC	The CBDC label flags discussion about retail CBDC and stablecoins. The dichotomy between stablecoins and CBDC is emerging as a distinct policy issue.
5	ESG	Environmental and social governance and associated topics such as sustainable development goals.

Source: thesis author.

Table 3. NLP Label Definitions.

	Label name	Definition: Keywords applied in the ProQuest search criteria.
1	DLT	(blockchain OR "distributed ledger" OR "digital currency" OR "bitcoin" OR "ethereum" OR "{crypto currency}" OR "{decentralised finance}" OR "defi" OR "{decentralised economy}" OR DAO OR "{decentralised autonomous organisation}" OR "smart contract*")
2	Activism	("civil societ*" OR "social movement*" OR activis* OR "collective action" OR "social change*" OR "civil right*")
3	Crowd	(crowdfund* OR gamestop OR crowdsourc* OR ICO OR "initial coin offering*" OR reddit*)
4	CBDC	(CBDC OR "central bank digital currenc*" OR "{stable coin}" OR stablecoin* OR "narrow banking" OR "{full reserve banking}" OR "100% reserve banking")
5	ESG	("ESG" OR "CSR" OR "Environmental governance" OR "social governance" OR "social responsibility" OR "corporate responsibility" OR "socially responsible invesment*" OR "Principles for Responsible Investment*" OR "Green bond*" OR "sustainable bond*" OR "Global Green Finance Council" OR "Sustainable Development Goal*")

Source: thesis author

Supervised machine learning for the multi-label classification of natural language text is a process of training, testing, and using probabilistic models to predict whether several predefined labels describe pieces of text, or not. In this study, the process was used to describe the content of thousands of *Economist* articles by considering whether the above five labels were applicable. After defining the labels, the process was as follows:

1. *Production of a dataset for training and testing the model*: A selective sample of *Economist* articles was retrieved from ProQuest and then systematically assigned one or more of the above labels. Each label was first independently defined by

lists of keywords and phrases shown in Table 3 above. These criteria were combined to produce ProQuest search queries specific to each unique label combination. See Step 7 below, Table 5, and Appendix 2, for full details.

2. *Data preprocessing*: The articles were first simplified by removing stopwords. stemming and lemmatization functions were then applied to reduce remaining words to their root form thereby further removing complexity from the text.
3. *Feature extraction using a TFIDF vectorizer*: (TFIDF = Term Frequency—Inverse Document Frequency). This is a statistical methodology for measuring the relevance of words within documents (or articles in this case) that are part of a collection of such documents. The first component, term frequency, is a count of how many times each word appears in each document. Term frequencies overstate the importance of common words and so the second component, the Inverse Document Frequency factor, is used to measure how common a word is across the collection of documents and then provide an appropriate weighting.
4. *Splitting the data:* The sample of articles that was pre-labeled using ProQuest search criteria in Step 1 was split into a dataset for training the model and a dataset for testing it.
5. *Model training:* Once text articles were converted to arrays of measures (vectorization) that weighted the importance of each word (Step 3), several modeling techniques that are freely available in Python were used. The first of which was the application of a Binary Relevance technique using the Multinomial Naive Bayes algorithm. This calculated the probability of each label, given the presence and weighting of words in the text.

6. *Testing*: Having calibrated the model using the training data, the model was used to predict labels for the test data. Predicted labels were compared to the pre-assigned labels, and accuracy was assessed. The accuracy measure used was the hamming loss which is the percentage of inaccurate labels. In the following simplified example (Table 4), there is a 20% hamming loss because of the ten labels (five for each of the two articles), two are inaccurate.

Table 4. NLP Accuracy Assessment: 20% Hamming Loss Example.

Article ID	Manually Assigned Labels					Predicted Labels				
	Label 1	Label 2	Label 3	Label 4	Label 5	Label 1	Label 2	Label 3	Label 4	Label 5
1	0	1	0	0	1	0	1	0	1	1
2	0	0	1	1	0	0	0	1	1	1

Source: thesis author

7. *Model Optimization*: Initial model accuracy produced hamming losses >20% which was not considered acceptable. One driver of low accuracy was a low number of articles for certain labels (a training dataset of 500 articles resulted in <5 articles for some important label combinations) so the size of the training data set was increased to 4,319 (see Appendix 2 for details). From there, both the classifier chain and the label powerset techniques were tested. The label powerset produced the most accurate results with hamming losses <7% (>93% accuracy). This technique transformed the process into a multiclass classification problem whereby the model was trained on every possible unique label combination, rather

than the initial Binary Relevance technique which assessed each label independently.

8. *Prediction*: Having achieved an acceptable level of accuracy, the model was then used to predict labels for all 8,171 *Economist* articles returned using the below search criteria (see Table 5).
9. *Validation*: As discussed in the results section, this machine-learning methodology produced some alarming findings. Despite a high prediction accuracy, findings were therefore further interrogated using ProQuest command line queries to validate them. The Python NLP approach identified specific focus areas which reduced the manual work associated with exploring all labels. As discussed, an objective of this project was to build a model, capable of processing less structured text data in future studies, repeating certain tests with this alternate methodology was therefore considered an essential validation exercise.

Table 5. Training and Testing Dataset Construction.

Count	Activism	ESG	CBDC	Crowd	DLT	ProQuest Search Criteria	Label for Python Script	Article Count
1	1	0	0	0	0	(pubid(41716))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	10000	499
2	0	1	0	0	0	(pubid(41716)OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	01000	500

To ensure each label had enough articles, labels were assigned using ProQuest search criteria as shown in this table. Each possible label combination (32 in total) had a unique search criterion. See Appendix 2 for full documentation.

Sampling

A selective sample of written mainstream media articles was used to assess whether DLT activism exists as a theme in DeFi narratives. Following preliminary analysis, this judgmental sampling approach was chosen to maximize conservatism where the null hypothesis is rejected.

All articles from *The Economist* since 2001 mentioning DLT, activism, ESG, crowd culture, or CBDC, as defined above, were sampled. *The Economist* is a weekly news publication covering international news, politics, business, finance, science, technology and the connections between them, and it assumes fundamental knowledge about economics. It regularly discusses democracy and capitalism along with issues such as ESG and DLT in technical depth. The publication remains aligned to its classic liberal ancestry and "opposes all undue curtailment of an individual's economic or personal freedom" (*Economist*, 2018). For these reasons, *The Economist* was judged as the top candidate for making the link between DLT, activism and political context, then developing narratives on the subject. Given this bias, one could argue that the presence of such narratives from *The Economist* would not be representative of the wider mainstream media, because less specialized publications are less likely to develop such technical narratives. Where the null hypothesis is rejected based on results from *The Economist*, the bias adds confidence to the conclusion that DLT activism does not exist as a theme elsewhere in the mainstream media. Where the null hypothesis is not rejected, this bias reduces confidence.

When optimizing the multi-label classification model, as described in Step 7 of the prior section, the size of the training dataset was increased. This was possible by

extending the search criteria to include articles from *Financial Times* and the *Wall Street Journal*. This is evident in Appendix 2, where ProQuest search criteria references PUBID(41716) OR PUBID(35024) OR PUBID(45441) for certain label combinations. Once trained using all three publications, the sample for which labels were subsequently predicted and used for hypothesis testing was limited to *The Economist*. It was obtained using the search criteria shown in Table 6.

Table 6. *Economist* Sample Query

ProQuest Search Criteria	(pubid(41716))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))
Publication Date	After January 1, 2001
Other	Full texts, exclude duplicate documents, include spelling variants for your search terms.

Source: Thesis author

As mentioned in Step 9 of the prior section, initial testing using the multi-label prediction model produced alarming findings and so ProQuest command line queries were used to validate results. In the next chapter, these two steps are discussed under the headings Prediction and Validation, respectively.

Chapter V

Hypothesis Testing and Findings

The 32 possible label combinations were coded as five binary digits, representing the five labels, in the following order: Activism, ESG, CBDC, Crowd, DLT.

1 means a label is assigned, and 0 means a label is not.

To illustrate, 10001 was assigned to articles including content about activism and DLT, but not to ESG, CBDC, or Crowd:

Table 7. Label Coding Example.

Activism	ESG	CBDC	Crowd	DLT
1	0	0	0	1

Source: thesis author

Prediction

Figures 2 and 3 show that neither the binary relevance prediction model, nor the label powerset model returned any articles containing:

- Activism and DLT (10001, 11001, 10101,10011, 11101, 11011, 10111, 11111)
- ESG and DLT (01001, 11001, 01101, 01011, 11101, 11011, 01111, 11111)
- Activism and CBDC (10100, 10101, 10110, 11100, 10111, 11101, 11110, 11111)
- ESG and CBDC (01100, 11100, 01110, 01101, 11110, 11101, 01111, 11111)

This zero result suggests that the null hypothesis should be rejected without need for considering significance level. According to the multi-label prediction methodology, DLT activism does not exist as a theme in DeFi narratives presented by the mainstream written media.

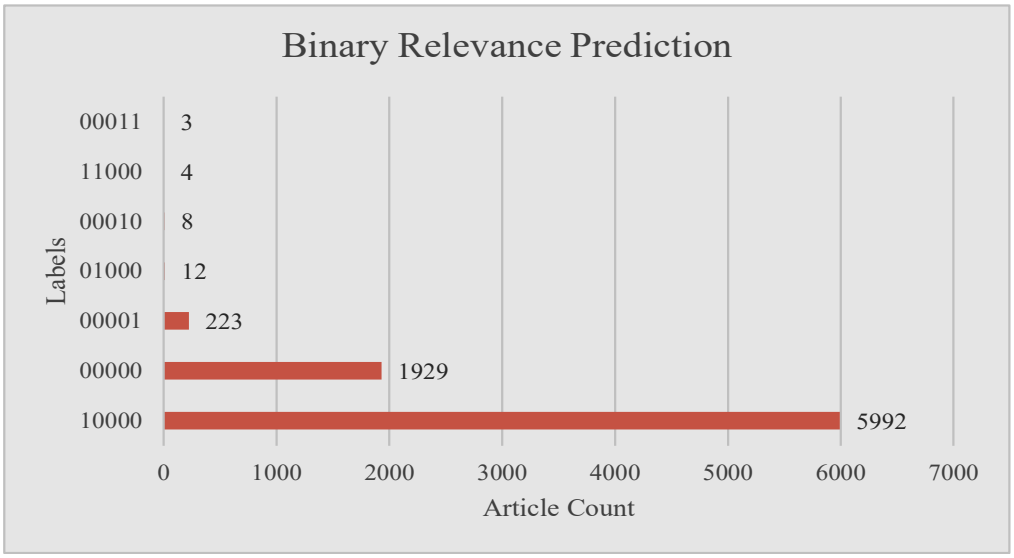

Figure 2. Binary Relevance Results.

Source: thesis author

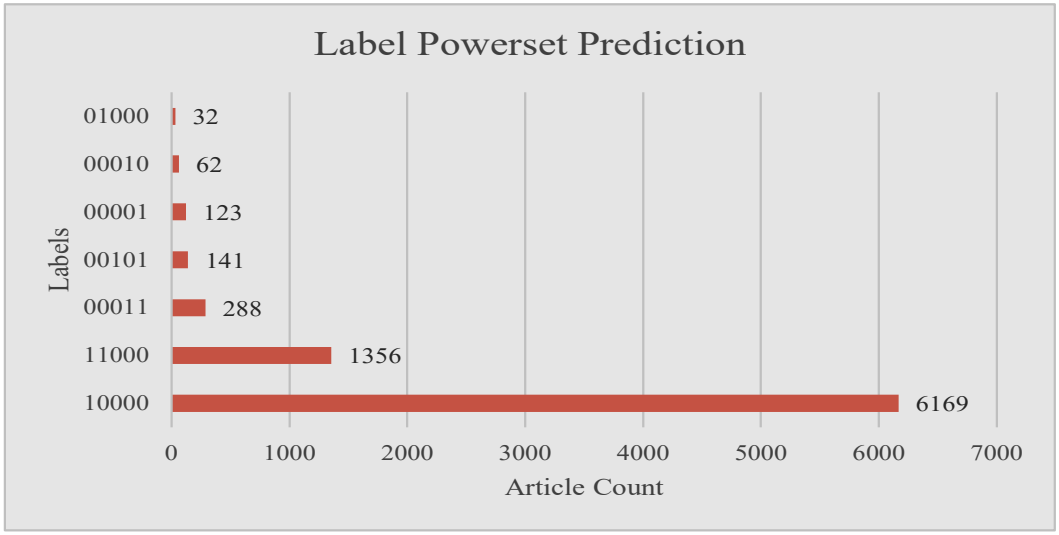

Figure 3. Label Powerset Results.

Source: thesis author

While the binary relevance and label powerset models were trained with 86% and 93% accuracy respectively, this result is surprising given that 187 articles containing activism and DLT (10001) were used for training both models. Similarly, 92 articles containing ESG and DLT (01001) were used for training. The result is not as surprising for CBDC because only two articles containing either DLT or ESG, and CBDC were available for model training. Given that prediction results appear to deviate from training data for articles involving ESG, activism and DLT, further validation was conducted to ascertain statistical significance.

Validation

When optimizing the multi-label classification models, increasing the number of articles used for training, directly increased model accuracy. To maximize efficiency when downloading articles from ProQuest, the number of articles used for each of the 32 possible label combinations was capped at 500. For certain combinations however, even when the training data was extended to include the *Financial Times* and the *Wall Street Journal*, there were less than 500 articles available. Case in point, per the ProQuest search tool, zero articles contained discussion of Activism, ESG, CBDC and DLT all together in a single text. Label combinations with minimal articles returned from ProQuest are highlighted in red in Appendix 2.

For Activism and DLT labeled articles along with ESG and DLT labeled articles, 103 and 50 articles were returned respectively when querying the three publications. The validation phase of this research answers whether, as a proportion of total DLT articles, these are statistically significant proportions or not. This validation work was first

conducted at an aggregate level and then by quarter. For such testing, because the proportion count is not zero, one needs to specifically define what constitutes a “theme”. The null hypothesis must therefore be expanded.

Table 8. Validation Label Counts.

Article Count by Label	Activism and DLT	ESG and DLT	Total DLT
10001	187		
11001	16	16	
10101	2		
10011	20		
01001		92	
01101		1	
01011		4	
Total Articles Retrieved from ProQuest Total (ties with Appendix 2.)	225	113	
Total after correcting for data quality issues.	103	50	2408

Note the data quality correction. The Financial Times reports many articles in multiple regions that do not get flagged as duplicates in ProQuest this is because they contain unique text for each region in their titles such as [Europe], or [U.S.A]. These duplicates were not considered an issue for model training but were essential to remove for the validation step.

Source: thesis author

Table 9. ProQuest Queries for Validation.

Total DLT	(pubid(41716) OR PUBID(35024) OR PUBID(45441)) AND (blockchain OR "distributed ledger" OR "digital currency" OR "bitcoin" OR "ethereum" OR "{crypto currency}" OR "{decentralised finance}" OR "defi" OR "{decentralised economy}" OR DAO OR "{decentralised autonomous organisation}" OR "smart contract*")
DLT and Activism	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND(("civil societ*" OR "social movement*" OR activis* OR "collective action" OR "social change*" OR "civil right*")AND(blockchain OR "distributed ledger" OR "digital currency" OR "bitcoin" OR "ethereum" OR "{crypto currency}" OR "{decentralised finance}" OR "defi" OR "{decentralised economy}" OR DAO OR "{decentralised autonomous organisation}" OR "smart contract*"))
DLT and ESG	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND(("ESG" OR "CSR" OR "Environmental governance" OR "social governance" OR "social responsibility" OR "corporate responsibility" OR "socially responsible invesment*" OR "Principles for Responsible Investment*" OR "Green bond*" OR "sustainable bond*" OR "Global Green Finance Council" OR "Sustainable Development Goal*")AND(blockchain OR "distributed ledger" OR "digital currency" OR "bitcoin" OR "ethereum" OR "{crypto currency}" OR "{decentralised finance}" OR "defi" OR "{decentralised economy}" OR DAO OR "{decentralised autonomous organisation}" OR "smart contract*"))
Publication Date	After January 1, 2008. Data for prediction testing began in 2001 because all five labels were being explored. Given validation was focused only on DLT combinations articles before 2008, the year of Bitcoin inception, were dismissed.
Other	Full texts, exclude duplicate documents, include spelling variants for your search terms.

Source: thesis author

Expanded Hypothesis

Activism exists as a theme in articles about DLT where:

- 20% proportion of DLT articles discussing activism constitutes a central theme
- 10% proportion constitutes a significant theme
- 5% proportion constitutes a minor theme
- 2% proportion constitutes a minimal theme.

Using a 5% significance level (-1.64 z-score) at an aggregate level:

- One must reject the hypotheses that DLT activism exists as a central or significant theme. One should however accept the null hypothesis that DLT activism exists as a minor theme.
- One can only accept that ESG exists as a minimal theme in articles about DLT.

Table 10. Aggregate Hypothesis Validation.

							Null Hypothesis: ESG exists as a theme in articles about DLT			Null Hypothesis: Activism exists as a theme in articles about DLT		
a	b	c	d = a/c	e = b/c	f	g	h = (d-f) / sqrt((f*(1-f))/c)	i = NORM.DIST(h,0,1,TRUE)	j = if(h<g,"Reject null", "Do not reject null")	k = (e-f)/sqrt((f*(1-f))/c)	l = NORM.DIST(k,0,1,TRUE)	m = if(k<g,"Reject null", "Do not reject null")
dlt AND esg Article Count	dlt AND Activism Article Count	Total dlt Article Count	dlt AND esg Sample Proportion	dlt AND activism Sample Proportion	Null Hypothesis Proportion	5% Significance z-score	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)
50	103	2408	2.08%	4.28%	**20%**	-1.64	-21.99	0.00	Reject null	-19.29	0.00%	Reject null
50	103	2408	2.08%	4.28%	**10%**	-1.64	-12.96	0.00	Reject null	-9.36	0.00%	Reject null
50	103	2408	2.08%	4.28%	**6%**	-1.64	-8.11	0.00	Reject null	-3.56	0.02%	Reject null
50	103	2408	2.08%	4.28%	**5%**	-1.64	-6.58	0.00	Reject null	-1.63	5.19%	Do not reject null
50	103	2408	2.08%	4.28%	**3%**	-1.64	-2.66	0.00	Reject null	3.67	99.99%	Do not reject null
50	103	2408	2.08%	4.28%	**2%**	-1.64	0.27	0.61	Do not reject null	7.98	100.00%	Do not reject null

Source: thesis author

Using a 5% significance level (-1.64 z-score) to review proportions on a quarterly basis, there is insufficient data for testing before 2013 (see Table 11), but for quarters afterward:

- One must reject the hypotheses that activism or ESG exist as a central theme in DLT articles (see Table 12).
- There are mixed results for the hypotheses that activism or ESG exist as a significant theme in DLT articles. In some quarters the hypotheses should be rejected, in others they should be accepted. See Table 13 for a full breakdown.
- One can accept that both ESG and Activism exist as minor themes (see Table 14).

Table 11. Quarterly Hypothesis Validation, Pre-2013.

								Null Hypothesis: ESG exists as a theme in			Null Hypothesis: Activism exists as a theme			
Formulas:	a	b	c	d = a/c	e = b/c	f	g	h = (d-f) / sqrt((f*(1-f))/c)	i = NORM.DIST(h,0,1,TRUE)	j = if(h<g,"Reject null", "Do not reject null")	k = (e-f)/sqrt((f*(1-f))/c)	l = NORM.DIST(k, 0,1,TRUE)	m = if(k<g,"Reject null", "Do not reject null")	
Publication date	dlt AND esg Article Count	dlt AND Activism Article Count	Total dlt Article Count	dlt AND esg Sample Proportion	dlt AND activism Sample Proportion	Null Hypothesis Proportion	5% Significance z-score	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Conclusion
1Q2008	0	0	1	0.00%	0.00%	20%	-1.64	-0.50	0.31	Do not reject null	-0.50	30.85%	Do not reject null	
2Q2008	0	1	1	0.00%	100.00%	20%	-1.64	-0.50	0.31	Do not reject null	2.00	97.72%	Do not reject null	
3Q2008	0	0	0	No Data	0.00%	20%	-1.64	No Data	No Data	No Data	No Data	No Data	No Data	
4Q2008	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
1Q2009	0	0	0	No Data	0.00%	20%	-1.64	No Data	No Data	No Data	No Data	No Data	No Data	
2Q2009	0	0	1	0.00%	0.00%	20%	-1.64	-0.50	0.31	Do not reject null	-0.50	30.85%	Do not reject null	
3Q2009	0	0	0	No Data	0.00%	20%	-1.64	No Data	No Data	No Data	No Data	No Data	No Data	
4Q2009	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
1Q2010	0	0	1	0.00%	0.00%	20%	-1.64	-0.50	0.31	Do not reject null	-0.50	30.85%	Do not reject null	
2Q2010	0	0	0	No Data	0.00%	20%	-1.64	No Data	No Data	No Data	No Data	No Data	No Data	Insufficient sample sizes 1Q2008 to 1Q2013
3Q2010	0	0	1	0.00%	0.00%	20%	-1.64	-0.50	0.31	Do not reject null	-0.50	30.85%	Do not reject null	
4Q2010	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
1Q2011	0	0	6	0.00%	0.00%	20%	-1.64	-1.22	0.11	Do not reject null	-1.22	11.03%	Do not reject null	
2Q2011	0	0	3	0.00%	0.00%	20%	-1.64	-0.87	0.19	Do not reject null	-0.87	19.32%	Do not reject null	
3Q2011	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
4Q2011	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
1Q2012	0	1	1	0.00%	100.00%	20%	-1.64	-0.50	0.31	Do not reject null	2.00	97.72%	Do not reject null	
2Q2012	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
3Q2012	0	0	6	0.00%	0.00%	20%	-1.64	-1.22	0.11	Do not reject null	-1.22	11.03%	Do not reject null	
4Q2012	0	0	2	0.00%	0.00%	20%	-1.64	-0.71	0.24	Do not reject null	-0.71	23.98%	Do not reject null	
1Q2013	0	0	3	0.00%	0.00%	20%	-1.64	-0.87	0.19	Do not reject null	-0.87	19.32%	Do not reject null	

Source: thesis author

Table 12. Quarterly Hypothesis Validation, 20% Null Hypothesis Proportion.

								Null Hypothesis: ESG exists as a theme in articles about DLT			Null Hypothesis: Activism exists as a theme in articles about DLT			
Formulas:	a	b	c	d = a/c	e = b/c	f	g	h = (d-f) / sqrt((f*(1-f))/c)	i = NORM.DIST(h,0,1,TRUE)	j = if(h<g,"Reject null", "Do not reject null")	k = (e-f)/sqrt((f*(1-f))/c)	l = NORM.DIST(k,0,1, TRUE)	m = if(k<g,"Reject null", "Do not reject null")	
Publication date	dlt AND esg Article Count	dlt AND Activism Article Count	Total dlt Article Count	dlt AND esg Sample Proportion	dlt AND activism Sample Proportion	Null Hypothesis Proportion	5% Significance z-score	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Conclusion
2Q2013	0	4	39	0.00%	10.26%	20%	-1.64	-3.12	0.00	Reject null	-1.52	6.41%	Do not reject null	
3Q2013	0	0	16	0.00%	0.00%	20%	-1.64	-2.00	0.02	Reject null	-2.00	2.28%	Reject null	
4Q2013	0	1	53	0.00%	1.89%	20%	-1.64	-3.64	0.00	Reject null	-3.30	0.05%	Reject null	
1Q2014	0	2	83	0.00%	2.41%	20%	-1.64	-4.56	0.00	Reject null	-4.01	0.00%	Reject null	
2Q2014	0	2	35	0.00%	5.71%	20%	-1.64	-2.96	0.00	Reject null	-2.11	1.73%	Reject null	
3Q2014	0	2	32	0.00%	6.25%	20%	-1.64	-2.83	0.00	Reject null	-1.94	2.59%	Reject null	
4Q2014	0	0	30	0.00%	0.00%	20%	-1.64	-2.74	0.00	Reject null	-2.74	0.31%	Reject null	
1Q2015	1	2	44	2.27%	4.55%	20%	-1.64	-2.94	0.00	Reject null	-2.56	0.52%	Reject null	
2Q2015	0	0	23	0.00%	0.00%	20%	-1.64	-2.40	0.01	Reject null	-2.40	0.82%	Reject null	
3Q2015	1	1	29	3.45%	3.45%	20%	-1.64	-2.23	0.01	Reject null	-2.23	1.29%	Reject null	At 20% null hypothesis
4Q2015	0	3	46	0.00%	6.52%	20%	-1.64	-3.39	0.00	Reject null	-2.29	1.11%	Reject null	proportion:
1Q2016	2	4	50	4.00%	8.00%	20%	-1.64	-2.83	0.00	Reject null	-2.12	1.69%	Reject null	
2Q2016	2	0	54	3.70%	0.00%	20%	-1.64	-2.99	0.00	Reject null	-3.67	0.01%	Reject null	Reject the hypothesis
3Q2016	0	1	43	0.00%	2.33%	20%	-1.64	-3.28	0.00	Reject null	-2.90	0.19%	Reject null	that ESG exists as a
4Q2016	1	1	33	3.03%	3.03%	20%	-1.64	-2.44	0.01	Reject null	-2.44	0.74%	Reject null	theme in articles about
1Q2017	0	2	28	0.00%	7.14%	20%	-1.64	-2.65	0.00	Reject null	-1.70	4.45%	Reject null	DLT for all quarters
2Q2017	1	2	74	1.35%	2.70%	20%	-1.64	-4.01	0.00	Reject null	-3.72	0.01%	Reject null	between 2Q2013 and
3Q2017	0	2	67	0.00%	2.99%	20%	-1.64	-4.09	0.00	Reject null	-3.48	0.02%	Reject null	4Q2021
4Q2017	3	7	128	2.34%	5.47%	20%	-1.64	-4.99	0.00	Reject null	-4.11	0.00%	Reject null	
1Q2018	1	8	119	0.84%	6.72%	20%	-1.64	-5.23	0.00	Reject null	-3.62	0.01%	Reject null	Reject the hypothesis
2Q2018	1	5	75	1.33%	6.67%	20%	-1.64	-4.04	0.00	Reject null	-2.89	0.19%	Reject null	that activism exists as a
3Q2018	2	1	61	3.28%	1.64%	20%	-1.64	-3.26	0.00	Reject null	-3.59	0.02%	Reject null	theme in articles about
4Q2018	2	4	68	2.94%	5.88%	20%	-1.64	-3.52	0.00	Reject null	-2.91	0.18%	Reject null	DLT for all quarters
1Q2019	1	0	31	3.23%	0.00%	20%	-1.64	-2.33	0.01	Reject null	-2.78	0.27%	Reject null	between 2Q2013 and
2Q2019	1	1	65	1.54%	1.54%	20%	-1.64	-3.72	0.00	Reject null	-3.72	0.01%	Reject null	4Q2021, apart from
3Q2019	1	2	46	2.17%	4.35%	20%	-1.64	-3.02	0.00	Reject null	-2.65	0.40%	Reject null	2Q2013
4Q2019	0	3	57	0.00%	5.26%	20%	-1.64	-3.77	0.00	Reject null	-2.78	0.27%	Reject null	
1Q2020	1	1	23	4.35%	4.35%	20%	-1.64	-1.88	0.03	Reject null	-1.88	3.03%	Reject null	
2Q2020	0	1	28	0.00%	3.57%	20%	-1.64	-2.65	0.00	Reject null	-2.17	1.49%	Reject null	
3Q2020	3	3	37	8.11%	8.11%	20%	-1.64	-1.81	0.04	Reject null	-1.81	3.53%	Reject null	
4Q2020	3	3	62	4.84%	4.84%	20%	-1.64	-2.98	0.00	Reject null	-2.98	0.14%	Reject null	
1Q2021	4	3	163	2.45%	1.84%	20%	-1.64	-5.60	0.00	Reject null	-5.80	0.00%	Reject null	
2Q2021	8	14	221	3.62%	6.33%	20%	-1.64	-6.09	0.00	Reject null	-5.08	0.00%	Reject null	
3Q2021	3	4	192	1.56%	2.08%	20%	-1.64	-6.39	0.00	Reject null	-6.21	0.00%	Reject null	
4Q2021	8	12	216	3.70%	5.56%	20%	-1.64	-5.99	0.00	Reject null	-5.31	0.00%	Reject null	

Source: thesis author

Table 13. Quarterly Hypothesis Validation, 10% Null Hypothesis Proportion.

								Null Hypothesis: ESG exists as a theme in			Null Hypothesis: Activism exists as a theme in articles			
Formulas:	a	b	c	d = a/c	e = b/c	f	g	h = (d-f) / sqrt((f*(1-f))/c)	i = NORM.DIST(h,0,1,TRUE)	j = if(h<g,"Reject null", "Do not reject null")	k = (e-f)/sqrt((f*(1-f))/c)	l = NORM.DIST(k,0,1, TRUE)	m = if(k<g,"Reject null", "Do not reject null")	
Publication date	dlt AND esg Article Count	dlt AND Activism Article Count	Total dlt Article Count	dlt AND esg Sample Proportion	dlt AND activism Sample Proportion	Null Hypothesis Proportion	5% Significance z-score	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Conclusion
2Q2013	0	4	39	0.00%	10.26%	10%	-1.64	-2.08	0.02	Reject null	0.05	52.13%	Do not reject null	At 10% null hypothesis proportion: Mixed results for the hypothesis that esg exists as a theme in articles about DLT: For quarters between 2Q2013 and 4Q2021, with the exception of 3Q2013, 2Q and 3Q2015, 2016, 1Q2019 and 2020, reject the hypothesis that ESG exists as a theme in articles about DLT. Mixed results for the hypothesis that activism exists as a theme in articles about DLT.
3Q2013	0	0	16	0.00%	0.00%	10%	-1.64	-1.33	0.09	Do not reject null	-1.33	9.12%	Do not reject null	
4Q2013	0	1	53	0.00%	1.89%	10%	-1.64	-2.43	0.01	Reject null	-1.97	2.45%	Reject null	
1Q2014	0	2	83	0.00%	2.41%	10%	-1.64	-3.04	0.00	Reject null	-2.31	1.06%	Reject null	
2Q2014	0	2	35	0.00%	5.71%	10%	-1.64	-1.97	0.02	Reject null	-0.85	19.90%	Do not reject null	
3Q2014	0	2	32	0.00%	6.25%	10%	-1.64	-1.89	0.03	Reject null	-0.71	23.98%	Do not reject null	
4Q2014	0	0	30	0.00%	0.00%	10%	-1.64	-1.83	0.03	Reject null	-1.83	3.39%	Reject null	
1Q2015	1	2	44	2.27%	4.55%	10%	-1.64	-1.71	0.04	Reject null	-1.21	11.39%	Do not reject null	
2Q2015	0	0	23	0.00%	0.00%	10%	-1.64	-1.60	0.05	Do not reject null	-1.60	5.50%	Do not reject null	
3Q2015	1	1	29	3.45%	3.45%	10%	-1.64	-1.18	0.12	Do not reject null	-1.18	11.98%	Do not reject null	
4Q2015	0	3	46	0.00%	6.52%	10%	-1.64	-2.26	0.01	Reject null	-0.79	21.58%	Do not reject null	
1Q2016	2	4	50	4.00%	8.00%	10%	-1.64	-1.41	0.08	Do not reject null	-0.47	31.87%	Do not reject null	
2Q2016	2	0	54	3.70%	0.00%	10%	-1.64	-1.54	0.06	Do not reject null	-2.45	0.72%	Reject null	
3Q2016	0	1	43	0.00%	2.33%	10%	-1.64	-2.19	0.01	Reject null	-1.68	4.67%	Reject null	
4Q2016	1	1	33	3.03%	3.03%	10%	-1.64	-1.33	0.09	Do not reject null	-1.33	9.10%	Do not reject null	
1Q2017	0	2	28	0.00%	7.14%	10%	-1.64	-1.76	0.04	Reject null	-0.50	30.71%	Do not reject null	
2Q2017	1	2	74	1.35%	2.70%	10%	-1.64	-2.48	0.01	Reject null	-2.09	1.82%	Reject null	
3Q2017	0	2	67	0.00%	2.99%	10%	-1.64	-2.73	0.00	Reject null	-1.91	2.78%	Reject null	
4Q2017	3	7	128	2.34%	5.47%	10%	-1.64	-2.89	0.00	Reject null	-1.71	4.37%	Reject null	
1Q2018	1	8	119	0.84%	6.72%	10%	-1.64	-3.33	0.00	Reject null	-1.19	11.67%	Do not reject null	
2Q2018	1	5	75	1.33%	6.67%	10%	-1.64	-2.50	0.01	Reject null	-0.96	16.80%	Do not reject null	
3Q2018	2	1	61	3.28%	1.64%	10%	-1.64	-1.75	0.04	Reject null	-2.18	1.48%	Reject null	
4Q2018	2	4	68	2.94%	5.88%	10%	-1.64	-1.94	0.03	Reject null	-1.13	12.89%	Do not reject null	
1Q2019	1	0	31	3.23%	0.00%	10%	-1.64	-1.26	0.10	Do not reject null	-1.86	3.17%	Reject null	
2Q2019	1	1	65	1.54%	1.54%	10%	-1.64	-2.27	0.01	Reject null	-2.27	1.15%	Reject null	
3Q2019	1	2	46	2.17%	4.35%	10%	-1.64	-1.77	0.04	Reject null	-1.28	10.07%	Do not reject null	
4Q2019	0	3	57	0.00%	5.26%	10%	-1.64	-2.52	0.01	Reject null	-1.19	11.66%	Do not reject null	
1Q2020	1	1	23	4.35%	4.35%	10%	-1.64	-0.90	0.18	Do not reject null	-0.90	18.31%	Do not reject null	
2Q2020	0	1	28	0.00%	3.57%	10%	-1.64	-1.76	0.04	Reject null	-1.13	12.84%	Do not reject null	
3Q2020	3	3	37	8.11%	8.11%	10%	-1.64	-0.38	0.35	Do not reject null	-0.38	35.06%	Do not reject null	
4Q2020	3	3	62	4.84%	4.84%	10%	-1.64	-1.35	0.09	Do not reject null	-1.35	8.78%	Do not reject null	
1Q2021	4	3	163	2.45%	1.84%	10%	-1.64	-3.21	0.00	Reject null	-3.47	0.03%	Reject null	
2Q2021	8	14	221	3.62%	6.33%	10%	-1.64	-3.16	0.00	Reject null	-1.82	3.47%	Reject null	
3Q2021	3	4	192	1.56%	2.08%	10%	-1.64	-3.90	0.00	Reject null	-3.66	0.01%	Reject null	
4Q2021	8	12	216	3.70%	5.56%	10%	-1.64	-3.08	0.00	Reject null	-2.18	1.47%	Reject null	

Source: thesis author

Table 14. Quarterly Hypothesis Validation, 5% Null Hypothesis Proportion.

								Null Hypothesis: ESG exists as a theme in articles about DLT			Null Hypothesis: Activism exists as a theme in articles about DLT			
Formulas:	a	b	c	d = a/c	e = b/c	f	g	h = (d-f) / sqrt((f*(1-f))/c)	i = NORM.DIST(h,0,1,TRUE)	j = if(h<g,"Reject null", "Do not reject null")	k = (e-f)/sqrt((f*(1-f))/c)	l = NORM.DIST(k,0,1,TRUE)	m = if(k<g,"Reject null", "Do not reject null")	
Publication date	dlt AND esg Article Count	dlt AND Activism Article Count	Total dlt Article Count	dlt AND esg Sample Proportion	dlt AND activism Sample Proportion	Null Hypothesis Proportion	5% Significance z-score	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Sample Proportion z-score	p-value	5% Significance (-1.64 z-score)	Conclusion
2Q2013	0	4	39	0.00%	10.26%	5%	-1.64	-1.43	0.08	Do not reject null	1.51	93.40%	Do not reject null	
3Q2013	0	0	16	0.00%	0.00%	5%	-1.64	-0.92	0.18	Do not reject null	-0.92	17.94%	Do not reject null	
4Q2013	0	1	53	0.00%	1.89%	5%	-1.64	-1.67	0.05	Reject null	-1.04	14.92%	Do not reject null	
1Q2014	0	2	83	0.00%	2.41%	5%	-1.64	-2.09	0.02	Reject null	-1.08	13.94%	Do not reject null	
2Q2014	0	2	35	0.00%	5.71%	5%	-1.64	-1.36	0.09	Do not reject null	0.19	57.69%	Do not reject null	
3Q2014	0	2	32	0.00%	6.25%	5%	-1.64	-1.30	0.10	Do not reject null	0.32	62.72%	Do not reject null	
4Q2014	0	0	30	0.00%	0.00%	5%	-1.64	-1.26	0.10	Do not reject null	-1.26	10.45%	Do not reject null	
1Q2015	1	2	44	2.27%	4.55%	5%	-1.64	-0.83	0.20	Do not reject null	-0.14	44.50%	Do not reject null	
2Q2015	0	0	23	0.00%	0.00%	5%	-1.64	-1.10	0.14	Do not reject null	-1.10	13.56%	Do not reject null	
3Q2015	1	1	29	3.45%	3.45%	5%	-1.64	-0.38	0.35	Do not reject null	-0.38	35.07%	Do not reject null	At 5% null hypothesis proportion:
4Q2015	0	3	46	0.00%	6.52%	5%	-1.64	-1.56	0.06	Do not reject null	0.47	68.21%	Do not reject null	
1Q2016	2	4	50	4.00%	8.00%	5%	-1.64	-0.32	0.37	Do not reject null	0.97	83.48%	Do not reject null	
2Q2016	2	0	54	3.70%	0.00%	5%	-1.64	-0.44	0.33	Do not reject null	-1.69	4.59%	Reject null	For most quarters
3Q2016	0	1	43	0.00%	2.33%	5%	-1.64	-1.50	0.07	Do not reject null	-0.80	21.05%	Do not reject null	between 2Q2013 and
4Q2016	1	1	33	3.03%	3.03%	5%	-1.64	-0.52	0.30	Do not reject null	-0.52	30.18%	Do not reject null	4Q2021, do not reject
1Q2017	0	2	28	0.00%	7.14%	5%	-1.64	-1.21	0.11	Do not reject null	0.52	69.86%	Do not reject null	the hypothesis that ESG
2Q2017	1	2	74	1.35%	2.70%	5%	-1.64	-1.44	0.07	Do not reject null	-0.91	18.23%	Do not reject null	exists as a theme in
3Q2017	0	2	67	0.00%	2.99%	5%	-1.64	-1.88	0.03	Reject null	-0.76	22.46%	Do not reject null	articles about DLT.
4Q2017	3	7	128	2.34%	5.47%	5%	-1.64	-1.38	0.08	Do not reject null	0.24	59.61%	Do not reject null	
1Q2018	1	8	119	0.84%	6.72%	5%	-1.64	-2.08	0.02	Reject null	0.86	80.57%	Do not reject null	For most quarters
2Q2018	1	5	75	1.33%	6.67%	5%	-1.64	-1.46	0.07	Do not reject null	0.66	74.61%	Do not reject null	between 2Q2013 and
3Q2018	2	1	61	3.28%	1.64%	5%	-1.64	-0.62	0.27	Do not reject null	-1.20	11.42%	Do not reject null	4Q2021, do not reject
4Q2018	2	4	68	2.94%	5.88%	5%	-1.64	-0.78	0.22	Do not reject null	0.33	63.08%	Do not reject null	the hypothesis that
1Q2019	1	0	31	3.23%	0.00%	5%	-1.64	-0.45	0.33	Do not reject null	-1.28	10.07%	Do not reject null	activism exists as a
2Q2019	1	1	65	1.54%	1.54%	5%	-1.64	-1.28	0.10	Do not reject null	-1.28	10.02%	Do not reject null	theme in articles about
3Q2019	1	2	46	2.17%	4.35%	5%	-1.64	-0.88	0.19	Do not reject null	-0.20	41.96%	Do not reject null	DLT.
4Q2019	0	3	57	0.00%	5.26%	5%	-1.64	-1.73	0.04	Reject null	0.09	53.63%	Do not reject null	
1Q2020	1	1	23	4.35%	4.35%	5%	-1.64	-0.14	0.44	Do not reject null	-0.14	44.29%	Do not reject null	
2Q2020	0	1	28	0.00%	3.57%	5%	-1.64	-1.21	0.11	Do not reject null	-0.35	36.44%	Do not reject null	
3Q2020	3	3	37	8.11%	8.11%	5%	-1.64	0.87	0.81	Do not reject null	0.87	80.72%	Do not reject null	
4Q2020	3	3	62	4.84%	4.84%	5%	-1.64	-0.06	0.48	Do not reject null	-0.06	47.68%	Do not reject null	
1Q2021	4	3	163	2.45%	1.84%	5%	-1.64	-1.49	0.07	Do not reject null	-1.85	3.21%	Reject null	
2Q2021	8	14	221	3.62%	6.33%	5%	-1.64	-0.94	0.17	Do not reject null	0.91	81.87%	Do not reject null	
3Q2021	3	4	192	1.56%	2.08%	5%	-1.64	-2.19	0.01	Reject null	-1.85	3.18%	Reject null	
4Q2021	8	12	216	3.70%	5.56%	5%	-1.64	-0.87	0.19	Do not reject null	0.37	64.60%	Do not reject null	

Source: thesis author

Shortcomings

The Crowd label does not feature in hypothesis testing because its definition needs further attention. One can conceptualize what crowd culture is (see page 43) and speculate that it is a new form of social movement. One can acknowledge that because it is civil and virtual in nature but also part of the economic sphere, it slips through a theoretical crack between civil society studies and social studies, and for this reason requires attention. Unfortunately, however, for the purposes of automated NLP, instances of crowd culture are difficult to separate from general discussion of DLT, communication technology or finance. It is also difficult to separate this new form of crowd culture and collective power from well-known ideas about democracy and social movements.

Consider the crowd label definition used in this thesis. Crowdfunding, whether it be via equity investment portals legalized through the JOBs Act or via unregulated initial coin offerings using DLT, are ways to democratize investment opportunities. Not all articles discussing crowdfunding however come at it from a political or social angle. Standout examples of online crowd culture, such as the 2020 GameStop fiasco, became viral internet sensations, thereby complicating conversation about its impact on decision framing. Reddit, while used in certain instances to facilitate collective action among retail investors using the financial markets for political rather economic purposes, is widely discussed in other media contexts as well. The below definition is therefore under-developed and requires attention if it is to be of any use in the discussion about political context for DLT.

Crowd	(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)

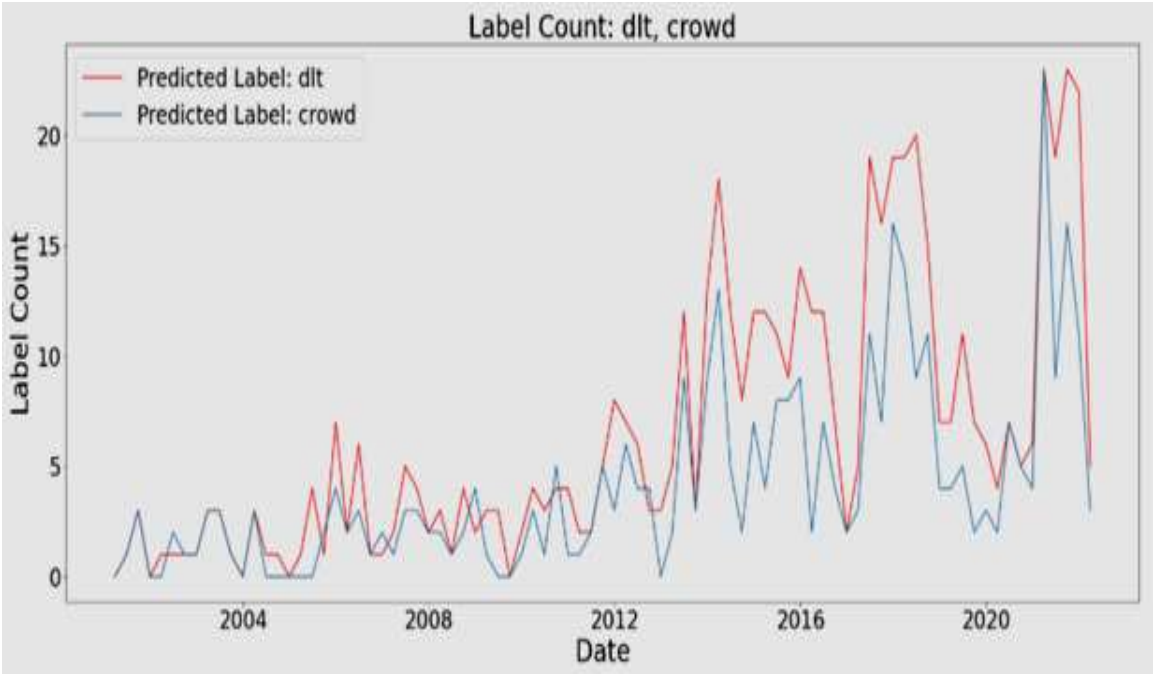

Figure 4. DLT Crowd Correlation.

Source: thesis author

Chapter VI

Conclusions and Future Study

Advocacy, policy, design, and implementation decisions pertaining to the use of distributed ledger technology in finance will have social implications. The dichotomy between central bank digital currency and stablecoins highlights several of them.

On the one hand, if governments use DLT to produce CBDC and administer financial services directly to the public, deposits will likely need to be passed to commercial banks via some form of pass-through funding (Brunnermeier & Niepelt, 2019; White, 2021). This is to avoid funds being sucked out of the capitalist engine that is the fractional reserve banking system. As White discusses, it is conceivable that this might become a politicized process with "strings attached" (White, 2021, p.243).

On the other hand, if stablecoins are endorsed for mainstream retail payments by the government, it will be important to address concerns about concentration of economic power (PWG, 2021), particularly concerns about big tech entities with monopolies on data as they seek affiliation with stablecoin issuers. Beyond CBDC and Stablecoins, a marriage between the ESG movement and DLT appears destined to become reality.

At the March 2021 BIS Innovation Summit, Chairman Jerome Powell clarified that "the real threshold question for us is, does the public want or need a new digital form of central bank money to complement what is already a highly efficient, reliable and innovative payments arena and system and arena" (p. 30). Regarding what the public wants, DLT developers have been involved in "the ultimate form of protest" (Russo,

2020, p. 70) for over a decade now. They should be considered as operating an arena where economic society, civil society and social movements intersect.

That civil society studies largely exclude the economic sphere and that social movements focus on conflict means that the civil, organized, and collective actions of DLT activist developers slip through the proverbial crack. By taking the stance of Adloff (2020)—that civic practices exist within the economic sphere—one can better translate the effort of DLT developers into the right political context. Congressman Patrick McHenry mentioned the risk of a partisan divide during the December 2021 Congressional hearing (U.S. House Committee on Financial Services, 2021a, 0:09:48). Considering DLT developers as civil society brings to light important risks relating to such an outcome.

DLT is used to create decentralized organizations and facilitate widespread contractual cooperation. One could go as far as to say that political polarization regarding DLT could result in extreme collective organization within rather than across group lines thereby exacerbating social cleavages. As democracy faces the growing challenge of political polarization, the inclusive and open ecosystems that DLT communities have nurtured so far should be considered in more depth with a view to strengthening cross cutting ties, not alienated, and forced to develop in isolation from the mainstream.

The findings in this thesis show that any discussion whatsoever of civil society, activism, or social movements within mainstream media articles about DLT, collectively represent only a minor theme to date, yet this is a huge discussion requiring attention. When considering DLT projects or actors, with a view to shaping the political context, one must first parse instances of economic automation from instances of social activism

and then understand the social or political movement to which they are aligned. DLT projects range in sophistication, reputation, and have varying ties to political society or the traditional finance establishment, yet they all cling to revolutionary claims of democratization and decentralization. To frame societal contributions accurately and in turn support adaptive decision making, media narratives and descriptions need to distinguish automation from activism.

This study focuses only on the existence of civil society or social movement themes within mainstream media narratives about DLT. The next steps will be to:

1. Differentiate motivations of different segments within this civil society. To what extent, for instance, is the DLT community engaged in building technology infrastructure that counters the threat of data monopoly by big tech. Should this take political priority?
2. Measure the extent to which DeFi specific narratives, rather than mainstream media narratives, discuss civil society or social movements. The standardized NLP machine-learning methodology from this study will support such work because it can be used to process data that is not available in well-structured databases like ProQuest. This might include transcripts of podcasts or YouTube videos specific to the DeFi community. If ideas about civil society and social movement constitute a more central theme within the DeFi community than the mainstream media, that would support analysis about whether their motives might be misinterpreted.

Appendix 1.

Case Studies

Table 15. DeFi "Banking" Case Studies: Coinbase Lend and Aave.

CRITERIA	COINBASE LEND	AAVE
Overview	Coinbase is a U.S. based digital asset exchange platform. It facilitates trading for both retail and institutional clients. The Coinbase Lend program, which was announced and subsequently abandoned in 2021, intended to facilitate both borrowing and effectively, high yield deposits.	Aave is an open-source lending protocol. More technically, it is a decentralized non-custodial liquidity protocol where users can participate as depositors or borrowers.
Available Rate	4% APY on U.S.D Coin was included in advertisement straplines.	Market quotes. Deposit APY ranging from 0% to 21.72% APY depending on crypto asset deposited, as of January 24th, 2022. 2.28% APY on U.S.D Coin.
Risk of mass migration from traditional banking	 Low Risk High Risk Medium to high risk because the offered rate is materially higher than commercial bank savings accounts and Coinbase provides simple accessibility to otherwise relatively difficult to navigate DeFi products, assets or protocols. Coinbase is a centralized intermediary that removes the need for strong technical skills thereby increasing accessibility to alternative DLT financial products with high yields.	 Low Risk High Risk Medium to low risk. While the available yields are greater than traditional savings account yields, Aave is tailored toward participants with an understanding of DeFi. Loading the Aave platform requires users to acknowledge and agree the following redirect notice: "This redirect takes you to a community deployed and maintained instance of the open source Aave front end, hosted and served on the distributed, peer-to-peer file network known as the Interplanetary File System (IPFS)."

CRITERIA	COINBASE LEND	AAVE
DeFi continuum	 1 2 3 **4** 5 6 7 8 9 10 Toward DeFi Ideals → Although Coinbase facilitates exposure and channels funds to DeFi protocols and tokens, as a centralized intermediary the company is not fully aligned with DeFi ideals.	 1 2 3 4 5 6 7 8 **9** 10 Toward DeFi Ideals → AAVE strives to make its lending protocol autonomous. In other words, it strives to facilitate deposits and lending, entirely using smart contracts, without the needs for centralized corporate or human intermediation. Through governance mechanisms and financial incentives, dubbed Aavenomics, the AAVE team have created a path towards increased community ownership and management of the platform. (Governance FAQ, n.d.)
Liabilities overview (comparability to demand deposits)	Formally no demand deposits, although evidence suggests Coinbase were trying to move toward a comparable service. Per their program announcement: "Pre-enroll today to earn interest on U.S.D Coin (U.S.DC), with rates more than 50x the national average of a traditional savings account.[1] Best of all, your U.S.DC is guaranteed by Coinbase, giving you peace of mind while you earn interest.[2] Watch your interest grow in real-time through the lifetime rewards ticker in your portfolio and receive monthly payouts, all with no fees or withdrawal limits." (Not launching the U.S.DC APY program, 2021)	Liabilities are explicitly described as deposits. AAVE users can deposit a wide range of DeFi assets ranging from stablecoins such as U.S.D Coin and Tether to Ethereum and Wrapped Bitcoin.
Asset overview	Collateralized loans (What is CeFi, n.d.)	Borrowing is via overcollateralized loans or undercollateralized "flash loans".
Systemic Importance?	73m verified users, 255bn assets on platform, 327bn quarterly volume traded. Operational in over 100 countries. (About Coinbase, n.d.) Systemically significant.	Total Market Size: 19.9bn U.S.D Of which: Aave Market v1: 0.1bn, Aave Market v2: 10.8bn, AMM Market: 0.01bn, Aave Market Polygon: 4.9bn, Aave Market Avalanche: 4.1bn Systemically notable.

CRITERIA	COINBASE LEND	AAVE
Licenses	U.S.: Money Transmitter and or Sales of Checks Licenses in many states. Money Services License in Iowa, Virtual Currency License in New York.	UK: Electronic Money Institution
Protocol Accessibility and Blockchain	Coinbase is a private company not a decentralized ledger protocol. It facilitates the exchange of digital assets originating from various blockchains.	The Aave protocol exists on the Public Ethereum network. Open-source implementation of the Aave Decentralized Lending Pools protocol is publicly available at github.com (GitHub – aave, n.d.)
Further discussion and examples.	It seems that the intention of Coinbase, regardless of language used (customers to lend to Coinbase versus deposits), was to effectively take deposits from customers, pool those deposits together and facilitate loans, collateralized by digital assets. Although they are not a licensed depository institution their product was advertised as a "...high yield alternative to traditional savings accounts…" and customer U.S.DC balances were to be "...guaranteed by Coinbase…" giving "...peace of mind…" while earning interest. According to Coinbase there were to be "no fees or withdrawal limits" suggesting any U.S.DC balance used for earning rewards could be withdrawn at any time, akin to demand deposits such as checking or savings accounts. Coinbase did caveat that all terms and residual risks would require customer agreement and provide a link to their user agreement which as of December 2021 included no mention of the Coinbase Lend program—one can only assume because the project is on hold due to difficulties with the SEC.	Notably, in response to a December 2021 governance proposal, the AAVE community voted for a business license which will require a legal entity to manage the use of Aave's code (Malwa, 2021). The motivation of those in favor was purportedly to prevent forks. In software engineering, the term fork is used to describe divergent versions of a network, or protocol, due to either an upgrade or a dispute among developer communities (Voshmgir, 2020, p. 50). By restricting the use of open-source code, the Aave community will avoid this to keep the project cohesive in its early stages.

Source: thesis author

Table 16. DeFi “Banking” Case Studies: BlockFi and Olympus Dao.

COMPARISON	BLOCKFI	OLYMPUS DAO
Overview	Blockfi is a privately owned U.S. based digital asset exchange platform. Like Coinbase, it facilitates trading for both retail and institutional clients. Unlike Coinbase, BlockFi’s lending program is already underway. While it is possible the SEC may also be putting pressure on BlockFi to cease such activity, such news has not been made public.	The Olympus DAO protocol is an economic experiment to create a decentralized treasury and reserve-backed, free floating currency. The Olympus DAO project aims to create an alternative to stablecoins by providing a DeFi currency that is not pegged to a fiat currency, but has a floor backing of 1 U.S.D. Olympus DAO is included as a DeFi banking case study because of parallels with treasury or central banking activity. (Olympus DAO Explained, 2021; Giove, 2021)
Interest rate offered	Their crypto interest account is advertised as earning up to 9.5% APY https://blockfi.com/crypto-interest-account	2280% APY as of January 25th, 2022. This yield is so extreme because 1) the protocol is growing its treasury reserves and 2) there is market interest in the idea of a pure DeFi stablecoin that is not pegged to fiat currency.

COMPARISON	BLOCKFI	OLYMPUS DAO
Risk of mass migration from traditional banking	 1 2 3 **4** 5 6 7 8 9 10 Low Risk High Risk Medium risk at present but re-assessment needed in the near term. The offered rate is materially higher than commercial bank savings accounts and BlockFi provides simple accessibility to otherwise relatively difficult to navigate DeFi products, assets, or protocols. Like Coinbase, BlockFi is a centralized intermediary that removes the need for strong technical confidence thereby increasing accessibility to alternative DLT financial products with high yields. That BlockFi engages in lending activity but Coinbase abandoned their program due to SEC pressure, raises the question of why the two are being viewed differently from a regulatory perspective. At the surface, the only difference appears to be their size. (73m users on Coinbase, <0.5m users on BlockFi)	 **1** 2 3 4 5 6 7 8 9 10 Low Risk High Risk Low risk due to the project's novelty. Critics describe it as a Ponzi scheme but committed supporters have built a treasury balance of 0.5bn U.S.D as of January 25th, 2022.
DeFi continuum	 1 2 3 4 5 6 7 8 9 10 Toward DeFi Ideals →	 1 2 3 4 5 6 7 8 **9** 10 Toward DeFi Ideals →
Liabilities overview (comparability to demand deposits)	Liabilities are explicitly described as deposits. Users can deposit a range of DeFi assets.	The Olympus DAO protocol borrows funds via bonds. It attracts funds to the protocol by way of staking; this removes OHM from the market, thereby reducing supply

COMPARISON	BLOCKFI	OLYMPUS DAO
Asset overview	Digital Asset Loans	Treasury reserves. No lending activity.
Systemic Importance? *Assets under custody* *Total locked value*	As at March 2021: ~250k users, 15bn assets on platform. International growth aspirations and IPO rumors following 350m series D funding and a 3bn valuation. (Bambysheva, 2021)	0.5bn Market Cap and therefore competes among the top 10 stablecoins? Not systemically important as of 2022 however, if free-floating DeFi currencies such as OHM challenge the current prestige of U.S.D-pegged stablecoins such as U.S.DC or Tether, then the dichotomy between stablecoins and CBDC needs reassessing. (Giove, 2021)
Licenses	*Unavailable*	Unlicensed
Protocol Accessibility and Blockchain	*Private*	Public smart contracts on the Ethereum network

COMPARISON	BLOCKFI	OLYMPUS DAO
Further discussion and examples		To more technically explore Olympus DAO's extreme staking yield, consider that market demand for the protocol's token, OHM, means that it trades at a premium to its floor backing of 1 U.S.D. When the value of OHM is greater than 1 U.S.D, the protocol mints more currency thereby reducing this market premium. When OHM is minted, 90% of it goes to current OHM owners who have staked it into the protocol to provide liquidity, and 10% goes into the treasury. To compensate OHM stakers for their depreciating market premium, their holding is "rebased" through a compound interest rate. Consider the following simplified example. There are 10 OHM in circulation, all of which are staked. OHM is trading for 2 U.S.D each. If the protocol mints 10 more OHM to bring its price down to 1 U.S.D each, then stakers receive 9 of the newly minted OHM. Stakers began with OHM worth 2 U.S.D each, but ended with value of 1.9 U.S.D. The loss is because the treasury took 10% of the newly minted OHM. This will be paid back through a compound interest rate over time. The protocol maintains at least 1 U.S.D stablecoin of backing for every OHM and therefore its price should not fall below 1 U.S.D. If it does, the protocol increases staking rewards thereby incentivizing holders to stake, which removes OHM from the market, thereby reducing supply and pushing its price back up.

None of these case studies present a DeFi solution to revolving lines of credit, which are essential for business to survive downturns.

Source: thesis author

Appendix 2

Documentation

Table 17. Multi-label Classification Model Training Documentation.

ID	Activism	ESG	CBDC	Crowd	DLT	ProQuest Search Criteria	Label for Python	Article Count
1	1	0	0	0	0	(pubid(41716))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	10000	499
2	0	1	0	0	0	(pubid(41716)OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	01000	500

3	0	0	1	0	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	00100	182
4	0	0	0	1	0	(pubid(41716)OR PUBID(35024)OR PUBID(45441))AND((crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	00010	500
5	0	0	0	0	1	(pubid(41716)OR PUBID(35024)OR PUBID(45441))AND((blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	00001	500

6	1	1	0	0	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”))NOT((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	11000	500
7	1	0	1	0	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	10100	1
8	1	0	0	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	10010	262

9	1	0	0	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	10001	187
10	0	1	1	0	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	01100	1
11	0	1	0	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	01010	26

12	0	1	0	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	01001	92
13	0	0	1	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	00110	1
14	0	0	1	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	00101	500

15	0	0	0	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))	00011	500
16	1	1	1	0	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))NOT((crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	11100	0
17	1	1	0	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	11010	5

18	1	1	0	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	11001	16
19	1	0	1	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	10110	0
20	1	0	1	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	10101	2

21	1	0	0	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))	10011	20
22	0	1	1	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	01110	0
23	0	1	1	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	01101	1

24	0	1	0	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))	01011	4
25	0	0	1	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)OR(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”))	00111	20
26	1	1	1	1	0	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*))NOT((blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	11110	0

27	1	1	1	0	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((crowdfund* OR gamestop OR crowdsourc* OR ICO OR “initial coin offering*” OR reddit*))	11101	0
28	1	1	0	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”))	11011	0
29	1	0	1	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”))	10111	0

30	0	1	1	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))NOT((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”))	01111	0
31	1	1	1	1	1	(pubid(41716) OR PUBID(35024)OR PUBID(45441))AND((“civil societ*” OR “social movement*” OR activis* OR “collective action” OR “social change*” OR “civil right*”)AND(“ESG” OR “CSR” OR “Environmental governance” OR “social governance” OR “social responsibility” OR “corporate responsibility” OR “socially responsible invesment*” OR “Principles for Responsible Investment*” OR “Green bond*” OR “sustainable bond*” OR “Global Green Finance Council” OR “Sustainable Development Goal*”)AND(CBDC OR “central bank digital currenc*” OR “{stable coin}” OR stablecoin* OR “narrow banking” OR “{full reserve banking}” OR “100% reserve banking”)AND(crowdfund* OR gamestop OR crowdsourc* OR “initial coin offering*” OR reddit*)AND(blockchain OR “distributed ledger” OR “digital currency” OR “bitcoin” OR “ethereum” OR “{crypto currency}” OR “{decentralised finance}” OR “defi” OR “{decentralised economy}” OR DAO OR “{decentralised autonomous organisation}” OR “smart contract*”))	11111	0
32	0	0	0	0	0	N/A	00000	

Source: thesis author.

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