Addressing the Gaps in Legal Frameworks for Blockchain Technology: A Comparative Analysis of Regulatory Approaches and Challenges

On the Way to a Decentralized World

by

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(This is a version of the dissertation prepared for the preliminary debate)

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Table of Contents

I. Preliminaries

1. List of Tables

2. List of Abbreviations

1. **PoW** - Proof of Work
2. **PoS** - Proof of Stake
3. **PoH** - Proof of History
4. **NFTs** - Non-Fungible Tokens
5. **DEFI** - Decentralized Finance
6. **DAO** - Decentralized Autonomous Organization
7. **DEX** - Decentralized Exchange
8. **MiCA** - Markets in Crypto-assets Regulation
9. **KYC** - Know Your Customer
10. **AML** - Anti Money Laundering
11. **GDPR** - General Data Protection Regulation
12. **DLT** - Distributed Ledger Technology
13. **EPI** - Environmental Performance Index
14. **ASIC** - Application Specific Integrated Circuit
15. **GPU** - Graphics Processing Unit
16. **IRS** - Internal Revenue Service
17. **CGT** - Capital Gains Tax
18. **ATO** - Australian Taxation Office
19. **BZSt** - Bundeszentralamt für Steuern
20. **HMRC** - Her Majesty's Revenue and Customs

Attributes

Technology today has made significant advances since 2012, when I was first introduced to the concept of blockchain. Today, technology has a more immense effect on our lives on a global scale than ever before. The triangle of my life consists of three main pillars as the solid basis of family, moving forward in life with determination, and the continuous growth of knowledge through innovation and curiosity. This study embodies these principles, performing as a progressive, comparative research endeavor intended to encourage innovation and shape the future. I want to thank my supervisors, who became a light on my long PhD journey, Mr. Dr. Peter Mezei and Ms. Dr. Csatlós Erzsébet, and my friends who contributed to this study: Dr. Gizem Gültekin Varkonyi, Att. Sabire Sanem Yilmaz, and the person who has been around me throughout my academic life, Dr. Giray Gerim, Dr. Gizem Erboz, Dr. Melek Aylin Özoflu, Ali Ilhan, and Dr. Tuğçe Kılıç. I also thank my beloved parents, Ayşegül and Suphi Gürcan, and my beloved sister, Dr. Aydan Gürcan, who are the most important people in my life and, contrary to the name of my study, the most centralized, and who made me who I am today. I hope this work will be one that you read with pleasure..

December 14, 2024 Budapest/Hungary

II. Introduction

Blockchain technology is recognized as one of the most groundbreaking technologies in recent years. Although it has a brief history of a little over ten years, its practical impact on everyday life is less apparent than the considerable attention it attracts. Blockchain has introduced an important notion known as decentralization, significantly changing the foundations of systems and trust mechanisms. Essentially, blockchain minimizes human involvement, providing a structure that protects data integrity using cryptographic techniques, enabling individuals to engage without mutual trust or direct acquaintance.

The decentralized architecture of blockchain mitigates these issues. This dissertation analyzes the emergence of blockchain technology since 2008 with the creation of Bitcoin, while we briefly discuss the evolution of the internet to provide a broader view of blockchain technology.

Since its inception, the blockchain ecosystem has seen rapid developments, leading authorities to establish flexible governance strategies. Initially, during the "gray zone" era, blockchain operated without significant legal regulation, allowing the technology to develop undisturbed. However, this absence of regulation also exposed investors and businesses to risks like fraud, tax evasion, and money laundering. This regulatory void encouraged innovation but also resulted in an increasing link between blockchain, especially cryptocurrencies, and high-risk, unstable systems.

Therefore, governments started introducing restrictive measures to mitigate these risks. Unfortunately, these reactive regulations often obstructed the advancement of blockchain by focusing on current issues instead of thoroughly understanding the technology's potential. At present, although many legal frameworks have evolved to recognize the unique characteristics and uses of blockchain, others continue to be excessively restrictive, hindering technical advancement.

This dissertation builds upon current knowledge in the fields of blockchain and law to assess the opportunities and challenges of blockchain from a legal perspective. It investigates developing ideas such as Decentralized Finance (DeFi) and Decentralized Autonomous Organizations (DAOs) and critically assesses whether existing legal frameworks in different countries adequately address the unique features of blockchain technology. This research seeks to provide more than a mere overview of the prevalent, often undeveloped, legal frameworks. It aims to provide a comprehensive guide for understanding blockchain's

potential and establishing regulatory frameworks that promote innovation while ensuring legal certainty.

We will begin with an analysis of the technology from a legal perspective, then examine the unique characteristics of several cryptocurrencies. Through the comparison of various legal methods worldwide, especially in countries at the forefront of blockchain regulation, we aim to clarify the challenges and potential in developing more efficient and effective legal frameworks. This study aspires to reconcile technological advances with regulatory flexibility, ensuring that legal systems progress simultaneously with blockchain's potential.

III. Methodology of the Research

1. Motivation and Objective of the Research

To understand the motivation behind this study, I would like to reference the 1960s, a time when there were no significant intercontinental connections. Communication between two continents, such as the United States and Europe, was quite challenging, and access to technological developments was limited. In the years following the Second World War, technological development accelerated and became highly competitive, particularly during the Cold War between the Soviet Union and the United States.

The regulatory approach to the internet emerged much later as an issue. The Chairman of the Federal Communications Commission (FCC) stated during his speech at the Economic Development Forum in September 1999:

"Our hands-off approach wasn't entirely a choice. The reality is that the Internet grew so fast that policy-makers could not have written a code to govern it even if they wanted to."[1]

This speech occurred 11 years after the FCC's decision to leave computer-mediated information virtually unregulated by categorizing it as "value-added" services[2], thus exempting it from traditional taxation. It could be argued that this unregulated environment facilitated the development of the internet. The primary motivation behind regulations has often been the taxation of commercial activities. However, as we will discuss further in this study, the internet began as a military project and later evolved into a research initiative. While we imagined flying cars by the 2020s, we instead entered a new era of the internet and social media, a development that was difficult to foresee in the 1960s.

When regulatory approaches are designed before technological development, they may inadvertently hinder progress—or be intentionally designed to do so. As we will explore through examples from various countries, regulatory frameworks are typically established after technological advancements have already made significant progress. Blockchain is one

[1] William Kennard, "Speech at the World Economic Development Forum," September 1999, in *Revisiting the Origins: The Internet and Its Early Governance*, ed. Andrew Murray (Oxford University Press, 2019), https://academic.oup.com/book/35243/chapter/299786913.

[2] Milton Mueller, "Revisiting the Origins: The Internet and Its Early Governance," in *The Oxford Handbook of Internet Governance*, ed. Andrew Murray https://academic.oup.com/book/35243/chapter/299786913.

of the most discussed technological developments since its inception in 2009 and has introduced a deeper understanding of decentralization.

In my thesis, the motivation is to provide lawmakers and scholars with a comprehensive resource to understand blockchain technology, supported by examples of regulations from around the world tailored to its specific features. In my view, successful regulation requires three key components: clearly identifying the purpose of the regulation, ensuring the purpose is beneficial to society and citizens, and executing the regulation effectively.

However, I have observed that some regulatory approaches to blockchain are neither clear nor beneficial in fostering a more competitive society. Additionally, many are not executable due to a lack of understanding of the technology's capabilities (e.g., the notion of "shutting down" Bitcoin, which is not currently possible).

Hence, this dissertation aims to explain what blockchain is and its key features, highlight what must be understood before drafting any new or existing regulation, and analyze the executive bodies authorized to implement these regulations.

In the existing literature, many works focus on just one feature of blockchain technology, often missing the broader ecosystem and its capabilities. This narrow focus can result in incomplete lawmaking and a failure to fully understand the technology itself. In this study, we will evaluate the legal approaches of different countries through a comparative analysis, while also providing a detailed description of blockchain technology and its various capabilities.

2. Research Questions and Research Hypotheses

In this part of my dissertation, we aim to clarify the research questions and formulate the research hypotheses to be addressed. Without the determination of well-structured and well-defined research questions, the purpose of scientific research would not be clear. These research questions and research hypotheses are interrelated. Based on this understanding, the following research questions and hypotheses are proposed:

Research Question 1: Does the present legal framework in various countries effectively address the unique features of blockchain technology?

Hypothesis 1: Existing legal frameworks across many countries often fail to properly address the distinctive characteristics of blockchain technology. In the absence of a full understanding of blockchain's technological attributes, these frameworks are often ineffective and do not support the technology. Recent developments, such as the Markets in

Crypto-Assets (MiCA) legislation, have made significant strides in tackling these issues by enhancing the comprehension of technical elements. Through the examination of these legal frameworks and their development, we can identify essential modifications to guarantee legal clarity, safeguard investors, and enhance governance, thereby profoundly influencing the legal system, market dynamics, and technological advancements.

Research Question 2: Do current regulatory frameworks in different countries effectively handle the distinctive features and applications of various cryptocurrency kinds, including stablecoins, utility tokens, and privacy coins?

Hypothesis 2: Current legislative frameworks in many countries often fail to effectively address the distinct features and applications of various cryptocurrencies, including utility tokens, stablecoins, and privacy coins. This regulatory inadequacy results in inconsistencies in classification and treatment, creating obstacles to the integration and innovation of cryptocurrencies within the financial system. A more flexible and coherent global regulatory framework is essential to accommodate all aspects of the blockchain ecosystem.

Research Question 3: Are current legal frameworks sufficiently prepared to address the advancements in blockchain technology, and which innovations—such as Decentralized Finance (DeFi), Decentralized Autonomous Organizations (DAOs), the Metaverse, and Artificial Intelligence (AI)—present more significant legal challenges through a review of their technical requirements and different regulatory efforts across jurisdictions?

Hypothesis 3: The broad comprehension of blockchain technology by regulators and lawmakers greatly influences the successful outcome of legal frameworks. When the regulatory framework highlights merely its overall context while neglecting complex aspects such as Decentralized Applications (DApps), Decentralized Autonomous Organizations (DAOs), Decentralized Exchanges (DEXs), Non-Fungible Tokens (NFTs), the Metaverse, Decentralized Finance (DeFi), Layer-2 solutions, and the integration of Blockchain and Artificial Intelligence (AI), it proves insufficient. An in-depth knowledge of these various fields is essential for formulating suitable regulations that promote innovation while safeguarding investor security. Through the comparison of several legislative examples, we aim to determine which regulatory approaches are most effective in addressing the distinct issues presented by these emerging technologies. Notably, certain developments, such as DeFi, pose greater challenges to regulators due to their capacity to disrupt established legal frameworks, while others, such as AI and NFTs, may present comparatively fewer regulatory difficulties.

We examine the infancy period of the blockchain ecosystem, its adolescence, and its future aspects, creating a way of thinking about how to regulate this new decentralized world. We began our dissertation with the technical aspects of blockchain technology through the lens of a legal perspective. Since understanding the technological aspects plays a crucial role before making any regulatory action or critique, it is an essential foundation. By the end of our research, we even touch upon Artificial Intelligence and its connection with blockchain, aiming to propose innovative approaches not just for blockchain but for all emerging technologies. The history of the legal framework surrounding blockchain technology is briefly described in this thesis; however, the main focus is to analyze and discuss the existing legal structures for blockchain while outlining the institutional duties across different jurisdictions.

The purpose of this research is to summarize how blockchain technology works and discuss potential qualifications of these new terms to help regulatory bodies understand and take informed steps. Based on our comparative research, while some countries have made valuable progress in their regulatory approach to blockchain technology, others have failed to establish progressive regulations.

3. Research Methodology

To achieve its purpose, this research employs the following methods: a literature review, comparative legal analysis, analysis of blockchain technology, technical description reports known as white papers, official public statements from institutions in several countries, legal codes, evaluations of countries' perspectives on blockchain technology and its future, media reports, and critical articles on similar topics. This research is grounded in legal theory, exploring international law, domestic law, and relevant legal concepts.

Several blockchain-related textual data sources are publicly accessible, such as news stories that often report on cryptocurrency performance and technical innovations. Digital platforms such as GitHub, Reddit, and social media like Twitter also function as hubs for developers and regulatory news. White papers provide comprehensive technical and marketing details to prospective cryptocurrency enthusiasts and investors.[3]

[3] X. Zhuo, F. Irresberger, and D. Bostandzic, "How Are Texts Analyzed in Blockchain Research? A Systematic Literature Review," *Financial Innovation* 10, no. 60 (2024): https://doi.org/10.1186/s40854-023-00501-6.

The research topic is based on blockchain technology, which has a history of less than two decades. Moreover, even the technical aspects of this technology are still being explored by experts. The legal side of blockchain technology, however, has not yet been examined in detail within the literature. While some researchers focus on narrow aspects of the legality or qualifications of blockchain technology's features, this dissertation takes a broader approach. It examines various regulatory actions from a global perspective, offering an extensive analysis of the legal frameworks surrounding blockchain technology to determine whether the present legal frameworks in different countries effectively address the unique features of blockchain technology.

Several challenges are anticipated in this dissertation, including the limited availability of sources due to the novelty of blockchain, countries' evolving approaches, a lack of regulations, unclear definitions, and the complexity of the technology. Accordingly, desktop research involves delving deeper into the features of blockchain technology and evaluating the legal problems and scope of regulations. The methodology of this research is designed to showcase comparable approaches worldwide to blockchain technology and provide a roadmap for regulatory bodies.

We have undertaken an extensive literature review on two primary aspects: the technological aspect and the legal aspect. Based on our analysis of the available literature, we have identified gaps in the research on key legal problems related to blockchain technology that have not yet been adequately investigated. We have conducted a thorough examination of certain components, while other areas have not been explored in depth due to their current level of relevance. This research seeks to serve as a comprehensive guide for lawmakers, equipping them with a technical understanding of blockchain from a regulatory perspective to develop effective legal frameworks.

In this regard, our research adopts a mixed-methods approach, including the literature review method and comparative law method, to provide a holistic understanding of the blockchain matter, combined with desktop research on the existing regulatory frameworks of different jurisdictions to address the dissertation's research questions.

This dissertation aims to analyze different leading countries and compare their regulatory approaches to various blockchain features and applications, including cryptocurrencies, non-fungible tokens (NFTs), the Metaverse, and even their connection with artificial intelligence. The analysis will focus on examining differences in legal strength and technological integration across these jurisdictions. These discrepancies are believed to stem from variations in technical knowledge among these countries. Based on the research, the United States, the United Kingdom, and Germany are the top three countries by the number of academic papers published on blockchain. For this reason, we examine these countries, among others, and the regulatory bodies responsible for blockchain-related legal issues.

We propose that the regulatory frameworks governing blockchain technology display considerable variability among different international jurisdictions, such as the USA, the UK, Australia, and El Salvador, primarily as a result of differences in technological capacity, legislative agility, and cultural approaches to technology governance. The ability of these legal systems to adapt to rapidly evolving digital developments significantly influences the effectiveness of their blockchain regulations. This dissertation will comprehensively analyze successful regulatory examples, focusing on key aspects that contribute to variations in regulations, including technical knowledge, legislative responsiveness, and cultural attitudes towards technology and innovation. We aim to assist different stakeholders, such as policymakers, law makers, and legal experts, in developing a unified and flexible legal framework that can be applied on an international base and promoting the global adoption of blockchain technologies by outlining the optimal methods and challenges identified during the research. We seek to create a standardised approach to rules of law that supports technological innovation, ensures powerful regulatory compliance, and fosters international legal coherence across the different jurisdictions to evaluate current regulatory frameworks in different countries—whether they can effectively handle the distinctive features and applications of various cryptocurrency kinds.

In this dissertation, relevant academic publications, regulatory frameworks, legal texts, and several case studies concerning blockchain technology, legal difficulties, and taxes in various countries have been reviewed through a comprehensive literature review. This approach will clarify deficiencies in existing data and guide our hypotheses, offering a thorough understanding of the current state of blockchain technology and its legal implications. Additionally, we aim to develop a theoretical framework and contextual

foundation for our research inquiries. The literature review serves as the cornerstone of every research effort, including this dissertation. It establishes the research's general framework, clarifies the scope of inquiry, and provides justification for the chosen methodologies. Furthermore, it situates the existing body of literature within a broader intellectual and historical framework.[4]

To conduct a comprehensive analysis of the research topic and provide pragmatic insights into the practical implementation of the theoretical principles discussed, we use secondary sources, including judicial proceedings, statutes, and relevant documents. A complete literature review encompasses the relevant literature on the topic and is not restricted to a single research methodology, geographic region, or set of journals.[5] By synthesizing primary and secondary sources, we aim to provide a detailed and in-depth study that reflects the complex nature of blockchain technology and its legal framework.

Additionally, a comparative approach is employed to analyze the various methods taken by different nations on specific themes, where applicable. We use contrast analysis to evaluate regulatory approaches worldwide, focusing on countries like Australia and Japan, which are pioneers in blockchain-related regulations. How do different countries address blockchain-related challenges? We examine the legal frameworks of blockchain-related fields, enforcement mechanisms, and compliance requirements, highlighting similarities and differences to help create a roadmap for regulatory bodies.

The method of comparative legal analysis is particularly beneficial in new fields characterized by inconsistent regulation. By comparing various jurisdictions, researchers can identify regulatory difficulties and recognize effective practices.[6] This method is particularly well-suited to blockchain, as it facilitates a thorough understanding of the diverse strategies used by different countries. It will be used to investigate research problems and prove or disprove the hypotheses of this research. For example, national regulations can provide justification for regulating blockchain technology, while restrictive regulations may

[4] D. N. Boote and P. Beile, "Scholars Before Researchers: On the Centrality of the Dissertation Literature Review in Research Preparation," *Educational Researcher* 34, no. 6 (2005): 3–15.

[5] J. Webster and R. T. Watson, "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* 26, no. 2 (2002): xiii–xxiii.

[6] Mathias M. Siems, *Comparative Law* (Cambridge University Press, 2014).

demonstrate how they could become obstacles to technological development, as seen with certain data protection rules. This method will be used to understand opinions, underlying reasons, and motivations behind regulations and to qualify the features of blockchain technology.

The scientific foundation for this research will be the theory of international law and domestic law, including international relations and finance concepts such as currency, commodity, and security classifications, as well as cross-border business and regulations like the General Data Protection Regulation (GDPR), the Markets in Crypto-Assets (MiCA) legislation, the Anti-Money Laundering Act, and the Know Your Customer Act.

In the comparative research, six different methods have been described by Mark Van Hoecke: the functional method, the structural method, the analytical method, the law-in-context method, the historical method, and the common-core method. According to the functional method, even though rules and concepts may differ, many legal systems address similarlegal challenges in comparable ways. [7] This dissertation aims to determine whether better laws are possible for blockchain technology. The functional method does not compare primary rules but focuses on solutions to practical problems involving conflicting interests in different jurisdictions. In this dissertation, we primarily use the functional method to evaluate the existing regulatory approaches of different countries and assess whether they are suited to blockchain technology.

We also partially employ the law-in-context method to understand the different regulations as a foreigner to these legal systems and to explain why the law is designed the way it is. Additionally, the functional method inherently refers to context by considering which problem is solved using what kind of legal construction. As a result, the functional method includes some aspects of the law-in-context method.[8]

In this dissertation, we use the functional method to first identify the actual problems: whether the legal frameworks in various countries effectively address the unique features of

[7] Mark Van Hoecke, "Methodology of Comparative Legal Research," *Law and Method*, 2015.

[8] Esin Örücü, *Comparative Law: A Handbook*, ed. Esin Örücü and David Nelken (Hart Publishing, 2007), 52.

blockchain technology, how these challenges are resolved using similar or differing strategies (e.g., restrictive or supportive approaches), and with what outcomes. For instance, this is evident in the case of El Salvador, which we will discuss below.

The method of data collection is based on an overview of local regulations and reports from international institutions to provide an objective perspective alongside a literature review. We analyze official statements, legal codes, and regulatory actions to construct a global perspective on the blockchain ecosystem. This research aims to offer an objective overview to regulatory bodies while also providing some suggestions. Moreover, we critique existing regulations and official approaches to blockchain technology. Integrating these data sources is essential due to the multidisciplinary nature of blockchain research. Collecting key legal documents ensures an accurate understanding of existing legal frameworks, while secondary literature evaluations, such as judicial proceedings and statutes, provide theoretical perspectives and contextual backgrounds for the regulations.

The objective data is sourced from prominent and reliable references to obtain figures on the market capitalization, market value, and investment numbers of cryptocurrencies. We collect data on cryptocurrency market size, cryptocurrency investments, and other relevant metrics, such as the size of specific tokens. We also use the functional method to analyze this data effectively. Well-established sources are leveraged to ensure accuracy in market analysis and to support our approach. Blockchain technology holds vast potential for development in the coming years; however, regulations will inevitably follow these advancements.

Another method employed is the structural method, used to compare the legal systems of countries pioneering blockchain technology. Using the functional method, we first identify the key components of the blockchain ecosystem, namely cryptocurrencies, regulatory frameworks, technological infrastructure, and smart contracts. We then assess practical implications by evaluating how these legal frameworks function in practice within the blockchain ecosystem, incorporating case studies, regulatory decisions, and real-world applications of blockchain technology.

We also conduct critical evaluations of existing or planned regulations, such as MiCA, and official approaches. Will these measures effectively address blockchain's legal

implications? We provide constructive feedback and propose improvements where necessary.

This dissertation acknowledges certain limitations, such as the rapid evolution of blockchain technology, which may outpace current analyses, potential biases in the selection of legal or other sources, and the challenges in accessing proprietary or sensitive information from different jurisdictions.

IV. Technical Features of Blockchain Technology

1- What is Blockchain and Bitcoin?

Since the 1980s, researchers have been working on data chains that can be used by groups that have no trust relationship and do not know each other. These data chains are cryptographically protected and recorded in a way that ensures their existence cannot be altered, with the use of timestamps. Based on available evidence, it seems fair to suggest that a system developed in 2008 successfully found a way to add data to blocks with a timestamp, decentralized and without the need for a trusted third party. Moreover, thanks to improvements in its design, each addition to the blocks made the system more secure and more difficult to hack. This was made possible through proof of work (PoW). Proof of work and other blockchain protocols will be discussed in more detail in the following sections. Although PoW is not a new concept, the first decentralized blockchain in history was established with its use in this way.

Each block is essentially an electronic record cryptographically linked to others. This system, developed by an unidentified person or group in 2008, was called blockchain. The person or persons who created this technology used the pseudonym Satoshi Nakamoto, whose real identity remains unclear.[9] To ensure the continuity and sustainability of this decentralized method, Satoshi designed the first decentralized cryptocurrency, Bitcoin. Bitcoin, based on a public ledger technology that is open to everyone, was released as open-source software. A directive known as a white paper, commonly referenced in the cryptocurrency ecosystem, was published for Bitcoin. In October 2008, Satoshi shared the Bitcoin white paper on an encrypted mailing list. While Satoshi used the words "block" and "chain" separately in the white paper for Bitcoin, which launched in January 2009, the two terms were eventually combined into the term "blockchain," the focus of this dissertation.

Satoshi aimed to develop a peer-to-peer (end-to-end) payment system without intermediaries. Bitcoin was defined in its white paper as an end-to-end electronic cash

[9] Anonymous Developer: “Decrypting Satoshi Nakamoto’s Identity,” *FasterCapital*, accessed July 17, 2024, https://fastercapital.com/content/Anonymous-Developer--Decrypting-Satoshi-Nakamoto-s-Identity.html.

system, emphasizing its function as a payment platform rather than a currency.[10] Bitcoin works more like a payment platform. It is an open-source software, which is one of the main advantages of it.[11]

Evidence suggests that the name Bitcoin derives from combining the words "bit" and "coin." Each Bitcoin transaction is recorded on an open ledger maintained on the Bitcoin blockchain. Transactions from the first Bitcoin transfer in January 2009 to the present day remain publicly accessible.

A common misconception about blockchain is the assumption that all cryptocurrencies operate on the Bitcoin blockchain, the first blockchain. This is not the case. Today, many different blockchains function on distinct operating principles. While the Bitcoin blockchain is the first and remains the most popular, this dissertation considers blockchain as a general concept. Although blockchain is typically decentralized, centralized blockchains also exist.

So how did blockchain and Bitcoin emerge? Evidence suggests that in August 2008, the website Bitcoin.org was created anonymously.[12] This website, initially owned by Satoshi, is now managed as an open-source project by its stakeholders.

On January 3, 2009, Satoshi completed the first Bitcoin mining[13] operation—a process explained in detail below—and earned 50 Bitcoins in the transaction. This marks the birth of the first block, known as the Genesis Block. However, due to a technical error, these 50 Bitcoins could not be transferred and remain in the first account. Subsequently, on January 9, 2009, Bitcoin was made publicly available for download, use, and further development.

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[10] Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System*, accessed June 5, 2024, https://bitcoin.org/bitcoin.pdf.

[11] M. Ciarko, G. Poszwa, and A. Paluch-Dybek, "Cryptocurrencies as the Future of Money: Theoretical Aspects, Blockchain Technology and Origins of Cryptocurrencies," *Virtual Economics* (2023), accessed July 17, 2024, https://www.virtual-economics.eu/index.php/VE/article/download/309/139.

[12] "Timeline of Bitcoin's History," Bitrawr, accessed July 17, 2024, https://www.bitrawr.com/history-of-bitcoin.

[13] Y. Jaafar, "Overview of Blockchain Technology and Bitcoin," *Academia.edu* (2024), accessed July 17, 2024, https://www.academia.edu/download/110703218/Overview_of_Blockchain_Technology_and_Bitcoin.pdf.

On January 12, 2009—incidentally my birthday—the first Bitcoin transaction took place. Satoshi transferred 10 Bitcoins (currently valued at approximately $42.1 million) to the account 1A1zP1eP5QGefi2DMPTfTL5SLmv7DivfNa, owned by cryptographer Hal Finney.[14] This transaction played a crucial role in Bitcoin's development, as Hal Finney contributed significantly to its advancement. At the time of this transfer, Bitcoin's value was $0. Early Bitcoin transactions were typically used to purchase services to test or improve the system.

Research indicates that Bitcoin was first valued in terms of legal currencies on October 5, 2009, via a BTC buying and selling platform called New Liberty Standard. This platform evaluated 1,309 Bitcoins (1,309.03 BTC) at one US dollar, an approximate value of over $58 million today. [15]

To purchase Bitcoin, one would email New Liberty Standard with the desired amount. Payment would be processed via PayPal, and the Bitcoin transfer would then be completed. On October 12, 2009, Martti Malmi (known as Sirius), one of Bitcoin's early developers who worked with Satoshi for over a year, sold 5,050 Bitcoins to New Liberty Standard for $5.02.[16] This was the first known exchange of Bitcoin at an official exchange rate.
The consensus view seems to be that Bitcoins were changing hands, especially on software developer forums, in the very beginning. The development of the first marketplace project that allowed Bitcoin to be exchanged online occurred in February 2010. A user named "dwdollar" shared the idea of creating a Bitcoin online marketplace in a forum called Bitcoin Talk and established the first known marketplace that accepted payments via PayPal on a platform called Bitcoin Market.[17] However, on June 4, 2011, PayPal ceased providing services to Bitcoin Market due to complaints that some users were scammed and did not receive any BTC in return for their payments.

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[14] "Hal Finney's Bitcoin History," Blockworks, accessed July 17, 2024, https://blockworks.co/news/hal-finney-bitcoin-satoshi-nakamoto-zk-proofs.
[15] PlasBit, "What Was the Price of 1 Bitcoin in 2009?", accessed July 17, 2024, https://plasbit.com/crypto-basic/what-was-the-price-of-1-bitcoin-in-2009.
[16] Cointelegraph, "5050 Bitcoin for $5 in 2009: Helsinki's Claim to Crypto Fame," *Cointelegraph Magazine*, accessed July 17, 2024, https://cointelegraph.com/magazine/5050-bitcoin-for-5-dollars-2009-helsinki-claim-to-crypto-fame-crypto-city-guide.

[17] Bit2Me Academy, "History of Bitcoin Exchanges and Trading," accessed July 17, 2024, https://academy.bit2me.com/en/historia-exchanges-trading-bitcoin/.

Research also indicates that on July 18, 2010, at the same forum, the legendary Bitcoin marketplace of that period, Mt. Gox, was announced.[18] By 2014, this Japan-based cryptocurrency exchange hosted 70% of all Bitcoin transactions worldwide.[19] Mt. Gox, which suffered from security vulnerabilities multiple times, eventually shut down in February 2014. It was later revealed that 744,408 Bitcoins were stolen from the website's users,[20] leading to its closure. Although Mt. Gox was one of the largest cryptocurrency exchanges to be hacked, it was not the last. In the following sections, we will discuss the regulations surrounding cryptocurrency marketplaces.

Since the 1980s, many researchers have worked on data security systems that allow parties with no mutual trust or prior acquaintance to interact securely. These systems ensure that data is timestamped and cannot be altered. The main challenge in this concept is guaranteeing that neither the energy provider nor the data provider can interfere with the system. To ensure such security, the system had to adopt a decentralized structure. In 2008, a system was introduced on an online forum claiming that data could be added to blocks with timestamps without requiring any central authority. Additionally, improvements to the system made it increasingly secure through a proof of work (PoW) mechanism, a concept we will investigate further in our research. While PoW was not entirely new, it was used for the first time within a decentralized system.

Each block in the system functions as a cryptographic electronic registry. This system was eventually called blockchain—a chain of cryptographically linked electronic records. To sustain the system, the first decentralized cryptocurrency, Bitcoin, was introduced under the pseudonym Satoshi Nakamoto. Bitcoin is open-source software designed with a public ledger. The foundational concept of Bitcoin was explained in an informational document

[18]Bitcointalk.org, "New Bitcoin Exchange (mtgox.com)," accessed July 17, 2024, https://bitcointalk.org/index.php?topic=444.0.
[19] Investopedia, "What Was Mt. Gox? Definition, History, Collapse, and Future," accessed July 17, 2024, https://www.investopedia.com/terms/m/mt-gox.asp.

[20] Andy Greenberg, "Bitcoin's Mt. Gox Implodes in 'Shocking' Theft of $350 Million," *Wired*, February 25, 2014. https://www.wired.com/2014/02/bitcoins-mt-gox-implodes-2/.

known as a white paper. Satoshi initially used the terms "block" and "chain" separately but later, in public [21] usage, these terms were combined to form "blockchain."

The main claim of the Bitcoin was a creating peer to peer electronic cash system without recourse. .[22] The name “Bitcoin” is derived from the words "bit" and "coin.".

In the Bitcoin system, every transaction is recorded on a public ledger, making all transactions traceable from the launch of the system in 2009 to the present day. In August 2008, the website Bitcoin.org was made public. It is now managed as open-source software, allowing anyone to contribute. In 2009, Satoshi conducted the first cryptocurrency mining operation and was rewarded with 50 Bitcoins by the protocol. This marked the creation of the first block in Bitcoin, called the Genesis Block. However, due to technical issues, these 50 Bitcoins remain in the original account where they were created. On January 9, 2009, Bitcoin became an open-source system that anyone could use, download, and improve.

On January 12, 2009, the first Bitcoin transaction was conducted when Satoshi transferred 10 Bitcoins to cryptographer Hal Finney’s account (1A1zP1eP5QGefi2DMPTfTL5SLmv7DivfNa[23]).

Bitcoin's first valuation was introduced by the New Liberty Standard website, where it was calculated that 1,309 BTC were equivalent to one US dollar. This price was determined based on the energy cost required to mine one [24] Bitcoin. The first known exchange of Bitcoin for fiat currency occurred when software developer Martti Malmi sold 5,050 BTC for $5.02 during an event.[25]

The first Bitcoin exchange, Bitcoin Market, was launched in February 2010 on the Bitcoin Talk forum. However, PayPal suspended its services to Bitcoin Market on June 4, 2011, following customer complaints. Another Bitcoin exchange, Mt. Gox, was launched on July 18, 2010, in Japan. By 2014, Mt. Gox was handling 70% of all Bitcoin transactions globally.

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[21] S. Rajvanshi and S. Sharma, “Blockchain Based Authentication and Privacy Preservation in IoMT Devices,” *2023 International Conference on*, 2023. IEEE Xplore, accessed July 17, 2024, https://ieeexplore.ieee.org/abstract/document/10434087/.

[22] Ibid.

[23] Ibid.

[24] “Dawn of Bitcoin Price Discovery: 2009-2011 – The Very Early Bitcoin Exchanges,” *SGT Report*, January 2021. https://www.sgtreport.com/2021/01/dawn-of-bitcoin-price-discovery-2009-2011-the-very-early-bitcoin-exchanges/.

[25] “Factbox: What Is Bitcoin?” *Reuters*, accessed June 5, 2024, https://www.reuters.com/article/uk-crypto-currencies-bitcoin-factbox-idUKKCN1N50FU.

Unfortunately, it was shut down after a hack resulted in the loss of 744,408 Bitcoins, making it one of the largest cryptocurrency hacks[26] in history.

In the following sections of our research, we will discuss the legal foundations of cryptocurrency markets.

2- How is the Price of Bitcoin Determined?

The understanding of Bitcoin's price determination (or that of other cryptocurrencies) depends on the category of the token or coin but shares some similarities with commodities. In the following sections of our research, we will explore the possibility of categorizing cryptocurrencies as commodities. For now, it is worth summarizing that commodity prices in trade are not determined by an individual or single entity. Commodities are traded using futures contracts, which obligate the holder to buy or sell commodities at a predetermined value on a specified delivery date in the future through exchange platforms. The price of commodities in futures markets is determined by supply and previous demand within the commodity market. A sharp increase or decrease in demand or supply can cause volatility in commodity prices, as witnessed during the COVID-19 crisis, particularly with the drop in oil prices.

Commodities can be traded on various exchanges, such as the Chicago Mercantile Exchange (CME), London Metal Exchange (LME), New York Mercantile Exchange (NYMEX), Winnipeg Commodities Exchange (WCE), and Intercontinental Exchange (ICE). Similarly, cryptocurrencies can be exchanged in cryptocurrency markets, much like commodities. Examples of cryptocurrency exchange platforms include Coinbase, Coinmama, Bitpanda, Kraken, CEX.io, LocalBitcoins, and Bitstamp.

In the case of cryptocurrency price determination, research indicates that the valuation of Bitcoin or other major cryptocurrencies varies depending on several factors.[27] These factors include:

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[26] Marius-Cristian Frunza, *Solving Modern Crime in Financial Markets: Analytics and Case Studies* (Academic Press, 2015), ISBN: 9780128045329.

[27] M.T. Wahyuni, E. Ridwan, and D.F. Salim, "US Macroeconomic Determinants of Bitcoin," *Innovations* (2024), accessed July 17, 2024, https://www.businessperspectives.org/images/pdf/applications/publishing/templates/article/assets/20085/IMFI_2024_02_Wahyuni.pdf.

1. The number of Bitcoins supplied to the market, which forms the basis of pricing, and the market demand for it.
2. The cost of Bitcoin production.
3. Regulations on sales and purchases decided by states.
4. The reward amount given to miners for each Bitcoin block.
5. The popularity of competing cryptocurrencies.
6. Technological developments.
7. Its internal management structure.

The market price of Bitcoin is determined in more or less the same way as other products and services. The above factors are the primary determinants of Bitcoin's market price, although numerous external factors also influence global pricing. For example, Elon Musk, the CEO of Tesla, announced in February 2021 that the company had purchased $1.5 billion worth of Bitcoin using its cash reserves. This decision had a significant impact on Bitcoin's price, as well as on Tesla's stock [28] price. However, in May of the same year, Tesla announced that it would no longer accept Bitcoin as payment for vehicles due to the environmental impact of fossil fuels, especially coal, used in Bitcoin mining. This decision caused a significant drop in Bitcoin's price.

At its peak in November 2021, Bitcoin's value reached $68,789.63—a record high.[29] This demonstrates how a single corporate decision can impact both Bitcoin's price and the share value of a company such as Tesla.

Technically, the market determines an average global price for Bitcoin in a decentralized and free manner. However, this does not mean that Bitcoin is sold at the same price everywhere. Many cryptocurrency markets that mediate Bitcoin sales implement different pricing strategies.[30] Recent studies suggest that brokerage commissions, exchange rates in different currencies, energy transfer costs at the time of purchase, and the urgent needs of sellers may contribute to price differences.

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[28] Tesla, Inc., "Form 10-K Annual Report for the Fiscal Year Ended December 31, 2020," U.S. Securities and Exchange Commission, last modified February 8, 2021. https://www.sec.gov/ix?doc=/Archives/edgar/data/1318605/000156459021004599/tsla-10k_20201231.htm.
[29] "Bitcoin Price Index from January 2016 to June 2021," *Statista*, accessed June 5, 2024, https://www.statista.com/statistics/326707/bitcoin-price-index/.
[30] Mohagheghzadeh, B. Amiri, and A. Makui, "A Novel Dynamic Model for Ranking Cryptocurrencies in Different Time Horizons Based on Deep Learning and Sentiment Analysis," *IEEE Access*, 2024, accessed July 17, 2024, https://ieeexplore.ieee.org/abstract/document/10555274/.

The most significant feature that distinguishes Bitcoin from other cryptocurrencies, as well as from traditional currencies or precious metals, is its finite supply. Bitcoin's algorithm is designed to [31]cap its total supply at 21 million. Research indicates that in Bitcoin's early days, more coins could be produced with far less energy. However, as the number of remaining Bitcoins decreases, [32] the energy required to mine one Bitcoin increases substantially. This design protects Bitcoin against hyperinflation.

Since no government or private institution controls Bitcoin, it is challenging to manipulate its value for political or institutional reasons. In contrast, a country's currency may experience severe price fluctuations due to decisions by its central bank, such as raising interest rates or printing more money. Although the value of traditional currencies is influenced by investor demand, it can also be adjusted through deliberate policy decisions. On the other hand, Bitcoin's decentralized nature largely shields it from such risks.

Recent evidence suggests that the value of Bitcoin is determined by the number of units supplied to the market, the demand for these units, and their relationship with other cryptocurrencies. As of March 2022, approximately 90% of Bitcoin—out of a total supply capped at 21 million—has already been released to the market, leaving about 2 million Bitcoins left.[33] Each Bitcoin block takes approximately 10 minutes to create, and each block currently contains 6.25 BTC. This means only 900 new Bitcoins are released [34] daily. Bitcoin miners currently earn a reward of 6.25 BTC per block they mine, but this figure will decrease gradually, reaching as little as 0.000000011641532 BTC by the time the last Bitcoin is mined.

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[31] *GCARD Special Feature*, "Cryptocurrencies, Bitcoin and Blockchain," 2018, accessed July 17, 2024, https://jpmcc-gcard.com/wp-content/uploads/2018/11/Page-SF1_35-Winter-2018-GCARD-SF_Soc_Gen.pdf.
[32] Y.I. Alzoubi and A. Mishra, "Green Blockchain: A Move Towards Sustainability," *Journal of Cleaner Production*, 2023, accessed July 17, 2024, https://www.sciencedirect.com/science/article/pii/S0959652623036995.
[33] Buy Bitcoin Worldwide, "How Many Bitcoins Are There?", accessed June 5, 2024, https://www.buybitcoinworldwide.com/how-many-bitcoins-are-there/.

[34] *NerdWallet*, "How Many Bitcoins Are There in 2024?", accessed July 17, 2024, https://www.nerdwallet.com/article/investing/how-many-bitcoins-are-there.

One of Bitcoin's most significant differences from fiat currencies, other cryptocurrencies, or even precious metals is its limited supply. Bitcoin has been designed to reach a maximum of 21 million units. To slow supply and increase purchasing power, Bitcoin mining becomes increasingly difficult as fewer Bitcoins remain, raising the energy cost of mining as well. Compared to fiat currencies, central banks have various tools, such as adjusting interest rates or increasing money supply, to stabilize value. However, these measures carry advantages and risks depending on the intentions of policymakers. Against this backdrop, Bitcoin's value is less dependent on institutional and personal decisions.

The Bitcoin algorithm is programmed to make it increasingly difficult to supply new Bitcoin as the number of remaining Bitcoins decreases. Each time 210,000 blocks are completed, the BTC reward per block is halved.[35] This limited supply mechanism ensures that the total supply of Bitcoin will likely be reached by 2140.[36] Each set of 210,000 blocks takes approximately four years to complete. In 2009, miners earned 50 BTC per block. This reward was halved to 25 BTC in 2012, 12.5 BTC in 2016, and 6.25 BTC on May 11, 2020. Recent studies indicate that the next halving is expected in 2024.

How many of the 18.9 million BTC mined so far can be freely traded in the market is another topic of discussion. It is believed that approximately 5% of the total 21 million BTC still belongs to Satoshi Nakamoto. Research suggests that between January and July 2009, Satoshi mined over 1 million Bitcoins, winning a reward of 50 BTC per block at that time. Bitcoin's blockchain transparency shows that from the genesis block (the first Bitcoin block) through block 36,288, created between January 1, 2009, and January 25, 2010, thousands of blocks were mined using the same equipment, presumed to belong to Satoshi. Because the same equipment was used in the genesis block, that is the first Bitcoin block.[37]

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[35] Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction* (Princeton University Press, 2016), accessed July 17, 2024.

[36] *River Intelligence*, "Bitcoin's Quadrennial Halving Is Coming!", accessed July 17, 2024, https://blog.river.com/bitcoins-quadrennial-halving-is-coming/.

[37] Sergio Demian Lerner, "The Well-Deserved Fortune of Satoshi Nakamoto, Bitcoin Creator, Visionary, and Genius," *Bitslog*, accessed June 5, 2024, https://bitslog.com/2013/04/17/the-well-deserved-fortune-of-satoshi-nakamoto/.

Another issue is the number of lost Bitcoins that cannot be accessed or used. Studies estimate that between 2.78 and 3.79 million BTC are currently lost, amounting to approximately 20% of the total BTC in circulation.[38]. These losses typically occur when users forget their login credentials, lose their hardware wallets, or misplace their private keys.

Some researchers suggest that Satoshi Nakamoto may have lost access to his 1 million BTC, which could explain why no transactions have been made from these holdings for years.[39] If Satoshi were to sell these Bitcoins, it could significantly impact Bitcoin's price. For instance, one of the most notable Bitcoin losses occurred when a San Francisco programmer, Stefan Thomas, forgot the password[40] to his USB wallet containing 7,002 BTC (worth over $309 million at today's value). Another example involves James Howells from the UK, who accidentally discarded his laptop containing 7,500 BTC. Despite attempting to recover the laptop in cooperation with local authorities,[41] he has yet to succeed.

There is little doubt that Satoshi is believed to be the largest Bitcoin holder today. Only three Bitcoin addresses (wallets) hold between 100,000 and 1,000,000 BTC,[42] amounting to a total of 576,979 BTC. Two of these wallets belong to cryptocurrency exchanges Binance and Bitfinex. The next 79 largest BTC wallet holders control 2,046,879 BTC, with holdings ranging from 10,000 to 100,000 BTC. The term "whale" is often used in the cryptocurrency market to describe individuals or entities holding over 10,000 BTC.

In summary, Bitcoin's price is determined similarly to other products in a free market. However, several external factors also influence its value, including supply and demand, production costs (mining costs), sales and purchase regulations, mining rewards, the

[38] *Chainalysis*, "Lost Bitcoin Report," 2017.

[39] MIT Sloan School of Management, "Blockchain Analysis of the Bitcoin Market," accessed July 17, 2024, https://mitsloan.mit.edu/sites/default/files/2022-06/Bitcoin-blockchain%20-%20AER.pdf.

[40] CBC, "This Man Owns $321M in Bitcoin — but He Can't Access It Because He Lost His Password," January 15, 2021, accessed July 17, 2024, https://www.cbc.ca/radio/asithappens/as-it-happens-friday-edition-1.5875363/this-man-owns-321m-in-bitcoin-but-he-can-t-access-it-because-he-lost-his-password-1.5875366.

[41] Annmarie Hanlon, *Digital Marketing: Strategic Planning & Integration* (SAGE Publications).

[42] Bitinfocharts, "Top 100 Richest Bitcoin Addresses and Bitcoin Distribution," accessed July 17, 2024,

popularity of competing cryptocurrencies, technological advancements, and internal governance of cryptocurrencies.

Today, many companies also invest in cryptocurrencies as part of their assets. For example, Tesla Inc., a U.S.-based company, made a significant investment by purchasing 42,902 BTC for $1.5 billion.[43] By March 2022, the value of this Bitcoin exceeded $1.9 billion, demonstrating the profitability of this investment. We will discuss the legal and tax implications of such investments in the following sections.

3- Bitcoin Pizza Day To See Evaluation of the Blockchain Concept

In this part of the dissertation, we examine Bitcoin Pizza Day, an important date in the cryptocurrency ecosystem. This event highlights the historical evolution and challenges faced in Bitcoin's early journey, providing context to help answer our research questions in subsequent chapters. The data generated by this study strongly suggests that on May 18, 2010, a software developer named Laszlo Hanyecz, living in Florida, announced on a forum called Bitcointalk that he would send 10,000 BTC to anyone who ordered two pizzas for him.[44] A user named Ender_X commented on Bitcoinmarket.com, stating he would sell 10,000 BTC for $41. At the time, $41 for two pizzas was likely considered expensive—possibly even for Ender (who is speculated to be Turkish).

When forum users discussed which pizzeria might accept online orders, Domino's was initially suggested, but Laszlo preferred ordering from Papa John’s. On May 22, Laszlo thanked a user named Jercos, announcing the arrival of his pizzas purchased for 10,000 BTC. He also shared photos of the pizzas and his daughter enjoying them. The data indicates this was likely the most expensive pizza purchase in history—valued at approximately $468 million today. For context, the market capitalization of Papa John’s pizza chain is $3.84 billion.

[43] Ibid.

[44] *Cointelegraph*, “From $41 to $710 Million: The Unbelievable Bitcoin Pizza Day Story,” May 22, 2024, accessed July 17, 2024.

Another study suggests that Jeremy Sturdivant, the 19-year-old user with the handle "Jercos," spent the 10,000 BTC he received on a road trip across the Americas with his girlfriend, missing the opportunity to capitalize on their current value.

This transaction was more than just an ordinary trade between two users on a developer forum. At the time, Satoshi Nakamoto designed Bitcoin as a payment system, but there was no established way to conduct commercial transactions using BTC. This pizza purchase is widely considered the first known commercial transaction involving Bitcoin.[45]

Although Laszlo Hanyecz has often been the subject of internet memes, his role was far more significant. On April 19, 2010, Laszlo published the first Bitcoin code for [46]macOS, making him a pioneer in Bitcoin development. Additionally, he was the first to script code allowing users to mine Bitcoin using Graphics Processing Units (GPUs) on personal computers. While Laszlo later conducted some of the earliest mining operations, it is believed that Satoshi was already aware of GPU mining and may have used it to prevent a 51% attack (a concept discussed in later sections).

Today, May 22 is celebrated as Bitcoin Pizza Day. About a year after this milestone, Bitcoin's creator, Satoshi Nakamoto, withdrew from the project on April 28, 2011, disappearing from public view entirely. This departure raises critical questions about Satoshi's identity and the implications for the safety and sustainability of Bitcoin, a topic central to our research.

4- Understanding the Mystery: Who Is Satoshi Nakamoto and What Is His Importance?

Revolutionary discoveries often come with the promise of securing the inventor's place in history. However, some innovators prefer to remain anonymous. Based on available evidence, Satoshi Nakamoto chose to conceal his identity when Bitcoin was introduced in 2009. The debate surrounding Nakamoto's true identity remains unresolved. Questions

[45] Lerong Lu, "Bitcoin: Speculative Bubble, Financial Risk and Regulatory Response," 2018.

[46]Laszlo, "Re: Mac OS X Universal Build for Testing," *BitcoinTalk*, accessed June 5, 2024, https://bitcointalk.org/index.php?topic=116.

persist as to whether Nakamoto is an individual, a group, a commercial entity, or even an intelligence agency.

According to global Know Your Customer (KYC) and Anti-Money Laundering (AML) regulations, financial systems aim to trace the origins and circulation of money or valuable assets, such as Bitcoin. In contrast, Bitcoin emerged from a desire for data privacy following the 2008 financial crisis. Despite this, the person or group who published Bitcoin's white paper used the pseudonym Satoshi Nakamoto and has remained unseen since 2009. There is no consensus on whether Satoshi is an individual, a group, a legal entity, or even an intelligence agency.

The data from this study provides compelling evidence that Satoshi Nakamoto had no known phone calls or face-to-face interactions with early Bitcoin users or developers [47], communicating solely via email. One of the first theories about Satoshi's identity involves Nick Szabo, a Hungarian-American computer scientist. Szabo proposed the concept of smart contracts in the 1990s and, in 1998, introduced Bit Gold, the first concept for a decentralized digital currency—though Bit Gold was never implemented. While it is uncertain whether Satoshi is Nick Szabo, it is highly likely that Szabo influenced Bitcoin's design. Szabo, however, denies being Satoshi. Interestingly, Elon Musk has also suggested that Nick Szabo could be behind Bitcoin.[48]

Some researchers have attempted to trace Satoshi from the server where he published Bitcoin Version 1.0. Internet users can reserve their own computer servers through proxy servers, also known as proxies. Satoshi also used such a proxy server. Researchers claimed that Satoshi's IP address was 87.251.146. When checked today, this IP address appears to be registered in Iran, but in 2009, it was part of the global IPv4 system. The IP addresses have since shifted due to reassignment following IP address exhaustion. This IP address reportedly became inactive in 2016. However, the IP was used to write a customer review for a hotel in Vietnam using a proxy in December 2008 and January 2009, and it was

[47] Jens Ducrée, "Satoshi Nakamoto and the Origins of Bitcoin," *arXiv preprint* arXiv:2206.10257, 2022.

[48] *TechCrunch*, "Who Is The Real Satoshi Nakamoto? One Researcher May Have Found The Answer," December 5, 2013, accessed January 8, 2017.

determined that the person used the username Sergey. [49] The fact that the username was Sergey reinforced suspicions that Satoshi might be Russian, contrary to the belief that he could be Japanese. It is also known that Vietnam is a popular destination among Russian programmers. A relevant study determined that the proxy Satoshi used to hide his identity was Russian. While this does not directly prove that Satoshi is Russian, it raises significant doubts. There are also other guesses about his identity.[50]

The reason Satoshi used a Russian proxy could also have been to avoid detection by intelligence networks. According to recent studies on this issue, one assumption is that if Satoshi lived in a country that is a member of the Five Eyes intelligence network (Australia, Canada, New Zealand, Great Britain, and the United States), he may have used the Russian proxy to evade detection by these countries' intelligence agencies. Another interpretation is that he may have worked with a friend or had his own proxy server.

A 60-year-old American man of Japanese descent living in San Gabriel, Los Angeles, was identified as Satoshi Nakamoto. However, this individual, who later changed his name, denied any connection with Bitcoin.[51] Another claim was made in 2016 by Australian computer scientist Craig Wright, who stated that he was Satoshi Nakamoto. The family of Wright's former partner, Dave Kleiman, who passed away in 2013, sued Wright for damages in Florida, alleging that Wright had benefited from Kleiman's contributions to blockchain technology, resulting in an intellectual property violation. The court found the claims of the parties significant but could not reach a concrete conclusion that Wright was Satoshi. In 2021, the court rejected the Kleiman family's demand for compensation but ordered Wright to pay $100 million to the joint venture company that partnered with Kleiman, citing intellectual property violations related to blockchain technology. However, Wright's inability to take any action regarding the 1.1 million Bitcoins allegedly mined by Satoshi cast serious doubt on his claims.[52]

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[49] Sergey, accessed June 5, 2024, https://otzyv.ru/review/44408/.

[50] Anders Lisdorf, *Still Searching for Satoshi: Unveiling the Blockchain Revolution* (Springer, 2023). https://link.springer.com/book/10.1007/978-1-4842-9639-4.

[51] *Business Insider*, "Who Is Satoshi Nakamoto? The Bitcoin Legend Is As Mysterious As Ever," December 21, 2021. Retrieved July 25, 2024. https://markets.businessinsider.com/news/currencies/satoshi-nakamoto-bitcoin-creator-identity-mystery-2021-12.

[52] *CryptoBriefing*, "Wright Is Not Satoshi, UK High Court Rules," March 14, 2024. Retrieved July 25, 2024. https://cryptobriefing.com/wright-not-satoshi-uk-high-court-rules/.

Another figure speculated to be Satoshi Nakamoto is programmer Gavin Andresen. In 2010, spreading Bitcoin's use was particularly challenging, as its success depended on widespread adoption. This was the goal of Laszlo Hanyecz's Bitcoin Pizza Day transaction, as mentioned earlier. Andresen created one of the first Bitcoin airdrop projects, Bitcoin Faucet, to distribute Bitcoin to a wider audience. The data suggests that visitors to the site could complete a simple captcha (security code) and earn 5 BTC (worth over $200,000 as of April 2022) in their Bitcoin wallets. Initially funded by Andresen's own BTC, the project later distributed 19,715 BTC (valued at approximately $837 million in April 2022) through donations from miners and software developers.[53]

The data from this dissertation strongly indicates that Satoshi Nakamoto is worth more than $42 [54] billion today. If the approximately 1 million Bitcoins allegedly belonging to Satoshi were moved or sold, it could have a significant destabilizing effect on the cryptocurrency market. For this reason, many long-term Bitcoin investors prefer that Satoshi's identity remain a mystery.

While there is no definitive proof of Satoshi Nakamoto's true identity, whether he is a Russian-born programmer, a Japanese individual, or an Australian computer scientist, it can be said that he is one of the most enigmatic figures in modern technology.

There have been numerous investigations into Satoshi's identity, beginning with tracking the servers used for Bitcoin Version 1.0. It is known that proxy servers can hide a computer's IP address, and Bitcoin was launched using a proxy server with the IP address 87.251.146. This server reportedly became inactive in 2016, but in 2008 and 2009, it was used in Vietnam by a person with the username Sergey. The use of this name has led to speculation that Satoshi might be Russian.[55]

While no conclusive evidence exists to identify Satoshi Nakamoto, the decentralized nature of Bitcoin raises concerns about the potential movement of the 1.1 million BTC attributed to him. Such an event could significantly impact Bitcoin's value and the stability of the broader cryptocurrency market. This dissertation examines Satoshi Nakamoto's identity as

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[53] Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction* (Princeton University Press, 2016).

[54] *Entrepreneur*, "5 Things To Know About Satoshi Nakamoto As The Founder of Bitcoin," April 6, 2023, accessed July 17, 2024, https://www.entrepreneur.com/en-in/entrepreneurs/5-things-to-know-about-satoshi-nakamoto-as-the-founder-of/449232.

[55] *Cointelegraph*, "Bitcoin Code Reveals Satoshi Nakamoto Used a Russian Proxy," June 3, 2020, accessed July 17, 2024, https://cointelegraph.com/news/bitcoin-code-reveals-satoshi-nakamoto-used-a-russian-proxy.

a critical factor in assessing risks to the sustainability of the cryptocurrency ecosystem. Since Bitcoin is often referred to as the "gold of cryptocurrencies" due to its limited supply, the uncertainty surrounding Satoshi's identity represents a key risk to the system's long-term stability.

5- What is Cryptocurrency Mining?

The term mining refers to the reward mechanism given to individuals who provide computing power to the operating system of some cryptocurrencies, especially Bitcoin. This is a modern version of compensating contributors for their services.

The available evidence suggests that there are three basic ways for an individual to acquire Bitcoin. The first option is purchasing Bitcoins from a cryptocurrency exchange.[56] The second is receiving a transfer as payment for goods or [57] services. The third option involves earning Bitcoin through mining by contributing one's own computer power.[58]

The organization of mining is deeply connected to blockchain technology's goal of creating a decentralized structure. As emphasized in the title of this dissertation, decentralization is a cornerstone of blockchain technology and is expected to have an even greater impact in the coming years. To understand the decentralized nature of blockchain technology, it is essential first to grasp how today's information infrastructure is designed with a centralized structure. Understanding the historical and current context of the internet will provide insight into why blockchain technology seeks to establish a decentralized structure that is becoming increasingly attractive. In a later section, we will examine the concept of Web 3.0 and provide an analysis of the evolution of the internet from its inception to its current state and its future potential.

The decentralization inherent in blockchain technology underpins cryptocurrency mining.[59] Blockchain technology, as part of Web 2.0, moves away from storing data on centralized servers to using distributed ledger technology. By distributing data across multiple ledgers, this system enhances security and ensures the immutability of stored content. However,

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[56] Narayanan, J. Bonneau, E. Felten, A. Miller, and S. Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction* (Princeton University Press, 2016).
[57] Christian Catalini and Joshua S. Gans, *Some Simple Economics of the Blockchain* (Cambridge, MA: National Bureau of Economic Research, 2016).
[58] J. Bonneau, A. Miller, J. Clark, A. Narayanan, J. A. Kroll, and E. W. Felten, "SoK: Research Perspectives and Challenges for Bitcoin and Cryptocurrencies," in *Proceedings of the 2015 IEEE Symposium on Security and Privacy*, 104–121 (IEEE, 2015).
[59] L. Ishchenko, M. Mashevska, and L. Uhryn, "Cryptocurrency Generation System Using Blockchain," *Journal of Crypto Technologies*, 2024, accessed July 17, 2024, https://ctp.uad.edu.ua/images/ktd/47_4.pdf.

providing data storage services globally is a costly endeavor, making it unrealistic to expect individuals around the world to offer such services for free. Mining addresses this challenge by introducing a reward mechanism that compensates participants for contributing computing power to the system. Rather than using traditional currencies, the system rewards miners with cryptocurrency. Convincing miners to incur energy costs denominated in traditional currencies to power the system with unproven cryptocurrencies was one of blockchain technology's earliest challenges. Significant effort was made to overcome this obstacle. Early initiatives such as offering free cryptocurrency through Bitcoin airdrops or pizza purchases aimed to assign value to these cryptocurrencies, thereby encouraging miners to strengthen and popularize the system. Given the current popularity of mining,[60] it is fair to conclude that this initial challenge was successfully overcome.

To fully understand mining, it is helpful to explore the protocols on which blockchain technology operates. While Bitcoin, the first blockchain, was developed using the proof-of-work (PoW) protocol, other protocols now exist. In subsequent sections, where we compare different cryptocurrencies, these protocols and their distinctions will be discussed in greater detail.

Based on current evidence, cryptocurrency mining, such as Bitcoin mining, has undergone significant development since 2009. Initially, miners used CPUs (central processing units) for cryptocurrency mining. However, this method proved inefficient due to the time required, high energy consumption, and cooling costs,[61] which often outweighed the profits. Further advancements introduced GPU (graphics processing unit) mining, where multiple GPUs are combined into a single unit with a dedicated cooling system. This setup maximized efficiency compared to CPU mining.

ASIC (application-specific integrated circuit) mining systems followed. Unlike GPUs, ASICs are specifically designed for cryptocurrency mining, making them more efficient.

[60] Lassi Harju, "Dynamics of Crypto Mining," Master's Thesis, University of Turku, 2024, accessed July 17, 2024, https://www.utupub.fi/bitstream/handle/10024/178736/Lassi_Harju_opinnayte.pdf?sequence=-1.

[61] H. T. Heinonen and A. Semenov, "Bitcoin Mining Could Revolutionize Grid Computing and Unconventional Computing," in *Proceedings of the 2023 International Conference* (IEEE, 2023).

However, due to the increasing difficulty of cryptocurrency mining and the high cost of equipment,[62] ASICs can quickly become outdated.

The rising costs associated with ASIC and GPU mining have led to the growing popularity of cloud mining. This model allows users to rent mining equipment for a specified period without purchasing physical equipment. Individual miners benefit by avoiding the technical complexities of mining hardware while simultaneously supporting larger companies in expanding their mining capacities.

The literature also provides numerous examples of miners forming mining pools.[63] In cryptocurrency mining, each miner competes to form the next block, much like a slot machine race against time. Mining pools reduce the likelihood of missing this opportunity. When a reward is earned, it is distributed among participants based on their contributions. Official mining pools often operate through specific applications, though independent mining pools formed by users are also common. Websites like Cryptocompare.com allow users to compare the reliability and profitability of different mining pools.

The efficiency of cryptocurrency mining [64]is influenced by several factors. For example, the energy required to mine a Bitcoin block is estimated to range from 86,000 to 286,000 kWh.[65] These efficiency factors are:

- Energy Prices
- Energy Consumption of the Systems and Devices Used[66]
- Cooling Costs (they get quite hot during production with the device, especially in the GPU-ASIC system)
- Sustainability
- Legal and Tax Framework

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[62] M. Jabłczyńska, K. Kośc, P. Ryś, P. Sakowski, R. Ślepaczuk, et al., "Energy and Cost Efficiency of Bitcoin Mining Endeavor," *PLOS ONE* 18, no. 3 (2023): e0283687. https://doi.org/10.1371/journal.pone.0283687.

[63] Lin William Cong and Zhiguo He, "Decentralized Mining in Centralized Pools," Working Paper 25592 (Cambridge, MA: National Bureau of Economic Research, April 2019)..

[64] CryptoCompare, "Compare Bitcoin, Ethereum and Other Cryptocurrency Mining Pools," accessed July 17, 2024, https://www.cryptocompare.com.

[65] Miner Daily, "How Much Power Does It Take to Mine a Bitcoin?" *Miner Daily*, 2021, accessed June 5, 2024, https://minerdaily.com/2021/how-much-power-does-it-take-to-mine-a-bitcoin/.

[66] *Bitcoin, Blockchain, and the Energy Sector*, Congressional Research Service, August 9, 2019, accessed July 17, 2024, https://sgp.fas.org/crs/misc/R45863.pdf.

- Labor Costs.

A research group at a university in Spain conducted an academic study to examine the environmental impact of mining and identify the most sustainable countries for this activity. Their research evaluated factors contributing to the Environmental Performance Index (EPI) as follows:

- Energy Prices
- The Way of Energy is Produced
- Average Annual Temperature
- Legal Restrictions
- Human Resource
- Research and Development Expenses.

As a result of related research, Denmark and Germany were identified as the most sustainable countries for cryptocurrency mining, followed by other developed countries such as Switzerland, Sweden, and Finland. The least sustainable countries included Bolivia, Kenya, Venezuela, Sudan, and Libya. Turkey was ranked in the middle of the list.[67]
Recent studies indicate that energy consumption in mining activities to acquire cryptocurrencies, especially Bitcoin, has reached critical levels. According to a study conducted by the Sunbird Company, if Bitcoin production facilities were a country, they would rank as the 61st highest electricity[68] consumer in the world. The same research also identified the world's largest cryptocurrency mines. However, it is worth noting that the locations and production capacities of some cryptocurrency mines are kept confidential. According to this list, the largest mines are as follows:

The Country Where It Is	**Hash Rate**	**Monthly Energy Cost**	**The Number of BTC Mined Per Month**	**What % of BTC has been generated here so far**

[67] S. L. Náñez Alonso, J. Jorge-Vázquez, M. Á. Echarte Fernández, and R. F. Reier Forradellas, "Cryptocurrency Mining from an Economic and Environmental Perspective: Analysis of the Most and Least Sustainable Countries," *Energies* 14, no. 4254 (2021). https://doi.org/10.3390/en14144254.
[68] Sunbird DCIM, "Largest Bitcoin Mining Farms in the World," accessed July 17, 2024, https://www.sunbirddcim.com/sites/default/files/Sunbird_InfoGraphic_Bitcoin.pdf.

Located				
Dalian, China	360,000 TH	$1,170,000	750	3%
Genesis Mining Farm, Reykjavik, Iceland	1,000 GH (1 TH is 0.001 GH)	It is estimated to have the most consumption among all companies in Iceland	-	-
Moscow, Russia	38 PH	$120,000	600	-
GigaWatt, Washington, USA	1.3 PH	-	-	-

Table 1: The largest cryptocurrency mines in the world

Source: The largest cryptocurrency mines in the world (it can be said that this picture has changed after China's recent bans) https://www.sunbirddcim.com/sites/default/files/Sunbird_InfoGraphic_Bitcoin.pdf

Available evidence suggests that the Genesis mine, located in Iceland, holds the title of the largest cryptocurrency mine in the world.[69]It is also the largest cloud mining company. The primary reason for the Genesis mine's location in Iceland is the country's cool climatic conditions. These conditions significantly reduce the cooling costs for the mining equipment, which generates substantial heat. When combined with low energy prices, this creates a highly profitable investment environment.

[69] World Economic Forum, "Iceland Will Use More Energy Mining Bitcoin than Powering the Country," February 13, 2018, accessed July 17, 2024, https://www.weforum.org/agenda/2018/02/iceland-may-use-more-electricity-to-mine-bitcoins-than-it-does-to-power-all-of-its-houses-this-year/.

For instance, the primary reason GIGAWATT is located in Washington is the state's low energy[70] costs. At this point, different countries also stand out due to various advantages, such as favorable tax policies or climatic conditions. Examples of such countries include Indonesia, Russia, and Kazakhstan. Diversifying the locations of mining operations is crucial for maintaining a sustainable blockchain ecosystem.

Kazakhstan, for example, quickly became a popular destination for miners due to its cheap energy costs and China's sanctions on miners. This was facilitated by Kazakhstan's abundant coal deposits.[71] However, in January 2022, power outages in Kazakhstan, the second-largest Bitcoin mining country in the world, caused 15% of the global Bitcoin network to be disconnected when its mines went offline. This led to an 8%[72]drop in global Bitcoin prices. Situations like these highlight the importance of distributing mining operations across different countries rather than concentrating them in a single location. Many states aim to generate income through these mining activities. Mining can serve as a form of service export, where energy and equipment are exchanged for cryptocurrency production. Legislators in countries with stable energy supplies can view this as an opportunity. The decisions of policymakers play a significant role in shaping the future of mining. In the next section, we will evaluate the various regulatory frameworks governing cryptocurrencies and mining worldwide.

Mining activity depends on providing energy to computer systems to sustain the blockchain (e.g., the Bitcoin blockchain). This requires a significant amount of energy. A study by Digiconomist revealed that Bitcoin mining alone consumes more energy than many mid-sized countries, such as the Czech Republic and the Netherlands.[73]

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[70] Energy Information Administration (EIA), "Washington State Energy Profile Analysis," accessed July 17, 2024, https://www.eia.gov/state/analysis.php?sid=WA.

[71] Reuters, "Crypto Boom Strains Kazakhstan's Coal-Powered Energy Grid," November 10, 2021, accessed July 17, 2024, https://www.reuters.com/business/energy/crypto-boom-strains-kazakhstans-coal-powered-energy-grid-2021-11-10/.

[72] CNBC, "Kazakhstan Bitcoin Mining Shuts Down Amid Fatal Protests," January 6, 2022, accessed July 17, 2024, https://www.cnbc.com/2022/01/06/kazakhstan-bitcoin-mining-shuts-down-amid-fatal-protests.html.

[73] Digiconomist, "Bitcoin Energy Consumption Index," accessed June 6, 2024, https://digiconomist.net/bitcoin-energy-consumption.

6. What is the Airdrop and Why Is It Important to Understand This Concept?

We can say that the main purpose of Bitcoin Faucet or Bitcoin Pizza Day, which we mentioned above, is a type of marketing activity conducted to measure the usage of a cryptocurrency and increase its prevalence. Currently, there are 19,808 cryptocurrencies traded on the cryptocurrency market[74], making it quite challenging to gain a significant position among all these options. At this point, projects that aim to secure a strong place must first build a robust community to gain an advantage in this competitive environment. This community can support the project's technical development through open-source contributions (as with Bitcoin), actively participate in the management of the cryptocurrency project through DAOs (Decentralized Autonomous Organizations), or, more simply, increase the project's visibility through social media shares.

One of the fastest ways to create this community is to give some gift of these cryptocurrencies for free to people who can make these contributions or promise they will be given as a gift. The website https://airdrops.io/ keeps track of current or potential airdrops and evaluates under which conditions these gift cryptocurrencies will be given.[75] The amount of cryptocurrency distributed can vary by project. For example, some projects reward people who hold their cryptocurrency during a specific period, demonstrating market retention, while others make automatic payments to wallets of users who have purchased the cryptocurrency at least once. In projects like Bitcoin Faucet, users could earn BTC with a simple click, but in other cases, participants might be required to complete specific tasks, such as sharing content on social media or performing a swap transaction on a token exchange platform. Uniswap and Stellar are notable examples of large-scale airdrops.[76]

As we discussed mining earlier, the core logic behind mining aligns with the principle of decentralization, a goal that remains difficult to achieve fully. To establish a truly decentralized global network, an independent energy supply is essential. However, even

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[74] CoinMarketCap, "Cryptocurrency Market Data on June 10, 2022," accessed June 6, 2024, https://coinmarketcap.com/.

[75] Airdrops.io, "The Best Airdrops in Crypto," accessed October 3, 2024, https://airdrops.io/.

[76] Blockonomi, "The Past, Present, and Future—A Look at the Biggest Crypto Airdrops Ever," April 18, 2022, accessed October 3, 2024, https://blockonomi.com/biggest-crypto-airdrops/.

today, the internet relies on power supply mechanisms controlled by states or private companies. Unlike centralized systems, Bitcoin servers are not hosted on private or state-owned servers. Bitcoin is the first decentralized cryptocurrency enabled by distributed ledger technology, which allows data to be stored simultaneously in multiple locations without central oversight. While Web 2.0 relies on centralized databases, the era of Web 3.0, represented by Bitcoin's model, decentralizes data storage.

Data storage, however, is not a cheap service, and it would be unreasonable to expect individuals to store distributed ledger data on their devices without monetary compensation. Bitcoin was designed to reward individuals who store this data by paying them in cryptocurrency, which can then be used for other services. One of Bitcoin's early challenges was convincing users to contribute energy to the system, which had to be paid for with fiat currency, while users were compensated with cryptocurrencies that lacked the established trust of traditional money. This example illustrates the importance of having more miners, as increased miner participation leads to greater data distribution, enhanced system security, and broader Bitcoin adoption. To achieve this, Bitcoin enthusiasts promoted the cryptocurrency in various ways, including free giveaways (airdrops) and donations, which introduced the airdrop concept.

For instance, as we discussed earlier, on May 18, 2010, software developer Laszlo Hanyecz announced on the Bitcointalk forum that he would exchange 10,000 BTC for two pizzas. A user named Jercos (Jeremy Sturdivant) accepted the offer, making the exchange[77]. This was much more than a simple pizza order; it was the first known commercial payment for a product using Bitcoin. Satoshi Nakamoto designed Bitcoin as a payment system, and this marked its first use for payment purposes. However, airdrops were a separate initiative intended to promote the system itself.

The legal framework surrounding airdrops is also an interesting topic. How can something distributed for free be banned or regulated? In a report published by the U.S. Securities and Exchange Commission (SEC), the regulator stated that not only investments made with

[77] BitcoinTalk, "Topic: 137," accessed June 6, 2024, https://bitcointalk.org/index.php?topic=137.0.

money but also any service or good with exchange value can be considered an investment.[78] For example, in a project where free cryptocurrency is distributed in exchange for social media shares, the act of sharing could be classified as providing a service with value, effectively making it an investment. Consequently, whether an airdrop is subject to regulation depends on the specific conditions of the project, including whether it meets the security requirements expected of cryptocurrencies.

In the example of the United States, the SEC (Securities and Exchange Commission) would likely consider any airdrop to be a security. The question then becomes whether airdrops are legal under U.S. federal securities law. A security cannot be offered for sale unless it is registered or qualifies for a registration exemption, and most airdrop tokens or coins are not registered.[79]

However, airdrops are free giveaways of tokens or coins. ICO developers are not raising funds from the public, nor are investors putting any funds at risk. As a result, investors cannot claim that they had an expectation of a return on their investment, which is an important distinction between a security and an airdrop.[80]

From the perspective of official institutions, these free cryptocurrencies are not truly considered free.[81]Airdrops exploit legal loopholes in some countries, as the concept is not yet fully understood. Despite this, many cryptocurrency projects begin with airdrops, which is why we discuss them in this section. Next, we turn to understanding platforms where these coins and tokens can be purchased before discussing the MiCA regulation of the EU in the following chapter.

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[78] Ibid. See: Report of Investigation, supra note 122

[79] Harris Sliwoski LLP, "Are Crypto Airdrops Legal?" *Harris Sliwoski LLP Blog*, February 27, 2024, accessed May 21, 2024, https://harris-sliwoski.com/blog/are-crypto-airdrops-legal/.

[80] Coin Bureau, "Cryptocurrency Airdrops: Where Could the SEC Stand on Them?" *Coin Bureau*, March 29, 2023, accessed May 21, 2024, https://www.coinbureau.com/analysis/cryptocurrency-airdrops-sec/.

[81] Bridgett S. Bauer, "Airdrops: 'Free' Tokens Are Not Free from Regulatory Compliance," *University of Miami Business Law Review* 28, no. 2 (2020): 311, accessed June 6, 2024, https://repository.law.miami.edu/umblr/vol28/iss2/5.

7. Where to Buy Cryptocurrency and Insights on Hot and Cold Wallets

Since we are exploring the blockchain and cryptocurrency ecosystem comprehensively, it is important to understand the historical development of cryptocurrency exchanges to see the bigger picture. As explained earlier, in decentralized cryptocurrencies such as Bitcoin, every transaction is recorded on a public ledger. This means every transaction can be traced on Bitcoin's public ledger since its launch in 2009. If we ask what the first crypto exchange was, the answer differs, but the first website associated with Bitcoin was Bitcoin.org, launched in August 2008. This open-source website was publicly accessible and maintained by [82] a decentralized community.

In 2009, Satoshi Nakamoto mined the first block of Bitcoin, known as the Genesis Block, and received 50 Bitcoin as a reward. However, due to technical bugs, these 50 Bitcoin remain in the original account where they were created. On January 9, 2009, Bitcoin became an open-source system that could be used, downloaded, and improved by anyone. On January 12, 2009, the first Bitcoin transaction took place, with Satoshi transferring 10 Bitcoin to cryptographer Hal Finney's account (1A1zP1eP5QGefi2DMPTfTL5SLmv7DivfNa[83]).

Bitcoin's first valuation was introduced by the website New Liberty Standard, which calculated 1.309 BTC as equivalent to one U.S. dollar. This price was based on the energy cost of creating one Bitcoin through mining.[84] The first known Bitcoin exchange for fiat currency occurred when software developer Finn Martti Malmi sold 5,050 BTC for $5.02 at an event.[85]

The first cryptocurrency marketplace, introduced in February 2010 on the Bitcoin Talk forum, was called Bitcoin Market. However, it was shut down on June 4, 2011, due to

[82] Bitcoin.org, "Bitcoin - Open Source P2P Money," accessed October 3, 2024, https://bitcoin.org.

[83] Guinness World Records, "First Bitcoin Transaction," accessed October 3, 2024, https://www.guinnessworldrecords.com/world-records/696243-first-bitcoin-transaction.

[84] SGT Report, "Dawn of Bitcoin Price Discovery 2009–2011: The Very Early Bitcoin Exchanges," January 2021, https://www.sgtreport.com/2021/01/dawn-of-bitcoin-price-discovery-2009-2011-the-very-early-bitcoin-exchanges/.

[85] Reuters, "Factbox: Bitcoin and Other Cryptocurrencies," accessed June 6, 2024, https://www.reuters.com/article/uk-crypto-currencies-bitcoin-factbox-idUKKCN1N50FU.

[86] customer complaints, and PayPal ceased its services. Another exchange, Mt. Gox, launched on July 18, 2010, in Japan, and handled 70% of all Bitcoin transactions worldwide until it shut down following a hack that resulted in the loss of 744,408 BTC. This incident remains one of the largest cryptocurrency hacks.[87]

In this research, we will explore the legal foundation of cryptocurrency markets. However, it is worth noting that buying cryptocurrencies from exchanges is not mandatory. Early adopters, or "decoders," often obtained Bitcoin through mining or by transferring it among themselves on forums.

Current data suggests that one of the advantages often cited for cryptocurrencies is their lower transaction costs and faster processing compared to traditional bank transfers. However, from 2010 to today, the history of cryptocurrency exchanges includes many failed attempts. Furthermore, as the number of global cryptocurrency exchanges has now exceeded 500, a significant monopolization trend is evident. For instance, Binance, the largest cryptocurrency exchange, processes a daily volume more than four times that of its closest competitors, such as FTX, which exceeds $12 billion [88] daily. This monopolization was even more pronounced in the early days, leading to cases like the Mt. Gox hack.

Additionally, the fees charged by cryptocurrency exchanges are not always as low as claimed. Some platforms impose exorbitant transfer fees, while others create significant hurdles when users attempt to withdraw funds.

Cryptocurrency exchanges provide services that go beyond trading; they also offer storage solutions for purchased cryptocurrencies. Users can store their cryptocurrencies in three main ways:

- In a wallet on the platform where they were purchased

[86] The Bitcoin News, "Bitcoin History Part 6: The First Bitcoin Exchange," December 25, 2018, accessed October 3, 2024, https://thebitcoinnews.com/bitcoin-history-part-6-the-first-bitcoin-exchange/.

[87] Marius-Cristian Frunza, *Solving Modern Crime in Financial Markets: Analytics and Case Studies* (Academic Press, 2015), ISBN 9780128045329.

[88]CoinMarketCap, "Binance Trading Volume," accessed October 10, 2024, https://coinmarketcap.com/exchanges/binance/.

- In a hot wallet, which is connected to the internet and can be used outside the purchasing platform
- In a cold wallet, which refers to offline storage on physical devices like USB drives or portable disks. Cold wallets are considered the most secure storage option as they are not connected to online systems, making them resistant to hacking. However, the challenge lies in safeguarding the physical device and remembering the login credentials. Many investors have lost millions of dollars worth of cryptocurrencies due to forgotten passwords or misplaced devices.

For those who do not want to invest in cryptocurrencies directly, there are alternative options. Financial brokers offering professional services in this area, exchange-traded funds (ETFs) that invest in cryptocurrencies, or funds that diversify investments across multiple cryptocurrencies are all viable options. Additionally, individuals can choose to become partners in firms that invest in cryptocurrencies.

The largest cryptocurrency exchanges that come to mind when we consider a cryptocurrency market are as follows:

- Binance (based in the Cayman Islands)
- FTX (based in Antigua and Barbuda)
- Coinbase Exchange (established in the USA, listed on the stock exchange in 2021, and the first exchange to start trading on Nasdaq)
- Kraken (based in the USA)
- KuCoin (established in Seychelles)

However, these are centralized exchanges. In other words, they are stock markets with specific owners and are inherently more fragile. In the following sections, we will also discuss Decentralized Exchanges (DEX), i.e., decentralized cryptocurrency exchanges.

One of the biggest risks of cryptocurrency exchanges is software attacks and glitches, which pose a significant risk, especially for investors who store their cryptocurrencies on the broker's site. Hacking incidents, such as the Mt. Gox hack, have occurred several times on major cryptocurrency exchanges. For this reason, it is crucial to analyze the reliability of the selected cryptocurrency exchange in addition to evaluating transaction fees.

8. What are the Risks of Cryptocurrency Investments?

In this part of the study, the risks of cryptocurrency investments will be discussed. When examining the data closely, it becomes clear that cryptocurrency investments are highly volatile. Novice investors often lose significant amounts of capital in this ecosystem every year. Although there is concern about legal measures in the ecosystem, clear and transparent regulations could lead to the creation of a much larger market.

To summarize the main risks of cryptocurrency investment:

- **High Volatility:** Cryptocurrencies are highly susceptible to international manipulation. Furthermore, the ecosystem is fragile, and even minor hacking incidents or legal investigations can lead to the collapse of an entire cryptocurrency project or Initial Coin Offering (ICO).
- **Legal Risks:** Some countries may ban cryptocurrency transactions altogether. For example, in 2021, China, the world's second-largest cryptocurrency economy, banned cryptocurrency transactions and mining for its citizens.[89] Similarly, India has imposed a high tax of up to 30% on cryptocurrency transactions and implemented several legal steps:[90]
- **Difficulty Finding an Addressee:** Due to its decentralized nature, in some cases, there may be no entity to address issues or resolve disputes.
- **Cybersecurity and Hacking Risks:** This is particularly problematic for those who store their cryptocurrencies in online hot wallets, which are more vulnerable to attacks.
- **Forgotten Private Keys:** Access to cryptocurrencies stored via private keys depends on knowing this information. However, many users forget their private keys, losing

[89] Ibid.

[90] Prakhar Harit, "Cryptocurrency and Social Justice: A Study of Indian Taxation Laws on Emerging Virtual Challenges," *SSRN Electronic Journal* (2020), https://doi.org/10.2139/ssrn.3615059.

access to their wallets. It is estimated that 20% of Bitcoin is lost due to forgotten login information lost in this way.[91]

- **Systemic Risks:** Cryptocurrency exchanges can be complex, leading to user confusion and potential losses during simple operations. For instance, swap transactions between different blockchains or layer-1 and layer-2[92] networks can result in errors. Additionally, high energy costs during mining can lead to financial losses.

The risks can be categorized further, but the primary goal is not to discourage people from adopting this technology or to mislead them into believing it is the ultimate investment. A good understanding of the technology and its underlying concepts enables individuals to evaluate these risks independently, rather than relying on trends or opinions from platforms like Twitter and Discord.

From an investment perspective, advanced technology does not necessarily guarantee that a cryptocurrency's value will increase. For instance, cryptocurrencies like Dogecoin, Coinye, and Ufocoin, which were created as jokes, have reached significant valuations. However, most ended in disappointment, although Dogecoin[93] continues to have a substantial investor base. To help readers make informed decisions, we will explain the technical aspects of blockchain infrastructure in the following sections.

9. What are the Types of Cryptocurrencies?

Between 2009 and 2014, cryptocurrencies were generally viewed as a collective category, with little distinction between them. However, the recent evolution of the cryptocurrency ecosystem has significantly changed this perspective. This research discusses cryptocurrency classifications and categories to guide rule-makers and entrepreneurs in understanding which regulations apply and to address our second research question regarding whether regulators can adequately distinguish between these concepts. Today,

[91]Nathan Reiff, "20% of All BTC Is Lost, Unrecoverable, Study Shows," *Investopedia*, June 25, 2019, https://www.investopedia.com/news/20-all-btc-lost-unrecoverable-study-shows/.

[92]CoinDesk, "Token Swaps: What Are They, How They Work & Why They're Happening Now," *CoinDesk*, June 16, 2018, https://www.coindesk.com/markets/2018/06/16/token-swaps-what-are-they-how-they-work-why-theyre-happening-now/.

[93]Techopedia, "Top 10 Dogecoin Holders: Who Owns the Most DOGE in 2024?" accessed October 10, 2024, https://www.techopedia.com/top-10-dogecoin-owners.

cryptocurrencies can be divided into various categories. Although categorization approaches differ, the following classification is particularly useful.

Table 3: Cryptocurrency Categorization

Source: The Value Determinants of Cryptocurrencies by Marius Vogel, Lucerne University of Applied Sciences and Arts 21. June 2019

At this point, when evaluating a cryptocurrency, categorization involves identifying the primary class to which it belongs, its specific category, and additional characteristics, such as whether it uses the proof-of-work mechanism and its final supply. These details will be elaborated upon in subsequent sections.

9.1. Cryptocurrency Classes—What is the Difference Between a Token and a Coin?

In this section, we discuss the distinction between a coin and a token. When making a first-class distinction, the terms "coin" and "token" are the primary categories encountered. The most basic distinction is that a coin operates on its own blockchain infrastructure, while a token functions on a blockchain infrastructure developed by another entity. Although often confused in practice, this distinction is fundamental. As we explore blockchain models and types in greater detail later, this difference will become clearer.

The term "coin" originated with Bitcoin, the first decentralized cryptocurrency. Bitcoin was described as a peer-to-peer payment system, issuing or mining coins. The term "token" gained popularity with the Ethereum revolution. While "token" has different meanings across disciplines, in this context, it refers to a cryptocurrency that operates on another blockchain’s infrastructure.

The basic function of a coin is to facilitate payments. In Bitcoin's white paper, the cryptocurrency was defined as "end-to-end electronic cash," with its payment feature[94] emphasized. Bitcoin remains the most well-known coin and serves as a digital currency. This is likely why El Salvador adopted Bitcoin as its official currency, rather than any token.

The token, as its name suggests, functions similarly to a gift voucher in everyday life. It can be designed for use within a specific time frame or location and may also be tailored for certain services. However, tokens have a much broader range of functionality compared to coins. While coins, like digital cash, can store value, be exchanged, and have a unit-dependent value, tokens are used to represent specific assets or services on another blockchain infrastructure. Although Ethereum, the second-largest cryptocurrency by market size, is itself a coin, the blockchain infrastructure it has developed allows users to issue their own tokens using the Ethereum platform. Applications such as DeFi (Decentralized Finance), NFTs (Non-Fungible Tokens), and DApps (Decentralized Apps), comprising approximately 78% of applications, operate on the Ethereum infrastructure.[95]

Based on the current available data, it is fair to suggest that issuing tokens is much easier than issuing coins. Users can quickly create their own tokens using pre-existing templates and infrastructures. The word "token" has two definitions in computer terminology: one refers to a small device, such as a USB, that authorizes the user (or serves as an e-signature); the other refers to regular symbols that identify or authenticate users, such as API (Application Programming Interface) keys. In both cases, tokens can be transferred to different owners.[96]

Some of the most popular coins include Bitcoin, Ethereum, Ripple, Bitcoin Cash, Litecoin, Cardano, Stellar, Neo, Iota, and Monero. These coins operate on their own blockchain infrastructures.

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[94] Ibid.

[95] "DAPP Statistics," *State of the Dapps*, accessed June 6, 2024, https://www.stateofthedapps.com/stats/platform/ethereum#new.

[96] Pavel Kravchenko, "Know Your Tokens: Not All Crypto Assets Are Created Equal," *CoinDesk*, August 14, 2017, retrieved April 12, 2018, https://www.coindesk.com/what-is-token-really-not-all-crypto-assets-created-equal/.

9.2. Categories of Cryptocurrencies

In addition to the coin and token distinction, cryptocurrencies can also be categorized based on the services they provide or claim to provide. Categorization plays a significant role in determining the legal framework applicable to any token or coin. In this part of our research, we aim to provide a deeper understanding of cryptocurrency categorization and the implications these categories have in the eyes of regulators. Below, we begin with privacy coins.

9.2.1. Privacy Coins (Cryptocurrencies Based on Privacy)

We can introduce privacy coins as the least favored by lawmakers and security forces. Notable examples of privacy coins include Zcash and Monero. Another cryptocurrency, Dash, initially launched as "Dark Coin," later rebranded and distanced itself from being considered a privacy coin.[97]

Privacy coins allow transactions to be completed with minimal or no data disclosure, making them susceptible to use in illicit activities such as money laundering and terrorist financing. Their anonymity has led regulatory bodies in Japan and South Korea to take action. The Korean Financial Services Commission (FSC) announced that "dark coins" (a term used to describe privacy coins) are prohibited from being used.[98]

In 2019, the Australian Securities and Investment Commission (ASIC) also banned the trading of privacy coins on registered crypto markets,[99] requiring them to be delisted.

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[97] Jeff Benson, "Darkcoin to Dash: The 5-Year Fight to Rebrand a Privacy Coin," *Decrypt*, November 7, 2020, accessed October 3, 2024, https://decrypt.co/47974/darkcoin-to-dash-the-5-year-fight-to-rebrand-a-privacy-coin.

[98] Financial Services Commission (FSC), "Public Announcement," October 3, 2020.

[99] Australian Securities and Investments Commission (ASIC), "Crypto Assets," accessed June 6, 2024, https://asic.gov.au/regulatory-resources/digital-transformation/crypto-assets/.

Although privacy coins enjoyed significant popularity in their early years, recent data shows a substantial decline in their market share compared to privacy blockchains. Privacy coins accounted for a dominant 96.6% share of the crypto privacy market in January 2021, with a market capitalization of $4.62 billion. By February 2024, this share had dropped to 52.3%, with a market capitalization of $3.08 billion. Conversely, the market share of privacy blockchains grew 14-fold during the same period, from 3.4% ($0.16 billion) to 47.7% ($2.81 billion).[100] This shift highlights the growing preference for privacy blockchains over traditional privacy coins.

Security concerns surrounding privacy coins have escalated. For example, the darknet marketplace White House Market discontinued Bitcoin payments in January 2021 and now exclusively accepts Monero, one of the most well-known privacy coins.[101]

Despite the risks associated with privacy coins, many advocates defend their use, citing enhanced control over data, business protection, consumer protection, and privacy preservation. While privacy is a politically significant issue, it has historically been secondary to the primary goal of decentralization.[102]

Privacy coins lie at the heart of the decentralized movement, with anonymity being a core principle. Advanced privacy-preserving technologies used in privacy coins have seen relative growth compared to non-privacy coins like Bitcoin and Ethereum, particularly following regulatory events targeting decentralized cryptocurrencies. However, as the data above indicates, the usage of privacy coins has decreased relative to non-privacy coins following the introduction of regulations restricting privacy-preserving protocols.[103]

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[100] "Privacy Coins," *CoinGecko*, accessed June 6, 2024, https://www.coingecko.com/en/categories/privacy-coins.

[101] "Darknet Giant White House Market Drops Bitcoin, Supports Monero Payments Only," *Bitcoin News* (Bitcoin.com), accessed June 6, 2024, https://news.bitcoin.com/darknet-giant-white-house-market-drops-bitcoin-supports-monero-payments-only/.

[102] John Harvey and Ines Branco-Illodo, "Why Cryptocurrencies Want Privacy: A Review of Political Motivations and Branding Expressed in 'Privacy Coin' Whitepapers," *Journal of Political Marketing* 20, no. 3 (2019): 1–25, https://doi.org/10.1080/15377857.2019.1652223.

[103] Sean Foley, Gbenga Ibikunle, Valerio Mollica, and Quan Sun, "Why So Many Coins? Examining the Demand for Privacy-Preserving Cryptocurrencies," 2023.

It is likely that the most stringent regulatory scrutiny in the coming years will focus on privacy coins. Laws concerning anti-money laundering (AML), know-your-customer (KYC) requirements, and anti-terrorism financing will likely be enforced with increasing rigor.

9.2.2. Utility Token (Cryptocurrencies Based on Interest/Utility)

Utility tokens are cryptocurrencies that allow users to perform several predetermined actions within a specific network. Current data suggests that utility tokens are typically not mined but are offered in whole or in parts in advance.[104]

While coins are generally used as digital money, utility tokens function more as software than as currency. They can facilitate asset transfers, but this is not their primary purpose. Security tokens, on the other hand, are designed to generate profits, which sets them apart from utility tokens. Utility tokens can be compared to gift certificates in grocery stores; their main function is to be used within a specific market or group of services, with any value associated with them limited to that context.

Utility tokens are standard on Decentralized Exchanges (DEX), as we will explore in detail later. The use of a DEX platform's proprietary tokens may sometimes be mandatory for exchanging cryptocurrencies that lack direct equivalence. Non-fungible tokens (NFTs) are also a type of utility token, as they serve as representations of intellectual property rights.

One significant challenge for utility tokens in the market is high transaction fees. Many utility tokens operate on the Ethereum ERC-20 protocol, where Ethereum's high energy costs create scalability and sustainability issues for projects.[105] Solutions such as layer-2 protocols, which will be discussed later, offer potential to mitigate these costs. From a legal perspective, utility tokens often provide easier regulatory compliance if they do not promise high profit margins. However, deviations from their intended purposes can lead to

[104] dYdX, "What Are Utility Tokens?" accessed October 3, 2024, https://dydx.exchange/crypto-learning/utility-tokens.

[105] Supra, "What Are Utility Tokens?" accessed October 3, 2024, https://supra.com/academy/utility-tokens/.

manipulation. Stablecoins, which are tied to a fixed value, have emerged as one solution to this issue.

The use of tokens has also opened new avenues for employment. Research has shown that Korean game companies could integrate Web 3 products into their operations. Unlike traditional Web 2 game companies focused on profit maximization, Web 3 companies prioritize sustainability and innovation. By creating loyal customers and providing incentives such as stock-option-like rewards (which may fall under the category of security tokens[106]), these companies can establish more engaging business models.

Utility tokens can also serve as tools for enhancing engagement through Decentralized Autonomous Organizations (DAOs). For instance, blockchain-based fan tokens allow holders to participate in club decisions and gain other perks. This mechanism fosters democratized decision-making and enhances fan engagement, particularly in sports and esports sectors.[107]

Utility tokens share some similarities with non-fungible tokens. Although utility tokens primarily provide access to blockchain applications or services, their marketing, sale, or transfer may sometimes resemble a security offering under the Howey Test. Financial market regulations, however, should not apply to utility tokens that are solely for consumer use and do not function as financial instruments.[108]

Examples of the most popular utility tokens include:

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[106] M. Song, "Web3 Business Model Innovation Approach and Cases of Korean Game Giants," *International Journal of Internet, Broadcasting and Communication* (2023), https://koreascience.kr/article/JAKO202408557720046.pdf.

[107] Lennart Ante, A. Saggu, B. Schellinger, et al., "Voting Participation and Engagement in Blockchain-Based Fan Tokens," *Electronic Markets* 34, no. 26 (2024), https://doi.org/10.1007/s12525-024-00709-z.

[108] Y. Kharitonova, "Utility NFT: Legal Issues of Decentralized Services," *International Journal of Law in Changing World*, Special Issue NFTs (2023): 3–17, https://doi.org/10.54934/ijlcw.v2i3.60.

- Basic Attention Token (BAT): A token used as payment for viewing ads on Brave, a privacy-focused search engine.
- Chainlink (LINK): Also known as Oracle, it collects real-time data and submits it to blockchain systems. It is widely used in DeFi applications to provide accurate price data, and data providers and verifiers earn LINK tokens for their services.
- Binance Coin (BNB): The native token of Binance, one of the largest cryptocurrency exchanges, offering users specific transaction advantages on the platform.

9.2.3. Collateral Tokens (Cryptocurrencies with Collateral / Fixed Coins)

Decentralized Finance (DeFi) applications often use collateral tokens, which are also known as stablecoins. These fixed-value cryptocurrencies aim to mitigate the volatility associated with other cryptocurrencies.

Stablecoins adjust their value based on another asset, such as a fiat currency, gold, or other physical assets, to maintain stability. For instance, if a service is priced at 1 BTC, and the value of BTC increases by 20% during the transaction process, both the buyer and seller face significant price fluctuation risks. Stablecoins address this issue by maintaining a fixed value tied to an asset or currency. The asset's value [109]serves as collateral, ensuring the stablecoin's price remains constant.

The mechanisms used to stabilize stablecoin values vary. While some employ straightforward methods, others rely on complex algorithms. Stablecoins can be categorized into three primary types:

Legal Unit Secured Stablecoins

Here, the value of the stablecoin is determined based on a legally accepted unit. The most common examples are those with a currency-based mechanism. For instance, stablecoins pegged to the American Dollar are among the most popular globally. The value of cryptocurrencies such as Tether (USDT) and TrueUSD (TUSD) is calculated based on the

[109] Techopedia, "Stablecoin," accessed October 3, 2024, https://www.techopedia.com/definition/stablecoin.

value of the American Dollar. While some stablecoins employ complex algorithms for valuation, the value of USDT is currently maintained at 1 USD. It is important to note that some cryptocurrencies cannot be purchased directly with legal currencies. In such cases, stablecoins like USDT provide a bridge for transactions.

Tether (USDT) is currently the third-largest cryptocurrency by market capitalization, with a total value exceeding $72 billion.[110]

Crypto-Secured Stablecoins

Based on the current available data, some stablecoins derive their value from another cryptocurrency.[111] In such cases, the American dollar in the USDT example is replaced with another cryptocurrency as collateral. However, fluctuations in the value of the underlying cryptocurrency make it challenging to maintain a fixed value. To address this, crypto-secured stablecoins typically require over-collateralization. For instance, to issue stablecoins worth $1 million, another cryptocurrency worth $2 million might be deposited as collateral. This ensures that the stablecoin retains its value even if the collateral loses up to 50% of its value.

The value of the DAI coin used by MakerDAO is linked to the US Dollar, but Ethereum (ETH) and other cryptocurrencies are deposited at 150% of the market value of DAI as collateral.[112] This approach is particularly logical for stablecoin creators who avoid directly tying their assets to legal currencies.

Algorithmic Stablecoins

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[110] "Historical USDT Market Size," *CoinMarketCap*, June 4, 2022, https://coinmarketcap.com/.

[111] European Parliamentary Research Service, *Regulating the Digital Economy: Stablecoins and the Financial System* (European Parliament, 2021), 2, accessed October 3, 2024, https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698803/EPRS_BRI(2021)698803_EN.pdf.

[112] MakerDAO, "SAI Whitepaper: Examples," *MakerDAO*, accessed October 3, 2024, https://makerdao.com/en/whitepaper/sai/#examples.

Algorithmic stablecoins may or may not be collateralized. Instead of relying on a specific asset, their valuation is controlled by algorithms. These algorithms regulate factors like the number of coins released, based on market conditions. However, algorithmic stablecoins carry significant risks.

In May 2022, a change in the TerraUSD (UST) algorithm led to a catastrophic loss of value. Both UST and the associated Luna stablecoin lost approximately 80% of their value.[113] This dramatic fluctuation, particularly in a cryptocurrency marketed as stable, severely damaged market trust in algorithmic stablecoins.

Legal Infrastructure of Stablecoins

The data yielded by this study strongly suggests that stablecoins are attracting greater attention from legislators compared to other cryptocurrencies. While motives such as preventing money laundering, terrorist financing, and protecting consumers and investors play a role, the primary concern appears to be the potential threat stablecoins pose to the financial system.

A country's economic strength is often reflected in the demand for its currency. When a nation's currency is widely used and sought after, both domestically and internationally, its economy becomes more robust. Standard cryptocurrency investments may not pose a major threat to national currencies, as their volatility makes them impractical for everyday use and less reliable for value preservation compared to most national currencies.

At this point, the current available data seems to suggest that the fixed price promise, which is the claim of stablecoins, distinguishes them from other cryptocurrencies. Even though some stablecoins are not always[114] stable, users can now use stablecoins, which are in demand in the cryptocurrency market almost as much as the US Dollar and even more than

[113]Michael J. Martin, "The Fall of Terra: A Timeline of the Meteoric Rise and Crash of UST and LUNA," *CoinDesk*, May 2022, accessed October 9, 2024, https://www.coindesk.com/learn/the-fall-of-terra-a-timeline-of-the-meteoric-rise-and-crash-of-ust-and-luna/.

[114]Lennart Ante, Ingo Fiedler, Jan Marius Willruth, and Fred Steinmetz, "A Systematic Literature Review of Empirical Research on Stablecoins," *FinTech* 2, no. 1 (2023): 34–47, https://www.mdpi.com/2674-1032/2/1/3.

the US Dollar in some cryptocurrency swaps, instead of trading with the currency of their country. At this point, as the cryptocurrency ecosystem grows, the money leaving the national currency system increases, which may cause the depreciation of the country's reserve currency, albeit indirectly. At this point, some countries are being more careful, especially against stablecoins, and are conducting special legislative studies on this. The stablecoin supply figure in the system exceeds $180 billion as of June 2022.[115]Although this corresponds to a share of more than 10% of the cryptocurrency ecosystem, the value of which is between $1.3 trillion and $2 trillion, the area of use is quite broad. It is also worth reminding that the figure of $180 billion comes from levels of only $20 billion in 2020.[116] High inflation and interest rates after COVID may also be behind this intense interest and demand. Because there are also loans among the DeFi services that we will explain in detail, stablecoins are also frequently used in DeFi transactions.

The International Organization of Securities Commissions (IOSCO), which covers 95% of the financial market in the world, stated in its report that stablecoins should be regulated within the scope of the existing financial market infrastructure as well as under payment system and clearing features.[117]

The Financial Sunday Working Group of the United States Presidential Office (President's Working Group on Financial Markets - PWG) published a report in November 2021 that drew attention to the risks of stablecoins, emphasizing that legal work should be done in these areas.[118]

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[115] *Total Stablecoin Supply*, *The Block Crypto*, June 6, 2022, https://www.theblockcrypto.com/data/decentralized-finance/stablecoins.https://www.theblockcrypto.com/data/decentralized-finance/stablecoins.

[116] Ibid.

[117] International Organization of Securities Commissions, "Application of the Principles for Financial Market Infrastructures to Stablecoin Arrangements," *IOSCO*, accessed June 6, 2024, https://www.iosco.org/library/pubdocs/pdf/IOSCOPD685.pdf.

[118] Financial Stability Oversight Council, "Stablecoin Report," *U.S. Department of the Treasury*, November 1, 2021, https://home.treasury.gov/system/files/136/StableCoinReport_Nov1_508.pdf.

At this point, the foregoing discussion implies that developments in the European Union and America are being closely monitored. The Draft Law on Sunday Crypto Money Marketplaces, initially released as a draft in 2020, also addresses stablecoins, and potential legal steps have been discussed in the accompanying impact analysis report. The report suggests that some stablecoins fall under the European Union Financial Instrument Directive (Markets in Financial Instruments Directive—MiFID II) as financial instruments, while others should be evaluated as electronic money under the European Union Electronic Money Directive (Electronic Money Directive II—EMD 2[119]).

During the legislative process, the European Commission considered three approaches to regulating stablecoins:

- Taking bespoke legal measures
- Including stablecoins under the scope of the European Union Electronic Money Directive (Electronic Money Directive II—EMD 2)
- Limiting their use

The prevailing opinion, however, focused on the second option.[120]

The MiCA law also stipulates that stablecoins must receive approval from the competent authority in the country where the White Paper (Technical Report) is published to be listed on cryptocurrency markets. This requirement, along with other provisions, will be discussed further in the next chapter. Key points of interest in the regulation of stablecoins include cryptocurrency management and decision-making processes, reserve guarantees, and risk assessments. The crisis involving the UST stablecoin in May 2022 brought significant attention to the risks associated with stablecoins. However, one critical issue for legislators is how to regulate decentralized structures effectively. Legislators typically regulate products or services based on the responsibilities assigned to their creators or owners, ensuring compliance within a legal framework. How decentralized cryptocurrency projects

[119] European Commission, "Markets in Crypto-Assets (MiCA) Impact Analysis Report," *European Union Law*, accessed June 6, 2024, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2020:0380:FIN:EN:PDF.

[120] Research Service of the Parliament of the European Union, "Title of the Document," *European Parliament*, 2021, https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698803/EPRS_BRI(2021)698803_EN.pdf.

will fit within such scopes remains debatable. Moreover, it is questionable how effective regulation will be that overlooks the concept of decentralization.

A closer examination of the data identifies the four largest stablecoins by market size as of 2023:

- USDT (Tether, based on the US Dollar)
- USDC (USD Coin, based on the US Dollar)
- BUSD (Binance USD, the first stablecoin based on the US Dollar approved by the New York Department of Financial Services)
- DAI (Based on the US Dollar and collateralized by over 150 cryptocurrencies)[121]

While these are currently the leading stablecoins, the rankings can fluctuate frequently. It is worth noting that Tether has maintained its top position for a considerable period.

The final discussion on stablecoins pertains to the determination of applicable law. In cases where there is no physical transfer of a real-world asset, but a token is transferred on a distributed ledger technology (DLT/blockchain) platform, the applicable law for the transfer of collateral will depend on the specific token involved. This situation may arise when the stable token represents a real-world asset that is not physically transferred between the provider and taker of collateral or when the token is native to the blockchain system and is used to fulfill the collateral requirement.[122]

9.2.4. Platform Tokens (Platform Cryptocurrencies)

Platform cryptocurrencies are cryptocurrencies that facilitate the creation of smart contracts, provide decentralized applications, and offer blockchain infrastructure for issuing

[121]CoinGecko, "Stablecoins Statistics 2024," *CoinGecko*, accessed October 3, 2024, https://www.coingecko.com/research/publications/stablecoins-statistics.

[122] G. Chartier, "Conflict of Laws and the Use of Distributed Ledger Technology in Derivatives Markets," in *Blockchain and Private International Law* (Brill, 2023), accessed May 20, 2024, https://brill.com/edcollchap-oa/book/9789004514850/BP000028.xml.

cryptocurrencies. These platform tokens, which enable smart contract creation, are often favored by investors due to their high potential and the possibilities they provide.

Examples of some of the largest platform cryptocurrencies by market value, which also support decentralized financial applications (DeFi), include:

- Cardano (ADA)
- Solana (SOL)
- Polygon (MATIC)
- Near Protocol (NEAR)
- Chainlink (LINK)

These are notable examples.[123] As we explore the areas of blockchain use, we will examine these tokens more closely.

9.2.5. Security Tokens (Security Cryptocurrencies)

Based on the current data, it appears to be fair to suggest that security tokens can be defined as the digitalized version of securities traded on the market. As explained in detail in the section examining the legal infrastructure of cryptocurrencies, a cryptocurrency must meet certain criteria to be classified as a security offering. Recently, there has been a trend among legislators and regulatory institutions to define a significant portion of cryptocurrencies as securities. If a cryptocurrency is defined as a security, the applicable legal regulations differ significantly.

Exchanges providing access to securities are usually divided into categories. On blockchain infrastructure, some platforms allow the purchase, sale, and holding of rights from stocks, commercial real estate, shares in early-stage startups, corporate bonds, and even government bonds, all on a single decentralized platform. While the legal responsibilities of security tokens are strictly regulated, they also offer various advantages. For example, in Canada, a marketplace that provides a listing function, guarantees a two-sided market for a security

[123]CoinMarketCap, "Top Platform Tokens by Market Capitalization," accessed October 9, 2024, https://coinmarketcap.com/view/platform/.

(token) on a continuous or reasonably continuous basis, and sets requirements for cryptocurrency marketplace participants—disciplining them through fines or enforcement actions—can be considered an exchange.[124] Security tokens can also be classified as financial products. In Australia, the term "financial product" was introduced as part of financial services regulation reform in 2001, intending to be sufficiently broad and flexible to encompass emerging products. It uses criteria similar to the Howey Test discussed.[125]

Security tokens can bring transparency and functionality to the current capital market system. For example, consider a person (Person X) who buys shares on Stock Exchange A and holds them for five years, earning dividends proportional to their share ownership. Another person (Person Y), owning the same number of shares but for a much shorter time, also earns dividends at the same rate. For investors seeking rights and benefits over an asset, a system could be designed where long-term holders of shares or tokens receive higher dividends. Blockchain-based systems could enhance and streamline processes like dividend distribution and administrative rights for shareholders. For instance, Person X, who has held stock for many years, could have more voting power at general assemblies. While stock grouping currently achieves similar outcomes, blockchain systems could make such processes more accessible and efficient. Additionally, multi-level marketing (MLM) benefits could be integrated to incentivize shareholding. Similar to referral systems used by platforms like Uber or food delivery apps, where users receive coupons or benefits, such features could be applied to stock markets. The primary goal here is to retain investors for longer periods, strengthening the financial stability of the company while attracting new investors.

Security tokens linked to real estate provide another example. Currently, with the partnership of real estate investment trusts (Real Estate Investment Trusts—Reits) it is possible to be a partner in a certain part or return of the real estate.[126] However, such investments typically

[124] Ontario Securities Commission, *Exchanges* (Toronto: Ontario Securities Commission, 2018), accessed May 21, 2024, http://www.osc.gov.on.ca/en/Marketplaces_exchanges_index.htm.

[125] Lowell Milken Institute, *Understanding Digital Tokens: Market Overviews and Proposed Guidelines for Policymakers and Practitioners* (UCLA School of Law, 2018), accessed May 21, 2024, https://lowellmilkeninstitute.law.ucla.edu/wp-content/uploads/2018/08/Understanding-Digital-Tokens.pdf.

[126]U.S. Securities and Exchange Commission, “Real Estate Investment Trusts (REITs),” accessed October 9, 2024, https://www.investor.gov/introduction-investing/investing-basics/investment-products/real-estate-investment-trusts-reits.

require higher minimum amounts. Through blockchain technology, these barriers can be reduced, enabling minimal investments. For example, someone in Mumbai might need substantial funds to invest in a property on New York's Fifth Avenue. Blockchain and smart contracts can simplify tracking investments while allowing global projects to access funds from previously inaccessible sources.

To determine whether a token or project qualifies as a security, the primary indicator is whether it involves an investment contract. The first international criterion is the Howey Test, as mentioned in the categorization chapter. The Howey Test, established in a 1946 case between the U.S. Securities and Exchange Commission (SEC) and W.J. Howey, requires three criteria to classify a security:

- There must be a monetary investment.
- The investment must be collective.
- There must be an expectation of profit.[127]

In December 2020, Ripple (XRP) was sued by the SEC for offering securities without proper licensing. However, this accusation was dismissed in March 2022.[128].

For example, the SEC has confirmed that ETH and BTC are not securities, classifying them instead as payment [129]tokens.

SEC criteria have been widely adopted by many other countries' securities commissions. However, given the Howey Test's age, many cryptocurrencies could potentially fall under the security classification. To address this, the SEC published a guide supplementing the

[127] *Securities and Exchange Commission v. W. J. Howey Co.*, 328 U.S. 293 (1946).

[128] *SEC v. Ripple Labs, Inc.*, 1:20-cv-10832 (S.D.N.Y. 2020).

[129] William Hinman, "Digital Asset Transactions: When Howey Met Gary (Plastic)," *U.S. Securities and Exchange Commission*, June 14, 2018, https://www.sec.gov/news/speech/speech-hinman-061418.

Howey Test to determine security conditions. The guide outlines characteristics that reduce the likelihood of meeting the Howey Test:[130]

Although none of the following characteristics of use or consumption is necessarily determinative, their stronger presence reduces the likelihood that the Howey Test is met:

- *The distributed ledger network (blockchain) and digital asset (tokens) are fully developed and operational .*
- *Holders of the digital asset are immediately able to use it for its intended/promised functionality on the network, particularly where there are built-in incentives to encourage such use.*
- *The digital assets' creation and structure is designed and implemented to meet the needs of its users, rather than to feed speculation as to its value or development of its network. For example, the digital asset can only be used on the network and generally can be held or transferred only in amounts that correspond to a purchaser's expected use.*
- *Prospects for appreciation in the value of the digital asset are limited. For example, the design of the digital asset provides that its value will remain constant or even degrade over time, and, therefore, a reasonable purchaser would not be expected to hold the digital asset for extended periods as an investment.*
- *With respect to a digital asset referred to as a virtual currency, it can immediately be used to make payments in a wide variety of contexts, or acts as a substitute for real (or fiat) currency.*[131]

Following this test, lawmakers enable authorities to determine whether a particular cryptocurrency project falls into the category of a security. In sum, it can be stated that the tokenization of securities and trading them on digital token trading platforms (or

[130] U.S. Securities and Exchange Commission, "Framework for 'Investment Contract' Analysis of Digital Assets," accessed June 6, 2024, https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets.

[131] Ibid.

cryptocurrency exchanges) could provide a potential solution to the illiquidity of exempt securities.[132]

9.2.6. Transactional Tokens (Transaction Cryptocurrencies)

These cryptocurrencies are tokens used to preserve value through the exchange of goods or services. In essence, these tokens function like legal currencies but can sometimes offer additional options beyond these core functions. For example, Bitcoin facilitates transactions for the purchase and sale of goods and enables direct, end-to-end transactions without the need for intermediaries such as banks or payment platforms. Bitcoin, Ethereum, and Litecoin are examples of transactional cryptocurrencies.

9.2.7. Exchange Tokens (Exchange Cryptocurrencies)

Exchange tokens are typically tokens offered by cryptocurrency markets to increase cash flow and provide incentives for trading on their platforms. If these tokens are part of a decentralized marketplace (DEX), they can also be used for platform management.

In addition to purchasing cryptocurrencies with legal currencies, swapping cryptocurrencies for other cryptocurrencies via exchanges has become increasingly popular.[133] During such swaps, using a third cryptocurrency can help reduce transaction costs.

A closer examination of the data indicates that cryptocurrency markets often offer discounts to holders of exchange tokens. Active users may also benefit from reward mechanisms integrated into the platform.

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[132] Han Wang, "Trading Securities as Digital Tokens: Is a Secondary Market Practicable for Tokenized Exempt Securities?" *University of New Hampshire Law Review* 22, no. 1 (2023): 1–45, accessed May 21, 2024, https://scholars.unh.edu/cgi/viewcontent.cgi?article=1467&context=unh_lr.

[133]Dilip Kumar Patairya, "Crypto-to-Crypto Swaps Explained," *Cointelegraph*, April 26, 2024, accessed October 10, 2024, https://cointelegraph.com/explained/crypto-to-crypto-swaps-explained.

In addition to the Initial Coin Offering (ICO), which is widely recognized, these exchange tokens can also be launched through Initial Exchange Offerings (IEOs), which have gained popularity recently. To encourage platform usage, some exchanges distribute these tokens for free to early users, allowing them to trade the tokens for other cryptocurrencies after holding them for a specified period. This distribution of free cryptocurrency is known as an airdrop, similar to the Bitcoin Faucet project [134] mentioned earlier.

In January 2020, the American Securities Exchange Commission (SEC) issued a warning stating that some IEOs may qualify as securities and pose significant risks.[135] The most prominent example of an exchange [136]token is the BNB coin, issued by Binance, the world's largest cryptocurrency exchange, with a daily transaction volume approaching $16 billion. It is also the fifth most valuable cryptocurrency globally.[137]

9.2.8. Social Tokens (Social Cryptocurrencies)

The data gathered in this study suggests that tokens and coins operating on blockchain networks and aimed at facilitating social connections are known as social cryptocurrencies. These tokens empower users to control and utilize their own data as they wish. For instance, on major social platforms like Instagram or YouTube, a third party (e.g., Instagram) mediates access to the digital work created by content producers and their final users (followers). Typically, neither the viewer nor the creator directly benefits monetarily from this arrangement; instead, the third-party platform generates significant revenue and controls access to valuable data. Social cryptocurrencies, while similar to utility tokens, aim to directly share benefits between digital content creators and their fans or supporters. Supporters can purchase social cryptocurrency issued by their favorite artists, who reward

[134] Ibid.

[135] U.S. Securities and Exchange Commission, "Initial Exchange Offers (IEOs) – Investor Alert," accessed June 6, 2024, https://www.sec.gov/oiea/investor-alerts-and-bulletins/ia_initialexchangeofferings.

[136] Statista, "Leading Cryptocurrency Exchanges by Trading Volume on May 17, 2022," accessed June 6, 2024, https://www.statista.com/statistics/864738/leading-cryptocurrency-exchanges-traders/.

[137] CoinMarketCap, "Cryptocurrency Market Data as of June 7, 2022," accessed June 6, 2024, https://coinmarketcap.com/tr/.

them not only with exclusive works but also through other perks, such as access to a specific community or unique rewards tailored for these supporters. In cases where the tokens are of limited supply, token buyers may also profit from their rising value (assuming demand increases). Simultaneously, the content creator secures funding and motivation to continue producing new works.

In fact, there were various social token trials even before blockchain. For example, the British artist David Robert Jones (known as David Bowie) tied the current and future earnings of the albums he created before 1990 to bonds with the Bowie Bond he issued in 1997, creating an asset-based securities bond. Those who purchased this bond received both a share of Bowie's royalty earnings from past albums and a portion of future earnings. By receiving $55 million in advance, Bowie ensured financial security, enabling him to continue creating art for a long time.[138] This approach can be an alternative for talented but economically challenged artists. The innovation brought by blockchain is that this funding process becomes much easier and can be completed without the need for a brokerage house.

One of the most important steps toward Web 3.0, which we will discuss in detail below, is the emergence of social tokens. As we transitioned from Web 1.0 to Web 2.0, artists could upload their content to platforms hosted by third parties. However, with Web 3.0, they will be able to publish their works on their own platforms, eliminating the need for intermediaries. This creates the possibility of building a direct social community between artists and their fans, bypassing third-party platforms like Instagram.

Not only artists but also a wide range of individuals—from football clubs to athletes—will be able to utilize social tokens. However, a significant risk associated with these tokens is their vulnerability to valuation fluctuations based on impulsive behavior by creators or personal life events. For example, if Will Smith had issued a token, what would have been the fate or pricing of a potential "Smith Token" after the incident at the 2022 Oscars, when he slapped Chris Rock[139]?

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[138] Nicole Chu, "Bowie Bonds: A Key to Unlocking the Wealth of Intellectual Property," *UC Law SF Communications & Entertainment Law Journal* 21, no. 2 (1998): 469, https://repository.uclawsf.edu/hastings_comm_ent_law_journal/vol21/iss2/5.

[139] BBC News, "Oscars 2022: Will Smith Slaps Chris Rock over Joke about Wife," *BBC*, March 28, 2022, https://www.bbc.com/news/entertainment-arts-60897004.

Examples of social tokens include some of the largest projects:

- Hive (A coin whose main function is to provide and support a decentralized space for content producers)
- Rally (An Ethereum-based token of the Rally Network that enables content producers to issue their own social tokens)
- Status (A decentralized messaging application and Web3 interface allowing users to access dApps and crypto wallets—akin to a decentralized WeChat)
- Link (Or Chainlink, a token project that provides the real-time data required by smart contracts in a decentralized manner)
- Steem (A coin operating on its own blockchain using the proof-of-stake model, which incorporates a reward mechanism for content producers and curators)

Determining the legal framework for social tokens raises several issues, including whether they should be categorized as securities. Challenges such as false advertising, endorsement, and the clarity of disclosure terms—issues that arise with other categories of tokens[140]—are also relevant here. Two main opinions dominate the discussion. The first suggests that social tokens should be classified as securities because a creator issues tokens to raise funds for a project, and investors aim for returns. Regulators may view such tokens as securities. The second opinion considers social tokens distinct, emphasizing community participation, utility, and the personal connection between creators and fans, as seen in examples like FC Barcelona and Paris Saint-Germain Football Clubs. The legal and regulatory framework for social tokens is evolving rapidly. Collaboration among creators, fans, and regulators is essential to strike a harmonious balance between innovation and compliance. While the future status of social tokens—whether as a groundbreaking paradigm or a temporary fad—remains uncertain, their influence on the digital economy is undeniable.[141]

9.2.9. Commodity Tokens (Commodity Cryptocurrencies)

[140] Hannah Taylor, "A Legal Primer on Social Tokens," *Advertising Law Updates* (blog), June 21, 2021, accessed May 21, 2024, https://advertisinglaw.fkks.com/post/102h13i/a-legal-primer-on-social-tokens.

[141] Purple Trader Blog, "Social Tokens: How to Create and Distribute Social Tokens for Your Crypto Startup," accessed May 21, 2024, https://www.purpletrader.io/learn/creating-social-tokens-a-comprehensive-guide.

In this section, we will discuss commodity tokens. These cryptocurrencies are projects that supply cryptocurrency in exchange for a certain commodity value. These commodities are typically data, storage capacity, or computing power, but they can also include gold, silver, oil, or other precious metals. Tokenizing commodities offers several advantages, such as increased liquidity by transforming assets that are often difficult to sell into readily tradable tokens. This creates opportunities for diverse investments, enhances accessibility in commodities markets by dividing large assets into smaller digital tokens (commodity tokens), and ensures safe transactions while providing a clear, immutable record of ownership, thus enhancing transparency and security in the commodity market.[142]

With tokenization, cash flow increases, and faster, cheaper transactions become possible. Additionally, the Internet's global reach amplifies these benefits. Technically, three different types of assets can be offered via token/cryptocurrency. These can be divided into abstract goods that are intangible, items that can be determined by weighing or measuring, and those that cannot be exchanged. Examples of abstract goods include patents, stocks, and copyrights. Items that can be measured include legal currencies such as dollars. For assets whose value cannot be easily determined or exchanged, such as gold, gas, and oil, tokenization is being explored, although increasing costs and legal barriers currently limit large-scale implementation.

Examples of commodity cryptocurrencies include Paxos Gold (PAXG), Cache Gold (Cache), and Tether Gold, which derive their value from the gold market.

In the categorization presented here, it is important to note that a token or coin does not have to belong to a single category; it may fall under multiple categories. For instance, Link exhibits features of both utility and social tokens. Legislators and market participants must consider this overlap when conducting liability analyses.

In summary, lawmakers and institutions should recognize the distinctions between these categories and clearly define the legal consequences associated with each service

[142] John Lombela, "The Legal Roadmap: Tokenizing Commodities within Regulatory Frameworks," *LinkedIn*, February 20, 2024, accessed May 21, 2024, https://www.linkedin.com/pulse/legal-roadmap-tokenizing-commodities-within-john-lombela-ki58f.

categorization. However, it is essential to remember that a single project may fall into more than one category.

This chapter has so far examined the technical features and classifications of cryptocurrencies, emphasizing the differences between tokens and coins to understand the various legal frameworks. Initial discussions among lawmakers focused on whether to ban or endorse cryptocurrencies in general. However, as the ecosystem developed, legislative approaches began targeting specific types of cryptocurrencies.

This study references our second research question, which investigates whether existing legislation adequately addresses the unique features of various cryptocurrencies. As anticipated, most regulatory frameworks poorly accommodate the complex nature of cryptocurrencies, such as security tokens, utility tokens, and privacy coins. For example, security tokens are subject to stricter regulatory approaches, particularly in the U.S. under the SEC's oversight, while utility tokens face fewer restrictions and enjoy broader acceptance. Privacy coins, on the other hand, face significant challenges due to non-compliance with AML and KYC regulations, whereas social tokens encounter fewer legal obstacles.

The analysis of tokens and coins shows that tokens now dominate due to their flexibility in leveraging existing blockchain infrastructures economically. This confirms the notion that disparities in regulatory frameworks limit the integration and innovation of cryptocurrencies within the financial system, underscoring the need for a unified global regulatory strategy. In the following section, we lay the foundation for examining blockchain technology and its influence on comparative legal frameworks.

10. Overview of the Blockchain Infrastructure

Although blockchain technology is relatively new, it offers solutions to various problems through its diverse infrastructures. Bitcoin, the first decentralized cryptocurrency introduced in 2009, operates on the Proof of Work mechanism, which we will explain in more detail below. However, newer mechanisms, such as Proof of Stake, are gradually replacing Proof of Work. Ethereum has emerged as Bitcoin’s biggest competitor in terms of sustainability and scalability. It ranks second with a 19% market share, compared to Bitcoin’s 39.2%

market dominance. [143] The blockchain infrastructure provided by Ethereum, which enables the development of applications and smart contracts, plays a significant role in its growth. But what are smart contracts? Before diving into smart contracts, it is essential to revisit the journey from the early days of blockchain to the present. This background is crucial for our dissertation, as regulators sometimes misunderstand these concepts, leading to overly restrictive measures. Recognizing the differences between these concepts is vital, and we will examine relatively recent developments in later parts of this dissertation.

Blockchain technology promises to solve numerous everyday challenges by offering a reliable infrastructure. As discussed at the beginning of our research, to sustain the blockchain system, the first decentralized digital currency (also referred to as a cryptocurrency), Bitcoin, was launched in 2009 by an unidentified programmer or group of programmers under the pseudonym Satoshi Nakamoto, who authored a white paper [144] detailing Bitcoin's basic functionality.

Advancements in information technology (IT) have exposed current regulations to challenges in addressing new technological features. Developments in IT exploit legal loopholes, allowing uncontrolled global growth. This has highlighted not only national legal gaps but also international legal gaps, reflecting the global nature of IT networks.

Blockchain technology is open-source, software-based, and peer-to-peer. It uses a distributed ledger to store users' transactions. There is often confusion between blockchain and cryptocurrency. To clarify, blockchain is the technology behind cryptocurrencies. Cryptocurrency is merely a small part of the broader, foundational blockchain technology. This distinction highlights why our research extensively focuses on blockchain technology.

Several legal concerns have been identified regarding services stored or provided based on blockchain technology. One of the main aims of this research is to uncover legal gaps that may arise due to blockchain's unique features. Consequently, an important aspect of this study examines the current legal challenges of blockchain services. We will also analyze

[143]Cointelegraph, "Ethereum's Dominance on the Rise: Market Share Increases by 3% Among Global Crypto Assets," accessed October 10, 2024, https://news.bitcoin.com/ethereums-dominance-on-the-rise-market-share-increases-by-3-among-global-crypto-assets/.

[144] Ibid.

potential solutions to these legal gaps, aiming to shape a robust legal framework for blockchain technology.

Blockchain technology provides transparency due to its open-source, software-based, and peer-to-peer nature. It encrypts information through a hashing process, and blockchain infrastructure claims that these encryptions are virtually unhackable. Each transaction on the blockchain is timestamped and associated with a fixed-length code, which indicates when the transaction occurred.

In addition to blockchain, other distributed ledger technologies, such as Hashgraph, DAG, Tempo, and Holochain, are also classified as distributed ledger technologies (DLTs).

Blockchain technology challenges the traditional model of centralized authentication. It has the potential to create a paradigm shift. Although the system is built on a technological foundation, it transforms social arrangements rather than merely reforming the technology itself.[145]

Blockchain technology functions as an unchangeable, self-regulating database. There are four core characteristics of blockchain. These are consensus driven (trust verification), immutability (permanent and tamper proof), decentralized (networked copies), and transparency (full transaction history).[146]

Hashing refers to the process of generating a fixed-size output from an input of variable size. This is achieved through mathematical formulas known as hash functions (implemented as hashing algorithms). One of the greatest advantages of hashing is its ability to handle enormous amounts of data.[147] For example, a large file or dataset can be processed through

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[145] Tom Lyons, Ludovic Courcelas, and Ken Timsit, *Blockchain for Government and Public Services* (European Union Blockchain Observatory & Forum, 2018), 4–6.

[146] Karim Sultan, Umar Ruhi, and Rubina Lakhani, "Conceptualizing Blockchains: Characteristics & Applications," 2018.

[147]Coding Age, "Understanding Hashing in DBMS: Benefits and Techniques," accessed October 10, 2024, https://www.codingage.biz/understanding-hashing-in-dbms-benefits-and-techniques.

a hash function, and the resulting output can be used to verify the data's integrity and accuracy. This is possible because of the deterministic nature of hash functions: the same input always results in the same output (hash). This eliminates the need to store and manage large volumes of data.[148]

Every hashing process generates an output key, such as "123ABCDE456SZEGED59801KFNNA101." While everyone has access to this output as proof of the data on the system, the main data itself remains private on the blockchain. This "proof of existence" feature is achieved by recording the hashing process on the blockchain.

Cryptocurrencies are among the many services provided by blockchain technology. It must be acknowledged that the term "digital currency" lacks precision. Economists, regulators, and legislators are still debating whether digital currency is truly a currency or something else[149] entirely. As discussed earlier, digital currency and electronic money are distinct concepts. Electronic money is simply an electronic representation of national currencies. In other words, electronic money is not a currency itself, as digital currency[150] is. However, digital currencies do not have intrinsic value in the international monetary system.

Cryptocurrency is a type of digital currency. It is stored electronically and transferred via electronic gateways. Early examples of digital currencies, such as E-gold and Liberty during the 1990s, were centralized systems. As a result, the U.S. government was able to shut down these systems under anti-money laundering policies.[151]

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[148] Binance Academy, "What Is Hashing?" *Binance Academy*, October 3, 2019, https://www.binance.vision/security/what-is-hashing.

[149] J. E. Glass, "What Is a Digital Currency," *IDEA: The Law Review of the Franklin Pierce Center for Intellectual Property* 57, no. 3 (2017): [specific page range, if available].

[150] David Evans and Richard Schmalensee, *Paying With Plastic: The Digital Revolution in Buying and Borrowing*, 2nd ed. (Cambridge, MA: MIT Press, 2005).

[151] Ibid.

The first decentralized digital currency was Bitcoin, launched in 2009. In the Bitcoin white paper, it is described as a "peer-to-peer version of electronic cash" that uses cryptography to secure transactions within the system.

In principle, Bitcoin is pseudonymous because each user is represented by a random, cryptographically generated string of digits, called an address, which does not reveal the user's actual identity.[152] However, the entire transaction history of Bitcoin is completely public and can be followed from beginning to end.

The question arises: is Bitcoin a traditional electronic payment system? Traditional electronic payment systems ensure integrity by relying on a trusted centralized party, such as banks or other reliable financial institutions. In contrast, Bitcoin avoids these centralized systems and instead uses a distributed ledger, known as the blockchain, to store users' transactions. This blockchain is maintained and updated by the consensus of system participants. These participants use an Internet Protocol that is technically very difficult to subvert. This technical security ensures the integrity of all transactions that have occurred on the chain.

To own or transact in Bitcoin, an individual can either run a program on their computer that implements the Bitcoin protocol (a Bitcoin client) or create an account on a web platform that operates Bitcoin for its users. Individuals can save Bitcoins in a file called a wallet. These programs connect over the Internet, forming peer-to-peer networks that make the system distributed and resistant to central attack.[153]

Emerging 21st-century digital currencies have three characteristic components: the digital currency itself (e.g., Bitcoin), the software that performs transactions, and the underlying ledger on which all transactions are recorded. At the "top level" of the digital currency stack,

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[152] Joshua Baron et al., *Technical Challenges to Virtual Currency Deployment: National Security Implications of Virtual Currency* (Santa Monica, CA: Rand Corporation, 2015).

[153] Reuben Grinberg, "Bitcoin: An Innovative Alternative Digital Currency," *Hastings Science & Technology Law Journal* 4 (2012): 159–208.

the currency itself is a string of code. This code identifies the currency object and includes cryptographic features to secure the system and protect individual users from hackers.[154]

As discussed earlier, cryptocurrencies are broadly divided into two categories: tokens and coins, both described as units of blockchain value. Coins act like money and are used as a means of payment. A coin represents a unit of account, a medium of exchange, and a store of value.

Tokens, on the other hand, have broader functionality than coins. While coins offer money-like functionalities as digital cash, tokens represent utilities or assets, typically hosted on another blockchain. A token may enable its holders to create a tradeable asset, a virtual share, proof of membership, or various other functionalities.

On the one hand, token creation is easier than creating a coin or another blockchain. Token holders can follow standard templates on an existing blockchain to offer features and create tokens for loyalty[155] or other purposes.

On the other hand, in computer terminology, the term "token" has two meanings: a fixed array of symbols identifying a user (such as an API key) or a gadget authorizing a user (such as a dongle or specialized thumb drive). In both contexts, tokens can be transferred between different owners.[156]

Coins and tokens have distinct structures. Coins use their own blockchain infrastructure primarily as a form of money, while tokens operate on other blockchains to provide additional functionalities through decentralized applications. After this summary of

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[154] Melanie Swan, *Blockchain: Blueprint for a New Economy*, 1st Kindle ed. (Sebastopol, CA: O'Reilly Media, 2015).

[155] Neil Gandal, J. T. Hamrick, Tyler Moore, and Marie Vasek, "The Rise and Fall of Cryptocurrency Coins and Tokens," *Decisions in Economics and Finance* 44, no. 3 (2021): 981–1014, https://doi.org/10.1007/s10203-021-00329-8.

[156] Pavel Kravchenko, "Know Your Tokens: Not All Crypto Assets Are Created Equal," *CoinDesk*, August 14, 2017, retrieved April 12, 2018, https://www.coindesk.com/what-is-token-really-not-all-crypto-assets-created-equal/.

blockchain and its sub-service cryptocurrencies, we can discuss what smart contracts are and how they emerged.

10.1. What is the Smart Contract?

First, as a lawyer, it is necessary to clarify the most confusing aspect of smart contracts, as many people assume the term refers to a legal document simply because it includes the word "contract." However, in this context, the term has a primarily technical meaning.

Legally, a contract is a document that establishes a performance obligation through mutual agreement by two or more parties concerning a specific action.[157]This document may be in written or digital form. Smart contracts, on the other hand, are sets of codes regulating performance and conditions. Unlike traditional contracts stored on the internet, smart contracts are stored on blockchain infrastructure. Their main purpose is to ensure the automatic execution of actions quickly and without involving a third party.

In 2008, Satoshi Nakamoto was working on the Bitcoin blockchain and engaging experts to improve this open-source software via forum websites. Since Bitcoin is based on cryptography, some speculate that Nick Szabo, a well-known cryptographer, might be behind Bitcoin. Szabo first introduced the concept of smart contracts in 1994 and proposed the Bit Gold project in 1998 as the first decentralized cryptocurrency, though it was never [158] implemented. Satoshi created Bitcoin 11 years later. However, the popularity of smart contracts gained significant attention through Ethereum, which uses the Solidity language to program these contracts.

A common analogy for understanding smart contracts is a vending machine. For instance, when you buy a soda from a vending machine, you interact directly with the machine, bypassing a cashier. The machine checks your payment and automatically dispenses the soda

[157] James Gordley, "Contract," in *The Oxford Handbook of Legal Studies*, ed. Peter Cane and Mark Lunney (Oxford: Oxford University Press, 2012), 3–20, https://doi.org/10.1093/oxfordhb/9780199248179.013.0001.

[158] David Petersson, "How Smart Contracts Started and Where They Are Heading," *Forbes*, October 24, 2018, https://www.forbes.com/sites/davidpetersson/2018/10/24/how-smart-contracts-started-and-where-they-are-heading/?sh=63c586ff37b6.

if the payment is correct. A smart contract operates similarly: it automates predefined conditions and actions on blockchain infrastructure.

The essence of smart contracts lies in defining the conditions, timing, and actions to be performed. These conditions are executed automatically and instantly without delay. This feature makes smart contracts advantageous in situations requiring prompt action. For example, in the event of an earthquake above a certain magnitude, the system could analyze data from a central authority and automatically cut off the city's natural gas supply.[159]

To summarize the main advantages of smart contracts:

- Speed, Efficiency, and Accuracy: When conditions are met, the system executes the pre-entered final command instantly, without delays, paperwork, or the risk of human error.
- Reliability and Transparency: For instance, in a commercial transaction, funds deposited with an intermediary are released to the other party upon satisfying certain conditions. Traditional systems rely on trust in the intermediary, whereas smart contracts remove this need by coding the terms directly between the parties, excluding third-party involvement.
- Security: While blockchain infrastructure varies, it is exceptionally difficult to hack due to its decentralized nature. As a result, it is far more secure than many other existing systems.

Not all blockchain infrastructures support the coding of smart contracts. Ethereum, as the market leader, allows users to create smart contracts using its blockchain infrastructure. Languages like Solidity are [160] employed for this purpose. Once a smart contract is deployed, it is not easily modified unilaterally, as the system is built to ensure this guarantee. Therefore, when drafting a smart contract, users should ensure their terms are clear and comprehensive. Nick Szabo, mentioned earlier, was one of the first to conceptualize smart contracts. Most blockchain applications, examples of which we will discuss below, are based on this concept.

[159]Ahed Habib, Abdulrahman Alnaemi, and Maan Habib, "Developing a Framework for Integrating Blockchain Technology into Earthquake Risk Mitigation and Disaster Management Strategies of Smart Cities," *Smart and Sustainable Built Environment* 12, no. 3 (2024): 123–135, https://doi.org/10.1108/SASBE-12-2023-0376.

[160] Solidity, "Solidity Programming Language," accessed October 10, 2024, https://soliditylang.org/.

Examples of cryptocurrency projects with their own blockchain infrastructures that enable the creation of smart contracts include:

- Ethereum
- Solana
- Polkadot
- Cardano[161]
- Binance Smart Chain (BSC)
- Ripple

These blockchain infrastructures operate under different models. For investors, understanding these concepts is crucial because technical problems within these models could result in significant losses. In the following section, we will explain these blockchain concepts.

10.2. Blockchain Concepts

Initially, blockchain was often perceived as a singular technology with one working principle. However, due to environmental concerns and high energy costs, new blockchain concepts have emerged. While hundreds of projects claim to solve various problems, blockchain primarily operates under three main concepts[162]: Proof of Work (PoW), Proof of Stake (PoS), and Proof of History (PoH). We will begin with the most widely used, Proof of Work, and then examine the newer concepts.

10.2.1. Proof of Work (PoW)—The Concept of Proof of Work

[161] Emma Newbery, "6 Top Cryptocurrencies With Smart Contracts," *The Motley Fool*, September 21, 2021, accessed October 10, 2024, https://www.fool.com/the-ascent/cryptocurrency/articles/6-top-cryptocurrencies-with-smart-contracts/.

[162] Min Xu, Xingtong Chen, and Gang Kou, "A Systematic Review of Blockchain," *Financial Innovation* 5, no. 27 (2019), https://doi.org/10.1186/s40854-019-0147-z.

The blockchain network powering Bitcoin, the first decentralized currency, operates through Proof of Work (PoW). PoW was the foundational technology enabling data verification on the blockchain without third-party involvement, which remains one of the blockchain's defining features.[163] In PoW, the system operates via a consensus mechanism. On the Bitcoin blockchain, every piece of data submitted for inclusion in the network must be accepted and approved by the network's stakeholders to ensure security. This approval process involves solving complex mathematical problems. Participants who successfully solve these problems are rewarded with newly minted cryptocurrencies. Cryptocurrency mining, therefore, supplies the energy and computational power needed for this confirmation process, compensating miners with cryptocurrency for their contributions.

The primary advantage of PoW is its high data security. Since data approval requires consensus across the network, hacking or tampering with the system is extremely difficult. For example, in the Bitcoin blockchain, altering data requires a 51% majority consensus, making unauthorized changes nearly impossible unless a "51% attack[164]" occurs.

The major disadvantage of PoW is its significant energy consumption. According to a study by the Cambridge Center for Alternative Finance (CCAF), the Bitcoin blockchain alone consumes approximately 110 terawatt-hours of energy annually, accounting for 0.55% of global energy production.[165] This level of consumption has sparked widespread debate, including discussions within the European Union under the Markets in Crypto-Assets (MiCA) regulation, which we will address in the next section. Proposals have even been made to limit PoW due to its environmental impact. To address these concerns, the Proof of Stake (PoS) concept has gained prominence as an energy-efficient alternative. Ethereum, the second-largest cryptocurrency by market capitalization, and its blockchain infrastructure currently rely on PoW, similar to Bitcoin, making it another energy-intensive system. An

[163] M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, 2nd ed. (Newton, MA: O'Reilly Media, 2017).
[164] Sarwar Sayeed and Hector Marco-Gisbert, "Assessing Blockchain Consensus and Security Mechanisms against the 51% Attack," *Applied Sciences* 9, no. 9 (2019), https://www.researchgate.net/publication/332737156_Assessing_Blockchain_Consensus_and_Security_Mechanisms_against_the_51_Attack, accessed October 3, 2024.

[165] Cambridge Centre for Alternative Finance, "Cambridge Bitcoin Electricity Consumption Index (CBECI)," *Ccaf.io*, 2022, https://ccaf.io/cbeci/index, accessed December 20, 2021.

Ethereum transaction consumes approximately 209.13 kilowatt-hours of energy. To put this into perspective, 100,000 Visa transactions consume only 148.63 kilowatt-hours.[166]

10.2.2. Proof of Stake (PoS)—The Concept of Proving Stake

In addition to the high energy requirements of the Proof of Work (PoW) system, there are performance issues regarding time and speed, as the approval of the entire network is required. To address this, a blockchain concept was needed that would consume less energy and enable faster transactions.[167] In 2012, three years after Bitcoin's debut, the Proof of Stake (PoS) concept was introduced. The key difference between PoS and PoW is that PoS relies on networks with vested interests in the system for verification, rather than using computational power through mining. In PoS, stakeholders with significant interests or shares in the system carry out the verification of data added to the blockchain.

This contrasts with PoW, where all stakeholders in the network must approve a transaction, consuming more energy and time.

Naturally, questions about security arise. How reliable are these stakeholders? In PoS, only stakeholders who pledge their shares to the system are authorized to make confirmations. Unlike PoW, where thousands of independent computers verify transactions through mining, PoS stakeholders earn regular payments for confirmations and keep the system operational. If a stakeholder performs fraudulent or incorrect transactions, they risk losing all their pledged cryptocurrencies—a penalty mechanism[168] that incentivizes honesty and accuracy.

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[166] "Ethereum Energy Consumption 2022," *Statista*, 2021, accessed December 8, 2022, https://www.statista.com/statistics/1265891/ethereum-energy-consumption-transaction-comparison-visa/.

[167] George Milunovich, "Assessing the Connectedness Between Proof of Work and Proof of Stake/Other Digital Coins," *SSRN*, 2021, https://dx.doi.org/10.2139/ssrn.3968227.

[168] Takeaki Matsunaga, Yuanyu Zhang, Masahiro Sasabe, and S. Kasahara, "An Incentivization Mechanism with Validator Voting Profile in Proof-of-Stake-Based Blockchain," *IEICE Transactions on Communications* E105.B, no. 2 (2022), https://dx.doi.org/10.1587/transcom.2021cep0004.

One major drawback of the PoW protocol is its scalability problem. PoS is more scalable and faster[169] in comparison. However, PoS introduces the risk of dominant influence by founders or investors who control significant portions of the system's cryptocurrencies. For projects prioritizing security, PoW remains preferable, while PoS is favored for sustainability concerns. A newer concept, Proof of History (PoH), has also emerged as an alternative to PoS.

10.2.3. Proof of History (PoH)—The Concept of Proving Time

Proof of History (PoH) focuses on time as its fundamental principle. In PoW, the system requires the entire network to confirm the time of new data by achieving at least 51% consensus, which is secured with a timestamp. This process consumes significant energy and time. PoH, on the other hand, eliminates the need for network-wide approval by creating a timestamp based on the time before and after the last event. This results in a historical record that precisely identifies when an event [170] occurred.

Nick Szabo, a pioneer in blockchain and cryptographic innovation, is credited with early developments in timestamp technology. PoH is less widely adopted compared to PoW and PoS, though it represents an alternative approach to addressing blockchain inefficiencies.

The main disadvantage of PoS and PoH compared to PoW is that they offer slightly lower security, as they rely on fewer participants.

Blockchain Concept	**Speed**	**Security**	**Energy Consumption**
Proof of Work	Slow	Very High	Very High
Proof of Stake	Fast	High	Low
Proof of History	Fast	High	Low

[169] Garrick Hileman, "Proof-of-Stake: Advantages and Efficiency in Blockchain Consensus," *OriginStamp,* April 27, 2022, https://originstamp.com/blog/top-8-reasons-why-proof-of-stake-is-more-efficient.

[170] Solana Foundation, *Solana: A New Architecture for a High-Performance Blockchain*, whitepaper, 2020, accessed October 10, 2024, https://solana.com/solana-whitepaper.pdf.

Table-5: Comparison of Blockchain Concepts

10.3. Blockchain Structures

Up to this point in the study, we have primarily focused on the cryptocurrency aspect of blockchain. From here onward, we will explore the technological infrastructure underlying blockchain applications. Without understanding the technological framework, it is difficult to make informed investments or leverage blockchain to develop applications for personal or business needs. We begin by differentiating between Permissionless Blockchain and Permissioned Blockchain, followed by an explanation of blockchain structures.

10.3.1. Permissionless Blockchain

As the name suggests, permissionless blockchains allow anyone to participate without needing special permission.[171] Since participation in these blockchains is open to everyone, they tend to have higher security due to a larger number of participants and more nodes (node-network). However, verification on permissionless blockchains takes longer and consumes more energy because of the higher number of participants.

10.3.2. Permissioned Blockchain

Permissioned blockchains require special access or permissions to join the system. With fewer participants, verification of new data is faster and cheaper. However, this comes at the cost of reduced security. Permissioned blockchains are typically used in centralized systems, such as those operated by private companies or government agencies.

[171] Yannis Bakos and Hanna Halaburda, "Permissioned vs. Permissionless Blockchain Platforms: Tradeoffs in Trust and Performance," *NYU Stern School of Business Working Paper*, February 1, 2021, https://ssrn.com/abstract=3789425.

Permissionless blockchains often achieve widespread adoption later than permissioned blockchains.[172] However, a single blockchain project can be designed to incorporate both permissionless and permissioned models simultaneously.

Within these two categories, there are four primary blockchain structures: public, private, consortium, and hybrid blockchains.

10.3.3. Public Blockchain

Public blockchains are types of blockchains that anyone can join without needing permission. Users who join these systems freely upload their own data and undertake the task of verifying new data to be added.

The essence of blockchain technology lies in public blockchains, as they are fully decentralized applications. Cryptocurrency mining is essentially associated with public blockchains. Examples of public blockchains include Bitcoin, Ethereum, and Litecoin. Due to their decentralized nature, public blockchains are among the most technically secure blockchain structures. In these systems, each node/network participant has equal rights.

10.3.4. Private Blockchain

Private blockchains, also referred to as managed blockchains, require authorization for participation, determined by an authority or administrator. Unlike public blockchains, not all nodes have equal rights. Private blockchains are more centralized and often tailored for specific use cases, such as enterprise or government projects.

While these blockchains offer greater control and flexibility for the administrator, they are less decentralized, making them somewhat more vulnerable to attacks. Examples of private blockchains include the Hyperledger Fabric project, developed by Walmart to track product

[172] C. Helliar, Louise Crawford, Laura Rocca, Claudio Teodori, and M. Veneziani, "Permissionless and Permissioned Blockchain Diffusion," *International Journal of Information Management* 54 (2020): 102136, https://dx.doi.org/10.1016/j.ijinfomgt.2020.102136.

origins, and Ripple.[173] Consortium and hybrid solutions have been proposed to address the security challenges inherent in private blockchains.

10.3.5. The Consortium Blockchain

Consortium blockchains share similarities with private blockchains in that they operate under a private management mechanism. However, instead of a single administrator, a group or consortium manages the system. This arrangement reduces centralization compared to private blockchains, offering a higher level of security.

The primary challenge with consortium blockchains lies in forming and maintaining the consortium. Participants must have comparable technological expertise to prevent monopolization. Examples of consortium blockchains include the Quorum, Hyperledger, and Corda projects.

10.3.6. Hybrid Blockchain

Hybrid blockchains combine elements of both private and public blockchain infrastructures. They are controlled by a single administrator but limit that administrator's powers,[174] unlike fully private blockchains. Hybrid blockchains can be designed to allow specific transactions to be closed and authorized while others remain open and unauthorized.

An example of a hybrid blockchain is the IBM Food Trust project, which enhances food security across the supply chain, from manufacturers to retailers.[175]

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[173] Minky Sharma and Pawan Kumar, "Adoption of Blockchain Technology: A Case Study of Walmart," in *Blockchain Technology in Supply Chain Management* (2021), https://doi.org/10.4018/978-1-7998-8081-3.ch013.

[174] Jorge Bernal Bernabe, José Luis Cánovas, J. L. Hernández-Ramos, Rafael Torres Moreno, and A. Skarmeta, "Privacy-Preserving Solutions for Blockchain: Review and Challenges," *IEEE Access* (2019), https://dx.doi.org/10.1109/ACCESS.2019.2950872.

[175] V. Sri Vigna Hema and Annamalai Manickavasagan, "Blockchain Implementation for Food Safety in Supply Chain: A Review," *Journal of Food Science* 89, no. 1 (2024): 70002, https://doi.org/10.1111/1541-4337.70002.

Hybrid blockchains can also leverage smart contract features. The hybrid smart contract architecture enables real-time enhancements to on-chain code in response to new circumstances, such as geolocation data for tracking goods within a supply chain (as in the IBM project) or capital market data related to tokenized assets, securities benchmarks, or interest rate updates. Off-chain data could include legal archives detailing contractual terms and external events relevant to contract performance, such as those invoking the theory of frustration. [176]

11. Blockchain Areas of Use

Blockchain technology has rapidly expanded into various sectors, with growing literature detailing its applications. While this study cannot delve into exhaustive details, we will outline the primary industries where blockchain is being utilized. Blockchain applications, known as DAPPs (Decentralized Apps), are commonly developed on the Ethereum network, offering smart contract functionality.

Blockchain is being explored across diverse industries, including financial services, telecommunications, healthcare, fashion, and government services. Any sector relying on database integrity can apply blockchain to reduce costs and create a more efficient, robust system.[177]

Blockchain provides an independent infrastructure applicable across numerous fields. Just as the World Wide Web (www) serves as a foundational technology used in countless ways, blockchain similarly functions as a versatile infrastructure. Understanding this technology is

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[176] Niloufer Selvadurai, "Mitigating the Legal Challenges Associated with Blockchain Smart Contracts: The Potential of Hybrid On-Chain/Off-Chain Contracts," *Washington and Lee Law Review* 80 (2023): 1163.

[177] Shlomit Yanisky-Ravid and Edward Kim, "Patenting Blockchain: Mitigating the Patent Infringement War," *Albany Law Review*, forthcoming, March 12, 2019, available at SSRN: https://ssrn.com/abstract=3357350.

crucial for effective regulation. For example, data protection has emerged as a significant area for regulatory focus following the realization of how big data is stored and controlled online.

In subsequent sections of this research, we will delve deeper into the technical features of blockchain technology.

Areas where blockchain technology is mainly used today and examples:

1- Finance and International Money Transfers (*Ripple-XRP*)[178]
2- Supply Chain Management (*Vechain*[179])
3- Health (*MediLedger*[180])
4- Real Estate (*RealBlocks*[181])
5- Media (*MediaChain*[182])
6- Public Services (*IBM Blockchain Vaccine Project*[183])
7- Cyber Security (*The Apollo Data Cloud Project*[184])
8- Data Management (*Gem Health - Philips Project*[185])

[178]Ripple, "Finance and International Money Transfers (Ripple - XRP)," accessed October 10, 2024, https://ripple.com/.

[179]VeChain, "VeChain - Web3 for Better: Sustainable Blockchain Solutions," accessed October 10, 2024, https://vechain.org.

[180]MediLedger Network, "The MediLedger Network," accessed October 10, 2024, https://www.mediledger.com/.

[181] RealBlocks, "RealBlocks - Building a Better Alternative," accessed October 10, 2024, https://www.realblocks.com/.

[182] Mediachain, "Home - Media Chain B2B," accessed October 10, 2024, https://mediachain.co/.

[183] IBM, "IBM Blockchain for Vaccine Distribution," accessed October 10, 2024, https://www.ibm.com/blog/vaccination-management-ibm-blockchain-covid-19-vaccines/.

[184] Westpoint-io, *Apollo Open Data Project*, GitHub, 2024, accessed October 3, 2024, https://github.com/westpoint-io/apollo-open-data.

[185] Gem Health, "Gem Health Network," accessed October 10, 2024, https://www.gem.health/.

Although the areas of use extend far beyond these examples, this section summarizes key fields with relevant examples. A more comprehensive study could delve deeper into their technical and legal infrastructures.

This section aims to inspire creative thinking about how blockchain technology could be utilized and, if implemented, what its legal implications might be. For instance, in the insurance sector, blockchain could be used for micropayments and processing insurance claims through smart contracts.[186] Another potential application could be the secure recording of medical data for insurance companies due to blockchain's tamper-resistant nature. A project like MIStore exemplifies the use of blockchain for storing and maintaining medical insurance data.[187]

Another critical application could be in voting. In many countries, democracy faces challenges, and equal access to elections is not always guaranteed. Online or electronic voting has been a long-discussed solution but comes with concerns, such as the risk of cyber-attacks, which may cause large-scale disruptions. Blockchain-based e-voting systems could mitigate these risks, offering cost-efficient, energy-saving, and accessible voting methods that allow citizens to cast their ballots securely from anywhere.[188].

The increased demand for energy has led to innovative methods of power production, enabling bidirectional energy exchange networks between customers and providers. Smart grids have been developed to facilitate energy exchange via centralized networks.

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[186] F. Lamberti, V. Gatteschi, C. Demartini, M. Pelissier, A. Gómez, and S. Victor, "On-Demand Blockchain-Based Car Insurance Using Smart Contracts and Sensors," *IEEE Consumer Electronics Magazine* 7 (2017): 72–81.

[187] L. Zhou, L. Wang, and Y. Sun, "MIStore: A Blockchain-Based Medical Insurance Storage System," *Journal of Medical Systems* 42, no. 149 (2018).

[188] Reza Soltani, Marzia Zaman, Rohit Joshi, and Srinivas Sampalli, "Distributed Ledger Technologies and Their Applications: A Review," *Applied Sciences* 12, no. 15 (2022): 7898, https://doi.org/10.3390/app12157898.

Blockchain-based smart contracts have proven useful in such energy trading[189] systems, offering transparency and efficiency.

The implications of blockchain technology on records management, particularly in the context of archival trustworthiness, have also been explored. National archives could potentially use blockchain to preserve the integrity of records. However, there remain hesitations about applying blockchain technology for archiving[190] purposes due to questions about its long-term reliability and scalability.

Blockchain could even play a role in machine learning. This study will discuss the intersection of AI and blockchain in greater detail. In distributed machine learning (DML), evaluating data quality is crucial, especially when data from diverse Internet of Things (IoT) devices may include biases that reduce the accuracy of deep machine learning models. Blockchain-based methods have been proposed to assess the accuracy of such data, even when they are not independent or identically distributed.[191]

Using blockchain for data storage can enhance security, transparency, and privacy. For example, blockchain technology improves record-keeping by providing a tamper-resistant and immutable system. However, balancing security with flexibility remains a challenge, especially as the technology evolves and scales.[192]

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[189] Neng Wang, Xiaojing Zhou, Xiong Lu, Zhenhua Guan, Liang Wu, Xin Du, and Mohsen Guizani, "When Energy Trading Meets Blockchain in Electrical Power System: The State of the Art," *Applied Sciences* 9 (2019): 1561, https://doi.org/10.3390/app9091561.

[190] AI Collaboratory, "Will Blockchain Technology Change How Well National Archives Preserve the Trustworthiness of Digital Records?: Preliminary Results of a Survey," 2023, accessed May 22, 2024, https://ai-collaboratory.net/wp-content/uploads/2023/11/S01205_7202.pdf.

[191] Y. Du, Z. Wang, C. Leung, and L. Victor C.M., "Blockchain-Based Data Quality Assessment to Improve Distributed Machine Learning," in *2023 International Conference on Computing, Networking and Communications (ICNC)*, Honolulu, HI, USA, 2023, 170–175, https://doi.org/10.1109/ICNC57223.2023.10074543.

[192] Victoria L. Lemieux, "Blockchain and Recordkeeping: Editorial," *Computers* 10, no. 11 (2021): 135, https://doi.org/10.3390/computers10110135.

The core principles of blockchain technology are openness, immutability, and the maintenance of public data. Industries requiring public recording in an unchangeable manner, such as notaries, could benefit significantly from using blockchain technology. Real estate is one of the most highly regulated fields for public recording. Several countries, including Brazil, the Republic of Georgia, Ghana, India, Japan, and Sweden, have already tested or considered using blockchain solutions to record land ownership transfers. These solutions, assessed through an archival science theoretical lens, have demonstrated potential for improving efficiency, reducing transactional friction, and enhancing security.[193]

One of the burgeoning sectors adopting blockchain technology is the gaming industry. The gaming sector was valued at USD 272.86 billion in 2024,[194] with a compound annual growth rate (CAGR) of approximately 9.32%.[195] As the gaming industry grows, games are becoming increasingly intricate and require more storage capacity. Cloud systems have been utilized for this purpose. An example of a cloud system leveraging blockchain technology is the CloudArcade project. This token-based cloud gaming system integrates blockchain-powered cryptocurrency as a payment mechanism for gamers accessing cloud gaming services. CloudArcade offers a transparent and resource-aware pricing model using cryptocurrencies. It also supports time-independent silent payments at fluctuating prices to ensure the security of players' payments. These features prevent declines in the quality of experience caused by price fluctuations in traditional dynamic pricing approach.[196]

Since the inception of blockchain technology, the use of cryptocurrency for purchases—ranging from pizza to advanced technologies like Web 3—has consistently improved. In the future, we can expect numerous other examples of such usage, which will require evaluation

[193] Victoria L. Lemieux, "Evaluating the Use of Blockchain in Land Transactions: An Archival Science Perspective," *European Property Law Journal* 6, no. 3 (2017): 392–440, https://doi.org/10.1515/eplj-2017-0019.

[194] Mordor Intelligence, "Global Gaming Market - Growth, Trends, and Forecast (2024 - 2029)," accessed October 10, 2024, https://www.mordorintelligence.com/.

[195] Ibid.

[196] Juntao Zhao, Yuanfang Chi, Zehua Wang, Victor C. M. Leung, and Wei Cai, "CloudArcade: A Blockchain Empowered Cloud Gaming System," in *Proceedings of the 2nd ACM International Symposium on Blockchain and Secure Critical Infrastructure*, 2020, 31–40, https://doi.org/10.1145/3384943.3409420.

within the legal framework established by existing laws or, in some cases, within a legal grey area.

In this chapter, following the cryptocurrency section, we investigated blockchain infrastructure and its fundamental elements, including consensus mechanisms such as Proof of Work (PoW), Proof of Stake (PoS), and Proof of History (PoH), along with various blockchain architectures like smart contracts. Understanding these technological characteristics is crucial for developing effective regulatory strategies.

This strongly relates to the first research question of our dissertation, which investigates the effectiveness of existing legal frameworks in addressing the distinctive features of blockchain technology. Consistent with hypothesis one, current frameworks often insufficiently address the challenges of blockchain, sometimes hindering its adoption. Early discussions over the Markets in Crypto-Assets (MiCA) Act included proposals to prohibit Proof of Work (PoW) due to high energy consumption, overlooking the essential role of Bitcoin—a PoW-based coin often referred to as the "gold of cryptocurrencies"—within the ecosystem.

Private blockchains, designed for limited use by organizations, require more regulatory support to encourage innovation and approval. By understanding blockchain's architecture, as emphasized here, authorities can develop fairer and more effective legal frameworks. This understanding provides the foundation for deeper discussions about MiCA and the development of blockchain-related regulations in subsequent sections.

V. Comparative Analysis of Legal and Regulatory Frameworks

1- The Legal Framework of Cryptocurrencies

Lawmakers and governments closely monitor the developments surrounding cryptocurrencies, particularly concerning know-your-client (KYC) and anti-money laundering [197] (AML) processes. Additionally, the growing value accumulated in the cryptocurrency market has drawn the attention of tax authorities. To regulate this market and prevent tax evasion, it is essential to categorize cryptocurrencies—whether as money, securities, or commodities. This section of the research evaluates the definitions of cryptocurrencies.

A functional method is employed to examine cryptocurrency practices across various nations. Comparing the definitions and regulations of cryptocurrencies globally helps

[197] Amir Zohar, "Bitcoin: Under the Hood," *Crime, Law and Social Change* 69, no. 2 (2018): 111–32, accessed July 17, 2024, https://doi.org/10.1007/s10611-017-9756-5.

identify common approaches and techniques. This method enables an evaluation of the practical effects of diverse regulatory regimes and their efficacy in appropriately categorizing cryptocurrencies.

To determine the rules applicable to cryptocurrencies, it is first necessary to define the relevant cryptocurrency. Since 2009, the year Bitcoin—the first decentralized cryptocurrency—was introduced, countries have developed divergent views on cryptocurrency and blockchain applications. For instance, while countries like Qatar, China, Russia, and Bangladesh have banned or restricted cryptocurrency use, El Salvador declared Bitcoin an official currency in 2021, allowing it to be used in all types of transactions.

El Salvador's decision warrants closer analysis. The country, located in Central America, has a population of about 7 million and a per capita national income of less than $4,000.[198] Notably, 70% of El Salvador's citizens lack bank accounts.[199] The country does not have its own currency and instead uses the US dollar as its official currency. Given these details, El Salvador's goals in adopting Bitcoin as legal tender include improving cash flow, promoting the country, attracting blockchain enthusiasts and entrepreneurs, and [200] fostering investment. A similar strategy was employed by Estonia, which gained global attention for its e-residency program.

For comparison, the percentage of the adult population with a bank account—a key indicator of economic development—varies widely, from 8.6% in South Sudan to 99.9% in Denmark.[201] By adopting Bitcoin, El Salvador aims to increase cryptocurrency adoption and indirectly integrate unbanked individuals into the economic system. In this context, Bitcoin serves as an alternative and competitor to the dollar.

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[198] Trading Economics, "El Salvador GDP per Capita," accessed June 6, 2024, https://tradingeconomics.com/el-salvador/gdp-per-capita.

[199] Cointelegraph, "What Is Really Behind El Salvador's Bitcoin Law? Experts Answer," accessed July 17, 2024, https://cointelegraph.com/explained/what-is-really-behind-el-salvadors-bitcoin-law-experts-answer.

[200] Adityawardhan Gaikwad and Sushil Mavale, "The Impact of Cryptocurrency Adoption as a Legal Tender in El Salvador," *International Journal of Engineering and Management Research* 11 (2021), https://doi.org/10.31033/ijemr.11.6.16.

[201] Acuant, "The World's Unbanked Population," accessed June 6, 2024, https://www.acuant.com/blog/the-worlds-unbanked-population/.

On the basis of the available data, it is appropriate to analyze El Salvador's acceptance of Bitcoin as legal tender as an independent nation with its own central bank. Despite receiving significant global support, 67.9% of El Salvador's citizens oppose the adoption of Bitcoin as an official currency, citing concerns about its reliability and unfamiliarity with the technology.[202]

The current data indicates that the government of El Salvador has implemented several measures to accelerate the transition to Bitcoin adoption. The first is the obligation for merchants to accept payments made in Bitcoin. Additionally, the government has installed approximately 200 Bitcoin ATMs in various regions, introduced a Bitcoin wallet called Chivo, and gifted $30 in Bitcoin to all citizens who download the wallet. These efforts aim to facilitate[203] the integration of Bitcoin into daily life. However, the global financial system has not responded favorably to this decision. For instance, the International Monetary Fund (IMF) halted negotiations for a $1.3 billion support package with El Salvador,[204] citing concerns about Bitcoin's limited adoption, its inability to meet essential criteria for recognition as a currency, and the country's inadequate internet and technology infrastructure. Mandating the use of an online currency in a country where nearly half the population lacks internet access has sparked criticism. Additionally, the compulsory acceptance of Bitcoin has raised concerns about potential rights violations. Combined with El Salvador's weak democratic record and autocratic governance, this imposition has led countries such as the United States to view the Bitcoin decision unfavorably. The global value of Bitcoin also fell on the day of this announcement, as Salvadorans sold the $30 worth of Bitcoin in bulk for US dollars.[205] The volatility of cryptocurrencies remains one of the most significant obstacles to their acceptance as official currencies. While El Salvador

[202] Central American University (UCA), "Survey," September 2021, accessed June 6, 2024, https://www.reuters.com/technology/majority-salvadorans-do-not-want-bitcoin-poll-shows-2021-09-02/.

[203] Princeton Legal Journal, "El Salvador's Bitcoin Law: Contemporary Implications of Forced Tender Legislation," *Princeton Legal Journal*, accessed August 22, 2024, https://legaljournal.princeton.edu/el-salvadors-bitcoin-law-contemporary-implications-of-forced-tender-legislation/.

[204] BBC News, "IMF Urges El Salvador to Remove Bitcoin as Legal Tender," *BBC News*, January 25, 2022, accessed August 22, 2024, https://www.bbc.com/news/world-latin-america-60135552.

[205] National Bureau of Economic Research, "El Salvador's Experiment with Bitcoin as Legal Tender," *NBER Digest*, July 2022, https://www.nber.org/digest/202207/el-salvadors-experiment-bitcoin-legal-tender.

recognizes Bitcoin as legal tender, the prevailing view among most nations is that Bitcoin and other cryptocurrencies cannot yet be considered legitimate forms of money.

Although cryptocurrencies are often referred to as "currencies" or "money," they are not legally classified as such in most jurisdictions. While the [206]classification varies by country, the leading interpretations of cryptocurrencies are as follows:

1- Currency
2- Digital Currency
3- Commodities
4- Securities
5- Online Payment System

These represent forms of money or financial instruments. To better understand these terms, it is helpful to examine them individually.

1.1. Are Cryptocurrencies a 'Currency'?

The initial purpose of money was to facilitate the exchange of surplus goods for those needed by others. At its core, money depends on trust and acceptance. For any item, whether a physical object or a digital record, to function as money, it must meet [207] several key criteria:

- Facilitate the exchange of goods
- Express a specific unit of value
- Maintain value over time
- Be backed by a guarantor (typically a government or institution such as a central bank)

[206] Anna Gerbrandy and Anthony Garde, "The Nature of Rights Upon Cryptocurrencies," in *Data Economy and European Law*, ed. Hans Micklitz, Marc R. van Look, and Tobias D. Seeley (Springer, 2021), 471–82, https://doi.org/10.1007/978-3-030-69583-5_26.
[207] Ibid.

Cryptocurrencies could theoretically be described as money, but this classification raises several challenges and uncertainties. Moreover, the concept of money itself has evolved over time. Historically, money has been categorized into three types: commodity-based currencies, commodity-representative currencies, and credit currencies.[208]

Commodity money was the first example of money. Items used as money had the same value in exchange and were the first representatives of money. The first commodity money appears to have been grains. However, using grains as money posed challenges because they could rot or were unwieldy. Eventually, metal coins [209] were introduced. To give an example of commodity-based currency, wheat was used as currency for a time. Until the advent of metal coins, wheat grains were used like metal money and facilitated exchange. In the case of commodity-representative coins, coins corresponded to the value of precious metals such as gold and silver. At this point, money was worth less than the metal it was made of. In other words, the credit coins we use today are a kind of credit document with a value greater than the materials used to create them (for example, paper). These loan documents work like checks, and their value is guaranteed by a government or institution, making them accepted as money by third parties.

The second kind of money is representative money. It could have little or no intrinsic value but could be exchanged for gold, silver, or their equivalent value. For example, in the 19th century, American banks issued pieces of paper known as banknotes, which enabled holders to exchange them for silver or gold coins.

Credit money is the third type of money. By credit money or debt money, we mean any money, except representative full-bodied (commodity) money, that circulates at a value greater than the commodity value of the material from which it is made.[210]

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[208] Frederic S. Mishkin, *The Economics of Money, Banking, and Financial Markets*, 12th ed. (Boston: Pearson, 2019), accessed August 22, 2024, https://archive.org/details/economics-of-money-banking-and-financial-markets-mishkin.

[209] L. R. Wray, *Money and Credit in Capitalist Economies: The Endogenous Money Approach* (Northampton, MA: Edward Elgar, 1990).

[210] S. Goldfeld, *The Economics of Money and Banking* (New York: Harper & Row, 1986).

Credit money works similarly to representative commodity money. However, unlike representative money, credit money cannot be exchanged for gold or silver coins. The existing monetary system today is based on credit money. Hence, the use of credit cards or electronic money represents these nonphysical forms of money.

At this point, Bitcoin, the first decentralized cryptocurrency, serves as an example. Bitcoin meets many of the main conditions of a currency. There is no doubt that today Bitcoin fulfills the requirement of facilitating exchange, as it is accepted in many areas—from pizza purchases to real estate services to official payments.[211]

Since the value of Bitcoin is determined by free market conditions, the fact that one unit of BTC expresses a specific value in most exchange rates also fulfills the unit condition. Additionally, the preservation of value for purchasing goods or services with this unit is a notable characteristic. However, the biggest obstacle to BTC being accepted as a "currency" by states today is the condition of a guarantor. Due to its decentralized structure, Bitcoin does not have any institutions or governments backing it. The available evidence suggests that it is not possible to guarantee that a purchased Bitcoin will maintain its value in the future. Unlike Bitcoin, the value of an American dollar is guaranteed by the United States Federal Reserve, and as long as the government remains stable, it maintains this guarantee. For this reason, cryptocurrencies are not widely accepted as currency by most governments. In some cases, such as in El Salvador, Bitcoin is accepted as a currency, but it is often treated as a form of money primarily for taxation purposes. For example, the European Union Court of Justice ruled in 2015 that cryptocurrencies could be considered goods in a case about whether cryptocurrencies purchased through brokerage institutions were subject to VAT. However, the court determined that they should be exempt from VAT, similar to how currency exchanges between legal currencies, such as euros to dollars,[212] are treated.

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[211] Ahmet Faruk Aysan, Hüseyin Bedir Demirtaş, and Mustafa Saraç, "The Ascent of Bitcoin: Bibliometric Analysis of Bitcoin Research," *Journal of Risk and Financial Management* 14, no. 9 (2021): 427, https://doi.org/10.3390/jrfm14090427.

[212] Court of Justice of the European Union, "The Exchange of Traditional Currencies for Units of the 'Bitcoin' Virtual Currency Is an Example from VAT," accessed June 6, 2024, https://curia.europa.eu/jcms/upload/docs/application/pdf/2015-10/cp150128en.pdf.

The data also suggests that definitions of electronic money and digital money are often used interchangeably when describing cryptocurrencies.[213] However, it is important to distinguish between these two terms. Electronic money is an electronic representation of national currencies.[214] Cryptocurrencies, on the other hand, fall under the category of digital money. It is crucial to note that digital money is not the same as electronic money. While electronic money represents national currencies, digital money [215] exists as an independent currency. Electronic money is not a separate currency in itself; it is merely a representation of an accepted currency in an electronic format. Digital money, however, functions as the main currency itself. Cryptocurrencies, therefore, are not electronic money but are categorized as digital currency.

The first examples of digital currencies appeared in the 1990s. One such example was E-Gold, a digital currency based on gold that had a market valuation. E-Gold accounts allowed users to buy gold online at the gram price and make instant transfers to other E-Gold accounts. Between 1996 and 2009, E-Gold amassed nearly 5 million accounts before it was shut down for legal reasons.[216] The closure stemmed from E-Gold not possessing a money transfer license in the United States. Initially, the U.S. Federal Revenue Office determined that E-Gold did not fall under money transmitter regulations because it was a gold-based

[213] Usman W. Chohan, "The Double-Spending Problem and Cryptocurrencies," Centre for Aerospace & Security Studies (CASS), Critical Blockchain Research Initiative (CBRI), International Association of Hyperpolyglots (HYPIA), University of New South Wales (UNSW), August 17, 2017, https://doi.org/10.2139/ssrn.3024330.

[214] David Evans and Richard Schmalensee, *Paying With Plastic: The Digital Revolution in Buying and Borrowing*, 2nd ed. (Cambridge, MA: MIT Press, 2005).

[215] International Monetary Fund, "Digital Money, Cross-Border Payments, International Reserves, and the Global Financial Safety Net," *IMF Note*, 2024, accessed October 1, 2024, https://www.imf.org/en/Publications/IMF-Notes/Issues/2024/01/04/Digital-Money-Cross-Border-Payments-International-Reserves-and-the-Global-Financial-Safety-538733.

[216] P. C. Mullan, "E-gold," in *A History of Digital Currency in the United States*, Palgrave Advances in the Economics of Innovation and Technology (New York: Palgrave Macmillan, 2016), https://doi.org/10.1057/978-1-137-56870-0_2a.

transfer.[217] However, regulatory changes later included all types of online asset transfers under this coverage, and E-Gold was unable to meet the licensing requirements, which stipulated that the transferred value had to be a recognized currency.

Another example is Liberty Coin, which was valued based on other precious metals besides gold. Liberty Coin operations included both digital and physical coins. However, these operations were eventually identified as producing counterfeit U.S. dollars, leading to their shutdown and legal action against their owners. [218] The key difference between these examples and Bitcoin lies in their centralized nature. Both E-Gold and Liberty Coin were centralized systems, with identifiable founders and operators, making them susceptible to government intervention. Bitcoin, by contrast, is the first decentralized digital currency, operating without a central authority.

The first digital currencies, E-Gold, which was backed by gold in 1996, and another example, Liberty Reserve, made it possible to convert dollars or euros to Liberty Reserve Dollars and Euros and exchange these currencies freely with one another. These systems were centralized and were commonly used for money laundering purposes. Consequently, both digital currencies were shut down by the U.S. Government. The government was able to shut down these systems because of their centralized systems.[219]

One possible definition of cryptocurrencies is electronic money. To be classified as electronic money, cryptocurrencies must meet three conditions: they must be electronically

[217] U.S. Department of Justice, "Digital Currency Business E-Gold Indicted for Money Laundering and Illegal Money Transmitting Charges," April 27, 2007, accessed October 1, 2024, https://www.justice.gov/archive/opa/pr/2007/April/07_crm_301.html.

[218] Southern Poverty Law Center, "After 'Liberty Dollar's' Creator Convicted, Feds Seek Millions," *Hatewatch*, March 25, 2011, accessed October 1, 2024, https://www.splcenter.org/hatewatch/2011/03/25/after-%E2%80%98liberty-dollars%E2%80%99-creator-convicted-feds-seek-millions.

[219] "Liberty Reserve," *CoinDesk*, last modified May 26, 2023, https://www.coindesk.com/learn/liberty-reserve/.

stored, used as a payment method, and issued in exchange for funds accepted by law.[220] Cryptocurrencies are electronically stored, and some, such as Bitcoin, have been widely accepted globally. Today, it is possible to pay for several services using cryptocurrencies, fulfilling one of the conditions for electronic money. However, the obstacle to recognizing cryptocurrencies as electronic money is their lack of backing by licensed fund institutions. Cryptocurrencies are not backed by any licensed funding. Current research supports the view that it is challenging to categorize cryptocurrencies as electronic money.

To consider a tender as currency, it must meet three criteria: the ability to be used for transactions, the ability to act as a unit of account, and the ability to store value.[221]

Cryptocurrencies, including Bitcoin, Ether, and Ripple, meet the criterion of being used for transactions. According to data from Buy Bitcoin Worldwide, the average number of daily Bitcoin users is 400,000, and approximately 100 million people [222] own Bitcoin. These numbers pertain only to Bitcoin; there are hundreds of other cryptocurrencies.

Cryptocurrencies can also function as a unit of account. However, the limited supply of Bitcoin (with a 21-million-unit cap) raises questions regarding its suitability as a unit of account. Van Alstyne argues that fractional ownership of Bitcoin is possible, so the 21 million limit is not necessarily restrictive. Additionally, Bitcoin is fungible, meaning that every piece of Bitcoin is created equally and can be interchanged. Lastly, Bitcoin is countable and subject to mathematical operations.[223]

Another debate regarding Bitcoin's ability to act as a unit of account concerns the volatility of coins and tokens. The most significant challenge to using cryptocurrencies as money is

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[220] European Central Bank, *Virtual Currency Schemes – A Further Analysis* (Luxembourg: Publications Office of the European Union, 2015), https://op.europa.eu/en/publication-detail/-/publication/96fe84e9-3d29-4790-a1a4-d89218c244ac/language-en.

[221] Nobuhiro Kiyotaki and Randall Wright, "On Money as a Medium of Exchange," *The Journal of Political Economy* 97 (1989): 927–54.

[222] "How Many Bitcoin Users Are There?" *Buy Bitcoin Worldwide*, accessed March 18, 2020, https://www.buybitcoinworldwide.com/how-many-bitcoin-users/.

[223] M. Van Alstyne, "Why Bitcoin Has Value," *Communications of the ACM* 57, no. 5 (2014): 30–32.

their volatility, which complicates the valuation of goods and services. However, it is worth noting that some national currencies exhibit higher volatility than cryptocurrencies. Despite this volatility, these national currencies are still accepted as money. In this respect, there is strong support for the claim that cryptocurrencies can function as a unit of account.

The ability to store value is another criterion for accepting cryptocurrencies as currency. For cryptocurrencies to serve as a store of value in trade, both parties to a transaction must agree on the currency's value at the same time. To use Bitcoin as a store of value over time, users must estimate its future value.[224] While several national currencies have experienced high levels of volatility, the primary difference between these currencies and cryptocurrencies is that national currencies are backed by governments. Bitcoin's legitimacy as a currency will likely remain ambiguous for the foreseeable future.[225]

In sum, much of the current debate revolves around whether cryptocurrencies should be described as money, currency, or electronic money. The volatility of cryptocurrencies remains one of the strongest arguments against their acceptance as money. If the cryptocurrency market succeeds in providing stable value and proving its ability to store value, lawmakers may be persuaded to regulate cryptocurrencies as money or electronic money. However, at present, without backing from licensed, government-supported funds and given their high volatility, it seems unlikely that cryptocurrencies will be widely accepted as money.

1.2. Are Cryptocurrencies a "Commodity"?

Following the above explanations, the prevailing global opinion is that most cryptocurrencies are considered commodities.[226] The use of cryptocurrencies, particularly as a means of payment, distinguishes them from traditional commodities and assets. However, after examining the legal background of money, and based on the approaches of many

[224] F. C. Glaser, "Bitcoin: Asset or Currency? Revealing Users' Hidden Intentions," in *Twenty-Second European Conference on Information Systems* (Tel Aviv, 2014).

[225] J. Carrick, "Bitcoin as a Complement to Emerging Market Currencies," *Emerging Markets Finance and Trade* (2016).

[226] Yukun Liu and Aleh Tsyvinski, "Risks and Returns of Cryptocurrency," *The Review of Financial Studies* 34, no. 6 (June 2021): 2689–727, https://doi.org/10.1093/rfs/hhaa113.

institutions, it appears that categorizing cryptocurrencies as commodities is the most prevalent perspective.

The high volatility of cryptocurrencies supports the view of treating them as commodities. If cryptocurrencies are regarded as commodities, they must be considered abstract commodities, as their ownership is based on code. Commodities are generally defined as items that can be weighed or measured and that hold intrinsic value. These may include goods or services. A commodity must be exchangeable with another commodity of the same grade, regardless of its producer. Examples of commodities include gold, aluminum, uranium, copper, or certain agricultural products like wheat, oranges, or cotton. The commodity-based coins mentioned earlier were also derived from this concept. For instance, salt, which was immensely valuable at one time, was used as a form of money, and the English word "salary" originates from the Latin word for 'salt'.[227]

The unstable valuation of cryptocurrencies makes a compelling argument for categorizing them as commodities. However, if cryptocurrencies are to be considered commodities, they must be classified as intangible commodities.

Economic goods or services that are fully or substantially fungible are commodities. Commodities of the same grade are considered fungible. Fungibility means that commodities are interchangeable with others of the same grade, regardless of who produced or farmed them. The most commonly traded commodities include raw materials such as gold, aluminum, uranium, and copper, as well as basic resources and agricultural products like wheat, soybeans, oranges, corn, coal, cotton, cattle, and oil.

A closer look at the data suggests that there are various commodity exchanges where these commodities change hands. Some of the most well-known commodity exchanges in the world include the Chicago Mercantile Exchange (CME), the London Metal Exchange (LME), and the New York Mercantile Exchange (NYMEX[228]). The prices of commodities are not determined by a single person or institution. Instead, through instruments called

[227] S. A. M. Salt, *Salt and Civilization* (London: Macmillan, 1992).

[228] IG Group, "What Are Commodities and How Do You Trade Them?" accessed October 1, 2024, https://www.ig.com/en/commodities/what-are-commodities-how-do-you-trade-them.

futures, buyers commit to purchasing commodities that will be produced or delivered in the future at predetermined prices. In this process, supply and demand in the market play a significant role in determining commodity prices for these long-term contracts. Like cryptocurrencies, commodity prices can also be subject to sudden fluctuations. For example, during March and April 2020, fuel consumption dropped by 10% in March and 30% in April due to lockdowns at the beginning of the COVID-19 crisis. As a result, the price of oil fell to $18 per barrel, a sharp decline not seen in a long time. By the summer of 2022, this figure had risen to over $100[229] per barrel.

If we compare commodities and cryptocurrencies, both are produced by various manufacturers but are traded at the same market price, regardless of the producer. For example, although Bitcoin is mined using different devices, it is traded at a global price in cryptocurrency markets, similar to commodities in commodity markets. At this point, the mechanism of trading commodities and cryptocurrencies is quite similar.

The data appears to suggest that cryptocurrencies differ from commodities in one key aspect: the supply of some cryptocurrencies, such as Bitcoin, is limited (Bitcoin's supply is capped at 21 million units). In contrast, commodities are typically considered unlimited in supply.

However, when the properties of commodities are examined, cryptocurrencies appear closer to the definition of commodities than money, and they are generally treated as such globally. In 2014, the U.S. Commodity Futures Trading Commission (CFTC) classified cryptocurrencies as commodities under the Commodity Exchange Act.[230] Four years later, in a case against the cryptocurrency exchange platform Coin Drop Market, the CFTC charged the platform with misappropriation and fraud related to Bitcoin and Litecoin trading. In the U.S. District Court for the Eastern District of New York, the federal judge upheld the notion that cryptocurrencies such as Bitcoin and Litecoin are commodities. The court further

[229] International Energy Agency, *The COVID-19 Crisis and Clean Energy Progress: Fuel Supply* (IEA, 2020), accessed October 1, 2024, https://www.iea.org/reports/the-covid-19-crisis-and-clean-energy-progress/fuel-supply.

[230] Timothy Massad, "Testimony of CFTC Chairman Timothy Massad before the U.S. Senate Committee on Agriculture, Nutrition and Forestry," 2014.

stated that these cryptocurrencies can be regulated by the U.S. Commodity Futures Trading Commission. [231]

Another example involves the case against Mt. Gox, which was once the largest Bitcoin exchange in the world. After its bankruptcy, the exchange faced lawsuits from clients seeking damages and the return of the Bitcoin held in their accounts. In 2015, the Tokyo District Court ruled on the claims of former Mt. Gox users, stating that virtual currency is "not subject to ownership" claims.[232]

According to Japan's Civil Code, proprietorship applies to tangible entities that occupy space and allow for exclusive control.[233] The court ruled that Bitcoin does not meet the criteria of a tangible entity and does not offer exclusive control due to the structured system of exchange platforms and user interactions. As a result, Bitcoin itself could not be claimed as property. However, this decision applied specifically to cryptocurrencies stored on exchange platforms. It is worth noting that cryptocurrencies can also be stored in hardware wallets, which provide a different level of control.

It is important to recognize that when the CFTC made its commodity classification in 2014, the variety of cryptocurrencies was significantly more limited than it is today. Consequently, the comments made at that time were interpreted as applying to all cryptocurrencies. However, as the cryptocurrency market has developed—now exceeding $2 trillion in market size (comparable to the valuation of Apple, the world's largest company)—cryptocurrencies have diversified significantly in their characteristics and uses. This diversification has made it increasingly challenging to provide a universal legal definition for cryptocurrencies.

[231] *Commodity Futures Trading Commission v. McDonnell*, No. 18-CV-361, 2018 WL 1175156 (E.D.N.Y. Mar. 6, 2018).

[232] "Bitcoins Lost in Mt. Gox Debacle 'Not Subject to Ownership' Claims: Tokyo Court," 2015.

[233] Japan Civil Code, Ministry of Justice, Japanese Law Translation, accessed October 1, 2024, https://www.japaneselawtranslation.go.jp/en/laws/view/3494/en.

Today, it has become [234] necessary to categorize each cryptocurrency based on its specific features and the services it provides.

Future prices of commodities may be stipulated by traders as securities. In this respect, there are similarities between cryptocurrencies and commodities. First, both cryptocurrencies and commodities are technically produced by different producers or miners. Nevertheless, their prices are uniform without considering the quality or the specific producer. While commodities can vary in quality, cryptocurrencies have identical features and qualities. Commodities, however, are also exchanged in the market at the same value regardless of their quality and origin. Thus, both commodities and cryptocurrencies share a similar exchange mechanism.

The value of cryptocurrencies is determined by market supply and demand.[235] In general, cryptocurrencies have a limited supply, which enables certain supply conditions, in contrast to commodities that are not inherently limited in quantity.

Cryptocurrency users view these assets as an alternative investment class. Lacking a formal valuation method, users form expectations about the future prices of cryptocurrencies based on any information they can gather from sources such as newspaper articles, social media, friends, peers, and internet communities.[236]

At this point, attention has started to focus on this distinction in subsequent judicial decisions. For instance, as mentioned above, in a case heard in New York in 2018, a district judge addressing a lawsuit filed by the Commodity Futures Trading Commission (CFTC) against the cryptocurrency platform Coin Drop Market defined cryptocurrencies like Bitcoin

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[234] European Central Bank, *Virtual Currency Schemes – A Further Analysis* (Luxembourg: Publications Office of the European Union, 2015), https://op.europa.eu/en/publication-detail/-/publication/96fe84e9-3d29-4790-a1a4-d89218c244ac/language-en.

[235] Yukun Liu and Aleh Tsyvinski, "Risks and Returns of Cryptocurrency," *National Bureau of Economic Research Working Paper No. 27477*, July 2020, https://www.nber.org/system/files/working_papers/w27477/w27477.pdf.

[236] Ibid

and Litecoin as commodities.[237] The term "like" in this context implies that cryptocurrencies offering similar services can also be evaluated within this framework. As observed, cryptocurrencies share more common features with commodities than with traditional forms of money. Cryptocurrencies could be described as a special type of "grain" that facilitates payments for the exchange of goods and services. Some countries consider cryptocurrencies as commodities and regulate them accordingly. However, when examining recent judicial decisions, it is clear that some cryptocurrencies are defined as securities based on the specific services they offer. This raises the question: what criteria are needed to classify cryptocurrencies as securities?

1.3. Are Cryptocurrencies "Securities"?

The aim of this section is to generalize beyond the data, as the cryptocurrency ecosystem increasingly produces services that overlap with those traditionally offered by financial institutions, particularly banks. The concept of decentralization has facilitated the emergence of decentralized finance (DeFi), making it possible to earn interest on capital, borrow, and lend. At this point, it becomes increasingly difficult to define these cryptocurrencies purely as commodities.[238] To better understand this classification, we must examine the concept of securities, which has recently posed significant challenges for many cryptocurrency companies.

A security is a written document evidencing ownership that provides rights to property without requiring the holder's possession of the underlying asset. The most common types of securities are stocks and bonds. Securities and commodities share certain features: investors in both asset classes seek profits through rising values, and both are traded on exchange markets.

In the United States, commodities and securities are regulated under different frameworks. The Securities and Exchange Commission (SEC) oversees securities, while the Commodity

[237] Ibid.
[238] Dirk A. Zetzsche, Douglas W. Arner, and Ross P. Buckley, "Decentralized Finance," *Journal of Financial Regulation* 6, no. 2 (September 20, 2020): 172–203, https://doi.org/10.1093/jfr/fjaa010.

Futures Trading Commission (CFTC) regulates commodities. These asset classes are also traded on distinct markets.

In 2014, the Internal Revenue Service (IRS) in the U.S. declared that cryptocurrencies have no legal tender status in any jurisdiction. The IRS classifies cryptocurrencies as capital assets, subject to capital gains or losses upon their sale or exchange, similar to securities like bonds and stocks.[239]

In the U.S., there is an ongoing conflict between the IRS and the CFTC regarding whether cryptocurrencies constitute property. The IRS recognizes cryptocurrencies as property for taxation purposes, while the CFTC classifies them as commodities. However, it is clear that in cases of theft, such as hacking incidents, stolen cryptocurrencies are recognized as property[240] for legal purposes.

Owning cryptocurrency involves possessing a private cryptographic key, which allows the holder to unlock a specific address. The debate surrounding the conceptualization of cryptocurrencies as property centers on the fact that a private cryptographic key is essentially confidential information. Regulations do not typically support the idea of property in confidential information.[241]

Furthermore, a private cryptographic key does not grant full control over the asset. Instead, it provides only limited control over cryptocurrencies to the holder. This raises the question: is cryptocurrency truly a form of property?

Cryptocurrency shares both similarities and differences with traditional categories like currency (money), securities, or commodities, making it challenging to classify definitively.

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[239] Internal Revenue Service (IRS), "Notice 2014-21," 2018, accessed June 6, 2024, https://www.irs.gov/pub/irs-drop/n-14-21.pdf.

[240] David Borsack, "Cryptocurrencies and the Commodity Futures Trading Commission," *JD Supra*, August 10, 2021, https://www.jdsupra.com/legalnews/cryptocurrencies-and-the-commodity-2167827/.

[241] Tanya Aplin, *Gurry on Breach of Confidence: The Protection of Confidential Information*, 2nd ed. (Oxford: Oxford University Press, 2012), 121–37; cf. *Veolia ES Nottinghamshire Ltd v Nottinghamshire County Council* [2010] EWCA Civ 1214, criticized by Tanya Aplin, "Confidential Information as Property?" p. 172.

A security is a broad term for financial instruments that can be exchanged based on a specific asset. Securities grant ownership rights without requiring physical possession and hold a certain value. The most well-known examples are stocks and bonds. Securities provide ownership benefits, such as dividends from stocks or rental income from real estate, making them distinct from commodities or money.

The foregoing discussion highlights that even institutions within the same country sometimes express differing opinions on whether cryptocurrencies qualify as securities. For instance, cryptocurrencies deemed money for tax purposes might simultaneously be treated as goods or securities by another regulatory body. While many cryptocurrencies and platforms operated for years without adhering to the strict requirements of stock exchanges or financial institutions, regulatory scrutiny has increased significantly in recent years.

To determine whether cryptocurrencies qualify as securities, their fundamental nature must be analyzed to see if they resemble an investment contract. The Howey Test, established by the U.S. Supreme Court in 1946 in the case between the Securities and Exchange Commission (SEC) and W.J. Howey Co., remains the standard for this determination. According to this test, an asset must meet three criteria to be considered a security.[242]

- It should be an investment with money (in the logic of the investment contract we mentioned above)
- It should be a collective initiative (such as the stock Market example)
- It should carry a reasonable expectation of profit expected from this joint investment

Ripple Labs Inc., the company behind the cryptocurrency XRP, faced a lawsuit filed by the SEC in December 2020. The SEC alleged that Ripple and some of its executives had raised $1.3 billion through the unregistered sale of XRP as securities. It was argued that non-cash services, such as labor and marketing, were [243] funded through XRP. However, in March 2022, the court dismissed individual complaints against Ripple's executives, ruling that

[242] *SEC v. W.J. Howey Co.*, 328 U.S. 293 (1946).

[243] *SEC v. Ripple Labs, Inc.*, 1:20-cv-10832 (S.D.N.Y. 2020).

these claims were unsubstantiated. The SEC's argument focused on Ripple's control over XRP, likening it to a stock since Ripple held the majority of XRP and sold it under specific programs. In contrast, Bitcoin (BTC) and Ethereum (ETH) were considered safer assets because they lack centralized control or ownership. The SEC does not classify BTC or ETH as securities,[244] primarily because their creators did not have profit as their primary objective.

The SEC remains a global leader in determining which cryptocurrencies qualify as securities. The Howey Test is central to this assessment. Applying the test broadly, a significant number of cryptocurrencies could fall under the definition of securities, particularly due to the profit expectation criterion. If a cryptocurrency project focuses on high-profit expectations rather than technological functionality, it is more likely to be interpreted as a security.

The SEC has also published a guide identifying conditions under which digital assets are less likely to be classified as securities under the Howey Test. These conditions include:

- The digital asset must operate on a distributed ledger (blockchain) and be fully developed and operational.
- Owners of the digital asset should have immediate access to its promised functionality on the network.
- The asset's creation and structure should prioritize user needs rather than speculation or network expansion.
- Promotional efforts for the asset should emphasize its intended use rather than the potential for profit from its value appreciation.
- The asset's value should remain stable or decrease over time, discouraging its use as a long-term investment.
- If classified as a cryptocurrency, the asset should be widely usable as a medium of exchange or as a substitute for legal tender.

[244] U.S. Securities and Exchange Commission, "Remarks at the Yahoo Finance All Markets Summit: Crypto - William Hinman," accessed June 6, 2024, https://www.sec.gov/news/speech/speech-hinman-061418.

- Changes in the asset's value should not deviate significantly from its original design purpose.
- Potential buyers should be able to use the network and asset for its stated purpose.
- Restrictions on the asset's transfer should align with its intended functionality and avoid speculative objectives.[245]

Despite these guidelines, many developers release digital assets before they are fully functional, focusing first on marketability. Such projects are more likely to fall under the SEC's securities regulations. However, as case law, such as the Ripple decision, continues to evolve, the application and interpretation of these conditions will become clearer.

Although being categorized as securities might seem like a daunting prospect for many cryptocurrency startups, some institutions view it as an opportunity and are willing to operate under this scope. For example, the Swiss Stock Exchange (SIX Digital Exchange, SDX) has launched a project to tokenize existing securities in the market, aiming to leverage the speed and infrastructure of blockchain technology.[246] Similarly, Intercontinental Exchange, an affiliate of the New York Stock Exchange, developed a platform called Bakkt to offer a safer investment environment for large investors.[247] Additionally, the Australian Securities Exchange is working on integrating its existing systems with blockchain infrastructure.

We will explore tokens that possess securities features in greater detail in the section on cryptocurrency types, as security tokens—with their significant potential—can create a safer investment environment, especially as cryptocurrency regulations become increasingly stringent.

1.4. Other Definitions Used for Cryptocurrencies

[245] U.S. Securities and Exchange Commission, "Framework for 'Investment Contract' Analysis of Digital Assets," accessed June 6, 2024, https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets.

[246] Unity Lab, Vilma Mattila, and Rico Pang, "Blockchain Technology in the Capital Markets: Confronts and Prospects," *International Journal of Social Sciences and Management Research* (2023), https://doi.org/10.37602/IJSSMR.2022.5342.

[247] U.S. Securities and Exchange Commission, "Bakkt Holdings, Inc. Annual Report (Form 10-K)," *SEC Edgar Archives*, 2022, accessed October 1, 2024, https://www.sec.gov/Archives/edgar/data/1820302/000182030223000016/bakkt-20221231.htm.

Beyond the definitions of securities, commodities, or currencies, another potential legal categorization for some cryptocurrencies is as an online payment system. In the Bitcoin White Paper, Satoshi Nakamoto described Bitcoin as "an end-to-end electronic cash system (peer-to-peer electronic cash system)," highlighting it as the first decentralized cryptocurrency. Traditional payment systems ensure integrity by relying on a trusted centralized party, while cryptocurrencies bypass these systems by using blockchain to store users' transactions.

The European Parliament [248]has introduced regulations for electronic payment systems. According to these directives, an electronic payment system must facilitate the transfer of money or securities of equivalent value. However, blockchain technology, as implemented in cryptocurrencies, does not satisfy these requirements. Furthermore, the European Union (EU) does not recognize cryptocurrencies as either money or securities, making it impossible to classify blockchain technology itself as an electronic payment system.

The distinction between traditional electronic payment systems and Bitcoin lies in the established infrastructure of the former. Many electronic payment systems, such as PayPal, rely on centralized institutions to maintain integrity. By contrast, Bitcoin operates independently without such infrastructure.

For example, the European Union Payment Services Directive (PSD), initially enacted in 2007 and updated in 2018 as PSD2, regulates electronic payment services. The European Court of Justice (ECJ), in the case of Skatteverket v. David Hedqvist, recognized Bitcoin transactions as payments and exempted them from VAT.[249] However, this decision does not indicate that Bitcoin or other cryptocurrencies qualify as electronic payment systems under the scope of PSD2.

To further analyze cryptocurrencies within the context of electronic currencies, it is necessary to revisit their relationship with traditional money. Cryptocurrencies are not widely included under the category of electronic currencies in established legal frameworks,

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[248] European Parliament. *Directive 2015/2366/EU*.

[249] Section § 17, Advocate General Kokott, *Skatteverket v. David Hedqvist*, Case C-264/14.

such as EU Law. Under the European Union Electronic Money Directive (2009/110/EC), the criteria for classifying an asset as electronic money include:

- It must be electronically stored
- The unit value should not be less than the value of real capital
- It should be acceptable as payment within the scope of the EU Electronic Money Directive (Electronic Money Directive (2009/110/EC) of the European Union).[250]

In summary, the Electronic Money Directive (2009/110/EC) defines electronic money as: monetary value as represented by a claim on the issuer which must be electronically stored, issued on receipt of funds of an amount not less in value than the monetary value issued and accepted as a means of payment by undertakings other than the issuer.[251]

Since electronic money is treated as the digital equivalent of traditional money, cryptocurrencies largely fall outside this definition. However, as we delve into the specific types of cryptocurrencies in later sections, we will analyze these distinctions further.

	Electronic Currency Scheme	**Virtual (Crypto) Currency Scheme**
Currency Format	Digital	Digital
Account Unit	Traditional currencies that must be received in accordance with the law (USD, Euro, Pound, etc.)	Invented Currencies, Without Any Official Acceptance (Bitcoin, etc.)
Acceptability	General Acceptability Other than the Issuer	Usually By Its Own Cryptocurrency Community
Legal Status	Regulated	Unregulated

[250] D. Wilusz, "Legal Determinants of Electronic Money Systems Development in European Union," *Prawny i Ekonomiczny Przegląd Prawa Gospodarczego* (2011), accessed October 1, 2024, https://www.kti.ue.poznan.pl/sites/default/files/Wilusz_Legal_determinants_of_electronic_money_systems_development.pdf.

[251] *Electronic Money Directive (2009/110/EC)*, April 18, 2018, accessed June 6, 2024, http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32009L0110.

The Issuer	Legally Established Electronic Currency Institution	Non-Financial Private Company
The Supply of Money	Fixed	Not Fixed (Depends on the founder/s)
Depreciation of Investment	Under Warranty	Not Under Warranty
Audit	Yes	No
The Type of Risk	Usually, Operational	Legal, Credit, Cash Flow, and Operational Risks

Table- 2: Comparison of Electronic Currency and Cryptocurrency

Source: European Central Bank

The European Central Bank published a report in 2012 stating that some criteria for electronic money are met by cryptocurrencies. However, the report highlighted that the funds of electronic money are stored and expressed in the same unit of account as fiat currencies (e.g., the Euro, US Dollar). In contrast, cryptocurrencies use their own unit of account, such as Bitcoin or Ether. This distinction may pose challenges when exchanging cryptocurrencies for fiat currencies. Additionally, cryptocurrencies are governed differently, as the funds are not required to be redeemed at par value. This leaves control entirely to their issuers, who are typically non-financial entities.[252]

On the other hand, European Central Bank published another report in 2015 and precisely stated that virtual currency can therefore be defined as a digital representation of value, not issued by a central bank, credit institution or e-money institution and added that in some circumstances can be used as an alternative to money. It has been clearly stated that virtual currencies do not have the nature of a highly liquid asset and have not reached the level of acceptance commonly associated with money.[253]

[252] European Central Bank, "Virtual Currency Schemes Report," October 2012, accessed April 10, 2019, https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemes201210en.pdf.
[253] European Central Bank, "Virtual Currency Schemes – Further Analysis," February 2015, accessed April 5, 2020, https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf.

The definition of cryptocurrencies varies significantly depending on the context, influencing their classification in areas such as taxation, licensing, registration, anti-money laundering measures, and the regulation of market participants.

As a concluding remark for this section, existing legislative frameworks across countries exhibit varying levels of effectiveness in addressing the distinctive features and applications of cryptocurrencies, such as stablecoins, utility tokens, and privacy coins. For example, El Salvador, as discussed earlier, has established a relatively robust legal structure to regulate Bitcoin, although its approach may be viewed as less democratic. On the other hand, the regulatory landscape in the United States has shifted under different administrations. While the Biden administration initially adopted a cautious approach to cryptocurrencies, the Trump administration of 2024 was more crypto-friendly. Achieving a balanced regulatory framework is crucial. Laws should not be so stringent that they stifle innovation, nor should they be so permissive that they jeopardize financial stability and security. A fair and pragmatic approach is essential to foster a sustainable environment for cryptocurrency development. By separating the features of cryptocurrencies into distinct categories, regulators can create more efficient and supportive laws. These frameworks must have a clear structure and reduce bureaucratic barriers within reasonable financial limits to encourage both development and compliance.

2. Blockchain and Legal Fields

2.1. Various Aspects of the Blockchain Legal Approach

Developments in informatics technologies create legal loopholes through new technological features and possibilities. Tech companies have grown uncontrollably worldwide before official bodies, tasked with monitoring the legality of their operations, could fully realize their features, as seen in the Cambridge Analytica data scandal. This situation highlights not only national legal gaps but also international ones due to the global IT network.

On these grounds, blockchain technology, which is open-source, software-based, peer-to-peer, and decentralized, has grown massively in the last decade.

Several legal concerns surrounding the services stored on or provided through blockchain technology have drawn significant attention. There is a rapidly growing body of literature on blockchain, which means that the academic world is also trying to determine what kinds of legal gaps may emerge due to blockchain technology. In this part of our study, we examine current and potential legal problems related to blockchain services from the perspective of different legal fields. It is important to explore solutions for the problems or legal gaps in blockchain services to shape the legal framework of blockchain technology.

Before moving to the section on the various legal approaches to blockchain, it is worth revisiting how the system was born, as discussed at the beginning of our study. As previously mentioned, every block in the chain is a cryptographic electronic registry, and this system is called blockchain, or in other terms, chains of blocks or cryptographic electronic registries. It is also referred to as distributed ledger technology in several countries' legal texts. The first decentralized cryptocurrency, Bitcoin, was introduced by Satoshi Nakamoto, whose identity remains unknown. Bitcoin is still an open-source software project designed as a public ledger, described in an informational document called the white paper. Although the term "blockchain" was not used by Satoshi, the words "block" and "chain" were mentioned separately, and later, the public began using the combined term "blockchain."

The main claim of Bitcoin (its name derived from the words "bit" and "coin") was to create a peer-to-peer electronic cash system without recourse. [254] For our first research question, this part is crucial.

2.1.1 Blockchain and Data Protection

Billions of data points are stored in blockchain databases, with each piece of data locked by every new block. This means that every single piece of data stored in the blockchain database becomes part of the next consensus among all participants in the database. Changing any single piece of data in a blockchain database requires the consensus of the entire network,

[254] Satoshi Nakamoto, “Bitcoin: A Peer-to-Peer Electronic Cash System,” accessed June 6, 2024, https://bitcoin.org/bitcoin.pdf.

meaning billions of block acceptances would be needed to make a change. It is claimed that data stored on the blockchain is secure and very difficult to hack or alter by any third party.

Data privacy involves the right of data owners to freely control their data. However, data on the blockchain is controlled by the consensus[255] mechanism of the system. In this part of our study, we review the literature on data privacy in blockchain technology.

Data and blockchain are increasingly converging in the context of healthcare. Considering that both the Internet of Things (IoT) ecosystem in general and e-Health environments specifically involve handling sensitive personal data such as health conditions, biometric data, and genetic data, it is clear that blockchain technology used in these ecosystems must fully adhere to the General Data Protection Regulation (GDPR) and its specific provisions for such data, as outlined in GDPR Article 9 regarding special categories of personal data, often referred to as sensitive data.[256]

Although blockchain offers benefits, there are obstacles to its use in healthcare data management. Key challenges that must be addressed for wider adoption include scalability, regulatory compliance, integration with existing systems, privacy considerations, and user acceptability. Novel advancements should be explored, along with the design of effective governance frameworks, the establishment of industry standards, the analysis of ethical implications, and the evaluation of social repercussions associated with blockchain technology. To fully harness the potential of blockchain in healthcare data management, researchers, medical practitioners, and policymakers need to collaborate to resolve these challenges.[257]

The General Data Protection Regulation (GDPR) of the European Union is one of the most pioneering and detailed regulations regarding data protection. GDPR came into force in May

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[255] Z. Li, J. Li, F. Nie, B. Zhang, and J. Guo, "Optimization of Blockchain Consensus Mechanism Based on DPOS," *Proceedings of SPIE - The International Society for Optical Engineering* (2023), https://dx.doi.org/10.1117/12.3006759.

[256] G. M. Riva, "What Happens in Blockchain Stays in Blockchain: A Legal Solution to Conflicts Between Digital Ledgers and Privacy Rights," *Frontiers in Blockchain* 3 (2020): 36, https://doi.org/10.3389/fbloc.2020.00036.

[257] Prakash Kanade and Sunay Kanade, "Blockchain Application in Healthcare Data Management," *International Journal of Advanced Networking and Applications* 15 (2023): 5952–58, https://doi.org/10.35444/IJANA.2023.15305.

2016 and became applicable in May 2018. The enforcement of this detailed regulation on blockchain remains questionable. Provisions such as the right to data portability (Article 20), accountability (Article 5), control by the data subject (Articles 14 to 21), the right to be forgotten (Article 17), data protection by design (Article 25), and data minimization (Article 5) introduce new control mechanisms under GDPR.

The controller of the data is responsible for ensuring compliance with all GDPR privacy principles, such as transparency, accuracy, lawfulness, fairness, purpose limitation, data minimization, confidentiality, storage limitation, and integrity. Moreover, every organization must demonstrate compliance with these principles.

Permissioned blockchains can comply with GDPR's accountability requirements. Conversely, joint-controller blockchains would fail to meet the requirements of Article 26 of GDPR due to the growing number of permissionless nodes. Similarly, data minimization under GDPR Article 5 may not be fulfilled due to the inherent nature of blockchain.[258]

It could be noted that private and permissioned blockchains have a higher likelihood of adhering to legal obligations, such as the General Data Protection Regulation (GDPR), compared to permissionless blockchains. Evaluating the compliance of blockchain with GDPR requires a case-by-case approach, considering the diverse technological characteristics and governance frameworks of each system. Blockchains cannot be categorically classified as fully compliant or non-compliant with GDPR; each specific use requires thorough examination. Furthermore, notable difficulties exist between blockchain technology and GDPR, particularly regarding the definitions of anonymous data, data controllers, and the concept of erasure, as outlined in the General Data Protection Regulation (GDPR), which we discuss here.[259]

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[258] Shraddha Kulhari, *Fitting the Blockchain Solution into the GDPR Puzzle: Building the Blocks of a Data Protection Revolution* (2018).

[259] European Parliament, Directorate-General for Parliamentary Research Services, and M. Finck, *Blockchain and the General Data Protection Regulation – Can Distributed Ledgers Be Squared with European Data*

Data on the blockchain is replicated by each node, meaning data continues to be stored even if it is no longer processed.[260] The anonymity of data on the blockchain may offer a solution through the use of zero-knowledge proofs. Several digital identity management solutions exist that can help ensure blockchain compliance with GDPR requirements by granting data subjects control over their personal data.

Another challenge for blockchain under GDPR is the "right to erasure." Blockchain's complex system makes the removal of any stored [261] data particularly challenging.

The indefinite locking of data on an immutable blockchain should be considered compliant with the data protection principles of GDPR rather than seeking to admonish it under the right to erasure. This may provide an alternative solution for GDPR compliance.[262]

Data portability is another aspect of GDPR compliance. In this respect, permissioned and public blockchains must be differentiated. Public blockchains do not allow access to off-chain storage of personal data by any party, except through pointers to the data. Therefore, in public blockchains, there is no controller of the servers, as required under GDPR's data portability rules. In contrast, on permissioned blockchains, the data owner can download their data using their digital private key and transfer it from one digital identity management platform to another, ensuring the freedom of data movement.

Maintaining a delicate balance between privacy and openness is essential in blockchain technology. The innate transparency of this technology has the potential to enhance security

Protection Law? (Luxembourg: Publications Office of the European Union, 2019), https://data.europa.eu/doi/10.2861/535.

[260] S. Qose, R. Zoltán, and B. Fregan, "Blockchain Technology in Healthcare Industry: Benefits and Issues," *2023 IEEE 17th International Symposium on Applied Computational Intelligence and Informatics (SACI)*, 2023, https://doi.org/10.1109/SACI58269.2023.10158669.

[261] Garry Gabison, "Policy Considerations for the Blockchain Technology: Public and Private Applications," *SMU Science and Technology Law Review* 19 (2016): 327.

[262] Ibid.

and foster confidence in various applications. However, it also raises privacy concerns for users, particularly in public blockchains such as Bitcoin and Ethereum, where transactions are publicly accessible. To address these challenges, ongoing efforts are needed to develop privacy-enhancing technologies, such as zero-knowledge proofs.[263]

2.1.2. Blockchain and Money Laundering

Money laundering has become a significant issue in recent years due to the globalization of capital and tax evasion. It causes substantial losses to national tax [264] revenues and can finance illegal activities. In this context, KYC (Know Your Client) regulations aim to detect and verify identities to prevent criminal financing.

Cryptocurrency service providers must adhere to the same rules that apply to banks and other financial institutions, given the exchange nature of cryptocurrencies.[265]

The determination of cryptocurrency as a concept is an important element for rule implementation, as it defines which regulations must be followed. In light of AML (Anti-Money Laundering) and KYC regulations, it can be argued that cryptocurrency is often treated as money. This is because it stores value, has an exchange rate with fiat currencies, and its decentralized nature makes the cryptocurrency market susceptible to use for money laundering purposes.

For instance, the FATF (Financial Action Task Force) 2010 report on new payment methods highlights the need for payment system providers[266] to implement robust measures. A closer look at Bitcoin, the most well-known cryptocurrency, reveals that it meets many of the conditions outlined in the FATF report, such as customer due diligence, usage limits, funding

[263] Salman Saleem Virani, "Blockchain End User Adoption and Societal Challenges: Exploring Privacy, Rights, and Security Dimensions," *Blockchain Letters*, May 7, 2024, https://doi.org/10.1049/blc2.12077.

[264] Financial Crime Academy, "Globalization and Money Laundering," 2023, accessed May 22, 2024, https://financialcrimeacademy.org/globalization-and-money-laundering/.

[265] Helga Danova, "KYC, AML, and Bitcoin," *CEX Blog*, July 20, 2014, accessed November 27, 2017, http://blog.cex.io/cryptonews/kyc-amland-bitcoin-6086.

[266] Financial Action Task Force (FATF), *FATF Report* (2010), p. 17, accessed March 20, 2020, http://www.fatf-gafi.org/.

methods, record-keeping, value limits, segmentation services, and geographical restrictions. However, there is no consensus on whether cryptocurrency is a payment system. Kevin argues that Bitcoin, conceived as a cryptocurrency and electronic cash, can reasonably be compared to more established forms of money[267] in proprietary analyses.

Some countries are well known for their offshore financial centers, which are renowned for providing corporate anonymity and concealing the identities of beneficial owners. Virtual currencies, like Bitcoin, have been used for money laundering due to the near impossibility of tracing their owners. Approximately 70% of global centralized cryptocurrency exchanges are established or located in offshore financial centers, which aim to attract financial operations by offering lenient rules and minimal or no taxation.[268]

Cybercriminals laundered $8.6 billion in cryptocurrencies in 2021, representing a significant 31% growth compared to 2020.[269] However, there are differing opinions on this issue. Cryptocurrencies are currently used for a very small percentage of crimes and are not the primary future threat that many claim. Traditional cash remains the real enemy in the fight against crime, as it continues to dominate due to its anonymity. It is more useful to criminals than cryptocurrency, which is traceable. Of course, another perspective is that the future of money is uncertain, and regulators must recognize that cryptocurrency is surrounded by more controversy than headlines suggest.[270]

In transnational money laundering involving cryptocurrencies, Bitcoin is commonly used along with alternative coins (such as stablecoins), and third-party currency exchanges (sometimes at DeXs) are frequently utilized to obscure illicit funds. However,

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[267] Kelvin F. K. Low and E. G., "Bitcoin and Other Cryptocurrencies as Property?" *Law, Innovation and Technology* 9, no. 2 (2017): 235–68.

[268] Roland Subashi, "Cryptocurrencies and Money Laundering," *Research Article*, May 20, 2024, https://doi.org/10.2478/bjir-2024-0005.

[269] J. Greig, "Report: Cybercriminals Laundered at Least $8.6 Billion Worth of Cryptocurrency in 2021," *ZDNet*, January 26, 2022, https://www.zdnet.com/finance/blockchain/cybercriminals-laundered-at-least-8-6-billion-worth-of-cryptocurrency-in-2021/.

[270] S. Butler, "Criminal Use of Cryptocurrencies: A Great New Threat or Is Cash Still King?" *Journal of Cyber Policy* 4, no. 3 (2019): 326–45, https://doi.org/10.1080/23738871.2019.1680720.

cryptocurrencies are mainly used in the early stages of money laundering due to their anonymity and ease of transfer but are often paired with fiat currencies due to their limited acceptance in the legal economy. Hence, the usage of multiple currencies complicates the detection of illicit funds.[271]

The link between cryptocurrency adoption and money laundering often focuses on the negative aspects of cryptocurrencies in the literature while ignoring their benefits, such as lowering transaction costs, increasing transaction speed, and expanding investment opportunities. A lack of standardized regulations for cryptocurrency transactions highlights the need for a regulatory framework to mitigate financial crimes associated with digital currencies.[272]

Some research shows that blockchain technology enhances anti-money laundering (AML) and sanctions compliance by optimizing KYC protocols and facilitating live monitoring of financial transactions. Nevertheless, the deployment of this technology is obstructed by obstacles such as legislative uncertainty, compatibility, privacy concerns, and scalability. To tackle these issues, it is necessary to have regulatory cooperation, create privacy technologies, and establish interoperability standards across the world. To fully use blockchain's potential in regulatory compliance, it is crucial to improve legal frameworks for smart contracts, blockchain scalability, and foster cross-sector cooperation among stakeholders.[273]

The use of blockchain technology in money laundering, specifically in the context of payment and asset tokens, has the potential to result in three outcomes: first, it may prompt existing money launderers to adopt other techniques without causing a net rise in overall

[271] C. Leuprecht, C. Jenkins, and R. Hamilton, "Virtual Money Laundering: Policy Implications of the Proliferation in the Illicit Use of Cryptocurrency," *Journal of Financial Crime*, forthcoming, https://doi.org/10.1108/JFC-07-2022-0161.

[272] A. Guidara, "Cryptocurrency and Money Laundering: A Literature Review," *Corporate Law & Governance Review* 4, no. 2 (2022): 36–41, https://doi.org/10.22495/clgrv4i2p4.

[273] Varun Jain, Anandaganesh Balakrishnan, Pradeep Chintale, Sivanagaraju Gadiparthi, and Madhavi Najana, "Blockchain Empowerment in Sanctions and AML Compliance: A Transparent Approach," *International Journal of Computer Trends and Technology* 72 (2024): 11–26, https://doi.org/10.14445/22312803/IJCTT-V72I5P102.

instances; second, it might attract new individuals to engage in money laundering if the benefits outweigh the risks; and third, it may sustain the present levels of money laundering if the advantages of using blockchain are not significant enough to drive a notable increase. If blockchain does not provide any benefits compared to conventional techniques, its adoption and influence on money laundering will likely remain negligible.[274]

As we discussed above, market opinion sometimes indicates that blockchain technology enhances anti-money laundering (AML) and sanctions enforcement. However, overcoming these concerns necessitates regulatory cooperation and worldwide connectivity standards. In order to maximize blockchain's potential, it is essential to improve intersectoral collaboration among stakeholders. It is important to understand that money laundering is not exclusive to cryptocurrencies. For example, in 2020 alone, banks globally incurred fines totaling $10.4 billion for money-laundering violations.[275] Legislators and regulators must comprehend blockchain's fundamental concepts and technological characteristics to create effective legal frameworks that prevent abuse without slowing innovation through excessive administrative hurdles.

In sum, AML and KYC policies and their impacts on the cryptocurrency market will be investigated in greater depth. The cryptocurrency market and exchange providers are among the first respondents to AML and KYC regulations.

2.1.3. Blockchain and Jurisdiction

In this section, the discussion will focus on jurisdictional preferences in blockchain-based smart contracts and transactions on distributed ledgers.

Blockchain’s infrastructure enables users to create smart contracts implemented in a decentralized manner, without the presence of a third party. All transactions on the

[274] L. Müller, I. Langenegger, and S. Kem, “Blockchain-Based Assets and Anti-Money Laundering: A Law and Economic Analysis,” *Working Paper*, July 30, 2020.

[275] Zippia, “34 Money Laundering Statistics [2023]: How Much Money Gets Laundered Every Year?” last modified July 27, 2023, https://www.zippia.com/advice/money-laundering-statistics/.

blockchain are entirely independent of the locations of the participants.[276] Hence, determining jurisdictional authority faces challenges due to the anonymity of parties, the decentralized storage of large computer networks, and unspecified values exchanged. Much of the current debate revolves around whether transactions in smart contracts can be evaluated as "goods" under the United Nations Convention on Contracts for the International Sale of Goods (CISG).[277]

The dramatic rise in international capital flows seemingly anticipates a future where multinational companies may develop their own regulatory frameworks, freely operating while avoiding the constraints of state-made law.[278] Thus, deeper research is required to understand how state and international law would apply to transactions conducted through blockchain infrastructure.

With the recent developments in smart contracts, parties can devise mechanisms whereby disputes on agreements could be resolved by private adjudicators through self-enforcing decisions. The enactment of these decisions does not depend on state-controlled recognition and enforcement procedures.[279]

The possibility of non-centralized blockchain jurisdictions is under discussion. However, the enforcement of verdicts poses challenges for dispute resolution, especially when contrasted with state-recognized private international arbitrations such as those conducted at the Swiss or London Arbitration Centers. Some suggest using smart contracts for automatic enforcement but acknowledge the limitations due to cryptocurrency volatility. The potential need for state intervention as a backup in cases of non-compliance is also highlighted,

[276] S. K. Chauhan, "Blockchain Technology - An Introduction," *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, 2019, https://doi.org/10.22214/ijraset.2019.6161.

[277] S. Breu, "Are Blockchains and Cybercurrencies Demanding a New Legislative Framework?" *Law and Digital Economy* (2018), p. 13.

[278] Susan Strange, *The Retreat of the State: The Diffusion of Power in the World Economy* (Cambridge: Cambridge University Press, 1996).

[279] P. Ortolani, "The Judicialization of the Blockchain" (2018).

referencing examples such as Chinese or EU online dispute resolution mechanisms. This raises questions about integrating private and state jurisdictions into smart contract design.[280]

To create legitimate non-centralized blockchain arbitration, it is essential to discuss the New York Arbitration Convention, which has 161 state parties as of January 2020. This convention ensures the recognition and enforcement of foreign arbitral awards under specific conditions. While blockchain arbitration centers have the potential to meet these standards, it must be clarified whether smart contracts align with the convention's requirements. This alignment requires further examination.

Parties seek the best institutional governance method to resolve disputes with consideration of the cost and time of the solution, and it will be discussed even if a blockchain-based dispute resolution mechanism is designed as private arbitration.

2.1.4. Blockchain and Tax Regulations

The implementation of tax rules for transactions on blockchain plays an important role in today's discussions on blockchain. Lindquist argues that by classifying cryptocurrencies as money, private money, taxable vouchers, or any kind of financial instrument, governments can bring cryptocurrencies within their current tax laws.[281]

In 2014, VAT exemption lay at the heart of the discussion on cryptocurrencies. In 2015, the Court of Justice of the European Union described Bitcoin as a digital currency rather than a good and stated that cryptocurrency transactions should be exempt from VAT, similar to banknotes, currency, and coins used as legal tender. The decision stated:

> *VAT Directive must be interpreted as meaning that the supply of services such as those at issue in the main proceedings, which consist of the exchange of traditional*

[280] B. Gürcan, "Jurisdiction on the Blockchain," in *Proceedings of the ICBEMM-ICISSS 2020* (March 2020), p. 14 (FLE Learning, ISBN 978-1-913016-27-2).

[281] Aaron Lindquist, "Funny Money: Why Bitcoin Does Not Warrant Increased Governmental Regulation," *Journal of Global Justice and Public Policy* 1 (2014): 79–114.

currencies for units of the 'bitcoin' virtual currency and vice versa, performed in return for payment of a sum equal to the difference between, on the one hand, the price paid by the operator to purchase the currency and, on the other hand, the price at which he sells that currency to his clients, are transactions exempt from VAT.[282]

Ainsworth and Schact encourage debate about using blockchain technology to tackle tax fraud. They claim that blockchain databases can track commercial transactions and address taxation frauds through their decentralized nature.[283]

Anti-money laundering regulations are one of the subfields of blockchain and tax regulations. Due to money laundering, states lose taxable income worldwide, estimated to total between $800 billion and $2 trillion annually, which accounts for 2–5% of global GDP.[284]

Current research appears to validate the view that for taxation purposes, cryptocurrencies would be recognized as money.

We keep this section brief since we have covered the tax aspects of blockchain in many chapters of our research.

2.1.5. Blockchain and IP Law

One of the most promising features of blockchain technology is its potential for intellectual property rights (IPR) protection, particularly through transparent timestamping and a decentralized, secure proof system.

There are several applications of blockchain technology in the field of intellectual property law, including: Utilizing blockchain technology for the registration of intellectual property (IP) rights; administering IP rights, including licensing and identifying right holders;

[282] Court of Justice of the European Union, *Skatteverket v. David Hedqvist*, Case C-264/14, October 22, 2015.

[283] Richard T. Ainsworth and Andrew Shact, "Blockchain (Distributed Ledger Technology) Solves VAT Fraud," *Law & Economics Working Paper* No. 16-41, June 20, 2016.

[284] United Nations, "Money-Laundering and Globalization," accessed April 10, 2020, https://www.unodc.org/unodc/en/money-laundering/globalization.html.

conducting investigations on IP infringement; and addressing enforcement concerns and combating counterfeiting.

Copyright is a crucial part of intellectual property rights. Today, copyright management is mostly organized by intermediaries. However, it is possible to create agentless protection for copyright management. The connection between blockchain and copyright, however, is more complex. Copyright protection does not require registration, but it is enforceable in certain jurisdictions. In this context, blockchain may serve as an optional tool rather than an essential one, enabling producers to create a verified timestamp for their work's creation without replacing conventional copyright standards. Blockchain enhances copyright management by enabling transparent tracking of activities along the value chain and automating royalty payments to stakeholders, including writers, performers, and labels, via smart contracts. The blockchain system can ensure prompt payments in contrast to traditional procedures. Additionally, blockchain can manage rights ownership by recording the holders of specific rights, determining their respective percentages, and monitoring transfers while also enabling royalty calculations based on these specifics, including chronological and geographical elements.[285]

Blockchain platforms could allow rights holders to become intermediaries themselves or disintermediate the relationship between users and rights holders. Blockchain protocols operate across jurisdictions, eliminating the territorial complexities and inconsistencies of national collective licensing systems and reciprocal relationships.[286]

Using blockchain technology to distribute copyrights has advantages such as accessibility to copyright ownership data, traceability of subsequent changes, and transparency. However,

[285] Roberto García, Ana Cediel, Mercè Teixidó, and Rosa Gil, "A Review of Media Copyright Management Using Blockchain Technologies from the Academic and Business Perspectives," *arXiv preprint*, arXiv:2307.16244 (2023), https://arxiv.org/abs/2307.16244.

[286] Annabel Tresise, Jake Goldenfein, and Dan Hunter, "What Blockchain Can and Can't Do for Copyright," *Australian Intellectual Property Journal* 28 (2018): 144, https://ssrn.com/abstract=3227381.

it also raises potential issues, such as aligning copyright management on blockchain with the jurisdictional privileges of state authorities.[287]

Another discussion focuses on how to identify responsible parties to address copyright infringement. Providing affordable licenses for software developers of decentralized applications, such as distributed ledgers, could enable copyright holders to influence the decentralized culture in their favor.[288]

Removing content from a public blockchain is another challenge. In cases where copyrighted material must be removed due to infringement, there are four entities to consider: the original poster of the copyrighted materials, the Intermediary Service Providers (ISP), the public blockchain's creator, or subsequent downloaders.[289]

Collective rights management organizations (CMOs) provide services to track copyright infringements and take protective actions. However, CMOs have faced criticism over the years for their lack of transparency, delays in royalty payments, abuse of monopoly positions, and inefficiency.[290] Blockchain-based CMO models could offer an alternative solution.

Confidentiality-required services related to IP rights, such as trade secret protections or patent applications, could be executed through blockchain infrastructure by encrypting data securely on the chain with a transparent and exact time-proven node system. These systems can verify the existence and ownership of data while maintaining confidentiality. However, the trade secret requirement acts as a gatekeeper to ensure the law encourages disclosure of certain information, which might otherwise remain secret, while channeling inventors of

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[287] Alexander Ivanovitch Savelyev, "Copyright in the Blockchain Era: Promises and Challenges," *Higher School of Economics Research Paper* No. WP BRP 77/LAW/2017, November 21, 2017, https://ssrn.com/abstract=3075246.

[288] Nick Vogel, "The Great Decentralization: How Web 3.0 Will Weaken Copyrights" (2015).

[289] Garry Gabison, "Policy Considerations for the Blockchain Technology Public and Private Applications," *SMU Science and Technology Law Review* 19 (2016): 327.

[290] Daniel J. Gervais, *Re(structuring Copyright* (Cheltenham, UK: Edward Elgar Publishing, 2017), n. 69, ch. 11.

self-disclosing products toward the patent system.[291] This could conflict with the inherent transparency of blockchain technology.

Blockchain can also be applied to Artificial Intelligence Generated Content (AIGC). AIGC-Chain gathers and stores data throughout the lifecycle of AIGC products on the blockchain, leveraging its immutability and distributed nature to ensure secure storage and traceability of AIGC copyrights. This provides significant data support for managing copyright ownership.[292]

In 2018, the European Parliament discussed the potential of blockchain to improve processes related to the privacy and confidentiality of data exchanges, including access to online government services through decentralized digital identity. The European Parliament proposed that blockchain could enable greater transparency, streamlined processing of information, and the development of more secure services to store citizens' data securely and flexibly. They also highlighted the potential of blockchain to "digitalize" creative content via a permitted blockchain network shared among Member States. Furthermore, they emphasized that blockchain could enhance intellectual property tracking and management while facilitating copyright and patent protection.[293]

[291] Mark A. Lemley, "The Surprising Virtues of Treating Trade Secrets as IP Rights," *Stanford Law School* (2008), https://law.stanford.edu/wp-content/uploads/sites/120/2018/04/The-Surprising-Virtues-of-Treating-Trade-Secrets-as-IP.pdf.

[292] Jiajia Jiang, Moting Su, Xiangli Xiao, Yushu Zhang, and Yuming Fang, "AIGC-Chain: A Blockchain-Enabled Full Lifecycle Recording System for AIGC Product Copyright Management," *arXiv preprint*, arXiv:2406.14966 (2024), https://arxiv.org/pdf/2406.14966.

[293] European Parliament, "Resolution of 3 October 2018 on Distributed Ledger Technologies and Blockchains: Building Trust with Disintermediation (2017/2772(RSP))," http://www.europarl.europa.eu/doceo/document/TA-8-2018-0373_EN.pdf?redirect.

Regulators may initiate the first step by officially recognizing blockchains and establishing the criteria that blockchains must fulfill to gain legal recognition. The International Organization for Standardization (ISO) has already begun the process of standardization.[294]

There are several in-depth discussions about blockchain and IP law. One of them pertains to database regulations. According to Directive 96/9/EEC (European Economic Community), blockchain is classified as a database since it arranges data into blocks. Copyright could be applicable if the arrangement is unique; however, block arrangements often lack creativity on the blockchain. The sui generis right safeguards the blockchain as a mechanism for storing and transmitting data, with all nodes acting as collective proprietors. The substantial allocation of resources toward validating and upholding the accuracy of data underscores the need for this safeguard mechanism, especially for prominent investors and miners involved in public blockchain applications.[295]

When discussing IP law and blockchain, significant conversations are also taking place within the metaverse due to its nature as a digital representation of the real world. The growth of the metaverse on the blockchain is promising, but IP law issues remain problematic. Legal frameworks must evolve to rethink copyright rules for virtual creations and adapt intellectual property enforcement mechanisms to the decentralized digital world. Effective IP protection across nations also requires international legal collaboration in terms of enforcement.[296]

For example, in the USA, there have been several court cases concerning the protection of IP rights in blockchain environments. One prominent case is Hermès International v. Rothschild, where Mason Rothschild created and sold MetaBirkin non-fungible tokens (NFTs) in 2021 that resembled Hermès' iconic fur Birkin bags. Rothschild claimed First Amendment rights, while Hermès sued for trademark infringement and dilution. Judge

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[294] Gonenc Gurkaynak, İlay Yılmaz, Burak Yeşilaltay, and Berk Bengi, "Intellectual Property Law and Practice in the Blockchain Realm," *Computer Law & Security Review* 34, no. 4 (August 2018): 847–62, https://doi.org/10.1016/j.clsr.2018.05.027.

[295] Eleni Tzoulia, "The Blockchain Ecosystem in the Light of Intellectual Property Law" (PhD diss., 2022), accessed May 22, 2024, https://www.jipitec.eu/archive/issues/jipitec-13-3-2022/5560.

[296] Gonenc Gurkaynak, İlay Yılmaz, Burak Yeşilaltay, and Berk Bengi, "Intellectual Property Law and Practice in the Blockchain Realm," *Computer Law & Security Review* 34, no. 4 (August 2018): 847–62, https://doi.org/10.1016/j.clsr.2018.05.027.

Rakoff denied Rothschild's dismissal in May 2022, noting that digital commodities are subject to standard intellectual property evaluations. In June 2023, Rothschild was found guilty of deceiving consumers regarding Hermès' sponsorship of his products.[297]

Proper licensing is necessary when using third-party IP in digital goods, rather than relying on fair use principles. Artists and companies should expand trademark protections to virtual worlds. As IP protection issues in digital spaces increase, applying the same legal IP principles to NFTs and digital art as in the physical world is crucial to ensuring the protection of IP rights.[298]

The concept of decentralized and irreversible records of ownership has several advantages but also presents challenges, such as authenticating rightful ownership without centralized procedures. Current centralized systems, although lacking in speed, verify ownership assertions effectively. Concerns surrounding decentralized registration systems in the future[299] should be addressed.

In our study, we discussed blockchain structures as private, public, etc. In this context, one of the challenges of IP law on blockchain is enforcement. Harmonizing blockchain technology with legal mandates while preserving its benefits is challenging. Two potential solutions include granting government authorities superuser privileges to alter blockchain material on private blockchains—which undermines the robustness of the blockchain—and implementing offline enforcement of judgments via conventional legal claims, which is inefficient and diminishes national jurisdiction in the digital realm. It is anticipated that governments will prioritize the superuser technique for private blockchains.[300]

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[297] *Hermès International and Hermès of Paris, Inc. v. Mason Rothschild*, Case No. 1:22-cv-00384 (S.D.N.Y. 2023).

[298] Alanna Sadler, "Legal Uncertainty in Virtual Worlds and Digital Goods: Do the Same Laws Apply?" *University of Miami Business Law Review* 32, no. 3 (n.d.): 381, https://repository.law.miami.edu/umblr/vol32/iss3/7.

[299] Andres Guadamuz, "Smart Contracts, Blockchain and Intellectual Property: Challenges and Reality" (University of Sussex, 2020), https://hdl.handle.net/10779/uos.23466527.v1.

[300] Alexander Ivanovitch Savelyev, "Copyright in the Blockchain Era: Promises and Challenges," *Higher School of Economics Research Paper* No. WP BRP 77/LAW/2017, November 21, 2017, https://ssrn.com/abstract=3075246 or https://doi.org/10.2139/ssrn.3075246.

On these grounds, we can state that efforts are underway to explore blockchain's potential for improving IP rights protection. Organizations like the World Intellectual Property Office (WIPO) and the European Union Intellectual Property Office (EUIPO) are working on the idea of smart IP registries. The consensus appears to be that, in the coming years, IP rights protection through distributed ledger technology will be a significant area of focus.

2.1.6. Blockchain and Criminal Law

Today, the cryptocurrency market has a market cap of approximately $196 billion with 5,332 different cryptocurrencies.[301].

The cryptocurrency market draws significant attention due to the potential misuse of cryptocurrency transfers for financing criminal activities. The anonymity offered by cryptocurrencies provides conditions more favorable than established payment methods, making them attractive for purposes such as money laundering (ML), terrorist financing, or tax evasion.[302]

The concept of the Initial Coin Offering (ICO) has garnered substantial attention from lawmakers and various institutions due to its popularity and numerous instances of fraud. ICOs can be described as the crowdfunding of blockchain-related projects, often involving the presale of a project's cryptocurrency. In some ICOs, these cryptocurrencies represent company shares or promise profits similar to Initial Public Offerings (IPOs). Consequently, many countries have taken action to either ban ICOs entirely or impose restrictive conditions similar to IPO regulations. For example, Ecuador, Cambodia, and Nigeria have prohibited cryptocurrency transactions for banks and financial institutions to prevent money laundering under their AML policies.

[301] "Number of the Cryptocurrencies at the Market," 2020, https://coinmarketcap.com, accessed April 14, 2020.

[302] Lennart Ante, "Cryptocurrency, Blockchain, and Crime," in *The Money Laundering Market: Regulating the Criminal Economy*, ed. Killian J. McCarthy (Newcastle upon Tyne, UK: Agenda Publishing, 2018), 171–98.

Regulatory technology (Reg-Tech) can be employed to combat terrorist financing worldwide.[303] The potential use of blockchain systems by the Financial Action Task Force (FATF) to combat terrorist financing is an area of exploration. The limitations of FATF's risk-based approach under the Anti-Money Laundering and Combating the Financing of Terrorism (AML/CFT) provisions and their impacts should also be discussed.

When analyzing criminality within the blockchain ecosystem, financial crimes are often a primary concern. Cryptocurrency's close association with blockchain technology places it at the forefront of discussions in criminal law. This research will analyze several rules concerning the criminal implications of the blockchain ecosystem.

2.1.7.- The Tax Framework of Cryptocurrencies

This section will discuss the tax framework for cryptocurrencies. When addressing cryptocurrency taxation, the first consideration is taxation if the cryptocurrency is generated for commercial purposes. Mining provides a starting point for this discussion. As discussed above, cryptocurrency mining involves providing energy to the blockchain system through specific equipment investments. Two primary considerations define the legality of mining: the service platform to which energy is supplied and the compatibility of mining activities with the infrastructure of the location where they occur.

For instance, providing energy to a system engaged in illegal activities could result in indirect liability. This process is analogous to the responsibilities of web hosting service providers. Companies that provide hosting services are generally not responsible for the purposes to which their servers[304] are used. For example, if a hacker conducts illegal activities using a hosting company's servers, the hosting company is not directly liable.

Tax regulations were the first to address cryptocurrency miners. Cryptocurrency miners are subject to tax liability in two ways: The first way is when the earnings from mining activities,

303 Iwa Salami, "Terrorism Financing with Virtual Currencies: Can Regulatory Technology Solutions Combat This?" *Studies in Conflict & Terrorism* 41, no. 12 (2018): 968–89.

304 F. Wilman, "Responsibility of Intermediaries for Third Party Content: The European Union Approach," *JIPITEC - Journal of Intellectual Property, Information Technology and E-Commerce Law* 12, no. 3 (2021), https://www.jipitec.eu/archive/issues/jipitec-12-3-2021/5343/wilman_pdf.pdf, accessed July 17, 2024.

and the second one is when earnings originate from the purchase and sale of these cryptocurrencies.

Countries differ in their approaches to taxing cryptocurrencies. In the United States, the Internal Revenue Service (IRS) classified cryptocurrencies as goods in an official 2014 announcement. According to this classification, cryptocurrencies are taxed under the same standards as general goods.[305]

For example, profits and losses from the sale of cryptocurrencies can be reported as income and expenses. Cryptocurrencies held for one year or less result in short-term gains or losses, while those held for more than one year are treated as long-term gains or losses.

According to the IRS, expenses such as brokerage commissions or transfer fees incurred during cryptocurrency transactions can also be deducted as expenses.[306] . When purchases are made with cryptocurrencies, the exchange rate is calculated based on the price of the purchased goods. This is treated as if the cryptocurrency was sold, and earnings are taxed accordingly. For instance, if you use BTC purchased for $100 to make a $200 purchase (e.g., buying pizza), you must declare $100 as income and pay taxes on the earnings. The income tax rate depends on how long the cryptocurrency was held.

To better understand cryptocurrency taxation, the IRS guidelines provide valuable insights. The IRS defines digital assets as any digital representation of value recorded on an encrypted, secure distributed ledger (DLT) or similar technology. This definition includes, but is not limited to, cryptocurrencies, convertible virtual currencies, stablecoins, and non-fungible tokens (NFTs).

These digital assets are not categorized as real currency or fiat currency, as they are not issued by a central government bank of any country.

[305] Ibid.

[306] Internal Revenue Service, *Publication 550: Investment Income and Expenses (Including Capital Gains and Losses)* (Washington, D.C.: Department of the Treasury, 2023).

Tax consequences arise from the following taxable transactions: selling digital assets for real/fiat currency, trading one digital asset for another digital asset, exchanging digital assets for goods, property, or services, receiving digital assets as payment, staking, hard forks, airdrops (explained further below), and mining activities.

Some of the IRS's guides on the taxation of cryptocurrencies propose Section 6045 Regulations[307], which set requirements for brokers to report certain sales and exchanges of digital assets. These rules aim to align the tax reporting of digital assets with that of other financial instruments, such as stocks. Another key guideline, as mentioned above, is IRS Notice 2014-21 & 2023-34, which provides tax treatment for transactions using convertible virtual currencies, treating them as property. The most recent addition is IRS Notice 2023-27, offering specific guidance on the tax treatment of non-fungible tokens (NFTs).[308]

Digital asset incomes also fall under revenue rulings related to hard forks and staking rewards. Additional regulations about cryptocurrency taxation are referenced in various IRS publications, addressing income, charitable contributions, capital assets, asset basis computation, and the valuation of donated property.

In the following sections of our research, we will discuss specific tax practices in different countries in greater detail.

Taxation of Cryptocurrency Mining

Based on current evidence, it seems reasonable to conclude that if cryptocurrency is earned through a reward mechanism as a result of mining activity, this gain is considered income derived from a service or sale provided.[309] Moreover, it will be subject to income tax based on the market value of the cryptocurrency on the date of receipt.

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[307] 26 U.S. Code § 6045 - Returns of Brokers, accessed June 6, 2024, https://www.law.cornell.edu/uscode/text/26/6045.

[308] Internal Revenue Service, "Treatment of Certain Nonfungible Tokens as Collectibles," accessed June 6, 2024, https://www.irs.gov/pub/irs-drop/n-23-27.pdf.

[309] Burak Can, Jens Leth Hougaard, and Mohsen Pourpouneh, "On Reward Sharing in Blockchain Mining Pools," Maastricht University, Graduate School of Business and Economics, 2021, https://doi.org/10.26481/umagsb.2021009.

As previously discussed, while outlining the legal framework of mining activity, we now focus specifically on the taxation approach. If you are generating income through cryptocurrency mining, the steps to consider from a tax perspective include:

- The purchase cost of the relevant cryptocurrency,
- The duration for which the relevant cryptocurrency has been held,
- The sale price of the relevant cryptocurrency, and
- Maintaining accurate records related to these transactions.

If you are engaging in cryptocurrency mining professionally, expenses related to mining—such as equipment, internet connection, and energy costs—can be deducted as business expenses.[310] To calculate tax liabilities arising from cryptocurrency earnings in different countries, service providers such as Tokentax.co and Koinly.io may be useful.

International Perspectives on Cryptocurrency Taxation

Although the primary aim of this dissertation is to provide a broad framework for understanding cryptocurrency taxation, it is also necessary to examine specific conditions on a country-by-country basis. As cryptocurrency taxation is still a developing field, the rules and regulations can change rapidly. Understanding the fundamental logic behind taxation is therefore essential.

Data available on the subject indicates that not all activities related to cryptocurrencies are subject to taxation. For example, in Germany, you are not obligated to pay taxes under the following conditions:

1- Buying cryptocurrency with legal currencies,
2- Holding your cryptocurrency,

[310] Y. Zhang, X. Li, Y. Wang, and J. Liu, "Understanding the Impact of Urbanization on Ecosystem Services: A Case Study of the Yangtze River Delta," *PLOS ONE* 18, no. 3 (2023): e0283687, https://doi.org/10.1371/journal.pone.0283687.

3- Transferring cryptocurrencies between wallets that belong to you,
4- Receiving cryptocurrency as a gift or donation up to €20,000, and
5- Donating cryptocurrencies to charitable organizations.

If you are trading cryptocurrency as an individual in Germany and realize a profit between the purchase and sale, this profit will be subject to income tax. However, if the holding period of the cryptocurrency exceeds one year, it will not be subject to income tax.[311] Additionally, profits from sales up to €600 in value are exempt from income tax.[312] In Germany, the profit from cryptocurrency mining is assessed differently from standard income tax and is classified as a commercial activity.[313] The distinction between mining cryptocurrencies as a hobby versus conducting it as a business will determine the tax treatment applied.

As explained above, incomes through Decentralized Finance (DeFi) activities are taxable, and the swap or sale of NFTs within a year is subject to income tax unless held for longer than a year.

The Bundeszentralamt für Steuern (BZSt), Germany's tax authority, publishes guidelines to ensure compliance and outlines the details of potential fines and penalties for tax evasion.

Based on the current data available, it seems fair to suggest that income is taxed in specific categories. Of course, each country's interpretation may differ. Additionally, earnings made through forks, which can occur in cryptocurrencies, may also be subject to tax in some jurisdictions. The critical issue here is the ability to predict where current tax regulations and the cryptocurrency ecosystem overlap.

The United Kingdom is known for its fintech startups and companies. Cryptocurrency-related services have drawn significant attention from British startups, which is why Her

[311] CoinLedger, "Crypto Tax in Germany," accessed June 6, 2024, https://coinledger.io/guides/crypto-tax-germany.
[312] KPMG, "Flash Alert 2022-123: Tax Treatment of Cryptocurrencies," June 2022, https://kpmg.com/xx/en/home/insights/2022/06/flash-alert-2022-123.html, accessed July 17, 2024.

[313] Germany, Bundesministerium der Finanzen, "Ertragsteuerrechtliche Behandlung von virtuellen Währungen," May 9, 2022.

Majesty's Revenue and Customs (HMRC) has clarified many aspects of cryptocurrency taxation.

The UK's approach to cryptocurrency taxation is governed by HMRC.

Capital Gains Tax (CGT) in the UK applies in cases of selling, swapping, gifting, using crypto for payment, or converting crypto to fiat. A person may be subject to CGT if the cryptocurrency asset has increased in value. The tax-free allowance for capital gains in the UK is £12,300 for individuals, which includes cryptocurrency earnings.[314]

Earnings from cryptocurrency staking, receiving crypto as employment income, and mining are subject to Income Tax in the UK. The specific rate of income tax depends on the individual's total income level[315] Another obligation for cryptocurrency investors is record-keeping and reporting. HMRC requires detailed records of all crypto transactions, including the types and dates of each transaction, their values in GBP,[316] and the parties involved—even if it's just the wallet address of the other party. Besides tax purposes, this is also crucial for compliance with anti-money laundering regulations.

Cryptocurrency airdrops received in exchange for a service are also subject to Income Tax in the UK.[317] The taxation of hard forks depends on whether new cryptocurrencies are received, with such instances generally not being taxable unless new assets are involved.[318]

[314] CoinLedger, "Crypto Tax in the UK," accessed June 6, 2024, https://coinledger.io/guides/crypto-tax-uk.

[315] HM Revenue & Customs (HMRC), "Check if You Need to Pay Tax When You Receive Cryptoassets," last modified April 20, 2023, accessed July 17, 2024, https://www.gov.uk/guidance/check-if-you-need-to-pay-tax-when-you-receive-cryptoassets.

[316] HM Revenue & Customs (HMRC), "Cryptoassets Manual: Crypto10400 - Record Keeping and Reporting Requirements," accessed July 17, 2024, https://www.gov.uk/hmrc-internal-manuals/cryptoassets-manual/crypto10400.

[317] HM Revenue & Customs (HMRC), "Cryptoassets Manual: Airdrops," last modified December 2, 2022, accessed July 17, 2024, https://www.gov.uk/hmrc-internal-manuals/cryptoassets-manual/crypto21250.

[318] Ibid.

Australia is another pioneer in cryptocurrency taxation. The Australian Taxation Office (ATO) has published clear guidelines for cryptocurrency taxation, focusing on accurate reporting obligations and compliance.

Capital Gains Tax (CGT) in Australia functions similarly to that in the UK, except where cryptocurrency is held as trading stock in a business. Mining income is taxable, as in other countries. For personal use of cryptocurrency, such as purchasing goods or services under AUD 10,000, transactions are exempt from CGT. The ATO also mandates detailed record-keeping, much like in the UK.[319]

One noteworthy practice in Australia is the distinction between personal-use assets and investment or business activities. Specific guidelines clarify how this distinction affects an individual's tax obligations.[320]

The USA, UK, Germany, and Australia provide specific guidelines and rules for the taxation of cryptocurrency transactions. Germany's rules favor long-term holdings with tax exemptions to discourage fast buy-sell activities, aiming to protect the cryptocurrency market from high volatility. Australia, on the other hand, makes a clear distinction between personal use and investment purposes.

Compliance and detailed record-keeping are essential in almost all jurisdictions to navigate the tax implications of cryptocurrency activities effectively. These records also ensure adherence to related financial obligations, such as anti-money laundering laws.

In the following sections of our research, we will continue to explore official guidelines and the varied approaches to cryptocurrency taxation in other jurisdictions, alongside their associated regulatory frameworks.

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[319]Australian Taxation Office (ATO), "Crypto Asset Transactions," accessed June 6, 2024, https://www.ato.gov.au/individuals-and-families/investments-and-assets/crypto-asset-investments/transactions-acquiring-and-disposing-of-crypto-assets/crypto-asset-transactions.

[320] Australian Taxation Office (ATO), "Crypto Asset as a Personal Use Asset," accessed July 17, 2024, https://www.ato.gov.au/individuals-and-families/investments-and-assets/crypto-asset-investments/crypto-asset-as-a-personal-use-asset.

2.1.8. Legal Framework of Cryptocurrency Mining

First regulations on cryptocurrency mining focus on the taxation aspect of the activity. It can be divided into three main regulatory approaches by the countries. Respectively, the first approach is to regulate activity to avoid any tax evasion, money laundering, and protect energy supply. The second approach is a more restrictive approach, either banning the activity or making it harder. The third approach is without specific regulations regarding mining activity, more like any commercial activity.

There are two ways of cryptocurrency earnings taxation, namely earnings following mining activity and earnings resulting from purchase and sale differences, i.e., profit. Another form might be from commercial activities, such as taxation of commissions from marketplaces. In terms of mining activity, miners receive free cryptocurrency in exchange for their investment in mining activity with energy provision and equipment investment. In general, profit calculation is based on the value of cryptocurrency when received.

In the case of making a profit from cryptocurrency trade, tax calculation is made based on the following indicators:

- Purchase cost of the cryptocurrency (market value after commissions, etc.)
- Time of holding cryptocurrency
- Sale value of the cryptocurrency
- And records related to all of the above.[321]

In the case of mining with a commercial aim, it is possible to deduct expenses such as connection fees, energy costs, staff wages, and equipment costs. The legal framework of mining is regulated differently by country. In cases where cryptocurrencies are banned, mining activity may mean providing a service to an illegal activity. Hence, mining is forbidden, while if cryptocurrency is not illegal (or not regulated at all), mining activity will be carried out under the general conditions of doing business. Mining activity has similarities with hosting service providers since hosting companies do not carry responsibility for what

[321] TokenTax, "How to Calculate Crypto Taxes for Gains and Losses," July 1, 2024, accessed July 17, 2024, https://tokentax.co/blog/how-to-calculate-your-crypto-taxes.

they host. No doubt that they should collaborate with official bodies, but it might be said that it is similar to mining activity as well. Due to increased prices of energy production, some countries may ban or limit cryptocurrency mining activities since it requires a large amount of energy. Despite that, technological improvements help to decrease the energy consumption of mining activity.

In the example of Germany, income derived from cryptocurrency mining is accepted as a commercial activity.[322] Nevertheless, there is still a division between mining for commercial purposes and as a hobby. Taxation logic in Germany works as follows in the crypto industry:

- Regular payment receiving – salary
- Income derived from cryptocurrency – income
- Payment received in cryptocurrency – income or salary
- Awards based on reference – commission
- Awards based on share – dividend
- DeFi (Decentralized Finance) interest incomes – interest[323]

Besides that, a fork of cryptocurrency may cause taxation. In the example of the United States of America, an official announcement by the Internal Revenue Service (IRS) in 2014 shaped the categorization of cryptocurrencies and classified them as goods, meaning taxation of cryptocurrencies would be based on the general taxation standards for goods.[324]

In general, the tax on goods is calculated with the purchase price minus expenses and price increase to determine profit. The system is designed to avoid speculation. Hence, if the owner keeps the goods for up to one year, it is calculated as short-term income, while holding for over one year is accepted as long-term income.

[322] Germany, Bundesministerium der Finanzen (Federal Ministry of Finance), "Draft Decree on the Tax Treatment of Cryptocurrencies," 2021.

[323] Plisio, "Germany Crypto Tax Guide in 2024," April 3, 2024, accessed July 17, 2024, https://plisio.net/blog/germany-crypto-tax-guide.

[324] Internal Revenue Service (IRS), "Notice 2014-21, 2014-16 I.R.B. 938," accessed June 6, 2024, https://www.irs.gov/pub/irs-drop/n-14-21.pdf.

According to the IRS announcement, it is possible to deduct expenses for transfers and market commissions from the profit. Of course, the calculation must be made based on the exchange rate between fiat currency and cryptocurrency.

In Germany, German taxation regulations stipulate that under the circumstances below, you are exempt from tax payments:

- Purchase of cryptocurrency with fiat currencies
- Holding cryptocurrency
- Transfer of cryptocurrency among the personal wallets,
- Cryptocurrency donation or gift up to €20.000
- Donations to the Charities[325]

In Germany, individuals and companies are responsible for the profit generated from the difference between the purchase and sale price of cryptocurrencies. Nevertheless, if the cryptocurrency is held for over one year, this profit will not be subject to income tax. In addition, sales of up to €600 are exempt from income tax. Cryptocurrency mining income is calculated as commercial income rather than personal income. Again, there is a distinction between mining with a commercial aim and as a hobby.[326]

2.2. Regulative Approaches to Blockchain

The general idea of this research is to provide a general outlook on the blockchain ecosystem and discuss existing regulatory approaches to this emerging technology. However, regulatory approaches to blockchain technology vary significantly from country to country, reflecting the diverse economic, legal, and technological landscapes shaped by each country's policies. Below, we will discuss the approaches of several countries to provide a comparative perspective regarding the blockchain ecosystem. However, the remainder of the research will focus on more specific approaches in a detailed manner.

[325] Germany, Bundesministerium der Finanzen, "Einzelfragen zur ertragsteuerrechtlichen Behandlung von virtuellen Währungen und von sonstigen Token," May 9, 2022, accessed July 17, 2024.

[326] Koinly, "Crypto Tax in Germany: The Complete Guide," accessed June 6, 2024, https://koinly.io/guides/crypto-tax-germany/.

It is important to examine legal systems and efforts to make blockchain more sustainable. As mentioned above, due to several energy crises, governments might adopt more restrictive stances on mining activities. Many Bitcoin (BTC) mining operations relocate to regions with lower energy costs; however, this brings risks as well. [327] For instance, in response to the Chinese government's restrictive approach toward the cryptocurrency mining industry, many mining companies moved to Kazakhstan because of its proximity and very low energy costs. Yet, due to large-scale demonstrations in Kazakhstan during January 2022, the country, the second-largest BTC mining hub, shut down electricity, disconnecting 15% of the BTC network from the system. Consequently, BTC lost 8% of its value. [328] This example demonstrates the importance of creating a sustainable legal structure to protect users' rights while fostering technological development in a more sustainable manner.

To investigate whether lawmakers and regulators have an adequate understanding of the fundamental ideas and technological attributes of blockchain technology to create effective legal frameworks, this study will analyze regulatory strategies concerning blockchain through a functional approach and a comparative framework. By examining cases of both restrictive and favorable regulatory processes, we aim to determine which organizations in these countries are responsible for regulation. This section will clarify the origins of these regulatory approaches in the selected countries. We aim to list the executive and supervisory agencies, as well as the regulatory bodies of pioneer countries in blockchain and cryptocurrency regulations, and discuss their legal approaches toward blockchain and cryptocurrency in a comparative study.

2.2.1. United States

In the United States, since every state may have different jurisdictions, blockchain regulation is multifaceted, with various state and federal agencies responsible for different aspects. The Securities and Exchange Commission (SEC) evaluates blockchain tokens to determine if they qualify as securities, which is discussed in detail in this research. The Commodity Futures Trading Commission (CFTC) oversees cryptocurrencies as commodities, and the

[327] Stefan Scharnowski and Yanghua Shi, *Bitcoin Blackout: Proof-of-Work and the Centralization of Mining*, October 5, 2021, https://ssrn.com/abstract=3936787 or http://dx.doi.org/10.2139/ssrn.3936787.

[328] Rohan Sharma, "Kazakhstan's Bitcoin Mining Shuts Down Amid Fatal Protests," *CNBC*, January 6, 2022, https://www.cnbc.com/2022/01/06/kazakhstan-bitcoin-mining-shuts-down-amid-fatal-protests.html.

Internal Revenue Service (IRS) generally classifies them as property for tax purposes. These designations impact how blockchain projects are to be launched, managed, and taxed, as discussed above. Additionally, there is significant focus on anti-money laundering (AML) regulations and consumer protection perspectives.

In the USA, regulatory approaches to blockchain involve multiple federal agencies in addition to state regulations. These agencies have specific focuses:

Securities and Exchange Commission (SEC)

The Securities and Exchange Commission (SEC) is the most-discussed institution in terms of cryptocurrency classification and the types of blockchain projects. The SEC has regulatory authority over digital assets, including some cryptocurrencies considered securities. This is determined by the Howey Test, which is discussed in more detail below, and assesses whether an asset is an investment contract based on expectations of profits derived from the efforts of other stakeholders.

The SEC's stance on regulating cryptocurrencies has remained consistent, advocating for an expansion of its oversight to enhance investor and consumer protection.[329] The SEC has also actively enforced regulations against entities like Ripple Labs Inc., alleging that the sale of their digital tokens constituted unregistered securities offerings, a case that is also examined below.[330]

Commodity Futures Trading Commission (CFTC)

The Commodity Futures Trading Commission (CFTC) regulates derivatives transactions related to commodities, which sometimes include certain aspects of digital assets. In some blockchain projects, the CFTC specializes in digitalizing commodities and representing

[329] J. Koenraadt and E. Leung, "Investor Reactions to Crypto Token Regulation," *European Accounting Review* 31, no. 4 (2022): 811–44, https://doi.org/10.1080/09638180.2022.2090399.

[330] Library of Congress, "United States: Blockchain and Cryptocurrency Resources," *Library of Congress Blogs*, October 2020, https://blogs.loc.gov/law/2020/10/united-states-blockchain-and-cryptocurrency-resources/.

them through cryptocurrencies. The CFTC has established that virtual currencies like Bitcoin and Ether are considered commodities and thus fall within its regulatory scope.[331] However, the CFTC's jurisdiction over virtual currency markets is generally limited to addressing manipulative activities and policing fraudulent projects.

The Internal Revenue Service (IRS)

The Internal Revenue Service (IRS) is the tax-focused institution in the United States. The IRS classifies cryptocurrencies as property for tax purposes, similar to the approach taken by many other countries, which affects how blockchain transactions are reported and taxed.[332]

In accordance with the Bank Secrecy Act of the United States, the Financial Crimes Enforcement Network (FinCEN), a division of the United States Department of Treasury, has established that cryptocurrency exchanges, primarily Bitcoin exchanges, are considered monetary services. Furthermore, FinCEN has mandated that cryptocurrency administrators register as money services businesses (MSBs).[333]

In its 2013 guidance, the Financial Crimes Enforcement Network distinguished virtual currency from fiat currency.[334]

These agencies work within a framework set by the President of the United States Administration's Executive Order. President Biden's Executive Order outlines six key priorities for digital asset strategy and regulation: financial stability, financial inclusion,

[331] D. A. Nathan and N. Mathews, "In or out? – the CFTC Explains When Virtual Currencies Come Within Its Jurisdiction," *Journal of Investment Compliance* (2020), https://doi.org/10.1108/joic-09-2020-0026.
[332] Global Legal Insights, "Blockchain Laws and Regulations: USA," accessed June 2024, https://www.globallegalinsights.com/practice-areas/blockchain-laws-and-regulations/usa.

[333] U.S. Department of the Treasury, Financial Crimes Enforcement Network, "Guidance: Application of FinCEN's Regulations to Persons Administering, Exchanging, or Using Virtual Currencies," 2013, http://www.fincen.gov/statutes_regs/guidance/pdf/FIN-2013-G001.pdf.

[334] Ibid.

consumer and investor protection, among others. This framework is part of an ongoing effort to provide comprehensive regulation of digital assets, including cryptocurrencies.[335]

2.2.2. European Union

Twenty-seven countries together comprise the Member States of the European Union. The European Union has a common regulatory framework for blockchain and cryptocurrencies. As we will discuss more deeply below, the AML regulations of the EU focus on the blockchain ecosystem. The EU's Fifth Anti-Money Laundering Directive (5AMLD) enhances transparency by establishing a more centralized record of cryptocurrency users and their identities across the European Union and aim to increase customer protection of EU Citizens.[336]

Another significant development in the EU's regulatory approach is the Markets in Crypto-Assets (MiCA) regulation. MiCA aims to create a comprehensive regulatory framework for digital assets like cryptocurrencies, ensuring market integrity, consumer protection, and financial stability across EU member states.

In the European Union, several regulatory bodies and agencies oversee the cryptocurrency and blockchain field:

European Commission:

The European Commission is the executive arm of the European Union. The Commission drafts regulatory frameworks in many fields, including the Markets in Crypto-Assets (MiCA) regulation, and manages MiCA's implementation across all member states. Within the complex structure of the European Union's regulatory framework, the Commission works in consortium with other regulatory bodies and agencies to oversee cutting-edge

[335] The White House, "FACT SHEET: President Biden to Sign Executive Order on Ensuring Responsible Development of Digital Assets," March 9, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/09/fact-sheet-president-biden-to-sign-executive-order-on-ensuring-responsible-development-of-digital-assets/.

[336] European Union, *Directive (EU) 2018/843 of the European Parliament and of the Council of 30 May 2018 Amending Directive (EU) 2015/849 on the Prevention of the Use of the Financial System for the Purposes of Money Laundering or Terrorist Financing, and Amending Directives 2009/138/EC and 2013/36/EU*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018L0843.

technologies like blockchain and the web of cryptocurrency-related operations. The European Commission ensures the harmonized deployment of regulations across different member states to create a unified approach to managing digital assets.

European Securities and Markets Authority (ESMA):

The European Securities and Markets Authority (ESMA) is the agency responsible for safeguarding the stability of the European Union's financial system. Its responsibilities include providing oversight and regulation for financial activities related to blockchain and cryptocurrencies.[337]

European Central Bank (ECB):

The European Central Bank (ECB) is not a regulatory body for the cryptocurrency and blockchain field; however, it is actively involved in research and discussions on digital currencies and cryptocurrencies. The ECB has undertaken significant work on the potential creation of a digital euro and assessing the influence other digital currencies could have on the digital euro. The digital euro could revolutionize the European monetary landscape.[338]

European Banking Authority (EBA):

The European Banking Authority (EBA) is not a traditional regulatory body but works diligently to uphold the integrity of the European finance and banking sector. The EBA's activities naturally encompass the domain of various financial activities, many of which are influenced by the advent of cryptocurrencies. Its supervision extends to financial activities involving cryptocurrencies.

European Insurance and Occupational Pensions Authority (EIOPA):

[337] European Securities and Markets Authority, "Crypto-assets and Financial Stability," 2023, https://www.esma.europa.eu/sites/default/files/library/esma50-165-2251_crypto_assets_and_financial_stability.pdf.

[338] Francisco Hernández Fernández, "Hacia una Moneda Digital Europea. El Euro 2.0," *Revista de Derecho Comunitario Europeo* 70 (2021): 273–303, https://doi.org/10.18042/cepc/rdce.70.06.

The European Insurance and Occupational Pensions Authority (EIOPA) actively participates in and contributes to the regulatory framework of the crypto market. In areas where crypto assets intersect with pension funds and insurance, EIOPA provides valuable regulatory field.[339]

The collective efforts of agencies such as the European Commission, ESMA, ECB, EBA, and EIOPA form a robust regulatory structure and network. This structure is designed to fortify the cryptocurrency environment against the volatility of the cryptocurrency ecosystem and promote the progressive integration of blockchain technologies into the European banking and financial ecosystem through their regulatory powers and supervision.

2.2.3. United Kingdom

Following Brexit, the United Kingdom has the opportunity to establish its own regulatory framework independent of the European Union.

In the UK, the regulatory body that oversees crypto assets, focusing on consumer protection and the prevention of financial crimes, is the Financial Conduct Authority (FCA). Another institution, the UK Treasury, has also launched consultations to further refine the regulatory approach, emphasizing competition and innovation while managing the potential risks of the cryptocurrency ecosystem.[340]

In the United Kingdom, there are four main significant bodies, each with distinct roles and responsibilities in managing the implementation of blockchain technology and cryptocurrencies.

The Financial Conduct Authority (FCA) is the primary regulatory body responsible for upholding the integrity of the financial markets in the United Kingdom. One of the FCA's

[339] European Insurance and Occupational Pensions Authority, "Consultation Paper on Guidelines under Article 97 of the Markets in Crypto-Assets Regulation (MiCA)," January 12, 2024, https://www.eiopa.europa.eu/document/download/eed552ef-61bc-480b-8cac-b90bc5810a56_en?filename=ESA-2024-12%20-%20Consultation_Paper_Art_97_MiCA_Guidelines.pdf.
[340] HM Treasury, "UK Sets Out Plans to Regulate Crypto and Protect Consumers," *GOV.UK*, last modified February 1, 2023, https://www.gov.uk/government/news/uk-sets-out-plans-to-regulate-crypto-and-protect-consumers.

primary objectives is consumer protection. The FCA regulates financial markets, encourages competition, and monitors the use of cryptocurrencies and blockchain technology. Its scope includes overseeing both organizations and individuals involved in providing financial services or connected to financial products.

The Bank of England

The Bank of England is the central bank of the United Kingdom. It is responsible for preserving financial and monetary stability. The Bank closely monitors developments in the blockchain sector, with particular focus on central bank digital currencies (CBDCs), which are discussed further in this research. The Bank of England actively tracks and evaluates the potential impacts of CBDCs on the existing British financial system.

HM Treasury (HMT)

Her Majesty's Treasury (HMT) is responsible for formulating and implementing the financial and economic policies of the United Kingdom's government. HMT oversees policy direction, risk assessments, and regulatory frameworks, while also working to protect consumers in connection with cryptocurrencies and comparable technologies such as blockchain.[341]

Information Commissioner's Office

The Information Commissioner's Office (ICO) is an independent organization in the United Kingdom dedicated to protecting the public's rights to information. It addresses data security and privacy concerns related to blockchain technology, specifically focusing on managing personal data securely and in compliance with regulations on distributed ledgers. It concentrates on areas where blockchain technology may be used.[342]

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[341] HM Treasury, "UK Sets Out Plans to Regulate Crypto and Protect Consumers," *GOV.UK*, last modified February 1, 2023, https://www.gov.uk/government/news/uk-sets-out-plans-to-regulate-crypto-and-protect-consumers.

[342] Pantelis Koutroumpis, Farshad Ravasan, and Taheya Tarannum, "(Under) Investment in Cyber Skills and Data Protection Enforcement: Evidence from Activity Logs of the UK Information Commissioner's Office," July 23, 2022, SSRN, https://ssrn.com/abstract=4179601.

The ICO has provided several guidance documents on technology-related fields, such as artificial intelligence (AI) and data protection. These guides contain information relevant to blockchain technologies.[343]

Each institution discussed above aims to create regulatory frameworks for the blockchain ecosystem while encouraging innovation. Nevertheless, they prioritize ensuring financial stability, consumer protection, data privacy, and market integrity in the blockchain sector.

2.2.4. Japan

Japan is a significant country in terms of early regulatory work and one of the pioneers in the blockchain era. One of the largest cryptocurrency exchange crashes in Bitcoin history occurred in Japan, where the cryptocurrency market Mt. Gox handled over 70% of all Bitcoin (BTC) transactions worldwide before its bankruptcy[344] in early 2014.

Due to its early adoption and notable market failures, Japanese lawmakers took action earlier than many European countries. Below, we discuss the regulatory bodies in Japan that impact the country's blockchain regulatory approach.

The Financial Services Agency (FSA) in Japan

The blockchain ecosystem in Japan is comprehensively regulated by several institutions, each with specific roles in the regulatory framework.

The Financial Services Agency (FSA) is the primary regulatory body that supervises crypto-asset exchange service providers. These providers are regulated under the Payment Services Act and the Financial Instruments and Exchange Act.[345] Under these acts, services are

[343] Information Commissioner's Office, "UK GDPR Guidance and Resources," *ICO: Information Commissioner's Office*, accessed June 6, 2024, https://ico.org.uk/for-organisations/uk-gdpr-guidance-and-resources/.

[344] Paul Vigna, "5 Things About Mt. Gox's Crisis," *The Wall Street Journal*, February 25, 2014.

[345] Government of Japan, *Financial Instruments and Exchange Act*.

defined to include the sale and purchase of crypto-assets, intermediary and brokerage services for cryptocurrencies, the exchange of crypto-assets with other crypto-assets, and the management of funds and crypto-assets in connection with these activities.

The Financial Services Agency (FSA) is the regulatory body to supervise crypto-asset exchange service providers. FSA requires crypto-asset exchange service providers to comply with several obligations, such as separation of user's funds, implementing robust security measures for customer protection, and providing clear information about the given services. Service providers are also subject to anti money laundering and counter-terrorist financing regulations.[346]

The Japan Virtual and Crypto-assets Exchange Association

The Japan Virtual and Crypto-assets Exchange Association (JVCEA) is a self-regulatory organization that aims to ensure the secure and proper provision of crypto-asset exchange services. The JVCEA works in coordination with the Financial Services Agency.

The FSA, however, retains greater authority than the JVCEA, as it can conduct inspections and enforce reporting requirements for service providers.

In the context of innovation, Japan operates a regulatory sandbox that allows companies to demonstrate projects that might not be fully covered by existing regulations. This promotes the development and use of technologies like blockchain, AI, and big data.

It is important to note that while service providers are permitted to manage and offer exchange services for crypto-assets, they are prohibited from dealing with assets considered security tokens without additional registration under the Financial Instruments and Exchange Act (FIEA).

Japan actively promotes fintech innovation through its regulatory sandbox scheme. Managed by the Cabinet Office of Japan, this initiative is part of a strategic effort to drive economic growth through technological advancement, including blockchain. The sandbox allows

[346] Gaurav Arora, *Cryptoasset Regulatory Framework in Japan*, October 27, 2020, SSRN, https://ssrn.com/abstract=3720230 or http://dx.doi.org/10.2139/ssrn.3720230.

individuals or companies, both domestic and international, to apply for temporary deregulation to test their fintech solutions and services within the Japanese market. As a result, companies can demonstrate the practical applications and benefits of technologies like blockchain.

The Cabinet Office of Japan is responsible for managing the regulatory sandbox. Japan has made strategic efforts to promote economic growth through technological innovation, such as blockchain. The sandbox scheme in Japan allows individuals or companies, both domestic and international, to apply for temporary deregulation to test their fintech solutions and services within the Japanese market. As a result, companies have the opportunity to demonstrate the practical applications and benefits of technologies like blockchain.[347]

The National Tax Agency of Japan

Taxation of crypto-related activities was one of the first regulatory approaches by many governments, and the National Tax Agency of Japan followed suit. It provides guidelines on the tax treatment of crypto-assets to outline their tax results.[348]

Japanese lawmakers have issued special bills regarding various blockchain services. For instance, on 14 March 2023, the Japanese government submitted a bill to define tokenized real estate fund interests as "securities" under the Financial Instruments and Exchange Act. The bill also proposed necessary amendments to the Act on Specified Joint Real Estate Ventures of Japan.[349]

2.2.5. Singapore

[347] Cabinet Secretariat, Government of Japan, "Regulatory Sandbox Portal," *Prime Minister of Japan and His Cabinet*, accessed June 6, 2024, https://www.cas.go.jp/jp/seisaku/s-portal/regulatorysandbox_e.html.

[348] Akihiro Shiba, Dai Mizui, and Yuji Okada, "Japan: Trends and Developments," in *Blockchain 2023*, ed. Chambers and Partners (Nishimura & Asahi, 2023), https://practiceguides.chambers.com/practice-guides/blockchain-2023/japan/trends-and-developments.

[349] Ibid.

Singapore's approach to new technologies is well known, particularly its proactive stance in blockchain. Blockchain is a significant focus for Singapore as it aims to maintain its position as a leading financial center in Asia.

Digital asset and blockchain regulation is led by the Monetary Authority of Singapore (MAS), which has actively adapted its regulatory framework to keep pace with technological advancements.

The MAS's guidelines, published on 17 January 2022, go beyond the mere classification of digital tokens. They establish a broad framework for digital asset activities, setting out comprehensive rules for service providers and token issuers to ensure transparency and high-security standards.[350]

The MAS has cautioned the public that trading in digital payment tokens (commonly referred to as DPTs or cryptocurrencies in Singapore) is highly risky and unsuitable for the general public. It has recommended that individuals should not be encouraged to engage in DPT trading.[351]

The Payment Services Act of Singapore is a milestone in the country's regulatory structure for digital assets, including cryptocurrencies. This Act regulates both traditional financial services and modern payment solutions, such as transfer services and digital currency exchanges. It facilitates a dynamic and secure environment for digital transactions. This legislation reflects Singapore's commitment to fostering financial innovation while focusing on consumer protection and maintaining the integrity of its financial system.[352]

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[350] Lexology, "MAS Issues Guidelines on Provision of Digital Payment Token Services to the Public," January 17, 2022, https://www.lexology.com/library/detail.aspx?g=f259858e-b244-4271-b358-5f1395759e08.

[351] Monetary Authority of Singapore, "Guidelines on Provision of Digital Payment Token Services to the Public (PS-G02)," *Monetary Authority of Singapore*, accessed June 6, 2024, https://www.mas.gov.sg/-/media/mas-media-library/regulation/guidelines/pso/ps-g02-guidelines-on-provision-of-digital-payment-token-services-to-the-public/guidelines-on-provision-of-digital-payment-token-services-to-the-public-ps-g02.pdf.

[352] *Payment Services Act 2019 (Singapore)*, available at: https://sso.agc.gov.sg/act/psa2019.

Additionally, the MAS has positioned itself as a global leader by actively engaging with private players, such as fintech companies, financial institutions, and blockchain developers. This engagement ensures that regulations remain relevant and supportive of growth. By providing clear guidelines and support, Singapore aims to create a conducive environment for digital assets and blockchain technology. This approach attracts investors and businesses seeking regulatory clarity and stability in the Asian market, one of the largest markets globally.

Under the Payment Services Act of Singapore, which came into force in 2019, several types of licenses have been established:

- An account issuance service license
- A domestic money transfer service license
- A cross-border money transfer service license
- A merchant acquisition service license
- An e-money issuance service license
- A digital payment token service license[353]

Account issuance service refers to issuing a payment account or providing any service related to operating such accounts. Examples include electronic wallets (e-wallets) or stored-value cards that can be used to pay at various merchants or transfer funds to other second or third parties.

Domestic money transfer service involves providing local funds transfer services within Singapore, such as through payment gateway services or payment kiosk services.

Cross-border money transfer services include facilitating inbound or outbound remittance services in Singapore. These services enable remittances between entities in different countries, even if other currencies are not accepted or received in Singapore.

[353] Attorney-General's Chambers of Singapore, *Payment Services Act 2019*, *Singapore Statutes Online*, published February 20, 2019, Article 6, https://sso.agc.gov.sg/Acts-Supp/2-2019/Published/20190220?DocDate=20190220&ProvIds=pr6-,pr37-.

Merchant acquisition services involve accepting and processing payment transactions for a merchant under a valid contract. These services typically include providing online payment gateways or point-of-sale terminals. Merchant acquirers may also offer money transfer services if they facilitate fund transfers.

E-money issuance service pertains to the issuance of e-money for fund transfers or payments.

Digital payment token services cover a broader range of services, including:

- Supplying a platform that allows users to exchange digital payment tokens or cryptocurrencies.
- Buying or selling digital payment tokens.
- Arranging or transmitting the exchange of cryptocurrencies.
- Providing custodian wallet services for cryptocurrencies.
- Facilitating the buying or selling of cryptocurrencies without holding the money or cryptocurrencies involved.[354]

The Monetary Authority of Singapore (MAS) recommends updating regulations to empower the central bank to impose additional requirements on cryptocurrency service providers. This includes a focus on user protection, financial stability (especially concerning the potential risks of stablecoins), anti-money laundering (AML), and countering the financing of terrorism (CFT).

To obtain a Standard Payment Institution (SPI) license, an applicant must meet the following thresholds:

- S$3 million (approximately $2.2 million) in monthly transactions for any payment service (excluding e-money account issuance and money-changing services).

[354] Monetary Authority of Singapore, "Types of Payment Services," *Monetary Authority of Singapore*, accessed June 6, 2024, https://www.mas.gov.sg/regulation/payments/licensing-for-payment-service-providers/types-of-payment-services.

- S$6 million (approximately $4.4 million) in monthly transactions for two or more payment services (excluding e-money account issuance and money-changing services).
- S$5 million (approximately $3.7 million) in daily outstanding electronic money (e-money).[355]

If a cryptocurrency token's features fall under the definition of a security under Singapore law, it comes under the purview of the Securities and Futures Act (SFA). This means cryptocurrency issuers must comply with prospectus requirements unless exempted by the same regulations. To determine the category of a cryptocurrency, Singaporean authorities apply a procedure similar to that used in the United States. The Howey Test, adapted from the U.S. Supreme Court's definition of an investment contract, is also used by Singaporean authorities.[356] We will discuss the Howey Test in greater detail in the security section.

The Monetary Authority of Singapore (MAS) follows specific steps and processes to determine whether a cryptocurrency falls under security regulations. These processes align with the framework of the Howey Test and consider several indicators, including: attribution of the token project, value proposition of the project and intended use, market behaviors, and a case-by-case evaluation.

Under the Howey Test, an investment contract is defined as an offer involving the investment of money in a project or common enterprise with an expectation of profits primarily derived from the efforts of others. Besides applying the Howey Test, MAS examines tokens based on their rights and functions. If a token represents a debt or ownership claim against the issuer and provides for participation in profit-sharing (e.g., dividends) or has other attributes traditionally associated with securities, the token project may be classified as a security and fall under relevant regulations. When evaluating whether a token is classified as a security,

[355] Tookitaki, "Licensing Requirements for Payment Service Providers in Singapore," *Tookitaki*, accessed October 3, 2024, https://www.tookitaki.com/regulations/licensing-payment-service-providers-singapore.

[356] Jonas Lei Koh, "The Howey Test and Its Application in Singapore," *SAL Practitioner*, accessed October 3, 2024, https://journalsonline.academypublishing.org.sg/Journals/SAL-Practitioner/Technology/ctl/eFirstSALPDFJournalView/mid/595/ArticleId/1486/Citation/JournalsOnlinePDF.

Singaporean authorities also focus on its intended use. For example, if a token is designed primarily for purchasing goods or services listed on the issuing platform and lacks characteristics of an investment, it might not be considered a security. An important indicator MAS examines is how the token is traded and marketed. For instance, if the token is marketed as an investment with expected returns (especially high returns) or traded like a security on secondary markets, the project could be classified as a security.[357] Each case is reviewed individually, and the structure and purpose of the token project may evolve over time. Thus, MAS considers not only the initial offering documents but also the token's actual functions and uses to determine its classification.

Taxation of Cryptocurrency Services in Singapore

Singapore is well known by its position regarding capital gain tax exemptions; it is why Singapore attracts massive investment from all over the world. Singapore encourages investment with tax schemes, and it seems its outcomes are pretty good. 1,100 family offices managing more than US$4 trillion have moved to Singapore, and financial wealth booked in Singapore is expected to grow at a rate of 9% through to 2027.[358]

In 2020, to attract crypto holders to Singapore, the Inland Revenue Authority of Singapore (IRAS) clarified the tax treatment of cryptocurrencies, stating that as of January 1, 2020, the supply of digital payment tokens is exempt from the Goods and Services Tax (GST).[359]Hence, since then, transactions involving the exchange of such digital payment tokens for fiat currency (like USD, Euro, etc.), other digital payment tokens, or the provision of loans of digital payment tokens are not subject to Goods and Services Tax in Singapore. However, this exemption applies not to all cryptocurrencies but only to recognized cryptocurrencies such as Bitcoin, Ether, Litecoin, and others that meet specific characteristics set out by the Inland Revenue Authority of Singapore. These characteristics

[357] Allen & Gledhill, "MAS Issues Guidelines on the Provision of Digital Payment Token Services to General Public," *Allen & Gledhill*, accessed October 3, 2024, https://www.allenandgledhill.com/sg/perspectives/articles/20076/sgkh-mas-issues-guidelines-on-the-provision-of-digital-payment-token-services-to-general-public.

[358] Knight Frank, *The Wealth Report 2024* (Knight Frank, 2024), https://content.knightfrank.com/resources/knightfrank.com/wealthreport/the-wealth-report-2024.pdf.

[359] Inland Revenue Authority of Singapore, *Income Tax Treatment of Digital Tokens*, IRAS e-Tax Guide, October 9, 2020, https://www.iras.gov.sg/media/docs/default-source/e-tax/etaxguide_cit_income-tax-treatment-of-digital-tokens_091020.pdf?sfvrsn=91dbe1f7_0.

aim to better reflect the nature of cryptocurrencies and avoid double taxation in the crypto economy and define unit, fungible, not pegged or denominated to any fiat currency, and designed to be a medium of exchange.

IRAS has categorized the tokens as payment tokens, security tokens, and utility tokens. A payment token, under the definition of IRAS, is regarded as intangible property. Consequently, transactions involving the use of payment tokens as payment for goods or services are viewed as barter trade, and the value of goods or services transferred should be determined at the point of the transaction. For the second category, a utility token that is used to exchange for goods or services is unlikely to create an income subject to tax on the user at the point of exchange. However, it may, on the other hand, give rise to a deductible expense subject to the usual deduction rules of IRAS. For the last category, security tokens, the taxability of the return derived depends on the nature of the return. This return of the security token could be in the form of dividends, interest, or other distributions.[360]

The amount incurred by the user to purchase the utility token will be treated as a prepayment under IRAS taxation guidelines. Subject to tax deduction rules, a deduction will be allowed on the amount incurred at the point the token is used to exchange for the goods or service. The tax treatment of security tokens, which give the token holder a fractional ownership or rights to an underlying asset and usually come with a specified or implied degree of control or economic entitlement, may be accounted for as a form of debt or equity. Where the security token is disposed of by the holder, the tax treatment of the gain or loss on disposal will depend on whether the security token is a capital or revenue asset to the token holder and, accordingly, whether the gain/loss is capital or revenue in nature under the consideration of the rights and obligations of the token as well.[361]

In sum, Singapore has a clearer regulatory approach than many other countries regarding cryptocurrencies. Besides strict Anti-Money Laundering and other regulatory obligations, as in Japan, which we have discussed above, Singapore also introduced a regulatory sandbox, particularly for startups and established financial institutions alike, as it offers a way to

[360] Ibid.

[361] Ibid.

innovate responsibly while managing regulatory risks of cryptocurrencies. This approach enhances Singapore's attractiveness as a global fintech hub, also for the cryptocurrency ecosystem. This sandbox scheme offers flexibility in regulations, support and guidance to firms, sets some limits and volume of transactions to relax regulatory requirements up to that, and offers time-bound experimentation. To enter the sandbox, companies must have clear exit strategies.

2.2.6. China

China's regulatory approach to blockchain is strict, with a ban on cryptocurrency exchanges and Initial Coin Offerings (ICOs). However, China supports the development of blockchain technology for industrial and government applications and is actively developing a central bank digital currency (CBDC), the Digital Currency Electronic Payment (DCEP).

China had the title of having the biggest cryptocurrency market in the world until 2017, and by then, 80% of Bitcoin transactions, which is the first decentralized cryptocurrency and most prominent one globally, were carried out using the yuan, which is Chinese currency.[362] As of May 24, 2022, the value of investments in cryptocurrencies in China amounted to over 1.5 billion yuan. Right before the Chinese government began to place restrictions on the cryptocurrency industry, cryptocurrency investments were valued at around 14 billion yuan at their peak year of 2019.[363]

Strict regulative approach of the Chinese Government to cryptocurrencies, the blockchain sector in China continues to hold one of the top positions globally with 263 blockchain projects. The number of businesses legally registered with the term "blockchain" in their official title has increased from 500 in 2017 to over 5,000.[364]

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[362] BBC News, "China Declares All Crypto-Currency Transactions Illegal," *BBC News*, September 24, 2021, https://www.bbc.com/news/technology-58678907.

[363] Statista, "China: Digital Currency Investment Value," *Statista*, accessed June 6, 2024, https://www.statista.com/statistics/1368253/china-digital-currency-investment-value/.

[364] *South China Morning Post*, "Reality Show Dating and Rapping: How China's Cryptocurrency Stars Are Trying to Stand Out," *South China Morning Post*, accessed June 6, 2024, https://www.scmp.com/tech/blockchain/article/2184611/reality-show-dating-rapping-how-chinas-cryptocurrency-stars-are.

The regulations about blockchain in China are primarily under the jurisdiction of the Cyberspace Administration of China (CAC), which is the institution responsible for setting specific regulations to govern blockchain.[365] For example, blockchain service providers in China are required to authenticate the real identities of their users with the details of their national ID numbers or mobile phone numbers (as seen with the WeChat platform) and keep these identity records for at least six months. Providers must file with the Cyberspace Administration of China within 10 business days of commencing operations, detailing the services offered.

One of the first actions regarding cryptocurrencies in China was published by the People's Bank of China (PBoC) and four other ministries together in December 2013. It declared that Bitcoin is not a currency but would be treated as a virtual asset or digital commodity.[366] Hence, China does not consider cryptocurrencies, including Bitcoin, to be a valid form of money, and the financial system does not accept Bitcoin or provide any related services. The main aim of these restrictions is to mitigate financial risks in the system and enhance customer and investor protection.

China implemented a formal prohibition on September 4, 2017, on Initial Coin Offerings (ICOs)—a move that caused a significant shift in the country's strategy for overseeing the blockchain and cryptocurrency industry. The prohibition of ICOs included suspending all cryptocurrency issuance and financing operations conducted under the Initial Coin Offerings framework. Additionally, projects that had received capital through their ICOs were required to return the capital to investors in compliance with the new prohibitions.[367]The following joint action was taken by several institutions responsible for the regulatory framework of

[365] Mondaq, "Blockchain Comparative Guide," *Mondaq*, September 5, 2023, https://www.mondaq.com/china/technology/1462542/blockchain-comparative-guide, accessed October 3, 2024.

[366] Zhongguo Renmin Yinhang, Gongye he Xinxihua Bu, Zhongguo Yinhangye Jiandu Guanli Weiyuanhui, et al., "Announcement of Preventing Risks of Bitcoin by People's Bank of China, Ministry of Industry and Information Technology, China's Banking Regulatory Commission, and Other Departments," promulgated by People's Bank of China, Ministry of Industry and Information Technology, China's Banking Regulatory Commission, China's Securities Regulatory Commission, and China's Insurance Regulatory Commission, December 3, 2013, Article 1, CLI.4.214081 (*Pkulaw*).

[367] Conghui Chen and Lanlan Liu, "How Effective Is China's Cryptocurrency Trading Ban?" *Finance Research Letters* 46 (2022): 102429, accessed April 23, 2024, https://doi.org/10.1016/j.frl.2021.102429.

cryptocurrencies, including the People's Bank of China, the Central Cyberspace Affairs Commission (CAC), the Banking Regulatory Commission, the Ministry of Public Security, and the State Administration for Market Regulation. They issued a warning against illicit fundraising activities disguised as events related to cryptocurrency and blockchain.[368]

The People's Bank of China (PBoC) issued an official statement in June 2019, declaring that it would block access to all domestic and foreign cryptocurrency markets/exchanges and Initial Coin Offering websites. This aimed to restrict all Bitcoin and other cryptocurrency trade by implementing a prohibition on international exchanges.[369]
In 2019, the Hangzhou Internet Court determined that Bitcoin and other cryptocurrencies possess value, are limited in supply, and may be easily transferred or disposed of. The Hangzhou Internet Court classified them as virtual property at the result of the case.[370]

In terms of taxation, the Shanghai Municipal Tax Service explained levies imposed on digital currency transactions in China. According to the official reply, any revenue obtained by investors/individuals via the purchase of virtual currency from game players and its subsequent sale to others at a higher price would be classified as taxable income (under Chinese tax regulations) for individual income tax purposes. This classified revenue will be computed and remunerated as property transfer income. The base cost of the virtual currency sold by investors/individuals will be equal to the price of acquiring that cryptocurrency online, together with any relevant taxes and fees. If any person is unable to provide documentation of the original price of the virtual currency, the initial value of the virtual money will be determined by the relevant tax authorities.

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[368] Wei Wang and Dong Qian, "Blockchain Risk Series No. 14: Supervision in Progress—Interpretation of the Five Departments' 'Risk Tips on Preventing Illegal Fund-raising in the Name of "Virtual Currency" and "Blockchain,"'" *Merits & Tree Law Offices*, accessed June 6, 2024, https://www.meritsandtree.com/wapen/news/detail?id=168.

[369] Rahman Ravelli, "China and Cryptocurrency," *Lexology*, accessed June 6, 2024, https://www.lexology.com/library/detail.aspx?g=7ad8a7a8-cef7-49ab-b68d-6a2f27fb82a5.

[370] CGTN, "Chinese Court Rules Bitcoin's Legal Status as Virtual Property," *CGTN*, July 22, 2019, https://news.cgtn.com/news/2019-07-22/Chinese-court-rules-Bitcoin-s-legal-status-as-virtual-property--IxcRhxWAKI/index.html.

On the 18th of May 2021, three prominent regulatory groups in China—namely the National Internet Finance Association of China, the China Banking Association, and the Payment and Clearing Association of China—released a detailed report reaffirming the prohibition on the use of cryptocurrencies within the nation.[371] This updated report is, for the most part, a reiteration of the prohibitions previously imposed. However, it also specifies several services that were not clearly outlined in earlier restrictions.

For example, the report explicitly states that companies and establishments are prohibited from accepting virtual currencies or utilizing them for settlement purposes or as a method of payment. Chinese financial institutions are also barred from providing exchange services between cryptocurrencies (such as Bitcoin and Ethereum) and the Chinese yuan or other fiat currencies. Furthermore, it is illegal for certain institutions to offer services related to Bitcoin, such as saving, trusting, or pledging, as well as issuing financial instruments associated with virtual currencies. Additionally, fund and trust products are not permitted to use virtual currencies for investment purposes.

This 2021 report does not introduce new restrictions on virtual currencies but significantly broadens and clarifies the range of prohibited services.[372]

As an exception to the ban on cryptocurrencies, China permits two types of entities to engage in virtual currency businesses: online gaming operators (called Game Operators) and online gaming virtual currency exchange service providers (called Service Providers).[373]

Rain Xie's research on the comparative analysis of regulations between the U.S. and China highlights China's state-driven efforts to create blockchain projects and potentially its own crypto-fiat currency (central bank digital currency). In contrast, the United States refrains from making premature judgments about cryptocurrencies as a whole. Currently, the U.S.

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[371] People's Bank of China, "关于虚拟货币交易炒作风险的公告 [Announcement on Preventing Cryptocurrency Speculation Risk]," *People's Bank of China*, May 18, 2021, https://www.pbc.gov.cn/goutongjiaoliu/113456/113469/4348556/index.html, accessed October 3, 2024.
[372] Ibid

[373] Pillsbury Winthrop Shaw Pittman LLP, "Market Entry: Virtual Currency, Electronic Money and Electronic Payments," *Pillsbury Law*, accessed June 6, 2024, https://www.pillsburylaw.com/images/content/6/1/v2/613/MarketEntryVirtualCurrency.pdf.

approach appears to strike a better balance between investor protection and fostering technological development. Despite China's ban on cryptocurrencies, the U.S. presumes a functional and efficient capital market.[374]

In conclusion, China maintains a strict policy against the crypto ecosystem despite the huge potential and public interest in cryptocurrencies. However, the country's policies still consider blockchain to have significant potential for economic and technological innovation.

2.2.7. Switzerland

Switzerland, one of the most developed countries in the world, has a comprehensive and innovation-friendly approach to regulating blockchain technology and cryptocurrencies, aligning with the country's vision for technological advancement.

The regulatory body in Switzerland treats cryptocurrencies as an asset class (similar to a commodity), making them subject to several taxes, such as income, wealth, and capital gains taxes, to ensure clarity and fairness in taxation policies.

Some cities in Switzerland actively promote the use of cryptocurrencies. For example, the city of Zug has taken the initiative to accept cryptocurrencies for council services. Additionally, institutions like Swiss Federal Railways have enabled the purchase of Bitcoin at their ticketing machines since 2016. These examples reflect Switzerland's early adoption of cryptocurrencies in public services.[375]

The main regulatory body overseeing cryptocurrencies in Switzerland is the Swiss Financial Market Supervisory Authority (FINMA). FINMA oversees all matters related to cryptocurrency exchanges, which are deemed legal provided they obtain the necessary licenses. Depending on the specific features of a blockchain project, different types of

[374] Rain Xie, "Why China Had to 'Ban' Cryptocurrency but the U.S. Did Not: A Comparative Analysis of Regulations on Crypto-Markets Between the U.S. and China," *Washington University Global Studies Law Review* 18, no. 2 (2019): 457, https://openscholarship.wustl.edu/law_globalstudies/vol18/iss2/9.
[375] Swissinfo.ch, "Rail Ticket Machines to Offer Bitcoins," *Swissinfo*, October 11, 2016, https://www.swissinfo.ch/eng/business/trial-run_rail-ticket-machines-to-offer-bitcoins/42552776, accessed October 3, 2024.

licenses—such as fintech, exchange, investment fund, or banking licenses—can be issued by FINMA.[376] When issuing any license, FINMA aligns with Switzerland's Federal Act for Combating Money Laundering and Terrorist Financing (AMLA).

One of Switzerland's most significant steps was the Blockchain Act, which came into force on August 1, 2021. This law amended securities legislation to provide a legal basis for trading cryptocurrencies and reinforced investor protection, particularly in events like the bankruptcy of exchanges.

With this Blockchain Act, Switzerland aims to promote technology neutrality and improve conditions for blockchain businesses to attract more foreign enterprises to the country. The town of Zug, today known as the Swiss Crypto Valley, hosts a significant number of established cryptocurrency firms, blockchain developers, related service providers, and, of course, advisors such as legal consultants. Zug was ranked first in the Global Crypto Hubs 2023 report, followed by major financial cities such as Singapore, London, Seoul, and Dubai. The report's criteria included a beneficial regulatory structure, digital infrastructure, and quality of life.[377]

The Swiss Distributed Ledger Technology (DLT) Act, fully enacted in August 2021, was introduced in two phases. The first phase, effective from February 2021, allowed the introduction of ledger-based securities on blockchain platforms. The second phase, which came into force in August 2021, provided for the creation of trading facilities utilizing blockchain or distributed ledger technology.[378]

Before the DLT Act (also referred to as the Blockchain Act) was designed, there was a FinTech License aimed at startups intending to collect money from the general public in a

[376]FINMA, "Factsheet: Crypto-Based Assets," *FINMA*, accessed October 3, 2024, https://www.finma.ch/en/~/media/finma/dokumente/dokumentencenter/myfinma/faktenblaetter/faktenblatt-kryptobasierte-vermoegenswerte.pdf?sc_lang=en&hash=C301BDEC9A7DED4EF2E23634B86F8FEF.
[377] CoinDesk, "Crypto Hubs 2023: Where to Live Freely and Work Smart," *CoinDesk*, June 27, 2023, https://www.coindesk.com/consensus-magazine/2023/06/27/crypto-hubs-2023-where-to-live-freely-and-work-smart/.

[378] Swiss Federal Department of Finance, "Digitalisation Financial Sector - Blockchain," *State Secretariat for International Finance (SIF)*, accessed June 6, 2024, https://www.sif.admin.ch/sif/en/home/finanzmarktpolitik/digitalisation-financial-sector/blockchain.html.

professional manner, allowing them to collect up to CHF 100 million (approximately €102M). This license, subject to approval by the Swiss Financial Market Supervisory Authority, had standards less stringent than those of a conventional banking license. However, while the FinTech License provided a comprehensive and beneficial framework for the entry of FinTech startups into the Swiss market, it was not a perfect match for the characteristics of cryptocurrencies, tokens, and distributed ledger technology (DLT), nor did it address the unique legal challenges faced by these concepts.[379]

The Federal Council (Swiss Government) made a decision on December 11, 2020, to adopt revisions to the Swiss Code of Obligations, the Federal Act on International Private Law, and the Federal Intermediated Securities Act, effective February 1, 2021. These revisions introduced a new type of uncertificated securities (Wertrechte) represented on distributed ledger technology, also known as blockchain-based securities. These ledger-based securities, both in terms of their characteristics and legal status, are comparable to certificated securities, which have strict[380] regulatory requirements.

Under the Blockchain Act, DLT securities include ledger-based securities (security tokens) and their foreign equivalents. In addition to DLT securities, other digital assets such as payment tokens (e.g., Bitcoin, Ethereum, Litecoin) and utility tokens (e.g., ADA, WINGS) may also be traded in DLT trading facilities. DLT trading facilities differ from traditional trading venues by allowing retail customers as participants, holding DLT (blockchain) securities in safe custody, and clearing and settling transactions involving DLT securities. These facilities also differ from traditional token or cryptocurrency exchanges by enabling the trading of security tokens, safekeeping of tokens, DLT securities, and payment tokens, and maintaining accounts.[381]

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[379] Loyens & Loeff, *FinTech 2020: Legal Guide for Swiss Practitioners*, accessed June 6, 2024, https://www.loyensloeff.com/fintech-2020-legal-guide-for-swiss-practitioners.pdf.

[380] Swiss Federal Council, "Media Release on Digitalisation," *The Federal Council*, accessed June 6, 2024, https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-81563.html.

[381] MME Legal | Tax | Compliance, "New Swiss DLT Exchange License," *MME Magazine*, accessed June 6, 2024, https://www.mme.ch/en/magazine/articles/new-swiss-dlt-exchange-license.

Ledger-based securities are defined in the Distributed Ledger Technology Act (DLT Act) as rights that can be exercised and transferred via a securities ledger, subject to specific limitations designed to safeguard stakeholders, with a particular focus on investors.[382] This includes maintaining the integrity and transparency of the distributed ledger, specifying the content criteria for entries, and ensuring that creditors (investors) have control over their rights.

An institution that facilitates the multilateral trading of distributed ledger technology (DLT) securities is referred to in the Blockchain Act as a DLT trading facility. These facilities are subject to a licensing procedure in Switzerland. While traditional trading venues are regulated similarly, DLT trading facilities are distinct in their capacity to provide services such as central custody and allow non-financial intermediaries to participate in trades.

The Blockchain Act also addresses insolvency law by specifying the segregation of crypto-based assets in the event of bankruptcy, thereby increasing legal certainty for holders of crypto assets. For example, to enhance customer protection, the new law includes requirements for custodial wallet providers to publish clear risk disclosures to promote transparency for investors and customers. It also ensures that investor assets are held in a bankruptcy-remote manner, protected from claims by other creditors of the custodial wallet provider. In such cases, tokens held by investors will not form part of the custodial wallet provider's bankruptcy estate. Instead, customers will retain the right to claim the cryptographic keys held by the bankrupt custodial wallet provider.[383]

This amendment provides investors with better protection in the event of the bankruptcy of a DLT trading facility. This means that in the case of bankruptcy of such a facility (a common occurrence in the crypto industry), digital assets such as tokens and cryptocurrencies held in a distributed ledger can be reclaimed by investors as rightful owners. This provision offers a significant level of legal certainty for crypto stakeholders and investors in Switzerland.

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[382] Ibid.

[383] Eric Stupp and Gadi Winter, "Switzerland: Enabling Bankruptcy-Remote Custody of Crypto Assets," *International Financial Law Review*, June 1, 2021, https://www.iflr.com/article/2a646brsryd6111vpxuyo/switzerland-enabling-bankruptcy-remote-custody-of-crypto-assets.

One of the main concerns of lawmakers is combating money laundering through the cryptocurrency industry. The Swiss Blockchain Act strengthens existing anti-money laundering measures by extending the scope of the Swiss Money Laundering Act to include this new category of DLT trading facilities as financial intermediaries, thereby subjecting them to existing anti-money laundering rules.[384]

In Switzerland, cryptocurrency exchanges (referred to in the law as DLT Trading Facilities) and banks are fully legal but are subject to strict requirements under Anti-Money Laundering (AML), Know Your Customer (KYC), and counter-terrorist financing principles. These align closely with the recommendations of the Financial Action Task Force (FATF), an intergovernmental organization that develops policies to combat money laundering.

The Swiss Federal Tax Administration (SFTA) has issued comprehensive guidelines on the taxation of cryptocurrencies. Cryptocurrencies are treated as an asset class and are therefore subject to income tax, wealth tax, and capital gains tax, just like other forms of property. On December 14, 2021, the SFTA published an updated version of its 2019 working paper on the taxation of cryptocurrencies. This update introduced a new category called "Investment tokens with participation rights."

This new category reflects the so-called Distributed Ledger Technology (DLT) securities established under the Federal Law on the Adaptation of Federal Law to Developments in the Technology of Distributed Ledgers (explained as the Blockchain Law above), which came into force on August 1, 2021.[385]

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[384] A. Renda and S. Caneppele, "Compliant or Not Compliant? The Challenges of Anti-Money Laundering Regulations in Crypto Assets: The Case of Switzerland," *Journal of Money Laundering Control* 27, no. 2 (2024): 363–82.

[385] Martin Burri, "Taxation of Cryptocurrencies: Update of the SFTA Working Paper," *PwC Switzerland*, December 14, 2021, https://www.pwc.ch/en/insights/tax/taxation-of-cryptocurrencies-update-of-the-sfta-working-paper.html.

Investment tokens with participation rights, now treated as shares or participation certificates for tax purposes, are considered a dividend of the company and are consequently subject to a withholding tax of 35%. Additionally, the issuance of such tokens is subject to the issuance stamp tax. The updated guidelines also clarify that "investment tokens on a contractual basis" issued to employees, as well as utility tokens, do not qualify as artificial or non-artificial employee participation under federal tax law. These tokens are instead classified as other non-cash advantages under federal tax legislation and are liable to income tax if the difference between their market value and actual value exceeds their market value.[386]

The SFTA provides an annual course list to determine tax rates for cryptocurrencies and tokens. If no current course is available, cryptocurrencies or tokens should be declared at their original purchase price in Swiss Francs.[387]

Under certain circumstances, private investors in Switzerland can benefit from exemptions from paying taxes on capital gains derived from token or cryptocurrency investments. Conditions include holding cryptocurrency investments for more than six months, ensuring the volume of cryptocurrency transactions does not exceed five times the initial capital, limiting losses on investments to less than half the total taxable revenue, and minimizing reliance on third-party funding.[388]

The taxation scheme for commercial cryptocurrency traders differs from that for private investors. Gains derived from token or cryptocurrency investments are subject to progressive income tax rates. Federal tax rates for private taxpayers range from as low as 0.77% for incomes over CHF 18,300 (approximately €18,600) to up to 11.5% for incomes above CHF 783,200 (approximately €799,484). Losses from crypto transactions, including trading, can be carried forward for seven tax periods. Additionally, approximately 10% of profits must be contributed to old-age and survivors' insurance.[389]

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[386] Ibid.

[387] Swiss Federal Tax Authority, "Course Listing," *Swiss Federal Tax Authority*, accessed June 6, 2024, https://www.ictax.admin.ch/extern/en.html#/ratelist.

[388] Ibid.

[389] Deloitte, "Swiss Taxation of Cryptocurrencies: How Are Investors Taxed?" *Deloitte*, January 15, 2024, https://blogs.deloitte.ch/tax/2024/01/swiss-taxation-of-cryptocurrencies-how-are-investors-taxed.html, accessed October 3, 2024.

Revenue derived from other crypto-related activities, such as mining and staking, is also taxed in Switzerland. Income generated from staking or receiving tokens via airdrops (explained further in our study) is taxable as income from movable property and is therefore subject to income tax. Airdrop incomes are taxed based on their fair market value at the time of allocation.

Switzerland exempts several cryptocurrency transactions from general taxation. Some of these tax-free transactions are purchasing cryptocurrency with fiat cash, such as USD, Euro, and Swiss Franc (CHF), engaging in the sale, exchange, or use of permissioned cryptocurrencies for private investors, and transferring cryptocurrency/tokens between personal wallets. In addition, holding crypto (buying and holding) is tax-free as well but still subject to the wealth tax imposed on the whole of one individual's assets.

In sum, Switzerland has one of the most well-structured taxation and legal systems for blockchain and cryptocurrency investors and companies. The country's strategy of creating separate regulations for crypto-related financial activities, while maintaining strict banking-sector regulations, is particularly effective. The introduction of a new category of securities serves as a prime example of this regulatory strategy. It allows for regulating the crypto-related securities market without imposing excessive burdens on startups. As a result, Switzerland is likely to continue attracting a significant number of private crypto investors and companies due to its robust legal framework.

2.2.8. Australia

Australia is known as a technology-driven country and has taken a proactive stance in regulating blockchain technology as well. There are two main institutions responsible for the regulatory approach to the blockchain ecosystem in Australia, namely the Australian Securities and Investments Commission (ASIC) and the Australian Transaction Reports and Analysis Centre (AUSTRAC).[390]

[390] *Businesses.com.au*, "The Legal Landscape of Blockchain in Australia for 2024," *Businesses.com.au*, 2024, https://www.businesses.com.au/money/443472-the-legal-landscape-of-blockchain-in-australia-for-2024, accessed October 3, 2024.

Corporate, cryptocurrency markets, and consumer credit fields in Australia are regulated by Australian Securities and Investments. Cryptocurrency exchanges (or also described in Australia as digital currency exchanges) are required to register with the Australian Transaction Reports and Analysis Centre (AUSTRAC) since 2017 to verify investors and other users, maintain records of transactions, and report these transactions under AML/CTF obligations, which we give more details about below. However, companies that operate financial or consumer credit services or market infrastructure through blockchain or distributed ledger technology are regulated under the other relevant licensing regimes.

The classification of Bitcoin and other cryptocurrencies in Australia is not so different from other examples we discussed and is classified as property, but not currency. This means cryptocurrencies and tokens can be legally spent, received, stored, traded, and used as a means of payment for personal transactions. It is possible to use them for business transactions as well; however, acceptance of cryptocurrency as payment is not mandatory for merchants.

Cryptocurrencies have been legal in Australia since 2017, and cryptocurrencies and exchanges fall under the Australian Anti-Money Laundering and Counter-Terrorism Financing Act 2006, which is a creative way of regulating the crypto ecosystem. [391] Lawmakers focus on the biggest threat to the system through cryptocurrencies and start the regulatory approach from anti-money laundering regulations.

With the change to the old Anti-Money Laundering and Counter-Terrorism Financing Amendment Act of Australia, digital currency (as described in Australian law) exchange providers are now subjected to the regimes of anti-money laundering and counter-terrorism measures.[392]

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[391] Australian Transaction Reports and Analysis Centre, "AML/CTF Act," *AUSTRAC*, accessed June 6, 2024, https://www.austrac.gov.au/business/legislation/amlctf-act.

[392] PwC Australia, "New Anti-Money Laundering and Counter-Terrorism Financing Laws," *PwC*, January 30, 2018, https://www.pwc.com.au/legal/assets/legaltalk/new-anti-money-laundering-and-counter-terrorism-financing-laws-300118.pdf, accessed October 3, 2024.

In the case of any exchange service that entails the provision of any fiat money (like USD, etc.), regardless of whether it is Australian dollars or not, into any cryptocurrency and vice versa, individuals or entities are required to register.[393] This was an important step compared with other countries in 2017 (even though it came into force on April 3, 2018).

The new legislative change aims to describe digital currency exchanges (cryptocurrency exchanges) inside the existing framework of Anti-Money Laundering/Counter-Terrorism Financing regulations and provides reporting requirements. Hence, digital currency exchanges now have to bear these extra expenses and configure their technological infrastructure to ensure compliance, like many other financial institutions in Australia. It could be said that in the year 2017, there was a worldwide movement to enforce anti-money laundering and counter-terrorism financing restrictions on cryptocurrency transactions.[394]

The Australian government also published a detailed report in October 2021. In this detailed report, certain recommendations were discussed. One of these was the licensing of cryptocurrency exchanges. The parliamentary committee was made aware of concerns regarding the existing registration process of cryptocurrency exchanges with the Australian Transaction Reports and Analysis Centre, which appeared to apply little pressure and imposed minimal obligations on Digital Currency Exchanges (DCEs, as cryptocurrency exchanges are called in Australia).

Since the 2017 regulatory change, as discussed above, it is obligatory for Digital Currency Exchanges to register with AUSTRAC to fulfill their obligations regarding anti-money laundering and counter-terrorism financing (AML/CTF). However, this report suggested that rather than just registering digital assets under AML/CTF, there should be a licensing system for the cryptocurrency exchanges that includes the necessary duties and standards for the custody of digital assets under these Digital Currency Exchanges.[395]

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[393] Ibid.
[394] PwC Australia, "New AML/CTF Regulations for Cryptocurrency Exchanges," *PwC Australia*, April 23, 2018, https://www.pwc.com.au/legal/assets/legaltalk/new-amlctf-regulations-cryptocurrency-exchanges-23apr18.pdf.

[395]Australian Parliament, "Final Report," *Parliament of Australia*, accessed June 6, 2024, https://parlinfo.aph.gov.au/parlInfo/download/committees/reportsen/024747/toc_pdf/Finalreport.pdf;fileType=application%2Fpdf.

The aforementioned report had over 11 recommendations for the regulatory bodies and the Australian Government to move forward.[396]

Digital Currency Exchanges in Australia have had full legal status since 2017, starting with AML and CTF regulations. Despite the fact that Australian laws have embraced innovation, as seen in the example of Switzerland discussed above, sometimes a light touch on the ecosystem may cause unjust treatment of investors. The actions of the regulatory bodies should embrace innovation while maintaining a balance between protecting national interests and safeguarding investors.

The approach to cryptocurrencies in terms of taxation is decided by the Australian Taxation Office (ATO). Under the guidance of the ATO, cryptocurrencies are categorized, with examples of some common crypto assets including coins and tokens such as Bitcoin, a cryptocurrency; DAI, an investment token; USDC, a stablecoin; GALA, a game token; and BAYC, a non-fungible token. Based on this categorization, tax offices will treat each crypto asset that investors hold as a separate asset.[397]

For instance, Bitcoin has been described as foreign currency for the purposes of Division 775 of the Income Tax Assessment Act 1997, regarding income taxation.[398] However, there are two other descriptions of Bitcoin under the ATO: it is described as a Capital Gains Tax (CGT) asset for the purposes of subsection 108-5(1) of the Income Tax Assessment Act

[396] Ibid.

[397] Australian Taxation Office, "Crypto Asset Investments," *Australian Taxation Office*, accessed June 6, 2024, https://www.ato.gov.au/individuals-and-families/investments-and-assets/crypto-asset-investments/.

[398] Australian Taxation Office, "Tax Determination TD 2014/25," *Australian Taxation Office*, accessed June 6, 2024, https://www.ato.gov.au/law/view/document?DocID=TXD/TD201425/NAT/ATO/00001&PiT=99991231235958.

1997,[399] and as trading stock for the purposes of subsection 70-10(1) of the Income Tax Assessment Act 1997.[400]

As in other jurisdictions discussed here, in the case of holding cryptocurrencies for at least 12 months, capital gains tax may be discounted in Australia. The main purpose of this is to avoid volatility. Business transactions conducted through cryptocurrencies are taxed similarly to barter arrangements, and transactions involving cryptocurrencies are not subject to the Goods and Services Tax (GST) to avoid double taxation of these services.

A consultation paper on token mapping was produced by the Australian Government in February 2023 with the primary purpose of identifying the key activities and functions of crypto-related products and mapping these under existing regulatory frameworks. This paper was an important step following the collapse of the famous cryptocurrency exchange FTX, which exposed an $8 billion hole in FTX's accounts in November 2022.[401]

Crypto asset functions can be categorized in multiple ways.[402] In the aforementioned report, token mapping proposes a high-level taxonomy of four token types that can be grouped under two kinds of token systems. These are categorized as intermediated token systems with two subcategories: (i) crypto asset services and (ii) intermediated crypto assets. The second main category is for public token systems, with two subcategories: (i) network tokens (a type of crypto asset) and (ii) public smart contracts (covering crypto assets created using

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[399] Australian Taxation Office, "Tax Determination TD 2014/26," *Australian Taxation Office*, accessed June 6, 2024, https://www.ato.gov.au/law/view/document?DocID=TXD%2FTD201426%2FNAT%2FATO%2F00001&PiT=99991231235958&document=document.

[400] Australian Taxation Office, "Tax Determination TD 2014/27," *Australian Taxation Office*, accessed June 6, 2024, https://www.ato.gov.au/law/view/document?DocID=TXD%2FTD201427%2FNAT%2FATO%2F00001&PiT=99991231235958&document=document.

[401] David Yaffe-Bellany, "Sam Bankman-Fried Is Found Guilty of 7 Counts of Fraud and Conspiracy," *The New York Times*, November 2, 2023, archived from the original on November 3, 2023, accessed November 3, 2023, https://www.nytimes.com/2023/11/02/business/sam-bankman-fried-guilty.html.

[402] P. Freni, E. Ferro, and R. Moncada, "Tokenomics and Blockchain Tokens: A Design-Oriented Morphological Framework," *Blockchain: Research and Applications* 3, no. 1 (2022): 100069.

smart contract tokens).[403] This mapping is prepared in a detailed and descriptive manner and demonstrates how seriously Australian authorities are taking the cryptocurrency and blockchain ecosystem.

2.2.9. India

India is the last country we will discuss here. The country has been growing rapidly and recently surpassed the population of China to become the most populous country in the world.[404]

The interest in blockchain technology in India can be traced back to the early days of the technology. The Ministry of Electronics and Information Technology of India (MeitY) released the National Strategy on Blockchain in December 2021, which outlined its vision to adopt blockchain across various sectors such as agriculture, healthcare, voting, e-governance, and finance. The strategy also aimed to develop Made in India blockchain technologies for global use by 2027.[405]

However, India's regulatory stance on blockchain and cryptocurrency has fluctuated. In 2018, the Reserve Bank of India (RBI) prohibited banks from dealing with crypto-related businesses. [406] However, in 2020, the Supreme Court overturned this ban, enabling authorities to engage with cryptocurrency [407]businesses.

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[403] Ibid.

[404]Earth Population Database, "World Population by Country 2024," *Earth Population Database*, accessed June 6, 2024, https://database.earth/population/bycountry/2024.

[405] Ministry of Electronics and Information Technology, Government of India, *National Blockchain Strategy*, accessed June 6, 2024, https://www.meity.gov.in/writereaddata/files/National_BCT_Strategy.pdf.

[406] Reserve Bank of India, "Notification," *Reserve Bank of India*, accessed June 6, 2024, https://www.rbi.org.in/Scripts/NotificationUser.aspx?Id=11243.

[407] "India's Top Court Overturns Ban on Banks Dealing in Cryptocurrencies," *Financial Times*, accessed June 6, 2024, https://www.ft.com/content/c2f37f02-5df1-11ea-b0ab-339c2307bcd4.

Like many central banks around the world, the Reserve Bank of India also announced plans to introduce a Central Bank Digital Currency (CBDC) and is currently working on a model for its phased implementation.[408]

One of the most recent regulatory developments in India occurred on 7th March 2023, when the Ministry of Finance, Department of Revenue, introduced the 2002 Prevention of Money Laundering Amendment Rules (PMLA). The rules aim to prevent money laundering and terrorist financing. The PMLA mandates that financial institutions, banking companies, and intermediaries maintain records of their users' transactions and conduct due diligence comparable to that required of traditional financial bodies. This move seeks to strengthen existing regulations related to client due diligence and record-keeping.[409]

Despite recent regulatory measures, the legal environment surrounding blockchain technology in India remains uncertain. However, there is significant potential for future frameworks to emerge in line with government policies.

3. The Legal Responsibilities of Cryptocurrency Exchanges in the EU and The Markets in Crypto-Assets Regulation (Mica)

As legislators have increased their interest in the cryptocurrency ecosystem, they have faced a serious challenge in determining how to regulate this wild and independent market. The system was designed within the framework of international information law systems that are in use today. Current data suggests that, for crimes committed over the Internet, significant tracking can be conducted through centralized systems (except in the case of the dark web and deep web).

However, much of the misconduct in the cryptocurrency ecosystem arises from the activities of cryptocurrency exchanges. A substantial portion of these exchanges fails to fulfill their responsibilities in areas such as preventing money laundering and financing crime. Recognizing this, the European Union became one of the first institutions to take regulatory action.

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[408] Neha Kukrety, Pitresh Kaushik, and Shashank Pandey, "Blockchain Technology and Legal Framework in India: A Systematic Review," 2023, https://doi.org/10.5281/zenodo.8360087.

[409] Government of India, *The Gazette of India*, 2023, https://egazette.nic.in/WriteReadData/2023/244194.pdf.

The Draft Regulation of Cryptocurrency Exchanges, published in 2020 as part of the Markets in Crypto-Assets Regulation (Mica) framework, initially focused on crypto marketplaces but aimed to establish regulations for a broader segment of the ecosystem. The main objectives outlined in this draft were:

- To prevent money laundering
- To prevent the financing of terrorism
- To protect consumers
- To prevent market manipulation[410]

The data gathered in this study suggests that the biggest legal responsibilities of cryptocurrency exchanges may be their supervisory obligations against money laundering. From this point of view, most lawmakers in the world keep cryptocurrency exchanges under surveillance.

The American Securities Regulatory Authority (SEC) also stressed that a significant part of cryptocurrencies can be identified as securities, and at this point, institutions that broker these cryptocurrencies should also be registered as an agency that mediates the purchase of securities. For example, SEC charged Chicago-based Cumberland DRW LLC with operating as an unregistered security dealer in more than $2 billion of crypto assets and in violation of the SEC registration requirements under federal securities laws for investor [411] protection. In addition, the obligations of cryptocurrency exchanges to share certain customer records with government agencies for purposes such as tax tracking are also introduced. We can elaborate on this part more if MiCA is applied.

In order to understand the MiCA better to remember some key elements of cryptocurrency ecosystem today. In this example of Bitcoin, as it is claimed, at the beginning of BTC,

[410] European Commission, "Proposal for a Regulation of the European Parliament and of the Council on Markets in Crypto-assets (MiCA)," *EUR Lex*, published September 24, 2020, accessed October 10, 2024, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0593.

[411] Securities and Exchange Commission, "SEC Charges Cumberland DRW for Operating as an Unregistered Dealer in the Crypto Asset Markets," *SEC*, October 10, 2024, https://www.sec.gov/newsroom/press-releases/2024-169.

Satoshi has mined over 1M BTC by the generous award of mining, as 50 BTC per block it means that 5% of BTCs may be held up by just one person or group called Satoshi. (This conclusion has been reached after the research from the first created block (genesis) in 1 January 2009 to 25 January 2010, total 36,288 blocks and has been concluded that thousands of them were mined by the same mining equipment, which is also used for the creation of the genesis block as well. [412])

One another field need it for the regulation was that lost Bitcoins, which has been claimed that between 2.78 to 3.79 Million BTC is lost, which is almost 20% of the whole BTCs in circulation and even we do not know other cryptocurrencies.[413] In general, people who lost their login details to the platforms or hardware wallets or keys to access their cryptocurrencies are the owners of these lost BTCs, and since decentralized systems as BTC have no responsive body, customers have not much recourse other than just accept. It remains questionable for many legal sides as customer protection of decentralized cryptocurrency owners. (For example, software developer, resident of San Francisco, Stefan Thomas has forgotten the password of his wallet, which contains 7,002 BTC (with today's approx. value of $309M). Another example is James Howells, who trashed his old computer, which contains the code for access to 7,500 BTC.[414])

On 29 June 2023, The Markets in Crypto-Assets Regulation (MiCA) entered into force and will apply from 30 December 2024. The work has been started in 2018 under the FinTech action plan.[415]

Under MiCA, the main objectives are the categorization of the crypto-related products and services, determination of the license conditions, indication of the responsibilities for the parties and authorization of the EU bodies to have enforcement and investigations.

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[412] Ibid.

[413] Ibid

[414] SoFi, "How to Find Lost Bitcoin," *SoFi*, accessed June 6, 2024, https://www.sofi.com/learn/content/how-to-find-lost-bitcoin/.

[415] European Commission, "FinTech Action Plan: More Competitive and Innovative European Financial Sector," *European Commission*, accessed June 6, 2024, https://finance.ec.europa.eu/publications/fintech-action-plan-more-competitive-and-innovative-european-financial-sector_en.

The MiCA suggests as three types of crypto-assets (or also tokens) as we discussed in detail in our study, firstly utility tokens which is a type of crypto-asset that is only intended to provide access to a good or a service supplied by its issuer, second asset-referenced Token (ART), which is not an electronic money token and that aims to maintain a stable value by referencing another value or right or a combination thereof, including one or more official currencies and lastly E-Money Token (EMT) that purports to maintain a stable value by referencing the value of one official currency.[416]

However, it should be noted that MiCA does not regulate the issues which fall within the scope of existing regulatory frameworks as under Markets in Financial Instruments Directive (also known as MiFID II).

MiCA also lists the crypto-asset services and issues regulative approaches to these. Under MiCA, crypto-asset services are:

- the custody and administration of crypto-assets on behalf of third parties;
- the operation of a trading platform for crypto-assets;
- the exchange of crypto-assets for fiat currency that is legal tender;
- the exchange of crypto-assets for other crypto-assets (cryptocurrency markets);
- the execution of orders for crypto-assets on behalf of third parties (brokers);
- placing of crypto-assets;
- the reception and transmission of orders for crypto-assets on behalf of third parties;
- providing advice on crypto-assets (consultants).[417]

Under MiCA Article 23, asset-referenced token issuers should act honestly, fairly, and professionally in the best interests of the holders of asset-referenced tokens. They should communicate with the holders of asset-referenced tokens in a fair, clear, and non-misleading manner, act in the best interests of the holders of such tokens, and treat them equally, unless any preferential treatment is disclosed in the crypto-asset white paper (white paper

[416] White & Case, "MiCA Regulation: New Regulatory Framework for Crypto-Assets Issuers and Crypto-Asset," *White & Case*, accessed June 6, 2024, https://www.whitecase.com/insight-alert/mica-regulation-new-regulatory-framework-crypto-assets-issuers-and-crypto-asset.

[417] European Union, *Markets in Crypto-Assets Regulation (MiCA)*, Article 3, Paragraph 9.

conditions are also clarified under MiCA Article 8) and, where applicable, in the marketing communications.[418]

MiCA does not apply to crypto-assets that are unique and not fungible with other crypto-assets, which are known as Non-Fungible Tokens (NFTs). Their scope already falls under other existing regulations.[419]

MiCA has also introduced a new categorization for more detailed regulatory responsibilities for larger projects, referred to as significant asset-referenced tokens. Article 39 under MiCA suggests that a project will be classified as significant if it meets the conditions below:

> (a) the size of the customer base of the promoters of the asset-referenced tokens, the shareholders of the issuer of asset-referenced tokens or of any of the third-party entities referred to in Article 30(5), point (h);
> (b) the value of the asset-referenced tokens issued or, where applicable, their market capitalization;
> (c) the number and value of transactions in those asset-referenced tokens;
> (d) the size of the reserve of assets of the issuer of the asset-referenced tokens;
> (e) the significance of the cross-border activities of the issuer of the asset-referenced tokens, including the number of Member States where the asset-referenced tokens are used, the use of the asset-referenced tokens for cross-border payments and remittances and the number of Member States where the third-party entities referred to in Article 30(5), point (h), are established;
> (f)the interconnectedness with the financial system.''[420]
>
> If the above criteria are met by the project, the European Banking Authority (EBA) shall classify the asset-referenced tokens as significant asset-referenced tokens, which will then have extra threshold responsibilities as follows:

[418] European Commission, "Proposal for a Regulation of the European Parliament and of the Council on Markets in Crypto-assets, and Amending Directive (EU) 2019/1937," *European Commission*, accessed June 6, 2024, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0593.

[419] European Union, *Markets in Crypto-Assets Regulation (MiCA)*, Article 2(3).

[420] Ibid., Article 39.

‘’i) the threshold for the customer base shall not be lower than two million of natural or legal persons;

ii) the threshold for the value of the asset-referenced token issued or, where applicable, the market capitalization of such an asset-referenced token shall not be lower than EUR 1 billion;

iii) the threshold for the number and value of transactions in those asset-referenced tokens shall not be lower than 500 000 transactions per day or EUR 100 million per day respectively;

iv) the threshold for the size of the reserve assets as referred to in point (d) shall not be lower than EUR 1 billion;

v) the threshold for the number of Member States where the asset-referenced tokens are used, including for cross-border payments and remittances, or where the third parties as referred to in Article 30(5), point (h), are established shall not be lower than seven[.][421]

Under MiCA, all crypto-asset service providers must meet the conditions of acting honestly, fairly, and professionally in accordance with the best interests of their clients and prospective clients. They must provide fair, clear, and not misleading information, particularly in marketing communications, which shall be identified as such and shall not, deliberately or negligently, mislead a client regarding the real or perceived advantages of any crypto-assets. Crypto-asset service providers are also required to warn clients of the risks associated with purchasing crypto-assets through them and to make their pricing policies publicly available by posting them prominently on their websites.[422]

Under MiCA Article 68, the operation of a trading platform for crypto-assets, which we discussed in our study as cryptocurrency marketplaces, is also described. For example, crypto-asset service providers shall not deal on their own account on the trading platform

[421] Ibid., Article 39, Paragraph 6.

[422] Ibid., Article 59.

for crypto-assets they operate, even if they are authorized for the exchange of crypto-assets for fiat currency or for the exchange of crypto-assets for other crypto-assets.[423]

In Article 3, cryptocurrency marketplaces are categorized into the following three services:

1. Trading platforms for crypto-assets: These involve the management of trading platforms (one or more) for crypto-assets, within which multiple third-party buying and selling interests for crypto-assets can interact in a manner that results in a contract, including by exchanging one crypto-asset for another or a crypto-asset for fiat currency (as legal tender).[424]
2. The exchange of crypto-assets for fiat currency
3. The exchange of crypto-assets for other crypto-assets[425]

Given the circumstances, it is of the utmost significance to discuss the scope of MiCA's regulations. MiCA is only applicable to tokens or crypto assets that are not already regulated by the rules currently in place within the European Union, known as MiFID II (Markets in Financial Instruments Directive 2014). For example, security tokens are not covered by MiCA. In this respect, for security tokens and other issues such as NFTs, which are not covered by MiCA, several guidelines have been published by the EU. One of them is the European Banking Authority Report on the qualification of crypto-assets under the second Electronic Money Directive.[426]

Another is the European Securities and Markets Authority (ESMA) consultation paper about criteria and conditions for the qualification of crypto-assets as financial instruments. Crypto-assets should be designated as financial instruments if they align with MiFID II's definition

[423] Ibid., Article 68, Paragraph 3.

[424] Ibid., Article 3, Paragraphs 11, 12, 13.

[426] European Banking Authority, "Report with Advice for the European Commission on Crypto-Assets," January 2019.

of transferable securities.[427] In such instances, these crypto-assets (as security tokens) should be subject to the regulatory framework applicable to financial instruments. Transferable securities, as defined by MiFID II (Transferable securities under Article 4(1)(44) of MiFID II, means those classes of securities which are negotiable on the capital market), encompass a wide range of instruments from shares and bonds to "other securities" related to other securities, currencies, interest rates, commodities, or other indices.[428]

In summary, in the case of security token classification, existing EU regulations that are outside the scope of MiCA shall be applied, such as MiFID II instead of MiCA. We discuss the criteria to determine security tokens under the section of categorizations of the tokens.

Another interesting fact about MiCA is that it does not cover crypto-asset services that are fully decentralized. For instance, Bitcoin, the world's most well-known cryptocurrency, is not regulated by the MiCA Regulation, nor are many decentralized cryptocurrency exchanges.

MiCA also mentions requirements for the issuance of tokens that are not categorized as ART (asset-referenced tokens) or EMT (e-money tokens), though they are not as far-reaching as the requirements for EMT issuers. The requirements for ART or EMT do not apply to these tokens if the crypto-assets are offered for free (as airdrops). In addition, the requirements for issuers of crypto-assets do not apply when:

- The crypto-asset is automatically created as a reward for the maintenance of the distributed ledger or the validation of transactions;
- The offer concerns a utility token providing access to a good or service that exists or is in operation (e.g., social tokens or market chips); or

[427] European Securities and Markets Authority, "Consultation Paper on the Draft Guidelines on the Conditions and Criteria for the Qualification of Crypto-Assets as Financial Instruments," January 2024, https://www.esma.europa.eu/sites/default/files/2024-01/ESMA75-453128700-52_MiCA_Consultation_Paper_-_Guidelines_on_the_qualification_of_crypto-assets_as_financial_instruments.pdf.

[428] European Union, *Markets in Financial Instruments Directive II (MiFID II)*, Article 4(1)(44).

- The crypto-asset holder has the right to use it only in exchange for goods and services in a limited network of merchants with contractual arrangements with the offeror (e.g., tokens created for marketing purposes).

MiCA requires all crypto-asset service providers, including those operating cryptocurrency marketplaces (exchanges), to adhere to strict operational standards to prevent market abuse, such as market manipulation and insider trading, ensuring transparency and market integrity for crypto-assets.

To maintain a transparent market, MiCA outlines the transparency requirements for issuers of crypto-assets, including those offered on cryptocurrency marketplaces. It mandates that issuers of crypto-assets must have a white paper that complies with the regulatory standards under MiCA. Before offering tokens to the public, issuers should obtain approval from the competent national authority (for instance, in Germany, this is the Federal Financial Supervisory Authority (BaFin)).[429]

MiCA also sets out obligations for all issuers of asset-referenced tokens and describes the operating conditions for crypto-asset service providers, including those running cryptocurrency exchanges. MiCA specifies requirements for handling conflicts of interest, internal management, and procedures to ensure fair and transparent cryptocurrency trading.[430]

MiCA outlines the licensing requirements for all crypto-asset service providers, including cryptocurrency exchange operators, to operate legally within the European Union. These providers must comply with requirements set out by MiCA regarding operational resilience, risk management, and governance. Besides the obligation to act honestly, fairly, and professionally in the best interests of clients under Article 59, Article 60 sets out additional prudential safeguards for service providers. Under Article 61, organizational requirements are established. For example, records must be kept of all crypto-asset services, orders, and

[429] European Union, *Markets in Crypto-Assets Regulation (MiCA)*, Article 5.

[430] Ibid., Article 23.

transactions undertaken to enable competent authorities to fulfill their supervisory tasks and perform enforcement actions. This includes compliance with obligations related to clients or potential clients and the integrity of the market.[431]

Crypto-asset service providers must also meet organizational requirements and submit reports to the competent national authorities and meet the conditions of the fit and proper managers test under national supervisory law.[432] This applies to key personnel and, of course, executives involved in managing crypto-asset service platforms.

One of the main objectives of MiCA is to establish EU-wide recognition of services without the need for separate national registrations. It aims to harmonize regulations across all EU member states and allow licensed crypto-asset marketplaces and service providers to operate across borders without requiring additional national registrations or bureaucratic processes.

Besides these requirements, MiCA sets out additional capital requirements for service providers.

[431] Ibid., Article 61.

[432] CMS, "MiCA on Point," December 2020, https://cms.law/en/media/local/cms-hs/files/publications/publications/mica-on-point-12-2020-en?v=1.

Crypto-asset service providers	Type of crypto-asset services	Minimum capital requirements under Article (1)(a)
Class 1	Crypto-asset service provider authorized for the following crypto-asset services: – reception and transmission of orders on behalf of third parties; and/or – providing advice on crypto-assets; and/or – execution of orders on behalf of third parties; and/or – placing of crypto-assets.	EUR 50,000
Class 2	Crypto-asset service provider authorized for any crypto-asset services under class 1 and: –custody and administration of crypto-assets on behalf of third parties.	EUR 125,000
Class 3	Crypto-asset service provider authorized for any crypto-asset services under class 2 and: –exchange of crypto-assets for fiat currency that is legal tender. –exchange of crypto-assets for other crypto-assets; –operation of a trading platform for crypto-assets.	EUR 150,000

Table-4: Minimum capital requirements for crypto-asset service providers
Source: Minimum capital requirements for crypto-asset service providers, Mica Annex 4

MiCA not only sets out requirements for licensing but also creates a mechanism for checking and oversight of the crypto-asset marketplaces and service providers that have already obtained licenses. It establishes clear responsibilities between the European Banking Authority (EBA) and the European Securities and Markets Authority (ESMA), ensuring cooperation on the continuous oversight of license holders.

Once crypto-asset service providers, including cryptocurrency exchanges, obtain their required licenses, they enter a regime of continuous oversight to ensure adherence to ongoing regulatory requirements under MiCA. Some of these ongoing regulatory requirements include regular reporting obligations under Article 61 as organizational obligations, scheduled and unscheduled audits for verifying information provided in obligatory or voluntary reports, and sustaining the operational integrity and security of licensed platforms. This includes AML compliance, cybersecurity measures, and the robustness of daily operational procedures.

Crypto-asset service providers are obliged to maintain interactive communication with regulators and must respond to inquiries, participate in reviews, and update regulatory bodies about significant changes in their business model or operational environment.

In cases where crypto-asset service providers fail to comply with obligations, regulators have the authority to mandate corrective actions and even impose sanctions or fines, including revocation of licenses. MiCA Article 92 clearly sets out administrative sanctions and other administrative measures for noncompliant service providers.[433]

One of the most detailed sections regulated under MiCA pertains to stablecoins. In my opinion, the system views cryptocurrencies as a potential threat to the economy, but stablecoins occupy a different position. Stablecoins carry higher risks than other cryptocurrencies since they pose a direct threat to fiat currencies and could cause liquidity problems in the future. This is likely why MiCA has regulated stablecoins in greater detail than other cryptocurrencies. We discuss the regulations on stablecoins in the stablecoin section.

The date of being effective of MiCA changes. Title III and Title IV come into force on June 30, 2024, which are the chapters for asset-referenced tokens (Title III) and E-money tokens (Title IV). [434] There are several discussions and criticisms about these chapters. As it seems,

[433] MiCA, Article 92.

[434] European Securities and Markets Authority, "MiCA Implementation Timeline," *ESMA*, accessed October 3, 2024, https://www.esma.europa.eu/sites/default/files/inline-images/MiCA_Implementation_timeline_0.png.

MiCA brings stringent requirements for stablecoin issuers, such as the high percentage of reserve obligations to be held in banks. Another challenge with Title III is the obligations for international stablecoin issuers to engage custodians authorized under EU regulations. In cases where any issuer is already using foreign custodians, complications may arise, increasing concerns about the fungibility of tokens issued in different jurisdictions.[435]

These mentioned regulatory frameworks, licensing requirements, and obligations aim to standardize crypto-related markets across the EU while enhancing consumer protection and promoting a stable, sustainable, and transparent crypto-asset market. MiCA is certainly one of the milestones in the world to clarify the cryptocurrency ecosystem. The question here is whether the regulative approach of MiCA helps innovation to become more sustainable or, on the contrary, places a heavy burden on the shoulders of enterprises and entrepreneurs with extra bureaucracy. The example of the regulatory sandbox in Japan we discussed above may provide extra protection from liability under specific circumstances to new enterprises, while the main strict regulatory framework protects the interests of consumers.

The analysis of the legal responsibilities of cryptocurrency exchanges under MiCA highlights both developments and difficulties in addressing the unique features of blockchain. MiCA provides an organized structure for classifying crypto-assets, defining operational regulations, and clarifying the functions of service providers, in line with our research question 1. While MiCA represents an important growth, hypothesis 1 remains valid since the framework exposes weaknesses and limitations that could hinder innovation.

MiCA's comprehensive approach to crypto-asset services shows a partly solid understanding of the ecosystem. MiCA encourages openness and trust by categorizing services such as custody, trading platforms, and exchanges. The categorization of significant asset-referenced tokens imposes stricter regulations for large-scale projects while easing the restrictions on smaller enterprises, hence encouraging innovation. MiCA intentionally excludes the regulation of decentralized platforms such as Bitcoin, possibly reflecting legislators' intention to avoid interference in areas where they have little skill or understanding.

[435] Ledger Insights, "Report Highlights Pros & Cons of Stablecoin MiCA Regulations," July 4, 2024, accessed October 10, 2024, https://www.ledgerinsights.com/report-highlights-pros-cons-of-stablecoin-mica-regulations/.

Despite these benefits we discussed, MiCA's stringent stablecoin requirements and disjointed oversight, alongside frameworks such as MiFID II governing security tokens, result in regulatory challenges. This kind of complex regulatory requirement will slow down the European ecosystem, while competitors like the British fintech market can gain the upper hand in innovation. A wider structure may reduce complexity and guarantee uniformity, providing a clear framework for startups, especially.

Recommendations include the incorporation of more detailed and comprehensible standards for decentralized applications, the setting up of sandbox models to promote innovation (as seen in examples from our comparative research), and the integration of MiCA with other regulatory frameworks rather than avoiding interference altogether. MiCA represents an important and detailed step in cryptocurrency regulation, striving to find a balance between structure and flexibility. Nonetheless, more development is necessary to effectively manage decentralized systems and achieve complete oversight harmonization. Lastly, it should take less than six years to establish such regulations, as technology has evolved significantly over these past six years and is expected to continue accelerating in the coming years.

VI. The Future of Blockchain - Addressing Current Challenges and Anticipating Future

In this last chapter, we discuss the future of blockchain technology, which we have evaluated from the past to the present in previous chapters. Although many of the concepts we will describe here have already begun to be used, this is just the beginning, akin to the early days of the Internet. These concepts are some of the basic building blocks of a system in a world heading toward decentralization. First, we will examine the WEB 3.0 concept as the overarching framework. Then, we will summarize the concepts of Decentralized Apps (DApps), Decentralized Autonomous Organizations (DAO), Decentralized Exchange (DEX), Decentralized Finance (DeFi), Non-Fungible Tokens (NFTs), Metaverse, and, lastly, artificial intelligence, and attempt to predict tomorrow from a bird's-eye view today.

It is crucial to evaluate these innovative blockchain features to determine whether existing legal frameworks have the necessary capacity to address current developments in blockchain technology and to identify which innovations present greater legal challenges. This evaluation will include a review of their technical specifications and different regulations across various countries. This comparison will clarify the particular issues regulators face in modifying current legal frameworks to meet the rapidly emerging blockchain ecosystem.

To fully understand decentralization, we will first examine the evolution of the Internet and then broaden this understanding by looking into other technological innovations, such as decentralized applications, autonomous organizations, and finance, before addressing the associated legal frameworks.

1. The Way to Decentralized WEB-3.0—A Brief Overview of the Development of the Internet

The data suggests that the foundations of the Internet infrastructure we use today were first laid in the 1960s as a state project aimed at facilitating information sharing. During the Cold War between the United States and Soviet Russia, the Russians reached an advanced point in communication with the Sputnik satellite, prompting the United States Department of Defense to create ARPANET (Advanced Research Projects Agency Network). ARPANET

was the first step in the birth and development of [436] what would eventually become the Internet. However, as the name ARPANET suggests, it was a generally closed network accessible only to a limited number of institutions.

ARPANET and another project named Networks, such as the Defense Data Network, did not initially communicate. On January 1, 1983, different computers on separate networks were connected to each other using the Transfer Control Protocol/Internetwork Protocol (TCP/IP). This date is considered the official birthday of the Internet. From this point on, all computers began connecting in the same global language, even if they were on different networks.

The Internet became more visible in 1990 when British computer scientist Tim Berners-Lee—whose name will be referenced in the NFT section—founded the World Wide Web (WWW) at CERN, Switzerland. [437]Although often confused with the Internet, the Web is an infrastructure that made it easier to access information contained within the Internet via websites and hyperlinks. Through the WWW, the Internet became accessible to large masses. Between 1989 and 2004, the Internet evolved globally at a rapid pace. A network that was initially forbidden for commercial use has now become a billion-dollar commercial [438] marketplace. By 2004, to keep up with the rapid developments of the Internet, Web 2.0 entered our lives. We will examine Web 3.0 in greater detail in the following chapters of this study.

So, Who Manages the Internet?

Today, the Internet is not managed by a single institution or company. Various independent non-governmental organizations carry out the management of the Internet. The most important of these organizations are:

- Internet Society (ISOC)

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[436] DARPA, "ARPANET," accessed May 23, 2024, https://www.darpa.mil/about-us/timeline/arpanet.

[437] CERN, "The Birth of the Web," accessed May 23, 2024, https://home.cern/science/computing/birth-web.

[438] Kevin Kelly, "We Are the Web," *Wired*, August 2005, https://link.wired.com/public/32945405.

- Internet Architecture Board (IAB)
- Internet Engineering Task Force (IETF)
- Internet Engineering Steering Group (IESG)
- Internet Corporation for Assigned Names & Numbers ICANN)
- W3C[439]

To summarize these, ISOC is a non-profit institution that creates a legal framework to organize global developers for the development of the Internet. The IAB and IETF also come to the fore as organizations that provide organization and supervision of the technical infrastructure of the Internet.

Each device connected to the Internet network has its own number. This number is called the IP (Internet Protocol) address. The IP address basically provides identification and location determination of the transaction performed. To ensure the distribution and organization of these original IP addresses worldwide, IANA (Internet Assigned Numbers Authority) was established. IANA essentially organizes these IP addresses into five different local internet registration institutions (Regional Internet Registries—RIRs). These five regions are located in Africa, the Americas, Asia-Pacific, Latin America and the Caribbean, and Europe.

Although it is not very possible to cut off the Internet globally today, it is possible to cut it off regionally. For example, during the riots in Egypt in 2011, the Egyptian government ordered local Internet providers to cut off the Internet. Eventually, Egypt's Internet connection to the world was largely cut off.[440] Another example is North Korea, which has an Internet system closed in on itself, allowing very limited usage rights (for instance, sending emails only within the country). The Internet is more extensive only in certain government institutions or universities. Over the past 15 years, many governments and companies have gained extensive experience in using the power of the Internet for both good

[439] Alex Simonelis, "A Concise Guide to the Major Internet Bodies," *Ubiquity* 2005 (February 2005), https://ubiquity.acm.org/article.cfm?id=1071915.

[440] Internet Society, "An Introduction to IANA - Internet Assigned Numbers Authority," September 29, 2008, https://www.iana.org/about/presentations/davies-atlarge-iana101-paper-080929-en.pdf.

and bad purposes. In 2021, Twitter's permanent blocking of former US President Donald Trump's account[441] was a significant example of how the Internet has actually reached a level where it can be considered a fundamental human right and can be centralized and controlled by certain groups, in a way that even the former president of the most powerful country in the world could not challenge.

At this point, the very local state of the Internet, which was used only in the military or universities at the beginning, has allowed it to reach wider audiences more liberally with globalization. Still, many platforms (Google, Facebook, Twitter, Badoo, Yandex, etc.) that use the Internet infrastructure and quickly become monopolistic due to their rapid development have become a force that can threaten the same freedoms and lead vast masses of people to incorrect places.

For the sake of this discussion, at this point, Web 3.0 comes into focus. The emergence of blockchain technology is based on a reaction to this centralization.

Web 2.0, which entered our lives in the 2000s, saw a surge in mobile Internet connections with smartphones. The FAANG abbreviation, which came into use in 2013, started to reference the five most influential technology companies in America. It is used for shares of Meta (Facebook group), Amazon, Apple, Netflix, and Alphabet (Google group).[442] Such companies have undoubtedly been among the biggest beneficiaries of the growth in Web 2.0; they have created a powerful economy but have also had devastating effects on many traditional economic models.

This is where Web 3.0 stands against monopolization. The concept has started to build upon Web 2.0.

Web 1.0 or Web 2.0: What is next? Enter Web3.

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[441] BBC News, "Twitter 'Permanently Suspends' Trump's Account," January 8, 2021, https://www.bbc.com/news/world-us-canada-55597840.
[442] FasterCapital, "Global Influence: FAANG Stocks: Shaping the World Economy," accessed October 17, 2024, https://fastercapital.com/content/Global-Influence--FAANG-Stocks--Shaping-the-World-Economy.html.

Web 3.0 proceeds on three main basic concepts. These are decentralization, openness, and the creation of a more user-based system.

On these grounds, if it is necessary to explain these concepts, it is essential to examine the first concept of decentralization. As the study title suggests, the next 5–10 years will evolve toward a decentralized order against this monopolization. At least, the current data appears to suggest that.

Today, each computer or device uses the HTTP form, which provides original access to each site, to connect to the Internet. Since 1990,[443] these sites have usually been stored on a single server with a specific address. Billions of Internet data points are stored on the servers of companies such as Google, Amazon, or Meta, which have rapidly monopolized the market over the past 20 years. The foregoing discussion implies how ethically these companies use this data and whether they exploit it—issues that have become some of the most debated topics in recent years.

This is where Web 3.0 aims to replace this centralized system with a decentralized one. Web 3.0 aims to store data on multiple independent servers instead of centralized servers. Users should be able to transfer this data to decentralized servers and have much more control over their own data. The working principle of blockchain also relies on distributed servers that are not stored on a centralized server.

The second openness principle of Web 3.0 is provided by the fact that it is an open software. It is a system where users can make transactions with each other without being connected to any intermediary institution, and they will not need to get any approval to join the system. [444] At this point, Web 3.0 will work on a blockchain or an end-to-end encrypted network, or through decentralized applications such as Dapps (Decentralized apps), which will consist of a combination of them. Web 3.0 will also use artificial intelligence and machine learning to evaluate the data to draw much more efficient conclusions.

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[443] Roy T. Fielding et al., "Hypertext Transfer Protocol -- HTTP/1.1," June 1999, https://www.w3.org/Protocols/HTTP/1.1/rfc2616.pdf.

[444] Louise McNutt, "What Is Web 3.0?" *Wedia Group*, last modified March 15, 2023, accessed October 17, 2024, https://www.wedia-group.com/blog/what-is-web-3-0.

Web 3.0 decentralization also brings with it some legal questions. To give an example, how will a decentralized system take measures against actions such as fraud, hate speech, and fake news? In addition, which country's law will be applied according to which location for crimes committed with servers that do not have a specific location?

The security of data is becoming more important every day. For example, the Estonian State decided to move the state data on real estate and company records to Luxembourg in 2019 and to its own country.[445] With the agreement signed between the two states in 2017, Estonia has transferred the data belonging to its citizens to a country that can keep this data safely outside its borders and will not have any access to it. In recent years, increasing distrust towards large companies has also prompted Estonia to move this data to a data center in another country. The system that works like the world's first data embassy consists of a room or building full of servers in another country. The Russian threat that emerged after the Russian invasion of Crimea and became quite serious with Ukraine also prompted Estonia to move these data centers to another country by paying hundreds of thousands of dollars and already moved some sensitive data to Poland after the Russian occupation started.[446] On the other hand, Luxembourg is taking serious steps towards becoming a secure data center worldwide. It is rapidly moving towards becoming the choice of small countries such as Monaco, which find it challenging to operate or keep a large data center in a secure state outside Estonia. Here, the importance of Web 3.0 and blockchain technology comes to the fore once again.

2. Dapps (Decentralized Apps) / Decentralized Applications

The Ethereum infrastructure was the first blockchain project that allowed users to offer smart contracts. The most significant difference from the smart contract concept developed by Nick Szabo is that it can do this with a decentralized structure.

[445] STATEC, "Statistique publique," accessed May 23, 2024, https://statistiques.public.lu/en/statistique-publique/statec.html.

[446] Datacenter Dynamics, "Amid Russian Invasion, Ukrainian Government Moves Data to Poland, Negotiating with France, Estonia, and Others," June 14, 2022, accessed October 3, 2024, https://www.datacenterdynamics.com/en/news/amid-russian-invasion-ukrainian-government-moves-data-to-poland-negotiating-with-france-estonia-and-others/.

Based on this data, it is suggested that Ethereum is the Apple or Google of blockchain technology because the common feature of these companies is that they provide infrastructures that host the majority of applications in the world. The difference of Dapp is that it can make this infrastructure decentralized, unlike Google and Apple. The potential of Dapps is relatively high because just as there are thousands of different applications in Apple's App Store today, the Dapp infrastructure provides opportunities to migrate these services to a decentralized platform.

Other blockchain projects here besides Ethereum, such as Tron, Eos, and Neon, allow you to write Dapps. The market value of the Dapp ecosystem, which was at the level of 10 billion dollars in 2019, is expected to reach 368 billion dollars by 2027.[447]

The legal framework of Dapps is under discussion as traditional regulatory systems are usually based on a specific location (jurisdiction). Since Dapps are not centralized, it's harder to regulate activity based on where transactions occur directly between peers on a blockchain network but users without any third-party intermediaries.[448]

Swiss nonprofit organization, The Dfinity Foundation, established a European subnet on the Internet Computer Protocol (ICP), which is a blockchain decentralized autonomous organization (DAO), in December 2023. This European subnet is designed to adhere to the General Data Protection Regulation (GDPR) of the EU and is limited to the geographical boundaries of the European Union (EU). This subnet offers blockchain developers a set of IT tools to build decentralized applications for better compliance with data protection regulations like GDPR, safeguarding personal and financial information. The primary suggestions cover implementing encryption for the private data of users, allowing for data to be modified, and ensuring comprehensive control over both data and access by users. It is

[447] Emergen Research, "Market Synopsis," accessed May 21, 2024, https://www.emergenresearch.com/industry-report/dapps-market.

[448] Investopedia, "Decentralized Applications (dApps): Definition, Uses, Pros and Cons," accessed May 21, 2024, https://www.investopedia.com/terms/d/decentralized-applications-dapps.asp.

a substantial step in creating a safe and conforming environment for the development of Dapps.[449]

This kind of decentralized governance model provides communities with official authority and encourages creativity, but it requires meticulous planning and active involvement. Startup companies should customize these models to suit their own circumstances in order to effectively address legal obstacles and establish long-lasting companies, thereby ensuring confidence and openness in the blockchain technology industry.[450]

3. DAO/ Decentralized Autonomous Organizations

DAO is a term used in the abstract for autonomous organizations managed by smart contracts. Here, the rules are encoded into the blockchain infrastructure in advance and implemented in a digital environment. DAO structures can be designed in many different ways. Usually, you get involved in the DAO structure by taking the token of that project, and you play a role in the management of the DAO, just like a deputy in the process. While a majority is usually required to make decisions, the system can also offer tokens to its users to encourage them to vote or contribute to these decisions actively.

The best part of DAOs is that they are transparent and provide the opportunity to transfer more sustainable management concepts to digital platforms. However, there are also quite a lot of experts who are critical of the system due to the hacking incident that occurred in the DAO project on the Ethereum network in 2016. For example, the American Securities Regulatory Authority (SEC) has regulated that the project named DAO is covered by securities in its 2017 report.[451] Since the DAO concept is a fairly new concept, it is also quite

[449] PR Newswire, "The Internet Computer Provides GDPR-Ready Infrastructure with the Launch of European Subnet," *PR Newswire*, accessed May 21, 2024, https://www.prnewswire.com/news-releases/the-internet-computer-provides-gdpr-ready-infrastructure-with-the-launch-of-european-subnet-302017475.html.

[450] FasterCapital, "Decentralized Legal and Compliance: Navigating Decentralized Legal Frameworks for Startups," February 13, 2024, accessed May 21, 2024, https://fastercapital.com/content/Decentralized-legal-and-compliance-Navigating-Decentralized-Legal-Frameworks-for-Startups.html.

[451] U.S. Securities and Exchange Commission, "SEC Issues Investigative Report Concluding DAO Tokens, a Digital Asset, Were Securities," *Press Release*, July 25, 2017, https://www.sec.gov/news/press-release/2017-131.

likely that it will conflict with existing legal infrastructures. In response, an international working group called Coala (Coalition of Automated Legal Applications) has organized and published a Model Draft Law on how the legal infrastructure of DAOs could be [452] structured. The clarification of the legal basis of these decentralized applications can contribute to innovation and increase the security of investors and participants.

As previously mentioned in our research, several decentralized projects use tokens (cryptocurrencies) as a means of ownership and participation, allowing anyone to participate in token-based voting systems. Token holders have the ability to participate in voting processes concerning protocol improvements, money distribution, and other significant choices.

But there are other issues with the DAO model as well. Too much decentralization impedes development, while too much centralization undermines blockchain principles. Stake-weighted voting or reputation-based systems help to reduce Sybil attacks, in which fictitious identities may distort voting power. Involving token holders who mostly stay silent is another challenge. For this reason, encouraging factors, instruction, and intuitive user interfaces are crucial to raising involvement.[453]

Some proposals have been made to integrate DAOs into U.S. law by utilizing an unincorporated nonprofit association (UNA) as a temporary legal framework. This would help provide legal consistency, simplify tax reporting, and facilitate contract capabilities to address significant legal challenges faced by DAOs, such as tax reporting complexities and potential liabilities.[454]

In the United States, research mostly concentrates on the advanced legal framework of DAOs. A proposal being considered by U.S. states is the Model Decentralized

[452] COALA, "DAO Model Law," accessed May 21, 2024, https://coala.global/reports/#1623963887316-6ce8de52-e0a0.
[453] FasterCapital, "Decentralized Legal and Compliance: Navigating Decentralized Legal Frameworks for Startups," February 13, 2024, accessed May 21, 2024, https://fastercapital.com/content/Decentralized-legal-and-compliance-Navigating-Decentralized-Legal-Frameworks-for-Startups.html.

[454] Stephen A. Rutenberg, "Potential Legal Frameworks for DAOs," *Polsinelli BitBlog*, November 16, 2021, accessed May 21, 2024, https://www.polsinellibitblog.com/new-blog/2021/11/16/potential-legal-frameworks-for-daos.

Unincorporated Nonprofit Association Act, sometimes known as Model DUNAA. The bill's adoption by a state would create a new category called the decentralized unincorporated nonprofit association (DUNA) within the current business organization regulations. This category would be specifically designed for decentralized organizations. Choosing the Model DUNAA may provide advantages to the states, such as promoting Web3 innovation, attracting different international organizations, generating tax income, and resolving DAO-related legal inconsistencies and disputes within the legal systems. Several states are already contemplating the implementation of the Model DUNAA in various capacities, such as Texas, California, and Wyoming.[455]

4. DEX (Decentralized Exchange) / Decentralized Cryptocurrency Exchange

As the crypto market has grown from the first cryptocurrency exchange, which we explained in the previous chapters, to the present day, the number of platforms that mediate this trading has also increased significantly. Currently, there are 528 cryptocurrency exchanges worldwide.[456] However, many of these exchanges are platforms that can be described as island countries with relatively less strict laws and cannot legally provide many guarantees to their users. As in the case of Mt. Gox, a significant part of the grievances experienced by people who invest in cryptocurrency exchanges arises from reasons such as hacking of these cryptocurrency exchanges or malicious interference with wallets where cryptocurrency is stored. In November 2022, the big centralized exchange FTX collapsed and filed for bankruptcy, owing over $3 billion to its 50 biggest creditors, which shook the entire cryptocurrency industry.[457]

Although serious steps are aimed at regulating these exchanges, such as the MiCA Draft Law, the concept of Decentralized Exchange (DEX) has emerged as a reaction to changing this centralized and connected order. The main motive here is to create a less centralized

[455] David Kerr and Miles Jennings, "A Legal Framework for Decentralized Autonomous Organizations - Part III: Model Decentralized Unincorporated Nonprofit Association Act," March 5, 2024, SSRN, https://ssrn.com/abstract=4749245 or http://dx.doi.org/10.2139/ssrn.4749245.

[456] Jeffrey Albus, "FTX Owes Over $3 Billion to Its 50 Biggest Creditors: Bankruptcy Filing," *Cointelegraph*, November 20, 2022, https://cointelegraph.com/news/ftx-owes-over-3-billion-to-its-50-biggest-creditors-bankruptcy-filing.

[457] Ibid.

structure where people can trade cryptocurrencies independently among themselves from end to end without any intermediaries. Although this brings other risks, it provides a wider area for users. The main difference here is that in contrast to centralized exchanges (CEX), cryptocurrency trading in DEX is via swap, that is, an exchange from one cryptocurrency to another cryptocurrency. In other words, we cannot make a purchase from legal currencies. For example, with dollars, as in Coinbase, you exchange Matic cryptocurrency directly with your BTC. In general, these projects, whose codes are also open, give developers the opportunity to participate in the project as well. DEXs, which are a kind of non-owned trading platform, usually provide anonymity and offer faster transactions without asking for any personal data.

One of the biggest risks here is that smart contracts are based on DEXs, and users transfer cryptocurrencies to the cash pool and make exchange transactions at rates whose value is determined by algorithms. An error that may occur in these algorithms may cause serious losses. However, the advantage of these DEX projects is that they usually do not provide cryptocurrency storage, that is, wallet services, but give the possibility of transactions directly between your wallets. As for the legal framework of DEXs, while discussions are ongoing, high-risk cryptocurrencies listed on these exchanges are behind the fact that they are banned in some markets. Because while centralized exchanges pay more attention to them, you can access some cryptocurrencies only through DEXs. Projects such as Uniswap, Pancakeswap, and Sushiswap are currently among the largest DEXs. DEX is also one of the cornerstones of the DeFi concept, which we will examine in a moment.[458]

The legal framework of the DEXs seems a bit more complicated than other DeFi products due to its nature. One example of the regulative approach to DEXs comes from Hong Kong, where the DEX and virtual asset regulations are evolving. The Securities and Futures Commission (SFC) of Hong Kong offers an opt-in framework for platform operators, and the Financial Services and the Treasury Bureau (FSTB) of Hong Kong proposes a licensing

[458] TastyCrypto, "Uniswap vs. SushiSwap vs. PancakeSwap: Which DEX Is Best?" June 28, 2024, accessed October 10, 2024, https://www.tastycrypto.com/blog/uniswap-vs-sushiswap-vs-pancakeswap/.

requirement for all virtual asset exchanges, including DEXs.[459] However, there are three main questions behind the solution.

The three obstacles in overseeing Decentralized Exchanges (DEXs) are: first, the challenge of determining which regulatory body or bodies should have authority over decentralized exchanges (DEXs) due to their decentralized structure and operation in several countries. Having many regulators overseeing the same decentralized exchange (DEX) is not feasible since they could have different rules and needs. Second is determining the individual or individuals who hold the license. This is a complicated task, even though developers may first seem to be the most suitable stakeholder option. Complications could occur if these developers want to remain anonymous or resign after the launch of the project. For example, in Hong Kong, the Securities and Futures Commission (SFC) generally does not mandate that technical personnel working for conventional licensed companies possess licenses. Hence, the need for decentralized exchanges (DEXs) to have licensed stakeholders goes against the SFC's technology-neutral position. Lastly, how would it be regulated? Enforcing legal regulations on a DEX platform that operates via smart contracts on the blockchain system poses practical challenges, as modifying an existing smart contract that has already been implemented is not feasible. Furthermore, there is no assurance that a new smart contract would be accepted, and additional regulatory obligations present challenges, such as conducting customer due diligence and ensuring compliance with regulatory capital requirements.[460]

One of the biggest DEXs, Uniswap, is a decentralized exchange consisting of four smart contracts that are stored on the Ethereum blockchain. It also includes a publicly accessible and open-source front-end client that enables users with internet access to engage in trading several Ethereum-native tokens with other users of the service. Because of its open-source

[459] Reed Smith, "Hong Kong SFC Proposes Regulatory Requirements for New Virtual Asset Trading Platforms," last modified March 17, 2023, accessed October 2, 2024, https://www.reedsmith.com/en/perspectives/2023/03/hong-kong-sfc-proposes-regulatory-requirements.
[460] Kristi Swartz, "Decentralized Exchanges: The Relevant Considerations When Mapping Out How DEXs Might Be Regulated," *Technology's Legal Edge*, November 18, 2021, https://www.technologyslegaledge.com/2021/11/decentralised-exchanges-the-relevant-considerations-when-mapping-out-how-dexs-might-be-regulated/.

nature, Uniswap does not implement a client identity verification procedure, and consequently, the cryptocurrency community considers evading anti-money laundering (AML) rules as one of Uniswap's core principles. In September 2021, the Securities and Exchange Commission (SEC) initiated an inquiry into Uniswap Labs and its Uniswap Protocol. The Uniswap Protocol facilitated trades amounting to more than $620 billion in 2022.[461]

For example, in Japan, the question was whether DEX activities would fall under Japan's Payment Services Act or not. Some decentralized exchanges (DEXs) provide a mechanism where users may acquire cryptocurrency by exchanging different types of coins. In such a case, the system might be categorized as a crypto-asset exchange business according to Article 2, Paragraph 7 of the Payment Services Act of Japan. Since DEX projects often use a smart contract method, which enables the automated exchange of cryptocurrency assets, the decentralized exchange (DEX) would not need any intermediary firm to carry out cryptocurrency exchange operations. Consequently, DEX is exempt from regulation under Japan's Payment Services Act due to the absence of regulated corporate entities.[462]

Besides hard regulatory approaches, a soft-touch regulatory approach may be sensible while the technology is still emerging. For example, in the USA, the Internal Revenue Service (IRS) needs to participate in system design to handle the resulting funds and reports of the cryptocurrency ecosystem. For instance, Ambisafe's Regulatory Aware Protocol token (Orderbook.io) incorporates regulatory compliance directly into its smart contract, checking for regulatory permissions and ensuring that users meet compliance prerequisites before allowing them to buy any token in the USA.[463] As seen in this example, regulators should monitor technological developments like blockchain and AI and collaborate with decentralized exchanges to understand the technology before creating a regulatory

[461] Global Legal Insights, "Blockchain & Cryptocurrency Laws and Regulations | USA," accessed May 21, 2024, https://www.globallegalinsights.com/practice-areas/blockchain-laws-and-regulations/usa/.

[462] Monolith Law, "Legal Challenges in Decentralized Finance (DeFi)," *Monolith Law*, June 20, 2023, accessed May 21, 2024, https://monolith.law/en/it/defi-dex-regulations.

[463] Ken Silva, "Ambisafe's Orderbook Launches Token to Ensure Regulatory Compliance," *Blockchain News*, March 13, 2018, https://www.the-blockchain.com/2018/03/13/ambisafes-orderbook-launches-token-to-ensure-regulatory-compliance/.

framework. Hence, smart contract technology could eventually automate even tax withholding, information reporting, and Know Your Client verifications.[464]

Genuine decentralized exchanges (DEXs) inherently reduce the risks associated with third-party intermediaries. It is preferable to have a competitive market that can provide the required amount of consumer protection. There is a recommendation that by voluntarily registering with the Commodity Futures Trading Commission (CFTC) and Securities and Exchange Commission (SEC) in the USA, decentralized exchanges (DEXs) may promote innovation, demonstrate local regulatory compliance, and build confidence without being subjected to strict requirements. This approach complements creativity, prevents the imposition of conventional intermediate functions on DEXs, and enables the creation of novel technology for safeguarding consumers. Opting for optional registration reinforces the unrestricted and adaptable characteristics of DeFi, ensuring that the development of decentralized exchanges aligns with technological progress.[465]

To address international compliance challenges, DEXs should engage legal experts to understand regulations in different countries, use geo-blocking to restrict access in challenging jurisdictions, participate in regulatory sandboxes for supervised testing (like in Singapore or Australia), maintain transparency about several compliance efforts, and collaborate with industry associations to advocate for balanced regulatory frameworks.[466]

5. The Cool Kid of the System: Non-Fungible Token (NFTs)

NFTs, which gained more prominence during Covid, are a kind of cryptographically registered form of intellectual property rights. Unlike cryptocurrencies, data stored in the blockchain infrastructure cannot be exchanged as equal units because, as the name suggests, they are non-fungible.

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[464] Dashiell C. Shapiro, "Taxation and Regulation in Decentralized Exchanges," *Journal of Taxation and Regulation*, no. 36 (2023): 1–40.

[465] Jerry Brito and Andrea O'Sullivan, "Regulatory Clarity for Crypto Marketplaces Part I: Decentralized Exchanges," *Cato Institute*, May 10, 2023, accessed May 21, 2024, https://www.cato.org/briefing-paper/regulatory-clarity-crypto-marketplaces-part-i-decentralized-exchanges#addressing-intermediary-risks.

[466] Techopedia, "How Decentralized Exchanges (DEXs) Can Thrive in a Regulated World," *Techopedia*, March 21, 2024, accessed May 21, 2024, https://www.techopedia.com/how-decentralized-exchanges-dexs-can-thrive-in-a-regulated-world.

An NFT is essentially a type of Dapp. The most prominent feature of NFTs is that the represented value, cryptographically recorded, cannot be copied. NFTs can represent a work of art in the real world or data in the virtual world. Representation here means that the specific work is digitally recorded on the blockchain infrastructure, and its authenticity is protected. For example, when buying a painting, serious research is done about the authenticity of that work, yet the work may still turn out to be fake. NFTs guarantee the originality of that work. Unlike similar cryptocurrencies, the purpose here is not to mediate the exchange of fungible tokens but to tokenize and distinguish one value from another. One of the first NFT projects, Cryptopunk, emerged in 2017 when character photos were pixelated, and each was sold as original. Additionally, the first source code written by Tim Berners-Lee, the inventor of the WWW mentioned above, in 1989, was linked to a token to confirm the ownership and authenticity of the WWW (World Wide Web) and sold for $5.4 million at auction.[467]

Although the legal framework of NFTs has not yet been clearly regulated in many countries, it is important to understand the rights this smart contract (usually designed on the Ethereum infrastructure) provides to its owners. When purchasing an NFT, there may be legal rights such as registration of ownership of an asset, the right to use the intellectual property rights associated with the work, or other contractual rights (copyrights) depending on the work. Buyers should carefully examine the rights provided. For instance, receiving an NFT issued by the NBA (e.g., an image of Michael Jordan) may not grant the right to print the work on merchandise for profit, as only individual use might be recognized, and commercial use may be prohibited. Or, the intellectual property right may only be transferred for usage, while ownership remains with the creator. Users obtaining NFTs often expect a license to use the associated products or works for their intended purpose.[468]

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[467]The Guardian, "World Wide Web NFT Sold," June 30, 2021, https://www.theguardian.com/technology/2021/jun/30/world-wide-web-nft-sold.

[468] Jakub Wyczik, "The Rise of the Metaverse: Tethering Effect and Intellectual Property of Crypto Tokens," *Journal of Intellectual Property Law & Practice*, 2024.

It is possible to buy NFTs from NFT exchanges such as Opensea.[469] We will examine NFTs, a topic that can be studied extensively, in more detail in another study.

There is ongoing discussion over the legal framework around NFTs. Our analysis shows that the MiCA legislation in the EU does not include NFTs, as the current regulatory framework already addresses them.

The creation of NFTs can benefit creators or producers by allowing them to securitize their assets and intellectual property rights, as the NFT market functions similarly to a securities market. Producers can either protect their asset's exclusivity and potential cash flows through mechanisms like intellectual property rights or forego protection, making the intellectual property right or asset a public good while creating related NFTs. In both cases, producers face the risk of loss, regardless of whether they use a protection mechanism.[470]

NFTs found a popular field in the art sector, which poses some risks in terms of money laundering. Approximately $8 million USD of illegal money has been laundered through NFT-based platforms since 2017, based on conducted research. This amount accounts for only 0.02% of trading activity from sources that are already known. Additionally, $328.6 million (0.81%) has originated from obfuscation services like crypto mixers, such as Tornado Cash, which is an open-source, non-custodial, fully decentralized cryptocurrency tumbler. [471]

A significant hurdle in NFT regulation is accurately categorizing NFTs, as with other cryptocurrency projects, and ascertaining whether these NFT projects meet the criteria for being considered virtual or other assets according to AML/CFT rules of the respective

[469] OpenSea, "Purchase Your First NFT," accessed October 17, 2024, https://support.opensea.io/en/articles/8866945-purchase-your-first-nft.

[470] Kraizberg, E., "Non-Fungible Tokens: A Bubble or the End of an Era of Intellectual Property Rights," *Financial Innovation* 9, no. 32 (2023), https://doi.org/10.1186/s40854-022-00428-4.

[471]Elliptic, "NFT Report: NFTs and Financial Crime, Money Laundering, Market Manipulation, Scams & Sanctions Risks in Non-Fungible Tokens," 2022, accessed May 22, 2024, https://www.elliptic.co/hubfs/NFT%20Report%202022.pdf.

country. This might result in incongruous and conflicting outcomes across different jurisdictions when they adopt legislation at various rates. Therefore, it is essential for jurisdictions to consistently monitor NFT and crypto asset advancements to detect and rectify any deficiencies in legal, regulatory, and supervisory structures.[472]

Some regulatory fields concerning NFTs include regulated securities, AML and KYC requirements, sanctions, money transmitter laws, commodities classification, data privacy issues, and antitrust and competition law.[473]

In terms of IP rights, existing regulatory structures may help shape the practical application of NFTs. For example, in China, the Hangzhou Internet Court attempted to classify NFTs as NFT digital works, treating them as the content of transactions rather than certificates pointing to digital works. This approach reflected misunderstandings about the technical features and legal status of NFTs. The court concluded that NFTs, which represent unique metadata for digital works, create property rights over tokenized digital goods. Despite legal uncertainties, the court identified digital goods as virtual property, aligning with the recognition of NFTs as property by courts in England and Singapore.[474]

There are two distinct approaches to comprehending an NFT: the limiting perspective and the wide perspective. The restricted perspective describes an NFT as a non-fungible token

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[472] Mondoh, Brian Sanya, Sara Adami-Johnson, Matthew Green, and Aris Georgopoulos, "NFT Legal and Regulatory Compliance: Connoisseurship and Critique," 2023, accessed May 22, 2024, https://deliverypdf.ssrn.com/delivery.php?ID=046003123096017104004069071091089111005021033054029022031103031098028003091097076076107032111045008035107016109019117120088003052033026037083004070100067121094110119064032091066127096086081102086076092064019072067072003028125108103123029087015092093072&EXT=pdf&INDEX=TRUE.

[473] Norton Rose Fulbright, "Navigating Non-Fungible Tokens: A Global Legal and Regulatory Guide," 2023, accessed May 22, 2024, https://www.nortonrosefulbright.com/en/knowledge/publications/9628c085/navigating-non-fungible-tokens-a-global-legal-and-regulatory-guide.

[474] Xiao, Baiyang, "Copyright Law and Non-Fungible Tokens: Experience from China," *International Journal of Law and Information Technology* 30, no. 4 (Winter 2022): 444–471, https://doi.org/10.1093/ijlit/eaad007.

on a blockchain that is unique, cannot be substituted by another token or coin, and has a digital fingerprint enabling its circulation and exchange within the blockchain ecosystem. The second, comprehensive perspective encompasses the token, the smart contract responsible for its deployment, and the related information. This broader perspective may lead to ambiguity between the token and the artistic creation or intellectual property it references. For example, marketplaces such as OpenSea and Nifty Gateway often obscure these differences, resulting in ambiguity over the transfer of intellectual property rights when purchasing NFTs.[475]

Essentially, when it comes to regulating NFTs, local legislation tends to cover the structure of NFTs more comprehensively than other blockchain products like DEXs. The increasing popularity of safeguarding digital works in the Internet age is evident, and technologies like NFTs have the potential to enhance protection while establishing a fair revenue model. The future of this domain will be shaped by legal frameworks.

6. Metaverse and Legal Framework

In October 2021, the world's largest social media platform, Facebook, changed its name to Meta, and the term "metaverse" became one of the most important players in the blockchain ecosystem.[476] So, what is this metaverse?

The term "metaverse" was first used in Neil Stevenson's 1982 novel Snow Crash to describe a virtual world in which characters could escape.[477] In 2014, Facebook's acquisition of a virtual reality company called Oculus VR for a significant sum of $2 billion seemed to herald developments in the field of metadata.[478]

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[475] Terras, Melissa, Burkhard Schafer, and Antoine Favreau, "Ownership and Control in the Creative Economy," in *Blockchain and the Creative Industries* (OAPEN, 2023), 179, accessed May 22, 2024, https://library.oapen.org/bitstream/handle/20.500.12657/89801/1/9781040032008.pdf#page=179.

[476] Meta, "Introducing Meta: A Social Technology Company," published October 28, 2021, accessed October 10, 2024, https://about.fb.com/news/2021/10/facebook-company-is-now-meta/.

[477] Stephenson, Neal, *Snow Crash* (Bantam Books, 1992).

[478] Facebook, Inc., "Facebook to Acquire Oculus," press release, March 25, 2014, accessed October 10, 2024, https://about.fb.com/news/2014/03/facebook-to-acquire-oculus/.

The metaverse, one of the main pillars of the Web 3.0 concept, has given birth to different service items as well as a developing economy in a virtual reality world. There are many digital services that can be provided in this virtual world. One of the most ambitious ways to access the metaverse—a world created in a digital environment—is through virtual reality devices.

With developing technology, it has become possible for people from different parts of the world to come together in another virtual environment. However, with innovations to be made in areas such as sensory experiences like feeling and smelling, when it becomes impossible to distinguish between the real world and the virtual world, the metaverse will create a completely different economy. At that point, with blockchain infrastructure, the metaverse will usher in a new world during the transition to Web 3.0.

The relationship of the metaverse with cryptocurrencies is more complicated because, in this new world that has been created, the use of cryptocurrency rather than legal currencies will be quite common. However, some cryptocurrency projects can be designed not only for use in this virtual world but also to provide certain rights to their owners in this created world. The largest metaverse tokens by market capitalization are the Mana Token of the Decentraland project, Theta Network's Theta, Apecoin, Axie Infinity, and Sandbox.[479]

The legal framework of the metaverse varies according to the services provided within it. However, one of the concepts that can be evaluated at the very beginning is the concept of sovereignty. Today's legal system is based on the principle that those living within certain borders are subject to the laws of those borders. The question here is: where are the boundaries of the metaverse? Which country's law will apply in the new world that will allegedly be created?

For example, in the event of the death of a person who owns virtual land in one of the metaverse worlds, how will this land be shared among their heirs? Moreover, what kind of mechanism will arise if the joint owners later disagree? Two main conclusions can be drawn here. The first is the risk that the system's founders will gain disproportionate authority and encroach on personal property rights. Alternatively, if there is no smart contract to address

[479] CoinMarketCap, "Top Metaverse Tokens by Market Capitalization," *CoinMarketCap*, 2023, accessed October 10, 2024, https://coinmarketcap.com/view/metaverse/.

related problems, even if the system is designed to be decentralized, the issues may remain unresolved. Although DAOs partially address these challenges, these matters need to be clearly defined. Furthermore, given the extent to which we are already monitored in our daily lives, our footprints in the virtual world will become even more evident. The use and protection of the data collected will also be a significant issue.

The designs created in this virtual world may also raise issues such as intellectual property rights or brand infringements of existing trademarks. For example, if you open a physical store and name it Nike without a franchise agreement or use the name in e-commerce, the relevant company representatives may initiate legal proceedings and block your store's trade. However, how will this company protect its intellectual property rights against a virtual Nike-branded store opened in the metaverse? Or how will a person who bought that store based on its brand value seek legal recourse if it turns out that the store was not licensed by Nike?

The energy consumption required to sustain this new virtual world is another topic of discussion. The energy needed to keep the massive amounts of data traffic and load secure and functional will have significant environmental implications. In summary, the metaverse can take the kind of virtual life we live on social media today to another dimension with the support of various devices, creating its own rules and payment methods within its own economy. While doing this, it does not ignore brands like Nike in the real world.

Although the metaverse is seen as a failure by many experts—such as Facebook's Meta move—it is possible for it to evolve in different dimensions with new players. As long as it can address today’s needs and problems, it may reach a point where dissertations like this one could even be sold in the metaverse store in another 20 years. Just as Google Maps, which was hard to imagine 20 years ago, is now an integral part of our daily lives, the metaverse could develop collectively. Profit could be made from dissertations, or entirely new services could emerge, breaking out of standard patterns.

Our goal here is to provide a vision for the future by understanding and learning the terms used without losing our imagination. While the scale of future success may involve an element of luck, good analysis will be crucial. We can say that the metaverse and blockchain

technology are like a rich lake. One of its riches is financial services, and it is essential to define DeFi.

The metaverse lost much of its popularity in 2024 compared to its peak in 2020 during the Covid-19 pandemic. However, it still hosts numerous projects and an evolving landscape of intellectual property rights (IPRs), highlighting key concepts such as Non-Fungible Tokens (NFTs), blockchain technology, avatars, architectural drawings, and virtual worlds.[480] Despite its decline in popularity, the concept of the metaverse remains relevant to this dissertation because of its unique features, which pose challenges across various areas of law.

Our third research question emphasizes the connection between technological developments and legislative responses. By examining the concept of the metaverse, we aim to provide a framework for addressing new technologies with a balanced perspective, taking into account both innovation and regulatory protection. The metaverse integrates blockchain technology, NFTs, and virtual worlds, demonstrating the challenges legislators face in addressing these innovative developments.

In the example of avatars, which are digital expressions of individuals, they enable users to freely express their identity, personality, and appearance as they wish.[481] Some arguments suggest that avatars in the metaverse should be registered like companies, with legislation requiring minimum capital requirements for avatars, similar to limited liability companies. Additionally, infrastructures within the metaverse, such as schools, workplaces, and retail shops, should also be registered with higher capitalization mandates to cover potential liability claims, akin to opening a physical shop.[482]

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[480] Seo, Y., Hyo-Min Kim, and Austin Kang, "Analysis of Media Discourse on Intellectual Property Rights Related to Metaverse in Korea," *International Journal of Security Privacy and Trust Management* 13 (2024): 1–11, https://doi.org/10.5121/ijsptm.2024.13201.

[481] Umeå University, "Humlab, Avatars and the Digital Self," accessed October 10, 2024, https://www.umu.se/en/research/projects/avatars-and-the-digital-self/.

[482] Cheong, B.C., "Avatars in the Metaverse: Potential Legal Issues and Remedies," *International Cybersecurity Law Review* 3 (2022): 467–494, https://doi.org/10.1365/s43439-022-00056-9.

In the metaverse, intellectual property (IP) holds significant importance, particularly trademarks. These trademarks safeguard names, logos, slogans, melodies, visual forms, avatar names, and distinctive colors. Additionally, it is possible to tokenize these elements and sell them in the metaverse, prompting companies to reassess and expand the range of goods and services their trademarks cover in the virtual world. Prominent brands such as Victoria's Secret and McDonald's have submitted trademark applications to protect their brands in the metaverse, specifically for virtual items and services.[483]

With the new AI Draft Law of the EU, the metaverse could potentially find a place under the new regulations. In cases of trademark usage in the metaverse, it may be necessary to map and register trademarks, and it is worth exploring new technologies to track such trademark infringements. Data protection and cybersecurity risks associated with the metaverse are other legal issues, alongside advertisement, competition law, and consumer protection. However, these areas already fall under the existing regulatory framework and simply require better understanding and implementation.

The intellectual property (IP) offices of the G7 countries (namely Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States), under the leadership of the Japan Patent Office, gathered in the metaverse in December 2023 to discuss the implementation of intellectual property laws in digital settings.[484] During the conference, the aim was to develop a worldwide intellectual property ecosystem to support innovation. The joint declaration emphasized the importance of inclusiveness, diversity, and the need for IP systems that are accessible to micro, small, and medium enterprises, start-ups, and underrepresented groups. The patent offices of these countries are dedicated to addressing

[483] CMS Law, "Legal Issues in the Metaverse: Part 2 - Trademarks and Copyright, NFTs and Civil Law Principles in the Metaverse," 2024, accessed May 22, 2024, https://cms.law/en/int/publication/legal-issues-in-the-metaverse/part-2-trademarks-and-copyright-nfts-and-civil-law-principles-in-the-metaverse.

[484] Japan Patent Office, "G7 Heads of IP Office Conversation in the Metaverse," December 15, 2023, accessed October 1, 2024, https://www.meti.go.jp/english/press/2023/1218_002.html.

enforcement difficulties of court verdicts, promoting awareness of forgery and piracy in digital realms, and guaranteeing consumer safeguarding in the metaverse ecosystem.[485]

To ensure the implementation of judicial rulings, a new international legal framework approved by the majority of nations may be necessary for the functioning of the metaverse, potentially under the United Nations. Some authors propose that nations should either establish dedicated legislation for the metaverse or modify current cyber laws to include it. If a worldwide legal framework for the metaverse is to be successful, it must encompass both international treaties and state-level laws. Focusing solely on international crimes without considering repercussions at the state level would render it ineffective. An equitable approach is crucial for efficient global regulation.[486]

7. The Rebellious Boss of the System: Decentralized Finance (DEFI) Decentralized Finance and Legal Framework

A good example of how far cryptocurrencies can go financially is collateral tokens. When borrowing from a bank, the bank typically requires guarantees in exchange for the amount lent, such as a term deposit, regular income, or real estate.

In contrast, the primary purpose of some cryptocurrencies is as a medium of payment, while collateral tokens facilitate lending and borrowing—functions traditionally associated with banks. Through these tokens, users can pledge a certain cryptocurrency as collateral and borrow in another cryptocurrency or lend their cryptocurrency to the system to earn interest.

Typically, lending money at interest requires banking licenses. Moreover, lending to unknown individuals poses significant risks. Collateral tokens address this by enabling users to lend their capital to the system, which then evaluates borrowers and lends money on behalf

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[485] Deutsches Patent- und Markenamt (DPMA), *"G7 IP Offices Convene in Metaverse to Reinforce IP Laws in Digital Environments,"* last modified December 15, 2023, accessed May 22, 2024, https://www.dpma.de/english/services/public_relations/press_releases/15122023/index.html.

[486] Euclid International Research Publishing Journal, *"Challenges in the Metaverse: Jurisdiction and International Treaty Law,"* 2024, accessed May 22, 2024, https://irpj.euclid.int/articles/challenges-in-the-metaverse-jurisdiction-and-international-treaty-law/#.

of users, sharing the profits in return. To protect the principal amount, borrowers are required to pledge another cryptocurrency as collateral, significantly reducing risk.

A crypto project named COLL offers guarantees to users in exchange for cryptocurrencies denominated in legal currency units (dollars, euros, etc.), enabling payments for goods or services.[487] Thus, cryptocurrency investors can conveniently access services in daily life without leaving the cryptocurrency system. However, it is necessary to assess whether such systems comply with obligations like anti-money laundering (AML), as tax authorities and security agencies closely monitor the cryptocurrency ecosystem. Tracking money becomes more challenging when investors indirectly enter the system through such service providers, bypassing traditional points of conversion into legal currencies (e.g., withdrawing from a cryptocurrency wallet to a personal bank account or centralized payment platforms like PayPal).

The existence of financial services here is clear. In many jurisdictions, unauthorized money lending is considered usury and may result in severe penalties. At this point, collateral tokens challenge centralized institutions, such as banks, as they pave the way for a decentralized world. Decentralized Finance (DeFi) is one of the most ambitious innovations in this space, and collateral tokens are a significant component.
Some examples of these include:

- Compound
- Lendf.me
- Dharma
- Linen
- Aave, (a decentralized lending platform and coin)
- Dai (a decentralized stablecoin with a fixed value)

You can deposit your cryptocurrency on platforms and get annual interest. For example, a person who pledges their Ethereum to such a platform and borrows Dai in exchange for it can use this Dai to buy Ethereum again and benefit from the increase in the value of ETH by increasing the demand in the market. Technically, by pledging 1 ETH and converting it into Dai to buy another ETH with this Dai, the supply in the market decreases by one ETH,

[487] Boxmining, *"Collateral Pay: Bridging DeFi and Traditional Finance,"* May 15, 2021, accessed October 10, 2024, https://boxmining.com/collateral-pay-coll-collg/.

causing the price of ETH to rise. The borrower can then take the increase as profit and pay off the debt of 1 ETH. In addition, the person who deposits the ETH into the system also receives interest from the profit generated by this lending. DeFi operates as a branch and as a bank without an owner.

Since DeFi projects function as international financial institutions such as banks, the most effective strategy for regulating DeFi software protocols would involve establishing worldwide guidelines for constructing regulatory-compliant DeFi protocols. This would particularly emphasize stablecoins, with two potential options. The first option would require protocols to acknowledge and maintain a 1:1 ratio between the stablecoin and the digital dollar (such as a central bank digital currency, as previously discussed), to avoid dependence on stablecoins backed by cash equivalents. The second alternative is to mandate the exclusive utilization of algorithmic-backed stablecoins in DeFi. These stablecoins rely on algorithms to ensure a stable value by adjusting their circulating supply based on market behavior. This approach mitigates the risks associated with fiat-backed stablecoins, which are vulnerable to traditional financial debt instruments. Global measures are expected to have a broader and more significant impact compared to any regional strategy in controlling DeFi.[488]

To regulate the DeFi ecosystem, regulators have other alternatives due to DeFi's open-source and decentralized nature. One approach is to separate DeFi, thereby mitigating systemic dangers but sacrificing its potential advantages. However, this approach must be rationalized in comparison to other legal initiatives such as Open Banking. A second alternative approach is to fully adopt the benefits of DeFi by first establishing a clear definition of genuine DeFi and then directing regulatory efforts towards the interfaces connecting DeFi, on-chain CeFi (Centralized Finance), and traditional CeFi.[489]

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[488] Iwa Salami, *"Challenges and Approaches to Regulating Decentralized Finance," AJIL Unbound* 115 (2021): 425–429, https://doi.org/10.1017/aju.2021.66.

[489] Katrin Schuler, Ann Sofie Cloots, and Fabian Schär, *"On DeFi and On-Chain CeFi: How (Not) to Regulate Decentralized Finance," Journal of Financial Regulation* (2024): fjad014, https://doi.org/10.1093/jfr/fjad014.

8. Layer-2 (Second Data Connection Layer)

Finally, it is necessary to briefly mention Layer 2, which you may hear about frequently in the blockchain ecosystem, as well as the second data connection layer, as it is claimed that blockchain technology can solve problems such as high energy consumption. At this point, in addition to networks such as Bitcoin or Ethereum, which are referred to as Layer 1, Layer 2 appears as a faster and cheaper alternative. Those who make cryptocurrency investments should use an intermediary bridge between these two layers to avoid becoming a victim. For example, when transferring from a Bitcoin network using Layer 1 to a wallet using Layer 2 in your trendy cryptocurrency wallet, such as Metamask, the transfer may not occur, and the transferred cryptocurrency may also disappear.[490]

In summary, Layer 2 reduces the number of chains in the system by collecting many small transactions on the existing Layer 1 into the same common chain rather than creating a separate chain for each transaction. This alleviates the burden on the system and provides a faster and cheaper infrastructure for these small transactions. The famous Bitcoin trilemma seeks to provide a solution balancing three options.[491]

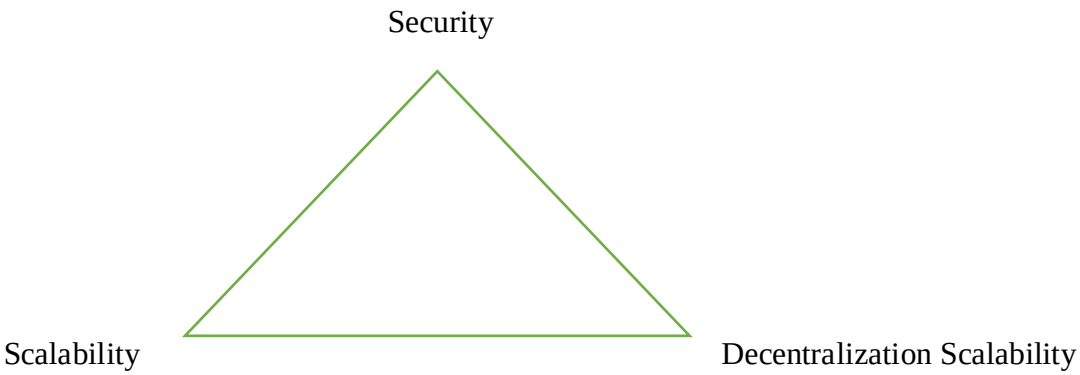

Table 6: Bitcoin 3 (Trilemma)

[490] MetaMask, *"How Do I Send ETH/Other Tokens to a Layer 2 or Other Network?"* accessed October 17, 2024, https://support.metamask.io/networks-and-sidechains/how-do-i-send-eth-other-tokens-to-a-layer-2-or-other-network-/.

[491] Ledger, *"What Is the Blockchain Trilemma?" Ledger Academy*, November 15, 2021, accessed September 10, 2024, https://www.ledger.com/academy/what-is-the-blockchain-trilemma.

As discussed in the proof-of-work and proof-of-stake concepts mentioned in previous chapters, a more scalable model can be created by compromising decentralization, which may also reduce security. Conversely, designing a less centralized structure to increase security can result in high energy costs (such as proof-of-work), reducing the project's scalability and its reach to a broad audience. Ethereum has also made serious attempts to switch to Layer 2 and develop existing Layer 1 solutions. Projects such as Optimism and Arbitrum One are also working in this field.[492] Hence, the aim of this study was to discuss these concepts.

9. Blockchain and Artificial Intelligence (AI)

Blockchain is now a relatively old technology (since 2008) if we consider the speed of technological developments. However, one of the recent technologies shaking the world is called artificial intelligence. Since the topic of study is blockchain, I believe that what makes blockchain very unique is the concept of decentralization. The world we live in today is quite centralized. Social media companies control vast amounts of our data, and this data enables them to control or even lead the community. The banking system and the rest of the financial system have also become extremely global, with companies like Visa or Mastercard holding monopolies over many payment services. In this world, blockchain solutions promise a decentralized system without the need for third-party interference.

If we consider these tech companies or banks as third parties, the question arises whether artificial intelligence (AI) companies count as third parties or not during a transaction they might interfere with. The way of thinking of AI can also be designed since it is all about the data you provide for machine learning.

In an AI environment, whether for personal, public, or business use, the network of data controllers and data processors is quite complex.[493]

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[492] Wilson Center, *"Understanding Ethereum's Layer 1 and Layer 2: Differences, Adoption, and Drawbacks,"* accessed October 1, 2024, https://www.wilsoncenter.org/article/understanding-ethereums-layer-1-and-layer-2-differences-adoption-and-drawbacks.

[493] Gizem Gültekin, *"Application of the General Data Protection Regulation on Household Social Robots,"* PhD diss., University of Szeged, Doctoral School of Law, 2020.

The intersection of artificial intelligence and blockchain has potential applications across a broad spectrum of industries, including finance. Blockchain technology offers a decentralized and secure ledger, which can provide a tamper-proof and reliable infrastructure for several artificial intelligence applications. Through blockchain, AI operations could potentially have better privacy and data security while improving efficiency and transparency.[494]

In this part of our study, we will discuss how blockchain and AI can work together and mention some integration benefits as well.

One of the first areas is data management and security, where both innovative technologies promise to preserve data integrity. They could guarantee the privacy of data across different networks and secure the interchange of data within AI systems. This ensures that the data used for machine learning and artificial intelligence operations is not altered, thereby establishing a solid basis for AI systems.

The topic of our study focuses on decentralization, where AI could potentially benefit. AI algorithms could be decentralized through blockchain, enabling more transparent and collaborative AI model development. By decentralizing training processes, contributions and modifications can be tracked and verified using blockchain infrastructure. This could make a huge contribution to the security of AI models, which could otherwise be led unethically, dangerously, or in an overly centralized way by a few stakeholders in the AI ecosystem. The creation of productive AI capacity requires significant investment and data, which may lead to monopolization by a few stakeholders, such as Google and OpenAI. Through blockchain infrastructure, it might be possible to control the data allowed to be used for machine learning. For instance, if machine learning is overexposed to content promoting anti-migration sentiments, it may manipulate its users with outcomes reflecting the same biases. Blockchain could allow control and guarantee the integrity of the data pool AI is exposed to, ensuring that it remains unchanged.

[494] Stephanie Heister and Kathy Yuthas, *"How Blockchain and AI Enable Personal Data Privacy and Support Cybersecurity,"* in *Advances in the Convergence of Blockchain and Artificial Intelligence*, ed. T. M. Fernández-Caramés and P. Fraga-Lamas (IntechOpen, 2021), https://doi.org/10.5772/intechopen.96999.

Additionally, blockchain can enhance AI capabilities to manage and utilize data from multiple sources without compromising the security of these data channels.[495] This broad and secure data access can enhance artificial intelligence learning capabilities and specificity. For instance, many countries provide a wide range of governmental services through e-government infrastructures, with impressive data storage. However, AI in many cases cannot access this data for training due to security and privacy concerns. What if a blockchain system ensures that the data AI can reach cannot be accessed by any third party? By means of this, AI could potentially have much better training and more accurate official data, while access to this data by third parties would be blocked by blockchain's decentralized infrastructure.

One other field where both innovative technologies could be particularly useful is Internet of Things (IoT) applications. In certain artificial intelligence-driven conditions, blockchain technology can facilitate smart contracts to automatically execute actions without human intervention as autonomous functioning. Of course, in this respect, there will be no human intervention to take responsibility for the actions of AI and smart contract execution, except for the person who designed both. However, this may cause some security problems if AI cannot be controlled and uses the smart contracts without the need for any human involvement.

Despite the significant potential for collaboration between both technologies, several challenges exist as well. One of these is that both blockchain and AI require high computational resources. Additionally, scalability can become an issue when combining these two technologies. Furthermore, this integration adds another layer of complexity in terms of maintenance and deployment. For successful implementation of blockchain and AI, ensuring smooth interplay plays a critical role. Another challenge, which is also a topic of our study, is regulatory compliance. Both technologies involve significant data handling. Adhering to data protection standards and maintaining transparency within regulations are crucial.

[495] LCX, *"How AI Can Benefit from Blockchain-Based Data Infrastructure,"* last modified October 17, 2024, accessed October 8, 2024, https://www.lcx.com/how-ai-can-benefit-from-blockchain-based-data-infrastructure/.

Understanding the legal and technical frameworks governing blockchain and AI is essential.

One of the streamlined discussions about AI has a similar background to decentralized autonomous organizations (DAO), specifically the issue of ownership rights created by DAOs or artificial intelligence. To better understand DAOs' ownership, we will also examine artificial intelligence in this context.

To refresh our memory, we can recall how DAOs work, as discussed above, and then proceed with AI. In summary, decentralized autonomous organizations are managed by smart contracts. Rules are encoded into the blockchain infrastructure in advance and implemented in a digital environment through DAOs.[496] DAO structures can be designed in many different ways. Generally, one becomes involved in the DAO structure by acquiring the token of that project and playing a role in the management of the DAO, similar to a deputy in a governance process. A majority vote is usually required to make decisions; however, the system can also offer tokens to users to encourage them to vote or actively contribute to these decisions, allowing the DAO to be managed autonomously. AI could lead to more efficient decision-making processes within DAOs while maintaining the transparency and security of operations.[497]

In artificial intelligence, the process differs from DAOs. In DAOs, there is more human intervention than in AI. In AI, a model is created in advance, similar to smart contracts, but the machine learning algorithm works autonomously and creates or makes decisions based on the model. While DAOs are decentralized, artificial intelligence is often centralized.

The emphasis of DAOs is typically on the administration of communal investments, the execution of decentralized business models, or the coordination of activities led by the community as a whole, without amendments unless there is consensus among stakeholders. In contrast, artificial intelligence encompasses a broad variety of applications that go beyond

[496] Vitalik Buterin, Gavin Wood, and Jeffrey Wilcke, *"Decentralized Autonomous Organizations (DAOs),"* *Ethereum.org*, 2015, accessed October 1, 2024, https://ethereum.org.

[497] Oleksandr Kuznetsov, Paolo Sernani, Luca Romeo, Emanuele Frontoni, and Adriano Mancini, *"On the Integration of Artificial Intelligence and Blockchain Technology: A Perspective About Security,"* January 10, 2024, https://iris.univpm.it/retrieve/f30e2f03-eaf3-41ac-bf05-fab78db9a86a/Kuznetsov_integration_artificial_intelligence_2024.pdf.

governance or financial transactions, such as machine learning procedures, data analysis, and autonomous vehicles. AI systems have the ability to learn and adapt over time, even for complicated decision-making processes, while DAOs require consensus for adaptation, which slows decision-making. (This is reminiscent of the governance of the Roman Empire, which used democratic mechanisms like the Senate but could grant exclusive authority to an individual in times of crisis to expedite decision-making—a role known as dictator. Here, AI acts as the "dictator" with significant capacity and execution rights.)

AI has two main categories: first, machine learning, where pre-designed algorithms are used to detect patterns and learn from them, and second, deep learning, which involves neural networks with multiple layers to analyze various factors of data inputs.[498] DAOs lack such categorization since they are designed with pre-coded orders. AI applications range from simple tasks, like understanding different spoken languages in digital assistants, to complex tasks, like humanless driving and advanced data analysis in various industries.

When discussing AI and blockchain connections, ownership rights must also be considered. AI could use input data from thousands to millions of designs to create output. This raises the question of ownership rights for the input data owners.[499] For example, imagine an image ordered from an AI system. The system uses a large dataset on which it has been trained, including original works under existing copyrights. These inputs may come from the Internet or other data sources, even if used solely for internal training purposes. A prominent case is Getty Images (a global media provider) suing Stability AI for allegedly using over 12 million of its copyrighted images, along with associated captions and metadata, to train its AI text-to-image tool without consent or compensation.[500] Similarly, authors Jodi Picoult and George R.R. Martin have sued OpenAI in the U.S. (Authors Guild, et al. v. OpenAI, Inc.),

[498] Christian Janiesch, Patrick Zschech, and Kai Heinrich, *"Machine Learning and Deep Learning,"* *Electronic Markets* 31, no. 4 (2021): 685–695, https://doi.org/10.1007/s12525-021-00475-2.

[499] Lyudmyla Oprysk, *"Intellectual Property Rights and Data Ownership,"* in *Artificial Intelligence and Machine Learning Powered Public Service Delivery in Estonia*, ed. Martin Ebers and Philipp K. Tupay, *Data Science, Machine Intelligence, and Law*, vol. 2 (Cham: Springer, 2023), https://doi.org/10.1007/978-3-031-19667-6_10.

[500] *Getty Images (US) et al. v. Stability AI Ltd* [2023] EWHC 3090, [108].

alleging infringement of their rights due to the AI system's wholesale copying of their works.[501]

The core discussion is whether IP rights holders can claim their work has been used to train AI systems. Alternatively, could this use be considered inspiration, similar to how human creators are inspired by other works—but performed by AI instead? Furthermore, it is challenging to determine the importance of specific inputs in creating AI-generated works.

Nevertheless, aside from infringement during the training of an AI system, it may also be the case that an AI system can create outputs that infringe on previously registered copyrights, with similarities to an original work. In this sense, the copyright discussion on output is easier than inputs since it is easier to recognize the similarities. In the case of GitHub and Andersen v. Stability AI Ltd., the court could not find similarities between the outcomes and the original work and dismissed some claims of GitHub.[502]

Here we can return to the blockchain discussion. As we discussed above, one of the main promising technological solutions of blockchain is non-fungible tokens (NFTs). NFTs can be tracked through the blockchain system and could be designed to maintain originality, as well as determine ownership and usage from the beginning until the end of the AI system's use—from input data to output. This might be an interesting solution to follow ownership rights through blockchain for AI system training.

There was an interesting discussion on the registration of patents by artificial intelligence. DABUS, an AI system, was claimed to be the owner of a patent submitted to the UK Intellectual Property Office (UKIPO), but the UKIPO objected. On 20 December 2023, the UK Supreme Court dismissed the appeal of Dr. Stephen Thaler, reiterating earlier decisions on the ineligibility for patent protection of inventions where there is no named human

[501] Jodi Picoult and George R.R. Martin v. OpenAI, *"Authors' Lawsuit Against OpenAI," The Guardian*, accessed September 20, 2023, https://www.theguardian.com/books/2023/sep/20/authors-lawsuit-openai-george-rr-martin-john-grisham.

[502] *GitHub and Andersen v. Stability AI Ltd*, Case No. 3:23-cv-00201-WHO.

inventor.[503] According to this verdict, an AI system itself is unable to be an inventor for the purposes of patent law. This raises another discussion: how to protect AI-generated inventions. The patent system rewards inventors with exclusive rights in exchange for disclosing their inventions, often to encourage further development. However, now AI systems are generating "creative" outputs.[504]

For determining the ownership of outputs created by AI, the Full Court of the Australian Federal Court suggested a number of options:

- the owner of the machine upon which the AI software runs;
- the developer of the AI software;
- the owner of the copyright in its source code; and
- the person who inputs the data used by the AI to develop its output.[505]

The ongoing attempts to regulate AI-related issues share similarities with blockchain regulatory approaches. Disputes arising from them demonstrate the challenge that IP law currently faces in striking a balance between encouraging and supporting AI technologies while protecting investments already made in the material (inputs) being used to train the AI.[506]

As seen in the example of MiCA, one of the most detailed regulatory frameworks, progress in regulating AI systems is also being made. In December 2023, the European Parliament and the Council of the EU reached a political agreement on the AI Act, the world's first attempt to regulate AI systems using a risk-based approach. This regulation is expected to

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[503] Supreme Court of the United Kingdom, *Judgment*, Case No. UKSC 2021/0201, accessed May 22, 2024, https://www.supremecourt.uk/cases/docs/uksc-2021-0201-judgment.pdf.

[504] Ryan Abbott, *"'Everything Is Obvious,'" UCLA Law Review* 66, no. 2 (2018): 22–26.

[505] *Commissioner of Patents v. Thaler* [2022] FCAFC 62.

[506] Aaron Hayward, et al., *"The IP in AI: Can AI Infringe IP Rights?"* Herbert Smith Freehills, March 12, 2024, https://www.herbertsmithfreehills.com/insights/2024-03/the-IP-in-AI-can-AI-infringe-IP-rights.

come into force in May 2025.[507] Other countries, such as the UK and Australia, are also developing approaches to regulate AI.

In sum, like all new technological developments, AI attracts attention and inspires creative ways to regulate or resolve issues to protect the rights of people or entities while encouraging invention and technological advancement. In this sense, the regulatory approach to AI has much to learn from the blockchain legal journey discussed in this study.

The examination of decentralized technologies underscores the increasing complexity of blockchain ecosystems and their legal barriers. In relation to our third research question, it is obvious that existing legal structures often fail to account for the technical and operational details of these innovations, thus confirming our hypothesis, which demonstrates the need for regulators to fully understand these technologies in order to develop effective and flexible regulations.

Current frameworks often miss complex elements like DeFi and DEXs, leading to oversight problems. For instance, as we discussed in the previous chapter, MiCA regulates certain crypto-assets but disregards decentralized exchanges and NFTs, resulting in contradictions. In addition, the fast development of technologies like AI and layer-2 solutions highlights the shortcomings of static legislation, while strict restrictions on stablecoins in some jurisdictions hinder innovation. At the same time, poorly regulated decentralized services such as DAOs and DEXs may pose significant hazards to the financial system and customer protection. Differences in definitions and implementation across countries worsen the problem, leading to regulatory arbitrage.

Regulators must develop an extensive understanding of particular innovations, such as DeFi's collateral token methods, to provide safeguards that encourage development. A unified international framework, facilitated by organizations such as the UN or EU, might standardize global norms while acknowledging regional variations. Flexible regulatory frameworks, such as sandboxes—as discussed in Japan—could encourage innovation, while distinguishing technologies according to their associated risks, such as the disruptive

[507] European Parliament, *"Artificial Intelligence Act: Deal on Comprehensive Rules for Trustworthy AI,"* accessed December 6, 2023, https://www.europarl.europa.eu/news/en/press-room/20231206IPR15699/artificial-intelligence-act-deal-on-comprehensive-rules-for-trustworthy-ai.

features of DeFi, would promote fair policies. Collaboration between industry participants, academic institutions, and regulators is essential to close information gaps and guide the effective formulation of policies.

In conclusion, existing legal frameworks insufficiently handle the unique issues presented by new blockchain technology, as outlined in our third research question. We argue that a thorough understanding and adaptive, collaborative regulation are crucial to encouraging innovation, safeguarding investor security, and maintaining market integrity.

VII. Conclusion

In 1995, during a TV show, host David Letterman interviewed the wealthiest person in the world at the time, Bill Gates. The two discussed the Internet, the groundbreaking technology of that era, comparing it to the radio [508] in a somewhat cynical tone. The main goal of this study is to avoid finding ourselves in David Letterman's shoes years later.

The rapid spread of technology often brings forth a wide array of technological developments. While we sometimes hear concepts like the metaverse and NFTs discussed singularly, the puzzle pieces do not fit perfectly without a full understanding of the main concept.

In this study, we aim to highlight the primary legal issues of blockchain technology to create an overview of cryptocurrencies and blockchain. Based on the current literature, it seems fair to conclude that the legal framework of blockchain technology would fall under a sub-branch of IT law.

From the lawmaker's point of view, blockchain is a disruptive technology due to the decentralized nature of its system. Implementing rules in a system with no owner or central

[508] Bill Gates, *"Bill Gates Explains the Internet to Dave (1995),"* YouTube video, 1:53, posted by "VHS Forever," February 5, 2008, https://www.youtube.com/watch?v=fs-YpQj88ew.

provider presents significant challenges. Therefore, lawmakers will need to understand the core features of blockchain technology itself.

The regulatory trend for blockchain technology is determined by the purpose of regulation. If the purpose is taxation, the trend leans toward accepting cryptocurrencies as money or payment methods while excluding them from value-added taxes. For data protection, however, many concerns arise.

In my dissertation, I have examined the existing legal frameworks governing blockchain technology across different jurisdictions. The comparison of regulatory approaches, such as those in the United Kingdom and China, demonstrates their influence on the development and utilization of blockchain technology, as well as the discrepancies in compliance requirements for investors and businesses.

I have also examined several case studies, such as the development of centralized cryptocurrencies to Bitcoin—the first decentralized cryptocurrency—and listed key legal challenges posed by the adoption and integration of blockchain technology across different jurisdictions, focusing on leading countries in the market. The decentralized nature of blockchain technology creates significant challenges for traditional legal frameworks, as illustrated by the example of decentralized finance (DeFi). I emphasize the need for new regulatory methods that address the unique features of blockchain.

We have analyzed the legal systems of several countries, focusing on the technical aspects from early centralized cryptocurrencies to Bitcoin, the first decentralized cryptocurrency. The result determines significant legal challenges associated with blockchain adoption in various jurisdictions, especially in popular markets, in accordance with our first research question and hypothesis, which points out the failings of current frameworks in addressing the distinctive characteristics of blockchain technology in many jurisdictions. The decentralized characteristics of blockchain present serious challenges for conventional legal systems, as shown in instances such as Decentralized Finance (DeFi), emphasizing the pressing need for creative regulatory strategies adapted to blockchain's unique characteristics.Bitcoin emerged following the 2008 financial crisis as a response to the need for decentralization and an unreliable financial system. Regulators had difficulties understanding the technology, resulting in postponed essential safeguards, as shown by the

Mt. Gox collapse.[509] Restrictive rules in nations such as China, intended to curb blockchain, have instead hindered innovation, while countries like Singapore have embraced blockchain with transparent, supportive frameworks, establishing themselves as pioneers. Japan presents an important example by establishing an exclusive entity, the Japan Virtual and Crypto-assets Exchange Association (JVCEA), which separated its regulatory responsibilities from its primary financial regulator.[510] This methodology, when combined with regulatory sandboxes, encourages innovation while safeguarding investors and avoiding market monopolization by dominant companies whose failures might yield severe repercussions.

The SEC in the United States adopts a strict enforcement-oriented strategy. It imposes hurdles for startups and smaller entities, emphasizing investor protection at the expense of innovation. In contrast, Singapore takes an intelligent strategy by exempting some targeted digital payment tokens from the Goods and Services Tax (GST) to encourage specific blockchain technologies without providing general support, which may cause problems.[511]

In some countries, there is hesitation in supporting stablecoins, which risk financial institutions, while supporting advantageous platforms such as DeFi, which might provide necessary liquidity and function as a direct form of foreign investment, especially for countries with limited credit access.

Despite these advanced instances, broader regulatory approaches sometimes fail to regulate effectively. Frameworks such as MiCA often overlook decentralized blockchain features, resulting in significant legal inadequacies. In contrast, Switzerland adopted the Blockchain Act to establish itself as the Global Crypto Hub, with Zug developing as a center for blockchain innovation.[512] This method stands out from the restrictive policies of countries such as China and India, which hinder innovation and market growth. The achievements of hubs such as Switzerland, Singapore, and London illustrate the importance of transparent, equitable frameworks, focused policies and institutions, and collaboration with industry players.

[509] Ibid.
[510] Ibid.
[511] Ibid.
[512] Ibid.

A balanced regulatory framework, demonstrated by progressive countries, is crucial for the thriving of blockchain innovation. Countries must implement specialized regulatory agencies, flexible frameworks like sandboxes, and sector-specific laws to ensure sustainable development. The Swiss approach shows how smart regulation can harness blockchain's revolutionary possibilities while mitigating concerns and promoting global leadership in this rapidly evolving sector. By adopting such strategies, governments may leverage blockchain innovations while protecting financial institutions and encouraging technological advancement.

I have examined the technological differences and features to qualify some aspects of blockchain technology, for instance, cryptocurrencies as money, securities, or other classifications. Classifying cryptocurrencies as securities results in more rigorous regulatory obligations in several jurisdictions, potentially hindering innovation in the blockchain field.

I have examined the different types of tokens/coins and compared their respective regulatory frameworks. As discussed during the dissertation, in many jurisdictions, current regulatory models for cryptocurrencies fail to adequately address the complexities of cryptocurrency activities, particularly in a cross-border context.

As we aim to analyze our second research question, it is evident that current regulatory structures often fail to accommodate the distinctive features of various cryptocurrencies. Stablecoins, given their systemic risks, and privacy coins, facing issues associated with anti-money laundering and counter-terrorism financing, are regulated strictly, which is reasonable in nature. However, in the case of utility tokens, mostly used for accessing services, it would be better to adopt supportive approaches, as successfully seen in Switzerland. For relatively risky categories such as security tokens—many projects might easily fall into this category due to the Howey Test—sandboxes may offer an equitable strategy allowing controlled experimentation while ensuring compliance with AML/KYC and investor protection requirements. The sandbox method, as applied to DeFi, may similarly promote innovation without imposing overly burdensome standards on startups. A globally unified framework by key stakeholders is needed to address categorization errors and promote innovation, especially for the classification and definitions of these

tokens/coins. Switzerland's supportive yet structured rules represent a respectable model for other countries, harmonizing legislation with growth in the blockchain ecosystem.

I have arrived at the future of the internet and blockchain with the example of Artificial Intelligence as well. I have examined the history of the internet and its evolution to ascertain what lies ahead in the future. The future will bring a shift in contract law, enhancing efficiency while scrutinizing enforceability and liability over jurisdictional difficulties.

The birth of Bitcoin, the first decentralized cryptocurrency, was a kind of rebellion against today's centralized institutions, which can be considered cumbersome, and served as a solution proposal. Social media and technology giants, which emerged with the promise of bringing more freedom to the masses, have now entered even the most private spaces of our homes through our personal data. They have become entirely unwilling to take steps that would remove people from the Internet world on their own initiative. Although I disagree with his political views, I consider the permanent blocking of former American President Donald Trump by a private company, Twitter, without question, as a violation of freedom of expression. Moreover, the power of the central system over normal citizens—which so conveniently blocks even a powerful person like Trump—has become disproportionate.

This disproportionate power has manifested itself not only in social media but also in the banking system. The economic crisis of 2008 arose mainly due to the personal mistakes of a handful of people, ruining the lives of millions. Although it is difficult to predict the next decade of blockchain technology, I can say that the concept of decentralization behind it will grow in prominence every day. This decentralization will also require sacrifices from some of the advantages provided by the centralized system.

At this point, the concept of decentralization can be built upon high technology, transparency, recordability, and trust principles to protect our future from monopolization. I am confident that we will be able to approach the future more confidently and securely in this journey that started from the past of blockchain technology.

In sum, blockchain technology is a cutting-edge innovation that offers several benefits for many applications while also presenting certain risks. A supportive approach to technology,

combined with protective measures, will facilitate the adoption of blockchain technology within the existing legislative framework.

Att. Bedrettin Gürcan

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