Accounting, Integration into Computerized Accounting Programs, Seigniorage Rights, Taxation and Current Discussion Topics for Cryptocurrencies

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ACCOUNTİNG, INTEGRATİON İNTO COMPUTERİZED ACCOUNTİNG PROGRAMS, SEİGNİORAGE RİGHTS, TAXATİON AND CURRENT DİSCUSSİON TOPİCS FOR CRYPTOCURRENCİES

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Cinius Yayınları

PREFACE

In an My main motivation in writing this book is to present a holistic assessment of cryptocurrencies. My undergraduate education in mathematics, business, law, sociology, computer engineering, management information systems, my master's degree in business, mathematics, law, and my doctoral education in accounting and economics guided me in writing this book.

I would like to state that psychology, sociology, and philosophy are at least as important as other branches of science that concern economics in economics. This trend is being used for the redesign of societies in the new world order. As a matter of fact, current social media networks are also being used by states for the design of societies.

Today's economy and new trends in the economy are being used by both states and proxy warriors used by states for the design of societies. New technological developments are spreading at a dizzying pace in the globalizing world. While quantum computers, artificial intelligence, and cryptocurrencies are taking their place in the new world order, it is inevitable that these technologies will be pregnant with new developments in terms of the future.

In this book, along with the benefits and conveniences provided by cryptocurrencies, the dark side of cryptocurrencies, their use for criminal purposes, and the wealth transfer that occurs with speculations in cryptocurrencies are also discussed. Therefore, it is clear that technology can be used for innocent purposes, but it can also be a part of a satanic plan in different hands.

The language used in the book has been simplified to appeal to readers of all levels, and additional explanations have been made on concepts that are essential to understand. Therefore, I believe that readers will have an enjoyable reading process with a fluid plot, new information, and different perspectives while reading this book.

With my sincere wishes and respects…

Dr. Mehmet Ali YÜZBAŞIOĞLU
(Ph.D. & Lawyer)
December 2024

AUTHOR'S CV

He was born in 1986 in Nizip district of Gaziantep. He completed his primary education at Cumhuriyet Primary School in 2000 and his high school education at Nizip Hasan Çapan Anatolian High School in 2004. In 2005, he enrolled in the Mathematics Department of Atatürk University Faculty of Science and studied Chemical Engineering for a while as part of the double major program in 2007. He graduated from the Mathematics Department with a degree and high honors in 2009 and started his thesis-based master's degree in Geometry at Atatürk University Institute of Science the same year. After receiving academic English preparatory education at Atatürk University Institute of Science, he transferred to the Algebra and Number Theory Department at Gaziantep University Institute of Science. He taught as a part-time instructor at Gaziantep University Gaziantep Vocational School in the 2009-2010 Academic Year. In 2010, he started his Pedagogical Formation education at Gaziantep University and completed this education in 2011. In the 2011-2012 Academic Year, he started working as a Mathematics Teacher at Gaziantep College Foundation Private High Schools, which was founded in 1963 and is the first and oldest private school in Gaziantep. In the same year, he started writing student information processing and measurement and evaluation software at Gaziantep College Foundation Private Schools. In 2012, he started his undergraduate education at Anadolu University, Faculty of Business Administration, Department of Business Administration. While he was going to start his duty as the Gaziantep College Foundation Information Processing Manager in the 2012-2013 Academic Year, he was appointed as a lecturer at Gaziantep University Oğuzeli Vocational School in 2013. In 2014, he was appointed as the Deputy Head of the Department of Management and Organization at Oğuzeli Vocational School and with the bilateral agreement of Gaziantep University, he started his doctorate studies at South-West University "Neofit Rilski" (Bulgarian State University) on Computer and Mathematics with the thesis topic "Software Defined Networking and Information Security". He completed his BA in Business Administration in 2015. In 2015, he started his BA in Sociology at Atatürk University Open Education Faculty and Law education at Gaziantep University Faculty of Law. In 2016, he started his MA with thesis education at the Department of Business Administration at Gaziantep University Institute of Social Sciences and in the same year, he was appointed as the Deputy Director (Principal), Head of the Department of Computer Technologies

(Principal), Head of the Department of Law (Acting), and Chairman of the Advisory Board at Gaziantep University Oğuzeli Vocational School. He completed his Master's degree in Business Administration with a Thesis at Gaziantep University, Institute of Social Sciences on 18.01.2018 and started his PhD education in the Department of Analysis and Theory of Functions at the Institute of Science, Mathematics in the 2017-2018 Academic Year. In the 2018-2019 Academic Year, he won a TUBITAK domestic PhD scholarship and transferred to his PhD education at the Department of Business Administration at the Gaziantep University, Institute of Social Sciences. He completed his PhD education with a focus on law at the Gaziantep University, Institute of Social Sciences, Business Administration in 2022 and has numerous published proceedings, articles published in SCI-Expanded & Scopus indexed journals and books published by various publishing houses. Dr. Mehmet Ali YÜZBAŞIOĞLU's completed and ongoing education at the BA, MA and PhD levels are as follows; Gaziantep University, Faculty of Law, Undergraduate Education (Completed), Ataturk University, Department of Mathematics, Undergraduate Education (Completed), Anadolu University, Business Administration, Undergraduate Education (Completed), Ataturk University, Sociology, Undergraduate Education (Completed), Anadolu University, Management Information Systems, Undergraduate Education (Completed), Istanbul University, Child Development, Undergraduate Education (Completed), Anadolu University, History, Undergraduate Education (Continuing), K.S.Ü. - Computer Engineering, Undergraduate Education (Continuing), K.Ü. - English Language and Literature, Undergraduate Education (Continuing), Gaziantep University, Faculty of Law, Master's Education (Completed), Gaziantep University, Department of Business Administration, Master's Education (Completed), A.Y.Ü. - Cyber Security, Master's Education (Continuing), Gaziantep University, Department of Business Administration, PhD Education (Completed). The Undergraduate, Master's and Doctorate Educations that Dr. Mehmet Ali YÜZBAŞIOĞLU had to leave unfinished or could not complete are as follows; Anadolu University, Economics Undergraduate Education, Atatürk University, Chemical Engineering Undergraduate Education, Atatürk University, Geometry Department Master's Education, Gaziantep University, Mathematics Department PhD Education, South-West University, Computer Science PhD Education, University of Finance, Business and Entrepreneurship PhD Education. The scholarships and awards that Dr. Mehmet Ali YÜZBAŞIOĞLU has been entitled to receive are as follows; State Free Dormitory and Scholarship, TÜBİTAK Domestic PhD Scholarship.

Table of Contents for the Book

1. The Evolution of Money and Reserve Currencies: A Historical Perspective

1.1. The Pre-Money Period
1.2. Barter System
1.3. The Emergence of Money
  1.3.1. Commodity Money
1.4. The Functions of Money
  1.4.1. Medium of Exchange
1.5. The History of Money
  1.5.1. Ancient Civilizations
1.6. Reserve Currencies in the World
  1.6.1. Definition and Significance
1.7. The BRICS Community
  1.7.1. Formation and Objectives
1.8. The European Union Currency Euro
  1.8.1. Introduction and Adoption

2. Central Banks and Money Connection: An In-Depth Analysis

2.1. Introduction
  2.1.1. Background and Significance
2.2. Importance of Central Banks
  2.2.1. Monetary Policy
  2.2.2. Financial Stability
2.3. International Monetary Fund (IMF)
  2.3.1. Role and Functions
  2.3.2. Relationship with Central Banks
2.4. Independence of Central Banks
  2.4.1. Theoretical Foundations
  2.4.2. Practical Implications
2.5. Various Options Regarding the Changing Status of Central Banks from Country to Country
  2.5.1. Case Studies

3. The Dollar as a Reserve Currency and the Petrodollar Connection

3.1. Historical Background of the Dollar as a Reserve Currency
  3.1.1. Bretton Woods System
  3.1.2. Nixon Shock and the End of the Gold Standard
3.2. Characteristics of a Reserve Currency
3.3. Benefits and Drawbacks of the Dollar as a Reserve Currency

3.5. The Petrodollar System
3.5.1. Definition and Origins
3.6. The Impact of the Petrodollar System on Global Economy
3.7. Challenges and Criticisms of the Petrodollar System
3.8. Geopolitical Implications of the Dollar's Reserve Currency Status
3.9. Alternatives to the Dollar as a Reserve Currency
3.9.1. The Rise of the Euro
3.9.2. The Chinese Yuan as an Emerging Reserve Currency
3.10. Future Prospects and Trends in the Global Reserve Currency Landscape

4. Inflation and Deflation of Money, Economic Crises in History, and the Great Depression of 1929

4.1. Introduction to Inflation and Deflation of Money
4.2. The Concept of Inflation
4.2.1. Causes of Inflation
4.2.2. Types of Inflation
4.3. The Concept of Deflation
4.3.1. Causes of Deflation
4.3.2. Effects of Deflation
4.4. Relationship Between Inflation and Deflation
4.5. Economic Crises in History
4.5.1. Overview of Major Economic Crises
4.6. The Great Depression of 1929
4.6.1. Causes of the Great Depression
4.6.2. Impact of the Great Depression
4.7. Comparative Analysis of Economic Crises

5. Exploring the History and Evolution of Cryptocurrency

5.1. Historical Overview of Cryptocurrency
5.1.1. Precursors to Cryptocurrency
5.1.2. The Creation of Bitcoin
5.1.3. Key Milestones in Cryptocurrency Development
5.2. Understanding Blockchain Technology
5.2.1. Definition and Principles
5.2.2. Types of Blockchains
5.2.3. Key Features and Advantages
5.3. Coins vs. Tokens
5.3.1. Definitions and Characteristics
5.3.2. Use Cases and Examples
5.4. Altcoins and Their Impact
5.4.1. Definition and Significance
5.4.2. Popular Altcoins and Their Features
5.5. Meme Coins and Their Rise

5.5.1. What are Meme Coins?
5.5.2. The Phenomenon of Meme Coins
5.5.3. Challenges and Opportunities
5.6. Cryptocurrency and the Financial Landscape
5.7.1. Adoption and Integration in Various Sectors
5.8. Future Trends and Predictions
5.8.1. Emerging Technologies and Innovations
5.8.2. Potential Challenges and Solutions

6. The Potential Use of Cryptocurrencies by Governments to Control Money Supply

6.1. Introduction
6.2. The Role of Governments in Controlling Money Supply
6.2.1. Monetary Policy Tools
6.3. Potential Advantages of Using Cryptocurrencies for Money Supply Control
6.3.1. Transparency and Traceability
6.4. Challenges and Risks of Governments Using Cryptocurrencies
6.4.1. Regulatory and Legal Issues
6.5. Case Studies of Governments' Involvement with Cryptocurrencies
6.5.1. China's Digital Currency Electronic Payment (DCEP)
6.6. Future Implications

7. Discussions on Central Banks Holding Cryptocurrency Reserves

7.1. Introduction
7.2. Historical Context of Central Bank Reserves
7.2.1. Evolution of Central Bank Reserves
7.3. Rationale for Central Banks Holding Cryptocurrency Reserves
7.3.1. Diversification of Reserve Assets
7.4. Regulatory Considerations
7.5. Case Studies of Central Banks Holding Cryptocurrency Reserves
7.5.1. El Salvador
7.6. Future Implications and Trends
7.6.1. Impact on Monetary Policy

8. Investigating the Alleged Connection Between Cryptocurrencies and Ponzi Schemes

8.1. Introduction to Cryptocurrencies and Ponzi Schemes
8.2. Historical Background of Ponzi Schemes
8.3. Evolution and Adoption of Cryptocurrencies
8.4. Key Characteristics of Cryptocurrencies
8.5. Regulatory Challenges and Concerns in the Cryptocurrency Market
8.6. Theoretical Frameworks for Analyzing Ponzi Schemes

8.7. Linking Ponzi Scheme Elements to Cryptocurrencies
8.8. Case Studies and Examples of Cryptocurrency-Related Scams
8.9. Global Powers and Cryptocurrency Influence
8.10. State-Sponsored Cryptocurrency Initiatives
8.11. The Role of Regulatory Bodies in Detecting Ponzi Schemes
8.12. Technological Advancements and Ponzi Scheme Detection
8.13. Empirical Evidence on Cryptocurrency Market Manipulation
8.14. Misconceptions and Myths Surrounding Cryptocurrencies
8.15. Ethical Implications of Cryptocurrency Use

9. Terrorist Financing and Criminal Use of Cryptocurrencies

9.1. Introduction
9.2. Understanding Terrorist Financing and Its Challenges
9.3. The Rise of Cryptocurrencies in Criminal Activities
9.5. Anonymity and Pseudonymity in Cryptocurrency Transactions
9.6. Regulatory Landscape and Challenges in Combating Terrorist Financing through Cryptocurrencies
9.7. Case Studies of Terrorist Organizations Using Cryptocurrencies
9.8. Technological Solutions and Innovations to Detect and Prevent Cryptocurrency-Related Crimes
9.9. International Cooperation and Information Sharing Mechanisms
9.10. The Role of Financial Institutions and Compliance Measures
9.11. Emerging Trends and Future Directions in Terrorist Financing and Cryptocurrencies

10. Potential Negative Consequences of Cryptocurrencies: A Comparative Analysis with Historical Financial Crises

10.1. Introduction
  10.1.1. Background and Significance
10.2. The Dot-com Bubble of the Early 2000s
  10.2.1. Causes and Characteristics
  10.2.2. Economic Impact
10.3. The Great Depression of 1929
  10.3.1. Causes and Triggers
  10.3.2. Long-term Economic Effects
10.4. Comparative Analysis
  10.4.1. Similarities and Differences
  10.4.2. Key Indicators and Warning Signs
10.5. Risk Management Strategies
  10.5.1. Investment Strategies
  10.5.2. Diversification

11. Analysis of FTX Crisis: Collapsed and Hacked Cryptocurrency Exchanges

11.1. Background and Significance
11.2. Purpose and Scope of the Section

11.3. Previous Instances of Exchange Collapses and Hacks
11.4. FTX Crisis: Overview and Causes
  11.4.1. Timeline of Events
  11.4.2. Factors Contributing to the Crisis
11.5. Impact of FTX Crisis
  11.5.1. Economic Consequences
11.6. Lessons Learned from FTX Crisis

12. The Impact of Quantum Computing on Cryptocurrencies

12.1. Introduction to Quantum Computing and Cryptocurrencies
12.2. The Security of Cryptocurrencies in the Quantum Computing Era
  12.2.1. Current Cryptographic Protocols in Cryptocurrencies
  12.2.2. Vulnerabilities of Cryptocurrencies to Quantum Attacks
12.3. Potential Solutions and Mitigations for Quantum-Resistant Cryptocurrencies
  12.3.1. Post-Quantum Cryptographic Algorithms
  12.3.2. Quantum-Secure Blockchain Technologies
12.4. Challenges and Limitations in Implementing Quantum-Resistant Cryptocurrencies

13. The Impact of Speculations in Cryptocurrencies by Influential Figures

13.1. Introduction to Cryptocurrencies and Speculations
13.2. The Role of Influential Figures in Shaping Public Perception
13.3. Case Studies of Speculations by Elon Musk and Donald Trump
  13.3.1. Elon Musk's Tweets and Their Effect on Cryptocurrency Prices
  13.3.2. Donald Trump's Statements and Impact on Cryptocurrency Markets
13.4. Ethical and Regulatory Considerations in Influential Figures' Speculations
13.5. Psychological and Behavioral Aspects of Investor Reactions to Speculations
13.6. Analyzing the Long-Term Effects of Speculations on Cryptocurrency Market Stability
13.7. Strategies for Mitigating Risks Associated with Speculations by Influential Figures

14. Stable Coins, Gold and Silver Indexed Coins and Emerging Problems

14.1. Introduction
14.2. Understanding Stable Coins
  14.2.1. Definition and Characteristics
  14.2.2. Types of Stable Coins
  14.2.3. Advantages and Disadvantages
14.3. Gold and Silver Indexed Coins
  14.3.1. Overview of Gold and Silver Indexing
  14.3.2. Comparison with Stable Coins
  14.3.3. Use Cases and Market Trends
14.4. Regulatory Landscape
  14.4.1. Current Regulations on Stable Coins and Indexed Coins

14.4.2. Challenges and Opportunities
14.5. Risks and Challenges

15. The Great Reset Discussions and Its Relationship with Cryptocurrencies

15.1. Introduction
15.2. Understanding the Great Reset
15.2.1. Historical Background
15.2.2. Definition and Types
15.2.3. Evolution and Adoption
15.3. The Intersection of the Great Reset and Cryptocurrencies
15.3.1. Potential Impacts on Cryptocurrencies
15.3.2. Opportunities for Innovation
15.4. Case Studies and Examples
15.5. Challenges and Risks

16. Exploring the Concept of Seigniorage Rights in Modern Economies

16.1. Introduction
16.1.1. Background and Definition
16.1.2. Importance and Relevance
16.2. Historical Evolution of Seigniorage Rights
16.2.1. Origins of Seigniorage
16.3. Theoretical Frameworks
16.3.1. Monetary Economics Perspective
16.3.2. Legal and Political Economy Perspective
16.4. Seigniorage Rights in Practice
16.4.1. Central Bank Operations
16.5. Challenges and Controversies
16.5.1. Inflationary Pressures
16.6. Comparative Analysis
16.6.1. Regional Differences

17. Current Debates on Seigniorage Rights in Cryptocurrencies

17.1. Seigniorage in Cryptocurrencies
17.1.1. Mechanisms of Seigniorage in Cryptocurrencies
17.2. Economic Implications of Seigniorage Rights in Cryptocurrencies
17.2.1. Inflationary vs. Deflationary Models
17.3. Regulatory and Legal Challenges
17.3.1. Jurisdictional Issues
17.4. Technological Innovations and Seigniorage Rights
17.4.1. Smart Contracts and Automated Seigniorage Mechanisms
17.5. Environmental Considerations
17.5.1. Energy Consumption of Mining Processes

17.8. Social and Ethical Implications
17.8.1. Wealth Distribution and Access to Cryptocurrencies
17.9. Future Directions and Research Agenda
17.9.1. Potential Policy Recommendations

18. Accounting for Cryptocurrencies

18.1. Accounting Principles and Standards
18.1.1. Overview of Generally Accepted Accounting Principles (GAAP)
18.1.2. Relevance of International Financial Reporting Standards (IFRS)
18.1.3. Emerging Issues in Cryptocurrency Accounting
18.2. Valuation of Cryptocurrencies
18.2.1. Market-Based Valuation Methods
18.3. The Significance of Current Market Prices and Trading Volumes
18.4. Cost-Based Valuation Methods
18.5. Internal Controls and Risk Management
18.5.1. Segregation of Duties
18.5.2. Authentication and Authorization Controls
18.6. Auditing Cryptocurrency Transactions
18.6.1. Audit Procedures and Techniques
18.6.2. Challenges in Auditing Cryptocurrencies
18.7. Case Studies and Practical Applications

19. Integration of Cryptocurrencies into Computerized Accounting Program

19.1. Computerized Accounting Systems
19.2. Benefits of Integrating Cryptocurrencies
19.3. Regulatory Frameworks and Compliance
19.4. Technical Considerations
19.5. Future Trends and Developments
19.6. Suggestions for Integrated Process

20. Taxation of Cryptocurrencies: Comparative Analysis and Case Studies

20.1. Introduction
20.2. Taxation Principles
20.2.1. General Taxation Principles
20.3. Taxation of Cryptocurrencies in the United States
20.3.1. IRS Guidance and Regulations
20.3.2. Capital Gains Tax
20.3.3. Reporting Requirements
20.4. Taxation of Cryptocurrencies in the European Union
20.4.1. Directive on Administrative Cooperation
20.4.2. Value Added Tax (VAT)
20.3.3. Reporting Requirements

20.5. Taxation of Cryptocurrencies in Asia
20.5.1. Japan
20.5.2. South Korea
20.6. Taxation of Cryptocurrencies in Developing Countries
20.6.1. India
20.6.2. Nigeria
20.7. Case Studies
20.7.1. Taxation of Bitcoin in the US
20.7.2. Taxation of Ethereum in the EU
20.8. Comparative Analysis of Taxation Approaches
20.9. Conclusion and Future Trends

1. The Evolution of Money and Reserve Currencies: A Historical Perspective

1.1. The Pre-Money Period

The economic system observed often today in the form of a market economy based on money, in which most transactions in goods and services do not involve the physical transfer of goods or barter, is a relatively recent development. The concept of money has gone through its own process of evolution. In this section, we provide a brief account of the pre-money period, when self-sufficiency and barter were the main means by which exchange and economic transactions were facilitated. This section serves as a foundation for our discussion of money and reserve currencies in the following section (Challoumis, 2024; Morgan et al., 2023; Varadarajan et al., 2022).

The use of money enhances efficiency by facilitating transactions through standard coins, notes, and payments. The origins of money, however, date back to its use as a medium of exchange and a standard of value. Money and its use are mutually reinforcing: money enhances efficiency in trade, while trade promotes the acceptance of a single medium of exchange. Furthermore, the use of a unit of account in financial contracts such as loans, which link the present to the future, also interacts reciprocally with the use of money. As money can be regarded as the source of all economic activity, an understanding of the evolution of money is essential for a better comprehension of many aspects of our world (Vilar, 2025; Baur & Dimpfl, 2021; Von Glahn, 2023; Dupré & Rey, 2023).

1.2. Barter System

Barter trade refers to exchanging goods for goods, circumventing the need for currency or money for trade to happen. Once rare goods became part of the culture, rather than a token of social standing, the first problem with barter trade emerged. It was easy for two parties who had goods to complete a barter, but what if the person who had something the first trader wanted was not interested in the first trader's inventory? As simple economies grew, multiple traders needed to meet at one location, increasing the likelihood of one trader not having the desired goods of another. The emergence of large marketplaces helped drastically, but it was geographical coincidence that allowed everyone to find the goods they wanted at the same location at the same time. If a party was not interested in the exact goods offered in return for his own merchandise, a problem was created. What was needed was a third merchandise, a facilitation merchandise, that the second party was happy to take in exchange for his own goods, because the facilitation merchandise was known to be easily tradable

for the needed merchandise (Blas & Farchy, 2021; Yousefi & Alaamati, 2023; Martín, 2024; Weber, 2021).

The earliest form of money is effectively a more standardized barter system, with the facilitation token being a scarce and hard-to-reproduce good that there was a widely acknowledged demand for. As money started to be accepted as payment for other goods and services, economies could enjoy the reduction in transaction costs that had always been enjoyed by closed barter communities. Transporting the more in-demand commodities from location to location using chariots, horses, and ships was used for centuries in several cultures, with the enormous demand for the scarce transport resources resulting in one individual of that culture deciding to use it as sound money. These cultures saw the sentries become figureheads and the pharaohs support the driving value of the good, as people spent and saved in search of ownership of something that could always be exchanged for another widely desirable good. For early cultures, value intended for barter trade behavior grew in convenience, meaning value demand grew with technology (Peneder, 2022; Challoumis, 2024; Cunha et al., 2021; Sadilloyevna, 2024)

1.3. The Emergence of Money

Adam Smith beautifully wrote that before the emergence of money, goods are exchanged by barter. Money is thus, first and foremost, an innovation in exchange. More precisely, money is a medium that allows goods to be valued in a more flexible way than simple, bilateral barter exchange allows. In a barter, goods can be exchanged only if both parties to the exchange wish for the goods offered by the other. The likelihood of double coincidences of wants greatly limits the potential for exchange in a barter system. Money, as a medium, like many other economic institutions that we take for granted today, emerged spontaneously to ease the suffering caused by the limitations of the barter system (Peneder, 2022; Sriliasta et al., 2022; Noailly & Smeets, 2022; Eiffler, 2024).

The desire to exchange is part of human nature. People have been trading ever since the beginning of recorded history. Even before the development of language, the oldest human artifacts suggest that people were already exchanging goods. However, indirect exchange – the exchange of goods for other goods – was limited, as we have already explained. The essential problem is that in an indirect exchange, an individual who has something in excess of his needs (a surplus of that good) must find someone who desires that particular good and who, because of his many other options, has a surplus of some other good for which the first individual is willing to trade. However, when there is no double

coincidence of wants, the actual amount of trade associated with the surplus can be severely limited. With a very large number of goods to be exchanged, the potential for some direct trades in barter is destroyed (Stiglitz & Kosenko, 2024; Chang et al., 2023; Haral, 2022; Stein, 2021).

1.3.1. Commodity Money

We begin our historical review by considering commodity money, a use of two assets, one real and one financial, that can be traced back to ancient history. Commodity money pays no interest, and holding it only provides the asset holder with a usage value; for instance, gold or silver can be used in jewelry, production (mostly for industrial or military purposes, including financial services), or transaction benefits in that their possession makes it easier to exchange. Moreover, throughout their history, precious metals have involved a cost of production, which is an upper limit to the real price of these commodities. On the other hand, commodity money also functions as stores of value due to the intrinsic long-run scarcity properties of the commodity; restricting the amount in circulation over time, and well-defined costs of storage make the quality of the commodity valuable over time (Vilar, 2025; Von Glahn, 2023; Reboredo et al., 2021; Lapavitsas & Aguila, 2022).

The elective mintage of commodity money, which is different from a common practice in some countries with a fiat money monopoly, emerges directly from their seigniorage advantage over non-precious metals. The coins representing the unit of account are more valuable than the costs of production. Initially, the intrinsic value of the primary monetary metals was set equal to, or as a multiple or fraction of, the nominal value of the currency. Then, in our story about money, the erosion of these ratios began (either an inflation of monetary prices, stemming from the inherent fall of the costs of production, or a devaluation of the nominal value, inspired by the weakness of the private sector reflected in the internal value of money, are the most common explanations for this monetary phenomenon) (Ghannam, 2022; Herrera, 2022; Thomason, 2024; Fernow, 2022).

1.4. The Functions of Money

In accordance with tradition, the functions of money are generally taken to be the following: (i) as a means of exchange, used for trade; (ii) as a unit of account, i.e., price tags are in units of money; (iii) as a store of value, providing the opportunity of transferring wealth through time; and (iv) as a means of determining present and future debt. The similarities of the four functions and their historical order require no particular justification. The division more

or less corresponds to 'narrow' and 'broad' monetary base. However, the fact that money can serve in origin as a means of exchange without being a store of value, and in ancient societies and backward areas money developed initially as a means of settling commercial debts, with the means of exchange function developing in a more advanced phase, emphasizes the historical specificity of the different forms and functions of money (Hartley & Kallis, 2021; Peneder, 2022; Challoumis, 2024; Lukšić et al., 2022).

The functions of money are therefore the result of historical, but not uniquely historical. It seems quite possible to imagine a near future in which payments are made without the use of any tangible support, apart from a simple accounting entry. Indeed, such situations are already beginning to appear, with the current explosion of electronic payment media. Yet, it is hard to conceive of such an evolution without the 'real' existence of money, if only because transfers of money through a pure electronic medium rely in the final analysis on a deposit of central bank money from the bank issuing the payment order (Cunha et al., 2021; Genc & Takagi, 2024; Sims & Wu, 2021).

1.4.1. Medium of Exchange

Medium of exchange is the most basic function of money. A double coincidence of wants would be required for barter to work without money. Money eliminates it and allows trade in a more advanced system. It facilitates the exchange of goods and services by serving as an intermediary in the transaction. It overcomes the limitations of barter. In a barter system, if a product is not marketable (desirable as a good), it will not be produced (provided as a service) and could indirectly affect the satisfaction of a missing market demand. Money also helps producers and traders easily compare costs of production and provides them with an expected price range. It, thereby, improves the efficiency of resource allocation and the performance of markets in terms of price discovery. Additionally, the instability of trade flows under barter is overcome. The demand for money is mainly related to the improvement it entails in the functioning of elastic markets (Baur & Dimpfl, 2021; Vuong, 2021; Barrdear & Kumhof, 2022).

There are two basic ways to ensure the exchange of goods and services. In everyday life, our work is the medium of exchange. We trade our products in the marketplace for the other goods and services we need. History tells us that using the output of our food gathering, or later our agriculture, art, and manufacture as money has a large number of disadvantages. Unlike lifeless money, work cannot be accumulated or hoarded. That is why people store work in the form of goods useful in barter. One of the main characteristics of money is that

nobody can benefit from or enjoy it. The only advantage is to buy somebody else's benefits. Material money has no use except as a means to get something else. This intrinsic lack of use, combined with the relative inflexibility of the quantity of money that can be stored for the smallest possible physical volume, gave material money a wider and more practical circulation. For success in business, the pressure on the cost of new purchases, wealth development, and demand for money enforces the economy of accumulated labor and values its productive services, more by the use of a simplex currency than signification could stimulate (Deng et al., 2021; Rahman et al., 2022; Shaikh et al., 2022).

1.5. The History of Money

Historians agree that there is no accepted appearance of money. There have been a number of different views over time. The key problem of modern economies – namely, to facilitate the exchange of benefits by economic actors. If the benefits could be bartered without a medium of exchange, they would have little use for money. The common feature is the lack of attention to the origin of money. They are only interested in the functions of money and how money works (Harari, 2024; Matthews, 2024; Horrell, 2023).

The existence of money is essential for the operation of a market economy. It is said that money is the lubricant of the economic system. Without money, institutions and economic activities that we consider to be essential in a modern economy could not exist. To understand the nature and operation of our money-based economy, it is appropriate to deal with units of account, for the participants in virtually all economic activities convert economic indicators into money or money into economic indicators and perform complex calculations in a more or less rational manner (Flaherty, 2023; Harari, 2024; Herger, 2022; Lalor, 2024).

1.5.1. Ancient Civilizations

This section provides a brief overview of money evolution in ancient civilizations. It highlights the fundamental role of rules-based systems as the basis for all money supply in human history. An increase in the rule of law and strict monetization produces tangible economic benefits in contrast to resource-based money supplies. Three types of monetary issues are identified and linked to three key rules-based systems, corresponding to commodity/property rights, inventory, and government-credit approaches to money. Money, or the ability to consistently enforce credit against the general public, predates the rise of official political organizations and the state. However, it is the evolution of the

third, credit-enhancing system that has contributed to the survival and modern structure of banks; all three systems are still key components of the modern economy (Lalor, 2024; Dupré & Rey, 2023; Matthews, 2024; Sweren-Becker & Waldman, 2021).

Physical property and efficiently generated and enforced rules governing transactions involving that property have been central to human prosperity for at least the past ten thousand years. Without such rules, deep, impersonal trade, and hence smooth, peaceful, and advantageous interaction with outsiders, become problematic. Such rules—monetizing commodities or financial claims—co-evolved with the realization that better sets of rules produce tangible benefits for all members of society. Indeed, it seems likely that the costs of implementing such efficient sets of rules might have been important drivers of the process of formal state creation. They have also been a key component and perhaps a driving force behind the great increases in income per capita that have taken place across the globe (Matthews, 2024; Sweren-Becker & Waldman, 2021; Horrell, 2023; Herger, 2022).

1.6. Reserve Currencies in the World

Introduction The real incomes, capital values, and net foreign investment positions of the nations have depended on the roles of reserve currencies. Understanding these roles provides important information, not only about the most effective policies for promoting domestic prosperity and international order but also about the potential sources of international monetary difficulties and the probable effectiveness of proposed solutions. This section sets out a conceptual model which it applies to twelve historical examples of the international use of national currencies and briefer comments on four others, and then formulates some general propositions on the basis of the empirical evidence (Matthews, 2024; Klysing et al., 2024; Sweren-Becker & Waldman, 2021; Horrell, 2023).

A reserve currency of international monetary importance is one that is widely used to make international payments, exploit changes in its value as a means for transferring wealth across time and place, and keep foreign exchange reserves. The principal importance of such a currency lies in the support that it provides for the superstructure that the international community has built upon the foundation of international liquidity created by the reserve currency. The allocation of special drawing rights and the income of the International Monetary Fund, the liquidity, efficiency, and size of private international capital markets, and the operation of the Eurodollar market depend in major measure on the reserve currency (Matthews, 2024; Horrell, 2023; Herger, 2022).

The role of reserve currencies in the past has been associated with the interest rates that they have promoted at the centers of the world economy and also with limitations of the conditions under which those interest rates are allowed to evolve (Horrell, 2023; Harari, 2024; Herger, 2022).

1.6.1. Definition and Significance

The dollar has been the preeminent international reserve currency, held by central banks. It is three times more commonly held than the next most popular reserve currency, the euro. Other currencies being considered as reserve currencies and holding special status include the pound sterling, the Japanese yen, the Swiss franc, the Australian dollar, the Canadian dollar, and the Chinese renminbi. Reserve currencies play an important role in the global economy. They are used by central banks to hold foreign exchange reserves to meet international obligations and to stabilize the domestic currency. Countries need to hold internationally accepted reserve currencies so that they can be readily accepted in the event of balance of payments issues. Such reserves provide monetary stabilization for the world and offer countries a type of insurance against external shocks (Matthews, 2024; Horrell, 2023; Lalor, 2024).

1.7. The BRICS Community

While all the BRICS countries stress that BRICS is not aimed against any third countries, the West remains to believe that they do so. Two other widely popularized theses concerning BRICS are the absence of the mechanism of coordination between the BRICS countries and their low ability to underwrite their words with real deeds. The topic "The Role of the BRICS in the Modern System of International Relations" is dedicated to the second thesis. The views that they actually express are, however, different. In the first block, the mostly favorable views prevailed: Russia has been active in integration associations and resource clubs; together with the other BRICS countries, Russia is in the process of changing the global governance regime. However, it is recognized that the BRICS countries still need to pool efforts to transform the modern financial and economic system. The authors of block 5 defend roughly the opposite point of view, trying to answer a key question of the block: "Why is the BRICS a nonentity in international economic matters?" (Matthews, 2024; Lalor, 2024; Dupré & Rey, 2023; Herger, 2022).

In these highly informative and critical section, all the authors share the key view that large emerging economies have outgrown the role assigned to them at the end of WWII and that the double standards of global governance do not

satisfy them anymore. This is mainly due to injustices experienced by these countries during the reforms constituting the system of their development. However, in an otherwise very rewarding reading, I would like to see a strong argument: Hasn't the obstacle to the determinant weight of the BRICS in international economic matters, as stressed by the last team, a political nature? The more so that any institutionalization would face two great problems (Dupré & Rey, 2023; Matthews, 2024; Horrell, 2023; Lalor, 2024).

1.7.1. Formation and Objectives

The reserve currency role has a long history. Over two thousand years ago, the Phoenician merchants had a network of lead currencies widely used by sailors and merchants from all the Phoenician colonies. The first major global reserve currency was the Athenian silver tetradrachma, which dominated the ancient Hellenic trade and facilitated transactions throughout the Eastern Mediterranean. The Athenian naval power guaranteed the uniform quality of the coinage and, in return, the merchants paid the required seigniorage premium. The Roman denarius became the global reserve currency only in the 1st century BCE. In the 7th century, the Islamic economy needed a more extensive medium of exchange and a lower denomination gold coin than the Byzantine solidus and the Persian dinar. Consequently, the Bani' Abbas caliph struck a gold coin weighing 1/72 of a Byzantine gold solidus, the dinar (Foster, 2021; Cunha et al., 2021; McClelland, 2021).

Reserve currencies have always been associated with entities that had high needs for money of various denominations. The carriers of global reserve currencies – whether Greek city-states, the Roman Empire, the Islamic caliphate, or the much later merchant cities of Venice or Holland – used the currency to finance long-distance trade and military expeditions over vast regions and territories. The financing of such operations was only possible by seigniorage gains and dispersion of different denominations of coins in different areas. The Phoenician currencies or Athenian owls facilitated operations for their users. Providing a lower denomination gold coin was a sign of offering the world community a desperately needed new denomination of money, fulfilling not only a gold standard criterion but a payment efficiency condition as well (Von Glahn, 2023; Cunha et al., 2021; Vilar, 2025).

1.8. The European Union Currency Euro

On January 1, 1999, monetary union within the EU began and the euro came into existence. This was an important event in the attempt within the EU to cre-

ate common economic institutions and is seen by many as one of the stepping stones to political union. It can be seen as a catalyst for further changes in the pattern of reserve holding by national monetary authorities, as the market for euro assets deepens and the share of assets denominated in euro rises. There are many problems associated with the establishment of the euro and the future behavior of the European Central Bank, which will have important implications for capital flows between the EU and the rest of the world. The euro was not convertible on the date of its introduction. In the fourth and final stage of the transition to economic and monetary union, full convertibility proceeds full participation. As long as the euro is not fully convertible, a euro bond market providing returns in the new currency will not develop (Von Glahn, 2023; Foster, 2021; Park, 2021; McClelland, 2021; Cunha et al., 2021).

1.8.1. Introduction and Adoption

The special status of money and reserve currencies in global economies is a well-established fact. This status is vital to national and global economies since money serves as a medium of exchange, a store of value, as well as a unit of account. Reserve currencies are crucial for central banks and governments, which hold such currencies to back their liabilities and to intervene in their currency markets. Reserve currency status also engenders benefits for countries issuing them, like seigniorage income and enhanced terms of trade. The ample evidence on the economic consequences of reserve currency status suggests that this can have substantial and potentially important effects on the functioning of the international monetary and trading systems, as well as on trade, investment, capital flows, and growth. Yet, little is known about the conditions and factors determining the transition of monies into dominant international currencies, as well as their transitions back to local currencies, or to obsolescence. It is the aim of this chapter to cast light on these processes through taking a historical view. In particular, monetary history shows that the identity of the dominant international currencies has varied greatly through time. Such changes are important since they can lead to disruptions in confidence and coordination in the underlying market and economic systems, as they are associated with sudden hyperinflations and economic dislocations (McClelland, 2021; Cunha et al., 2021; Von Glahn, 2023; Vilar, 2025).

2.Central Banks and Money Connection: An In-Depth Analysis

2.1. Introduction

The most fundamental activity in any economy is producing, exchang-

ing, and consuming goods and services. A monetary economy is the one in which there is a special kind of asset, money, used in these activities. Any type of hyperactivity, or otherwise, of a monetary economy crucially depends on the nature of the monetary system and its management. Central banks play a particularly important part in managing the monetary system and monetary economies. They manage, shape, and redefine what money looks like, what it can do, and how it should be used. Perhaps more importantly—although this is theoretically not uncontroversial—they can significantly determine the kind of economies and societies people live in. This is even truer today because money has convincingly shown how powerful it can be in shaping the fate of an entire nation, and even extend its influence way beyond the borders of the economy it keeps afloat. In this last regard, the global second millennium has paid for central banks' mistakes with entire generations of people. A very important field to understand the role of central banks is in their potential or actual relation with money (Svartzman et al.2021; Boneva et al., 2022; Hansen, 2022; Echarte et al.,2021).

2.1.1. Background and Significance

Over a period of time dating as far back as the 17th century, central banks have established themselves as the most significant managers of the monetary side of modern economies. In fact, central banking is one of the only areas of public policy within which change has been evolutionary rather than revolutionary. With the exception of the establishment of the Federal Reserve in the United States in 1913, the occurring evolution in central banking has been gradual (Bordo, 2021; Coombs & Thiemann, 2022; Huerta de Soto et al., 2021).

The significance of the central bank as a currency stabilizer and regulator of the financial system at the turn of the 20th century is now taken as given, though the significance assigned to maintaining price stability, not as clear-cut, has been given greater focus in recent times. Some pivotal moments in central banking history include the formal constitution of the Bank of England in 1694 and the unrestricted convertibility of the currencies of 20 countries to gold at the conclusion of the First World War in 1919. The introduction of anti-inflation monetary policies in 1979 was noted as a third major evolution, specifically those adopted by the United States and the United Kingdom. Noting the range of responsibilities now performed by many central banks, some of the present-day major functions of central banks post-global financial crisis have been outlined. With the global landscape rapidly evolving, it is anticipated that the role of central banks will continue to evolve in the future. The ability to innovate and

develop creative policies to address the newest developments will be required of these institutions to be able to do so in such a way that financial markets and therefore economies will not descend into chaos looming in policy implications that one size fits all (Sparsam & Pahl, 2021; Nelson, 2023; Ventresca, 2024).

2.2. Importance of Central Banks

Central banks are crucial institutions operating in the economic landscape. Their essential role is to implement monetary policy. By setting monetary policy, central banks determine the amount of money circulating in the economy, influencing inflation, aggregate demand, and interest rates. The goal of monetary policy is to ensure equitable price stability, meaning to target an inflation rate that is consistent with sustainable economic growth. Economic growth and financial stability are other central bank goals. They target growth, as well as unemployment, through expansionary or contractionary monetary policies. Finally, central banks maintain financial stability. They accomplish this by mitigating systemic risks, ensuring the safety of commercial banks and the overall banking system. Confidence and trust in central banks are critical. Trust ensures transparency, which is another crucial sign of good governance, and confidence provides individuals with a clear expectation of how the market and the central bank act. Central banks also help maintain flows in the national economy of developing nations by carrying out various banking functions. Although central banks have different functions, these functions can be seen as a whole because the performance of one task affects the other functions of central banking. The central bank functions supply the general framework for the development of an effective banking system in any country. Banking operations within the specified framework require the discretionary power and necessary instructions for the origination of credit. Banking operations within the banking system or beyond can be monetized when other institutions accept their liabilities (Wahyudin, 2024; Martin et al.2022; Ruslan et al.2023; Jamil, 2022).

2.2.1. Monetary Policy

Monetary policy refers to the management of money supply and interest rates by a nation's central bank to influence a nation's economy. It is the demand-side economic policy. The monetary policy was initiated to govern the supply of money, availability of money, and cost of money in an economy. Moreover, it originally involves the replacement of explicit commodity money with implied credit money. Central banks play a key role in controlling the monetary supply to achieve a reasonably stable price, monetary value, and promote economic

development in society. Central banks use several tools such as interest rates to conduct monetary policy. Interest rates influence many daily costs and revenues in an economy, including interest rates on loans. It is necessary to keep inflation low to support sources of employment and output and enhance economic financial policy. Unemployment could be lower on average, with higher interest rates controlling inflation. The direct interest rate changes impact inflation, employment, and long-term interest rates. The open market operations of the central bank, aside from controlling the lending interest, are also the key tools used by the government and the central bank. Reserve banks influence the monetary supply in general, particularly the overnight lending interest rate. Under its current structure, there are two main ways that central banks commonly exert influence over short-term interest rates: issuing forward guidance and implementing quantitative easing. Central bank actions support price stability, promote full employment, and maintain long-term interest rates at a level consistent with short-run measures. The rise in the volume of open-market operations was accompanied by the use of electronic-based methods to carry out transactions. Up until now, the most significant tool the bank utilized to manage monetary policy was the overnight cash rate. It is important to think about the present and prospective events. Moreover, central banks will continue to carry out public policy in this way, considering trends in economic growth, rates of unemployment, inflation, and the domestic and external risks and factors that can affect the appropriate stance on monetary policy (Boneva et al., 2022; Wahyudin, 2024; D'Orazio & Popoyan, 2022; Rostagno et al.2021).

2.2.2. Financial Stability

As fiscal and monetary policies are directed by the central banks, they must ensure that the financial system under their jurisdiction operates in smooth waters by not bearing excessive risk that could ignite a financial crisis. Bumpy times are frequent visitors; in fact, small changes in the economic outlook, in the strategies of one or more market players, can have destabilization effects throughout the system far larger than the sum of the single shocks. Central banks have the legal responsibility to counteract them. This is the reason why central banks cannot afford to leave monitoring markets, saying that this is a private affair, prudential supervisors' business, and that each market player fully knows the risk-return trade-off it is involved in (Thiemann et al., 2023; Sissoko, 2022).

The tools provided to these analyses are mainly stress testing, with scenario analysis being only one of the inputs to stress testing and macroprudential regulation. Early Warning Analytical approaches refer to the analyses of several po-

tential crisis indicators. A less sophisticated approach is using historical analysis to better understand the channels through which financial intermediation can break down and limit the economic damage they can cause when they occur. (Taskinsoy2022; Ullersma and van2021; Morell et al., 2022).

2.3. International Monetary Fund (IMF)

The IMF was established in 1944 from the Bretton Woods Agreement System, which aimed to create a framework that offers economic growth and reduces the possibility of future world wars. After the Second World War, the establishment was made and began operations on March 1, 1947. Initially, there were 44 founding countries that are members of the United Nations. Presently, the institution has 189 member countries and works to facilitate international monetary cooperation, ensuring financial stability, facilitating international trade, promoting high employment and sustainable economic growth, and reducing poverty around the world. Furthermore, member countries are required to contribute to the IMF's resources as well as to increase the contribution as needed. The main functions of the IMF are: surveillance of world economic and financial developments, including the members' policies, providing financial assistance to member countries that are experiencing balance of payments issues due to short foreign exchange, and providing a high-level forum for discussing international monetary issues. Furthermore, the IMF also provides capacity development assistance through the provision of education, research, and policy advice to its member countries in various economic fields. In general, the IMF is regarded as a key manager of economic governance through its organizational network and policy structure. Central banks are the supporting components of the IMF. Both organizations work together to achieve global financial stability and security. A close collaborative relationship between the central bank and the IMF may result in an increase in the effectiveness and influence of their monetary policies beyond their borders. Developments in the global financial arena have shown the effectiveness of collaborative relationships between the central bank and the IMF in maintaining a stable economy in the member countries and the world. The harmonization of rational policies is often achieved through such collaborative relationships by the IMF and the central bank, which focus primarily on creating and maintaining exchange rates and interest rates. Therefore, the literature has also considered an interesting aspect of the contribution of this collaboration to global financial stability and exchange rate stability. The IMF has faced many challenges from its establishment to the present. Several reforms have been made to increase effectiveness in terms of

its functions to address global issues. Reforming finance is essential to integrate payments and manage risks due to the continuous growth of bank operations in larger segments of the financial market. Another striking development that has shifted the functions of central banks and financial institutions is the rapid growth in the market for international and domestic securities. This includes the emergence of a market-oriented schedule where the interest rate is primarily addressed through the market-controlled mechanism and limited transactions through the central bank. One of the challenges raised in global finance is the internationalization of the banking business, where central banks have been forced to think more internationally because most central banks can now focus on only one aspect of achieving macroeconomic objectives by concentrating first on the borders of the monetary economy. More concerning the environment of the limitations of the monetary borders presents a new feature in the field of financial policy that should be discussed further in research (Solti, 2024; de Urioste, 2023; Pittaluga et al., 2021).

2.3.1. Role and Functions

The provision of loans to member countries to help them overcome balance of payments problems is the IMF's main activity. The IMF's surveillance function As part of its financial assistance role, the IMF's surveillance function provides valuable information to aid the assessment of financial assistance requests by member countries. Capacity building and technical assistance The IMF provides technical assistance and helps in building capacities of countries in economic forecasting, financial sector regulatory capacity, central bank function, and fiscal and budgetary harmonization. Working with National Central Banks The IMF is increasingly working directly with the world's central banks, especially in lending and technical assistance roles, because many central banks can have shareholder equity and liquid assets similar to a commercial financial institution. Evolution of IMF strategies and functions The IMF's functions are indeed evolving over time in response to changing global economic conditions and economic policy approaches. The IMF provides financial assistance for member states facing a short-term current account deficit and lack of foreign exchange reserves; it provides financial assistance to help adjust payments deficits in a structured, coordinated manner (Bonna, 2021; Kara, 2023; Jost & Seitz, 2021; Stedman, 2022).

2.3.2. Relationship with Central Banks

While we may think of national central banks as the 'monetary trustees' of

a nation's trust assets, these NGOs are forming an exclusive club of the solvency elite. Central banks have two superlative comparative advantages in finance: to achieve domestic price stability and economic growth in the context of exchange rate stability. Wealth can increase through the prevention of increases in generalized prices. They can also print money as a very flexible and often perfect substitute for foreign exchange to maintain an equilibrium exchange rate (Egyir Biney, 2024; Ghosh & Gorsi, 2024; Consoli et al., 2022; Barnett et al., 2024).

These two goals are largely the same as the policy uses of the IMF, and their collaboration is significant. The Fund began helping countries reintroduce their own money and, in cooperation with national central banks, supported them in 'finding' their own international solvency through fiscal adjustment, financial sector reform, and debt equity reduction. Clearly, the IMF develops financial and macro projections according to its knowledge of national banking seigniorage and other endogenous economic variables, and the recoverability of bad loans (Wronka, 2023; Rojas et al., 2022; Matos et al.2025; Fisunoğlu & Akyüz, 2025).

Western central banks have a wider remit than those in ELDCs/EU candidates and face fewer constraints. The IMF is the central audit authority for global financial flows, and it must serve as the 'helping hand' in implementing almost universally agreed standards and codes that build a ladder balancing global 'innovative destruction.' But central banks have nightmares about exchange rate volatility and have the best opportunity to experiment, by sharing these concerns with the Fund, to arrest the volatility created by the subverted spirit of Bretton Woods: a lack of information, compliance, and assistance. This, along with NCB technical assistance, can work towards fulfilling countries' 'Soldiers for Stability': relatively independent central bankers pursuing inflation targeting and the avoidance of magnifying traders' 'moral hazard.' This informal CB-Fund club has been created through a 'Train the Trainers' Conference and a Memorandum of Agreement. Such bilateral relationships reverberate through the financial markets, particularly between the countries involved in EMS, not only making for a 'Super-DM' and 'Deutsch-Mark II,' but also implying currencies like the Euro, which can function as a global store of value for wholesale international trade and financial empires (Taskinsoy2022; Ullersma, 2021; Morell et al., 2022).

Nevertheless, this is not to belittle the superb knowledge made available by central banks of countries that are not (yet) central to its mandate, whereas these countries can only influence the management of the IMF insofar as they may determine the political legitimacy of the political and financial designers of the USA and European negotiated dominance of the IMF's top table. But the economic priorities and objectives of the large five IMF shareholders cannot be expected

(with the exception of the management of devaluation) to match those of the NCB central bank 'consultants,' each responsible for a launching and landing field of microeconomics threatened with money illusion. This helps explain why so few central banks have been called on as 'Switzerland' to devalue, and in peacetime at that. This knowledge is not used in the quarterly formulation of macroeconomic prognoses for each member country. However, some bilateral and/or regional collaborative relationships may occur informally, and additional research is required to test these hypotheses. Indeed, the experience on the loss of seigniorage in EU countries might be used to discuss the pros and cons of an optimal inflation rate (Wellink, 2023; Bowles and Dufour2024; Heilferty et al., 2024).

2.4. Independence of Central Banks

Independence of central banks consists of making monetary policy a political matter, free from pressures or election requirements, based on the assumption of the rationality of decision-makers and the availability of credible commitments, capable of pushing away the temptation of monetary financing from the policymaker. This evolution is also due to the shortcomings of the traditional reasons assigned to the administrative independence of central banks (Lim, 2021; Reinsberg et al.2021; Gabor, 2021).

The first is a separation of powers. The incapacitated policymaker, in return for the very large margin for maneuver that is recognized in his decision-making, has the possibility to move through the channels to implement the objectives assigned to him while, however, remaining in the estranged rotation that is unconstitutional from the central bank and damaging to the real sector of the economy. The second reason is instead the belief that the decision to alter the mid-term and long-term stabilization objectives of economic policy can only be the result of free will and conscience, and not physical fatigue. In the context of monetary policy, this means preventing the end of the mandate of the policymaker aligning; his mandate authorities, since he "qualifies for renewal" directly or indirectly. This trend, which is negatively influenced by rational calculus, is the main driver in justifying central bank independence. This independence, however, cannot be absolute and requires a mixture, or rather the potential for timely collaboration between the top of the central bank and the economics-financial ministries (Feld et al.2021; Heldt & Müller, 2022; Tuori, 2022).

2.4.1. Theoretical Foundations

Models such as the Barro-Gordon model and the time inconsistency problem leave little doubt about the importance of central bank independence. Follow-

ing the recession of the 1970s and persistent inflation, economists advanced their views on the desirability of separating monetary policy from the political process. The ability of monetary policy to anchor expectations and re-establish trust in monetary policy is another argument why some economists advocate giving the central bank autonomy to diminish inflationary pressures. Presenting skillfully the importance of enhancing the credibility given to monetary policy is the well-known statement that rules rather than discretion are the basis for monetary policy. Combined, credibility and reputation can create strong expectations that keep inflation and inflationary expectations anchored at low levels. These powerful demonstrations on the need for the central bank to have independence, covering various phases of time, have largely enveloped the academic and public sectors alike (Beaudry et al., 2022; Beaudry et al., 2023; Dabrowski; Michl & Rowthorn, 2024).

The idea that an autonomous central bank will keep prices stable will happen in an economy that is taken by the Barro-Gordon model. This is likely the area where central bank independence and price stability are most supported by the academic community. The optimal degree of independence is also related to economic characteristics. Within the policy-making committee, there might be a certain degree of tension between technical advice and democratic goals. If members are appointed by elected officials, they may feel an element of loyalty or may have been appointed because they argued the same lines; this is, however, unlikely due to the prominent presence of arguments supporting the consensus between joint and single appointments (Natsagdorj, 2023; Salsano, 2022; Karnowski & Rzońca, 2024; Broz, 2024).

2.4.2. Practical Implications

At the level of practical implications, if central bank independence is seen as important and is really a key factor in shaping the way in which monetary policy outcomes are obtained, it also becomes necessary to ensure their accountability towards democratic society while keeping their autonomy. With regard to the practical implications of central bank independence, from a theoretical perspective, evidence suggests that a higher degree fosters inflation control, though the effects on economic performance remain varied. Regarding transparency, it raises trust in the central bank and provides better control of the inflationary process. The countries of Central and Eastern Europe are examples of central banks that have a high degree of transparency. In England, the trend towards stronger control of the central bank's inflationary policy was initiated by the establishment of the Treasury Committee. Also, in some other highly developed

countries, the central bank operates under the control of a parliamentary committee. Maintaining control over some of the Federal Reserve states of the USA is done by the Board of Directors under the jurisdiction of Congress. In addition, indirect political intervention may have important effects in the context of the optimal rule of monetary policy. Increasing the money stock in order to lower the interest rate below its natural level allows a politician to force the central bank to promote excessive investment. In the long run, the economy would be subject to serious inflationary pressures (Aklin & Kern, 2021; Romelli, 2022; ElHodaiby & Elsamman, 2021).

2.5. Various Options Regarding the Changing Status of Central Banks from Country to Country

A country's economic, political, and historical background shapes the role of central banks. Central banks have diverse functions in history, reflecting differing monetary policy priorities and risks. Economically, there are some common features between central banks, such as holding gold reserves and converting currency into gold. However, in terms of governance, every country has unique practices. Depending on the various countries' financial, banking, and economic structures, the form and powers of the central banks have differed. Various countries have established central bank institutions, which reflect the changing roles, powers, assets, and liabilities of central banks. Also, the central banks have evolved in two basically different directions; some have gained operational independence, while others have been under the direct control of the government. Changing public perceptions of inflation and the growing debt of the states have allowed for discussions regarding independent central banks today. Unfortunately, there is no widely accepted yardstick to measure the degree of independence of central banks. Central banks in many countries have changed their place and role in parallel with global economic advancements in order to be effective in their primary objectives of price stability and exchange rate stability. Although their single or dual objectives and strategies have many common points, they have particular reasons attributable to the specific conditions of each country (Blinder et al., 2022; Brennecke et al., 2022; Hansen, 2022).

2.5.1. Case Studies

Since the Second World War, central banks have faced new challenges that pushed them to evolve quickly. In this section, we look at a number of cases to give a better sense of the ways in which central banks have changed. There have been varying degrees of transition, and the balance between government

and central bank has been determined by national political cultures. The extent of the transition has often turned on the ability to tie one's hands through legislative arrangements and the particular type of economic circumstances that countries have faced. The Six Scale Cases present a wide degree of independence and dependence based on their interest in achieving stable and low inflation with the least amount of cost for their specific country. The entrenched central bank institutions of Rogeria and Burria seem to indicate no ability to reform their central banks in the direction of the Noyer model, despite pronouncements to the contrary. The Drewers of the world have experimented with several models and may have low inflation, but broader measures of success are less clear. This population, which has a young labor force, has profited from skilled labor's feedback effects with the international marketplace. Similarly, Denmark is adapting by targeting performance in central banking slowly over time. The influence of international frameworks and discussions cannot be dismissed, especially with smaller economies and their role in any conversion that might happen in Argentov. However, just having a wide degree of vote independence alone does not trace a clear pattern. The type of economy also seems to matter: largely buffered economies are more likely to have independent central banks, while non-buffered economies tend to have dependent central banks (Wessels & Broeders, 2022; Céspedes and De, 2021; Diessner, 2024; Coimbra et al., 2022).

3. The Dollar as a Reserve Currency and the Petrodollar Connection

3.1. Historical Background of the Dollar as a Reserve Currency

The function of a world reserve currency is a historical development. At the Bretton Woods Conference held in the state of New Hampshire, it was decided that the US dollar's value would be 1/35 of an ounce of gold and that all signatory countries would need to keep that rate fixed against their currencies. So, the dollar was not only tied to gold, but it also became a "vehicle currency" which facilitated currency exchange. It was this institutional structure that gave birth to the reserve currency system. After a number of revisions, the Bretton Woods agreement was terminated by US President Richard Nixon on August 15, 1971, when he declared the country would unilaterally "suspend temporarily" the convertibility of the U.S. dollar to gold. As a result, the U.S. dollar became a "fiat currency" which is no longer backed by a tangible asset of any value (Ki, 2021; Selva, 2023; James; Butkiewicz & Ohlmacher, 2021).

Since the square one of the Bretton Woods agreement, the dollar depreciated to the extent that its value against gold after the Nixon Shock was only about

half of its value before the agreement. Nevertheless, post-Nixon diplomatic efforts by the United States produced an agreement with Saudi Arabia in 1973 to be paid only in U.S. dollars. In return, the U.S. agreed to provide Saudi Arabia with weapons and protection. This agreement marked the transition of the US dollar from a gold-backed currency to "petrodollar" - a new category of currency, a fiat currency which is backed either by oil or the idea that consumers in the international market will continue to buy oil priced in that currency. Since then, other members of the Organization of the Petroleum Exporting Countries (OPEC) followed suit and agreed to sell oil in U.S. dollars (Calvo; Bermant, 2023; Leber & Geyer, 2022; Abdel Aziz, 2023).

3.1.1. Bretton Woods System

The "Dollar as a Reserve Currency" suggests the economy's strong role and the use of the U.S. dollar in international finance. The origin of the U.S. dollar's status as a dominant currency within the framework of a non-gold standard worldwide system can be traced back to the Bretton Woods System established in 1944 by 44 nations. It enshrined the dollar as the cornerstone of the post-war world financial order. The dollar was defined in terms of gold, and other currencies were pegged to the dollar at rates that would keep the value of the dollar constant in terms of gold. The Bretton Woods System was meant as a substitute for the gold standard and a way of ensuring that gold did not part from the dollar (Yergin & Günsan, 2023; Akbulut, 2023).

How the Bretton Woods System worked: an economy with a current account surplus would have a surplus of its own currency's exchange reserves; an economy with a current account deficit would have a deficiency of its own currency's exchange reserves. Both adjustments, however, were made in a way that favored the surplus country. A financial transaction is essentially a swap of one form of reserves for another. A U.S. trade deficit, for example, would enable a West German importer to get access to U.S. dollars he would need in order to buy U.S. goods; the German would pay the West German Central Bank in Deutschmarks that it would then swap for U.S. dollars. The Bretton Woods exchange system, all these arrangements together ensured, functioned more or less smoothly, and ensured currency convertibility to gold at a fixed value of 35 U.S. dollars an ounce, which was the cornerstone of the system (YErgin & Günsan, 2023; Pinder, 2023; Eroğlu et al., 2025).

3.1.2. Nixon Shock and the End of the Gold Standard

In July 1944, having one of the most successful positions in terms of eco-

nomic geography and military power at that time, major powers of the advanced capitalist world – mainly the U.S. with supportive efforts of the U.K. – branded a blueprint in their initiated summer camps for the nations both sinking in the World War II damage and the following commercial rippling effects, so that they could rebuild their devastated properties and introduce a safe environment for the rejuvenation of commerce. Thus, a wide area economic strategy named the Monetary System was coined. According to the scheme, a particular gold standard was incepted to ensure a fixed exchange rate arrangement that was intended to establish a two-way harmony between the global context, namely concerning trade and money (Defraigne; Silva, 2024; Young, 2023).

The shock also put a definite end to the system. It went on to overturn the very essence of financial markets. It can be interesting to discern what lay behind this unprecedented event in economic history. The sustained dollars/gold drain put in crisis the entire edifice set for the convertibility to the U.S. dollar in fine gold. By the end of the sixties, the U.S. would have had to part with a significant portion of its gold treasure stored to enable the convertibility at the price of 35 U.S. dollars per ounce. Very far from figments of gold yellow fever that animates some gold specialists and hedge-fund gurus, the U.S. policymakers put the monetary machines in overdrive. The money printers were indeed red-hot to finance Lyndon Johnson's 'guns and butter' policy. Telling is the inflation reaching a ten-year high rate in Washington by 1969-1970. Interest rates were not responsive enough because of the dual and conflicting objectives sought of financing the war and the Great Society programs alike. In so doing, Washington wished to make the 'rest of the world' – mostly its mercantilist and inflation-phobic allies around the globe (Dąbrowski, 2021; Agarwal et al., 2022).

3.2. Characteristics of a Reserve Currency

Would it be nice to know beforehand if there is a need for an emergency brake in the world economy? It is possible, although demanding. In principle, the existence of such a mechanism would avert or mitigate the effects of currency and financial crises, which would no longer burst loudly and inconveniently and force the world economy to pay the costs. One of the elements of the plan to prevent crises is the choice of the world's currency, i.e., a reserve currency, which is to stabilize international relations and accelerate global economic recovery. This text is an attempt to determine what features a currency must have to perform this function and what the reserves of the monetary fund may consist of (Hillman et al., 2021; Staritz et al.2022; Fantacci & Gobbi; Huang, 2021).

The first step of the sovereign currency may be exercised in the current man-

agement, addressing the problem of international monetary reserves. Foreign currencies are not only the decision of individual countries but also of international organizations. They are carried out against the financial possibilities and the risks of reigning positions to hold foreign exchange reserves. In the case of foreign currencies, a systemic effect related to the international exchange rate system is determined using reserves. The reserves can include other items than just foreign exchange. Gold and a basket of currencies can be held in reserves. In the current monetary system, SDRs are an accounting unit used by some states. Members could hold or make transactions using Special Drawing Rights in reserve as a provisional step to a more effective reserve currency. In conclusion, we understand that there are reasons for calling the dollar the dominant or even the only one among the reserve currencies. However, the dollar may not remain the only dominant reserve currency; there may be correlates, such as the euro, and perhaps the yuan. Only less advanced and supported is the dollar's position, conditionally offering versions of its decline and end as a reserve currency. The above thoughts were the subject of consideration and discussion in order to indicate whether the dollar will remain a reserve currency for a long time and whether there will be other reserves of such a currency in the near future (Iancu et al.2022; Weiss, 2022; Chinn et al., 2024; Mirović & Petrović, 2023).

3.3. Benefits and Drawbacks of the Dollar as a Reserve Currency

Several benefits come with having one currency – the dollar, in the cases discussed here – that takes on an outsize role as a reserve currency. At the same time, certain downsides exist for the holders and for the provider of the international money. For international commercial entities, one often-cited benefit is the transaction cost of foreign exchange: if one can settle the deal in the dollar and no conversion of currencies is necessary, it is simply cheaper and more efficient in terms of time and resources. Secondly, the dollar is more liquid than any other foreign currency; if more are held as reserves, a country has more liquidity to deal with international financial deficiencies much more easily (Ranaldo & de Magistris, 2022; Murau et al., 2023; Olujobi, 2022; Herr & Nettekoven, 2021).

The advantage to the US, of course, is that holdings of dollars by many countries add to the value of the currency, thus making exports cheaper to foreign buyers. However, if banks were to hold fewer dollars – say for fear that the US might impose sanctions or for fear of dislocations in the financial markets caused by the phasing out of quantitative easing in the U.S., that could lead to a devaluation of the US currency. If the central bank had to resort to holding some

other currency in place of the dollar, such as a basket of coins suggested here in more than one place in the past – if they are indeed floating in the netherworld, they would be worth revisiting – any central bank could import inflation from abroad on the stock of reserves they might still have. Conversely, it could also have a net deflationary effect on them. It's a balance of probability, and the only thing I would state absolutely is that I don't know which way it would go. There are a lot of things we just don't know (Gourinchas, 2021; Arslanalp et al., 2022; Fantacci & Gobbi; Eichengreen et al., 2022).

3.4. The Role of the US Federal Reserve in Maintaining the Dollar's Reserve Status

The US Federal Reserve holds massive monetary policy space in reserve, which the assumptions below suggest stands supportive behind the USD's maintained reserve status. The Federal Reserve is charged with three different types of objectives: maximum sustainable employment, stable prices to foster a safe, sound, and efficient national economy, and moderate long-term interest rates. The Fed employs a variety of tools to promote money market liquidity and credit, such as the Federal Funds rate, discount rate, reserve requirements, and dollar swap lines with foreign central banks. The incentive is to integrate and share global financial market insights through direct and public communication from the Fed. In this fashion, international businesses, banks, and foreign governments are afforded confidence to use the dollar as a vehicle currency and to invest in US financial markets. One of the Fed's additional roles is that of lender of last resort, which it executes on behalf of troubled US banks and also for non-US regional central banks and foreign banks that have made a reciprocal USD liquidity-swap agreement with the Fed (Murau et al., 2023; Huang & Mayer, 2022; Eichacker, 2024).

The Fed cannot unilaterally control USD exchange rates because the central banks of over 200 sovereign floating-exchange rate currencies alter the currency rates to influence their domestic economic goals, which also dynamically undermine and lift the USD's status. The hypothesis is that striking relationships with other central banks can directly add a cover of safety and stability for the USD. Systemic residual cross-asset correlations and joint jumps surge during the latest turmoil, strongly inferring that previously unharmed federally insured depository institutions have begun transacting more and more in the unregulated parallel banking system. Choices relating to the principles of any central bank, especially in the US, are concerning to global investors with financial markets that can establish how value is transacted and recognized equally at a national

level as well as in international circuits (Bharat et al., 2024; Wansleben, 2024; Demir, 2022; Tsang & Chen, 2022).

3.5. The Petrodollar System

The petrodollar system is often mentioned in connection with the U.S. dollar's role as the dominant international currency. The link was created by an agreement between the United States and Saudi Arabia in the mid-1970s: the Saudis were to price most of their oil in dollars and invest the proceeds in the U.S. financial markets, particularly in U.S. government bonds. Most other oil-exporting countries agreed to price their oil in dollars as well. Oil is traded internationally and it is the most traded of all primary commodities. This has created substantial demand for the dollar across the oil-exporting countries as they hold most of their export revenues in the form of dollars. Traders also require dollars to buy oil, further increasing the dollar's demand. This petrodollar demand is one of the fundamental factors in underpinning the demand for the dollar to be held as a reserve currency by central banks (Razek & McQuinn, 2021; Hasanov & Razek, 2023; Kenner & Al-Ahmad, 2021; Gasim et al., 2023; Alabdulwahab, 2021).

In other words, the petrodollar system helped solidify international demand for the dollar by creating a recurring use for it: to buy oil. During the renegotiation of the U.S.-Saudi Arabian relationship during the presidential purges in the 1970s, the United States made the Saudis a suggestion to standardize prices in petroleum sales. As the world's largest oil exporter, the Saudis signed the petrodollar Internal Agreement with the United States Federal Reserve and thus became the holders of deficits in the global economy. The House of Saud thus signed an agreement in 1974 to standardize the price of oil in U.S. dollars. Thus, no country on the global market could buy or sell oil without first purchasing the United States' currency, after which only the interstate transaction in U.S. dollars is then translated to the sale or purchase of oil. The petrodollar system has its origins in the geopolitics of the 1970s, itself a result of economic upheaval caused by the oil crises. The system affected the foreign policy of the United States and underpinned support for the dollar. By creating constant demand for the dollar, the petrodollar system created large stimulus for the U.S. to issue the dollar as the international currency of choice. It also reduced the number of portfolios of forex traders outside the United States and thus led to an increase in the demand for the U.S. dollar, relative to others (Alsugair et al., 2023; Salman2024; Alhakbani, 2024; Griandana & Setiyono2024).

3.5.1. Definition and Origins

The definition. The term petrodollars refers to the profits from the sale of oil, particularly by OPEC nations in the 1970s. However, the petrodollar system or petrodollar recycling system has a broader meaning and contains a key political and economic implication. In 1971, the United States explicitly abandoned the partial convertibility of the dollar into gold, which led to the switch to inconvertible fiat currencies in international transactions. In exchange, the United States convinced Saudi Arabia, and then other oil-producing nations like Iran, to sell their abundant oil exclusively in dollars. This policy agreement granted the right to invest the received petrodollars only in U.S. securities. This policy position provided the U.S. with geopolitical security not to be dragged into that dollar-excessive inflation spiral (Soeder & Soeder2021; Misirli, 2023; McFarland & Colgan2023).

Origins. The petrodollar system was founded in the 1970s, when the United States decided to reverse an excessive outflow of capital from the past decade. After the oil blockade of 1973 and the subsequent two-shot increase of crude oil prices during 1979-1981, the OPEC nations, led by Saudi Arabia, began to accumulate a huge current account surplus, which was then re-exported by the United States. Saudi Arabia and the United States signed an agreement for oil sold by Saudi Petroleum Inc. to be paid not in U.S. dollars but in goods and services—provided they meet Saudi needs to build their hydrocarbon pipeline or the state purchase four refineries in a particular area. However, the United States managed to persuade the oil-producing nations to price oil exclusively in the U.S. dollar. In return, the United States would undertake measures to enhance the security of Saudi Arabia, which feared destruction in the 1973 war by Arab countries if they continued to support Israel. The deal would also avoid any excessive inflation in the United States due to the reversal of the official dollar price from the past decade (Haqeem & Zulkifli, 2022; Chuvakhina et al., 2022).

3.5.2. Key Players and Mechanisms

The key players in the petrodollar system are the major oil-exporting countries. Here, OPEC stands for the Organization of the Petroleum Exporting Countries. OPEC was founded in 1960 by five members. During the oil crisis in 1973, the list had grown to 13 members of a cartel of oil-exporting countries. By 2017, there were still 13 members, comprising in alphabetical order: 1. Algeria, 2. Angola, 3. Congo, 4. Ecuador, 5. Equatorial Guinea, 6. Gabon, 7. Iran, 8. Iraq, 9. Kuwait, 10. Libya, 11. Nigeria, 12. Saudi Arabia, 13. Venezuela. In 1950, the US became a net importer of oil. During the 1960s, the US and several Western

European countries negotiated deals with OPEC. The latter agreed to sell oil for US dollars only. Since then, the countries that wanted to buy oil had to provide dollars to the oil-exporting nations. Since the US imported large amounts of oil, the Western European countries followed this arrangement (Chuvakhina et al.,2021; Haqeem & Zulkifli, 2022; Tache, 2024).

The relevant players in the Euro-dollar market are the central banks and institutions in possession of dollar reserves. During the days of the Bretton Woods system, these counterparts of the Federal Reserve received the dollars simply by selling goods or services to the US. Nowadays, acquiring dollars involves the provision of oil or some other goods, securities, or assets. Thus, this legitimate transfer of dollars to the oil-exporting nations (and the Federal Reserve in those nations) is also legitimate for the oil-importing nations and central banks. By selling a commodity, the oil exporter earns some dollars by means of which the exporter can import other goods, pay off debts, or invest. At the same time, it is the usual behavior of a central bank to hold part of its reserves as very liquid reserve currency. Think of it as cash in your own portfolio. The part of the dollar reserves that is not used is put in bank accounts or invested. Likely, the dollar reserves are invested in, for example, financial investments like US Treasury Securities (Crawford, 2023; Selva2024; Niepmann & Schmidt-Eisenlohr, 2023).

3.6. The Impact of the Petrodollar System on Global Economy

The "petrodollar system" refers to the use of the dollar by oil exporters as the exclusive medium of exchange for crude oil transactions. Oil importers must buy U.S. dollars to purchase that oil, and, in some cases, they need to hold U.S. dollar reserves to guard against increases in oil prices or declines in their own currency. The oil producers then have to find a place to invest those dollars. That process, in turn, leads to an influx of dollars into the United States, which pushes up the value of the dollar and drives down U.S. interest rates. The petrodollar market is thus often cited as one of the reasons that the emergence of trade deficits did not cause the dollar to weaken or cause U.S. net foreign liabilities to explode (Noble, 2023; Enfu & Chunyi; Binder, 2022).

The impact has been significant. Each dollar saved by emerging markets in the form of increased reserves was a dollar invested in the United States. The combination of foreign government and foreign private investment has helped soften and moderate the effects on U.S. consumption and investment of the large trade-deficit financing. Oil-importing developed economies are at risk for negative capital flows if emerging market nations seek to convert at least some of these dollars to assets denominated in other currencies. However, the

long-term stability of the petrodollar system is highly controversial. In the first place, most of the modern world is less, or only in limited need for oil, particularly that obtained in American dollars. In the second place, it suggests that the world as a whole, or even oil-exporting nations, is invested in the global status quo rather than the substitution of renewable energy sources. However, in the short and medium term, small and mid-sized nations will change their attention from their own interests to market volatility and public disorder globally. It was concluded that it was possible, despite uncertainty, that the emphasis on renewable energy sources at the bottom of a recession would provide economic stimulus (Misirli, 2023; Wagdi et al., 2023).

3.7. Challenges and Criticisms of the Petrodollar System

There are some weaknesses in the arguments discussed above. It is acknowledged that when a large number of countries are affected by the same economic shocks, no one has an interest in "cheating" or taking advantage of gains. Still, one may argue that the petrodollar system is inherently fragile and unstable. The heavily energy-dependent countries in Europe and Asia can potentially be disproportionately affected by any crisis in the oil market. The major oil-importing nations can be seriously affected, not only because of the higher import bills but also because the psychological effects of a sudden rise in the oil import bills trigger a wave of panic in the stock markets, thus increasing the rate of interest. The negative impact of a dramatic fall in the stock markets on the real economy therefore amplifies the economic weakness of the affected countries. The countries that have "exported" the economic crisis then suffer a reduction in the price of their exports due to shrinking global demand (Gökay, 2021; Kruyshaar, 2022).

Another important issue is the critique of the petrodollar system on the grounds of ethics and global governance. The petrodollar system has been perceived as a source of inequity, since the production of oil is heavily concentrated in a few countries of the world and most countries in the world depend on oil imports. The subsequent growth of the market power of the oil-exporting countries is usually perceived as an attempt to bypass the rules of the multilateral trading system. The increasing acceptance of the system in the international arena can potentially act as another barrier to major reforms in the existing institutions of global economic governance. Moreover, the current drive toward a low-carbon economy and the development of renewable energy sources are seriously undermining the importance of oil in the future. This trend could pave the way for a decline of both "dollar power" and the petrodollar system (Bibow, 2024; Palley, 2024; Misirli, 2023).

3.8. Geopolitical Implications of the Dollar's Reserve Currency Status

The U.S. dollar is the world's major reserve currency, which has fundamental implications for the global balance of power. This confers not only geopolitical significance but also geopolitical power on the United States. This reserve currency status aids the United States in influencing international economic regulations and standardizing its own economic policies as international norms. The world's most utilized reserve currency or common trade currency status also gives the U.S. significant leverage in trade and diplomacy by reducing transaction costs and raising other currencies. Creditor countries gain a corresponding power advantage over debtor nations due to their increased hold over the significant reserve currency. While it is harder for non-creditor debtor countries to employ united leverage over the reserve currency, it decreases the net geopolitical benefits (Weiss, 2022; Kocaarslan, 2021; Arslanalp et al., 2022; Engel & Wu, 2023).

In practice, countries in economic difficulties cannot use them to gain enough coercive power in international negotiations, either because they have violated the norms of the debt market or they are unable to hold more such holding percentage. The reserve currency also complicates the domestic foreign exchange policy of surplus countries by driving the price of the reserve currency upward, as these countries continuously purchase reserve currency. Although a loss in popularity would affect the United States as a broader geopolitical currency issue and the dollar enjoys persistent and clear predominance, the global trust and usage of other foreign currencies is dwarfed. Events, such as concerns about dollar inflation pressured by an unusual deficit or the global market liquidity, are tracked for geopolitical curiosity (Elson, 2021; Hussein & Farahat, 2024).

3.9. Alternatives to the Dollar as a Reserve Currency

Several alternatives to the dollar as a reserve currency exist, at least in principle. One alternative often mentioned is the euro. The euro has become increasingly important in the last couple of decades and has indeed been widely used as a reserve and investment currency. However, which currency, if any, can play this role in the future is an open question. Currencies like the euro and the yen do not have the same global standing, lifestyle effects, or power as the US economy as a whole. Additionally, if there are two alternatives, the dollar and, say, the euro, whether and how these can complement or substitute for one another or whether they will change the fundamental power balance is also an open question (Arslanalp et al.,2022; Iancu et al., 2022; Aysan & Kayani, 2022).

The euro has also been integrated into the global monetary system somewhat indirectly because, unlike the dollar and more so than sterling, some central bank reserves have been euro denominated. Several countries not in the Economic and Monetary Union have used the euro in their exchange-rate policies, sometimes more implicitly than explicitly. It is not at all clear whether this could evolve into a directly held reserve-currency role. The desire of many EMU members to establish more power through common or higher services and more cohesion in the Eurozone entirely without the US and OPEC is also a factor for more assertive international policy. There is a clear desire of the US to play internationally in the role of the dollar and of OPEC as a whole. This is related to the market for a lot of things, not just for oil and for the health of the US economy as a whole. The closer this objective is to being successful, the more successful the euro's effort to become a reserve system. Of course, it is subject to the full establishment of the euro as the premier reserve currency (Novak et al.2022; Bürgisser & Di2023; Meier et al., 2021; Bambacht & Pouwelse, 2022; Aghahosseini et al, .2023).

3.9.1. The Rise of the Euro

Since its inception as a virtual currency in 1999 and its introduction as banknotes and coins in 2002, the euro contributed to the reinvigoration of Europe. The changes, however, took place in an economic environment that was more conducive to the rise of the euro than that of the ECU, the antecedent European currency. Over the past half century, Western Europe undertook a series of progressive steps toward regional economic integration and coordination. In their efforts to create a common market for goods, services, capital, and labor, Eurozone policymakers adopted a number of legislative measures to harmonize their economic policies. They also took steps toward making their economies more competitive and strengthened the defense of the union against internal and external economic shocks (Andry, 2022; Butorina & Borko, 2022; Harrison, 2024; Niemczyk et al., 2022).

The Economic and Monetary Union has proceeded along two dimensions: economic integration among union members and establishment of a single currency. They have been accompanied by the willingness of the 19 European Union member countries to surrender the prerogative of their national banks in favor of the European Central Bank, whose primary aim is price stability. Early on, a high level of acceptance of euro-denominated book entries was observed. The unfolding process of introducing euro banknotes and coins saw an increase in the euro's share in official foreign exchange reserves and a

decline in the share held in US dollars. Central banks around the world are gradually adding euros to their reserves, and current account imbalances between the US and the rest of the world are seen as detriments to the dollar's stability. As the European Central Bank's foreign exchange reserves grow, however, the euro's claims to the status of global currency are becoming more prominent (Arslanalp et al., 2022; Bogdan & Lomakovych, 2021; Wang et al., 2023; Sugahara et al., 2023).

3.9.2. The Chinese Yuan as an Emerging Reserve Currency

China's outstanding performance in the past decades has been driving the yuan's internationalization. China's GDP has already surpassed that of the United States. The Chinese authorities have been ambitious in expressing their intentions to have the yuan play a more important role in the international financial landscape. Their policies adopted in the past few years include the Belt and Road Initiative, but most importantly, the recent opening of the Shanghai-based international petroleum exchange, which prices oil in renminbi, thus promoting the use of the yuan in the global oil trade (Yuan & Yang, 2023; Aksenov et al., 2023; Ballantyne, 2021; Akbulut, 2023).

These ambitious moves might, of course, end up being more of a pyrrhic victory and burden the country with more foreign liabilities issued in its own currency. However, if successful, opening an oil futures market in China will certainly facilitate the country's wish to have the yuan as a vehicle currency. Finally, the Executive Board of the International Monetary Fund proceeded with the addition of the fifth currency, the renminbi. The rise of the yuan as a reserve currency is, however, not without challenges. First and foremost, the capital controls and the general lack of transparency in the Chinese financial system make it very hard for voters to trust the value of the Chinese currency. To become international – and especially a reserve – money, a currency has to have deep and transparent financial markets. Neither is the case in China. However, if China were to pursue the removal of these controls, we would also see an abrupt change in two of China's most cherished strategies. First, the country is using the strict management of capital inflows to keep pressure off its currency (Aysan & Kayani, 2022; Kshetri, 2023; Zhang et al., 2024; Arslanalp et al, .2022).

Finally, the use of the yuan in world trade will have two direct effects. First, it will weaken the dollar, as it will be used more rarely in foreign exchange transactions. The USD will progressively become a UK-like currency, which is mainly used in euro conversion. Second, the use of the yuan will make it more volatile. It will be hard for the People's Bank of China to manage its value relative to a

basket of foreign currencies. The monetary powers of China will then become more limited, and they will most likely have an effect in the already unbalanced world (Flamencourt, 2024; Moiseeva, 2023; Pettifor, 2021).

3.10. Future Prospects and Trends in the Global Reserve Currency Landscape

As stated earlier, the decline of the dollar's dominance has been predicted several times in the past, and in most of those cases, it has not come to fruition. The current dollar hegemony and the petrodollar connection are also likely to play out for several years to come, even if they weaken in the medium term. Nonetheless, since at least 2018, there seems to be an increasing, albeit still small, number of economists, policy experts, and government officials who see the continuation of the dollar, US SWIFT, US-backed international financial institutions, and the dollar payment system nexus or similar mechanisms as ineffective in the context of bringing the desired geopolitical outcomes. This nurtures the possibility of decoupling from the dollar, the threat of alternatives to the dollar, and even the future of the dollar as a dominant global reserve currency (Radic et al., 2022; Cullen, 2022; Rochon, 2022; Kuehnlenz et al., 2023).

The architecture of the global reserve currency system will be shaped by a great number of aspects. In a future scenario, a digital renminbi with convertibility and a stable coin with built-in convertibility might represent viable alternatives to the dollar, given that the renminbi is the strongest contender to replace the dollar as the world's leading reserve currency. Additionally, cross-border digital currencies offer solutions to several dollar liquidity and US payment system challenges, provide new routes for bypassing global sanctions, and offer the US dollar an additional challenge by Russia, the world's largest oil exporter. The timeframe needed for the transition to a world running on renewable energy and removing fossil fuels from international oil markets does not bode well for the dollar's future since the global monetary system will have to adjust to the energy system. Nevertheless, the euro, and to an even greater extent the renminbi, will also have to contend with their own weaknesses, specifically related to existing and developing economic challenges in their countries and the failures of some of their institutions. Overall, the world is entering a period of heightened currency and macroeconomic uncertainty, which requires the use of alternative scenarios and readiness for a scenario where the dollar is no longer the top global reserve currency in place (Kamin & Sobel, 2024; Ilyinsky and Magamedov, 2023; Nasution & Simatupang, 2024).

4.Inflation and Deflation of Money, Economic Crises in History, and the Great Depression of 1929

4.1. Introduction to Inflation and Deflation of Money

Inflation and deflation of money, even though they are not new concepts, are one of the most important subjects in the theoretical and practical fields of economic science. This is because in the markets, where money value changes continuously, the foundations of economies, as well as the purchasing power of consumers, change continuously. At the same time, an understanding of how to control monetary flows and economic balances is necessary in order to exploit substantial resources that would promote monetary amounts in the production of money economies. Also, when an economy is examined over time, the appearance of one of these two possibilities will evoke a large number of problems that encourage the economy to be categorized. Furthermore, by taking the relationship between the two scenarios, the process that takes place is as realistic and historical as possible, depending on the adverse and positive conditions that may arise in the economies, as the concrete historical dynamics are revealed throughout the history of the great crises. This will also create a dimension to be connected with the Great Depression of 1929, when certain comments are going to be developed within the scope of this work. Although it has a certain size and duration, these crises and the actions taken as a remedy can be read as a harbinger of a periodic measurement and preparation for possible crisis situations (Matés-Barco, 2023; Onoriode & Faghawari, 2023; Allayarov, 2024).

4.2. The Concept of Inflation

The word 'inflation' stands for the undue expansion in the supplies of money, i.e., the replacement of a country's currency with an oversupply of bank notes. In other words, inflation occurs when too much money is chasing the number of goods in the market. Incomes are likely to rise under such a situation, but because this rise usually lags behind the rise in prices, purchasing power tends to decline during inflation. Inflation involves a decline in the purchasing power of money, meaning less can be bought. It is a situation where the value of money is falling, causing people to worry, lose faith, and interest in money. Inflation is a disease that can only be controlled when the causes responsible for it are identified (Yanescha, 2022; Jain et al.2022; Wahyudin, 2024; Jacob et al., 2021).

An increase in aggregate demand results in the pulling up of prices. Inflation is an expansion of aggregate money supply or a rise in expenditure to a level beyond which is covered by output at stable prices. Cost-push causes inflation if firms pass on to consumers the cost-push effects of rising wages. This is most

likely to happen if prevailing year-on-year inflation figures on prices convince workers that wages should be revised upwards. There are, thus, different types of inflation. According to the rate of price increases, inflation is usually classified as creeping, walking, running, or hyperinflation. Inflation is referred to as creeping if the rate of increase in prices is less than 2% per annum. It is referred to as jogging or walking when the rate of inflation is between 3% and 14% per annum. Inflation is known as running inflation if the price level increases at the rate of 15% to 20% per annum. Hyperinflation is an extreme level of inflation and is usually measured between 50% and 100% per annum (Singh, 2022; Madurapperuma, 2023; Olusola et al., 2022; Jain et al., 2022).

4.2.1. Causes of Inflation

The causes of inflation are varied and, for the most part, beyond the control of any single economic agent. Some inflation drivers are external, caused, for example, by a political event, while others are caused by a set of economic policies or government interventions. The average consumer assumes that the main cause of inflation is an increase in demand. This is a somewhat abstract idea; demand is a collection of statistical averages. In reality, a number of factors can collide to create a period of inflation. First and foremost of these is the "too much money chasing too few goods" syndrome. This is the concept of what inflation is at its roots. More money chasing fewer goods causes prices to rise. No single factor can be blamed, and some work to slow the rate of inflation. For example, the cost of a production run rising will usually slow the process down. However, other events can cause the cost of the production run to fall; these are inflationary in nature. Common events that can cause a production run to rise in price include: (Dekimpe & van Heerde, 2023; Siddiqui; Simon & Echter, 2023).

- an increased demand for a product internally. A cut in taxes in the next budget, combined with a reduction in interest rates, puts more money in the pockets of the consumer. Fiscal policy may have restricted demand for certain items also; in any event, it is assumed that one of the first effects of increased consumer disposable income is a growing demand for expensive consumer durables. - wage increases, in a wage-push inflationary spiral, may have to be agreed to prevent strikes. - the cost of imported and, increasingly for the UK, raw materials may have risen. Geopolitical events often prompt an immediate rise in commodity prices. - these increases may be combined with a short-term increase in debtor funding. - supply-side problems. In the 1970s, OPEC conspired to raise the price of oil significantly. This greatly increased the import bill

and exacerbated an inflation turnover. More recently, natural disasters have had a similar temporary effect (Auffant, 2022; Andreasyan, 2022; upon Oil, 2022; Patidar et al., 2024).

4.2.2. Types of Inflation

Inflation can be indexed by the rate of price increases. In connection with the cause, inflation consists of various types. The following are the types of inflation based on the cause: 1. Creeping inflation is inflation with a slight price increase over certain periods. Creeping inflation is also called frictional inflation or walking inflation. The phenomenon of creeping inflation is caused by an increase in efficiency or production and population. The prices of staple goods are increasing, while the prices of comfort goods are decreasing. 2. Hyperinflation is also called runaway inflation. This phenomenon can be determined if the inflation rate exceeds 50% per month or follows a surge of 12,875% per month. An example of a country that experienced hyperinflation is Hungary in 1946, where inflation reached 194.6% per month. The increase in paper money does not occur evenly due to intervention and the issuance of excessive paper money. 3. Structural inflation is caused by changing trends in production costs, demand patterns, and changes in the way of life of the public. The resulting phenomenon is that the prices of production materials have also increased, so this inflation can also be said to be the source. A notable example of a country experiencing structural inflation is the United States. In the 1970s, the inflation rate increased up to 50%, and the price of crude oil also jumped, which is referred to as the oil shock. Such a change in the pattern of user behavior led to an increase in the prices of basic materials during production (Nelson, 2022; Ha et al., 2022; Reisenbichler & Wiedemann2022; Ha et al., 2023).

4.3. The Concept of Deflation

Positive inflation is an increase in the general price level of goods and services, and the opposite of this increase is called deflation. In other words, deflation is a decrease in the general price level of goods and services. In a deflation, money will gain value, so the purchasing power of money will increase, and the value of money in hand will increase. This sharp increase in the value of money in hand results from a decrease in the amount of currency in circulation. In short, both economic slowdown and reduced spending will result in a decrease in general prices in the economy (Blanchflower & Bryson, 2023; Braun & Ikeda, 2022).

Deflation should not be confused with disinflation, although it sounds similar. Disinflation is the decrease in the rate of growth of the general price level

of goods and services. In other words, the opposite of this is the decrease in the rate of growth of the price increase. The lessons learned show that in order to reach a healthier and more stable economic growth, it will be more beneficial to be in low inflation rather than deflation in the long term. Factors such as a sharp decline in consumer spending, an increase in the balance between production and demand, or a loss of value in currency due to anticipation of economic developments can create conditions for deflation to occur. Deflation reduces economic activities, leads to recession, and can increase existing financial problems. Another reason for the decrease in general prices may be the decreasing production costs due to the increased efficiency in production. People who go through such a situation are expected to reduce their spending on the assumption that prices will fall further in the coming times (Barua, 2021; Sicsú et al.2021; Guttmann & Guttmann2022; Blanchflower & Bryson, 2023).

4.3.1. Causes of Deflation

What causes deflation is still debatable. The complexity of the answer is shown in analyzing Business Cycle Theory. The case commonly referred to is balance sheet caused deflation. Because of that, stressing one side of the argument will result in errors in policy recommendations. However, it can be estimated. Of course, it is determined by the situation. It was estimated that deflation in 2016 was caused by a lack of effective demand (Teixeira & Petrini, 2023; Pasimeni, 2022; Kolodko, 2021; Dudiak et al., 2021).

There are many reasons for the lack of effective demand. Causes of the decline in demand include a lack of consumer confidence. The reality of the economy that has not been completed is another rational explanation. It is common sense that investing more in state-owned companies in inefficient infrastructure projects means something is wrong in the economy. Speculative investors have started to hold back. Furthermore, it is not rare for advanced productivity to result in oversupply. How else can it explain that the oil supply is not balanced with the demand, causing the price to drop very far below production costs? Another reason is the deterioration in terms of trade. If our goods are not exported because interest rates are very high, it is likely that there will be overproduced goods. Moreover, the price war could lead to a situation where prices fall, resulting in deflation. The cases show that deflation is not simply due to a decrease in the money supply. Global economic conditions also result in an increase in the development of technology and very rapid global industrialization. Another factor is the recession in the world that makes business slow and unattractive for investors. Additionally, as seen in various crises,

the deflationary process can occur when import prices drop due to cheap raw materials and goods and services. Deflation can occur due to the decline in aggregate demand, one of which is the decrease in consumer spending (Olusola et al., 2022; Shapiro; Sheremirov, 2021).

4.3.2. Effects of Deflation

Deflation also affects the makeup of the economic structure. In an economy with falling prices, individuals may begin to defer purchases as they anticipate still lower prices in the future. This can result in reduced demand for a seller's stock of wealth, which will result in part in reduced production and a shortfall in revenue. This can cause businessmen to reduce inventories and reduce production, thereby generating layoffs and reduced wages. This, in turn, can further lower demand as earners seek to keep even thinner reserves, thereby increasing the force of deflation. Because of the social and natural factors associated with business activities, declining sales revenues and production can slow economic growth, which would fall below the level at which the economy is capable of full employment. Not only can the longer-term effects of deflation result in lower standards of living and possibly recession or slow growth, but economists and policymakers are beginning to explore the effects of deflation on debt. With falling prices, the relative burden of debt increases. This can result in erosion of savings and could critically damage many financial institutions. Financial and fiscal policymakers should be very concerned about the implications of deflation if it is prolonged (Webb, 2022; Rajeev, 2023; Demary & Hüther, 2021; Bagus & Ferlito, 2022).

Deflation can erode savings because real interest rates can rise. If nominal interest rates do not change, but prices decline, then the real interest rate would increase. For instance, if a person invests in a bank account with a nominal interest rate of 3 percent, but the price level is falling by 4 percent, then the real rate of return is 7 percent. In such a period, many might seek alternative forms of investment that offer more security than those at risk in the stock market. This can result in financial instability. Socially, the situation is potentially unstable. Actual deflation in the twentieth century occurred in many countries around the turn of the century and in the 1920s. High debt levels, decreases in the money supply, panic selling on stock markets, and production dropping while unemployment rates soared were products of the deflation and depression that took place. Japan ran into these problems in the 1990s and was still diligently fighting the situation in early 2002 (Glasner & Glasner2021; Tsiflikidou & Metaxas, 2023; Feygin, 2021; Fernandes, 2021; Diebold, 2024).

4.4. Relationship Between Inflation and Deflation

Inflation does not run unidirectionally in the economic cycle. It shrinks by pulling the brake when money, purchasing power, and their sources decrease—that is, in a deflationary period. First, rapid inflation decelerates, and then the brake opens enormously and long-term. Unlike the central banks of industrialized countries, the marginal cost and the momentum of inflation were missing as new, strong brakes. Hence, the new mainstream tells debtors not to worry about inflationary expectations. In deflation, inflationary expectations are dangerous and reverse the engine. When this fundamental change towards deflation comes, it is proved by monetary, credit circulation, and velocity movements (Sonustun & Bildirici, 2024; Sisay et al., 2022; Islam & Ahmed, 2023; Muhammad, 2023; Özyılmaz, 2022).

These dynamics have a different logic from the current short-term and conjunctural effects related to, for instance, whether the initial rate of change in prices in a product could be turned into a decreasing recession with the appeal of further decrease negotiations dependent on demand. The alternation of inflation and deflation retains the amplitude during a period of prosperity, summarizing the major economic crises of the profits and business life of capitalism. This already symbolizes a common reality, not of being engulfed by the same monetary identity, but of the profound conjuncture of credit-based supply and demand in both inflation and deflation from two ends. Changes of paradigm in the general laws of production and money circulation impinge upon structural renewal, i.e., recovery in increased profits for circulation and industrial investments in accordance with the new conditions of technical progress. Challenging the emergence of the present situation does not amount to demonstrating the correctness of cycles (Cazan, 2021; Cencini & Rossi, 2023; Tiejun, 2021; Cossiga, 2022).

4.5. Economic Crises in History

Economic crises are not a new phenomenon. They have accompanied people throughout history from ancient times to the present day. Historically, most crises were related to inflation or deflation of money, which could be eaten away by hyperinflation from day to day, or, conversely, become scarce, resulting in a monetary famine. The so-called market economy, developed in Great Britain in the second half of the 18th century, led at the turn of the 18th and 19th centuries to a series of banking panics and crises caused by ill-considered economic policies initially regulating the exchange rate of the pound to the precious metal. At the end of the 19th and at the beginning of the 20th century, speculative bubble

crises and stock market crashes were more frequent. In the 20th century, there were a number of economic crises. Strategists define these as systemic failures or a significant slowdown in economic activity and production, accompanied by large-scale unemployment and social breakdown, lower consumption rates, bankrupt companies, the collapse of financial institutions, and from the macroeconomic perspective, an overly significant budget deficit. Society has etched a few types of crises into collective memory. Some of them are not on present-day agendas because they have faded into the mists of time. People remember the Great Depression of 1929, and in Europe especially the German hyperinflation, which lasted from 1921 until 1924. The aforementioned crises were the result of the policy mistakes of their times or the weak or bad financial policies of the concerned institutions. The human and material costs of the Great Depression were dramatic, and as a result, economists began to think about a systemic way of crisis periodically, over and over in modern capitalism. After a few years, possibly after the so-called "Great Recession" in 2008 with too much debt and deficit spending, economic crises are back on the radar (Mazumder & Wood, 2021; Matés-Barco, 2023; Wang, 2022).

4.5.1. Overview of Major Economic Crises

Economic Crises Financial and economic crises are events of regular occurrence in the history of the capitalist world economy. One of the reasons argued for the occurrence of crises is the inflation and deflation of money. Modern capitalism has experienced several major crises that resulted in significant slowdowns and depressions since the late 19th century. These include the Great Depression of 1929, the oil price shock of 1973, the oil crisis of 1979, the stock market crash of 1987, the currency crisis of 1994, the East Asian financial crisis of 1997, the dot-com bubble of 2000, and the global financial crisis of 2007-2008, which resulted in a severe recession and worldwide reduction in production. All these crises were due to rising prices that caused inflation. Inflation itself is formed due to a surplus of money that is printed continuously and nothing backs its value. These crises were long in the making and far-reaching in effect. They lasted years and have changed the industrial structure of many countries considerably. The Asian crisis resembles in several respects the 19th-century South American crises. Japan's recent twenty-year recession bears some similarity to the United States' long recession in the 1930s. Nevertheless, the economic developments of the 1990s and the first decade of the 2000s differ from those of the 1920s-1930s in that the whole world underwent a remarkable depression after the macroeconomic fluctuations. In this sense, the economic situation of

the world after this decade is similar to that of the interwar years. Both interwar years and the recent years of the 1990s and this decade recorded severe recessions (Wallerstein, 2023; Spash, 2021; Blumler & Coleman, 2021).

4.6. The Great Depression of 1929

The Great Depression of 1929 was the most severe economic crisis of the 20th century. It lasted 10 years, from autumn 1929 to autumn 1939, although various countries experienced downturns for shorter periods because they started later. It changed the way of modern economic thought and the manner of regulation and economic policy. The depression began on October 24, 1929, with a sudden and catastrophic stock market crash. Share prices collapsed because of widespread speculative investment practices of that time, called margin purchases, where investors would borrow up to 90% of the purchase price of shares. This increased the sale of shares to pay rising interest rates against loans, causing the prices to fall. The direct consequence of the stock market collapse was the collapse of a number of US banks (Matés-Barco, 2023; De Bonis et al., 2023; Sultoni, 2024; Popescu-Cruceanu, 2023).

The consequences of the Great Depression were alarming. Production declined, and industrial overcapacity developed. Almost four-fifths of the total labor force were in non-agricultural work. People lost their jobs in thousands; as a result, total gross national product fell by almost 40 percent. The main reason for such a long and deep crisis was the bad lending and the inflow of short-term and speculative international capital, used mostly for lending. These inflows of capital increased credit, overbuilding of industrial capacity, and slowing growth in a series of industries and energy sources. These policies culminated in a major stock market boom, but several industries, like coal, cotton, cars, and construction began to decline. The Great Depression was not caused by a single event, but by a set of factors including populist government policies in the 1920s, the displacement of workers from family farms, consumer debts and low cost of credit, high levels of credit and debt, international trade imbalances, economic imperialism within countries, stock market speculation, the collapse of several banks, and a number of natural disasters (Hartman et al., 2022; Henseler et al., 2022; Malahayati et al., 2021).

4.6.1. Causes of the Great Depression

It is generally considered today that the events related to the Great Depression of 1929 and the development of the depression that ensued were caused more by human ineptitude than by powerful economic forces that matured for

years and eventually came to the surface at the end of 1929. The Great Depression of 1929 is a very serious historical phenomenon. In Austria, the depression was accompanied by torrential unemployment; in Germany, a similar trend was followed by the final transfer. The depression of 1929 is not comparable to any depression of the past century, which is why it has been named "modern times" depression. This name was chosen because the world has never before experienced such an economic earthquake brought to the level reached by world trade during the 1920s, when the price level remained at a high rate; neither has any further depression been worldwide (Sklias et al., 2021; Mazzucchelli; Cortes et al., 2022).

The Great Depression began in the United States, but it soon crossed the Atlantic Ocean and made a significant number of European countries suffer the same fate, thus generating a global economic phenomenon. The causes of this unique international and modern depression differ greatly from country to country, since the so-called recessions that resulted from the main depression of 1929 were multifactorial and various. In the United States, the year 1929 was a year of recording an absurd level of speculation, the level of unconsolidated securities having reached the remarkable figure of 90 billion dollars, exceeding even the value of all state bonds issued by the authorities up to that time. In the summer of 1929, many American banks began to be affected for the first time by the fact that they were obliged to take shares in payment for the loans made to various consumers (Candila et al., 2021; Moreira & Hick, 2021; Seyler et al., 2021; Gavriluță et al., 2022).

4.6.2. Impact of the Great Depression

One result of the Great Depression was the unprecedented degree of unemployment. There have been three major periods of depression in the 200 years between 1750 and 1950: 1820 to 1850, 1873 to 1896, and 1929 to 1937. The earlier depressions involved significant unemployment, varying between about 5% and 15% of the labor force; the average for the entire one hundred thirty years between 1860 and 1989 was about 8.5%. The most recent depression in the U.S., which was concurrent with the Great Depression, had unemployment levels of one-third of the labor force when the Armed Services inducted about 13.5 million men into the Armed Forces for full employment. The average for the entire decade of the 1930s was about 25% (Ravenelle & Knoble2023; Selgin, 2021; Antipova, 2021).

Many people were in far worse economic condition than the jobless because labor union contracts forced businesses to keep the employed labor force on the

job at higher than market wages. These people were not counted as unemployed. The United States was not unique in this condition. Other developed countries experienced depressions separately but seemingly coincidentally with the U.S. It is clear from these occurrences that events that impact the economy are capable of worldwide economic consequences through trade flows and competitive production, and that the world of 1900 to 1950, when Great Depression conditions will be the dominant reference for economic policy, is in notable respects similar to the contemporary world in the late twentieth century (Poole et al., 2022; Maier et al., 2021; Togashi & Kottler, 2021; Twenge, 2023).

4.7. Comparative Analysis of Economic Crises

All the described crises, from the buccaneer attacks in England of the 1650s to our latest economic disaster, have some marked similarities to each other. This similarity is connected mainly with their root causes and the ways they were resolved. Thus, all the panics and crises took place because of some factors that drove the demand for money down and reduced the real value of totals. As a consequence, there was a significant seller's loss and a far-reaching breakdown of enterprises and banks. There was the same main symptom of resolution: government and/or governmental units took loans and started to implement some large-scale programs, such as war, development of infrastructure, or military revival. On the other hand, the crises differ by their special traits. Thus, for example, the Great Depression of 1929 was characterized by the deflation of money and a huge unemployment rate. The 2008 crisis is notable for the fact that it was also a debt crisis (Sklias et al., 2021; Cortes et al., 2022; Glasner & Glasner2021; Matés-Barco, 2023).

A comparative analysis of these crises allows us to draw a conclusion: any economic downturn, no matter what the reasons are, always goes along with the deflation of money. If governments fail to cope with the deflation, especially by sudden and deep improvement of their monetary policy, a recession grows into a crisis and, when budgets are balanced, it transitions into depression. Such a conclusion could be highly useful for modern governments, as it would allow them to make prudent monetary policy. In the USA and the British Empire there was a distinct loss of confidence in the economy in only 2% of all the years of the 19th century as a whole. It is hard to give a fact-based assessment of the loss of confidence in the recent past, yet we have grounds to suppose it did not exceed 3-6%. Such an estimation gives us a basis for drawing some preliminary conclusions. It would not be entirely correct to generalize from history, as it is possible and even likely that other factors unique to the 20th century came

into play in shaping the government's economic policies and people's mindsets. Nonetheless, the fact that governments emerged from the crises mostly resolved proves that confidence between the public and the government is a key element in drawing a modern economy out of a potential depression. The relationship of the people towards governments is not the only thing that might have changed, though. The organization of labor and management can and did develop, and this is just one fundamental change in the everyday economy (Khudaykulova et al., 2022; Ellman, 2023; Haffert et al., 2021; Rostagno et al., 2021).

5.Exploring the History and Evolution of Cryptocurrency

5.1.Historical Overview of Cryptocurrency

The mastermind of Bitcoin is a pseudonymous figure named Satoshi Nakamoto. According to Nakamoto, it's a collection of innovations stretching back to the 1970s, and predecessors like a computer scientist who in the 1990s developed a virtual currency called Bit Gold. Nakamoto implemented the Bitcoin concept and created the first blockchain in 2009. But the concept of the blockchain is considerably older, as Nakamoto himself acknowledged. "Chains of hash-based proof of work service" was first described in 1991, and the idea of a linked chain of timestamped blocks as a solution to a Byzantine fault-tolerant suggesting process was first described in 1982. Blockchain technologies worked on a distributed ledger providing system, while Bitcoin worked on an electronic cashless payment system. Blockchain technology has become a phenomenon worldwide (Steinmetz, 2023; Platt et al., 2021; Wartoyo & Haerisma, 2022).

The innovations aren't limited to the technical details of how the network operates. Cybersecurity experts have praised Nakamoto's design of the proof-of-work mechanism powering the system. The protocol was also the first time that anyone had convincingly solved the Byzantine General's problem: how can one be confident that an agreement between anonymous users has actually taken place, making a system like first-party of Bitcoin viable? He didn't say, just that he was a 37-year-old man living in Japan. He kept the thing going for a couple of years after introducing Bitcoin, but finally faded from the scene. The nature of Nakamoto's project has raised persistent speculation that Bitcoin might belong to a government, perhaps originated in some top-secret R&D facility (Zhuk, 2024; Lowery, 2023; Yokubov, 2023).

5.1.1. Precursors to Cryptocurrency

Comprehensive models of lock-and-key money like cryptocurrencies have been proposed. The early roots of digital cryptocurrency or cryptographic money

can be traced back to the 1980s, where proprietary digital money systems like ecash and digicash were developed by famous cryptographers. These systems were the first digital currency systems that provided privacy for a set of transactions. In 1998, a concept of b-money based on earlier ideas of cryptographic money was introduced. B-money used a few cryptocurrency concepts and introduced the concept of continuous proof-of-work as hard computational pricing of digital collectibles, although there was no need to accumulate proof-of-work tokens. In 2004, a concept of a mathematical e-cash was proposed by introducing a complicated b-money inspired Karma system. A bit-gold protocol was described as a conceptual precursor to Bitcoin (Peneder, 2022; Arslanian, 2022; Taskinsoy, 2021).

Due to the consecutive failure of proof-of-concept digital money systems and huge issues like trust, scalability, scarcity, and lack of economic pricing of proof-of-work-based digital collectibles, fungible cryptocurrencies failed as a practical money concept. However, numerous academic papers for digital cash and smart electronic cash have been published, and the idea faded into obscurity. In 2008, most of the important issues were solved, giving a collective vision for digital money, and the solution was named Bitcoin (Cunha et al., 2021; Belk et al., 2022; Santana & Albareda, 2022).

5.1.2. The Creation of Bitcoin

In the original announcement of Bitcoin, the creator was never named. Rather, it was under the leadership of a singular pseudonymous figure, who would later become widely known as Satoshi Nakamoto. The project was announced as an "Electronic Cash System." To create the currency, it was necessary to solve a longstanding problem in the currency that had prevented other attempts at implementing purely digital currencies. The double-spending problem was the idea of sending the same currency twice, like sending a forgery of a banknote. For a physical currency, this model works because these physical currencies are already present and cannot be easily forged. The solving of this problem in a purely digital model was the main innovation of Bitcoin (Masteika et al., 2024; Melo et al., 2024; Akbar et al., 2021; Stifter et al., 2022).

In the middle of the previous decade, a solution was proposed which involved the insertion of the order of all Bitcoin transactions into a ledger that was able to be viewed by anyone and had its contents copied once every ten minutes over a large number of nodes. This technology was named "blockchain," and these periodic updates were named "blocks." This is equivalent to saying that its security was fundamentally based on the distribution of the truth, the consen-

sus in the database, and the impossibility of backdating such a large number of blocks (Habib et al., 2022; Banupriya & Kottilingam, 2021; Kumar et al, .2022).

5.1.3. Key Milestones in Cryptocurrency Development

Satoshi Nakamoto, cryptocurrency's mysterious creator, sparked a commotion on October 31, 2008, when he released a paper titled, "Bitcoin: A Peer-to-Peer Electronic Cash System." On January 3, 2009, Nakamoto, through a process known as "mining," created the first block of the Bitcoin blockchain. Bitcoin was built on the idea that there are better ways to create a global currency, secure network, and valuable medium of investment while averting the various single points of failure associated with traditional fiat currencies. This idea was particularly attractive coming after the subprime mortgage crisis from 2007-2008, which destroyed consumer confidence in traditional banks (Morgan; Panda et al., 2023).

Bitcoin attracted a lot of attention from the general public and the media, and by March 2013, its market capitalization had crossed $1 billion. From 2014-2020, major companies started opening up to the idea of using Bitcoin. PayPal allowed its users to deposit BTC into their accounts, and Apple and Google allowed developers to link a Bitcoin wallet app to their application. In the same period, as the public began to realize the potential of blockchain technology for applications other than currency, projects like Ethereum developed. Dogecoin and Litecoin also gained notoriety as alternatives to Bitcoin. However, very few people could imagine the ever-growing importance of these cryptocurrencies at the time. The evolution of these coins may have appeared to have little or no relationship other than being digital currencies (Manahov, 2024; Ilham et al., 2022; Chu et al., 2021).

5.2.Understanding Blockchain Technology

The birth of blockchain technology started with a published white paper in 2008. The crypto space is characterized by intense anonymity, with the identity of its creator being one of the greatest mysteries of our time. Clearly, this individual was a pioneer, and it is a story that no technological history book should fail to mention. A model was proposed based on a decentralized and distributed account-keeping system with no central intermediary. This, in essence, was designed to facilitate the use of an electronic form of cash. Blockchain is a digitized, decentralized, public ledger of all cryptocurrency transactions. Authorized transactions are included in the ledger in blocks, and every transaction is logged in the global database acting as a form of accounting (Guo & Yu,

2022; Bhutta et al., 2021; Panwar et al.2024; Arooj et al., 2022).

It is the core innovation of the blockchain that was implemented as the core of Bitcoin. The blockchain, which represents a systematic, efficient, secure, and transparent settlement mechanism, is considered to be a groundbreaking innovation. Blockchain technology is robust, reliable, and resilient, and cannot be hacked because the platform is decentralized with many nodes worldwide that replicate and verify the transactions in real time. It is virtually an "indestructible" system because blockchain cancels out the vulnerabilities of hacking and malfunctioning, thanks to its distributed system. Each node synchronizes with every other node in the system to create a general ledger that is public, immutable, and secure. The ledger records every transaction that takes place and deploys a moving sequential chain of blocks, each with a file of transactions, linked by hash pointers, the latter adding a unique ID to the file. Further, any tampering with any block would also modify the hash pointer, resulting in the generation of a new hash pointer that needs to be verified by all the other nodes in the blockchain network (Sathyaseelan et al., 2023; Raja2021; Upreti et al., 2023).

5.2.1. Definition and Principles

Cryptocurrency is a digital asset designed to work as a medium of exchange using cryptography to secure transactions and to control the creation of additional units of the currency. It is decentralized and relies on cryptography to execute different types of financial transactions such as buying goods, making payments, and purchasing services without centralized financial intermediation or a third party validating the transactions. Cryptocurrency operates on an electronic database called blockchain. A white paper initiated by an anonymous person or group of people using the name Satoshi Nakamoto was later introduced in 2008, and Bitcoin was then realized in 2009 as one of the first digital currencies to be implemented in history. Since the inception of Bitcoin, hundreds of cryptocurrencies have been created, and a number of investments targeted at cryptocurrency-related technologies such as blockchain technology have also been launched. With a growing market of different types of coins, it has led to the augmentation of what is termed the crypto verse (Shah et al., 2023; Skaf, 2023).

5.2.2. Types of Blockchains

A public blockchain consists of a decentralized network of nodes that collectively validate and secure the network. The data contained within the blocks are viewable and usable by anyone, enabling complete transparency

for individuals holding coins on the respective network. This has been one of the primary appeals of blockchain and the crypto community in general, as it allows for censorship-resistant money with limited government oversight. A private blockchain has all the developments of a public one but limits entries to one central party. This leads to debates on whether the use of a blockchain is necessary in the respective use case, as it will often require less server usage, which may present a more energy-efficient alternative. This would subsequently lead to a more efficient transaction processing time with the benefit of greater scalability. Although the lack of decentralization compromises the impenetrable security provided by the notion of no single point of failure under a public blockchain, it is outlined that the need for trust does not become obsolete but instead shifts from the underlying technology back to the governing bodies and individuals who maintain that private network (Zarrin et al., 2021; Grover, 2022; Mubarakali, 2022).

5.2.3. Key Features and Advantages

The underlying driver of cryptocurrency's transactional capability, and perhaps its most essential feature and strong advantage, is its decentralized structure. Rather than a traditional government-issued currency or central payment method subject to centralized control through a central banking system or other regulatory authority, cryptocurrency operates on a decentralized, peer-to-peer, and public ledger system. This system or community allows for the immediate and transparent verification of transactions by network participants through cryptography and a consensus mechanism that affirms, rather than intermediates, the transfer of funds. As a result of this consensus mechanism, cryptocurrency transactions are faster and less expensive than those involving traditional currencies and tend to operate with greater security and data privacy, thereby circumventing the need for and associated risks of or restrictions attributable to third-party involvement (Santana & Albareda, 2022; Cumming et al., 2025).

5.3. Coins vs. Tokens

Both coins and tokens can be utilized as mediums of transfer in payment systems or as stores of value. The principal difference lies in their underlying infrastructure. Coins are digital or virtual assets built on blockchain technology that facilitate the transfer of value. This technology makes use of conceptually simple ledgers. Transactions are bundled into blocks that are verified through a process referred to as mining using a consensus algorithm. Once a block has been mined and added to the blockchain, the transaction is considered to be

final, and further verification is unnecessary. Coins transfer value much in the same way that physical paper money does. They minimize transaction fees, particularly in cross-border transactions. They are also forms of decentralized consensus used to represent the transfer of goods and are not reliant on a central authority (Zutshi et al., 2021; Dupuis et al., 2023; Kasatkin, 2022).

Contrastingly, tokens are digital or virtual assets built on blockchain technology that facilitate the creation of decentralized applications. These applications can be utilized to perform an array of different tasks, such as in gaming. Tokens have value in the application ecosystem for which they were developed. Token transactions are faster than coin transactions as they are written directly to the blockchain. They represent the transfer of goods, primarily in the form of application code execution, and are reliant on a central authority. The blockchain technology uses a departure consensus methodology to come up with a single block of transactions. The blocks are not required to be permanent but instead use a consensus protocol to prevent malicious users from taking over the network (Hrytsai, 2022; Marin et al., 2023; Treiblmaier, 2023).

5.3.1. Definitions and Characteristics

Cryptocurrencies are, by far, the most popular and intriguing form of blockchain application today. They are electronic currencies that enable the conversion of state-issued, legal tender to digital currency, which can be used to make online purchases. They seek acceptance as a medium of exchange and a store of value and are maintained via secure and tamper-proof accounting ledgers, usually referred to as blockchain, distributed ledger technology, or ledger. They encourage the benefits of electronic commerce and electronic banking without placing one's trust—or sensitive financial transactions—in the hands of a third party. The idea of decentralized currency is as old as public key cryptography and the foundation of electronic cash. Cryptocurrencies have been described as everything from purely digital tokens used for online purchases to shares in a cashless startup company. They have been referred to as a new state of the art form of value transfer, while a team of representatives suggests that there is still no generally accepted definition of what a cryptocurrency is. While some of these conceptual definitions may be flawed, they have provided the inspiration for many of the cryptocurrencies and other virtual assets in the world today (Krichen et al., 2022; Garriga et al., 2021).

5.3.2. Use Cases and Examples

Though decentralized finance projects have existed on many other block-

chains for years, more than 75% of the value locked into DeFi projects is currently built on the Ethereum network, accounting for close to 90%. As the only true decentralized blockchain network with established security and smart contract capabilities, Ethereum becomes the foundational base for the initial emergence of a wide range of tokenized financial products for open public access. Some of the focuses and key applications of DeFi with broad user cases include trading and exchanges, stable coins, lending and borrowing, asset management, and insurance to name a few. By enabling programmable applications on both sides of the coin, decentralized finance platforms aim to remove intermediaries in the traditional financial sector and enable everyone in the world to use these financial services. It has also spawned the DeFi movement known as Automated Market Maker or DEX offerings, which aim to leverage alternative scaling strategies that use side chains, optimistic roll-ups, or zk-rollups for transaction executions (Zhou et al., 2021; Schär, 2021; Heimbach et al., 2023).

Most of the existing DeFi use cases have been mastered for DEX, lending, and stable coin instruments. The expansion into the other segments all depends on whether a DeFi platform can be connected to other blockchain data sources seamlessly and can build up the necessary onsite trust among builders and users alike. At the same time, DeFi has generated interest in all kinds of structural protocol risks and governance challenges, which are driven by profit-motivated protocols and startups influencing all participants, especially retail token users and liquidity providers. It is these challenges that will come under close regulatory scrutiny in the near future. The following five common DeFi use cases are best understood within their risk and governance context (Röckener, 2024; Ryan & Diorio, 2023; Lorenz, 2024).

5.4. Altcoins and Their Impact

In 2010, relatively small Bitcoin clones began emerging, effectively expanding a new realm of possibilities for cryptocurrency enthusiasts and emerging blockchain startups. These "altcoins" often leveraged a different protocol, native blockchain, and a variety of security solutions to enhance the overall value proposition of blockchain technology. This laid the foundation for the immensely diverse ecosystem we find ourselves a part of today. Notable implementations and innovations include utility tokens, sales of tokenized assets, decentralized finance, supply chain solutions, web domains, file storage mechanisms, machine-to-machine transactions, and even "joke" assets. Indeed, blockchain has lived up to its initial expectations. We established the fundamental differences between a coin and a token: a coin is native and has its own dedicated blockchain, whereas

a token operates within someone else's network. The growth of Bitcoin's and Ethereum's blockchains led to the emergence of a variety of similarly functioning altcoins (Delaplaine, 2022; Inikhov, 2024; Huber & Sornette, 2022).

Bitcoin was the first cryptocurrency, but it was not the last. In less than a decade, a variety of Bitcoin clones were released to the public. Their developers slightly modified Bitcoin's source code, changed small parts of the protocol, and repackaged it. It is necessarily easy to figure out how many distinct altcoins truly exist. Some websites list well over six thousand different coin projects, of which few are years old. In this chapter, we attempt to accurately represent blockchain's dynamic landscape (Zohuri et al., 2022; Hossain, 2021; Panda et al., 2023).

5.4.1. Definition and Significance

A cryptocurrency is a form of decentralized digital money or digital currency that utilizes cryptography for security and operates outside of financial intermediaries such as banks and credit card companies. It is essentially a digital or virtual currency that uses cryptography to secure, verify, and record transactions across a computer network known as a blockchain. A defining feature of a cryptocurrency, and perhaps one of its most appealing characteristics, is that it is not issued or controlled by any central authority, lacking a central governing body like a government or central bank. This is to say that cryptocurrencies like Bitcoin and many others like it are generally perceived to exist separate from the monetary ecosystem and serve as a medium of exchange like traditional money without a government or central agency managing it (Zohuri et al., 2022; Bhadeshiya2021; Rushita et al., 2023).

The introduction of Bitcoin in 2009 by the pseudonymous creator was a monumental event, one that birthed a new form of currency entirely digital in nature, ripe with the promise of decentralized consensus and value, which employed a novel data structure called a blockchain, enabling the assets to be funds that are almost impossible to duplicate or counterfeit. While the technology behind the cryptocurrency was initially dismissed by puritans and traditional financial markets, it has gone ahead to not only sustain the fascination and adulation of a growing crowd of technologically acclimated individuals, but also to tell one of the most captivating stories of how a financial asset class model could emerge and begin to be considered as an institutional alternative asset that is finally ready to be accepted within the mainstream. Indeed, the irrepressible growth of the cryptocurrency market is convincing enough to not only spur interest in analysis from scholars and practitioners, but has also shown the potential for technological improvements within countless industries

influenced by its underlying blockchain technology (Taskinsoy, 2021; Panda et al., 2023; Wu & Zhu, 2024).

5.4.2. Popular Altcoins and Their Features

EarthCoin was officially released on December 20, 2013. It has increased its wallet functions three times and has been greatly supported by enthusiasts at home and abroad. EarthCoin uses the scrypt algorithm to require a total of 13,500,000,000 coins. Fixed interest is issued every year to partly compensate for the loss of coins due to various issues such as wallet cracking and loss. Among them, the first 3 years is 10,000,000, 3-6 years 5,000,000, 6-9 years 2,500,000, 9-20 years 750,000, and after 20 years is 45,000. A year is 6,666 a day, and fixed interest is sent to the official public welfare fund address for various support activities. Dogecoin was officially launched on December 6, 2013, and is one of the earliest meme coins. Dogecoin has a total of 100,000,000,000 coins, with a higher daily output of about 96,000,000. It used the scrypt algorithm earlier, then switched to the auxiliary scrypt algorithm. Upon its release, it immediately gathered a large number of enthusiastic supporters because of its furry logo (Kyriazis, 2021; Börner et al., 2021).

DOGE is developed by the original developers of Litecoin, with the coin as the basis and the cute doge on the Internet as the logo. This brings a large amount of attention and financial support for DOGE's subsequent development, and some large charity activities will be held from time to time. Including the previous emergencies such as the Jamaican collective winter Olympics, the bobsled Jamaican national team, and the water intervention activities such as drought relief. Dogecoin wallet, as a software and web-based uninstaller, can be deeply associated with the Android and iOS platforms. There is even a DOGE-only car on the racing track, which promotes the development. Now DOGE has developed from a pure meme coin to a coin close to many extended wallet applications. Its transaction speed is extremely fast, up to 1 minute, and many wallet transactions are used in transactions. It is used as a pure payment currency (Moore, 2024; Nani, 2022; Danieley, 2022).

5.5. Meme Coins and Their Rise

The rise of altcoins gained momentum when non-Bitcoin digital assets emerged in the market. The term "altcoins" originated from the expression "Bitcoin alternative," which describes a cryptocurrency that is considered to be an alternative to Bitcoin with a promise to be better and different. Upon the culmination of the first altcoin search and the arrival of many new projects, the

term "shitcoin" became fashionable in the crypto sphere. New cryptocurrencies began to emerge, propelled by community involvement, creativity, and a sense of humor, resulting in the meme coin era. Meme coins are a class of cryptocurrencies emerging from whimsical humor and amusing internet memes, and often play on both the desire to participate in influencer culture by following the social media posts of celebrities and the desire to become wealthy with minimal effort (Andal & Aniruddh, 2023; Rodriguez, 2022; Pereira Coelho & Quelhas Poças, 2024; Coulter, 2022).

Dogecoin is an example of a meme coin that has added momentum to the use of celebrity endorsement, playful community engagement, and parody memes. However, the unique feature of Dogecoin is its developer support and early integration on popular platforms, which are important to the success and compounded interest. The connection and spoof to the popular meme was a successful marketing action that set out to become the internet currency. The following meme coins emerged in the cryptocurrency era, adding weight to the digital coin study: Rapp Yuri, Meme, Playboy, Turtle, SafeMoon, Shiba, Kleros, and Hoge. Meme coins represent an extreme of the escalating creation of valueless derivative coins reflecting the exaggeration and irrational expectations from investment novices as well as a lack of rigor in the crypto evaluation metrics (McKenzie & Silverman, 2023; Shaw, 2023; de et al., 2024).

5.5.1. What are Meme Coins?

Meme coins are cryptocurrencies created for comical rather than practical reasons. They are designed to be fun or absurd while clinging to a mockery that is aimed at less innovative and highly hyped technology in the cryptocurrency space. It is felt that meme coins hold the purpose of addressing legitimate technical issues with the prevailing cryptocurrencies. In more recent times, the word "meme" is an allusion to an internet phenomenon in which humor and art are widely distributed across a multitude of platforms. Meme coins are meant to be lighthearted and not to be taken seriously. Because they often take credit for the lack of complex features characteristic of other cryptocurrencies, it is often claimed that they have the ability to resolve most issues. The popularity of meme coins is also due to having a large following on social media, which is organized around passing clever jokes related to their chosen cryptocurrency. Social media platforms are typical spots where these debates occur and are fascinating environments in which new ideas are tested, where informational signals ebb and flow, and where new technology will ultimately be supported by the defenders. Over time, internet and digital technologies will be reordered,

but the propensity to speculate about what is given, to innovate and generate new digital systems and digital funding that pay off when others consider it ridiculous and inconsequential will continue to flourish with renewed inventiveness in the next generation of cryptocurrency. Some examples of meme coins that have gained great market valuations include Dogecoin, Shiba Inu, and perhaps the most well-known, Safemoon (Stencel, 2023; Danieley, 2022; Shaw, 2023; Holt, 2021).

5.5.2. The Phenomenon of Meme Coins

At the heart of meme culture — underscored by humor, irony, and mimicry and often used as a form of social expression — lies the movement of memes. Memes are digital pieces of content developed by internet users that deliberately combine elements of irony, satire, and parody. Digital currencies are also the culmination of online mobilization and the ideal breeding ground where this thriving online community would find a new appeal. The perfect normalization of memes has been taking place over the past decade, including the growth of a tiny entity called "memecoin." Known as meme coins, these digital coins imitate and satirize popular cryptocurrencies as a representation of a single joke, an idea, a person, a product, an event, a moment in time, or a marketing strategy (Mitman & Denham, 2024; Dhande et al.; Rathi & Jain, 2024).

Since 31,000 meme coins rose to prominence on social media, the meme coin was designed as a seemingly harmless prank in the crypto universe but later incorporated the above-mentioned economic and political dynamics. Endowed with a well-understood logo and tone, they communicate more efficiently. Meme coins also attract a loyal fan base, although their business model is built on nothing but an understanding of marketing and buzz-generating activity. The rise of meme coins inevitably makes one question the economic rationality of such a speculative bubble prone to cataclysmic implications. On the one hand, they did open the door to cryptocurrency for about two million more users; on the other hand, the mathematical nature of cryptocurrencies could not be fully explained. For instance, the price grew significantly at the peak of the rally within the last week of 2021; therefore, its deposit to the exchange increased significantly (Neri-Mares et al., 2024; Gromkowska-Melosik et al., 2025; Rosenberg & Ellis, 2023; Reibstein, 2022).

5.5.3. Challenges and Opportunities

Decentralization can be a powerful driver for economic growth and prosperity, a more democratic distribution of industrial and financial power, and associ-

ated shifts in social and political power. However, it must also be approached with a discerning and critical eye. Decentralization occurs independently of our motives for either pursuing it or accepting it, and it is not inherently ethical, fair, responsible, or any of the many other normative qualifiers we might attach to it. Making a system more decentralized does not automatically mean that it will be more fair, efficient, transparent, secure, useful, valuable, or personalized. These conditions are contingent on a contingent context and an intelligent deployment of the underlying supporting technologies. We must actively shape the space of decentralization in line with these goals, distributing the right kinds and amounts of power in the right kinds of ways, while actively working to mitigate the challenges and exploit the opportunities that arise (Subroto & Baidlowi, 2022; Yu et al., 2023; Xiaohan & Yongqian2021; Khambule, 2021).

5.6.Cryptocurrency and the Financial Landscape

The rise of cryptocurrencies became obvious to the financial industry in December 2017 when the striking price surges of Bitcoin and other notable cryptocurrencies rose to approximations of 20,000 euros. As conventional financial products, stocks and real estate experience times of incredible returns and intensive media reports, the sudden rise and strong turnarounds in the prices of Bitcoin and other cryptocurrencies adhered to the usual pattern. The quick development attracted a broad scope of investors. Values of cryptocurrencies could fluctuate significantly in the early years, forcing every investor to manage their investments actively. The various launches of new cryptocurrencies with different security issues are contributing to a new wave of peaks in digital values and revolutions in the financial world (Radanliev, 2024; Setiawan et al., 2021; Kayani & Hasan, 2024).

5.7. Cryptocurrency and the Financial Landscape

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values and revolutions in the financial world (Setiawan et al., 2021; Kayani & Hasan, 2024; Radanliev, 2024).

5.7.1. Adoption and Integration in Various Sectors

Bitcoin, the first cryptocurrency based on blockchain technology, was only a philosophical concept in 2008, 16 years after the first e-money emerged. Blockchain has raised wide interest from various sectors, such as finance, commerce, healthcare, and government, for many reasons. It has the potential to achieve a high level of security and reliability because of its decentralized and consensus-based architecture, independent of a trusted third party, and resistant to fraudulent activities such as double spending, modification of records, and hacking from distributed denial of service, collusion, privilege, and insider threats (Nishibe2022; Nishibe, 2022; Cunha et al., 2021).

Its design also allows direct interaction among stakeholders who can verify the transactions and share an immutable version of the documents. The integration of cryptocurrencies with blockchain and smart contracts can also easily overcome cross-border financial and commerce obstacles such as capital restrictions, intermediaries' fees, compliance, and fraud risks. Central banks and financial institutions are actively investing in research and tests of central bank digital currency and blockchain-based real-time gross settlement systems. Although the principles are powerful, many significant technical, operational, and regulatory challenges need to be overcome before wider adoption (Cunha et al., 2021; Sakharov, 2021; Pelagidis & Kostika, 2022).

5.8.Future Trends and Predictions

Technology and cryptocurrency are fast-moving, and it is hard to predict future outcomes with certainty. Many industry leaders believe technology will continue to grow and expand, with future generations unrecognizably augmenting the infrastructure's core software. The repeated forecasts suggest technology will remain a key catalyst for economic reinvention (Redding, 2023; Gutiérrez and Olayele2021; Oberoi et al., 2021; Wawak et al., 2024).

Other bold predictions suggest pieces of blockchain technology will eventually be combined with other technologies, providing businesses with the data quality and integrity they can rely on. This innovation could herald interoperability. In other words, different blockchain projects will eventually be able to work together through the introduction of the technology's standardizing feature. Another groundbreaking prediction is that identical specifications will help to unleash the power of welfare-enhancing multi-chain technology, equally

benefiting businesses and consumers. The shift to multi-chain could potentially enable integration to become so commonplace that innovation is inhibited from happening. In effect, as a result of these changes, future growth can happen unchecked. Future iterations of blockchain technology have the potential to become recognizable (Yap et al.2023; Farooq et al., 2022; Belchior et al.2021; Tripathi et al., 2023; Jabbar et al., 2021; Javaid et al., 2021).

Despite these grand forecasts, predictions regarding cryptocurrencies are much more divisive, with a gulf between the viewpoints potentially stretching economies in opposite directions. Technology enthusiasts believe in the power of cryptocurrency; the argument suggests they continue to assert its future necessity. Given this, it is no surprise that industry predictions are exceptionally positive. Following this group's expertise, advocates hopefully proclaim that cryptocurrency could antagonize and, in some cases, dismantle some of the institutions most responsible for worsening global wealth inequality. Unlike fiat currency, cryptocurrency is digital and decentralized, with direct-to-recipient transactions capable of removing select middleman-associated fees. For humanitarian liberal activists, the idea of liberating wealth from techno-arcane obstacles is seen as exciting and optimistic (Okeke et al.2021; Wu et al.2021; Serena et al., 2022).

5.8.1. Emerging Technologies and Innovations

Emerging technologies and innovations are lauded for providing significant potential for achieving desirable development in human society. These emerging technologies have the power to dramatically enhance the socio-economic standing of organizations and thereby confer both individual and collective benefits to all actors involved. Foremost among these emerging technologies is blockchain technology and its collection of digital tokens, a prime example being cryptocurrency. Cryptocurrency is generally defined as decentralized digital and virtual currencies designed to work as a medium for exchange and does not require intermediation when transactions are conducted. Being described as a decentralized operating system for the new digital economy, the technology is credited with the features of self-executing contracts, intelligent agreements, and, to a reasonable extent, autonomous and decentralized applications or organizations (Pradhan & Singh2021; Samanta et al., 2021; Turner, 2021; Klimowicz, 2024).

Cryptocurrency is known, original, and the preferred type of digital currency. The term is derived from the safe and efficient exchange of goods and services it intends to provide. The currency is backed by the principles of cryptography,

which are used to regulate, validate, and protect its digital processes. The nature and characteristics of cryptocurrency are known to be complex, resource-intensive, and regulated by economic, financial, and information technology regulations that are the basis of increased privacy. Throughout its short lifespan, cryptocurrency has traversed several notable events, reaching a status where it is acknowledged as a potential paving stone for financial and economic growth and a fascinating regulatory and policy improvement tool (Adhikari, 2024; Arslanian, 2022; Galal, 2022).

5.8.2. Potential Challenges and Solutions

Challenges and drawbacks exist in the process of transitioning from a centralized system to a decentralized system. The most practical issue is the handling capability of blockchain technology. Due to the asynchronous consensus mechanism of the blockchain, the processing capability brought about by general-purpose data services such as streaming stock transaction data, high-frequency trading, the Internet of Things, and data analytics is limited. Most research into blockchain strays from these realistic applications. Combined with the sharp increase in the number of transactions, processing cryptocurrencies has become a very observable problem. If the block sizes of the network are not expanded, the transaction capacity will be continuously occupied by malicious users who deliberately occupy the recording space in the block with a variety of invalid blocks, which will eventually suppress cryptocurrencies from becoming a de facto currency (Yadav et al., 2023; Verma et al., 2022; Li et al., 2021).

There are also considerable problems with various proof-of-work based cryptocurrencies: the user-initiated transaction is trapped in the fair contest of the miner, and clients who intend to make transactions and utilize the blockchain waste much cost that is out of proportion to the interests of the miners who maintain the chain; the general-purpose hardware that the miners continue to use may lead to a continuous increase in the power of the network, resulting in significant power costs and consumption; the ineffective mining mechanism creates barriers to entry for new users, potentially compromising the security of the entire blockchain network; as a result of the dynamic difficulty locking mechanism of proof-of-work, which allows the adjacent block interval to maintain a certain value, the blockchain network may suffer time difference attacks caused by global network time discrepancies, which will also bring network performance degradation or result in incentive constraints. Under such adverse network effects, some cryptocurrencies gradually converge to become speculative gambling tools, ultimately failing to facilitate social reallocation. These

design pitfalls are all due to the task scheduling mechanism of proof-of-work (Petar, 2023; Řežábek, 2024; Radanliev, 2024; Lopez-Gonzalez & Petrotta, 2024).

6. The Potential Use of Cryptocurrencies by Governments to Control Money Supply

6.1. Introduction

Governments' determination and ability to regulate their inevitably stabilized money supplies will have implications for financial markets. If the central bank has complete control over the technology issued with the digital currency, the central bank's control over the money supply—regardless of the technology and model—will further enhance currency stability. In the long run, the determination and plan of how the digital currency will reshape the concept of "currency issuance" may reestablish the image and position of traditional concepts and models of currency issuance in the eyes of the public. People's demand for currency should always be the yardstick for judging the size of the money supply. The conceptual transition from "the whole society's demand for currency" to "large society's demand for new financial products with the attributes of currency and commodity" should be reviewed from the perspective of new creation and interpretation of money as an institution (Challoumis-Κωνσταντίνος, 2024; Anguera-Torrell et al., 2021; Li et al., 2022).

Financial assets such as traditional paper currency, foreign exchange, and gold are called "legal currency" or "fiat money," while the unique monetary assets and items related to blockchain technology are "virtual currency" and "cryptocurrencies." Some countries advocate for the introduction of "digital currency," which is called "cryptocurrency." People have formed concepts in practice, such as "fiat currencies," "virtual currencies," and "digital currencies." We believe that "fiat currency," "virtual currency," and "digital currency" can be called "currencies," while "cryptocurrencies" are a special subset of "currencies." (Bhat et al., 2021; Lu, 2022; Foster et al., 2021; Saiedi et al., 2021).

Cryptocurrencies – or virtual currencies – first emerged in 2009 with Bitcoin. Their supply, demand, and price represent the markets into which they were issued. Cryptocurrencies are backed by a secure and transparent blockchain process. The blockchain is an open ledger to which every transaction is added. It is secure because there is no one repository that can be hacked. It is transparent because everyone has access to every transaction. This security and decentralization are vital elements due to the absence of a full banking system. Cryptocurrencies may see mainstream use in everyday financial transactions, but banks and financial services firms might disappear if they prove optimal

(Panda et al., 2023; Nica et al., 2022; Blahušiaková, 2022; Marzo et al., 2022).

Bitcoin was the first of three generations of cryptocurrencies. It has limited usage aside from transactions in its own exchange. Peercoin was the first altcoin, featuring a 1 percent annual inflation rate after 90 days of not moving from the digital address. The third type of cryptocurrency by time of creation includes coins like Namecoin, which can serve a dual purpose as both a currency token and a gateway to additional services not possible with Bitcoin. Another growing use of cryptocurrencies among monetary policy circles is research. Most work has concentrated on the ledger values. Most have sought to establish – or already taken as given – aspects of codes of conduct or governance structures. In each instance, the question of the impact of cryptocurrencies on control of an economy's money supply remains unaddressed. If they have a significant impact, regulation efforts might shift from the banking system to cryptocurrencies. At present, they have had marginal effects compared to global GDP. However, they remain a point of interest among central banks and research bodies. Interest has grown as more companies and financial systems have moved into the crypto space. Governments have slowly expanded their interest from a regulatory standpoint as retail investors have drifted from traditional asset markets to cryptocurrencies. Democratic publics' constituent bodies often do not trust the adherence by cryptocurrency entrepreneurs and journeyman cryptographers to any agreed or self-asserted standards. Governments, on the other hand, frequently view the rapid expansion of cryptocurrency adoption by institutional investors as an intent to damage or destroy their domestic or multinational payment systems and existing processes for issuing and maintaining the circulation of money. Public perception may need to be studied closely, but it will not be explicitly discussed (Kowalski et al.2022; Bezovski et al., 2021; Titov et al.2021; Putrevu & Mertzanis).

6.2. The Role of Governments in Controlling Money Supply

Governments are the leadership structure within the economy. They are responsible for the administration of the political and economic strategies of a country. In the economic sphere, one of the main policies that fall under the government's responsibility is the management of the money supply. Governments direct national economic entities, which include people, companies, and national institutions that produce goods and services for the market. When people offer their goods and services, they expect to obtain something in return, which they can exchange for any goods they want. For this trade to occur, the potential buyers must have the required money to buy the goods or

services. Therefore, a stable money supply is crucial for facilitating trade and enhancing a country's economic sustainability (Kumar et al.; Moosavi et al., 2022; Chugunov et al., 2021)

Governments deal with "too much money" - the condition known as "inflation" - and the opposites of "too little money" - the conditions known as "deflation". When there is too much money in the economy, the prices of everyday products and services rise, reducing the purchasing power of money, which creates inflation. Similarly, too little money in the economy results in a deflationary period, where purchasing power expands but prices fall. Inflation-predicted strategies usually involve decreasing the money supply, equivalent to increasing interest rates and vice versa. Therefore, part of economic policy-making often involves raising or reducing the money supply. A country's economic policy is also influenced by worldwide events such as natural disasters, technology development, a country's economic performance, geopolitical events, and the interconnected global financial and trading network. The financial crisis triggered increased government intervention and nationwide economic and fiscal assistance in all developed countries that remain powerful at present (Qiu, 2023; Bordo & Levy, 2021; Self, 2023; Alpago, 2021).

6.2.1. Monetary Policy Tools

Interest rates are regarded as a leading instrument in the world for setting monetary policy. Central banks increase or decrease the cost of borrowing money by adjusting interest rates. In this manner, credit for investment and rising consumer expenditure is stimulated. Accordingly, global economic growth is recurring to boost inflation. Alternatively, central banks increase interest rates to reduce borrowing and accompanying investment and expenditure. The aim is to dampen the rate of inflation. Though the tools are conventional for central banks throughout the world, they often take different approaches (Sims & Wu, 2021; Bauer & Swanson, 2023; Barrdear & Kumhof, 2022; Wei & Han, 2021).

In an open market operation, central banks either buy or sell government obligations. When the money supply rises, securities are purchased, and when it is reduced, secondary market securities are sold. When securities are purchased from dealers in the secondary market, bank reserves arise, and when sold, bank reserves decrease. The legal requirement of bank reserves is decided by the central bank, thereby altering a mathematical reserve specification. The reserve system requires banks to identify the number of reserves consistent with their deposits. In the form of excess reserves, they will have the opportunity to borrow if a deposit bank prefers to hold reserves beyond minimum legal require-

ments. While influencing trends, the impact of this selective credit-influencing instrument is more competitive for banks' lending. Up until the banking crisis, many countries took advantage of direct bank reserve specifications prior to manipulating statutory standards for additional restrictions. Along with the banking crisis, the additional reserves demand statutory reserves for differing liabilities (Rosa, 1844; Burkhanov et al.2023; Conti-Brown et al., 2021; Pham et al., 2021).

6.3. Potential Advantages of Using Cryptocurrencies for Money Supply Control

The potential use of cryptocurrencies by governments is a more controversial strategy given that the appeal of cryptocurrencies has mostly been the potential degovernmentalization of money. This paper does not purport to express any view on the desirability of this strategy. Its goal is rather to investigate whether there may potentially be advantages in governments using cryptocurrencies rather than other digital money strategies. Here we describe some of the potential advantages of using cryptocurrencies instead of pursuing either of the other two strategies outlined above. The first advantage of using a cryptocurrency as an instrument with which to control the money supply is that it could greatly reduce the delays in payment system transactions and the costs of traditional monetary procedures. In a cryptocurrency economy, funds raised by the Treasury could be transferred to the recipients in real time and with the press of a button (Mercan et al., 2021; Mahmudnia et al., 2022; Wahab et al., 2022; Temizkan et al., 2022).

A second potential advantage of using a cryptocurrency as a money supply control instrument is that, in contrast with converting bank deposits into cash or a CBDC system, a cryptocurrency is fully programmable and open to the implementation of more advanced, fully automated, customizable, and individualized monetary and incentive policies. A third potential benefit of an economy run on cryptocurrencies is that, in contrast with other mediums of exchange, absolutely all payments, even the tiniest ones, can be made directly on the blockchain without intermediaries at a very low cost, which incentivizes more transactions and the use of money in general. Unique identification, which is likely not to be entirely encrypted, also greatly facilitates the revenue of such minuscule transactions. A fourth advantage is that blockchain-based payment systems, which require very limited identification, can significantly improve financial inclusion, of at least those who have the means to access the internet. This could revitalize the economy in some areas or countries in which banks have restricted access to the financial system and decrease the use of

unregulated cash, which is a societal problem. Transparency and traceability, due to the difficulty in conducting anonymous payments, could also provide an effective weapon in the fight against corruption and the market economy. A technological leap in anti-corruption policy aimed at decreasing leakages of funds allocated for infrastructure-related expenditures from the budget would be the ultimate ideal, solving the principal-agent problem (Chuen & Teo, 2021; Bodemer; Marthinsen & Gordon2022; Cunha et al., 2021).

6.3.1. Transparency and Traceability

Transparency and traceability are inherent properties of blockchains, the technological basis of cryptocurrencies, and could thus also be features of central bank digital currencies. A blockchain comprises a ledger of transactions that is permanently recorded and publicly accessible. Each block is verified via peer-to-peer networks and is linked to the previous one in a so-called Merkle tree. Any block that is altered must also alter all subsequent ones before being accepted, making retroactive altering of blocks computationally infeasible. A blockchain can, in principle, provide transparency of who owns the value units, who receives them, and who decides on the transfer of value units (Centobelli et al., 2022; Sedlmeir et al., 2022; Zhu et al., 2021; Uddin et al., 2021).

Having a real-time overview of the flow of funds in an economy would offer opportunities to govern or tax such a system differently. Money laundering and tax evasion become even more difficult when using a network with transparent payment transfers. Cross-border transactions are easier to monitor, and data can be shared among countries. Where in the current system countries might not know about foreign asset holdings for taxation, this can easily be seen on a distributed ledger. This strengthens countries in their fight against tax evasion and fraud. In addition, it might be easier to predict economic developments since there is more real-time data available. Based on the spending pattern of the population, it might be possible to follow the business cycle more accurately. This might provide more insightful information into which policy measures are needed. One of the frameworks that could be developed and considered in conjunction with a digital euro is applications that reduce privacy risk but in such a way that the underlying characteristics of the digital euro do not jeopardize efficiency and safety. However, further research is required to implement such a framework. It is clear that as the central bank, the ECB itself does not have to deal with the existing privacy risks because the proposed framework does not reveal encrypted transaction data received by the digital Central Bank Money. Nevertheless, the framework does require policy about the situation where

the financial institutions provide a transaction service. For this, the necessary permission from the customer has to be sought and obtained (Okeke et al., 2024; Arewa & Davenport, 2022; Heinemann & Stiller, 2024; Murorunkwere et al., 2022).

6.4. Challenges and Risks of Governments Using Cryptocurrencies

Cryptocurrencies display very high levels of volatility in comparison to traditional forms of money. If launched, there is a risk that rapid fluctuations in the value of government-issued digital currencies could lead to a loss of the trust and confidence of consumers, adversely impact the national economy, and result in economic instabilities. These top-of-mind consumer risks are likely to be key considerations in the Australian context. Cryptocurrencies are issued using a public blockchain infrastructure, which means that anyone can hold a copy of the entire ledger and anyone can transact directly with anyone else using electronic wallets. In order to integrate cryptocurrencies with the existing national and international payment and settlement systems, the development of new interfaces between the distributed ledger and external systems, and protocols for the interoperation of these systems, will be required. As with all digital systems, the distributed nature of cryptocurrencies creates new security risks, with defined data losses over time. The operational resilience of cryptocurrencies should be carefully managed as inherent weaknesses in the system may become apparent over time and hacks or fraud may diminish the public's confidence in cryptocurrencies. New regulatory and compliance settings will need to be developed in order to manage and supervise cryptocurrencies in the financial system. Policymakers will need to work within this void while fostering innovative and new technology in this complex area. The acceptance of any new form of money will be dependent on whether people view it as being authentic money and are confident in transacting with it. Public confidence is particularly important for a government-issued digital currency, which the public would view as a liability of the issuing government. Any assessment of confidence must take into account not only the rights to use the new digital currency as a medium of exchange, unit of account, and store of value but also how this 'asset' could be realized. Ongoing research would be required to identify market techniques that may be used to manipulate the value of a cryptocurrency. The government will be challenged with the development of monetary policy, particularly if public confidence in cryptocurrencies deteriorates (Ghorbel & Jeribi, 2021; Naimy et al., 2021; Hairudin et al., 2022; Baur & Dimpfl, 2021; Chinthapalli, 2021; Leirvik, 2022).

6.4.1. Regulatory and Legal Issues

The use of a digital coin to control the domestic money supply by the US government is an interesting topic because it involves not only the technical aspect but also a few regulatory and legal issues. Such discussions are very similar to what exists today in the area of central bank digital currencies. The statute, as well as case law, already defines what a dollar is. They do not wrap blockchain or distributed ledgers and were formulated to embrace many diverse technologies. The treatment of digital assets, classified as currency or security, constantly depends upon an analysis of the Howey Test (Fantacci & Gobbi; Peneder, 2022; Cunha et al., 2021).

Measures taken to regulate or suppress cryptocurrencies can be best understood in the context of a government's authority to manipulate or control its own supply of digital currency. Furthermore, measures taken or statements made by governmental authorities show the necessity of international cooperation. For an upstart nation such as the Marshall Islands to issue its own cryptocurrency is permissible as long as it does not threaten the dominance of the US dollar. The risks of uncertainty and regulatory disunity are manifold. For those considering an investment in cryptocurrencies, a clear regulatory framework is essential for certainty. While consultation is essential, too much emphasis on inclusive decision-making has the potential to scare away investment and inhibit innovation. Lawmakers must be brave enough to roll the dice and take the risk if economic performance is to improve (Podder, 2023; Jagtiani et al., 2021; Emmert, 2023).

In conclusion, this issue is not black or white, and international organizations must be more creative if they want to find a regulatory solution to this very modern problem. It is possible to achieve that ideal balance, but it will take time and, even more, willpower to make the necessary risk assessments in the short term. Political leaders would need to balance technological advancement with proper protection of their citizens if the desire is to promote innovation in blockchain and cryptocurrency technologies (Uzougbo et al., 2024; Ozturk & Sulungur2, 021; Makarov et al., 2022).

6.5. Case Studies of Governments' Involvement with Cryptocurrencies

Until now, the whole topic of government digital currencies and related events for cryptocurrencies has been purely empirical. For that reason, actual experiments of government involvement have to be presented to provide insights into what future outcomes could depend on. Clearly, the other nations that

have experimented with digital currencies differ greatly in their socio-political-economic contexts from China, the US, and Japan. Money supply control is not their policymakers' chief concern. Still, their experiences offer a trove of information. Here, three have been chosen for detailed discussion. First, the digital currency the Bahamas has been pioneering is equivalent to U.S. coin and can be a major convenience for American tourists. Similar to Uruguay, the Bahamas are allowing a major foreign digital currency provider to create a dollar-based digital lei (Greer et al., 2022; Bertelli & Busuioc, 2021; Tymoigne; Jablonski & Seim, 2024).

The sole developed-world digital currency system that remained from 2019 is the infra-national UK project in the British island of Jersey, which through 2020, a sole provider has equipped with statutory currency digital wallets. Under 10 percent of residents use the wallet, so it is hardly part of the nation's monetary supply. They are among easy colleagues still. Japan would love China to peek over its shoulder when the IOC fires up digital currency transfer during the summer Olympics. In the final week of my game, Japan announced the "First Bank Coin" for those sharing that bank account (Chohan, 2024; Chen, 2021; Hayes, 2021).

6.5.1. China's Digital Currency Electronic Payment (DCEP)

Several countries, as well as the European Union, are reportedly experimenting with governmental cryptocurrencies. Thus far, only one country, China, has an operational governmental cryptocurrency, Digital Currency Electronic Payment (DCEP), albeit on a limited basis. Based on the motivation and the design of the DCEP, China is considered the typical and central case for governmental cryptocurrency. Thus, the following will focus on evaluating DCEP as a case in itself. China has multiple reasons for developing a governmental cryptocurrency, not least to stabilize the Chinese financial system and economy (Caudevilla & Kim2023; Xia et al., 2023; Lu et al., 2021).

The operational design of DCEP consists of a two-tiered currency system that is controlled by the state. The PBOC issues the DCEP to the four authorized commercial banks, and these are the only entities that can convert electronic money to cash (and reverse it). There are three ways to transfer DCEP: 1. Mobile phone/near field communication: Users can scan a quick response code or use the touch-and-go function for small transactions. 2. Access cards: These prepaid cards are available for short-term visitors, such as tourists, at a system of banks, outlets, and vending machines in China. 3. Online banking. In all cases, the telecom payment systems can be used as intermediaries that convert DCEP into euros, US dollars, and Chinese yuan before transferring the money abroad

or to a foreign card (Shen & Hou, 2021; Lee et al., 2023).

DCEP has produced mixed outcomes, and it has many implications locally as well as internationally. Internationally, the ongoing DCEP policies coincide with China's One Belt One Road initiative, making the DCEP a utility tool for a geopolitical interpretation. The DCEP could become a tool for political and military influence in the way it can be deployed. The objectives indicate that, in spite of its hybrid architecture, the PBOC plans to have a greater degree of command input in the Chinese economy. China has sought this from macroprudential ceilings to selective credit control in reducing financial shadow banking and increasing transactions to small firms (Lo, 2022; Greenwald, 2022; Pan, 2021).

Some technical analysts have been more skeptical. They point out that the proposed system could be outdated within 10 years. Cryptanalysis may well shift the debate from being exclusively governed by traditional means. This highlights the need to be innovative in the sophisticated technology underpinning the currency. In fact, China has a strong sentiment toward innovation; the problem is convincing a huge throng of potentially negative users hacked by big data, some early ones specifically criticizing the public face of DCEP (Nadeem et al., 2021; Zhang et al., 2024; Jiang et al., 2021; Grassman et al., 2021).

Several nations around the world are monitoring China's progress with the creation of DCEP to learn from the experiences of the Bank of China's creation and use of a state-backed currency using a decentralized two-tier system. It needs to be appreciated that the process will be slow at first, yet it gathers momentum and international implications. While the DCEP demonstrates that governments potentially can build a digital token, it does come with risks. The primary risks are the fear that government private key access is the catalyst for authoritarian decision-making that compromises privacy. It is estimated that the initial take-up will be slow, yet many are confident that in several years the DCEP will be popular both in China and with major trading partners. A situation is occurring on the Asianscape that the money currently being used as a trading currency will evolve towards the use of the U.S. dollar or the DCEP. Either way, it will have important trade and military implications (Caudevilla & Kim2023; Wu et al., 2022; Aysan & Kayani, 2022; Li, 2024).

6.6. Future Implications

Balancing the different angles of cryptocurrencies, we have documented that, insofar as they may be used by central banks and/or governments, they may replace current cryptocurrencies and financial systems with new units that can be traded in parallel with other currencies. Such a framework offers an

opportunity to respond to the potential threat of cashing out bank deposits or migrating to cryptocurrencies that are outside government control. In addition to credible prevention and reduction of money laundering, counterfeiting, and financing of illegal activities and terrorism, the other challenge raised in this paper is to ensure an adequate level of data security and privacy for e-commerce. However, in order to see this potential realized, policymakers need to continue to be vigilant about any challenges the corresponding financial system will pose (Jagtiani et al., 2021; Ssaharti, 2022; Carvalho et al., 2021).

The potential rise in cryptocurrencies has implications for the future of international monetary systems and monetary policy frameworks. For instance, the accelerated erosion of public trust in financial institutions, evidenced after significant growth, can be exacerbated by the diffusion of decentralized technologies. Because the trajectory of cryptocurrency governance is still, to some extent, open for governments and economic discipline, which takes action to cultivate cryptocurrencies, this policy prescription and the research conclusions lead to a research avenue that reveals more about the weaknesses. In addition, we also want to further investigate research questions aimed at the removal of credit growth, banking, and insolvency consequences for the general public and governments. In a nutshell, further research is imperative for a world inhabited by cryptocurrencies as a new policy, practice, and culture would be a good and great path to opening them (Wątorek et al., 2023; Wątorek et al., 2021; Sakharov, 2021).

It is likely that total economies will create both risk and reward institutions from which they are allowed to create. Additionally, one has to envision that the switchover to cryptocurrencies as a replacement for government money requires serious preparation to ensure security, decrease marginal dangers, and minimize systemic risk. The belief in the possible significant savings that could result from the joining of central banking actions of entirely equal degrees of relative quality and a similar amount of information from both will practically ensure that any government regulators abide by the maximal system that they regulate. However, if the central administration lacks the information, it may not adequately supervise. A new set of regulations and microeconomic instruments has never been retained by a Western party. A single global comparison of existing rules could provide insights into the extent to which distinctions need to be made between key partners and major worldwide economies. Regulatory bodies should work to avoid situations in which they benefit their home economies and firms. A directed effort can be used to build and operate a public database of central bank efforts to stop or prohibit activities in the digital currency industry.

The emphasis should be on the comprehensive and global nature of the data (Aziz et al., 2022; Gurgun et al., 2022; Allen et al., 2022).

Ideally, the involvement of governments in the creation and backing of digital money could offer substantial benefits. This could improve current monetary policy by increasing clarity and transparency about the amount of money in circulation. It could also allow for improved policy through automated policy implementation to increase efficiency and lower the cost of remittances for low-income cross-border workers. Governments have experimented with creating and backing decentralized cryptocurrencies and, most recently, with centralized varieties of digital currency. A slightly different idea of full government involvement, called central bank digital currency, has also been proposed. Central bank digital currencies are centralized, wholesale digital legal tenders on offer to non-banks. These gains could also be realized with a central bank digital currency to some extent, verifying the usefulness of central bank digital currencies. However, large gains are only likely to occur if the public is involved. This is unlikely, as information available from past experiences with other electronic payment media indicates that the public individually does not have strong preferences for bank account-based electronic money (Röckener, 2024; Ozili2023; Cunha et al., 2021).

There are legal, regulatory, and cybersecurity risks to be managed in adopting a central bank digital currency. A labor market survey of impoverished populations and small merchants found that the payments business model created partnerships and financial opportunities, indicating that low-cost, real-time payments were seen as somewhat positive. Although access to additional services was deemed to be a key incentive, consumer interest was mixed. This chapter has focused entirely on the monetary policy of cryptocurrencies offered by governments. It is possible that there may be additional public policy goals beyond generating profit. Central bank digital currency may also be useful for reducing the size of the shadow economy since lower fees can lead smaller businesses and individuals to use electronic money. Despite the potential, there is strong interest in seeing the results of the implementation of such a scheme. It is hoped that the project will provide useful findings concerning the security, business, and finance implications of implementing central bank digital currency. Any research into the cost of implementing central bank digital currency should include the cost of subsequent regulation. Jurisdictions considering such a scheme are discussing the need to develop a national approach, making choices among trade-offs between control and governmental sovereignty, and other factors. Given the potential losses if not seen through on desired or expected

policy results, there may be an 'only one chance' policy implementation option for central bank digital currency. The governments of Canada and Japan have both been considering the issue and are due to publish findings in the short term. It is yet to be determined how many nations are pushing forward with such a proposal (Chiu et al., 2023; Ozili, 2023; Tong & Jiayou, 2021).

7.Discussions on Central Banks Holding Cryptocurrency Reserves

7.1. Introduction

Central banks are discussing the possible future integration of cryptocurrencies and other digital assets into their reserves. A large part of the motivation behind this move is to transform their reserve assets into interest- and dividend-bearing ones. Reserve assets have traditionally contributed to the total interest income of central banks because central banks invest some of their reserves in interest-bearing assets. Common investments for such reserves have been government securities and gold. Over the last decade or so, major central banks have been discussing whether they should incorporate, and potentially trade with, reserve assets in the digital asset space. Reserve assets held by central banks contribute income that can enhance the fiscal position of these banks. The holding of assets in the digital space avoids counterparty or credit risk and has potential for operational efficiencies (Pelagidis & Kostika, 2022; Podder, 2023; Norton, 2024).

There are several reasons why central banks around the world would want to include cryptocurrency assets in their official reserves. One of them is the diversification of central bank holdings. A significant portion of the reserve assets held by central banks are held in the form of foreign exchange. Gold, which is another common reserve asset, makes up a small percentage of the total reserves. Of the total foreign exchange reserves, most are in the form of US dollars, followed by euros, renminbi, and yen. Another potential factor in favor of creating reserve assets with cryptocurrencies is speculative interest, which is believed to be growing at the moment. Central banks may benefit from investing in one of these cryptocurrencies, allowing these banks to book capital gains if prices surge over a period. These comments on a central bank creating wealth by investing in a speculative asset, however, deviate from the primary role of a central bank of price stability. Given that cryptocurrencies suffer from operational issues, they are also costly for central banks to operate (Pelagidis & Kostika, 2022; Jagtiani et al., 2021; Carvalho et al., 2021).

7.2. Historical Context of Central Bank Reserves

Central bank reserves have changed significantly over history. Generally, reserves have become more widely distributed, more explicitly held for policy reasons like domestic macroeconomic and financial stability, and the composition of the reserves has shifted from backing liabilities to acting as potential shock absorbers. A century ago, many top central banks held most reserves in gold, acting as the backing of their central bank liabilities. Although many emerging markets continued to back most liabilities with gold through the 1970s, central banks in high-income nations diversified partly out of gold into foreign assets in the decades before 1971, and then after gold convertibility was ended, they held significantly fewer amounts of gold as part of their reserves (Orebiyi & Archibong, 2022; Löscher & Kaltenbrunner, 2023; Baffes & Nagle, 2022).

Despite the risks posed by a gold-driven foreign asset portfolio consistently through at least the end of the Bretton Woods system, many central banks held a significant share of their reserves in gold in the 1960s and even early 1970s because of renewed speculative runs on the USD. With no known showing of direct price indexation of gold at the time, the accumulation of gold must have been less about holding wealth in a steady inflation environment and more about ensuring sufficient diversification of reserve assets. Today, central banks are under pressure based on the size of their reserves and their foreign asset assessments to back and ensure domestic financial system assets. Countries have different means of backing such liabilities due to the alternative adjustment mechanisms available to countries on their liabilities sides, which can come from outright collateral, government pledges, and the overall central bank value itself. Both accumulation and collateral pledges help ensure that central bank-issued money gets accepted domestically and in world markets (Fantacci & Gobbi; Eichengreen et al., 2022; Arslanalp et al., 2023).

7.2.1. Evolution of Central Bank Reserves

Central bank reserves have partially evolved. Once, countries mostly accumulated gold and silver. At the end of the 19th century, it comprised up to 90% of central bank reserves in developed countries. As precise institutional structures emerged conceptually, countries started to accumulate foreign currencies and financial assets in different foreign denominations. The period between the end of the 19th century and the early 1970s can be described as a time of a lack of consensus about the nature of the changes, conceptual advances, and policy recommendations designed to smooth the operation of global markets. Basically, two observations superseded every analytical framework. The first referred to

events, while the second was analytical and connotative. The 1930s featured two sets of events that proved the exceptional instabilities of international markets (Matthijs & Scholliers, 2022; Pittaluga et al., 2021; Gamba et al., 2021).

Above all, a massive flight of gold occurred in the wake of the combined U.S. stock market crash in October 1929, the breakdown of ordinary banking activities in the 1930s, and the subsequent defaults on financial obligations and restrictions on trade. The international economic disasters of World War II opened a new chapter in international politics. By the end of the war, the United States emerged as the world's major military and political power and a major creditor nation, transforming its world position and initiating the breakdown of the Bretton Woods arrangement. The period featured inexorable, endemic, and baffling instabilities in foreign exchange, global finance, and international payments. These market disturbances obliged the United States to make far-reaching changes in its post-war monetary and financial policies before other economic powers would agree on the terms for converting their dollar reserves into gold (Ikenberry, 2022; Gibson-Fall, 2021; Aydin, 2021).

Finally, global financial markets discount these changes in terms of country-specific risk; financial agents require higher compensation, seek to pursue international financial goals, and preserve liquidity. The third conceptual framework refers to currency wars and contesting fiat money standards. This would enable the exorbitant privilege to be converted partly into the creation of a new global public good: the emergence of the market for OTC derivatives. The supply of a safe and liquid admixture of reserve assets was absorbed, filled, and devoured by the growing demand for highly liquid dollar assets. This adaptation to a new global financial landscape opened the narrative of regional competition for liquidity. Finally, active discussions about adequate shapes of central banks' reserves, a multipolar world economy, and shifts toward multipolar concerns about monetary systems and reserve policies unfolded pathways of thinking about attitudes toward technically created currencies, central banks' liabilities and movements toward cryptocurrencies (Rostagno et al.,2021; Wellink, 2023; Challoumis & Eriotis, 2024).

7.3. Rationale for Central Banks Holding Cryptocurrency Reserves

Several authors have posited reasons that central banks might desire to integrate cryptocurrencies within their reserve management. It is observed that a diverse portfolio is a basic instrument of risk management for central banks, and that cryptocurrency's negative correlations with conventional assets can

potentially enhance central bank portfolio performance. These authors conclude that central banks are interested in holding portions of their assets in cryptocurrency based on the expectation of positive financial returns. The diversification rationale in these accounts is often couched in terms of the decentralization and privacy advantages of cryptocurrencies relative to the traditional banking sector (Pelagidis & Kostika, 2022; Podder, 2023; Chuen & Teo, 2021).

Several considerations other than financial returns have also been mentioned as potential catalysts for central bank interest in holding some amount of cryptocurrency at the asset level. It is argued that the global economy is short of safe, stable, and sovereign reserve assets, as demonstrated by recurring demand shocks for trustable assets, and that holding currency reserves in cryptocurrency form is a way to ameliorate the particularly sharp fluctuations in global bank dollar supply. As such, this analysis illustrates how central banks might choose to hold reserves in high-tech cryptocurrency as a route for indirectly offsetting fiat troubles. Furthermore, it is argued that the latest technological advancements in central bank digital currencies are designed to maintain the value of a national currency as a key player in global digital payment, facilitate cross-border international and cryptocurrency transactions, and meet scenarios for all sorts of generations, from inflation to deflation. These analyses envision central banks altering the composition of currency reserves to be more descriptive of the definitions approach to managing net asset lives. Additionally, underlying factors such as yield and credit quality, the context of low payments for currency reserves and reservation demand for native epidemiology problems has induced foreign-issued debt bets (Sakharov, 2021; Allen et al., 2022; Prodan et al., 2024; Plakalovic, 2024).

7.3.1. Diversification of Reserve Assets

This section discusses the diversification of reserve assets and particularly investigates cryptocurrencies as a potential option for diversifying a reserve portfolio. Central banks intervene heavily in domestic and foreign exchange markets, contributing to reserve assets in order to stabilize inflation rates and exchange rates. Diversification of reserves is used as a strategy to stabilize the country's economy by central banks. Reserves are diversified mainly into currencies and precious metals according to the central bank's goals, country-specific regulations, and standards to reduce their carry interest rate risk and to protect underlying sovereign risk (Adem, 2022; Brunnermeier et al., 2021; Arslanalp et al., 2023).

According to this approach, diversification contributes to less monetization,

less risk for depreciation, and more to store value. Currency exposure on reserves is one of the main trends for reducing sovereign risk. Especially, investment in foreign exchange reserves is suitable to decrease the risk of possible currency mismatches on the country's balance sheet. Diversifying reserves decreased the vulnerabilities of a country to vulnerabilities that arise from the external sector. In this context, reserve assets could be diversified with a further range of asset classes to reduce risk and offer a better worth against reserve asset depreciation. Those asset classes could be commodities, securities, and different interest-bearing securities. Central banks continue to invest in additional asset classes to control, reduce, and minimize the risks (Nguyen & Schinckus, 2023; Abdel Khalek & Rizk, 2023; Cardinale, 2022).

According to this view, countries can consider the diversification of reserve assets in a different direction that could help them in better preserving their domestic wealth against external economic crises from a new set of tools. In today's world, the rising status of cryptocurrencies makes them a potential candidate for central banks to hold sovereign reserves in addition to, or in replacement of, the already-held international reserves. Central banks are under great pressure from the increasing size of their own reserves, which might put them at serious risk in the case of financial and currency crises. This immediate coming place for these reserves as "precautionary tools" forces competitive countries like emerging countries to invest in the upper-tier asset classes in order to preserve capital and protect themselves in the face of inflating global values in the case of unexpected external shocks. The "phygital" feature of cryptocurrencies makes them even more interesting. When their central banks use them as reserves, countries can decrease their dependency on selected traditional currency types while obtaining the ability to take a portion of the shadow economy into the light and collect tax. On the other hand, even though they have some advantages, classifying new cryptocurrencies as reserve assets while there is no international standard or regulatory framework to regulate them might bear possible risks. While diversification into digital assets might allow central banks or not-so-rich players to save from robust returns, they may also lead to nullifying within some harsh contraction monetary policies when selling begins (Pelagidis & Kostika, 2022; Fantacci & Gobbi; Cunha et al., 2021).

7.4. Regulatory Considerations

There are considerations for the regulatory aspects of central banks holding cryptocurrencies, which explain central bank reticence to adopt such activities at present. Regulation of cryptocurrencies is inconsistent across countries and

central banks, reflecting the nature of rapid technological change and the slow pace of institutional development. The lack of harmonization of regulations governing cryptocurrencies between countries poses significant legal and oversight challenges for domestic central banks, which operate within a framework of prudential regulation. The role of various regulatory bodies ranges from adopting a wait-and-see attitude to becoming more technically engaged. Regulatory considerations are of primary importance for central banks considering the direct integration of cryptocurrency, with the size of the compliant ecosystem determined by the regulatory burden on DLT and custodial services. Any increase in costs would lead central bankers to serve a smaller segment of the market, resulting in constraints in the realization of technological benefits (Pelagidis & Kostika, 2022; Kouam2023; Wronka, 2024; Silva & Mira da Silva, 2022).

Regulating the use of cryptocurrency is necessary for developing robust control and operational integrity services, as well as security. Regulatory concerns about cryptocurrencies have not just been technical in nature. International regulators have voiced their concerns about the involvement of central banks in cryptocurrency markets. Key concerns are financial market interference, including both threats to growth, threats to the banking system, and disruption of transmission mechanisms. Hence, this monetary policy requires constant vigilance and dynamic assessment and consideration of international market conditions in the decision-making process. While the impact of the cryptocurrency market is currently quite low, it is beginning to gain credit and attract the attention of central banks these days (Wronka, 2024; Ferreira & Sandner, 2021; Corbet, 2021).

7.5. Case Studies of Central Banks Holding Cryptocurrency Reserves

The discussions presented in the previous sections are supported by the observations of several central banks that have managed or initiated the management of cryptocurrency reserves. This section presents a short summary of implemented and potential strategies across different world regions. Furthermore, it provides a preview of their political and economic climates and monetary policies (Prates, 2021; Carvalho et al., 2021).

Throughout this guide, case studies are drawn from several central banks. These institutions have declared that they currently hold cryptocurrency, are investigating the acquisition of cryptocurrency, or have considered the acquisition of cryptocurrency. Each jurisdiction offers a unique view into potential strategies and risks for an institution considering cryptocurrency assets. National ap-

proaches are dependent on the political, economic, and financial circumstances of each country; they differ significantly. In developed countries, for example, central banks tend to holistically recognize the economic and social potential of cryptocurrency and, at most, experiment with these assets. Conversely, in developing countries, emerging markets, and transition economies, there is currently a general negative or skeptical attitude among regulators regarding the potential of accepting cryptocurrencies as a legal method of payment. The experiments and initial research on the viability of these assets tend to be cautious, reflective of national characteristics and a slower pace of development that may influence adoption. Hence, strategies towards potentially holding or banning such assets in reserves should consider not only the characteristics and risks of specific cryptocurrencies but also the country-specific national context, potential hurdles, and challenges (Pelagidis & Kostika, 2022; Cunha et al., 2021; Auer et al., 2022).

7.5.1. El Salvador

El Salvador's adoption of Bitcoin as legal tender and its proposal to grant citizenship to the crypto wealthy have brought the country's government and people into the media's focus. After one and a half years since the proposal in June 2021, there have been discussions on the design, the obstacles, and potential gains, but none have addressed the issue of how the international investment community would react, either at the time of the announcement of the proposed adoption or later, after the detailed implementation measures have been made available. This sub-section is set to fill this gap. The adoption of Bitcoin by El Salvador has several sources, including the idea of attracting foreign investors, numismatic beliefs, distrust in central banks' monetary policy, and the harmful effects of the high cost of remittances. It could also allow El Salvador, and later other countries, to pool their reserves in Bitcoin. El Salvador's experiment has brought about economic gains through the increase in the inflow of dollars and potential gains from investments in the infrastructure needed to exploit Bitcoin mining and Bitcoin mining farms. However, the current account surpluses that resulted were not long-lasting. They were dwarfed by the potential capital losses when faced with all the challenges (Taçyıldız and Yorulmaz, 2022; Alvarez et al., 2023; Yorulmaz & Taçyıldız, 2022; Jaatinen, 2022).

We found three factors that would determine the inflow of investments whenever it approaches: skepticism, the intensity of Bitcoin volatility, and regulatory requirements. Until June 2021, it was difficult to find resounding praise for it. One analyst described it as signaling the new digital mode of a contemporary

presidency and heralded an age of economic independence reshaping the future of Latin America, but that did not lead to recommendations to invest. The other said, "Nice words from President Bukele, but with the expropriation of ASN by Daniel Ortega in Nicaragua plus the current laws, it looks awful to start a company in El Salvador that accepts Bitcoin." El Salvador's experiment provides a case study of under what conditions nations would adopt cryptocurrencies such as Bitcoin domestically. It also has implications for what would happen after their adoption. The case also serves as a warning of the kinds of problems nations will encounter, particularly in how to deal with money laundering, terrorism, and handling reserves that result. When countries pool their reserves in a country-wide or regional cryptocurrency, the conditions that must be satisfied have not been sufficiently studied. The adoption of Bitcoin in practice only started after cryptocurrency reserves became possible (Hernandez, 2022; Irmiya et al., 2023; Huang & Mayer, 2022; Bezovski et al., 2021).

7.6. Future Implications and Trends

As the financial world evolves, it is essential to reflect on the new developments and how the adoption of blockchain and cryptocurrency for more than a decade now could influence central banks' reserve management. There are, however, many trends that emerge within the central bank community of different opinions, programming, and platforms, collaborated projects, as well as the more cautious ones, who will only lead into digitalization and cryptocurrency at a much later time. It is too early to know what the future will bring, but this analysis will cover some of the shifts and ideas that might be shaping the central bank reserve management of 2023 and onward. Whether other organizations will have developed internationally accepted guidelines or if every central bank will have done its own research and shaped its reserve currency management will directly link to technological advancements and access, as well as legal regulations and the acceptance of the general public. In 2023, based on those factors, the analysis will delve into some of these different outlooks. If central banks start to hold digital currencies, the characteristics inherent with the product might present certain benefits, but equally important drawbacks, both of which might directly affect the business sector from central banks to cryptocurrency. On the one side, central bank-issued digital currencies might present less counterparty risk, as there will be no banks or financial institutions standing between the cryptocurrency emitter and the owner, thus bringing liquidity on a silver platter. In contrast, however, conventional CBDCs are faced with many regulatory requirements, and creating a successful and reliable network and

spacious adoption will require technological capabilities and a marketplace or sales stream that defies importance. Taking a cashless society route might also reach external solutions and have a greater impact on monetary policy, where the Bitcoin cryptocurrency rates might show the bank unfavorable regulations. This could result in a trend where either the value of the currency will gradually decrease or the rapid adoption of cryptocurrency will need to alter the monetary policy, which is based on that of banknotes and bank license issuance (Carvalho et al., 2021; Kayani & Hasan, 2024; Podder, 2023).

7.6.1. Impact on Monetary Policy

Over the last decade, there has been a likely shift from cryptocurrencies as a speculative bubble to a more widespread usage as a general medium of exchange or speculative asset. As a result, central banks have begun to interact with and monitor decentralized finance and cryptocurrencies, from risk management to financial stability. However, Bitcoin's market dominance continues to decrease, and other blockchain networks have grown in market capitalization, which will increasingly attract the attention of central bankers. These cryptocurrency networks have different governance and infrastructure compared to Bitcoin, some even designed to mimic the monetary policy of central banks from inception through ownership or block production distribution mechanisms. For this reason, they may be able to challenge any form of traditional monetary policy that arises in the future due to widespread central bank digital currencies. With the growth of controlled supply, internet-native blockchain token networks, the diversifying and growing market for these assets may affect major aspects of modern monetary policy (Pelagidis & Kostika, 2022; Kayani & Hasan, 2024; Cunha et al., 2021).

First and most prominently, there may be a shift in the transmission mechanism of monetary policy due to central banks holding cryptocurrency reserves. In the money multiplier model, holding more traditional reserve assets helps to create more demand deposits, which allow for money creation when currency is loaned out. However, under central bank holding of cryptocurrency reserves, the value creation of zero reserve cryptocurrencies persists between users of these cryptocurrencies, and holding these tokens as a reserve asset has limited ability to systematically alter their price or availability. Therefore, traditional control from commercial bank dollar reserves through the money multiplier system may be disrupted when cryptocurrency makes up a larger share of commercial bank reserves. To rebuild a system more like the traditional money multiplier, central banks could control interest rates or require a liquidity share in reserve balances

through open market operations to more directly change the supply of dollar reserves (Miranda-Agrippino & Ricco2021; Wei & Han, 2021; Luetticke, 2021).

8.Investigating the Alleged Connection Between Cryptocurrencies and Ponzi Schemes

8.1. Introduction to Cryptocurrencies and Ponzi Schemes

In recent years, cryptocurrencies have gained rapid acceptance in various financial markets all over the world due to their decentralized nature and transactional properties. Market regulation has made it difficult for Ponzi operators to operate freely, and almost all countries have regulatory authorities that ensure that such fraud does not spread to the wider economy. Over the years, users have been subject to today's large-scale frauds in the financial world. As an emerging financial investment tool, many studies have begun to investigate Bitcoin and cryptocurrencies and their position in the capital of investors. Following the popularization of cryptocurrencies due to their limited size and high levels of dissimulation, governments and central banks have launched studies and developed various discussions. The fast popularity of cryptocurrencies has led to reactions in public opinion, such as measures aiming to ban their use in many countries, official statements warning consumers to be cautious about such instruments, and studies that examine the potential applications that can be used in the economy. In recent years, the organizational process, warnings, and survey studies of many official institutions against fraud have made several investors worried about the safety of using cryptocurrencies, most of which are considered to be Ponzi fraud schemes. This has increased the importance of finding evidence linking this fraud structure to cryptocurrencies. The extent to which Ponzi operators manage to cheat investors and the characteristics of the investment tools must be investigated in terms of the existence of the relationship between cryptocurrencies and Ponzi schemes. (Trozze et al., 2022; Siu et al., 2022; Agarwal et al., 2024; Choi et al., 2024; Nguyen et al., 2024).

8.2. Historical Background of Ponzi Schemes

Ponzi schemes are named after Charles Ponzi, an Italian immigrant in the United States who enticed thousands of New England residents to invest in a complex postage stamp speculation scheme back in the mid-1980s. Over the years, however, the Ponzi idea has been adapted to a variety of conditions. Ponzi schemes have a few characteristics in common, the foremost of which is their aim of providing lucrative financial returns to participants with money from new participants rather than from actual revenue supplied by a product or ser-

vice. Profits as high as 50 percent over short periods or guarantees of a 10 to 18 percent return over a year are common. They also tend to employ psychological strategies to build excitement and create a sense of urgency, such as the fear of losing the opportunity (Fratrič et al., 2022; Fei et al., 2021; Halim et al., 2021).

Ponzi's corruptions triggered his rapid fall. Yet, by that time, he had received more than 7 million and tens of millions in investment. The testament of panic in the inspiration to issue a license is the bustling crowd, long lines, and agitation of Ponzi's anxious depositors. Despite losing 20 percent of their investment at Winchester Trust, thousands of depositors who had been previously ignorant of it queued at Ponzi's door, realizing they would never be able to recover what they had already invested. Any similarity with issues that have arisen regarding a digital financial entity is purely coincidental. Once a society has come to understand that their property is gone, its anxiety or enthusiasm abates, hence underlining the value of deception in marketing as well as disapproval of their disbelief. Nonetheless, the Ponzi issue will persist in the 20s, restricting trading and investment in securities to bank deposits for a long period as a result of creditors' losses stemming from the events (Tajti, 2022; Leslie, 2022; Yongding, 2022; El Hajj & Hammoud, 2023).

8.3. Evolution and Adoption of Cryptocurrencies

Cryptocurrencies have come a long way since their invention in 2008 by an unknown person (or group of people) named Satoshi Nakamoto. The underlying technology of Bitcoin, the first ever cryptocurrency, is often considered a logical next step in the digital currency phenomenon. It was argued in theoretical research on digital money from the late 90s that monetary systems should evolve from "national" to "transnational" and on "international" transactions, to finally evolve on a "multinational" global level. It wasn't until 2009, however, in the midst of an economic crisis, that this vision became an actual reality. In 2019, a new digital currency was announced that would enable cheap, direct, and fast international transactions without the need for interbank relationships (Panda et al., 2023; Kunaifi et al., 2022; Al-jabra et al., 2023; Madakam et al., 2023).

Blockchain technologies – the technology behind Bitcoin and many of the current cryptocurrencies – offer an unprecedented level of transparency and "trust" among transacting counterparts. This technology potentially enables the transition from the traditional "transaction model," based on the trustworthiness of the bank holding the participants' assets, to a more equitable trust through the "technology protocol," which has been particularly appealing to participants in the Sharing Economy. Decentralization, financial freedom, and a strong reaction

to the global financial crisis from 2008 all motivated the increased adoption of cryptocurrencies. This community was primarily made up of technical experts involved in cryptography, computer science, coding, and building a wide range of software applications. What is important to outline is that the original intention behind the design of the cryptocurrency mechanism was clear; however, the evolution of the motivations and the wider adoption converted the cryptocurrency space into more of an investment haven. This evolution and adoption have other knock-on effects, including new regulatory frameworks and central bank interest, large bank interest, and national government interest in terms of liabilities, criminal investigations, bilateral agreements, and the risk of impacting financial stability. The new landscape poses the question – is this evolution and wider adoption lucrative in terms of investment or fundamentally flawed and risk-laden? The situation might be considered as an "adaptation" or "evolution" of the initiatives. Due to considerations surrounding fraud and scamming, however, this hypothesis should be investigated further (Ollivier, 2023; Aharon et al., 2021; Mishra et al., 2021; Wątorek et al., 2023; Demiralay & Bayracı, 2021).

8.4. Key Characteristics of Cryptocurrencies

Cryptocurrencies offer many features and services that distinguish them from traditional fiat currencies. Most notable in this respect are the following four fittingly similar features. First, cryptocurrencies are decentralized, meaning that no government or financial institution has control over them. Digital shares of ownership of digital assets stored on remote decentralized servers are auctioned, bartered, and/or sold to anyone who wishes to purchase them. Because cryptocurrencies are decentralized, there are no central points of control or authority through which mismanagement bureaucracies operating within corrupt governments can steal funds (Hassan & Azhar, 2022; Jagtiani et al., 2021; Altschuler, 2022; Ahamad et al., 2022).

Second, the digital assets and all other information on cryptocurrency blockchains are highly encrypted. Digital asset owners hold private keys and/or passwords required for access. Third, users of these exchanges can store their digital assets anonymously, making them immune to seizure by governments and creditors or theft or hacking by unscrupulous employees of these exchanges. Fourth, with a small money-transfer device that is easy to use, requires no special resources, and can be operated by anyone with access to a smartphone, digital currencies can be sent anywhere in the world. Thus, these products and services enable not only darknet users but also a wide range of other individuals, including privacy and security-concerned individuals, to own entirely untraceable

currencies that are free from taxation and the monitoring of law enforcement and/or intelligence agencies. While there are many innovative ways that these features can be applied benevolently to serve humankind, they can also be used malevolently to harm humankind. Cryptocurrencies are a diverse, fast-evolving group of products and services. While some are provided by wealthy, benevolent oligarchs and their ethics and compliance teams operating within government-approved jurisdictions, others are provided by greedy, malevolent con men operating outside of the law. Although cryptocurrencies offer many benefits to various individuals involved in business, finance, mental healthcare, darknet crime, and other professional fields, all of the four distinguishing decentralization-related features that we have listed represent inherent consumer-protection risks; consequently, they are the four features most commonly used to facilitate fraudulent schemes, including Ponzi schemes. Although these are viewed mostly (but not exclusively) as adverse points associated with cryptocurrencies, there are relatively few studies investigating these points within cryptocurrency (Chen et al., 2021; Akash et al., 2024; Cross & Holt, 2021).

8.5. Regulatory Challenges and Concerns in the Cryptocurrency Market

Cryptocurrencies are now commonly used by both businesses and consumers to effect a broad range of financial transactions, from raising capital to making payments. Consequently, not only have an increasing number of states enacted laws regulating this burgeoning industry, but also a number of government regulators have attempted to develop regulations that will protect investors and consumers without stifling innovation. In the U.S., there is a perception that there is a rush to develop regulations that will provide clear guidance to industry participants and encourage capital formation from those who wish to avoid the perceived high cost of securities registration (Chen et al., 2022; Ahamad et al., 2022; Temizkan et al., 2022; Jagtiani et al., 2021).

However, there are a number of difficulties that hinder the development of laws and regulations for the cryptocurrency market. First, and perhaps more importantly, is the question of whether it is possible or practical to separate cryptocurrencies from Ponzi schemes, regardless of what the law provides. Many thought leaders in the cryptocurrency world maintain that Ponzi schemes are endemic to the cryptocurrency market for a variety of reasons. Indeed, it is stated that it is not productive to separate Ponzi schemes from crypto in the classical sense. This means that crypto and Ponzi schemes are inherently the same. There may not be fraud, but everything behaves like fraud. Given the analogy

between cryptocurrencies and Ponzi schemes, it is worth first considering the state of cryptocurrencies and their regulation. These laws and regulations will be relevant to regulators that are seeking ways to stop Ponzi and other frauds in the cryptocurrency space (Chen et al., 2021; Choi et al., 2024; Onu et al., 2023; Maurushat & Halpin, 2022).

8.6. Theoretical Frameworks for Analyzing Ponzi Schemes

In the literature, Ponzi schemes can be analyzed with various theoretical approaches, which cover fields from economics to psychology. An approach taken by economic theory is game theory, where a spectrum of people from one to many are analyzed. As part of a complete literature review on Ponzi schemes, the different characteristics of Ponzi schemes are categorized. While it was not the aim of the following paper to offer a precise definition of Ponzi schemes, it condenses the different characteristics of Ponzi schemes found in the theoretical research to offer a concise overview. This can be an interesting step to further connect the dots to findings within the field of cryptocurrencies. Furthermore, a close look at the theoretical papers provides a range of potential explanations for why people run Ponzi schemes and why people join them – key explanations are gathered and condensed. Additionally, when analyzing the bounds of Ponzi schemes, the issue of social trust and effects is often invoked. Social dynamics play a crucial role in processes, yet they remain mostly unaddressed when trying to find the roots of Ponzi networks. Finally, risk perception, loss aversion, and other cognitive biases can deeply influence the behavior of Ponzi participants. This can be essential to understand participation in cryptocurrencies, which is shaped by similar effects (Fei et al., 2021; Chiluwa & Chiluwa, 2022; Mandal, 2024; Dupuis et al., 2023).

In a similar interdisciplinary effort, economic reasoning has also been employed alongside psychological theories, such as prospect theory or cognitive dissonance, to investigate why people would participate in Ponzi schemes and why these schemes can persist for relatively long times under certain circumstances. Based on these theoretical frameworks, the findings indicate that the existence of a rational Ponzi promoter may be a spillover from investments related to Ponzi-like dynamics commonly observed in the early stages of smart contracts. Moreover, due to the strong incentives to allure new capital to the contracts, visible dispersion of investors' entry brackets is unavoidable. In sum, the intersection of Ponzi schemes with topics from economics and psychology shall be investigated more deeply in the following sections (Glavas et al., 2023; Li et al.2023; Wang et al., 2024; Zheng et al., 2024).

8.7. Linking Ponzi Scheme Elements to Cryptocurrencies

Cryptocurrencies have come under increasing scrutiny in light of allegations that they might enable fraud. Critics argue that some cryptocurrency projects embrace strategies typical of Ponzi schemes, such as offering steady returns, and thus depend on attracting new investors. The largely anonymous and unregulated character of cryptocurrencies is thought to make fraudulent activities easier and thus more widespread. In this paper, we ask whether cryptocurrencies themselves can be understood as facilitating activities typically associated with Ponzi schemes. We identify four key elements of Ponzi schemes and use these elements as benchmarks for assessing the 'Ponzi-ness' of cryptocurrencies. Herein, we draw on multiple cases of alleged crypto-Ponzi schemes as evidence (Hamilton, 2024; Srour, 2024).

Our overall goal is to illuminate the connection between specific aspects of crypto investment projects and cryptocurrencies in general and Ponzi schemes. More specifically, we are interested in whether Ponzi scheme elements are constitutive of the operational logic of certain types of cryptocurrency projects and whether certain features of cryptocurrencies, as a new asset class per se, run the risk of lending themselves to Ponzi-like abuses. We are particularly interested in the disposition of investors to assess information about a cryptocurrency's given investment potential in bullish markets, and the role of social media and online communities in perpetuating fraudulent narratives through self-reinforcing feedback loops of hype and financial speculation (Sanz-Bas et al., 2021; Liu & Yin, 2024; Chakravorty-Aspelin, 2024).

8.8. Case Studies and Examples of Cryptocurrency-Related Scams

The following sub-sections present case studies and examples of scams that either arose or are heavily couched in the context of cryptocurrencies. Some of these examples are well-documented in cryptocurrency discourse and in projects concerned with identifying fraud efforts. Others may have gained less notoriety. However, all are encouraged to recognize the recurrent themes that are deployed and, at least to a degree, maintain these entities operating successfully. Throughout these examples, the potential consequences on affected parties such as the financial and psychological impacts upon investors and their families, as well as the tarnishment of the cryptocurrency community, should be considered. In crafting this report, it was also affirmed that to streamline analysis of this problem, from here on forward – and without a degree of clarification – all references to Ponzi schemes can also be taken to include related schemes

such as pyramid schemes and similar anti-social and fraudulent investment opportunities (Kutera, 2022; Bar et al., 2022; Trozze et al., 2022).

Worthy of some definitional boundaries, a case-specific capacity to overcome common use nor the assignment of a rating. Grouped by their recurrent themes, the following selective examples describe dated and contemporary incidences of Ponzi-like schemes and Initial Coin Offerings. The granularity of detail in each description relates in part to the availability of information and the date of their occurrence. They are presented in the spirit of the study to encourage recognition of deceptions that operate amidst the widespread legitimate use of cryptocurrencies by an array of stakeholders (Ali; Emmert, 2023; Scharfman, 2023; Petar, 2023).

8.9. Global Powers and Cryptocurrency Influence

In 2021, Vladimir Putin aired his priority: "It's important to develop common rules for this sphere and, in general, to pay more attention to combating the use of cryptocurrencies for illegal activities." This proclamation extends to a growing list of major economic powers seeking to project their influence onto the development of cryptocurrencies. From the unconditional refusal to accept cryptocurrencies as a national or international payment instrument in countries such as Bangladesh and Ecuador, to complete bans on their mining, trading, issuing, and stock exchange listings in national territories justified by the fear of illegal activities and harms, early in the 2010s, the People's Republic of China shifted toward embracing the promise and dangers of money without borders. For then renewed economic superpowers like China or similarly India, crypto tokens might even help minor regional reserve currencies usurp or "internationalize" the accumulating redemptions of the U.S. dollar and interdict ever-dragging, stop-and-go inflation. These shifting stances mirror over a year of fluctuating global Bitcoin trade volumes — no matter the active gray market, forecast-busting yields, or worsening oscillations from Shiba Inu declaring itself the Doge of the People. Each regulatory episode of capital flows to and from participants in the global crypto market is a daily encounter with geopolitics' twin logic, as bracing as the adventures of haute fashion those same crypto windfalls might fund. Every uncorrelated daily micro doctrine of state or industry re-scaled leads to a post-financially abstracted proof of itself established. Profit and loss may be bulbously encoded, but Yellen and her European counterparts are always gambling some internal risk when bluffingly drawing attention to some highly speculative aspect of crypto finance, or erecting protective, attractiveness-depleting barriers to entry. The economic valuation of crypto

tokens is helped or hindered respectively by the exalted scorn of old capital, or by its rivals' vaccination against all but the most elaborate and complex of unconstitutionally constructed pyramid schemes (Begum2021; Ebekozien et al., 2024; Rohanifar et al., 2022; Wogu, 2021).

8.10. State-Sponsored Cryptocurrency Initiatives

Many governments worldwide are beginning to take blockchain seriously; some are already integrating the technology into their projects. State-sponsored cryptocurrency initiatives can serve as a resource pool from which economic analysts can glean valuable insights about key players' incentives and the direction of innovation in a rapidly changing cryptocurrency industry. The state's interest in its own cryptocurrency can have economic motives. The governmental, monetary, and fiscal policy of many states is aimed at expanding the financial inclusion of their citizens and economies. The systemic application of financial technologies based on open accounting registers and strengthening the financial system, its resilience, and the efficiency of digital accounting technologies is a logical step for the future of states' strategies. Additionally, a foreign currency could be used to achieve strategic economic advantages by expanding the detailed expertise and innovation of digital ledger technologies (Alam et al., 2021; Pauletto, 2021; Kalenzi, 2022; Krichen et al., 2022).

Moreover, the possibility of transactions operating at machine speeds facilitates moving from being market offerings themselves into internal transaction engines for large non-blockchain-based companies. These domestic uses of the blockchain can have wide effects. The projects can stir public interest in cryptocurrencies and other blockchain-based projects, which in turn may expand the demand for digital blockchain-enabled services. Finally, governmental blockchains can influence the international blockchain community by encouraging numerous developments in open software for blockchains—both open and exclusive. These projects implement both a governance structure that differs from typical cryptocurrency projects and heavily rely on an underlying technology framework that is currently not present in any public distributed ledger. Potentially, a faster functioning system with higher transactional throughput can make the state cryptocurrency competitive with current cryptocurrencies. As a result, this leads suddenly to enormous competition with public blockchain systems that do not cater to the 'fast money' crowd of traders and self-interested miners. While a nimbler currency is good for the state, its usage among traders can have large and disruptive effects. There are risks connected to the issuance of state-sponsored cryptocurrency. There is the potential that

the regulations and secrecy surrounding national cryptocurrency functions can link them with Ponzi scheme-like activities in the eyes of the world community. Such links enhance fraud, enhance internecine conflict, reduce the economic value of geospatial innovation, reduce innovation, and lead to decentralized blockchain-based technology and cryptocurrency evasion. Governments will have to make bold decisions about the use of this technology without also battling the unregulated internal ratio. With all these potential conflicts, the innovation would still, however, lead to net benefits if managed wisely. Regulatory actors also have to consider the domestic and international impact and must understand that the Ponzi-connected issue will not escape the geopolitical rivalry space. Rather than combating cryptocurrencies, it is instead worth investigating the similarity between such behavior and dedicated state-sponsored cryptocurrency funds (Stockburger et al., 2021; Maram et al., 2021; Ma & Huang, 2022; Ariemma et al., 2023).

8.11. The Role of Regulatory Bodies in Detecting Ponzi Schemes

Last, but certainly not least, the regulatory bodies are extremely important in detecting Ponzi schemes in the financial landscape. They have earned the reputation of being the cop on the beat for ensuring market integrity and protecting market participants. Regulatory bodies can bring enforcement actions against those who are suspected of engaging in fraudulent financial transactions or those who are attempting to manipulate financial markets. They are also responsible for regulating the financial activities inside the country. They oversee all the securities, including the cryptocurrencies that are sold inside the country. Those regulatory bodies in particular are very important in protecting their country's financial markets. Efficiencies, competencies, and cooperation at a national level between regulatory agencies can help to detect fraud not only in cryptocurrencies but also in other financial activities that are connected internationally. It is a necessity for regulators to work efficiently with international partners, not only with diplomatic representation but with other regulatory bodies as well (Daraojimba et al., 2023; Bello & Olufemi, 2024; Chiluwa & Chiluwa, 2022).

There are many challenges to detecting international Ponzi schemes. The fast technological development in cryptocurrencies is one of the specific challenges that makes detection difficult. International regulatory bodies can help in the international investigation of potentially fraudulent claims. They can have a positive effect in decreasing the number of potential victims by continuous educational campaigns done to raise awareness, not only about Ponzi schemes but also about good practices. It could be a part of the suggested action to constantly

upgrade the training and provide training for staff. Cryptocurrencies produce challenges in detecting fraud. In conclusion, regulatory bodies are crucial for the detection of Ponzi schemes in the financial landscape. Their detection can decrease the number of deceived financial consumers. But these actions need to be responsible for striking a balance between consumer protection and not stifling all the possibilities of innovation (Uzougbo et al., 2024; Quamara & Singh, 2022; Ozer & Sakar, 2022; Pocher et al., 2023).

8.12. Technological Advancements and Ponzi Scheme Detection

Technological innovation has always played a major role in the detection and prevention of Ponzi and other illegal schemes, with tools and methodologies being developed to ensure better oversight and protection. As of late, blockchain analysis, critical data, artificial intelligence, machine learning, and data-driven systems have emerged as means of identifying Ponzi schemes online and in real-time. Their capabilities have the potential to disrupt the market and improve transparency for possible investors and stakeholders. As a list of verified transactions, blockchain is essential for cryptocurrency and presents an opportunity to analyze the user's activity and expose fraudulent activities. In addition, because the data is distributed in a peer-to-peer network, it is very difficult and time-consuming to manipulate or delete. This feature also has the potential to create a fraud-resistant environment that would increase the difficulty of running a Ponzi scheme. There are many potential opportunities to disrupt the Ponzi scheme online without changing the nature of traditional Ponzi schemes. Currently, fraudsters are also continuously developing new strategies and taking action to avoid detection. The standard control and technology of today cannot provide ultimate security solutions. Therefore, developing technology platforms and algorithms that are continuously updated will not only increase the detection process but also increase the chances of eliminating the Ponzi scheme. Cooperation between all stakeholders online involving not only technological advances but also sociological studies is crucial. Therefore, investment in innovation and technological development should not be seen as a one-off cost but as an investment in ongoing protection (Trozze et al., 2022; Onu et al.2023; Liang et al., 2024).

8.13. Empirical Evidence on Cryptocurrency Market Manipulation

While the tools and mechanisms utilized by Ponzi promoters to manipulate and control supply are among the main similarities between cryptocurrencies

and Ponzi schemes, one also needs to take into account the greater flexibility of cryptocurrency market manipulation. As this overview has illustrated, some of the market manipulation behavior described in this section has since become integrated into the standard terminology for discussing market manipulation and/or is part of existing economic theory. Conversely, the recently developed tools and methods utilized by researchers to find such behavior on major exchanges may serve as useful future tools to study the ramifications of this market manipulation on Ponzi sustainability (Luna et al., 2024; Bouaicha & Drissi2023; Vinothkanna et al., 2024).

A flood of historical empirical research explores various approaches to cryptocurrency market manipulation, results of case studies of USA-centric activities, intrinsic statistical anomaly analysis, and there is marginal recent research. The empirical work within this paradigm consists of portraying various case studies or statistical analyses on real-world cryptocurrency data and contrasting them to the hypothesized model of market manipulation drawn from socio-economic theory. The historical work in this area of market manipulation can be divided into five descriptive sub-categories: pump-and-dump, market manipulation through media-related FUD or hype, journalistic accounts, including at least a few for which the median reader says the main charge is accurate or made more likely by the news outlet's practice, wash trading as fulfilled by simulation actors who play the part of both buys and sells, and mining pool-based front-running (Li et al., 2023; Ortu et al., 2024; Kumar & Chettri, 2024; Fernández-Macías & Bisello, 2022).

This volatility and level of anarchy lead some individuals and other government entities to willfully ignore cryptocurrency exchanges. Such a laissez-faire attitude is, in my opinion, equally problematic (if not more so damaging the public image) due to a "louder" effect: spreading confidence or aid in trust to "potential" investors. But by allowing "bad actors" to play in such a sandbox, government regulators and officials may be helping to substantially increase the level of harm and economic panics that are matched with market manipulations. Historic attacks in cryptocurrency markets are not speculative. Feature a section summarizing the evidence of historical frauds and market manipulations as indicated through the work of market regulators across the globe. This would also mention gaps or shortcomings of these forms of enforcement. Examples of regulations include investigations of complaints of companies executed with "fraudulent" (unethical or manipulative) business practices (Kukacka & Kristoufek, 2023; Caporale et al., 2021; Wątorek et al., 2021; Manahov, 2024).

8.14. Misconceptions and Myths Surrounding Cryptocurrencies

While it is true that the rate of autonomous systems from which cryptocurrency transactions occur is increasing, including Iran, Russia, and others, we simply do not make any connection with any form of Ponzi scheme. One possibility is that there is growing interest in initial coin offerings. With 81 percent of investors reporting no previous experience trading in ICOs and many users new to cryptocurrency, it is plausible that falling prey to speculation influences the market in a way they would not have to the same degree in more established markets. However, in and of itself, investing in cryptocurrency is not a de facto Ponzi scheme any more than buying shares in a company that is part of a criminal organization (Campino et al., 2021; Wang et al., 2022; Hadan et al., 2024).

There are any number of myths about cryptocurrency or perceived properties commonly conjectured during general discussion. Some of the more widely held misconceptions about cryptocurrency are that it is: a completely worthless scam; good only for criminal and terrorist financing; a rapidly appreciating asset with the potential to bring in 100-fold returns on modest investments; or a benign asset that might fluctuate but essentially has little risk. However, there are also unique misconceptions held by the critics. One common misconception held by cryptocurrency critics is that it is "good only for Ponzi schemes and pump-and-dump scams." This overlooks the very real technological, economic, and informational properties that cryptocurrencies possess. While history records hucksters operating in the cryptocurrency markets, it does not follow that cryptocurrency is inherently Ponzi. Economists like Irving Fisher, who bought stocks in the 1920s, were not all running Ponzi schemes; genuine companies, tech innovations, and new efficiencies were also growing across the financial spectrum. Given the different ways of thinking and the diversification of opinion about cryptocurrency, there are genuine concerns that unintended consequences of good intention could arise. For example, if there are any ways for the public to take even more regulatory actions towards cryptocurrency unwittingly by the loose association with Ponzi schemes, those who are familiar with Bitcoin will be put under suspicion by the public. An investment that carries a lower risk is going to be more profitable in the long run than one with a higher risk. If an investment opportunity looks too good to be true, it probably is, which leads to test whether this is true in the case of cryptocurrency Ponzi schemes. We argue that the seemingly high profits do not serve as a poison pill to scare away potential investors, even those who work in industries that require years of professional education to obtain, because everyone can make mistakes (McKenzie & Silverman, 2023; Norton, 2024; Nolasco Braaten & Vaughn, 2021; Corbet, 2021).

8.15. Ethical Implications of Cryptocurrency Use

Cryptocurrencies have a number of characteristics that influence user behavior and social norms and are already used in practice for various purposes. However, the use of this tool is associated with a clash between its innovative potential and ethical challenges. Potential problems include the development of a new digital divide, i.e., financial exclusion, and environmental concerns with respect to mining, as well as the creation process of most cryptocurrencies based on Proof of Work. Another issue is the attitude toward anonymity and its misuse for illicit activities. Therefore, there is a need to develop ethical frameworks for cryptocurrencies (Sestino et al., 2024; Esoimeme, 2024; Horobets et al., 2024; Klein et al., 2024).

Ethics influence the development of technology and the use of new experiments, ideas, and practices. The same applies to cryptocurrencies. This attitude is present primarily in legal and regulatory solutions, but also in the lack, weakness, or general social awareness and acceptance. It is very important for developers and investors in this area to approach a dialogue with society, ethical leaders, and governments seriously, and not to deliberately avoid regulatory issues. Therefore, an appeal should be made to these groups to be actively involved in social discussions and contribute to shaping the ethical dimension of new technologies, such as cryptocurrencies. There is a need to determine the ethical impact of the next values, considering their deeper understanding and meaning. The discussion and search for solutions should refer to the proposal of values derived in the area of the fabric sector but applicable in other sectors of any value chains. Before the values are stated, the responsible conduct of the industry and stakeholders in the management, development, and use of this decentralized payment system should be questioned. Finally, the system of values developed encourages loyalty to both customers and the concept of society (Petar, 2023; Klein et al., 2024).

Tests are designed to identify ethical failures that result in deceptive or fearmongering practices and to point out potential safety issues that pose problems for organizations, so that appropriate solutions can be established. Fraud investigation based on ethical considerations and modeled with this method has been extended to develop a model in the cash market with similar principles. It is also possible to link points to ethical trade behavior and prove its role in customer satisfaction. This study focuses on the interplay between ethics and measures to avoid fraud and plays a significant role in increasing public faith in the sphere of cryptocurrencies and, therefore, their broader adoption (Verwey & Asare, 2022; Shonhadji & Maulidi, 2021; Rashid et al., 2022; Wahyudi et al., 2022).

This chapter synthesized the results from the analyses presented, indicating a complex relationship between cryptocurrencies and Ponzi schemes. Technological advancements and regulatory deficiencies, as well as ethical considerations, were identified as main implications of the research. Investigating further the theme of regulatory deficiencies indicated some implications for investor education and revealed a possible way to mitigate the urgent negative leverage. The complexity of the cryptocurrency sector begs for more detailed insights and more comprehensive research in conjunction with other fields of expertise. Cryptocurrencies and blockchain should be of great concern, especially as rapid technological developments put enormous pressure on the effectiveness of regulation. Cooperation between international regulators, increased investor education and the introduction of proportional innovative policy are targeted for future directions to diminish the possible harm that such assets may bring about. The rapid and continuous changes in technology, criminal behavior and public opinion create a plethora of questions for future research. Research strategies need to be developed with regard to future regulatory changes, both statically and longitudinally, to gain a deeper understanding of the possible consequences of technological innovations and the continuous evasion of regulation. The aim of this study was to address one of the main challenges of Ponzi schemes in the cryptocurrency sector. In this section important results of the study are synthesized, and the implications are addressed (Klein et al., 2024; Agarwal et al., 2024; Onu et al., 2023; Trozze et al., 2022).

9.Terrorist Financing and Criminal Use of Cryptocurrencies

9.1. Introduction

The abuse of the global financial system for purposes of terrorist financing continues to demand dedicated research and sustained attention. A large and growing body of literature is beginning to address the use of cryptocurrencies and alternative financial instruments emerging as an inherent feature of terrorist efforts. The existing core of international standards and guidelines on the financing of terrorism, however, pays inadequate attention to the instruments and technologies underlying these illicit funding strategies. Edge users across the Dark Net raise the security profile of internationally operating terrorist groups as the shift towards non-traditional methods of payment is seen, tested, and embraced not only by malicious non-state actors but across a wide range of illegal activities, from drug trafficking to money laundering and tax evasion. We discuss recent cases widely attributed to terror activities and try to understand the modus operandi of the actors behind them by superimposing a technical

layer of blockchain analysis with broader financial intelligence. But, above all, we are offering a universal perspective that doesn't limit itself to instrumental terms of accessed technology. Could this happen, and what would al-Qaeda gain in accepting them as valid assets? (Whyte, 2023; Agorbia-Atta et al., 2024; Akartuna et al., 2022; Kapsis, 2023).

9.2. Understanding Terrorist Financing and Its Challenges

Terrorist financing typically refers to the process of providing financial support to individuals or groups that engage in terrorist activities. There are a number of ways to finance terrorism, many of which are legal and also utilized by legitimate businesses. Terrorist financing can be raised from, for example, legitimate income earned from employment, businesses, or profit generated from property. Moreover, fundraising through collecting donations or micro-financing is a realistic means of raising proceeds and, consequently, can qualify as terrorist financing. The pattern of flows of terrorist financing presents considerable complexity and is at the same time varied appreciably. Terrorist financiers move their illicitly acquired money through the financial system, utilizing both central and alternative value transfer systems. Terrorist financing developments point towards terrorist organizations moving from one region to another and from drugs to weapons trafficking, linking regions and therefore spanning countries. Financing is comprised of substantial numbers of small transactions acting as a safe haven from anti-money laundering measures and avoiding law enforcement. Inevitably, there is no one consistent way that terrorist organizations finance their operations. The terrorist threat is complex; however, the financial aspect is not overlooked. From the stated facts, it can be observed that the funding of terrorist networks can be facilitated by the formal financial sector when it is not properly regulated. These financial institutions can attract or engage in illicit transactions and open accounts for unknown customers involved in terrorist networks. Legal requirements in financial institutions may not always be able to detect these informal business practices. There is, therefore, a compliance mismatch, which makes the fight against money laundering and terrorist financing more challenging. Knowing that a comprehensive approach has to be taken to address the threat of terrorist financing, research funding by political policymakers, academics, and security practitioners is working to bridge gaps and offer up-to-date opinions on the matter (Levy & Yusuf, 2021; Fletcher et al., 2021; Singh & Lin, 2021; Canhoto, 2021).

9.3. The Rise of Cryptocurrencies in Criminal Activities

As fintech capabilities continue to expand, so does the exploitation of these

systems by criminals for a variety of illicit activities. One of the most worrying abuses of such systems is the use of cryptocurrencies by organized crime and terrorist organizations to facilitate funding and money laundering. Cryptocurrencies are a particularly appealing choice for criminal activities due to their decentralization, ease of transfer across borders, and relative privacy features. Notably, the percentage of global transactions annually involving cryptocurrencies in illegal activities with Bitcoin equivalent turnover alone skyrocketed from 10.1 percent in 2019 to 20.4 percent in 2020, with the current annual total illicit cryptocurrency transactions exceeding USD 140 billion. Furthermore, terrorist groups have also used cryptocurrencies in numerous incidents. For example, when a terror network that used cryptocurrency to fund militants was shut down in 2020, police reported that the group had managed to raise EUR 1 million via cryptocurrency funding over the course of a year (Saiedi et al., 2021; Sanz-Bas et al., 2021; Cherniei et al., 2021; Sestino et al., 2024).

One of the key attractions of cryptocurrencies for individuals engaged in funding or carrying out terrorist activities is their partial anonymity, especially where privacy coins are involved. While cryptocurrency transactions are recorded on the blockchain ledger, this distributed ledger technology fails to record any additional information linked to the cryptocurrency user outside of their wallet address. When using privacy coins, it is even easier for their users to cover their tracks. By using such privacy coins, a terrorist financier could transfer funds to a third-party wallet owner in exchange for fiat money, without the security or law enforcement authorities being able to trace the funds back to the privacy coin holder. Such an individual would essentially become untraceable if he or she further uses an anonymous exchange platform to convert privacy coins to other cryptocurrencies like Bitcoin, before converting to fiat currency. Cryptocurrencies are increasingly changing the method of operation of terrorists and criminals, who are now able to launder larger amounts of profits than before. Unchallenged, these numbers are expected to continue to grow in the coming years (Alfieri, 2022; Özyurt, 2021; Moorkattil, 2022; Teichmann & Falker, 2021).

9.4. Key Characteristics of Cryptocurrencies and Blockchain Technology

Cryptocurrencies are digital currencies that use a decentralized ledger to record and manage transactions. Blockchains, which underlie most cryptocurrencies, are transparent digital ledgers that are used to store transactional attributes, such as ownership or value transfers. One of the most significant benefits of cryptocurrencies is that they do not rely on a centralized system for authentication and validation, which means they can be used for individuals to make peer-to-peer transactions without intermediaries. Also, as the record

of transactions is unchangeable upon validation, using blockchains to record and manage transactions ensures that ownership details have not been created purely for criminal purposes (Garg, 2022; Ahamad et al., 2022; Skaf, 2023; Gowda & Chakravorty, 2021).

Transparency, combined with the security of the blockchain in recording transaction details and ensuring that the ledger cannot be changed to exclude a transaction, makes it ideal for cryptographically signed transactions. Furthermore, cryptocurrencies enable fast peer-to-peer transactions across the globe. For non-face-to-face remote transactions, where personal details are not immediately available for the payee to verify, the confirmations provided by the immutable blockchain would significantly reduce the risk to the payee, unlike legacy systems where fraudulent transactions can easily be reversed. However, transaction reversals are still possible during certain periods directly after the original transaction, making several confirmations essential. Nevertheless, transaction reversals and blocking requirements could also introduce discriminatory transaction facilities, as businesses could decide whether beneficiaries using these types of transactions would be accepted. These inherent characteristics are also appealing to criminals, who also value the encryption technologies used in blockchain and cryptocurrencies to hide their transactions. Thus, characteristics that were originally aimed at serving law enforcement in open investigations can be appreciated by criminals (Nolasco Braaten & Vaughn, 2021; KLJAJIC; Courtois et al., 2021; Whyte, 2023; Bjelajac & Bajac, 2022).

The decentralized nature of blockchain technology, the secure, anonymous, and swift payment routes, which bypass some or all controls of national and international payment providers, have great appeal to a wider financial and potential criminal-user audience. Therefore, a detailed understanding of these phenomena, including strategies for how such financial mechanisms can be exchanged and utilized for the purchase and undertaking of criminal activity, is an essential prerequisite for the design of any regulatory and compliance strategies (Kavallieros et al., 2021; Verma & Shukla, 2024).

9.5. Anonymity and Pseudonymity in Cryptocurrency Transactions

Cryptocurrencies, and especially their use in cross-border transactions, raise a number of legal and regulatory concerns. One of the most pressing issues that has been frequently mentioned in the context of the financing of terrorism is the relatively high level of anonymity or pseudonymity of many of the transactions in these financial instruments. Anonymity refers to the lack

of any personal identifiers, and pseudonymity to the fact that the transaction is identifiable only by pseudonyms or transfer codes, not by the real identity of the persons involved. The main problem of anonymity and pseudonymity is that they prevent law enforcement and regulatory authorities from tracing the transaction to its source to find the criminal receiving the proceeds of the crime or directly trace the crime itself (Arshad & Asghar, 2024; Treiblmaier & Sillaber, 2021; Fakrulloh, 2024; Kolain et al., 2021).

Although it is possible for law enforcement authorities to trace all transactions made with cryptocurrencies because all transactions made with them are entered on a public ledger, the fact is that cryptocurrencies are perceived as anonymous because the wallet IDs are just pseudonyms that change frequently, thus merging with the general flow of transactions. In the context of terrorist financing, the transactions at issue are frequently single and occasional transactions, without recurring receipts of large amounts of money. Using cryptowallets that are difficult or even impossible to trace back to a specific real-world identifier can provide terrorists with a certain level of anonymity and at least temporary immunity from tracking. This same level of pseudonymity enabled online darknet markets and their clientele to successfully operate in illegal and criminal transactions for many years before they were finally taken down by law enforcement (Nabeel & Sumathy, 2024; Erinle et al., 2023; Schmid & Houy, 2021; Mashatan et al., 2022).

9.6. Regulatory Landscape and Challenges in Combating Terrorist Financing through Cryptocurrencies

The regulatory landscape of cryptocurrencies presents a mixed picture. While some countries have imposed strict regulations, many others remain lenient. Despite the unique attributes of the crypto economy, most jurisdictions rely on the adaptation of established legal and regulatory frameworks, which predominantly center on the exchange of cryptocurrencies and are lacking in areas like blockchain identity management. The absence of international harmonization of these regulations has provided opportunities for terrorists and criminals to exploit regulatory arbitrage mechanisms. Given the lack of direct or intermediary intermediaries, financial intelligence units are also unable to prevent funds from getting transferred to high-risk countries, which makes them suitable jurisdictions to conduct terrorist attacks. Apart from its lack of borders, the decentralized nature has also placed the crypto economy beyond the reach of nations, with jurisdictional enforcement essentially being limited to tax implications and criminal investigation activities based on requests for mutual assistance. Then, given the

varying degrees of regulation, the anonymity features of some cryptocurrencies have provided platforms for terrorists to disseminate propaganda to recruit new members. Advances in the technological field utilize proof-of-burn to verify a miner's staking rights, functioning without the necessity of other miners to achieve consensus. Furthermore, information on IP address locations can also be manipulated, and complex mechanisms can be employed to create services such as a darknet. Despite the advancements on the law enforcement side to meet such challenges, the existing measures to combat terrorist grouping and financing are insufficient. Law enforcement officers continue to refer to existing regulations and practices when investigating terrorist cases, given the financing trends contained in the digital insights. However, this vision of 'leading from behind' will not generate effective responses, given that efforts to prevent terrorism are a continual contest, driven by the relentless development of new criminal tactics and their funding mechanisms, especially through cryptocurrencies (Blumenau & Müller, 2023; Ejova, 2023; Sultan et al., 2022; Packin & Volovelsky, 2023).

9.7. Case Studies of Terrorist Organizations Using Cryptocurrencies

In this section, we will critically review the statement that "terrorist organizations have not found cryptocurrencies to be of interest." We have introduced the different legal documents and pronouncements which indicate that fighter groups affiliated with certain organizations support and facilitate raising terrorist financing using virtual currencies, of which the financial packages can theoretically be associated with their other activities, including fighters. We will discuss specific evidence of the use of virtual currencies by different groups for terrorist financing. We have chosen case studies, one technological service provider for a beneficial foundation, the use by a group of virtual currencies for an opportunity for the movement of money when they used us as a compliance primer (Ibrahim, 2021; Akram et al., 2021; Levitt2023; Hook, 2021).

The first case study is the use by a group of blockchain and virtual currencies. This group has used blockchain mostly to keep the explanation of a monitoring script, a methodology we have seen before. They use virtual currencies in return for services. We also note that reports coming out of the social media group during the attack show pictures of hand-held accounts, as well as statements that so-called "jihadists" in the group are making serious amounts of money through virtual currencies. It is also being reported that some "jihadists" have donated significant amounts to help fund the group (Özyurt, 2021; Davis, 2024; Haider & Akhtar, 2024).

9.8. Technological Solutions and Innovations to Detect and Prevent Cryptocurrency-Related Crimes

There have been several technological solutions and innovations specifically developed to detect and prevent the misuse of cryptocurrencies and blockchain for criminal purposes, assisting law enforcement agencies and other relevant authorities dispersed around the world in monitoring transactions that are associated with terrorist financing and other illicit activities. Financial firms involved in virtual asset services are able to use a range of tools to monitor and verify whether incoming and outgoing transactions of clients comply with anti-money laundering regulations, and now it often involves not only traditional financial record checks but also searches for any crypto transactions being processed by one of the partners or parties involved. The 'Know Your Receiving Organisation' aims to trace the flow of money across multiple transactions that may involve numerous cryptocurrencies and exchangers, further adding to the detection toolbox for regulatory authorities and reporting entities. In addition to this, big data, artificial intelligence, blockchain forensics, and other analytics and pattern identification approaches have been adapted and applied by technology companies that work in close collaboration with law enforcement agencies to flag, detect, and visualize fraudulent activities and money laundering, with an emphasis on terrorist financing (Klein et al., 2024; Maurushat & Halpin, 2022; Kutera2022; Cherniei et al., 2021).

Large eCrime software, technology, and equipment industries collaborate with multinational, national, and regional law enforcement agencies and judicial authorities, not only in training and educating about new forms of detecting crime related to cryptocurrencies, but they are also providing new tools and training in the prosecution of complex cases by presenting tangible evidence in reports generated by these tools suitable for court proceedings. These technological solutions play a crucial role in preventing and intervening against terrorist financing that uses blockchain and other technologies. They provide the opportunity to identify and detect suspicious connections and patterns between cryptocurrencies and other financial transactions to give transparency and evidence of questionable activity. The disruptive effect of the open development market between law enforcement technology firms and intelligence officers is ongoing, and always several steps ahead of cybercriminal technology use. Advances in technology and forensic research should be embraced and accepted by senior management in law enforcement and forensics departments, who now have to adapt their new methods of disposal and investigation in a shifting and growing environment (Wagman, 2022; Akartuna et al., 2022; Akartuna et al., 2022; Sneck, 2024).

9.9. International Cooperation and Information Sharing Mechanisms

As the preceding chapters of this report made clear, the transnational exchanges intrinsic to virtual assets pose a significant problem in fighting terrorist financing at the international level. In this context, cryptocurrencies represent challenges to the regulatory capacities of law enforcement authorities to combat criminal use. Cryptocurrencies, which are fundamentally borderless, effectively mean that it is impossible for a national law enforcement agency to fight the criminal use of virtual assets or digital currencies on their own. Tackling the finance of terrorism campaigns is only possible if agencies are working together and utilizing an agreed-upon and established system of data and information exchanges between jurisdictions. Many international organizations have developed a number of frameworks and international agreements that address such issues as part of their mission mandates (Courtois et al., 2021; Wronka, 2024; Kumar, 2023; Harinam & Ariel, 2024).

One of the core standard-setting instruments produced is a number of regional or global mutual evaluation reports for all members showing the system of data and exchanges they have in place to assist with counter-terrorism, as well as for compliance monitoring. The Consolidated Strategy in 2016 reflects the current state of play when it comes to the subject of international cooperation among countries. It also calls for the establishment of international standards and a unified approach to mobile international assets and information. Since January 2017, the international framework for confiscating and managing criminal assets has been well received internationally. It is required to implement mutual evaluations of the options of domestic enforcement officials that can engage in confidentiality and debankability during terrorist finance investigations. It is necessary to discuss better international standards in this context. Diplomatically, guidelines on targeted financial sanctions have been adopted. With AXF and FPM, a universal framework has been created to bring together all relevant counter-terrorism participants to pass on relevant information in an intelligence exchange process (Sarkar & Biswas, 2021; Wu et al., 2022; Abdul et al., 2022).

9.10. The Role of Financial Institutions and Compliance Measures

Financial institutions are at the front line in the fight against terrorist financing and should therefore update and revise compliance measures to prevent the use of cryptocurrencies for illicit purposes and to deprive terrorist organizations of self-manufactured sources of income. Training, awareness programs, and

experience sharing are of utmost importance to provide the necessary tools and guidance for banking employees. Compliance with domestic legal requirements as well as international regulations in AML/CFT becomes of paramount importance for the risk management of TCGs. Organizations have to commit and integrate correspondingly effective compliance procedures. The enhancement of a due diligence tool tailored to the risk management of TCGs is particularly related to the development of robust AML/CFT compliance management, internal procurements, and reporting, as well as further processing of complex compliance functionalities which must be integrated by those organizations to elevate efforts in the context of terrorist financing risk management. This should be accompanied by the deployment of a comprehensive care policy designed to focus in genuine ways on management's decisions in order to further tune effectiveness with regulatory guidelines. If the risk of non-compliance is not mitigated and an FI is found to be in violation, grave repercussions will follow in the form of substantial legal fines and other severe administrative penalties or sanctions. The principal policy will require financial entities to adopt compliance measures according to both the instructions of their competent ministries as well as statutory regulations and widely accepted international enforcement. Such comprehensive care policies have to be aligned with blocks and industry, which will appreciably expand our capacity to address legal issues (Wronka, 2023; Sanz-Bas et al., 2021; Butt, 2023; Emmert, 2023).

9.11. Emerging Trends and Future Directions in Terrorist Financing and Cryptocurrencies

Terrorist financing is known as one of the traditional funding sources for terrorist organizations, and they have adopted various unconventional methods for funding. Cryptocurrencies are one of the emerging trends and future directions, where terrorist organizations have started investing in such forms, ranging from holding digital currencies to fundraising in cryptocurrencies by using the crowd-sale model. The future trends in terror financing and cryptocurrencies incorporate the early discourse on the emergence of bitcoins, stating that the criminal leaders in terror organizations are in a state of trust, believing that cryptocurrencies will play a deterministic role in funding the entire ecosystem. The future discourse has discussed that it is illuminating to address the emerging trends of terrorist operational tactics, wherein the future scenario, we might find the existence of new variants of digital currencies also known as privacy coins. As regulators and securities are trying hard to crack down on cryptocurrencies, the system is not free from the infiltration of digital currencies by regula-

tory oversight. Next, there is a future possibility where decentralized financial services can have a transformative effect on electronic commerce, where they might provide investment, trading platforms, and insurance products across digital assets to the community. The next-generation cryptocurrency markets and exchanges might get propelled, where sophisticated and innovative methods will be unfolded to curb market surveillance practices. Then, the prove-up consonant state could also bolster and bear broader implications that might endure remedial and beneficial effects on terrorist financing and sanctions evasion with cryptocurrencies. Taking clues from the evolving landscape of cryptocurrency markets, the report has also discussed the future possibilities and challenges that can be encountered by regenerative legislation and regulators. Various potential pending technological advancements in cryptocurrencies and the use of the same for terrorist financing unlock new vulnerabilities. Researchers have also advised that research should proceed one step at a time to conduct a tractable analysis of the potential future directions and emergent trends. It will further assist in developing forward-looking and proactive strategies that can curb the potential threats. In general, policymakers and governments would better take notice of the situation and the ongoing research trends related to terrorist financing (Dyntu & Dykyj, 2021; Whyte, 2023; Fletcher et al., 2021; Teichmann, 2022).

10.Potential Negative Consequences of Cryptocurrencies: A Comparative Analysis with Historical Financial Crises

10.1. Introduction

Cryptocurrencies have the potential to be the most significant technological innovation since the internet, as they may be able to replace traditional currencies. At present, however, their dominance is not substantial, except for the influence of the ecosystem of cryptocurrency trading over corporate finance. At the same time, there is growing concern about the negative effects of cryptocurrencies, including institutional and systematic risks, as well as the failure of traditional monetary policy functions and the instability of economic growth. These views suggest that virtual currencies should instead be seen as a purely speculative asset. We find that cryptocurrencies resemble the behavior of a bad early form of money, or of fiat money in periods of institutional uncertainty regarding the changing of the currency system. This implies that the rise in the importance of the economy of cryptocurrencies would aggravate the deficiencies of current monetary institutions and could provoke further periods of economic and financial instability (da Costa Nunes; Hairudin et al., 2022; Sadiq et al., 2023).

10.1.1. Background and Significance

Since the introduction of Bitcoin in 2009, over 6,000 other cryptocurrencies have been created. While the popularity and hype of cryptocurrencies have steadily increased alongside growing concerns about negative consequences mainly due to governance, security, currency instability, and economic, social, and ecological issues. Many analysts have noted a resemblance between the stabilization of the cryptocurrency market and price collapses seen in historical financial crises, but the examination of stock market reactions to cryptocurrencies has received less attention in previous studies. Yet, it is economically important for investors, trustees, and policymakers to know the nature of these crashes and understand the relationship between stock markets and cryptocurrencies (Schindler, 2021; Taskinsoy, 2021; Karan2022; García-Corral et al., 2022).

We find that the cryptocurrency price collapses induced widespread stock market declines and also found support for the extreme stock market volatility characteristic that has historically been observed. Moreover, the negative stock market reaction to some of these cryptocurrency crises was similar to that historically observed during financial crises. These findings offer several implications for both individual and institutional investors as well as securities and exchange commissions on future cryptocurrency activities (Bampinas & Panagiotidis, 2024; Wątorek et al., 2021; Ritschel et al., 2021).

10.2. The Dot-com Bubble of the Early 2000s

The dot-com bubble represented the era of speculative investment in electronics, during which many American and European companies were able to increase their capitalization by hundreds of times without making any profit at all or even without any real activity. In practice, before appearing on the market, a company would use registry statements to list 'sound' companies among its co-shareholders or to list its securities in the futures trading room. After that, any kind of report, interview with the company chief, or conference that this company organized became central in the global financial press, drawing attention to these markets. A so-called 'rich uncle' was appointed for the company, and then the listing inductors, offering potential investors an entry door through which they could yield joint discounts, capitalizing on the player indexes and mutual funds. These indices were made up of companies from different sectors of the stock market, giving great visibility to the many securities, the weight of which made up very high relative rates when compared to income (Delossantos, 2023; Eteman, 2024; Fairchild et al., 2022; Zubalj et al., 2021).

10.2.1. Causes and Characteristics

We build on the comparison of potential negative consequences of cryptocurrencies with the literature on historical financial crises, which has emphasized both private and public debt as major causes. A frequently mentioned subsequent cause of both types of debt is overly optimistic expectations about future income, which renders the assessment of the future value of income streams difficult. People's current spending can get ahead of their own and others' future income, placing herd behavior as another cause of financial crises. Excess financial speculation leads to a decrease in future income, which entails debt service problems and bankruptcy but also a sudden depreciation of public and private wealth, a banking crisis, defaults, and an outburst in public debt (Hirota et al., 2022; Franz, 2021; Bohl et al., 2021).

We find that the literature on the potential negative consequences of cryptocurrencies emphasizes the consequences for an overindebted and speculating state in the midst of a banking crisis. The literature indicates the use of cryptocurrency for fiscal policy as an additional source of potential public debt, which could impede sovereign debt restructurings, prevent debt service payments, lead to a forced sale of public assets, or significantly affect the functioning of the central bank. Political determinants received far less attention, even though pure possession of wealth by digital elites can destroy the connection between the government of a republic and the representatives of the people, disrupt social networks, and induce a government crisis (Echarte et al., 2021; Elsayed & Sousa, 2024; Al-Saadi & Khudari, 2024).

10.2.2. Economic Impact

The main concern is the deflationary impact, as the money supply could not adapt to the changes in the real economy due to the monetary rule. A mathematically perfect monetary rule could have deflationary effects that would bring some economic sectors into uncertainty and result in consequences similar to a rule without GDP linking. Although the overall money supply in a cryptocurrency would adapt to the changes in the real economy, initially, flows between tokens could create circumstances in which individual consumers and businesses would have a hard time matching their nominal money supply with the real exchange needs. Uncertainty about changes in value could affect demand and thus overall economic activity. Furthermore, an economy with a universally accepted cryptocurrency would most likely include fewer traditional financial transactions and money flows, such as interest rate policy, with which conventional economic policy operates. The banking sector would also decrease

(Cutsinger & Pender, 2023; Viitanen, 2022; De Santis & Van der Veken, 2022; Dery & Serletis, 2024).

The number of in-between transactions motivated by the shift from spending through banks to using coins would increase. The social impact of a reduced banking sector and the implications this could have on monetary, fiscal, and oversight policies is beyond the scope of this paper. Furthermore, there is a concern about the effects of an economy dependent on cryptocurrencies and maintained by the underlying decentralized ledger. Since the verification of transactions is costly in terms of both time and energy, concerns have been raised about the limits of the system's efficiency at high transaction rates, especially when payment verification times are multiple times longer than the maximum processing time of other established electronic payment systems. The downside of a network-reliant value is living with the intrinsically expensive feature of the verification process required by the underlying blockchain, as transactions can be confirmed at a price. On the other hand, a slow verification process could lead customers to seek faster means for certain payments, possibly through regulated banks, thereby interfering with the full migration towards new money issued by the DLT (Javaid et al.2022; Cuypers et al., 2021; Garg et al., 2021; Challoumis, 2024).

10.3. The Great Depression of 1929

The Great Depression of 1929 was the worst economic crisis in the history of the United States and the world. The economy of the United States was able to prepare for this depression due to the serious economic problems the country had faced over the previous three years, especially since 1928. While the last months of 1928 and the first week of 1929 bode well for the economy, a 10% decline in the quotations of shares on the New York Stock Exchange at the beginning was blamed on the growth of the discount rate of the US Federal Reserve for the period January 9-22, 1929. On May 8, when Richard Whitney, who was the leading representative of the stock exchange authority, was arrested, the speculative activity of the investors and the colossal rise of the stock exchange ended. On October 24, a large-scale sinking in stock prices without substantial fundamentals began to unfold. The stock market was just the territory where the game had been played for a long time and not the market that designates the strength of the economy, and the economy finally became subject to the market. Since then, the drop in stock prices has become a chain reaction that has penetrated particularly the weakest points where the psychological pressure was greater. From August 1929 to January 1930, the industrial productive system of the United States was hit and slowed

down, and the suicide curve began to grow. Business began to stand still and to inflate stocks, bonds, bills, trade credit, and mortgage credit. The most interesting thing was that many of the players who had previously opposed the companies by gambling with bearish signs realized after the fact that, in between, many large and small capital losses had to lose more than 90 billion dollars (Mazzucchelli; Matés-Barco, 2023; Choudhary, 2022).

10.3.1. Causes and Triggers

Excessive 'booms' and 'bubbles' were common in many recent and earlier fiscal and financial crises. The 'capital inflow bonanzas and their aftermath' were regular causes of financial troubles in the Western Hemisphere. It was stated that "big booms in investment ... and big rises in asset prices against the background of disinflation have been better predictors of financial instability than inflation." It is insisted that "there will be no speculative triggering of a crash without the turn of the business cycle" (i.e., the episode of significant economic recovery). Since the 18th century, there have been various so-called economic bubbles, but the cryptobubble of 2017-2018 was the first in history related not to economically productive assets or commodities but to virtual and artificial digital assets (Karaomerlioglu, 2023; Zhang et al., 2024; Shrotryia & Kalra, 2022).

10.3.2. Long-term Economic Effects

In addition to the mentioned short-term and long-term negative impacts of financial bubbles on the economy, the following long-term economic consequences should be noted based on a comparative analysis with past economic crises. Historically, financial distortions cause deflation of the national currency, since the educational structure of businesses and individuals lacks the currency needed to convert it into a certain exchange rate and withdraw from circulation. As a result of the demand, this causes a collapse in prices, i.e., a decrease in the level of prices in the domestic goods market and a decline in the exchange rate of the currency in the international market. As we have already mentioned, in the past, such devastating crises affected countries individually and did not impact the global economic space. As for the national economic infrastructure, the corresponding periods appeared as periods of capital transfer from other countries to the locally affected country. When the domestic economy saw preventive prices and the attractiveness of deposits in the domestic currency increased, the competitive position became painful, and I saw attracted foreign capital as a result of the overestimated national currency (Haque & Rahman, 2023; Dabrowski; Helou, 2022).

10.4. Comparative Analysis

There is often a comparison of the characteristics of cryptocurrencies with different types of financial assets, such as equity shares, bonds, or commodities. Sometimes, from the very general characteristics of the properties of different types of money or their aggregate measures, a comparative analysis of the properties of certain types of cryptocurrencies, such as Bitcoin or altcoin, with different types of money is performed. Comparisons are made between figures that characterize the behavior and financial characteristics of different cryptocurrencies (Doumenis et al., 2021; Grassman et al., 2021).

In this subsection, a comparative historical analysis of the features of some of the largest negative macroeconomic consequences of various causes and the conditions of occurrence of large crises in the history of the global financial market and the financial sphere of certain countries is presented, along with the potentially dangerous features of certain types of cryptocurrencies. For example, using data on the main macroeconomic consequences of a number of large financial crises, a model for the structure of the features of such consequences is constructed. It allows not only determining the places and the degree of influence of various historically identified popular negative financial consequences on macroeconomic parameters, but also can act as an adviser in the efficient allocation of measures to reduce the risks of financial crises. A model for the possible influence of the basic harmful qualities of cryptocurrencies on the financial system and the economic development of any country is proposed (Lee & Jeong, 2023; Delfabbro et al., 2021; Asl et al., 2021).

10.4..1. Similarities and Differences

To better understand the contribution, it is essential to compare the characteristics of some currencies with cryptocurrencies. During this subsection, we highlighted some features. There is a need to do a comparative analysis between these two types of assets. The definition of currency is initially used: "currency is the form of money used in a country or among countries. Countries have their national currencies. For some countries, the major part of their national currencies is exchangeable for some foreign currency. The exchange rate of a national currency versus a foreign currency is a price (it represents the number of units of a given foreign currency that can be exchanged for one unit of national currency)." (Kisswani & Elian, 2021; Sitompul et al., 2021; Tian et al., 2021).

The first difference between cryptocurrencies and fiat currencies refers to the physical nature of money: the former do not have a physical form and are digital. In contrast, the latter are in paper form or coins, which are issued by the

central banks of their respective countries. However, with the development of technology, fiat currencies have also been represented digitally in bank accounts, for example. Cryptocurrencies are not backed by the good faith and credibility of a country. They do not need banks and have been developed independently of councils, authorities, and any bureaucracies. Furthermore, the currency was released through an open-source client in 2009. Between 2017 and 2018, the number of cryptocurrencies increased rapidly with the emergence of Initial Coin Offerings or Token Sales (Arli et al., 2021).

10.4.2. Key Indicators and Warning Signs

Key Indicators The main leading indicators of a crisis are as follows: lending boom (positive differential between credit and GDP growth over an extended period); conventional indicators of overheating (positive inflation and asset prices overshooting); large capital inflows (positive differential between the capital account and the current account over an extended period); the behavior of monetary policy rates (the country lowers its interest rate vis-à-vis partner countries, or monetary policy becomes more lenient); and changes in external indicators (current account balance and foreign exchange reserves trends). In a global economy context, domestic credit and financial indicators are also of importance, and important crisis indicators refer to global risk aversion indicators, global commodity prices, and international financial conditions. Warning Time Prior to a Crisis Crises occur because there are always risk factors involved and warning signs for financial crises. Empirical evidence provides mixed evidence of a long leading potential for financial indicators, but there is no controversy that early warning systems provide longer cycles. The persistence of a surge in warning signs is important in understanding the time between indicators and crises (Forbes & Warnock, 2021; Afxentiou et al., 2022).

10.5. Risk Management Strategies

Due to the increasing popularity and indicators depicting the negative potential of some virtual currencies, implementing protective strategies is gaining attention. For investors who currently hold virtual currencies as part of their investment portfolio, several main approaches to protect their funds can be applied. The various heuristics are concurrently more or less complex with different cost implications, from very simple strategies such as increasing the regrettable transactions of the investment to very complex approaches such as derivative markets and financial instruments specifically tailored. Functionality in real life may vary and should be adapted to an investor's assessed diversified portfolio.

First, a simple, commonly implied strategy is to sell virtual currency holdings and revert to the fiat money standard. This approach may favor holding virtual currencies only for a very short period; otherwise, it may increase the number of expected loss transactions for the investor. Securing this transaction is still mandatory. Then, the virtual currency holders could prefer another investing market or the same virtual currency after a reversal of its depreciation. However, such actions in the case of a major or already publicized depreciation of a currency are likely to accelerate the loss while maintaining the depreciation period. Second, the frequently applied strategy that favors the investor and is market-specific is portfolio diversification. To the point, the implied risk management of virtual currencies due to the negative consequences of cryptocurrencies can be attenuated if financial assets commonly held in an investment portfolio are simultaneously included. Nevertheless, a correlation with other investors' behavior over a certain period should be considered. Or, on the contrary, is the virtual currency or the market purposely influenced by information released by a particular investor? Alternatively, another piece of public information might have caused sudden shifts in the virtual currency price. Great volatility is likely to occur until the overall investor reaction is muted. Third, when investors have never received the tangible cryptocurrency purchase, avoiding future questions is a pertinent action and a robust due diligence practice. The use of proper trusted guidance or avoiding unclear input can be performed. Should the investor have some suspicions of potentially being cheated while attempting to convert the cryptocurrency into universally accepted legal tenders, proper rule enforcement must be applied through the help of specialized authorities. Proper guidance and potential analysis of information already in highlights represent some good practices that may inhibit consumer fraud in the consumption of an ill-defined set of asset classes, purposefully private or at particular risk. A basic counter-fraud strategy consists of informing the population (or at least their investors) of the potential deleterious differences among cryptocurrencies and their potential negative implications. Crowdfunding and execution of very specific contracts for products and payments through cryptocurrency or others, pure or illegal, support the increase of doubts. Obligations and limitations of the different authorities involved in the various stands between the funds raised and the services or pre-purchased commodities and the different rights should be established and controlled. Furthermore, claimants should demand re-services and re-commodities exchanged, or funds should be guaranteed (Barrdear & Kumhof, 2022; Papathanasiou et al., 2022; Maitra et al., 2022).

10.5.1. Investment Strategies

The analytical sections of the results are split into two groups for simplicity. Beginning with those that dominate the distribution of portfolios: a safe interest rate, several return outliers, and a high level of sampling time with a decrease in investment. As our interest is in the histographical structure from an invincible sampling period, the information will be discarded and buried. Estimated downside potential for market participants to improve risk management for stable investment. While international market risk is widely used in research, it does not guarantee high margins every time. With the proposed methodology, the investors demonstrate little risk aversion. On the other hand, a decrease in market-related problems is advisable, although a combination of well-established results is more extensive. Forging one of the most productive investment strategies in binary variable ratio is a sign of strong, long-term market expectations (van et al., 2022; Chen et al., 2021; Lu et al., 2021).

10.5.2. Diversification

The use of multiple cryptocurrencies in the investment portfolio has been claimed to improve risk-adjusted returns, reduce portfolio volatility, and decline the correlation with traditional financial markets and other investments. One of the main motivations for investors to diversify in cryptocurrencies is their low correlation with equity, bond, or commodities markets in comparison with traditional hedge fund strategies. Cryptocurrencies are expected to provide profitable diversification through a safe harbor when traditional investments are hit by economic crises. Moreover, it is suggested that cryptocurrencies would not be affected by global market factors and would decrease the excessive impact of global risks as well. Historically, Bitcoin has been negatively correlated with the US stock market; thus, it can serve as a diversification tool for investors (Ullah et al., 2024; Almeida & Gonçalves, 2022; Khakzar et al., 2024; Tenkam et al., 2022).

According to various studies, in some previous financial crises such as those in Russia, Cyprus, Greece, and during Brexit events, there was a surge in the proportion of trading of cryptocurrencies when comparing different market events. Bitcoin has been utilized as a crisis asset and has been positioned in traditional investment portfolios for diversification benefits. The decrease of global financial and economic crises by using cryptocurrencies as a protector to diminish the damage to traditional economic and financial tools raises the importance of this phenomenon even more. The role of Bitcoin as an emerging gold is emphasized by comparing its performance with that of gold in global markets based on statistical tests conducted within a certain period and based on

discussions of political and macroeconomic uncertainties (Nguyen et al., 2022; Wątorek et al., 2021; Manahov, 2022; Manahov, 2024; Goodell & Goutte, 2021).

11.Analysis of FTX Crisis: Collapsed and Hacked Cryptocurrency Exchanges

11.1. Background and Significance

The Bitcoin frenzy, a bad investment for some people and a get-rich-quick scheme for others, has raised the attention of the world. The number of Bitcoins increased by 750% in 2013. This also helped Bitcoin-related businesses to grow and new related companies to be established. Among those Bitcoin-related companies, cryptocurrency exchanges that operate exchanges between different cryptocurrencies and different fiat currencies have been an important part (Taskinsoy, 2021; Grumbach & Sornette, 2024).

Despite the huge benefits that can be reaped, cryptocurrencies and their infrastructures are not considered reliable by various researchers. The largest Bitcoin exchange filed for bankruptcy in 2014, blaming the Bitcoin network for security flaws. In 2017, a major exchange was hacked and lost 36% of the funds it had, and customers bore the costs with a 36% haircut. As seen in those two cases, people may already avoid investing in the related businesses of the virtual currency exchange. The crisis right before the Chinese New Year of 2017 brought doubts to various Bitcoin investments (Gupta et al., 2021; Böyükaslan & Ecer, 2021; Quamara & Singh, 2022; Arıkan, 2021).

11.2. Purpose and Scope of the Section

The purpose of this section is to analyze the financial failure and hacking of cryptocurrency exchanges. More specifically, the analysis is done for collapsed and hacked cryptocurrency exchanges. As a field, the booming cryptocurrency technology with all its fintech applications has to confront external and internal threats. The collapse and hacking of cryptocurrency exchanges are major internal threats. A cryptocurrency exchange can collapse for various reasons. Bankruptcy, collapse, failure, and so on are used in this report interchangeably, meaning the onset of all or any one of those scenarios. A hacking situation specifically is legally different from cases where a cryptocurrency exchange is closed for reasons beyond haphazard, non-intervention damages. However, the suffering of the cryptocurrency market stakeholders from a hacked exchange and from a naturally closed exchange is equally felt. The depreciated value of the cryptocurrency assets, temporary and permanent loss of access to the full value of these assets, and the resultant prolonged or permanent inability to engage in

financial and commercial activities are also felt by those stakeholders. A cryptocurrency exchange that has suffered a decline in its profits and has suspended or collapsed due to internal activities is legally different from attacks by courts or from outside intervention. For many parties participating in a cryptocurrency market, such as physically untraceable parties and government authorities, it is irrelevant who caused the damages in both cases (Froehlich et al., 2021; Tsuchiya & Hiramoto, 2021; Alfieri, 2022).

11.3. Previous Instances of Exchange Collapses and Hacks

There has been a rich trove of instances when traders had deposited their cryptocurrency on exchanges, and the exchange collapsed and stole their funds. In August 2012, the Bitcoin Savings and Trust was launched, which offered an unbelievable 7% weekly returns allegedly through legitimate lending and arbitrage activities. The founder amassed 148,000 BTC over fourteen months of operation before abruptly shutting down and disappearing. The founder was eventually caught, tried, and sentenced to 18 months in prison and ordered to pay $1.23 million in restitution to investors (Govindan et al., 2024; Wątorek et al., 2021; Ooi et al., 2021).

In March 2014, the Japan-based cryptocurrency exchange filed for bankruptcy after reporting 850,000 BTC stolen by hacking. The company claimed the theft was due to an unknown flaw in the Bitcoin protocol and that the exchange was insolvent. The founder and CEO was accused of stealing the equivalent of $2.6 million from customer accounts and faking the company's financial documents. The founder was arrested but later released and tried for falsifying financial documents, for which he was found guilty and given a two-and-a-half-year suspended sentence. The stolen funds were eventually tracked to a wallet that the founder claimed was dormant but accidentally moved 600 BTC to an online wallet. Investigators traced the stolen funds and unearthed a secret exchange trading bot that traded small percentages of the stolen funds on a trading platform, laundering the stolen BTC into fiat for the operator. Panic gripped crypto markets, with Bitcoin crashing significantly due to the suspected sale of 400 BTC on a trading platform, triggering Bitcoin's price to drop by 35% (Cong et al., 2023; Saundal, 2021; Igbinenikaro & Adewusi, 2024).

11.4. FTX Crisis: Overview and Causes

Key sources of the FTX crisis events have emerged following a security question in mid-September 2018. Fortunately, the security breach was mostly operational, which means that only customers' wallets and backend metadata

were compromised, while private keys remained intact. However, the FTX exchange did not pay any money back to its customers, reducing the trust of FTX customers. That led to a subsequent outflow of money, which is a key factor in the closure of FTX. A security breach, proliferation of technical problems, and increasing distrust of the FTX trading platform accelerated the wide withdrawal of money from the exchange, increasing credit risk many times. It has increased the demand for all types of risk insurance, such as financial support from customer service management. The final factor in the fall was the switch of FTX to shut down its servers for almost an entire month in the midst of the digital currency price crisis, so that people could not exchange or sell their cryptocurrency in the rush of panic, making many investors speculate that the exchange may have absconded and run away. This ratcheting effect of technical problems, trust decline, and increased perceived credit risk caused the self-fulfilling collapse of this financial agglomeration (Trautman & Foster, 2023; Vidal-Tomás et al., 2023; Galati et al., 2024).

11.4.1. Timeline of Events

Failure of the exchange became the fourth significant event in the history of the existence of the exchange. The three previous large-scale events in the history of the exchange include the following areas of possible error: 1. Slow loading of the exchange interface; 2. Insufficient depth and poor execution of orders in certain trading pairs during less liquid hours; 3. Remote trade. After the successful restoration of the exchange's performance, the representatives did not make any official statements regarding the reasons for the incident. Nevertheless, the cause of the exchange failure was massive news and led to the investigation of the causes of the failure of a relatively young cryptocurrency. Subsequent events to help in this were different external signs of customers defending their rights in the form of the return of the example. A short-term drop in the rate of FTT from $9.11 to $5.2 occurred in the interval from 5:00 to 9:00 during which the exchange continued to remain inactive. Attention is drawn to the start of the recovery of the FTT cryptocurrency, from 13:00, when the activity is sharply reduced and a range of $ 6.2 - $ 8 is outlined for 24 hours, the so-called decline phase. At the second stage of interest, from March 10, 15:30 – 15:50, the number of participants is at its peak at 16:00, after which the costs decrease sharply. The phase of strong growth after the request of any of the market participants is also not observed. All actions are instantaneous and largely ritualistic. The work of the app is also remarkable during the decline phase of March 12, the predicted drop of March 24, the drop of approximately April 11, and the drop

of April 17. In each case, the minimum of the trend attribute before the future exchange rate movement reached a value of 0.875 for the first 2 cases and 0.900 for the second two (Butler et al., 2022; Mills; Zhou et al., 2024).

11.4.2. Factors Contributing to the Crisis

The sharp volatility of cryptocurrency prices has exposed a rare feature of cryptocurrency exchanges — their risks appear to be dynamic and time-varying. First, we propose a model for the equilibrium relationship between exchange rates and collateral deposits in cryptocurrency exchanges. We find evidence supporting the existence of bear equilibrium. The model also suggests two important predictors. Second, we investigate factors that may contribute to the crisis of cryptocurrency exchanges, including market conditions, liquidity risk, solvency risk, and commission fees. We find that market conditions and solvency risk are significant contributors. (Duran & Griffin, 2021; Nazareth & Reddy, 2023).

The possible factors contributing to the crisis we consider are classified into market conditions, liquidity risk, solvency risk, and commission fees. Market Condition: In the case of cryptocurrency derivatives, traders may suffer significant losses or bankruptcy if there is a significant adverse price movement as they are often leveraged. The collapse will cause a lack of confidence in the trading platform and money inside the exchange to be withdrawn. Furthermore, traders with short derivatives will then actively sell physical assets to exit, which would cause the price to fall and the exchange to default. Numerous studies find that higher volatility is associated with a greater probability of crisis (Xiuzhen et al., 2022; Basuony et al., 2022; Zhou et al., 2022; Ramzan, 2021).

11.5. Impact of FTX Crisis

In this section, we discuss the impact of the FTX crisis. Specifically, we discuss the nature of FTX as a cryptocurrency exchange in order to understand the significance of FTX from the investors' viewpoint. We then investigate and analyze the impact of collapsed and hacked cryptocurrency exchanges (Lee et al., 2024).

It is important to understand that FTX is a centralized cryptocurrency exchange. The main advantage of a centralized exchange over those of specialized marketplace or trading platform protocols is generally regarded to be efficiency, easier regulatory compliance, as well as the ability to incorporate a wider spectrum of trading pairs, better UI/UX, and functionality. However, the user needs to trust the system operators to maintain adequate liquidity, incorporate new coins, and avoid fraud or embezzlement. In the case of centralized exchanges,

there are new single points of failure, a significant weakness: centralized exchanges can be undermined in the same way as traditional banking systems, as well as by operator malfeasance or incompetence. The operators of such systems, or participants with significant influence, have the ability to censor transactions to and from users or even to abscond with all of the users' funds, closing down the system without warning. They can also place vulnerable coins at risk if coins could be traced back to the source or to the security of accounts servicing those coins (Wu et al., 2024; Arner et al., 2023; Barbon & Ranaldo, 2021).

11.5.1. Economic Consequences

Crypto exchanges are essential infrastructure in fostering the development of the blockchain ecosystem. As the losses suffered in the failed exchanges mainly resulted from hacking or management failures, efficient risk management practices may prevent or mitigate economic consequences when those exchanges experience financial distress. We investigate the relationship between exchange characteristics, risk management, and various short- and long-term outcomes associated with exchange collapse and hacking, as well as the associated failure risk. An important lesson for exchange investors is identifying warning signals before the occurrence of unfavorable exchange closure events. Exchanges with these characteristics might bear higher bankruptcy risk and consequently lead to more losses for investors and traders (Jebran & Chen2023; Younas et al., 2021; Chen et al., 2021).

Despite the increasing importance of cryptocurrency exchanges, to date, existing academic research mainly focuses on cryptocurrency price determination or high-frequency trading, while explanations of exchange functioning and underlying failure mechanisms are still very limited. This subsection complementarily investigates the available information from the characteristics of working cryptocurrency exchanges. To inform the potential economic consequences associated with the distressed exchange, we rely on an institutional perspective to measure the role of exchange functions, which is rooted in exchange order book transparency from the perspective of platform market making, thereby contributing to the literature of cryptocurrency exchanges (Anas et al., 2024; Petukhina et al., 2021; Hussain et al., 2023).

11.6. Lessons Learned from FTX Crisis

The FTX eXchange recently announced their decision to stop supporting USD tether transactions. Investors have been making their inquiries concerning the statement made by the trading platform. With all the negative reports and

issues comments made on USDT, could it be true that a reputable exchange with a high trading volume would lose faith in the currency? This decision might be compensated by the exchange with another USD stable coin or the native USDC stablecoin built on the Ethereum blockchain. As part of the trading platform regulated in the republic, the FTX project always ensures maximum compliance with the legal requirements for conducting activities. If the regulator asks to exclude any digital assets from trading, the company will do it without any questions. We plan to announce the stablecoins we will switch to soon. First, we wanted to give you a little bit of time on this. We understand that it takes time to withdraw and redeposit funds, but we hope that in the long term this will create a more frictionless environment with the ability to trade with more liquidity in the future, explained the team (Galati et al., 2024; Trautman & Foster, 2023; Lubben, 2023).

12.The Impact of Quantum Computing on Cryptocurrencies

12.1. Introduction to Quantum Computing and Cryptocurrencies

Quantum computing is a revolutionary field of work, based on the principles of quantum mechanics. Quantum mechanics is the branch of physics that describes how the smallest particles in the universe, such as atoms and hydrogen nuclei, move and behave. Quantum computing will hopefully unleash a tremendous amount of power, which may transcend everything we have previously believed to be conceivably feasible. Cryptography, on the other hand, aids in the security of transmission to avoid any hazards from cyberattacks. Cryptography is utilized in all types of transactions, most notably traditional currencies and cryptocurrencies. Cryptocurrencies are systematized using distributed ledger technology that uses blockchain to operate. Cryptocurrencies depend on encryption to secure transactions, wallets, and financial operations. Quantum computing is emerging in the field of cryptography, moving faster than researchers can foresee. Quantum computing, which relies on the principles of quantum mechanics, has the potential to further evolve encryption techniques, side-stepping computational systems that are currently not possible based on the present available technology. The decentralized architecture of cryptocurrencies is popular for being secure, safe, and unforgeable. The majority of cryptocurrencies derive their security from cryptographic methods. Over time, the increasing dominance of quantum technologies has involved the cryptocurrency community, resulting in many researchers providing solutions to quantum threats. A lot of research has been done in cryptocurrencies and quantum technologies,

which are directly and indirectly connected. In the field of cryptocurrencies, the shortage of awareness and encryption skills is the fundamental cause of the security problem. (Gill & Buyya, 2024; Mosteanu & Faccia2021; Patel et al., 2023; Sáez-Ortuño et al., 2024; Sahu & Mazumdar, 2024).

12.2. The Security of Cryptocurrencies in the Quantum Computing Era

The security of existing cryptographic systems used in cryptocurrencies makes the focus on blockchain security especially important in the quantum computing era. It is important to conduct early research to determine whether the security protocols used in cryptocurrencies today are, in fact, resilient to future quantum threats. Quantum computing will certainly increase the risk of data breaches. However, cryptocurrencies are also impacted by quantum computing in a renewed risk of a central point of failure. Since a cryptocurrency is built on top of a blockchain, a successful attack on a single block potentially makes the system's security vulnerable, as the blockchain has a broken history from that point on (Brooks, 2024; Sanzeri2024; Vaishnavi & Pillai, 2021; Boretti, 2024).

Even though the potential of quantum computing breaking the current PCK and ECC is clear, there are almost two separate types of discussion around quantum security and cryptocurrencies. The former focuses on how today's cryptographic protocols should be evaluated or replaced, solely from the technological cryptography point of view. However, this is insufficient for blockchain security because it puts the focus on a broader risk of blockchain technology. This is because the cryptographic protocols in use in establishing cryptocurrencies are not only at risk of attack, but many of them are actually expected to be breached in the foreseeable future. (Aziz et al., 2022; Ullah et al., 2023; Quamara & Singh, 2022).

12.2.1. Current Cryptographic Protocols in Cryptocurrencies

Cryptocurrencies primarily use hash functions such as SHA-256 and public-key cryptography, whose prime examples include RSA and ECC, to maintain transaction security. In a typical system such as Bitcoin or Ethereum, SHA-256 is implemented in a block header of each transaction as it demonstrates the proof of the work behind a block. Further, public keys are used to verify the sender in a transaction by checking whether the corresponding private key possesses the authority to spend the funds or not. Here, the use of public keys and their corresponding signatures in front of the sender's transaction ensures that the sender is initiating a valid transaction. Meanwhile, public-key cryptography also plays

a crucial role in preventing fraud such as double spending. The cryptographic protocols employed are adequate in classical computing platforms to secure the cryptocurrencies against adversaries, safeguard against digital threats, and impair the assets already acquired by attackers (Ferdous et al., 2021; Quamara & Singh, 2022; Yu et al., 2022).

Unfortunately, cryptographic techniques fail to cope with quantum computation capabilities. The hash functions, public key schemes, and widely relied cryptographic protocols implemented in different cryptocurrencies can undermine the security established by a quantum adversary. Once a quantum computer attains adequacy, it can launch attacks on these front lines. Public and private key pairs generated using ECC or RSA could be exposed through methods such as Shor's algorithm. Besides, Merkle-Damgård hash function constructions, relevant to SHA-256 and SHA-3, are prone to quantum forgeries which can inject new blocks to create fraud. These powerful quantum attacks are feasible and persuade the cryptocurrency to create incorrect transactions because SHA-256 can be reversed using Grover's algorithm in operations. Overall, new schemes and cryptographic protocols are required that can keep blockchain technology resistant to quantum adversaries (Scholten et al., 2024; Manda, 2024; Memon et al., 2024).

12.2.2. Vulnerabilities of Cryptocurrencies to Quantum Attacks

Vulnerabilities of Cryptocurrencies to Quantum Attacks: Once large-scale quantum computers are available, they will be able to exploit various aspects of classical cryptographic mechanisms that provide the security of cryptocurrencies. In particular, quantum computers are not only capable of quickly factoring large numbers into their prime-number components, but they can also compute discrete logarithms with similar speed. These capabilities will render two of the most critical public-key cryptography algorithms, namely RSA and ECC, completely ineffectual, making the classic currency wallets and digital signatures from these digital coins vulnerable to unauthorized access and theft. Convincing the crypto community to switch to quantum-resistant versions of these cryptocurrencies or to develop new digital currencies that are already based on quantum-resistant cryptographic primitives, however, entails addressing the issue of the urgency of the threat itself. Here, strategy-makers would need to decide to what extent the public should be informed about the true urgency, so that market panic and precipitous value loss do not ensue (Ajayi et al., 2024; Tambe-Jagtap, 2023; Tom et al., 2023).

It has long been known that large-scale quantum computers – if and when

constructed – must readily break the RSA and ECC to access the plaintext data of cryptography-protected systems. The advent of the quantum computer has been discussed at length in the cryptographic literature. At this date, the quantum computer remains theoretical. Quantum computers will not be freely available to the public immediately upon their construction. However, as for computers at the time of their inception, several world actors are investing heavily in quantum computing. Thus, it is not feasible to predict how long the cryptographic community will have to prepare for the global ramifications of quantum computing. Nonetheless, the time window appears to be shrinking. If a quantum computer of adequate size is run at 10°C, a real database of cryptography-protected data could be processed in a matter of seconds (Manda, 2024; Bhat & Giri, 2021).

12.3. Potential Solutions and Mitigations for Quantum-Resistant Cryptocurrencies

Solutions and Potential Mitigations: Post-Quantum Cryptographic Algorithms As quantum computing resources are estimated to become more accessible, it is of paramount importance that blockchain technologies adapt to the threat these machines may pose and address their vulnerabilities. Cryptographic algorithms that are quantum-safe have already been developed and are recommended as post-quantum alternatives. While some may view the development of such cryptography as premature, the significant growth in the quantum research field as well as contemporary trends in cryptographic attacks demonstrate the relevance and importance of continuing in this direction (Baseri et al., 2024; Manda, 2024).

The research community has partially embraced post-quantum cryptography for practical application, although researching algorithms and their potential attacks is ongoing. Differences between quantum and post-quantum cryptography exist, for example, in the signature and verification process, as well as key distribution. However, in the case of cryptocurrencies and their blockchains, the consensus mechanism and the way consensus is determined is largely quantum resistant at the theoretical level. Despite the absence of quantum computers with processing power sufficient to break common encryption, projects are indeed developing various consensus mechanisms independent, in part if not fully, from traditional encryption techniques. Many cryptocurrencies have also implemented, or plan to implement, post-quantum cryptographic algorithms at the application level as a precaution against future threats (Kethepalli et al., 2023; Satrya et al., 2023).

The generalized public ledger used by cryptocurrencies is composed of data, where the original data gets encrypted into blocks that form the chain. Hence, the

input data for the new block, or the transactions, are conceptually publicly available in advance. Full transparency, combined with the fact that blockchains are basically append-only (with data being written to the blockchain and kept cryptographically secured), will necessarily push the development of quantum and post-quantum cryptography in the context of blockchain, public key-encrypted transactions, and quantum-safe private keys. Efficient quantum-resistant cryptographic mechanisms and proof of work established on quantum-resistant secure hash functions are therefore theoretically required. Researchers who have delved into possible operations of quantum computers, information stored, and manipulation of massive quantum bits have noted that a quantum attack on Bitcoin may be economically unfeasible. Nonetheless, it is possible to enhance quantum-resistant capabilities, and thus security, for cryptocurrencies and related blockchains, which likely would drive a technology arms race, as is often seen with other forms of computing technologies (Serena et al., 2022; Dutta et al., 2023; Trequattrini et al., 2024).

12.3.1. Post-Quantum Cryptographic Algorithms

Cryptographers are currently pursuing a new class of algorithms that have been specifically designed to be secure against quantum computers. Now referred to as "post-quantum" cryptography, the field is being developed by researchers in industry, government, and academia. The most promising candidates among researcher-developed approaches are lattice-based cryptography, hash-based cryptography, code-based cryptography, and multivariate-quadratic-equations-based cryptography. Hash-based cryptography is considered the most conservative approach, as it is already relatively well-studied. The hash-based signature scheme secures a signature using the Merkle signature scheme and includes an underlying cryptographic hash function and a few elements. Its fundamental operations include hash construction, and signature generation and verification. To be considered for real-world deployment in cryptocurrencies, a post-quantum cryptographic algorithm must be practicable, efficient with achievable parameters, and secure (Joshi et al., 2024; Ghashghaei et al., 2024; Zhang et al., 2024).

Unfortunately, no single cryptographic primitive for the given primitive class is considered secure because of state-of-the-art attacks. A team collaborating on a project recently addressed this problem with hash-based cryptographic signature, which is a variation of the algorithm, at a conference. A cryptographic mechanism using the Merkle signature scheme for post-quantum cryptography may be used to secure crypto-transactions in current cryptocurrencies. As described in literature on this subject, a potential variant can be used in certain

cryptocurrencies leading to hybrid signature with key wrappings. To conclude, a key from which the payload can be rederived is incorporated into the hybrid signature—in essence, this process uses a form of key wrapping similar to hash-based methods. Hybrid signature generates an authenticated encryption tag used to encipher the commitment with privatizing its escrow (Reshi & Sholla2024; Gracy & Jeyavadhanam, 2022; Gracy et al., 2023).

12.3.2. Quantum-Secure Blockchain Technologies

Sophisticated attacks on existing public-key cryptography would immediately endanger all digital signatures and, therefore, the regular operation of existing cryptocurrencies and, more generally, dependent e-commerce, online banking, etc. With better quantum algorithms, basic cryptographic protocols and primitives that rely on well-established hard mathematical problems, such as DLP, ECDLP, factorization, and RSA, are also vulnerable to quantum computers. To fully mitigate such a threat to the entire ecosystem of digital finance and data exchange, we cannot linger, awaiting the fate of each one of those potentially profoundly disruptive emerging technologies; ready-to-deploy protective measures need to be developed in parallel with these primary field advancements. Quantum Key Agreement (QKA) / Quantum Secure Channel (QSC) protocols: Future blockchain technologies will need to smartly commercialize the underlying quantum network resources. A variety of functionalities, unlike traditional CTXs, will have to be incorporated in the next-generation blockchains. In particular, the underlying quantum keys will have to be "agreed" upon using new quantum key agreement (QKA) algorithms and then utilized to build quantum secure channels (QSCs) through quantum multi-hop networking. Next-generation blockchains will have to embed decentralized QOA, i.e., XBRQOA. A number of forward-looking projects are busy designing near-future technologies that can withstand quantum attacks. Different types of quantum secure channels (QSC) use the properties of photons to protect different types of information. Integrating the prototype low-speed quantum communication protocols and a blockchain that employs these tools is among the project's main goals. This approach takes advantage of the existing philosophy that has not yet been updated to the new repurposed design specifications. A number of other field experts do not focus on protecting quantum-based information and entangled resource allocation processes, including the open multidisciplinary field of quantum networking research. Several theoretical computer scientists and mathematicians are working on sharding, a blockchain scaling solution that nonetheless has several other valuable properties, such as strong error detection, error recovery, and resilience. None of these promising develop-

ing technologies have yet moved out of the purely experimental and theoretical realms and can thus be deployed in realistic infrastructures or contribute to the existing blockchain cryptoeconomics. Organizations are continuously developing them and seeking further study opportunities (Singh et al.; Ullah et al., 2023; Adeyinka & Adeyinka, 2025).

12.4. Challenges and Limitations in Implementing Quantum-Resistant Cryptocurrencies

Challenges and limitations in implementing quantum-resistant cryptocurrencies are evident in different areas. From a technical perspective, integrating new cryptographic algorithms into existing systems is complex as it may require involving multiple parties, including software developers and end users. Large-scale deployment of systematic solution designs could be hindered by their properties, such as latency to increase quantum security, or loss in terms of scalability of some cryptocurrencies. From the point of view of users, the need to support the transition to quantum-resistant currencies does not seem to be perceived as immediate, resulting in skepticism within the cryptocurrency community regarding the need and perceived costs to invest in this area. Finally, from a legal and ownership perspective, it is still unclear under which legal instruments of existing monetary laws cryptocurrencies with quantum-resistant digital identities will fall (Singh et al., 2024; Ullah et al., 2023; Sonko et al., 2024).

In conclusion, the technological challenges of quantum-proof digital identities need to be addressed within a more general and abstract path, while the integration in a real financial system requires solutions at the legal, financial, and economic layer and poses questions about user acceptance of the system and the education of end users. The challenges are too high for closed synthesis now; and we foresee, and highlight as future work, the open issues in all these fields which will require a decade of innovative research for transformative outcomes. Some of the key challenges and limitations that have been identified as key and that, though relevant for possible solutions, require overcoming as the first step, are synthesized in the rest of this section and as a result, it will provide the basis for the setting up of future actions and commissions (Gharavi et al., 2024; Yalamuri et al., 2022; Bishwas & Sen, 2024).

13.The Impact of Speculations in Cryptocurrencies by Influential Figures

13.1. Introduction to Cryptocurrencies and Speculations

Cryptocurrencies have received considerable attention from investors,

researchers, and the public at large. Since Bitcoin became the first-ever cryptocurrency in 2009, the number of digital assets available has been increasing steadily. The current pandemic has propelled the price of Bitcoin to record levels, with reported daily transactions averaging 400,000. A cryptocurrency is a digital or virtual currency that is decentralized and can be used to purchase products and services. Digital assets are, by nature, similar to real assets, such as foreign exchange, in that they are not regulated by any legal entity, but they are put to a slightly different use, such as facilitating online transactions, investing in various assets, and as a means of raising funds for ventures. With roughly 7,000 digital assets listed on 273 exchanges worldwide, the cumulative market value of cryptocurrencies has exceeded one trillion in the first quarter of 2021 (Wątorek et al., 2023; Pessa et al., 2023; Sarkodie et al., 2022).

With respect to financial markets, speculation can be considered a ubiquitous phenomenon in which participants make predictions regarding possible future events, including price alterations, and act accordingly, which may be based upon technical, fundamental, and/or sentiment analysis. Participants who speculate expect the price they speculate on to move in a certain direction, allowing them to make money. As a result, speculation is present in all markets. Speculation is a technique that can be profitable or disadvantageous. Within digital assets, the process of investing is altered by the involvement of finance and technology, which changes people's purchasing habits, attention, and decisions, including investment. It is consequently unclear how the market for digital properties will function. There aren't many public policies in place to guide one's choices, and there aren't enough scientists. Similarly, some of these digital assets may attract significant attention as a result of influential publicity. Speculative behavior can be influenced by the sentiments of main figures. In the contemporary realm, the research of such instances in terms of the digital asset market reveals its importance. The following section specifies pertinent terms that help in understanding our specifications (Almeida & Gonçalves, 2023; Naeem et al., 2021; WR Martin & Papadimitriou, 2022).

13.2. The Role of Influential Figures in Shaping Public Perception

Influential figures have found significant power in their ability to shape public perception of cryptocurrencies. Key stakeholders such as corporate leaders, celebrities, and other major public personalities can affect how many people view and invest in a given cryptocurrency. Celebrities, in particular, can lead and motivate potential investors to take action. This ability to move a significant

percentage of the public is known to be influenced by a few factors. First and foremost is a level of trust and respect that is developed over time by providing some level of perceived benefit or expertise. The second is the method through which the message is communicated. Media influence and a growing social network presence have been known to bolster the impact a given celebrity has within a particular market. Our subsection hopes to assess the possible power celebrities and other influential figures have on shaping the idea of a cryptocurrency for the masses through speculation (Steinmetz et al., 2021; Gupta et al., 2021; Senkardes & Akadur, 2021).

There have been a number of cases in history to highlight the power of influence regarding emerging asset classes. The dot-com boom of the 1990s is a great example. It is said that stock analysts would place their research next to bikini-clad women on television and advise investors to buy accordingly. Recently, the market has seen additional athletes, actors, and political figures sharing their views and endorsements of various products. As Bitcoin began to establish itself in February 2021, a major figure decided to place a large stake in Bitcoin with a company, while at the same time tweeting memes about patterns that pointed towards investing in another cryptocurrency. Following this tweet, that cryptocurrency rose significantly. It is clear from these two historical cases that individuals have the ability to move the market with their words and backing. The impact a statement holds is directly linked to credibility which, when assessed further in literature, demonstrates how the market responds in turn with the level of influence. Emotional behavior has also been noted in participants of targeted investment offerings. (Ullah et al., 2022; Simpson, 2023; Shah, 2023; Glebova & Mihail'Ova, 2023).

13.3. Case Studies of Speculations by Elon Musk and Donald Trump

How and under which conditions do influential figures impact cryptocurrencies through their speculations and why they do so are examples of interesting questions in CryptoEconomics. Before we can address the questions concerning the impact and thus the relationship of the event to the distribution of influence, cash flows, etc. that we could consider 'iffy,' it is important first to analyze why politicians and powerful businesspeople speculate and, second, to understand the context they are speaking from (Ballis & Verousis, 2022; Bajra & Aliu, 2023; Delfabbro et al., 2021; Sebastião & Godinho, 2021).

Influential figures have become well-known for voicing their opinions, and their comments are transcribed in various publications. Within the research data,

larger price fluctuations of Bitcoin, especially, can be attributed to comments from known pioneers in their fields and large investors in cryptocurrencies, most notably Bitcoin and Ethereum. Both of these figures have spoken at 'official' events, where one termed Bitcoin a 'scam.' A second speech of 'official' character was addressed at a prominent global forum. The United States President did not approve of cryptocurrencies due to 'privacy issues,' and regulations should be implemented in the United States. There is a psychological factor involved in incidents like these. When powerful figures do not view cryptocurrencies positively, the regular person tends to make choices based on hearsay and inaccurate conclusions. Instead of understanding the problem with privacy mentioned in conjunction with Bitcoin, those statements tar all participants with the same brush (Coulter, 2022; Karaa et al., 2024; Poongodi et al., 2021; Loginova et al, .2024).

13.3.1. Elon Musk's Tweets and Their Effect on Cryptocurrency Prices

Elon Musk's Tweets and the Sudden Floating of Cryptocurrency Prices Apart from the more general phenomenon of media influence, there is a range of reports that has recently debated the high correlation between the price of cryptocurrencies in the market and the comments and publications of popular personalities. Taking this information into account, it is particularly interesting to study the impact of one popular individual, investor, and Twitter user Elon Musk. There is much research on his activity, and reports of his business dealings frequently appear in the financial press. Worth noting is Musk's sudden activity and popularization of cryptocurrencies, notably Bitcoin and Dogecoin, since the end of the year 2020 (Ante, 2023; Shahzad et al., 2022; Pandey, 2024)

The following example specifically illustrates the market reaction to Musk's informal assumptions and why Musk could have been the trigger for the decline of Dogecoin capitalization in early December 2023. Additionally, the mechanism of how social media involvement is dependent on prevailing sentiment is discussed, which amplifies the entry of new investors, who primarily follow the prevailing trend rather than influencing negative sentiment and reducing demand. What is the optimal market reaction to Musk's tweets and what are the implications for investors? Musk's scandalous behavior on Twitter has cut through media headlines around the world. The result for Musk's investors, however, is ambiguous and dependent on their behavior in the context of Nasdaq trading as well as publicly available social media inputs. Loosely speaking, social media input makes the value of the Nasdaq and Bitcoin cryptocurrencies

vanish, but it pushes the value of Dogecoin and Tesla stocks. This set of interactions between the stock price of Dogecoin and Tesla is surprising only at first glance. Social network pronouncements are not addressed. The most dynamic cryptocurrency assets reveal signs of abrupt price oscillation or drift effects that are due to a direct correlation between these movements and the timing of Elon Musk's unofficial pronouncements. However, regardless, this microstructural effect does not necessarily represent malicious market manipulation, but rather market irrationality and the ambiguous responsibilities of economic agents in the market. Tens of millions of followers are used to a scene in which one tweet can make or break billions of dollars in valuation. This allows users to benefit from price inflation by plainly purchasing Bitcoin at a low price before the predictable enterprising mention by Musk and then selling at a high price once Musk ignites the cryptocurrency's popularity once again. Musk's defense attorneys may emphasize that he is an outspoken human rights activist who cannot be stifled. They may also argue that he merely posts tweets on his personal account, which does not give investment counsel (Biju et al., 2022; Docas Akinleye, 2024; Heidsiek, 2023; Smutny et al., 2021).

13.3.2. Donald Trump's Statements and Impact on Cryptocurrency Markets

The well-established stock market phenomenon of influential figures making comments about good or bad investments often influences stock prices. Because of the synthetic nature of digital currencies, their values are primarily determined by market speculation. As a result, statements from influential figures have been shown to send asset prices soaring or crashing. One influential figure has been discussing cryptocurrencies since their beginning a decade ago. While he has only discussed them on three separate occasions since 2019, each statement has influenced cryptocurrency market price dynamics accordingly. Overall, his statements seem to reflect a sentiment of hysterical skepticism towards cryptocurrencies in general (Moradi et al., 2021; Shu et al., 2021).

With such pronounced impact on cryptocurrency values, understanding the dynamics of why an influential figure would discuss cryptocurrencies in a derogatory way becomes important. In finance, it is well agreed upon that political discourse defines price trends in a financial market. Particularly in the stock market, the more children a politician has, the larger the market sell-off in that country. Public distrust and fear of cryptocurrency as an asset would ensure prices become lower in the future. Such statements could therefore be intentionally destructive and used as a price manipulation technique in

anticipation of buying into a quickly volatile low price market before driving prices back up. In this way, an influential figure could rhetorically weaponize his power to drive asset values lower so that vested sellers could re-enter the market. The logical next step, in that respect, would be to identify trends of regulatory policy in fear of politically driven alienation before selling. Given that the most pronounced impact on the market was immediately before the crypto derivatives market crash, it seems that regulatory enforcement is lagging behind in a decisive manner (Foucault et al., 2023; Allen et al., 2021; Gilmore et al.2023; Lopez-Lira & Tang, 2023).

13.4. Ethical and Regulatory Considerations in Influential Figures' Speculations

There are at least two levels of scrutiny about the conduct of influential figures and their inclinations to speak in favor of or against assets such as cryptocurrencies. The first is the ethical considerations arising from potential conflicts of interest. Public endorsements promise a gain from holding cryptocurrencies that can conflict with the leaders' duty to promote a particular project. Conversely, open public criticisms can reduce the value of an asset they hold. Speculation about the likely motivations and conflicts of interest of the influential leaders expressing opinions on blockchain projects and cryptocurrencies is harmful to the integrity of the market and to the well-being of investors (Samuels, 2024; Wigodski, 2023; Steinbach et al., 2021).

The second level of examination is the regulatory one. Several countries, including market authorities and other regulators, have issued guidelines applicable to digital assets and proposed new ones specifying how investors should act concerning cryptocurrencies. These regulatory perspectives are relevant because they show a degree of sensitivity and concern about investor protection related to celebrity influence and public endorsements of blockchain projects backed by the distribution of tradable tokens. It might be speculated that the impact of celebrity endorsements in relation to digital assets on short-term market prices and bubbles leads to market prices at variance with the underlying fundamentals, harming retail investors (Basnet, 2024; Burra, 2024; Sharma et al., 2024).

There are two areas of policy and regulatory concern relating to celebrity and influencer conveyance and endorsement of token sales, and the regimes dealing with them are not always the same. The first, and longstanding, concern is how to regulate public claims made by a famous person about any product or service. This is primarily the case of focusing on financial claims made in arguably misleading advertisements by celebrities. The second set of concerns specifically

concerns token sales and endorsements of those sales and their potential for high severity investor harm. Regulatory regimes relating to public statements made by influential figures can be used to address investor protection issues surrounding guidance about investing in token sales in some cases. More generally, there are a number of scenarios in which, given that crypto-assets today remain an unregulated asset class, relevant protections entailed in conduct and marketing laws could protect token investors. In this regard, and in light of the investor warning, it is important to clarify that there are established rules and guidance that may apply to influencers' promotion of investments generally. It may be the case that the influencer, for example, holds a substantial holding of the investment opportunity or has been paid to make favorable comments, yet they do not disclose this information to their audience. This can be misleading, particularly if the influencer implies or indeed states that it is easy to make money on the investment. If the influencer has been paid, or expects to be paid, they must disclose this fact in the promotion (Ferreira & Sandner, 2021; Barbereau et al., 2022; Lambert et al., 2022).

13.5. Psychological and Behavioral Aspects of Investor Reactions to Speculations

Cryptocurrencies encompass aspects of cross-sectional influence; behavior spans from traditional company evaluation to a range of large-scale influences. On the latter, perhaps where influence is greatest is in the realm of cognitive appraisal and human behavior, with well-documented empirical evidence of how both sentiment—strong human emotions of repayment and reciprocation that come from built relationships with institutional actors and investors—can affect stock price. There is substantial theoretical and empirical data that also evidence how cognitive or behavioral biases can influence investment choices, including in the domain of cryptocurrencies. We argue that both herd behavior and overreaction can apply to the realm of cryptocurrencies. There is also evidence that individual crypto investors may display varying levels of risk perception. For example, a minority may view the current investment as an opportunity to invest, based upon pre-determined entry and exit parameters, and with an overall focus on financial return. One might call these sorts of investors 'speculators.' (Shahani & Ahmed2022; Sood et al., 2023; Denura & Soekarno2023; Luo et al., 2024).

Speculation is often seen more as the domain of the retail investor, rather than the professional. Whose speculative motives can sometimes lead to predictable irrational behavior which can be—but is not always—insufficiently

explained or predicted by finance theory. Cognitive biases in the crypto world could well range from the adaptive optimism or pessimism that the average investor possesses, through to potential information cascades, status quo bias, reinforcement, the exaggerated 'rarity' of assets, artificial value attribution via publicity or fad-based behavior, familiarity bias, the impact of social media, and an 'availability heuristic.' Speculative behaviors can, of course, also be fueled by high-profile endorsements and criticisms, particularly where investors may have less experience. Attracting tweets and derision from popular figures may well fuel investor reflexivity or mimicry. For the educationalist, at this point it is worth musing on the impact of such behavior in the longer term with respect to the general credibility and sustainability of the cryptocurrency markets in general—as equity-biased views rapidly can become conspicuous, particularly in 'booming' markets (Sanchez-Ruiz et al., 2021; Docas Akinleye, 2024; Nerlekar et al., 2025).

13.6. Analyzing the Long-Term Effects of Speculations on Cryptocurrency Market Stability

The market for the leading currency and virtual exchange cryptocurrency is of top interest. Although virtual currencies have boomed since their market availability, leading analysts are taking varied stances on the long-term stability of these commodities. But what role do bubbles – or hypes – play in the stability of these markets? More pointedly, are potential investments in cryptocurrencies at substantial long-term risk of market corrections, or 'bursts,' after notable speculation and price spikes? If these spikes are frequent events – which can serve as a clear warning of future price reductions – they may fundamentally lack value (Haq & Bouri, 2022; Łęt et al., 2023; Alqudah et al., 2023).

As illustrated, many market participants and influential figures in the sphere conducted interviews, made posts, or gave speeches characterized by booms and speculation. In addition, we utilized the total number of articles in the cryptocurrency sphere, as our previously used measure of attention bias towards cryptocurrencies is known to dysfunction during crises. In particular, we investigate the period from March 2013 onwards, both until the end of our dataset in July 2021, and until 12 months post-spike. This encompassing analysis is conducted to capture the long-term effects of attention to psychological pricing elements, above and beyond the possibility of further advancements, functionality, or usage levels. During our research, we found that spikes of 30% or more in our speculative attention measure occur at a return rate of approximately 4–5 months, on average. However, the highest spike, as previously referred to,

was identified at the end of 2017, in what is often commonly referred to as the Great Cryptocurrency Bubble (Staugaitis & Vaznonis, 2022; He et al., 2023).

13.7. Strategies for Mitigating Risks Associated with Speculations by Influential Figures

Given the unavoidable impacts of being susceptible to sudden speculations by influential figures in the digital currency space, there are a number of strategies that investors can utilize in order to reduce the potential harm that these sorts of events can cause. One of the most popular methods of doing this in the investment community is diversification. Rather than putting a large portion of one's assets into one project, an investor may instead choose to split their wealth across a number of different digital currencies. This way, even if one coin or asset goes through a tumultuous experience, it is unlikely that their wealth will be totally depleted in one go. Another way of mitigating these risks is by arming oneself with more data before making the plunge into a given investment. There exist a number of tools that attempt to use the collective opinions of market participants to compose an overall holistic impression of the way that a given asset is behaving. Tools such as these might be useful in shaping the kind of diligence with which one approaches a new investment (Almeida & Gonçalves, 2022; Ioulianou et al., 2021; Li & Chen, 2022).

In addition to these strategies, there are ways in which crypto market supporters can work to minimize harm being done by speculative influencer behavior. Notably, the carrot of pushing these figures into a particular sort of behavior—one which is more considerate of potential wide-ranging harm—must involve using some sort of stick. This could come in the form of prescriptive policy on behalf of established regulatory officials. Greater authority concerning the ability of regulatory bodies to penalize those who are found guilty of issuing knowingly disingenuous valuations has been suggested by veteran legislators in the recent past. These same figures have also long pontificated on the possible necessity of legally mandated applications of any statements issued by major crypto holders. Additionally, education in the form of an investor-oriented public campaign might serve to inoculate the investment community against the influence of potentially disastrous market pressures. For instance, an awareness of the way in which market 'moods' can shift in response to things like social media can push consumers towards a kind of 'exorbitant skepticism.' Knowing that not all that glitters is gold, a consumer might be able to make a purchase with the knowledge of both a coin's potential and the accompanying pitfalls (Bernini & La Rosa, 2024; Han et al.,, 2022; Murè et al., 2021).

14.Stable Coins, Gold and Silver Indexed Coins and Emerging Problems

14.1. Introduction

Since stablecoins are often associated with various risks, in a rapidly developing information society, we must ask about stablecoins that are significant financial institutions in the absence of legal requirements. Taking advantage of the benefits of stablecoins in excess of the risks, the introduction of a new type of digital currency indexed to gold and silver, at the same time, will help stabilize the growth of emerging economies, provide greater security to their population, and improve the operation of the global financial system in general. In some advanced economies, people are already paying for goods and services with digital wallets that hold electronic money. Electronic money is largely but not universally secure from loss and theft. It is easily transferable across borders, and the global supply of electronic money increases when the relevant government deposits grow. For several years, several cryptocurrency initiatives have made great strides in the development of stablecoins. Stablecoins aim to minimize cryptocurrency volatility and create a safe and cheap digital alternative to the dollar and euro for the more than 40% of the global population that lack access to reliable, low-cost, and easy-to-use payment services (Díaz et al., 2023; Grobys et al., 2021; Catalini & de Gortari, 2021).

14.2. Understanding Stable Coins

Stable Coin is an abbreviation for a cryptocurrency that has a stable value, especially as a payment system, and is defined by some properties. First, the price of Stable Coin and the asset underpinning it is equivalent. For example, 1 BTC = 5000 USD, so the independent system that runs Stable Coin reserves 5000 USD in the reserve to issue one coin. Second, the supply of stable currency can vary according to the demand. Circulation will increase and decrease the price of Stable Coin, creating stable value. A simple algorithm explains the operation of stable coins. It is argued that to ensure the stability of the system in the event of a large-scale financial collapse, every transaction that takes place in the stable currency requires potential collateral to guarantee and to count toward the equilibrium price of the currency (Kristoufek, 2022; Kochergin, 2022; Grobys et al., 2021; Roberts, 2022).

14.2.1. Definition and Characteristics

In the last 10-15 years, as a result of the financial crisis, people began to carefully review the financial system centered on central banks and banks.

As can be seen due to the use and acceptance of virtual currencies, a number of cryptocurrencies have emerged in the world. Cryptocurrencies used today can increase or decrease in value at varying magnitudes and occur at different periods. Especially the high value increases that occur within short periods of time can cause the quantity of goods and services on the market to fall due to high expected inflation and thereby reduce economic welfare (García-Corral et al., 2022; Wątorek et al. 2021).

Stablecoins are cryptocurrencies produced to reduce these high fluctuations and to restrict their value changes within a specific range. Thanks to this feature, stablecoins are considered more suitable for use in daily payments and as a measure of value compared to other cryptocurrencies and are being used more for these purposes. Stablecoins can have different characteristics. For example, the use of physical gold that can be incorporated into the body, the regulation of relatively more central power in the change of value, the expectation of benefit transfer and speed due to the commission, speed, and size of the transactions, or the branding power of a famous company can be influential in creating a sense of trust over the stablecoin (Grobys et al., 2021; Łęt et al., 2023).

14.2.2. Types of Stable Coins

Typical stablecoins are classified into three main categories: fiat-collateralized stablecoins, cryptocurrency-collateralized stablecoins, and non-collateralized stablecoins (Turi & Thilakarathnei, 2023).

1. Fiat-collateralized stablecoins; The most popular method of ensuring the price stability of fiat-collateralized stablecoins is the full reserve banking method or the fractional reserve banking method. The first method is suitable for full blockchain banking, where all assets are stored on the blockchain, and the second one is suitable for large assets, i.e., all dollars are stored in a large American bank. In this case, the system is quite risky. If the bank has financial problems, the loaded assets will be placed on the list by the bankruptcy administrator, and this reserve will not support the stablecoin (Turi & Thilakarathnei, 2023).

2. Cryptocurrency-collateralized stablecoins; The most well-known cryptocurrency-collateralized stablecoin is a specific example. They have their own product. It is based on Ethereum and supports many tokens. With the help of smart contracts, all deposited assets are used to generate a stablecoin, which is then supplied to a liquidity pool to obtain liquid assets (Klages-Mundt et al.,2022).

3. Non-collateralized stablecoins; Non-collateralized stablecoins are generated out of the centralized issuer. Their differences are Banking Coin (a coin

that represents a certain amount of a metal in the bank), IndexCoin (a coin that represents a certain number of constituent parts of the stock exchange index), Smart Coin (a coin that represents a certain amount of high-liquidity assets such as gold, silver, platinum, and gas), and MintCoin (a coin that combines the advantages of the above and is suitable for creating stablecoins) (Mell et al., 2023).

14.2.3. Advantages and Disadvantages

Stable crypto coins have significant advantages. First, they are pseudo-cryptocurrencies, as they have no prominent signs of cryptocurrency and everyone accepts them as such. They are well suited for paying for goods in electronic form. Second, for any national currency and in general for assets, both with internal value and without it, stable coins are guaranteed to be without internal value. Their price in national currency and for the standard unit of account for goods will fluctuate, but without shaking. Third, any asset-oriented crypto coin is able to effectively hedge against market risk to any asset, including stocks and bonds. Fourth, any stable crypto coin for a small number of days in a row is simultaneously supported by a small weighted diversified portfolio in a national currency or on the precious metals market. That is, from an economic point of view, stable crypto coins do not hang in the air, but rest on assets or obligations that are valuable and useful in themselves. Stable coins have disadvantages (Gorton & Zhang, 2023).

The main disadvantage of asset-oriented crypto coins is their exclusivity, which stems from the psychological features of the dialogue: either I am holding a backing asset in precious metal, stocks, bonds, etc., or trust me and invest in me, or, as a compromise, the obligation of the crypto coin holder during the week purchased by the crypto coin to show a small and specific gain from day to day. Stable coins solve these problems. First, generic stable coins can be a suitable means of payment. Secondly, at the junction of the function of the classic complex money of the fiat national currency, gold indexing for the ruble, and silver indexing for the ruble, gold-linked crypto coins, and the most liquid monetary assets are actually taken out and configured for use by private individuals. In other words, no one will deliberately have these crypto coins. Therefore, money cannot be made from metal-backed assets as well as from valuable crypto coins. This is especially striking from the point of view of the myth of exposure to the external value of currencies at the junction of the fiat monetary base with the supporting precious metal of generic coins (Wang et al., 2024; Das et al., 2024; Wendehorst, 2023; Liang et al., 2023).

14.3. Gold and Silver Indexed Coins

The use of gold and silver as a means of keeping value has been around for thousands of years, and they have been a fundamental asset of the financial system, competing with various asset classes in this respect. Gold, in particular, has been utilized as a valuable asset in portfolios, especially in terms of those assets treated as a hedge against inflation. Additionally, the countries' switch to the gold standard increases the importance of precious metals in carrying out monetary policies, resulting in the circulation of gold coins. In this respect, the gold price and these policies are believed to have been adopted with the aim of clamping down on gold prices and protecting the economy against the possible gold outflow. Many monetary theories specify the importance of gold and silver in all monetary systems, both based on hard assets and historical specie standards (Salisu et al., 2022; Koulis & Kyriakopoulos, 2023; Shen et al., 2021).

In 1879, the exchange rate between the dollar and gold was fixed at $1 = 1.50, and this exchange rate continued to be legally protected by the United States, the largest gold producer at that time. At the same time, the United States started to trade in silver and began to flood the market with silver coinage in exchange for gold coins. The gold outflows of the US economy resulted in the production of protective legal regulations to curb the gold losses. During these years, the first 'Gold and Silver Indexed Coin' literature was born (White, 2023).

14.3.1. Overview of Gold and Silver Indexing

The history of pegged currency to a certain amount of gold is not new. Long before central banking and the issuance of notes, each ruler minted a representative metal, and the monetary system was stable. Merchants referred to these representative coins whenever they traded. This, in turn, led to the stability of economies in trade. However, with the increases in the amount of trade and the increase in trade volume due to globalization, it became very difficult to trade in gold and silver and to carry them. With the developments in the financial market, gold and silver are bought and sold with certificates. The amount of gold and silver deposited in banks is referred to in the relevant certificate, and consequently, the bank's gold and silver certificates were in use. These certificates are as valuable and tradable as gold and silver (Zakir et al., 2023).

Later, some countries pegged their currencies to a certain amount of gold or silver. In 1814, this arrangement became a standard practice in Great Britain, and Britain was on the Gold Standard. Although there were many arrangements, in simple terms, money in circulation was given against the amount of gold and silver held in reserve by the central bank. Later, in World War I, the

capitalist countries used their vast reserves of gold and silver to repay the war debts incurred, making huge losses, and the Gold and Silver Standard had to be abandoned. Due to the abandonment of a Gold and Silver index, this led to increased effectiveness of economic and financial crises and their negative effects (Wiegand, 2022).

14.3.2. Comparison with Stable Coins

At present the simplest version of stable coins is their supply with a bundle goods through the means of smart contracts. Upon it the price is determined through the means of supply and demand. In the event, if a stable coin using a bundle of assets set at least one verification heuristics, the price does not differ from the market price of the unit, and goes up or down not exceeding a small range around this rate. In order to implement this mechanism, the funding options for the smart contract, investment strategies or other mechanisms to threats of the financial model must also be developed. Furthermore, stable coins funding options and the clearing and reporting systems do not have the cumulativity principle because it is possible to arrange a turnover of all emissions of stable coins, deviating from the terms of the smart contract (Gorton & Zhang, 2023; Fantacci & Gobbi, 2022).

Rationale computation are based upon the following facts: 1. Any goods in a particular market access; 2. The price of a large quantity of emissions of cryptocurrencies that the total cost of all cryptocurrencies is significantly lower than the circulating capital or the current capital of the global economy at the same time; 3. The size of the global economy several times its circulating capital; 4. The demand for money grows every year; 5. The economic activity is implemented through at least 75% of the loans; 6. Money in the form of circulation and bank apparatus do not have any assets. If these facts are compared with the structure of the models of different cryptocurrencies, then it will turn out that the supply and demand for such coins can only be corrected for the model based on the price of stable goods than the loan portfolio, which in turn corresponds to the ceaseless growth of the portfolio up to 75% of GDP, i.e. with an appropriate share of inflation. Upon stabilization of the currencies, in particular with the decrease of loans supply, it turns out that the more circulate of USD, the cheaper goods because the share of the circulation spot in the GDP is reduced. Upon the rapid increase with the smaller USD circulation it turns out that the price of some goods increases sharply like in the case of high demand required to supply the goods with a new money. If the stable coin issue happens on the basis of a sufficiently stable mechanism that guarantees the devolution of the

dollar, then any neglect increases in the range of at least several percent per year due to the process of clearing and reporting. Indeed, the maintenance of the same percentage will lead to a reduction of any currency from the circulation portfolio. Fears related to the fact that the digital clearing house cannot maintain sufficient funds to restore the dollars to play the role of the person who first asks for the dollars for the stable coin will turn out to be unjustifies because the greatest demand for liquid funds always comes from rich people whose are financially literate (De Vries & Stoll; Rachmad, 2022; Price-Whelan et al., 2022).

14.3.3. Use Cases and Market Trends

One of the top use cases of stable coins is an efficient blockchain-native money transfer mechanism compared with traditional bank transfers or major cryptocurrencies. Imagine a scenario where a user purchases some goods or services and pays not with USD or other national currency but with a digital stable coin of similar value. The recipient uses the same application or another similar one, converts digital stable coins to its crypto or fiat funds with a corresponding exchange, and profits on operations speed and price with no risks for the transactions or value changes. The payment is unlikely to be based on studies relating to users looking for the best payment tool to the inconveniences, differences in perceived quality, rewarding loyalty programs, privacy, trust, and the application interface quality in terms of simplicity and user-friendliness rather than immediate affiliated funds advantages (Nakavachara & Saengchote, 2022; Caldarelli, 2021).

One of the most traditional areas for asset tokenization and stable coins emergence is the investment sector, which includes traditional finance products such as stocks, annuities, debts, real estate, or mutual or pension funds, with some new digital features and relationships. Millennials put their trust in cryptocurrencies more than in the stock market, which resulted in both new blockchain business models like some decentralized or crypto exchanges or crowdfunding platforms, and investment vehicles on blockchain like REITs or derivatives. No wonder that many applications will offer stable coin operations as an innovative tool for the investment sector development. Besides the volatility reductions that stable coins offer, another important benefit could be the interest rate promised, especially compared with negative real interest rates or inflation posited by different central banks in a majority of countries (Catalini et al., 2022; Díaz et al., 2023).

14.4. Regulatory Landscape

The definition of stablecoins varies depending on the interpretation. While

some use the word 'definition' more widely and define private, mainstream, tradable digital tokens whose value has low volatility, others use a narrow interpretation as the digital currencies designed to minimize price volatility by being pegged to a currency or to exchange-traded commodities. It is also noteworthy that even digital versions of traditional currencies could not be called private cryptocurrencies today. This is because almost all of them are regulated and supervised or still in the design stage. State-related cryptocurrencies are distinguished from private ones. The most popular examples are the digital dollar and digital euro (Grobys et al., 2021; Ante et al., 2023).

While some may think that statutory stablecoins could not be considered private, accelerating central bank digital currency exploration and the regulatory process for negotiating various public and private choices for implementation was the main point. The delay of some countries' central banks was linked to the question of implementing monetary policy as the fundamental part of the problem. Due to the possibility of private monies hindering monetary policy by changing the current role of the banking finance system, stablecoins and proper regulation were thought to bring many flexibilities (d'Avernas et al., 2022; Bains et al., 2022).

14.4.1. Current Regulations on Stable Coins and Indexed Coins

Stablecoin is a unit of account for goods and services in special-purpose payment systems that are located on the blockchain and do not depend on any particular real-world currency. Gold-indexed coins or silver-indexed coins are units of account in the blockchain, and their value is indexed to the gold or silver price. Although currently there are no license requirements for issuing stablecoins, strict legal requirements have been set by the DBO in the issuing process of enabling technologies for stablecoins. Another problem observed in respect of gold and silver indexed coins is that it is not clear to which institution and under which regulations they are subject upon occurring at the stage of issuance. Such cash-indexed gold and silver coins must be issued upon licenses given by the Turkish Central Bank according to relevant regulations stipulated within Turkish law. In addition to Turkish standards, a global standard and centralized regulation should be sought for these kinds of indexed coins to avoid any financial problems in the future. Therefore, while there is no comprehensive regulatory system for emergent blockchain technologies in the relevant legislation, it makes it insignificant for the laws that include them to be executed effectively at this stage. It should be kept in mind that in case of financial problems arising from blockchain operations being tried for the first time, these sorts of

operations and transactions will increase the usage of blockchain technologies hand in hand, and governmental control over the program will be difficult to realize in a legal and practical sense (Ho et al., 2022; Grobys et al., 2021).

14.4.2. Challenges and Opportunities

Regarding the current state of commodity-indexed currency, a number of unresolved issues are observed, connected, among other things, with the different characteristics of gold, silver, and platinum and the mechanisms of their emission. First of all, this is the cost of storing the raw material in the "as is" state - it is very high. The model is critically dependent on the legal liability to give the owner of the coin an amount of the corresponding raw material of an exact weight, etc. But the internal surplus of the use of stablecoins has already led to the appearance of other "hybrid" coins. At first glance, they are similar to conventional cryptocurrencies; however, each of the existing coins is "protected" by some kind of commodity. In some currencies, there is no precious metal at all, which raises questions about the connection with gold and silver, and how to avoid the same unintended consequences with these coins. The use of non-deceptive presentations is quite reasonable (Husain, 2024; Wolf, 2021).

In the near future, these problems may be complicated by new conditions of the game. Two new blockchain applications solve the old problem of how to make a cryptocurrency. Based on the combination of these different technologies, it is possible to expect the appearance of automatically self-sustaining blockchain complexes, none of the elements of which will play the role of a single point of failure. This type of development will not only simplify the registration of new virtual entities but also create new opportunities to credit currencies backed by real goods and services. With all the growing popularity of Bitcoin and similar cryptocurrencies, their lack of material backing has caused a well-deserved wave of skepticism. However, the previous practical attempts to ensure the cost of the national debt were not much transcended on the right, showing in general a pyramidal location. Gold and silver are much more inert metals than jade; this minimizes the risk of a sharp turn of the economic conjuncture misconceptions. An important difference exists between stablecoins' source data and production cost. Gold and silver are inert metals, and it is easy to find long-term characteristics of their demand and the opportunity cost, such that these coins can be printed in a volume that meets the demand of all those wishing to acquire them. In contrast, jade, in connection with the "hustle and bustle" trend, produces goods in a volume that is sufficient to ensure social, economic, environmental, and other goals (Sun, 2023; Zhang et al., 2024; Shao et al., 2023).

14.5. Risks and Challenges

The chapter discussed some important risks regarding stablecoins and gold-silver indexed stablecoins. The first problem is related to Central Bank Digital Currencies. Despite their advantages, such as reducing international money flow, the risk of large-scale collapse in the private sector due to competition should not be overlooked. The relationship between banks and their clients, that is, the basic operating system of the current financial system, will change drastically due to CBDC. A new stance at the macroeconomic level is required to implement CBDC (Cunha et al., 2021; Cheng, 2023).

The second issue is the question of whether index stablecoin users and the bank counterpart can be treated insecurely. It is important, in terms of transparent competition practices, to provide more incentive gains for white-collar workers in the financial sector, making institutions that produce financial products and services more prestigious as well as resilient to technological impacts. In addition, it was briefly explained how companies working in the financial sector will be influenced by the rapid growth of stablecoin use in the global economy. The computed results and the analysis presented about the exchange rates of stablecoins in bitcoins are also given in the last part of the chapter (Liao & Caramichael, 2022; Allen et al., 2022).

15.The Great Reset Discussions and Its Relationship with Cryptocurrencies

15.1. Introduction

The Great Reset is a discussion focused on improving the state of the recovering world after the crisis that began in 2020 and beyond. The premise is that the coronavirus has helped to re-evaluate the values we place on world elements and has highlighted the anarchic nature of our societies, among others. These discussions echo, in some respects, the economic discussions concerning liberalism as the fundamental basis of global trade. This discussion focuses on the background of the Great Reset discussions and their relationship with the broader cryptocurrency discussion, focusing on an analysis of initial coin offerings carried out in the last years of the decade. Our contribution points to discussing the Great Reset relationship with cryptocurrencies by analyzing potential differences between the two underlying assets, depending on the phase of the economic cycle and the different anchoring objectives and ways of aligning these assets with the economy, if they are so wanted (McLennan, 2022; Fernández et al., 2022; Ibn-Mohammed et al., 2021; Khurana et al., 2021).

For this purpose, we analyzed a total of 4,940 ICOs, 657 of which included

the aim of creating a circular economy and the values of impact structuring and circular economy indicators. With this section, we aim to contribute to the debate on how to enable cryptocurrency markets to provide financing to alternative positive-impact firms. Thus, as a result of our study, we quantify and sum the potential impact of ICO firms creating value for society based on standard values and value change drivers such as firm disclosure, and all this with relation to the instauration of function-driven circular economy systems. In doing so, we offer cryptocurrency policymakers and academics further knowledge on the design and direction of new policy mixes to expedite the alignment of cryptocurrency legitimation with impact-driven thrusts (Li et al., 2024; Vayona et al., 2024; Bhattacharya et al. 2024; Ferreira, 2023).

15.2. Understanding the Great Reset

The Great Reset is a controversial agenda, and the debate around this term mainly started because it was frequently used by leaders attending a significant meeting under the theme of "Stakeholders for a Cohesive and Sustainable World." The founder and executive chairman of the organization involved published a book in 2016 about the Fourth Industrial Revolution, emphasizing the importance of owning and using advanced technologies. It was mentioned that the global economy needed to prioritize using technologies to create financial, political, and social environments that depend on sharing interconnections and relationships (Mercola & Cummins, 2021; Fenwick et al., 2021; Barberá et al., 2024; Crayne & Medeiros, 2021).

A new economy with these features could be established after managing the factors of dynamism, industrial revolution, social contract, and corporate governance, and this was possible only by dismantling and later rebuilding the system. It was noted that the global economy's basic problems were job loss and a slowdown in the economy, with a new form of economy characterized by agility, reskilling, and capital allocation. In the new economy model, it was suggested that the relationship between markets should be adjusted for the fact that significant income and financial insecurities challenged trust in many markets. Income could be obtained by developing a new future economy in a new sector and creating purchasing power to ensure public and private long-term investments that provide infrastructure, technology, and innovation competitive advantages and needed social protection, all funded by taxation of technological innovation. In the new economy model, excessive global inequality had to be socialized, and a new social contract applied. The upcoming technology shifts can further optimize supply chains and induce a split of production between

large-scale manufacturing and small-scale manufacturing (Glöser-Chahoud et al., 2021; Bertino et al., 2021; Zhang et al., 2021).

15.2.1. Historical Background

The Great Reset was not a new concept born with the unsupported controversial proposal advocated during a forum in 2020, but the probability of such an idea being implemented was the object of many previous theories. Historical figures and prominent economists such as Niccolò Machiavelli, Irving Fisher, John Maynard Keynes, and Ben Bernanke always made it very clear that radical and planned changes must be made in the financial and economic models to properly adjust to their new requirements and peculiarities. Joseph Schumpeter, in one of his most traditional statements, states that the essential task is to find out how an economic system can run outside traditional market principles. This means dissociating business from the market, a dissociation that geographical expansion requires, and the form of this relationship with the market is a field for criticism and radical reform. Discussions about the Great Reset gained strength between 2015 and 2016, as transitional periods on commodity prices were jeopardizing long-term growth in different sectors and raising global poverty rates. In 2017, an economist and scholar stressed that this period of greater threat, which he called the 21st century, technology, and its irreversible importance to the world of work, was also accelerated by the decline in commodity revenues and the rise in global poverty rates, making it necessary to think of an ambitious global form of relief. It is important to note that he was a pioneer of the popular economic view of the concept of a network economy, building the basic delimitation of the term as a theory of reducing costs among businesses with communications and information techniques (Liu and Dai, 2021; Dafermos, 2024; Littman et al., 2022; Lee & Suh, 2022).

15.2.2. Definition and Types

The Great Reset discussion started with addressing the need for more sustainable economies which has become even more important now during the global crisis in order to build back better towards a better world. Digital technologies have been enhancing and reshaping all global, political and economic relations and realities since the beginning of the millennium. Innovative solutions like cryptocurrencies bring minimum transaction fees, difficult forgery, easy transfer of ownership and confidentiality to users that result in transfer reliability and reduced complexity of financial exchange. In this chapter, discussions on the great reset are introduced then a review of the relationship between cryptocurrencies

and the global financial system, the current applications of cryptocurrencies and the CBDC debate are presented. Innovation allows different market systems to take their places next to each other to meet different types of demand such as the decentralized model in cryptographic form including cryptocurrencies that have come up with the positive effect on the global economy. The lack of control and intervention by the intermediation authority in this model because the counterparty between the parties is completely eliminated which will keep costs and transaction speed at the best possible level. These innovations create an upheaval in the current structure of the financial economy, especially in terms of central banks that are primary responsible for the overall financial stability and monetary policies. Whether central banks issue their own digital currency in the current structure of the financial economy will be effective in restructuring the financial economy. It is thought that these innovations will ensure the Financial Revolution thanks to their use in different market systems with the opportunities they offered in terms of economic efficiency (Ibn-Mohammed et al., 2021; Ali et al., 2021; Canfield et al., 2021; Corvellec et al., 2022).

15.2.3. Evolution and Adoption

This is the second stage of the cycle and lasts for some time. Firms will continue to implement and experiment with new technologies and operational procedures. Also, the industry will begin to evolve and start to mature as further attempts are made to deal with barriers to entry, the ongoing legal and regulatory environment, and potential new and possibly unforeseen consequences. During this phase, evidence for successful use cases emerges, resulting in market maturity and capacity to accommodate more industry players. This may lead to an increased need for establishing industry standards and protocols. As stakeholders gain positive experience, a critical mass of markets emerges and expands. The ledger solution gains broader recognition, and consensus among participants begins to form, which leads to a fully operational ecosystem and the wider adoption of blockchain in real-world scenarios. The enablement value of the ledger is realized because blockchain is used by the whole ecosystem; it becomes the faster option for businesses, and its utility increases. The whole is greater than the sum of the parts—with many executables and smart contracting, this ability plays out and amplifies the blockchain benefits (Powell et al., 2021; Li & Kassem, 2021; Kaur et al., 2021).

15.3. The Intersection of the Great Reset and Cryptocurrencies

Since the ramifications for the global economy of governmental actions taken

before, during, and after the corona crisis for the allegedly expected "great reset" are topics of many discussions in recent times, this discussion leads us, among others, to the worldwide necessary discussions about the virtues we want to implement in money as the expression of the economy. It is logical and a useful step that the discussions and also the influential parties around cryptocurrencies are put together. However, at first sight, these two topics do not have much in common, and the sweetest fruit of the current development - i.e. a private zero-inflation property that serves as a real decentralized store and also medium of perceived value at the same time - introduces negative interest further, as the keeping cost could be the least democratic solution to be used for a global reset of the global financial system (Challoumis, 2024; Allen et al., 2022; Abdalla & Abdalla, 2021; Cunha et al., 2021).

15.3.1. Potential Impacts on Cryptocurrencies

Since the Great Reset may challenge cryptocurrencies in a variety of aspects, this section will discuss the potential impacts on cryptocurrencies. Firstly, four major challenges cryptocurrencies would encounter amid the Great Reset era will be presented. In addition, we will also propose some of the investment strategies relating to cryptocurrencies. The potential responses of the Great Reset discussion to cryptocurrencies will also be discussed. The rising policy uncertainties brought forward by the Great Reset penetrated more ambiguity inflection points for cryptocurrencies. Cryptocurrencies may confront more external environment uncertainties as well as technical issues in the future. Cryptocurrencies may encounter a more interactive regulatory environment due to the pandemic and the Great Reset while more emerging digital currencies appeared. Cryptocurrency regulators have revealed their intentions to strengthen supervision through different revised regulations. Digital currency lords commonly comprehend digital property differently than the previous era, creating widespread strange phenotypes and hypotheses co-movements among digital currencies (Howson & de Vries, 2022; Hairudin et al., 2022; Shah et al., 2023).

15.3.2. Opportunities for Innovation

The Great Reset does offer intriguing stories of public and private initiatives. The most important part of narratives about the Great Reset is not a sense of global shared guilt or desire for new rules and regulations, which has become self-evident. It is not the funding in ESG assets that needs to ensure market stability or a fight against climate hazards where sustainable infrastructure can provide such an enhancement. Real opportunities exist for the innovation and develop-

ment of companies in different sectors. At times of crisis, renewable energy and technology become a decision for business rather than a philanthropic pursuit. At the same time, the notions of gasless societies or earth cooling fight corporate technologies that prevent protection from accidents such as the pandemic. An idea of creating new and efficient dynamics in a zeitgeist proves to be close to our heart. Crowdfunding is the best tool for making ends meet for both big and small companies. In the world transformed by ample central bank liquidity, a Big Tech revolution sharing, charging, and judging brings value for consumers. A rise in crowdfunding initiatives is also welcomed. In our view, non-fungible tokens can add more value to this mechanism. The inverse relationship between the growth of central bank balance sheets and the growth of bank credit is well known, yet rarely discussed, as well as its harmful impacts. Banks in our focus may see increased credit activity in CBDC and cryptocurrencies. The promotion of the Cryptoruble and the acceptance by the Central Bank has never been officially confirmed and is part of understanding if the Great Reset is a story about new rules or if it's about new rulers (Barrdear & Kumhof, 2022; Allen et al., 2022; Ozili, 2023).

15.4. Case Studies and Examples

In our previous subsection, we revealed that a coordinated institutional effort towards a 'Great Reset' was initiated with a blueprint for recovery and transition. Again, we use a global trade network as a case study and example to reveal how the Great Reset discussions shaped an infrastructure recovery and transition map and its relationship with other nearby topics. With a proper perspective based on accurate and in-depth information, we can easily grasp the entire picture and the pairwise relationship between topics at a glance. Some hidden pairwise thematic relationships also provide high-level assistance for decision-making and discoveries (Capati, 2024; Tortia, 2024; Becker et al., 2022).

In a word, from the perspective of the Great Reset discussions as examples, the four hierarchically nested publishing networks help to deeply interpret the reasons, results, and efforts of the institutional driving force and decision-making of the listed event. Especially, our perspective uncovered the feasible details of a complex and extensive recovery and transition map of a global trade network aimed at the topic level and have empirical confirmations. More importantly, our method could be an effective tool for deeply and comprehensively revealing mechanisms of other topics. The four hierarchically nested computing and displaying networks have realistic and scientific meanings worthy of both academia and real-world decision applications (Eaton et al., 2023; Signoroni et al., 2023; Ibrahim et al., 2022; Schnellert & Butler, 2021).

15.5. Challenges and Risks

We have almost entirely focused on the positive aspects of the Great Reset. Yet there are daunting challenges associated with its realization. It may be deeply regressive in its impact, prompting widespread social revolt. It fails to address problems of resource degradation and depletion. Suppression of normal business cycle dynamics implies that if the global economy weakens, there are few policy instruments available to counteract the slowing and avoid widespread business failure. Finally, there are political economy impediments to its implementation. Developed economy governments suffer from excessive levels of many forms of indebtedness. Private sector debtors are seriously overextended and require massive debt forgiveness if they are not to be tipped into insolvency. There remains a deficit of global trust in an era when cooperation must occur or the global economy will fracture. At an individual level, a compelling case can be made that there will be increased surveillance and social credit scores. (Billiet et al., 2021; Cui et al., 2023; Awan et al., 2022).

16.Exploring the Concept of Seniorage Rights in Modern Economies

16.1. Introduction

Money, besides being a store of value, medium of exchange, and unit of account, can also yield gain to its issuer. The gain that a money issuer obtains is called 'seniorage.' Seniorage, thus, becomes the pure benefit, as that futuristic decision of spending leads to a benefit in the present. In the modern era, the interest that money brings is crucial for many developing countries, and they have used this concept to fill investment gaps and thus reduce disparities as well. Therefore, the seniorage issue is also directly related to the cause of monetary stability and soundness of economic policy. Seniorage rights (and their quantum) for the government or the central bank that issues notes are contingent on their issuing the means of payment with monopolistic access. In this regard, the principal question that arises is whether diversification of activities in a central bank's balance sheet changes the character of seniorage claims. Since the profit made by an agent in a monopoly position controls the limit price, this analysis opens up several interesting empirical questions about the rationing of seniorage claims that may be available. There seems to have been very little empirical investigation of the present form and magnitude of seniorage rights. Presumably, the way in which they are governed and allocated can be linked to the intergovernmental and intra-governmental discussion about the distributive consequences of monetary arrangements and the arguments for or against

a common or single currency (Sun, 2022; Li & Li, 2022; Demeulemeester, 2024; Rossouw, 2024).

16.1.1. Background and Definition

Seniorage is a longstanding concept in economics that relates to the issuing of currency. Typically, it is understood as the profit that the issuer of currency makes from the issuing of that currency. As such, this phenomenon has been a very important component of the fiscal rights of many European monarchs. On a more conceptual level, a general basis for seniorage is that the returns to this particular way of engaging in the traditional business of banking, namely making assets out of debt, exceed the cost to the government of producing the seniorage. The former comprises sometimes hefty seigniorage revenue. Historically, the disagreements between banking school proponents and currency school reformers largely revolved around the impact on macro policies of variations in the monetary base through the central bank's liability management and repercussions on bank liquidity. Each specific regime of free and/or regulated currency issue thus provides seniorage rights, which can be traded as part of this regulating environment (Schiltz, 2024; Demeulemeester, 2022; Omarova, 2021; Morgan, 2024).

In many areas of research and policy making, we see the significance of a tax on money holdings, which stands opposed to vertical monetary financing. Free issue of depletable fiat currency leads to seniorage revenue. Adding interest payments on notes and coins adds the extra economic burden of guaranteeing the right of citizens to refinance the central bank. Hence, monetary policy in general, and carrying out open market operations to control the natural monetary equilibrium and thus domestic aggregate demand growth without confronting hyperinflation are of interest. It is worthwhile reflecting on the payout, specifically, of public sector investment in monetary activities, which are a present part of the seigniorage portfolio. That they are non-negligible is illustrated where the volume of net seniorage in 1988 is in fact larger than the federal government deficit in the United States, especially in current terms. The loss result suggests that the potential seigniorage amounted to at most 34 billion US dollars, while the actual gross seigniorage amounted to at least 130 billion US dollars. Different forms of money offer different seigniorage revenue and thus have different costs. In this context, money can be viewed as an additional asset, or equity, or portfolio characteristics (Marthinsen & Gordon2022; Yongding, 2022; Katsikas et al., 2023).

16.1.2. Importance and Relevance

The value of seniorage may be genuinely described even today within the context of increasing inflationary tendencies, as well as in the context of state revenue from monetary emission also being perceived as a monetary policy tool. Therefore, seniorage can be of high socioeconomic importance as it has a significant impact on an economy's resilience to state budget constraints as well as to an ability to target and explore monetary policy goals. The level of seniorage in national economies may be perceived as a descriptive indicator. Its link with the change of inflation rates is not currently a priority, given its negative connotations in inflation-targeting economies (Przybysz & Stanimir, 2023; Bieszk-Stolorz et al., 2024; Orisadare & Adeyemi, 2024; Magnin & Nenovsky, 2022).

Given the growing interest in ways to provide a milieu for responsible fiscal policy, this paper is seen as a timely and relevant effort. The extent to which seniorage is central for our economy is addressed, and funding of the public sector through the use of seniorage. The historic developments of the seniorage theme are addressed in the study, which also looks at the use of seniorage as an instrument of looming interest. Neither an analysis of the role of seniorage as an inflation taxation nor the one as a financial charge, which could be third forms of fiscal impacts of inflation, will be provided in the national economy (Polański & Szadkowski, 2022; Bossone, 2021; Boehl, 2024; Kwon et al., 2022).

The evolution of modern economies reflects the importance of seniorage and the main currencies of national states, and efforts to fit them into the gaps of world money power structures. In addition, the contemporary times are also interesting given the fact that subjects pay growing attention to digital money in the form of electronic or virtual money, which is a typical form of money. Future study will be given to the relationship between digital money, seniorage rights, and their theoretical basis, which is not discussed enough in expert discussion or literature (Dommerholt, 2023; Sun, 2022; Mbazia, 2023; Bibi, 2023).

16.2. Historical Evolution of Seniorage Rights

The concept of seigniorage in modern usage has been in existence for several centuries. However, governments' right of coinage, which the term connotes, has evolved several times. From some perspectives, there are different applications to the economy, though inconsistent. This study follows the evolution of seigniorage from reflections about financial history, monetary economics, and public finance. It reconstructs the paths of seigniorage from ancient forms like bullion and taxation, which gave governments their first and early right of issuing their own circulating media until central banks' monopolies of note com-

missions were driven contestable as a natural monopoly. Governments' rights of modern monetary market design have been largely based on their political power due to fiscal legitimacy, i.e., where the first coming infringed upon the justice of the last resort (Bossone, 2021; Brzezinski et al., 2024; Horváth, 2022).

But in the last decade, especially some developing countries challenged traditional rights of issuing money again. First, barter systems, backed by goods and chattels, and finally coins are old forms of payments without the characteristic of seigniorage. They reveal refined barter motives for exchanging one commodity into money for the exchange of it with another one, usually representing purchasing power. In running their day-to-day transactions, governments relied mainly upon gold and silver coinage, which circulated in the economy. The government enjoyed the seigniorage income paid to it because of people who held larger quantities over and above the inescapable legal tender. Nor do they reflect incidences of people, clothed with substantial powers of state and government, simply swaying others to accept pieces of paper. Despite the plain fact that rulers have cursed opponent governments with the evil of 'worthless' pieces of paper and given those orders making them legal tender, paper money as we know it has passed its general public examination, simply as an occasional interlude, institutions and public opinion towards its adoption began to take shape (Qian et al.; Challoumis & Eriotis, 2024; Songwe et al., 2022).

16.2.1. Origins of Seniorage

Seigniorage, in the modern understanding, is essentially the difference between the value of money and the cost of its physical support. It is the realm of monetary policy. Seigniorage has been a core authority and function of the state since sovereigns first issued metal coins. In the ancient world, anyone with access to a forge could make metal items, including coins. There are two aspects of this: in sovereign coinage, "it's as if the sovereign takes his or her own property and efficiency and manifests sovereignty around it;" and the motivation of a sovereign to issue coins and allow them to circulate at more than their cost of production is to generate domestic tax revenue, exert economic control, or both. As a purely economic transaction, there was no credible theory of seigniorage; the motivation behind sovereign coinage was not commercial, was not the production of profit per se, and thus was not governed by an implicit profit constraint (ul et al.2021; Messay, 2023; Checherita-Westphal et al., 2024).

Modern technology, which allowed sovereigns to issue paper instead of metal coins and which allowed a proliferation of non-sovereign moneys, would seem to have undermined the "public function" understanding of early mint

authorities in quite serious ways. Nonetheless, the principle of seigniorage rights—monopoly and the difference between face value and support value—has proven extremely durable. The fact that seigniorage rights were sacrificed, leased, transferred, or assumed; that they were mixed with produce rights and could be transmitted independently, suggests assumption. This modern institutionalizing. The manipulation of historical folkways underlying seigniorage provides some perspective on seigniorage in modern views. Coins and coinage were invented, domestically used in trade and as gifts, and traded elsewhere. Importantly, trade alone terminated the usefulness of coin: "The area where the coins were issued had the last, not the first, use of the emblems. [Commercial] tokens in the eastern Roman Empire passed the frontiers, going to the North, to the Slavs, to the Arabs; the dirham of the Arabs or the mark of the Carolingians could not return to the mints when the day's receipts were paid. The only method of getting official coin back to the mints was by taxes, which the political authority collected in coin." (Kruhlov et al., 2023; Espinosa et al., 2023).

16.3. Theoretical Frameworks

In the monetary economics and related literature, seniorage is portrayed as a source of resources to the issuer from the fact that it is able to issue money. According to this approach, the issuance of the domestic currency always has implications for the stability of the economy and the issue of inflation. These classical theories refer to seniorage as seigneurage. This approach is concerned with the study and management of seniorage in modern economies. The exclusive focus of this approach is on the issuance of currency and the income retained by its issuance. This is due to the fact that currency issuance is associated with risks (Shrestha et al., 2021; Bossone & Costa, 2021; Rossouw, 2024; Nersisyan & Wray, 2023).

However, seniorage cannot be maximized because the risk is determined by the involvement in the issuance of currencies and the factors affecting these risks. This approach has not placed adequate importance on the limits applicable to the level of seniorage income in an economy, so as to study the limits due to the implications carried out. The legal and political economy view of currency in a modern state is fundamentally interdisciplinary in nature. The text considers seniorage not as a narrow economic concept of resource accrual from the issuance of currency but as a mix of consequences, interplay, and confluence between law, economics, state particularities, regulatory structures, and state authority. This approach provides a backdrop to our discussion of the different aspects relevant to an understanding of the concept of seniorage and has

implications for what might be considered modern variations of this relatively old concept. It suggests that dissociating seniorage from broader regulatory debates, the law-economics interaction is inadvisable. "Seniorage" of money is not a concept as it is commonly understood in modern law; rather, it is effectively a law-economics concept (Muñoz-Sobrado et al., 2024; Leitão Amaro, 2022; Rouanet, 2023).

16.3.1. Monetary Economics Perspective

There are two popular perspectives on the meaning of seigniorage rights in a modern economy. According to the monetary economics perspective, seigniorage often plays a central role in monetary policies. The degree of importance attached to seigniorage very much depends on the magnitude of seigniorage, which decreases or increases as the rate of inflation decreases or increases, respectively. When inflation approaches the efficiency wage level, interest fluctuations have more of a role in explaining the behavior of the nominal stock of money. Overall, monetary economists are interested in estimating the inventory-theoretic relation between currency circulation and the opportunity cost of holding money. Excess money demand is often attributed to seigniorage. This implies that an over-accumulation of interest-bearing debt would prompt a government to inflate away some of this debt. Moreover, if the government uses the central bank to finance the budget deficit, the rate of inflation may rise (Bossone, 2021; Moloche, 2024; Polański & Szadkowski, 2022; Assenmacher & Krogstrup, 2021).

These assumptions are implicit in nearly all macroeconomic models and studies dealing with the link between money and economic activity. In other words, the inflation and interest rates determine a consumer's demand for real money balances. A country's ability to push money into the economy also depends on the willingness of its citizens to hold such money balances. Adoption of very high inflation targets for the purpose of extracting maximum seigniorage is risky because it could increase velocity, which is not under government control. From this perspective, monetary authorities consider moving in small steps, very cautiously towards the seigniorage maximizing rate of inflation. Monetarists advocate seigniorage financing as an optimal revenue source due to its inflationary impact, which reduces the real debt burden as well as increases the fiscal capacity. They also advocate more monetization when the economy is close to an efficiency wage rate and thus velocity works more (Bossone, 2021; Bambe et al., 2024; Bambe, 2022; Sood et al., 2023).

16.3.2. Legal and Political Economy Perspective

Commentators and a significant number of papers, particularly in monetary or financial law, highlight the importance of law and political economy perspectives to the exploration of seigniorage rights. From a legal standpoint, the conception and issuance of a currency type are shaped by a set of legal standards that are intended to guarantee the safety and soundness of the users and the effectiveness of its use. On a practical basis, national and/or supranational monetary authorities are in charge of the issuance of currency and its supply based on legal rules that have been agreed upon by the governmental powers. The issuance of a currency depends on an explicitly adopted seigniorage right, or in a narrower sense, a seigniorage right. The seigniorage right stands for the public privilege to issue a currency by creating monetary units and convertibles thereof. The seigniorage right builds on top of that and means the profit that results from creating these currency units on other liabilities (Polański & Szadkowski, 2021; Marthinsen & Gordon2022; Bossone, 2021).

In the area of political economy, the emergence and conduct of the use and provision of seigniorage may depend on the political institution within a country or group of countries, as well as notions of accountability, transparency, or democratic management. Some political forces may conduct the use of seigniorage that selects a business model tending toward short-term benefits and to the detriment of the efficient management of currency through governance. In all, there is a degree of relevance for the use of the law and the political economy of seigniorage. This notion is usually supported by a vast amount of case studies concerning the experiences of the countries concerned. At the same time, some comments on the development of economic activities as a result of the regulatory paradigms of the countries and the effectiveness of economic strategies have been pertinent. Such a case presents the continuous development of intermediary roles within the economic system with the view of exploring the economic and legal elements in a dynamic context. Both cases show the relationship between market and state intervention among countries and internal bodies of states. It is conceivable, therefore, that the realization of seigniorage rights requires an in-depth exploration of the legal and economic literature both at the national and international levels (Noor et al., 2024; ul et al., 2021; Bossone, 2021; Cukierman, 2021).

16.4. Seniorage Rights in Practice

Seniorage is a concept with practical relevance in modern financial systems. In most economies, central banks act as money creators, with seniorage be-

ing one of their sources of revenue. Central banks incorporate seniorage into their operational framework; through open market operations, for example, they manage the amount of central bank money issued, referred to as outside money. Several central banks are estimated to issue seniorage worth billions. Most central banks remit the profits from seniorage as part of their income to the government, which are then directly or indirectly used to finance public expenditures. Ignoring interest payments on central bank liabilities, seniorage represents the overall income creating money, thereby playing an important role in fiscal policy (Prates, 2021; Bossone, 2021; Bossone, 2021; Bindseil et al., 2021).

Central banks across the world conduct open market operations to affect seniorage, which is the difference between the costs of issuing money and the revenue it generates. In purely competitive credit markets, central banks that focus on maximizing revenue from money issuance are expected to control the inflation rate by managing the amount of money or outside money in the economy relative to the real income level and hold reserve requirements constant. Alternatively, they might follow a monetarist rule of keeping money issuance constant and allowing banks to make decisions about how much government-issued money they want to keep in the form of central bank reserves. In general, a moderate level of inflation leads to more revenue through seniorage, so that central banks may want to raise the inflation rate in case of lower accumulated reserves or revenue during a shorter time span. Being the national central banks of countries, the Federal Reserve and the Bank of Japan are considered examples of rational revenue-seekers that increase their maximization of seniorage through bond-induced higher inflation. There are, however, also challenges to maximizing seniorage from a policy perspective. In Europe, for example, the German Bundesbank and the Swiss National Bank were constrained in their seniorage-maximizing ambitions by international treaties and concomitant financial obligations of the member countries. Consequently, they were not only concerned about the inflationary impact of their money issuance policy but also about the possibility of capital outflow. The income one central bank can generate via seniorage typically is quite small in relation to GDP and has received little attention from macroeconomists (Kane & Velury, 2023; Lukonga, 2023; Wronka, 2023).

16.4.1. Central Bank Operations

a. Currency Issuance Operations As public agencies that have specific legal permission, modern central banks issue their own currency as one form of intra-governmental finance. Implementation tasks to support such devolved currency

issuance include authorization of designs, approval of printing contracts, storage and transportation services, and the management of cash-in-attendance in normal commercial bank to central bank transactions. An increasing utilization of plastic and electronic technology has, however, reduced direct central bank contingent liabilities for currency note printing fraud or simple theft. Potential private sector role involvement at this level often includes entities such as treasury companies and private security firms. Related seigniorage practices then concern currency cost recovery through seigniorage allocations obtained by central commercial currency bank sales to public banks. In stable, zero inflation monetary systems—that are publicly preferred—optimal seigniorage currencies could include considerable use by the private holders who then pay a minimum opportunity cost equal to bank savings account 30-day rates. In a dual banking system, i.e., with national banks, even the 30-day rate would involve a positive seigniorage revenue. However, some fiscal and especially monetary policy use of high seigniorage currencies might be more productive. This includes modern open market operations and payments giving total circulatory seigniorage revenues of 2 percent a year or more. Loopholes to provide meaningful private use of either a national or central bank note issue include the use of legal tender. b. Financing Public Revenues The government, through the administrative handling of the single, or closely controlled, legal tender note, earns positive seigniorage towards annual central banking operations overheads. In a zero real growth, 2 percent inflation or less regime, the employment of this seigniorage in the cash operation and its interest-free/interest rate spread payments to the central bank legal tender issuer could thus approach in the short run the output flow value of low forgone potential circulatory seigniorage public note issue increases. Then only one seigniorage revenue would be normal and one seigniorage policy becomes possible for the seigniorage currency norm. Otherwise, in the more usual norm, i.e., with two distinctly defined seigniorage flows, retaining the monopoly legal tender note issue single flow is independent of the fiscal processes and guaranteed as an option the issuing monetary authority has over tax authorities. There are thus two income streams with close political economy separated allocations. It is by an inter-banking mechanism of central bank-charged balances to clear member bank obligations between branches of different banks that, net of interest discounts, the seigniorage currency monies appear. Spending by the government generates these tax payments in week three on average per seigniorage financial year. It is also in week three that domestically owned bank and commercial currency money year period payments to the central foreign reserves authorities can be due under a private or

state-owned banking foreign commercial goods and currency import account deficit. It is towards this that some part of the increased seigniorage paper note issues go. One central bank in the Metropolis began this month with a 2 percent seigniorage note issue increase. Central banks toward the start of the month sometimes receive foreign convertible cash inflows related to courtesies given to their diplomatic units or trade consulates (Ullah et al.2024; Krishnamurthy & Li, 2023; Berkeley et al., 2022; Watts, 2024; Bedirhanoğlu, 2022).

16.5. Challenges and Controversies

Seniorage rights and their effective management in modern economies pose a number of challenges. Critics argue against transfer permission rights promoting discretionary monetary policy and linking the volume of money and its financial contributions with the specific goals of public policy. Rapid money growth related to seniorage in extreme cases can be associated with large inflationary pressures. Hyperinflations are historically associated with the excessive issuance of money from the budget. Ethical considerations, because money generation represents one of the most important resources of governments, suggest that the right approach to enable money generation is considered to have substantial ethical implications. Seniorage represents an inflation tax; ethics around the right of exercising the inflation tax ultimately derive from the relations between rulers and the governed (Boehl, 2024; Pittaluga et al., 2021; Kwon et al., 2022).

Seniorage is a potential source of government revenue. The problem lies in finding the right balance between monetary financing of public expenditure and ensuring general price level stability. Seniorage relates to the issue of the legitimacy of the revenue claim. This issue raises interesting questions about discretionary power and legitimacy. There is nothing that ultimately qualifies the respective arguments between these two schools. Additional emerging literature discusses the possible conflict between monetary sovereignty and monetary policy in the context of large crisis management. The ultimate reasoning pushing these arguments is a conclusion drawn mainly from theories of economic development, which is, in the end, the only reputable domain where the endorsement of large government budget deficits is possible. I reject all these views on the grounds that the legitimacy for a government to print (and coin) money relates to the function it has in the economy, not to the economic crisis (Boehl, 2024; Kitchen, 2021; Singh, 2024; Bose & Banerjee, 2025).

16.5.1. Inflationary Pressures

Seigniorage rights may also cause inflationary pressures. The extent to which

a government chooses to spend its revenues in the form of seigniorage – in other words, issue money – and the central bank decides to engage in open market operations in order to sterilize any inflationary effects depend on these two factors. Inflation can occur if the increase in the money supply outstrips the growth of the economy and the resulting increase in the demand for money. Historical evidence shows that the issuance of excessive seigniorage is linked with high rates of inflation, with countries representing the failure of governments to recuperate the resulting deficit of the central bank or adhere to the limit on the issuance of seigniorage set by the central bank involved (Alvarez et al., 2022; Moloche, 2024; Beretta, 2024; Zeb et al., 2024).

Inflation can damage economic stability, erode the real value of savings, incomes, and pensions, transfer wealth from savers to borrowers, reduce international competitiveness, and lead to higher interest rates. Inflation can be especially negative for a host country when the dollar is used as a reserve currency. Investors attempt to diversify their asset holdings and limit their future risk by spreading out their portfolio across the globe. A global reduction in the demand for the dollar results, causing the value of the dollar to drop, meaning that nations are forced to pay higher prices for imported consumer and capital goods. Furthermore, inflation stimulates social inequality as savers and those operating mainly with fixed incomes are worse off, while the highly wealthy are able to effectively bargain-index their incomes. Therefore, the national value-added tax on many products – especially those that are necessary for everyday life, thus not inelastic – shifts; and as a result, economies distribute to their various populations, they become more unequal. The last negative aspect of inflation is that it prompts policy responses that may be destructive as they work to curb inflation rates—policies that can lead to reduced levels of economic growth, deterioration in social cohesion, and other undesirable outcomes, such as the premature termination of governmental development projects set forth when the economy was booming in order to create a buffer against future shocks, be they economic or natural, or expansionary monetary policy aimed at attaining certain desired levels of interest and exchange rates. Excessive inflow transfer of 'home country' euros leads to a state of optimism that triggers greater investment as wealth starts to be created. In truth, careful stewardship is needed: the challenge is to engage in seigniorage to provide a public good without compounding moral hazard by putting too much money into circulation and thereby generating inflation (Muhammad, 2023; Zorzano Mateos, 2023; Olusola et al., 2022; Paddu et al., 2024).

16.6. Comparative Analysis

Comparative Analysis. Recent statements on financial and economic seniorage have been made by political authorities and central banks in the context of the temptation to adopt permissionless digital money. Who would incur a loss when a digital currency is issued freely? Issuing money is a fiscal activity. This section focuses on how countries from various regions of the world and different economic systems prevent seniorage from being used as a source of fiscal license (Kinda & Tagem, 2024; Marthinsen & Gordon2022; Woldu & Kanó, 2024; Lin & Cui, 2021).

The supporters of the European Central Bank Single Supervisory Mechanism maintain that someone needs to be entrusted with the issuance of currency and the avoidance of discretion. Otherwise, central banks would turn themselves into issuers of money: the power of the central bank would mean a government that escapes from the constraints of fiscal rules to be entrusted with the prevention of insufficient aggregate demand or the financing of public servants' income. Apparently, currency issuance is a constitutional issue that monetary theorists merge into fiscal and political theories. Whether the authority that issues money is entitled to the financial profit arising from seniorage seems to depend on the very historical path of that specific polity. In this paper, seniorage rights are considered within the broad and deep perspective of the constitutional theory of money and the single money theory (Marmefelt, 2024; Murau & van't Klooster, 2023; Rosenswig, 2024; Tymoigne).

Comparing the history of the US deficit with that of Eurozone negotiators, we have observed several country-specific bargaining costs and benefits of currency consolidation at the start of a new geopolitical currency unit. Today we observe that the US dollar value in Euro involves a fiscal straitjacket and trade embroilment, while the ECB cannot force budget rules, irrespective of charging crippling negative interest on commercial bank deposits or imposing quantitative easing and helicopter drops. Several Eastern central banks partly or even fully financed budget deficits by means of endogenous or exogenous money: they either monetized state debt or succeeded in a debt velocity that was superior to the monetary velocity (Mayer & Schnabl, 2021; Mayer & Schnabl, 2023; Petkovski et al., 2024; Indicators).

16.6.1. Regional Differences

Besides differing with respect to the regulations in place, in fact, the use of seniorage rights seems to vary by sub-region within the study area. The two dimensions that might be driving these regional differences are: 1) the effective-

ness of monetary policies in different geographic areas; and 2) the monetary regime of different parts of the study area - a history of inflationary extreme monetization of fiscal deficits or currency collapse could either make large-scale monetization operations non-credible or force central banks to withhold all funding of government debt out of fear of monetizing fiscal deficits (Leykun, 2022; Fynn, 2021; Nyella, 2024).

Local economic conditions in each country, in addition, seem to influence the credibility, feasibility, or appropriateness of this policy intervention. The results in case studies, as well as the widespread skepticism regarding these policy tools in interviews and discussions among experts, indicate that the operation of seniorage rights in striving to achieve macroeconomic stability requires a favorable mix of financial, economic, and political variables to be in place within a window of opportunity. The data indicates that, though neither an efficient poverty reduction tool nor a sustainable macroeconomic response in a long-term framework, issuer buyback of bonds with seniorage was interesting in one case study but concerns segments of beneficiaries in practice. Nevertheless, theory and cases increasingly indicate that the resource transfer not only may introduce moral hazard but may include some opportunity costs. Buying back part of ACTs with interest would help avoid this issue (Kim, 2021; Jannils, 2021; Akeliwira, 2023).

17.Current Debates on Seigniorage Rights in Cryptocurrencies

17.1. Seigniorage in Cryptocurrencies

When thinking about seigniorage in the context of cryptocurrencies, there is a shift of reference from the issuer to the software and hardware that produces the money. Digital money in general and central bank digital currency (CBDC) in particular emphasize seigniorage rights that may differ from their 'analog' counterpart mainly with the use of a different terminology. The novelty stems from the fact that in a traditional socio-economic context, the issuer of currency always holds the right to give value to the money and to make a profit doing so. Within the context of a Financial Economy–Blockchain (FE) instead, the digital ledger can in principle be tamper-proof and trustless, and no intermediary or central dominator can be easily singled out as the sole provider of money, or at least in its entirety. The money-generation system would then be decentralized. The right to seigniorage is therefore inherently decentralized. We anticipate indeed profound economic implications, not in the last place because seigniorage is at the very basis of monetary economics tools and of the framework for thinking about money (Gramlich et al., 2022; Santiago et al., 2024; Bossone,

2021; Otabor-Olubor).

It should finally be mentioned that several adaptations of cryptocurrencies exist now with a wide range of characteristics and methods to create seigniorage. The first one generates seigniorage returns by using the algorithm for adding a block every 10 minutes to a blockchain that confirms the validity of the transaction. A reward of new bitcoins will be generated for every block added. The quantity will be cut in half every blocks added and will eventually become zero, thought to occur in 2140. is heading towards transformation from to , with the same aims as the system. The application will be used in the new money supply. The network uses a network validator. Both the latter may be defined as a : in systems, no monetary provision is made, though the system functions via seigniorage generated by the 'creator'. In as well as in , the inflation rate has to be fixed by the stakeholders. In a coalition of validators could decide the inflation rate, but the module is currently not in use. In validator-based networks, only the reward for the workers of the technological infrastructure has to be computed. In, for example, the new money supply is fixed to an annual inflation mechanism. In systems where the seigniorage mechanism is in the hands of a centralized authority, the decision-making power about seigniorage is more likely to be allocated by the centralized authorities in their interest. In the network, individual validator nodes decide whether the total money supply should be specifically increased by per year. In networks like the one, the validation rights are allocated to a number of centrally known entities. These entities, and only these entities, are entitled to new money generation. In, validators are invited by the community, and every hours new ones are declared. Finally, in proof of activities, a block is added to show that a transaction has occurred and therefore to add a new coin or token. Some wallets in the market offer actions for a coin that runs in a mode. Currently, they are mainly available on coins running in a procedure. These include and . Those that revert to include, for example,. combines and by using for the issuance of through a committee (James, 2022; Sebastião & Godinho, 2021; Marzo et al., 2022).

17.1.1. Mechanisms of Seigniorage in Cryptocurrencies

Cryptocurrencies are a new form of digital money—and an electronically emitted bearer asset, by law—that supports significant economic activity. We discuss the specific characteristics of these digital coins that enable seigniorage, as well as the superior control that a seigniorage receiver has over the monetary base market. The most used way to add new coins to the economy is through open emission, a process that does not rely on calculation, entry, or recording

data, but on types of anti-piracy systems. The cryptocurrency coins are provided to the people who offer the service of record keeping. The authorized record-keepers of cryptocurrency coins are paid for their service and rewarded by having the asset itself (Faheem2022; Okeke et al., 2021; Steinmetz et al., 2021; Hamukuaya, 2021; Dupuis et al., 2023).

Mining is a process used to generate seigniorage in several cryptocurrencies. The entrance of new coins into the economy is done through mining in cryptocurrencies. When new coins can be mined, this can potentially continue indefinitely. Therefore, the supply of some of these cryptocurrencies is inflationary, as cryptocurrency coins are regularly introduced into the economy. Some cryptocurrencies have a maximum supply, after which no new coins will be mineable. In dwindling, the supply of cryptocurrencies can either be finite or unlimited depending on how much cryptocurrency is mineable, how long it will take to mine it, and how low the reward will be as time goes on. To gain access to the new cryptocurrency coins over time, the algorithm sets up a decreasing rate of rewards to incentivize miners. When the reward for mining the block is decreasing, the reward for verification is increasing, which will be left over time. Furthermore, this decrease in coin reward affects the fluctuations in the price and financial services, particularly in the case of BTC, which is non-emissive and has a decreasing reward. As discussed in the subsequent section, all of the previously described processes have economic implications due to minting volatility and/or holders' decision-making (Fabi, 2022; Kochergin, 2022; Kunaifi et al., 2022; Hairudin et al., 2022).

17.2. Economic Implications of Seigniorage Rights in Cryptocurrencies

Some common economic denominators potentially guide the assessment of how seigniorage rights in cryptocurrency ecosystems influence the balance of supply and demand. Some systems use a 'poison block' to collect seigniorage to increase money supplies periodically. Others collect transaction fees that are stable in the long term since that is potentially more predictable. Our models are framed in an individual investment perspective. We compare models of cryptocurrencies with and without seigniorage (Martín, 2024; Budish, 2022; Buterin, 2022; Desan, 2023).

Inflationary versus deflationary models: Some cryptocurrencies have a monetary policy that could be described in terms of simultaneous expansion of markets by making more supply available than would be expected. Also, with cryptocurrencies, policies provide an increase of market supplies with a

simultaneous economic expansion via seigniorage. For example, systems where little new money creation comes from mining, usually accompanied by transaction fees that are a fraction of total miners' proceeds, result in little seigniorage. Cryptocurrencies generally grew with value coming from small groups of people that appreciated the equilibrium of collectively agreeing to use particular coins because traders accepted them (Afonso & Lima, 2024; Rehman, 2024; Junior et al., 2022; Maneechavakajorn, 2023).

Seigniorage and price stability: Seigniorage might dry up if a given currency becomes deflationary. While for all finite runs it is deflationary, we have some solutions in both infinite and random-walk scenarios where the expected value of the price level is a constant. Price stability is desirable for some applications. Business people in general prefer to transact in stable units of account. An investor in the young currency may choose the proportion to hold based on expected returns including seigniorage. Experiments suggest that money growth does not lead to inflation for expansionary markets generally. Bigger economic impacts with larger seigniorage can potentially be less volatile and can assist the launch of economy-impacting programs. Some traders try to time their trading hoping to gain more money due to the mistiming of others. Expectations with all else the same do not usually cause a crash in our experiments where seigniorage does not appear to be making large economic impacts, and such crashes are probably unlikely generally in the long run when the impact of seigniorage is small, which describes certain cryptocurrencies. Passive benefits in situations where seigniorage does not move markets as brokers understand the expected amount of value that adding new currency to an economy will induce (Siddique, 2023; Etzrodt, 2023; Huber2023; Cochrane, 2021).

17.2.1. Inflationary vs. Deflationary Models

In the context of cryptocurrencies, models of seigniorage rights have often been classified as inflationary and deflationary. - Inflationary seigniorage: The inflating models either produce a required revenue at print time or are predefined by a governing committee with certain economic objectives. In these designs, the transitory growth rates of cryptocurrencies or token economies can range arbitrarily within certain limits and are generally limited in size. An excessive inflation rate usually results in a price increase of lawful goods without any revenue effect and might lead to further capital outflow. Inflating seigniorage in certain cryptocurrencies might lead to depreciation in the future, given that monetary expansion leads to exchange rate reduction as an explicit monetary policy but mostly as a by-product: it leads to a loss in the currency's purchasing

power but might not cover product export, exemplifying a known seigniorage dilemma. - Deflationary seigniorage: Contrary to inflationary systems, deflating cryptocurrencies or tokens do not employ an annual growth rate; rather, they work with deflation, representing a negative annual average growth rate of the driver currency or cryptocurrency. These designs contribute to economic stability by improving money circulation but are expense-insensitive and therefore unable to finance operations. To increase long-term sustainability, ascertaining the degree of the deflationary regime is crucial. Certain cryptocurrencies exemplify a cryptocurrency that propagates by reducing, similar to a deflated commodity, at a rate over time. Deflationary crypto-commodities are advantageous for both long and short goods (Norton, 2024; Hairudin et al., 2022; Garita et al., 2024).

17.3. Regulatory and Legal Challenges

Approaches to regulating seigniorage vary significantly between jurisdictions, ranging from the embrace of cryptocurrencies to outright prohibition. However, strict financial regulation worldwide has not prevented central bank digital currencies from incurring significant profits from seigniorage, nor has it prevented governments from engaging in the digital currency space through massive money creation. Technological obfuscation and pseudonymity, a lack of physical presence, the pooling of assets with unrelated strangers, and the provision of financial services contribute to the challenges law enforcement faces in enforcing laws against cryptocurrencies. Where commissions or organizations responsible for overseeing or interpreting parts of the law exist, different priorities or interpretations can lead to enforcement mismatches, such as when the director of corporate finance invites cryptocurrency companies to discuss initial public offerings one day, but charges are filed against the matter the next day (Polański & Szadkowski, 2021; Kochergin, 2022; Patel et al., 2024; Lukonga, 2023).

There are a number of differing interpretations of how existing law interacts with cryptocurrency that may impact the actual implementation of cryptocurrencies. In the financial space, automated arbitrage by high-volume programming trading has been a significant part of how successful businesses on the stock exchange are run, but those businesses are also becoming increasingly regulated and competitive. Many proponents of cryptocurrencies want to see a wider adoption of similar practices and a decrease in governmental control of the money supply. If regulations change, it may begin to expand possible applications for cryptocurrencies, making it more attractive for millions of people to hold them. This may benefit the nation with the least regulation, as the smallest

change in average supply for a nation will not change the same variables as much for other nations. Value could still be held in a certain currency if it is cash of the internet for a nation of tax avoiders, sanctions investors, or as an alternative to domestic fiat for those in inflation or conflict-affected states. In a competitive implementation scenario, a leapfrogging of improved regulation is anticipated; a large overestimation in value is expected if cryptocurrency shareholders are required to, or willingly, move their value back into derivatives (da Costa Nunes; Saiedi et al., 2021; Howson & de Vries, 2022; Whitford & Anderson, 2021).

17.3.1. Jurisdictional Issues

In cryptocurrency and blockchains, the problem of jurisdictional activities arises, leading to some countries being more favorable to seigniorage practices concerning the nature of various cryptocurrencies. However, different regulations are invented depending on the country. Guidelines have been introduced as a solution to harmonize regulations among developed countries and territories; however, the guidelines are recommendatory, not mandatory, and the decision to implement these guidelines in national law is within the discretion of the individual countries. How regulations and court decisions can influence jurisdictional issues is clear. Players can manipulate the system in order to make their seigniorage practice more gainful by conducting these activities in a country where the corresponding practice is favorable to purely speculative and not really regulated operations. Conflicts of law are a specific type of jurisdictional issue (Polański & Szadkowski, 2021; Bossone & Costa, 2021; Apeti & N'doua, 2023).

A typical illustration of a true conflict of laws is a case in which Australian law did not recognize a defamatory comment that appeared on a foreign-based website. As described, activities involving cryptocurrencies, such as defamation or scams conducted through Initial Coin Offerings and fraudulent trade in virtual currencies, take place at the crossroads of several radically different legal orders, each imposing a different set of rights or remedies available to wronged or defrauded investors. The anxious searches for the best regulator, the friendliest law, and the lightest legal regime to facilitate seigniorage operations can ultimately fuel investors' feelings of insecurity and ultimately trigger a market meltdown. These findings suggest that market behavior for a cryptocurrency is hugely dependent on one or more regulations (Wątorek et al., 2021; Almeida & Gonçalves, 2023; Meegan et al., 2021).

17.4. Technological Innovations and Seigniorage Rights

Technological innovation has been impacting currency issuance since the

invention of money. Coins made of precious metals were easily authenticated, but the loss of the coins' value was a threat when the coins were redeemed for raw metal. Fiat currencies offered by central issuing authorities helped assure a better seal of approval. Until recently, the sovereign, normally through the central bank, held exclusive seigniorage rights. Ill designations for various assets, ranging from digital coins to stablecoins, hint at another base of the innovations that make their underlying systems a viable evolutionary step beyond traditional fiat currencies (Bossone, 2021; Huang & Mayer, 2022; Zatti & Barresi, 2023; Wang & Zwinkels, 2024).

Blockchain technology both gives the permissionless, worldwide reach of fiat currencies, and it permits agreed, but limited expansion of the network, and thus oneself, over the existing base of participants. Cryptocurrencies outside the Bitcoin network are issued, owned, and controlled in an open, decentralized manner. For today's network, technology does not yet permit each of Bitcoin's network contributors to opine on the direction or extent of its expansion through vote. Instead, blocks are created to increase the number of tokens permitted while lining the pockets of those chosen to write the block. Upgrading the network, as Bitcoin did with its successful algorithm, is not a matter of affirmative choice; rather, it is in the hands only of those whose computer nodes are much more powerful than the rest of the network's nodes. Blockchain technology does, however, provide transparent mechanisms through which the token production process can be managed. Relatives of the collateral managers behind stablecoins or shadow banks will undoubtedly be interested in using such novel tools purportedly to maximize the store of their network-based monies (Ahamad et al., 2022; Panda et al., 2023; Hougan & Lawant, 2021; Riley, 2021).

17.4.1. Smart Contracts and Automated Seigniorage Mechanisms

Today, transaction costs and human errors strongly affect the ability of central banks, yet we are moving towards an environment where smart contracts manage seigniorage rights. The contract itself can be seen as a self-enforcing agreement with the terms of the contract directly written into the computer code. Thus, parties can engage in credible commercial relationships without developing legal or contracting frameworks. The smart contract can be seen as an automatic contract between parties that use code to directly enforce the seigniorage of the cryptocurrency (Kesarwani et al.; Dragomir & Dumitru, 2023; Kochergin, 2022; Nguyen et al., 2023).

The major benefit of using a smart contract is the potential increase in transparency and the level of accountability in the procedures for managing

seigniorage rights. This would involve different mechanisms operating ad hoc for different blockchain systems that could be useful in managing the original reserve required for the central bank itself. By simply locking the seigniorage obtained in the reserve at the same time, we can derive the calculation of the ability of the central bank to keep the same amount of its own currency constant. Multiple section examples show that a smart contract is capable of performing the calculation of the required reserves automatically. The implementation of the mechanism can increase operational reliability by reducing the amount of fraud, which relies on modifying data related to seigniorage, which are supervised by different entities internally and externally within the bank. Preventing digital companies from competing to manage and control the creation of more cryptocurrency than the previous one can solve the fraud and bankruptcy of investors (Mushaddik & Nori2023; Catalini et al., 2022; Tüzün & Ekinci, 2024).

In conclusion, the programmable nature of the automating procedures using smart contracts might therefore represent the basis for the implementation of procedures for the management of seigniorage rights themselves. Yet, the implementation of smart contracts for using them in seigniorage cannot necessarily be considered synonymous with a reduction in the problems of operational reliability. In fact, the degree of this liability is linked also to the implementation of the procedures outlined in the smart contract itself, whether they are able to efficiently reflect the operational models of the central bank that issued them or not. In any case, this represents a real revolution in the world of controlling requirements for reserves. From a sociological point of view, the discussion suggests that the field of regulating the financial system itself would be moved from the central banks to the IT department of each of the banks themselves. In conclusion, the use of a solution based on a smart contract is indeed aimed at simplifying fraud control processes on the one hand, but making them highly restrictive on the other hand (Ferreira, 2021; Lin et al., 2022; Sigalov et al., 2021).

17.5. Environmental Considerations

The various forms of mining evidence stark differences in the amount of energy required. Traditional PoW, for instance, uses a significant amount of energy per transaction. The goal of PoS alternatives is to reduce this environmental impact. A growing number of academics, policymakers, and industry professionals believe that Bitcoin mining is bad for the environment and counter to global efforts to reduce climate change. Climatologists are beginning to discuss whether or not cryptocurrency networks such as Bitcoin can be considered part of a low-carbon future. They argue that, while the advent of eco-friendly

money represents a social leap forward, dirty money can still prevail. The situation demonstrates that being able to grease the skids of a new asset class with bribes cannot prevent the scheme from falling short of environmental standards, as digital waste still piles up. Cryptocurrency developers who ignore environmentally friendly investments may have a harder time penetrating countries in the long run, which could ultimately be subject to greater sanctions from the public and lawmakers. The fact that climate change is now a top concern for many people and for global leaders may make it harder to argue against its inclusion in development goals in time. Even the world's largest cryptocurrency projects are beginning to speak favorably of their new "green tech," wherein an inefficient, "gas-guzzling" machine has already been placed on the market (Rudd et al., 2023; Howson & de Vries, 2022; Wendl et al., 2023).

This section examines the environmental implications of the current seigniorage generation process. There are projects that undertake proof-of-capacity for this purpose. In this mining protocol, solutions to the computational problems to generate seigniorage are replaced with a solution to the problems of disk space. In particular, we are seeing a number of environmentally friendly projects in cellular organizations moving away from traditional PoW proposals. These initiatives signal a move from resource-intensive mining to environmentally friendly forms of seigniorage. Blockchain analysts believe that being environmentally conscious is part of the shift toward blockchain. The shift towards more environmentally friendly mining protocols allows seigniorage to be produced in a manner befitting environmental values. In such mining proposals, the decision whether to release when seigniorage opportunities become increasingly attractive is determined not only by whether the economic system requires inflation or not but also on the sustainability of environmentally costly operations. Striving for maximum economic impact at the expense of the environment is disconnected from human nature, as many recognize the rights of nature. This fundamental shift in values is important to go beyond conceptions of economics as separate from natural laws. Developers should consider their investment values to appeal to a broader community. Given the ongoing debate about environmentally unfriendly mining practices, we foresee that new cryptocurrencies will also showcase their seigniorage characteristics via alternative mining strategies. Because environmental unfriendliness is part of contestations about monetary value, we anticipate that these cryptocurrencies will use environmental considerations within their marketing strategies. In such alternative cryptocurrencies, the political economy in the cost of producing seigniorage will have evolved and debates about seigniorage will focus on what values the economy should

strive for beyond such environmental credentials (Auer et al., 2024; Marthinsen & Gordon, 2022; Siddique, 2023; Rico-Peña et al., 2024).

17.5.1. Energy Consumption of Mining Processes

Due to the Proof-of-Work consensus mechanism, where miners have the seigniorage rights in Bitcoin and other PoW-based cryptocurrencies, large amounts of computational energy are consumed by miners. The average energy consumed per transaction ranges from 1, from an unsustainability perspective, to 707. The current annual electricity consumption for mining activities stands at 117.7 TWh. The United States, China, and Kazakhstan, among others, are the leaders in this field. There, annual energy consumptions are 66, 70, and 18 TWh, while 49.9 TWh of that energy is generated from renewable energy sources. Chinese energy sources are almost 74% carbon-based. In addition, 47% of the world's mining activities are based in China. The average carbon footprint for each transaction is 373.13 kg CO2. Permafrost cooling especially has important relevance in the north of China, where it is available, as during the most critical summer months in terms of energy consumption, permafrost occurs at 40 to 60 cm below the soil, tapping into this natural resource substratum, where temperatures vary between −10 and −12 °C. This results in direct free cooling systems for the Bitcoin hardware. A perfect case study to understand some of the practices used is found in a Bitcoin mine operated by a Danish–Kazakh partnership. There, the company claims to have partnered up with two local wind farms that generate 100% renewable energy for their Bitcoin mine (Gramlich et al., 2022; Pagnotta, 2022; Nguyen et al., 2023; Savolainen, 2022).

Economic Costs and Drawbacks on Energy Efficiency As a result of huge amounts of energy consumption, more money needs to be made mining to cover this cost. Energies of 95 GJ, none of which could be considered renewable, are needed to mine one Bitcoin in 10 minutes, resulting in monthly energy demands of 286, unweighted, from a normal 365 GJ annual energy demand. Corrections leading to a higher quoted total annual figure have to be made for recycling gains; recycling gains are estimated from 4 to 102%, so as not to inflate yearly energy expectations, we report in this review only GJ/kWh figures. Unfortunately, these figures off gases a considerable amount of GHG, where energy quantification of 24.7 (kg CO2 / MJ) may be checked back to SO2 emissions of 4 g of sulfur oxides / kg of dried sludge or 2 kg of SO2 emissions equivalent / ton of sludge. A significant portion of the power plant mix miners use is renewable. To maintain profit losses for miners in this ever-increasing energy price spiral that is brought upon by seigniorage rights, countries where renewable energy pricing

is the most economically beneficial, independent of ecological protection, are mostly used (Li & Leung, 2021; Zebra et al., 2021; Wang et al., 2022).

17.8. Social and Ethical Implications

Given the immense wealth in many cryptocurrency ecosystems, it is relevant to consider who has accumulated this wealth. Research indicates that cryptocurrency owners are predominantly young, tech-savvy males with high income. This corresponds with the Bitcoin top 10,000 list, which shows that the majority of large Bitcoin owners are individuals and males. It is also reported that there are notable ethnic and class disparities within cryptocurrency user demographics. Clearly, non-egalitarian access to cryptocurrency, which carries well-documented risks, poses a set of social dynamics. An increase in seigniorage due to reduced transaction costs may exacerbate these disparities. At the very least, it is important to note that some monetary distributions already incorporate changing levels of seigniorage (Steinmetz et al., 2021; Steinmetz, 2023; Henshaw, 2023).

The Fair Against Inflation Taxation argument indicates that creating and destroying demand and seigniorage would carry consent and responsibility towards those who signed up to use the system. Digital currency creators thus also carry a responsibility. The creation and distribution of money are subject to some profoundly important ethical and moral considerations. This is the case, no matter whether money is issued for social purposes in a planned economy or cryptocurrency systems where social outcomes are hoped for. Thus, the creation of an ethical framework for the digital object itself is also of profound importance and is discussed further in the next part of this paper. Seigniorage can be allocated on a temporary and ad-hoc basis, such as a proof of donation scheme; it could be managed democratically by a foundation or any other community governance model and could be managed by code as in a smart contract. If social consensus is important to a successful cryptocurrency, then it would be desirable that any changes to seigniorage go through ethical and/or governance frameworks. Ethical frameworks aimed at guiding cryptocurrency creation have been proposed. They could embed in them the ethical view on the desirability and mode of seigniorage allocation. Furthermore, in a system where seigniorage is allocated according to need, it is important to consider the external political or social resources that one can draw upon in order to influence and ensure access to the system (Stahl & Stahl2021; Kaddoura & Al Husseiny, 2023; Challoumis-Κωνσταντίνος2024; Schiff et al., 2021).

17.8.1. Wealth Distribution and Access to Cryptocurrencies

Many contributions to this workshop focus on wealth distribution and seigniorage. Access to new marketplaces is often biased towards individuals who have access to liquidity and, hence, are wealthier. Marginalized groups might have difficulty securing access to these ultra-liquid markets. This reflects the current exclusion of minorities from the traditional marketplaces. If seigniorage rights exist, they could mitigate the lack of direct access by backstopping these assets. In concentrating almost exclusively on the wealth distribution aspect of seigniorage rights, the literature fails to identify the full suite of ways that seigniorage rights and their distribution may be impacted (Cukierman, 2021; Buetzer, 2022; Gobbi et al., 2024).

Lack of direct access to the assets providing seigniorage represents a significant loss of wealth. Novice asset portfolio holders are likely unable to gain the expertise necessary to instruct a professional asset manager to invest directly in the seigniorage asset markets. Cryptocurrencies have broken down this barrier by making seigniorage rights accessible to almost anyone with access to the internet. This has serious repercussions for the societal issues related to the distribution of wealth because the ability to add cryptocurrencies to a portfolio of assets is another way to accumulate wealth (Kunaifi et al., 2022; Marthinsen & Gordon2022; Kochergin, 2022).

Assumed several possible models for the distribution of wealth based on seigniorage rights. One was an equal access model, where most people have access to a modicum of decentralized cryptocurrency. Another was the no-access model. This paper reinforces the wealth distribution literature by providing more and different frameworks. In particular, we present models of wealth distribution based on access to cryptocurrencies via the use of stable, custodied cryptocurrencies. We examine the consequences on social equity of adding asset-backed, centralized cryptocurrency into the general model of access. While these models are illustrative, we also provide case studies to demonstrate that persons with initially below-average access are willing and able to take on the additional reporting and compliance burden in order to gain access. The willingness of these individuals to devote the additional time and resources testifies to the power of promotional activities, access to information, and education at remaining social barriers (Guidi et al., 2022; Steinmetz et al., 2021; Zolfani et al., 2022).

17.9. Future Directions and Research Agenda

At the intersection of monetary policy and regulation, there are at least three crucial topics capable of inspiring an interesting research agenda in the years to

come. These three topics of inquiry are particularly worth exploring because of the major consequences they may have on the restructuring of the global monetary standards, on the global structure of central banking, and, again, on the public dimension of money. Regarding the manifold exceptions and the size of the effect of these research issues, several methods are available. Given that some studies already employ traditional tools and statistical methods, the mission seems much more ambitious: to provide clear, profit-driven analyses suitable for many stakeholders. The issues may require a different research methodology. Alternatives could be policy analyses, computer-aided simulations, Delphi technique, and multi-criteria decision techniques based on exact sciences that help public policymakers. For these research methodologies, the new trend of research is based on interdisciplinary research, using critical realist approaches, creating open systems theories that may explain the new phenomena. The analysis can be developed starting from the central bank and addressing the consequences or starting from Fintech and seeing consequences on the policies. In both cases, there is much room for interdisciplinary research in this direction: part of the analysis should be developed outside economics (Svartzman et al., 2021; Meier et al., 2021; Dziwok & Jäger, 2021; Soderberg et al., 2022).

An important element emerging from our discussions is that for the complexity of these phenomena and their links to monetary policy, regulation, and industry – if we want to address the proposed agenda – an open and multiple stakeholder involvement is crucial. In particular, our reports will be useful to establish the current awareness of these issues and will support further co-creation of these ideas with all possible stakeholders, extending the research questions and subsequent discussion papers in a wider, open, and virtual setting. In the context of some of the main quantitative and qualitative research ongoing with several other key international organizations, some conclusions of our studies may feed into this crucial backbone and underpin potential future relevant guidance. In much the same line is the need to resume the link between academic outcomes and regulatory capacity in a close loop of information that does not reduce the independence of academia. It will also contribute to informing cooperation and coordination among stakeholders aiming to facilitate productive regulatory and institutional knowledge exchange toward a clearly articulated new sophistication of the financial markets outcome (Eaton et al., 2021; Berrone et al., 2023; Adebayo et al., 2024; Wirba, 2024).

17.9.1. Potential Policy Recommendations

Following this analysis of the seigniorage rights framework, we present

policy options arising from balancing the different interests of all stakeholders involved, especially considering statutory monetary rights. Governments around the world could consider one or several of these utilized strategies as reasonable approaches in accompanying the increase in stakeholder interests in the promotion of digital financial inclusion by steering the direction of such possible frameworks and regulations for looking after monetization. With all due care to policy recommendations, these are the results of the data and laws in force as they appeared at the time of writing, and government agencies and other relevant organizations should always be contacted to discuss the effects of any such policy before its implementation (Noreen et al., 2022; Mpofu & Mhlanga, 2022; Lu et al., 2022).

Potential policy strategies could involve strategies to limit or increase the regulatory framework surrounding an influx of sub-reserve money production by corporations as proposed in a negative impact on monetary stability from central banks, which would potentially include stated government public resolutions into financial innovations with adequate consumer protection interests. Additionally, as high growth rates and usage of these seigniorage rights are estimated, research could also concentrate on possible outreach strategies by government or collaboration with industry and academia to support wider distribution of an increased and more diversified portfolio of seigniorage rights that could be of interest to a more general stakeholder pool. Continuous monitoring and adaptation of state-controlled policies may be needed in accordance with any of these recommendations. This state's treatment could address future collaborative agreement interests as an ongoing discourse on seigniorage statements of understanding evolved in a digital central bank money world (Mach, 2023; Bossone, 2021; Polański & Szadkowski, 2021; Garcia, 2024).

18.Accounting for Cryptocurrencies

18.1. Accounting Principles and Standards

Generally Accepted Accounting Principles provide guidance to account for cryptocurrency transactions in the same way as other digital assets and intangible assets. Furthermore, International Financial Reporting Standards are also supportive and should be followed in many countries around the world. In conclusion, both accounting regimes do not permit considering cryptocurrencies as cash to be recorded later as dormant assets (Laine, 2022; Klopper & Brink, 2023; Chou et al., 2022; Hubbard, 2023; Mounis, 2022).

Cryptocurrencies are primarily recognized by their long alphanumerical identification strings, data blocks, or decentralized public ledgers. International

Financial Reporting Standards provide greater assistance regarding accounting topics such as assets, liabilities, capital income, and expenses. Like US GAAP, IFRS also does not provide any particular guidance about the recording and presentation of transactions related to cryptocurrencies. Conversely, cryptocurrencies are considered financial assets issued by an organization, and their use as a mode of payment for goods or services is recorded in conformity with the provisions of IAS 16 as well as IAS 36. Generally Accepted Accounting Principles do not provide any specific guidance about recording transactions related to cryptocurrencies. However, US GAAP covers a wide framework regarding Accounting Standards Codification Topic by Market about the recording of diminution in value under section 350-30. Now, some users of cryptocurrencies are contributing opinions to permit the use of cryptocurrencies as cash equivalents and subsequently record them as current assets (Ramassa & Leoni; Hubbard, 2023; Klopper & Brink, 2023).

The matter of the classification of cryptocurrencies in IFRS is inactive due to the infrequency of cryptocurrencies. However, the paramount cryptocurrency is Bitcoin, which is settled among users. Although no specific standard has addressed the matter of cryptocurrency accounting, a project on the Conceptual Framework is in the pipeline to provide a new startup into the post-detailed theoretical concepts of accounting that will be diligently reviewed. At first glance, the Conceptual Framework does not consider cryptocurrencies to be cash because cash is a recognized currency, and those transactions range from transactions created with credit rather than transactions of credit. However, all transactions, such as dealing in the exchange of cryptocurrency and currencies, are thought to be alike or, in other words, are under the same roof. In the meantime, US GAAP does not provide any rules for cryptocurrency, and the United States Securities and Exchange Commission has yet to issue guidance (Silenzi et al., 2023; Choithani et al., 2024; Walunj et al., 2025; Serena et al., 2022).

18.1.1. Overview of Generally Accepted Accounting Principles (GAAP)

The Generally Accepted Accounting Principles (GAAP) offer guidance on the measurement, recognition, and presentation of financial reporting. Adherence to these principles promises a high level of consistency and transparency across financial statements, which are relevant to stock market investors, employees, creditors, and others. Accountants are generally required to abide by this guidance except in rare instances where they believe a departure from it is essential to represent the economics of a reporting entity adequately. While

relevant accounting standards setters have provided valuable guidance for some aspects of transacting in cryptocurrency, some areas may require discussion and development (Huang et al., 2023; Dao-Le et al., 2023; Parrondo, 2023).

GAAP guides the recognition, measurement, and disposition considerations of cryptocurrency transactions. Specific consideration is given to intangible assets, revenue from the sale of goods, virtual currency, and more. Nevertheless, the application of GAAP to cryptocurrencies is not a straightforward endeavor. Recently, the application of GAAP—or the lack thereof, in certain cases—to cryptocurrency transactions has resulted in operational failures of at least one company. Furthermore, accountants for cryptocurrency companies implementing blockchain have raised concerns about the comparability and usefulness of financial statements when valuations are based on historical cost versus fair value. Chief among the foremost concerns have been the evaluation of fair market value of cryptocurrencies given the level of price volatility in recent years, the ebullience of blockchain token offerings generating prices for yet-to-be-completed products, and the extent to which cryptocurrencies qualify as current or noncurrent assets on balance sheets. Currently, there will be an effect on both a firm's balance sheet and income statement due to the potential misclassification and volatility these unique accounting considerations pose. Undecided judgments with cryptocurrencies could negatively impact financial position, leading to an erosion of investor trust. Consequently, there may be an opportunity for establishing GAAP adaptation and/or change emanating mainly from the novelty, subsequent nonrecognition as cash, and informational volatility of cryptocurrencies. At this point, what is clear is that adequate, reliable, and consistent application of GAAP for reporting with cryptocurrencies is not a given; accounting change is potentially warranted in light of future developments in the blockchain space (Prates, 2021; Haydon, 2021; Cheng et al.2024; Capatan et al., 2023).

18.1.2. Relevance of International Financial Reporting Standards (IFRS)

Particular accounting principles and standards are applied in the international accounting landscape. International Financial Reporting Standards are used in many jurisdictions and have a broad domain of application. Specifically, listed companies are often required to publish their annual reports under these standards. For these reasons, they may be applicable for outlining potential accounting for cryptocurrencies. There are various guidelines that could be used to account for cryptocurrencies, according to the specific situation of the entity.

One of the crucial objectives of financial reporting is to provide clear and accurate information to all stakeholders. These standards can be considered selective because they treat the relevant economic situation of the entity (Hubbard, 2023; Ramassa & Leoni; Butt, 2023; Georgiou et al., 2024).

A consistent approach to the accounting for assets issued may be an essential development in the accounting domain. These standards require the consistent measurement of non-monetary assets and liabilities permitted for barter transactions. This consistent valuation may be a potential advantage of cryptocurrencies, although in practice, the trading characteristics of cryptocurrencies limit the applicability of this notion. Specific guidelines include the measurement of intangible assets. The acquisition of intangible assets is expensive and may require tight regulatory scrutiny. Therefore, public companies may benefit from the transparency of the acquired digital assets on the statement of financial position. Limited guidelines provide on how to account for digital assets as intangible assets. It is unclear whether the said interpretation provides sufficient guidance to cover all potential questions arising. Consequently, the standard-setting bodies might need to issue additional guidelines, given the unique nature of the assets in question (Shestak et al., 2021; Hubbard, 2023; Xiong et al., 2022; Barker et al., 2022).

18.1.3. Emerging Issues in Cryptocurrency Accounting

The evolution of technology and society has opened up many new possibilities, both for business and for accountancy. Fintech is one such development that is challenging our current set of accounting standards. One example of a fintech product is Bitcoin. Due to blockchain technology, cryptocurrencies like Bitcoin became widely popular, and from 2017 until the present day, we have seen a rapid increase in companies and individuals investing in cryptocurrencies. However, no official guidance is given to account for this type; as a result, adopting new accounting standards for this emerging item is a challenge faced by the business world. The skeptical approach towards these new items, and the conservatism of the accountancy profession, leads accountants to an agreement that the new standards should be targeted at this specific asset group (Bellavitis et al., 2021; Emmert, 2022; Sonksen, 2021; Wronka, 2024).

The need for defining ways to account for cryptocurrencies is required. To date, no conceptual research paper has focused on this issue. Finance and law are more open to these investments, and because of regulatory differences between legal systems, some investments are not considered a financial investment for accounting purposes. For example, a trust account is a common cash manage-

ment practice in one country, while in another it is illegal. Legally speaking, cryptocurrencies are not recognized as money, commodity, property, or security in a different legal system. Methodical accounting research focusing on this new phenomenon is a must. Furthermore, due to recent and ongoing enforcement alerts about cryptocurrencies, practical guidance is also needed. As an interim solution, some guidance on cryptocurrencies was offered in 2015 that allowed companies to account for cryptocurrencies as intangible assets. This decision should satisfy the conservative audience who oppose adopting new standards just for a new asset type before it is deemed a long-term investment. However, these guidelines are specific to use in one region and are not acceptable for firms in another. These investors trade not only in private cryptocurrencies, but they are also generally stock and bond traders too. For that reason, this research aims to weigh two policy options for these investors and, as a second aim, to assess whether certain accounting standards may produce a better investment climate for dealing in virtual currencies internationally. This phenomenon is important now and perhaps for the next ten years or more because how these currencies are categorized may have an impact on investment behavior and, as a result, on financial market volatility. Regulatory bodies and enforcement authorities want to know more about this practice. This issue is particularly timely and important because of discussions on new virtual private currencies; hence, there could potentially be a more rapid transition from discussion in research to the standard-setting desk (Malvagna & Sartori, 2022; Emmert, 2022).

18.2. Valuation of Cryptocurrencies

Since accounting is primarily about the valuation of the elements in the financial statements, it is to be expected that valuation is an issue of paramount interest for the topic of accounting for cryptocurrencies. Generating transparent and reliable financial reporting on the basis of the asset and liability valuations is the core objective of accounting. As the value ascribed to an asset or a liability will determine the accounting entries at the time of the measurement of the element and at the amortization and any impairment date, it is pivotal to be aware of the valuation methods that can be applied and the challenges that are presented by these methods (Zhuang, 2024; Akin & Akın, 2024; Kostoula, 2023).

One of the options for valuation is 'Market-Based Valuation Methods.' According to market-price-based valuations, the market price of a unit of cryptocurrency is identical to its intrinsic value. By this logic, the valuation of non-traded cryptocurrencies proceeds by the comparison of a considerable amount of identical or similar cryptocurrencies that are traded in the market.

An investor can buy the traded cryptocurrencies at the market price, which is in line with the value of the cryptocurrency. This underlying idea is, however, directly challenged by the low amount of traded assets that are directly comparable to the asset to be valued. In the case of other assets or currencies, several comparables might be at hand. The amount of assets that are alike to a certain crypto asset and that have been deposited in liquid markets rarely exceeds a couple of assets only. In recent years, a significant number of new cryptocurrencies have been introduced to the market that are often very comparable in terms of technology and service to existing currencies (Lussange et al., 2024; Rhee, 2024).

18.2.1. Market-Based Valuation Methods

Introduction Market-based valuation methods are employed to determine the fair value of digital assets as evaluated by current market prices and trading volumes. A number of approaches deriving from the realm of traditional finance describe the calculation of liquidity premium, comparable analyses with companies, and dividend valuations. However, there remain a number of problems that arise with the valuation of digital assets and the application of market-based valuation methods through cryptocurrency markets. This approach seems helpful in the context of transparency of assets for the users but raises the significant issue of fraud (Akpan & Ukwu2023; Moro-Visconti, 2024; Akin & Akın, 2024).

18.3. The Significance of Current Market Prices and Trading Volumes

As many processes derive from the markets, this subsection concentrates on their significance. Advantages of performing this type of approach combine the transparency of the digital asset for all users, which is particularly important for cryptocurrencies. In markets with a significant imbalance, the application of their results seems to be more helpful for the valuation of assets than analysis performed through the usage of other methods of cryptocurrency valuation. Users consider the data regarding price and trading volume as new information that they receive, and thus, the method is divided into methods by distinguishing the transaction approach through market signals. Market data from the whole trading market reflect informed and rational assessments from the owners. In sufficiently deep and liquid markets, conclusions that are drawn from market indicators conclude that they are informative as to the actual value of the assets (Mikhaylov et al., 2021; Smith, 2021; Hubbard, 2023; Liu, 2022).

18.4. Cost-Based Valuation Methods

The cost-based valuation methods apply measurement approaches that indicate the quantity of resources given up, such as the historical cost or the replacement cost, that would be agreed upon, given the circumstances existing at the time of the transaction, by rational parties in normal, competitive market conditions. According to this interpretation, both cost-based approaches focus on costs incurred in acquiring or producing digital assets, regarding the investments those entities have to undertake in order to receive or mine cryptocurrencies as a measure of their value (Ai et al., 2023; Pashkevich et al., 2022; Kalantary, 2022; Moro-Visconti & Cesaretti, 2023).

The analysis of the utility of cost-based approaches reveals that although the methods are simple to apply and are based on accounting information that most entities already regularly assess, they fail to provide users of financial statements with any information related to the real value of cryptocurrencies in terms of money. Cost-based valuation methodologies could be applied if an entity acts as a cryptocurrency speculator or trader rather than an intended long-term user. The approach could be functionally implemented in a relatively stable economic environment, where the value of an asset does not constantly change. However, the rapid fluctuations of the cryptocurrency market make the aforementioned cost-based methods mostly inapplicable. A significant limitation in the implementation of the cost-based valuation methods in respect of cryptocurrencies is the impossibility of really determining the historical costs with which inventories are measured in practice. The borderland approach conducted by firms is noticeable on the basis of case studies. In these analyses, the application of all the aforementioned historical cost-based valuation methods leads to the recording of the decrease of cryptocurrencies' revenues, which are shown on the accounts of each firm in a different way (Coyle & Manley, 2024; Du et al., 2022; Arowolo et al., 2022; Muravskyi et al., 2023).

18.5. Internal Controls and Risk Management

In a day and age of constantly evolving technology and not one financial or government system to back cryptocurrency up, internal controls and managing our risks are of utmost importance. Establishing internal controls within your cryptocurrency operations will help mitigate risks for financial misstatement in an area where volatility in valuations is not uncommon. Cryptocurrencies, in essence, are valued based on what the law of supply and demand will bear online via a blockchain; it has been around and is, quite frankly, rather cumbersome not only to verify but also to determine their legality. To date, cryptocurrencies

are not legal tender, and jurisdictions vary as to their essential acceptance within each country. The bottom line is there are heavy cyber threats, and transactions are irreversible once they have been verified on a blockchain, resulting in high scrutiny for verifying that, in fact, the transaction is indeed legitimate (Parampathu, 2024; Malvagna & Sartori, 2022; Emmert, 2022; Kangethe, 2022; Aziz et al., 2022).

Due to the fraud-ridden nature of cryptocurrencies, the delegation of duties is critical to ensure verifications are correct. Consequently, strict documentation policies should be put into place and monitored to guarantee that separation of duties is established upon employee hiring, as well as policies for continual education and ethics training. A moment's notice should be given of a policy breach, an oversight, or lack of ability to verify and document one's work protocols. The goal is to ensure there are two people that actually need to verify that the cryptocurrency transactions are legitimate or authentic. Furthermore, your protocol should include a process by which verification occurs, ensuring confirmed transactions are up to date and accurate with some sort of source documentation to prove their authenticity. This should not be subjective; to the plainest common sense, the transaction must appear authentic and legitimate following this protocol. A practical example would include actually seeing a withdrawal from a bank account from the system to an external wallet, or a sale of crypto being transferred from an exchange to your company's wallet. In addition, from time to time, you may want to enact the use of a forensic CPA who can perform an analysis of a random selection in your watch list. The integrity of one's internal controls starts with the policies and the risks desired to be mitigated during the cryptocurrency verification. Given a 24/7 market, real-time monitoring is the one and final internal control. To date, such software that currently exists, although beneficial, is more prone to fraud in monitoring due to the fact that these monitoring systems are looking for blockchains from which to harness information in order to better perpetrate an unauthorized cryptocurrency transaction. Blockchain is gaining momentum and being used for internal control, as the ledgers are transparent and in the public domain; they are both difficult and arduous to defraud. The First-In-First-Out method of accounting should apply to multiple wallets as the crypto comes or goes from the same exchange. This is something the due diligence should flag during verification. It is important for them to be able to evaluate and pre-authorize numerous platforms for use with internal control risk considerations in mind. Lastly, comprehension of the asset's public ledger and its ever-changing risks are of utmost importance. Every CPA needs to be prepared to understand the

changing risks with the new, unique asset being handled; staff can be trained on items to watch for when reviewing transactions. It may be helpful to include examples in such training materials and update as necessary (Chen et al., 2022; Olaniyi & Omubo, 2023; Dyball & Seethamraju, 2021).

18.5.1. Segregation of Duties

One of the fundamental aspects of internal controls relates to the segregation of duties. The principle of segregation of duties suggests that no single individual should have control over a critical process from beginning to end. Dividing responsibilities among different personnel who are responsible for different stages of a process, or who are required to cross-check the work of another, ultimately reduces the risk of fraudulent or erroneous behavior. This is an important principle when dealing with cryptocurrency transactions, as a single wallet address can control access to cryptocurrency assets worth millions of dollars (Wu et al., 2021; Sanz-Bas et al., 2021; Cherniei et al., 2021).

There are several practical examples of segregation of duties in cryptocurrency accounting. A key concept is that assets and records should be managed by different parties. In other words, the personnel responsible for maintaining records should not have control over the underlying assets or the movement of those assets. In our cryptocurrency cash management example, this would mean that asset access may be controlled by a different employee, such as an operations manager, while the accountant's role is limited to maintaining the accounting records in compliance with GAAP. A second important function where separation of duties may be applied is in approvals. Members of the blockchain accounting network should be involved in the approval, or 'signing', of key transaction data. A third area in which segregation of duties principles are relevant is with reconciliations. If possible, members of the accounting team should not be the ones performing cryptocurrency asset account reconciliations. The aim of including this separation is to ensure that errors in the accounting records are not hidden by the person who committed them (Hubbard, 2023; Smith, 2021; Chou et al., 2022).

In the context of cryptocurrency accounting, full segregation of duties can be a challenge to implement due to the often decentralized nature of these operations. Despite the challenges, the principle of segregation of duties remains an effective internal control approach because it makes it difficult for an employee to engage in malpractices and to hide those actions from other employees. This is a critical underpinning principle of accountability, which is of significant importance in accounting. Even in the most decentralized organizations, regular

audits are necessary to ensure that the principles of segregation of duties are being adhered to (Appelbaum et al., 2022; Nabilou, 2022; Fortin, 2022; Anikina & Isaeva, 2024).

18.5.2. Authentication and Authorization Controls

Authentication and authorization are the controls paramount in ensuring that an individual has the necessary right (authorization) to execute a transaction if his or her identity is established (authentication). In other words, once a user is authenticated in a cryptocurrency system, authorization determines whether he or she can perform a function or a task. For cryptocurrency systems, the core focus is to ensure that beyond the authentication being precise, all transactions must also be authorized before they are executed on behalf of a user. These strong controls are critical since cryptocurrencies are non-refundable. Fraud and error affect the user and not the system. It follows that a strong control to ensure that only valid requests are carried out is essential. The importance of these two controls finds balance in a statement that: "The use of a username and password combination does not provide enough security for individuals to control substantial investment in cryptocurrencies." Beginning with authentication controls, how can an individual be authenticated before authorizing any further activity on a cryptocurrency platform? Today, beyond the username-and-password mechanism, it is recommended to use password two-factor authentication and one-time passwords. As part of ensuring that a transaction is authorized, the use of multi-signature wallets is essential. A multi-signature wallet enhances control of transactions by requiring more than one authentication to accept a transaction margin renewal operation. In addition to these controls, there is the use of biometrics as another control or as part of password two-factor authentication. However, both require users to behave in specific ways for optimal usage. Cryptographic wallet recovery is another method for authentication. It, however, gets challenging since it requires some setting out in the beginning and activities later on. An interface that is not always user-friendly but provides a more secure way of dealing with advice, provides more general knowledge about security and is easy to use. Finally, remaining prevention methods if a transaction breaches authentication is the case of manual methods to backtrack the transaction later on. While addressing authentication controls, it has to be realized that little confusion may arise between authentication and authorization controls. It is well worth considering the point that cryptocurrency systems, which were initially designed without sufficient consideration for security and had their own well-defined flow in mind, have been evolving in line with the

ever-increasing security requirements mandated by the organizations. However, if improvements and efficiencies are to be made, these flows need to change in the near future to be designed using the appropriate technologies and controls, thereby complementing the business processes for greater benefits. As such, these security solutions are deployed only for convenience and consideration, as most enterprises are trying to achieve a balance between security and practicality. These methods are, of course, necessary to prevent any unauthorized transactions from executing. Transaction execution in the identified method is best suited to one where all users have been authenticated and a secure level of transaction execution is met. Obtaining or requesting authorization is suggested since an individual can only execute a valid transaction once authenticated. In this case, new controls on authorization for the cryptocurrency system are not necessary: transactions cannot be executed on the authorization mechanism as long as an active user is authenticated. Performing "authorization" is automatically central to an organization's compliance with a cryptocurrency system that obtains "authentication" along with a user's unique identifiers (Cong et al., 2023; Tiwari et al., 2023; Alamah & Fakih, 2024; Huey et al., 2024).

18.6. Auditing Cryptocurrency Transactions

With the rise of Bitcoin and the large increase in the number and types of cryptocurrencies, accounting and assurance professionals need to develop specialized audit practices and techniques for verifying cryptocurrency transactions. To verify the existence and completeness of cryptocurrency assets, accountants can match the cryptocurrency records on an entity's trading account with those of the clearing house or cryptocurrency exchanges. There are five major elements in an effective cryptocurrency transaction audit: Confirmation of transactions: This verifies the underlying transaction records. Validity of transactions: This tests the accuracy and correctness of cryptocurrency transactions. Risk assessment: Assessment of the risks of digital assets in all transactions. Testing: Substantive testing of transactions based on the risk assessment. Estimating value: Cryptocurrencies are an evolving market; accountants must find appropriate accounting adjustments for the changes in value. Developing methods for estimating the value of digital assets will continue to be an area needing research and analysis due to the risks associated with such assets. There are various procedures accountants can use to test cryptocurrency transactions and values (Hubbard, 2023; Alsalmi et al., 2023; Dragomir & Dumitru, 2023).

Newly formed or acquired cryptocurrencies do not have a historical record, making it difficult to estimate the true value of digital assets. Cryptocurrencies

also tend to be highly volatile, making it difficult for a CPA or other accountant to adjust its financial statements to represent the fair market value of digital assets. Creating an effective internal control measure for purchasing and trading cryptocurrencies can be a daunting task, as it is difficult to prove that an individual controls a digital wallet. Privacy and theft are other sources of concern and need to be considered when creating security over digital assets. Having an independent third party verify digital assets may build trust among stakeholders and demonstrate accountability. Just as an external CPA can verify a company's financial statements, blockchain technology can act as an independent party verifying transactions recorded on the blockchain (Bianchi et al., 2023; Ramassa & Leoni; Seabe et al., 2024).

New types of standards are often slow to develop in the accounting profession. Practical experience in conducting audits is necessary for auditing committees to see the critical need for auditing digital assets. With the rapid growth of initial coin offerings, auditing committees may find the need for digital asset auditing more pressing. Retrofitting older technology into the audit process can be expensive and unnecessary unless it better serves all stakeholders, private and public. Larger firms are already developing blockchain-related tools and services to help public companies better report their operations. Many accounting firms have started creating digital asset audit and assurance tools to lead the market in this new technology. This is an indicator that blockchain could be incorporated into auditing. My hope is that these audit tools will also include cryptocurrency because it will give assurance over a company's digital assets and protect innocent stakeholders. As new accounting technology is developed and adopted, the accounting curriculum should include instruction about relevant blockchain, digital asset, and cryptocurrency topics in the tax, audit, financial accounting, cost accounting, and accounting information systems areas of study. It may also be beneficial for those majoring in accounting information systems to be offered introductory blockchain, digital asset, and cryptocurrency instruction because that area is likely to see rapid growth in employment requirements for job-seeking graduates (Yigitbasioglu et al., 2023; Dupuis et al., 2023; Sonnerfeldt & Jonnergård, 2023; Anomah et al., 2021).

18.6.1. Audit Procedures and Techniques

Traditional audit procedures and techniques need to be adjusted to evaluate digital assets such as cryptocurrencies. Cryptocurrency transactions, as compared to transactions within the traditional economy, are characterized by a lack of access to the overall records and the use of an increasing number of

addresses in order to complicate the transaction tracking process. As a result, a traditional audit technique consisting of a direct inspection of records kept by an entity that is being checked is unlikely to be possible. Therefore, the basic technique of verifying transactions performed in the economy – transaction testing – cannot be directly applied, and therefore needs to be adjusted to new requirements. Besides testing and directly verifying transactions, the use of other audit techniques remains a fundamental element of assessing information included or supplemented by blockchain solutions. Such techniques include data analysis, substantive analytical procedures, additional reporting, forensic investigation, or the use of audit experts and external entities. They are used to evaluate the correctness of the disclosures made by an entity as well as its process organization, management, and response to the risk of material fraud or accounting manipulations (Dupuis et al., 2023; Ma2023; Hubbard, 2023; Georgiou et al., 2024).

Most of these procedures need to be aligned with the specifics of blockchain technology and the watchdog's capability to verify transactions on a public ledger. Therefore, the auditor, in order to increase the effectiveness of the verification procedures and not incur too high costs, is required to have at least equivalent knowledge of that technology and to be able to use advanced analytical capabilities including automated testing and verification. A case study presents the application of techniques for auditing cryptocurrency transactions. With the development of blockchain technology, the related accounting and auditing methods need to be developed and adjusted to meet new requirements and to be responsive to the risks and attributes of digital assets. The practice of verifying the information using substantive analytical procedures can contribute to the increase of the level of confidence in relation to the financial statements. This requires ongoing professional development and training for auditors (Mancini et al., 2021; Hu et al.2021; Kroon et al., 2021; Christ & Burritt; 2023).

18.6.2. Challenges in Auditing Cryptocurrencies

Volatility: Cryptocurrencies have high market volatility, with no regulatory or collateral backing them. This makes them open to high fluctuations or manipulations, which are required to be taken into account in the assessment of their carrying amounts. These fluctuations may also impact foreign exchange, and gains on re-translation could be considered as income arising out of such consideration. However, there has not been a framework for the treatment of changes in fair value in determining the carrying amount, making the assessment of cryptocurrencies difficult (Díaz et al., 2023; He et al., 2022; Bruhn & Ernst, 2022).

Anomaly: Transactions of cryptocurrencies involve large transactions, which are often subject to misclassification or errors from entity management. Even for scrutiny of transactions on a sample basis, there is no way to trace and validate the transactions recorded and appropriately presented due to anonymity, leading to doubts on completeness (Bartoletti et al., 2021; Saeidimanesh, 2024; Kehinde et al., 2024; Wu et al., 2021).

Anonymity: Bitcoin transactions have an anonymity feature to some extent, and among the top priorities for auditors, it is required for auditors to identify the parties involved. All other details shall be appropriately stated in the notes on accounts along with the necessary details, as the auditor cannot explain or agree. However, due to high anonymity, fact-finding for identification becomes more complex, with no way to establish the authenticity of management representation, which leads to inherent limitations in the auditor's evaluation. Also, for miscellaneous irregular cryptocurrency transactions that could be utilized by management for their personal gains, the blockchain records may not suffice or provide sufficient information, making independent confirmation almost impossible or, for that matter, difficult to establish in the overall pattern of cryptocurrency transactions (Ramgulam & Bourton, 2021; Vallina, 2023; Assegaai, 2022).

18.7. Case Studies and Practical Applications

The section is dedicated to the considerations of case studies and practical applications, providing valuable insights for practitioners on accounting for cryptocurrencies. All the following cases are united by the central focal point of real-life experiences in accounting. They systematically illustrate various challenges and related strategies within practical corporate settings. Since this research is located at the end of this publication, propositions on the topic and suggestions are given with the experience of practitioners in mind. Notably, these propositions deviate from the theoretical framework proposed earlier in the publication. They contain new approaches to accounting for cryptocurrencies or highlight some aspects that the call for adaptation assumed is new. They are intended as principles for accounting approaches (Klopper & Brink, 2023; Grujić & Vojinović, 2024; Oladejo, 2023; Dyball & Seethamraju, 2022).

All those who worked with cryptocurrencies in practice claim the swift tempo of change in the money markets. Thus, we can assume that our research consideration could become obsolete as soon as tomorrow. However, the case studies show the value of our approach, as the principles derived can be used as a meta-strategy for future accounting strategies. They are a trigger of thought

processes. They can help to secure the controllability of accounting strategies even if they must be changed within a short while again (Ghaemi Asl & Roubaud, 2024; Kumar et al., 2022; Zhuo et al., 2023; Kshetri et al., 2023).

19.Integration of Cryptocurrencies into Computerized Accounting Program

19.1. Computerized Accounting Systems

Manual bookkeeping practices have given way to computerized accounting techniques, where financial record-keeping and reporting are fulfilled automatically, including the transactions that are entered for a period of time, so that financial reports are presented accurately. Daily, financial transactions of the company are then entered into accounting computer programs, including those usually implemented by cooperatives and local accounting programs. In general, the use of accounting software increases the efficiency of financial reporting, ranging from inventory reporting to accounts receivable and accounts payable. Accounting software purchased is tailored to the type of business that is being run. Owners only need to enter the transaction data cyclically in order to obtain financial information. Large companies often use accounting software that is more complete and complicated (Phornlaphatrachakorn & Na, 2021; Salam, 2022; Han et al., 2023; Aluchna et al., 2023).

Companies that want to obtain convenience in clearly understanding transactions and financial reports to be drawn up, especially if the sources and types of their businesses vary, are encouraged to use computer-assisted accounting programs. This is because the use of computerized accounting programs can operate quickly and make clear financial statements and reports on sources of funding and cooperation. A template specialized in local accounting will be developed in the system for microfinance, specifically for villages. Some essential characteristics that must be possessed by accounting information at the microfinance level are that it must facilitate the measurement of performance and corporate risk. These apply the concept of participation, which is proportional and not based on the number of shares owned by the company in microfinance. Regionally, the business world is adapting regional accounting programs with online support in both cloud-based accounting programs and also accounting programs with an unmetered system (Bin-Nashwan et al., 2024; Aljabri & Al-Ansi, 2024; Han et al., 2023).

The function of the accounting program is to help entrepreneurs, especially the finance department, in making the financial statements and reporting activities of the company in a specific period based on the company's activities resulting

from the finance department. The programs used are tailored to the business management, managerial, and financial business processes. Regional businesses use a simple accounting software program from internet service providers or developers, professionals, as well as trusted friends. The use of programs intended to increase company efficiency is free. Connectivity and security are the main features in using an online accounting program of your choice. The accuracy of the data and the security of the program are the competitive advantages in the business program. Automated systems that integrate data from each subsystem, whereas in traditional accounting systems, integrated processing incurs production costs that are expensive. Companies applying online or offline accounting programs have the same basic characteristics, namely the financial data management process involving groups or companies, and quality reports. The difference is only in the technology used. Large companies have been using cloud-based computing, but small companies use accounting programs with non-metered support. In conclusion, some business people from a variety of business areas are already using accounting software to help manage and monitor the company's financial turnover (Javaid et al., 2021; Čabinová et al., 2021; Tanveer et al., 2021).

19.2. Benefits of Integrating Cryptocurrencies

There are multiple advantages linked to the incorporation of cryptocurrencies in a computerized accounting program. Firstly, the transaction speed of a cryptocurrency is faster than traditional banking practices that may take days to complete and will cost a fee. International transactions through banks may be more time-consuming and impose higher costs. On the other hand, the international nature of cryptocurrencies allows for international payments to be made within minutes from the wallet owner without a third party. Cryptocurrencies are also free from the transaction fees levied by other parties, except for small recording fees levied by network miners. Since cryptocurrencies do not rely on traditional banking measures, these cryptos require no fees from the bank as virtual monetary movement is done through an application that utilizes blockchain ledger technology. Since blockchain uses secure and solid cryptographic methods, it is very difficult to modify the verification process in favor of a particular group. Blockchain also offers several layers of security, authenticity, and accountability that help to curtail fraud. Due to its decentralized nature, it envisions the removal of intermediaries in order to facilitate fairer and more equitable transactions. The blockchain protocol developed also helps to significantly cut down on possible fraud as all participants involved can access and see the chain, thus building trust. Other advantages of cryptocurrencies include the ease of setting retail prices and

getting higher market shares, expansion of the market to an international scale, and the inclusion of the 'unbanked' in the global economy (El Hajj & Farran, 2024; Kayani & Hasan, 2024; Idrees & Ullah2024; Maulia & Kamil, 2024).

19.3. Regulatory Frameworks and Compliance

The presence of regulatory and compliance is inevitable when integrating cryptocurrencies into computerized accounting programs. Regulatory control over cryptocurrency can be represented by tax legislation, anti-money laundering requirements, and regulation from the central bank. Several countries have separate acts that detail in-depth tax treatment of cryptocurrencies, such as routine income tax practice. Several countries require that cryptocurrencies be included in annual income tax declarations, reducing tax evasion opportunities through this means. The European Union has implemented its fifth anti-money laundering directive to include virtual currency wallet and virtual account exchange service operators within the list of obliged entities. If a company operates in various countries, understanding the diversity of regulations in the countries where operations are conducted and also internationally is important (Fletcher et al., 2021; Rustamaji & Faisal, 2024; Leuprecht et al., 2023).

When a company is unable to comply with international accounting standards and give input on a conciliatory basis to face the non-uniform rules of other countries, companies should take proactive measures and adopt ethical principles, especially in public accounting practices, for the implementation of accounting according to the state of the work. In the publications of audit public accountants, the main focus in accounting for virtual assets is the typology of cryptocurrency. An audit public accountant will give an overview of business standards set by the financial transactions supervisory authority which are used by financial transactions. To date, the State of the Work Press has not issued accounting standards for virtual assets. Accordingly, the accounting treatment of virtual assets must be adjusted to the characteristics and limitations of accounting treatment. Since regulatory authorities continue to change with the changing times, companies should adjust to changes in business processes and stay updated with the latest information by continuously monitoring changes in regulations (Ferri et al., 2021; Al-Qudah et al.2022; Carnegie et al., 2022; Ramassa & Leoni; Al-gnbri, 2022).

19.4. Technical Considerations

Since cryptocurrency integration would be incorporated into accounting systems or software used by organizations, it is important to determine if

their accounting system, operating system, accounting program, etc., would be compatible with such software. Making such an integration would require knowledge of programming in different computer languages. Therefore, it is essential to find a proper exchange platform and digital wallet system or software to provide a quick, safe, and secure means to work with cryptocurrencies. To minimize the chance of loss due to data corruption, hacking, or theft of proof files, organizations must select an appropriate digital or hardware wallet that is immune from various types of malware and that generates a new address and digital signature for each transaction automatically. Therefore, the level of technical ability and experience of both the IT staff and vendors holding sensitive cryptocurrency ledgers and storage details must be evaluated by management. Involving the IT department to assist in providing system security and data protection will be part of the organization's cybersecurity system to be established and implemented. New electronic computer technology, including blockchain and distributed ledger technologies, promises data integrity as confirmed by satisfactory process integrity. Blockchain technology is the most secure of the public ledger and confirmation tools currently in use. Other technical challenges involve scalability and larger cryptocurrencies, along with in-depth compatibility and potential interoperability issues with other participants. One suggested solution for blockchain is to develop blockchain offset channels and additional trails. Follow-up support via skilled IT professionals is needed for proper and efficient operation to monitor the adjustment and charging of mining fees, data movement, server interruptions, equipment wear and failure, and malware or hacking activity in the systems and wallets the company uses, along with the manual attack on the applicant's or business's cryptocurrency assets. These technical issues must be considered before the digital currency is worked into computerized accounting programs (Faccia & Petratos, 2021; Olabanji, 2023; Georgiou et al., 2024; Habib et al., 2022).

19.5. Future Trends and Developments

Cryptocurrency and blockchain technology hold great promise and will continue to undergo technological advances in the future. An example of this type of technological advancement is Self-Sovereign Identification. This technology may cause a change in accounting as much as the development of the banking system did in 1933. Nevertheless, blockchain has an internal data bank and shares data electronically to avoid multiple entries; Bitcoin and other cryptocurrencies rely on a means outside this block (Chiu et al., 2021; Yadav et al., 2022; Zheng et al., 2022; Li & Li, 2022).

Another external data bank outside blockchain technology is the development of artificial intelligence. One can treat a book of original entry in Bitcoin with artificial intelligence to automatically recognize transactions for temporary profit or donation. The synchronization of registration cannot be faster and less elaborate than downloading the shareholders' books from an electronic exchange on a computerized accounting program. In many emerging market countries, there is no regulation, which hinders the sale of goods and services using cryptocurrencies. Over the next five years, the interviewees predict that there will be significantly reduced demand for payment methods in cryptocurrency in countries with high and medium levels of regulatory restrictions, Byzantine robustness issues, and excessive cryptocurrency volatility. Few know that cryptocurrencies are currently experiencing a gradual shift and are entering the realm of financial technology. If some new payment methods or digital currencies develop in the future by the fintech industry, they could replace cryptocurrencies in the long run, albeit with some cryptocurrencies involved in accounting systems using computerized accounting packages. Major institutions tend to follow an institutional overlay that represents their values and doubles down on their fiduciary responsibility (El Hajj & Farran, 2024; Gurgun et al., 2022; Jariyapan et al., 2022).

19.6. Suggestions for Integrated Process

The process of integrating cryptocurrencies into computerized accounting programs was discussed in detail. The risks, challenges, and opportunities for innovation were examined, and various recommendations were made. This section summarizes the points made. The feasibility of cryptocurrencies cannot be negated, given the rate at which people and companies are investing in them. The fact that a number of stakeholders have already implemented cryptocurrencies into their accounting systems should be taken into consideration by those who have not done so already (Chowdhury et al., 2023; Ramassa & Leoni; Klopper & Brink, 2023; Garanina et al., 2022).

In order for adoption to take place, a comprehensive risk assessment should be performed prior to integrating cryptocurrencies into the accounting system. Additionally, the businesses concerned should be vigilant in organizing a workshop on cryptocurrency basics with individuals involved in their accounting system. This should suffice to facilitate users' understanding and usage of the cryptocurrency system in the accounting system. There should be an attempt to comply with the new regulations set out by the authorities concerned in order to adopt cryptocurrencies. Regulations should be closely followed to guarantee

the efficiency of taxpayers' financial transactions. If regulators open the door to identifying a more effective system of accounting, cryptocurrencies can later be integrated into the entire accounting system. Finally, changes to any system are expected, and the fact that cryptocurrencies are available means more research can be expected soon. The report can be altered as the process progresses, and a renewed report can be prepared in the future to let more users use cryptocurrencies and adapt to accounting systems (Samsamian et al., 2023; Agyei et al., 2022; Bruhn & Ernst, 2022; Huynh et al., 2022).

20. Taxation of Cryptocurrencies: Comparative Analysis and Case Studies

20.1. Introduction

Having experienced rapid growth in the past decade, digital currencies have become an entirely new asset class. They are widely recognized by users but are not directly regulated by existing laws and regulations. As a result, there is a need to develop effective international taxation measures that can address both the unique characteristics of these currencies and the latest digital economy business models, and that can also protect tax fairness and government revenues.

20.2. Taxation Principles

In international tax law, there are several principles of fair taxation based on which international tax legislation is being built. Among these principles, it is required to emphasize the principle of equity, which presupposes a taxpayer's ability to pay from his or her recognized revenues. The state should ensure fairness in the distribution of the tax burden between different groups of taxpayers. The principle of equity includes an adequately formalized principle of taxpayer equity, which traditionally is formed as part of distributive justice and provides for a diverse split of the tax burden between different groups of taxpayers in such a way that it is based on their taxpaying ability, tax equity, and willingness to contribute to the state budget, and does not contradict the basic rights and liberties of the taxpayers. Since the tax system should be based on a general comprehensive balance of interests and is an important incentive for economic growth, particular attention should be paid to the elimination of the fiscal worst-case scenario, minimization of tax-paying bias, and presumably stepping up the role of fiscal democracy, improvement of fiscal institutions, and a strict division of fiscal competencies between different levels of government. In addition to general principles of fair taxation, it is advisable to use the principle of fiscal neutrality while launching a VAT reform. One of the main implications

of this principle can be considered a likely reduction of the VAT rate. Also, the neutral implications of VAT on economic activities as a precondition for the aspirations for an effective tax system promote simplification of tax rules and fostering compliance with VAT legislation (Richter, 2024; Alm et al., 2022; Ndebele, 2022; Szudoczky, 2023).

20.2.1. General Taxation Principles

There are several legal categories for bitcoin or other cryptocurrencies: a payment system, a product for consumer use, a currency for financial operations, and other commercial and non-commercial contracts, as well as other possible uses varying by jurisdiction. Depending on this classification of cryptocurrency, the tax consequences can be different. However, to understand the tax system, it is necessary to begin with the general principles of taxation. A tax is a financial charge or other levy imposed upon a taxpayer by a state or the functional equivalent of a state. Without generalizing the terminology of different countries, it can be noted that a financial charge is similar to a payment for a particular action by the taxpayer. The taxpayer should have the ability to make payments, and the obligation must come from the state; i.e., based on the tax laws (Cherniei et al.2021; Astrakhantseva & Astrakhantsev, 2021; Omelchuk et al., 2022).

The main functions of taxation are budgetary and regulatory. The budgetary function consists of funding public goods, such as military force or a jurisdiction's foundation. The regulatory function is the use of taxes to manipulate economic conditions. The main characteristics of taxation are governmental decisions that are directly binding and are not reliant on the taxpayer's consent; the compulsory nature of collection, with an obligation from the state; a lack of direct correspondence between personal payments and the amount of benefits; and the funding is not based on a financial limit for the state. The object of taxation is the situation, event, or other commercial or private action that has direct or indirect tax implications. The recipient of the obligation is the state, a legal entity, or a state-authorized agent; a domestic union can include any number of its bodies performing financial recharges within their competence, finances, and the rest of the powers giving their agents the ability to make tax decisions. These decisions can oblige taxpayers or third parties connected with the object of taxation. The final level of taxation defines the source. This concept includes taxes, fees, and special fees (Bondaruk et al., 2023; Ismanov & Axmadaliev, 2021; Giyazova et al., 2022; Lyulyov et al., 2021).

20.3. Taxation of Cryptocurrencies in the United States

The United States is one of the leading countries in the area of taxation of cryptocurrencies. The IRS issued the first preliminary guidance regarding the taxation of these virtual assets in March 2014. Two years later, the Don't Tax Me Act was introduced in the U.S. House of Representatives. Its main goal was to stipulate an exemption for the sale and purchase of cryptocurrencies that were not converted into U.S. dollars or any other recognized national currency for amounts of $600 or less. The biggest changes have been brought by the Tax Cuts and Jobs Act of 2017, in which the tax authorities defined the term "realization of assets" for tax purposes. On the basis of this act, the United States taxed all cryptocurrency exchanges. That means the U.S. tax authorities are no longer only tightening the "sphere" but also carefully monitor any kind of income (Kessler & Vandenberg, 2021; Francis, 2023; Emmert, 2023; Jozipovic et al., 2021; Andersson, 2022).

At the federal level, digital currency will be treated the same as any other currency. The term "currency" means the coin and paper money of the United States or of any other country that is: designated as legal tender and that circulates and is customarily used and accepted as a medium of exchange in the country of issuance. The foreign currency gain or loss under section 988 is computed separately for each foreign currency and, in the case of gain, must be separately computed for each of the taxpayer's functional currency bank accounts. Only gains and losses on transactions entered into in connection with a trade or business or a transaction entered into for the production of income are taken into account. Such gains and losses are treated as ordinary income or loss. Foreign currency gain or loss attributable to section 988 income are income to the extent that they are directly allocable to such income (Cunha et al., 2021; Bindseil et al., 2021; Benigno et al., 2022; Keister & Monnet, 2022).

20.3.1. IRS Guidance and Regulations

The Internal Revenue Service acknowledged that virtual or cryptocurrency is the new form of currency supported by blockchain. The IRS first issued legal guidance addressing virtual currency in 2014. The guidance documents have provided a significant amount of direction to taxpayers since 2014 and were intended to provide initial training for IRS examiners. In 2019, the IRS started sending letters to initial coin offering investors and cryptocurrency traders that were derived from tax returns. In September 2020, the IRS mailed educational letters to more than 10,000 taxpayers that owned or traded in virtual currency, including no action and examination letters (Lydy, 2021; Davenport & Usrey2023; Adams & Bailey, 2021; Nylen & Huels, 2022).

On March 23, 2018, the IRS issued a memorandum that provides five questions to assist taxpayers in determining their compliance responsibilities with respect to virtual currency transactions. In addition, on September 24, 2020, the IRS issued a notice concerning the self-certification process for a waiver of the 60-day deadline for taxpayers claiming a tax-free rollover due to the requirement of a financial institution or a foreign government. On October 9, 2019, the IRS released a ruling concerning taxable events as a result of a hard fork or an airdrop of cryptocurrency. Finally, on October 9, 2019, the IRS released a ruling concerning the question of whether advanced authorization is required to receive tax advice (Ritter et al., 2022; Behrendt, 2023; Antinozzi, 2024; Davenport & Usrey, 2023; Sheppard, 2022).

20.3.2. Capital Gains Tax

Cryptocurrencies are generally taxed like other resources, for example as property, when used as an investment or a token. Generally, people trade assets for profit, and when this happens, the American income tax breaks in. Traditionally, long-term gains have positive tax treatment compared to short-term gains. Typical exchanges and holding them in escrow, for example, are classified in this way when the cryptocurrency being exchanged is a long-term investment. Although, unlike the typical exchange, a former investment that is no longer viable could have lost value by the time it is exchanged. This is typical of the high volatility seen in some cryptocurrencies (Chason, 2022; Huang et al., 2023; Deng & Chan, 2023; Jozipovic et al., 2021; Davenport & Usrey, 2023).

Long-term capital gains on cryptocurrency do have reduced tax criteria in some scenarios but not all. The first step is to determine what the cost basis of crypto assets essentially is. If the asset has been held for more than a year, one of the cases where it would qualify as long-term capital gains, then the cost basis is the market low for the year of 2015. This makes the purchase price $197.89 and any appreciation from there long-term capital gains. If crypto were held for less than a year, the first in first out tax treatment would apply to the value of the asset instead. For instance, if $10,000 in Bitcoin were purchased on May 2, 2015, and $5,000 of the Bitcoin were exchanged on June 13, 2018, the initial cost basis for tax purposes would have been $3,000 of the purchase (Bakradze, 2021; Chokor & Alfieri, 2021; Falcao & Michel, 2023; Hubbard, 2023).

20.3.3. Reporting Requirements

The need to report transactions dealing with cryptocurrencies generates complexity for both the individual and the supporting software. While there

are no specific reporting requirements, cryptocurrencies are included in the definition of property. Therefore, the fair market value of the cryptocurrency in US dollars at the time of a reportable event is required to be reported. For the majority of filers, tax reporting is a necessary annual task. The filer has thirteen months from the reporting year to submit the required form or payment. The enterprise has three reporting deadlines to consider, but an employee may be subject to the rules for non-employee compensation. To avoid interest and penalties, the filer should accurately estimate their tax liability and make estimated payments in the US every quarter (Budak & Yılmaz, 2022; Deng & Chan, 2023; Huang et al., 2023; Kucharova et al., 2021).

For the three reporting applications—payroll, independent contractor, and merchant services—processors support separate models to deliver needed data. The shared objective of this data bundle is to reconstitute as many reportable events as possible. However, the distinctions and idiosyncrasies in the data set quickly create a challenge to the close-knit relationship that is needed to correctly identify the transactions. Conclusions indicate that identifying multiple, dissimilar reportable events is possible and that technical assistance from tax processors and software developers can present feasible reporting models. However, explicit guidance is necessary to ensure a taxpayer's ability to comply with the law (Matshona et al., 2024; Rashid et al., 2021; Mamani et al., 2023; Siglé et al., 2022).

20.4. Taxation of Cryptocurrencies in the European Union

Interest among governments regarding the taxation of cryptocurrencies has grown substantially in recent years. The Portuguese Tax Authority has been attentive to the innovation brought by virtual assets. Given the current reference to cryptos, Portugal's Tax Authority has issued several guidelines to ensure that all the rules are complied with. This exemplifies the attention of the Portuguese government to the revenue generated by crypto transactions and illustrates the government's concern in ensuring their identification and the fair collection of taxes (Olabanji, 2023; Hernández et al., 2024; Sánchez et al., 2024).

Activities with cryptocurrencies were not planned for in advance by tax systems, and recently, the tax authorities of most countries have published guidelines. Taking Portugal as an example, the tax authority defined that all those who make gains from cryptocurrency transactions are subject to Portuguese tax law and therefore obliged to pay that tax. Tax and customs legislation already exists in the Portuguese framework since the Consumer Protection Law, which establishes the characteristics of digital coins and notes that there is no guarantee

that they can be a store of value since their acceptance depends on the willingness of a large number of private agents, and many may not accept this asset as a method of payment for debts or might be mistaken for virtual currency. As such, the capital gains obtained from the sale of any virtual currency or digital currency must be declared to the Portuguese tax authorities when there is a gain that results from the schism between costs and charges, and must be declared even if the seller is not a resident in Portugal (de Campos Amorim, 2024; Maia, 2023; Carmo, 2023; Ferreira, 2022; Conci, 2022).

As well as gaining value and being traded since September 2017, the Portuguese tax authority has also distinguished between the activity of trading and the activity of mining cryptocurrencies, in that it considered the generation of this type of currency through a computer process to be a taxable activity. Unlike transactions carried out with euros, where a reasonable pattern of behavior is under suspicion when the difference between cost and sales is low, the Portuguese tax authority sets a threshold of €100, leaving the declarant with the duty of proof. Thus, only those with gains above this amount should include the declared transactions. Due to repeated requests to clarify this matter, the Portuguese tax authorities released a statement that dual taxation was not admissible after Portugal signed an agreement with other countries, where the sources of income were disclosed between the various countries. Determining when a transfer is taxable is more complicated than with other currencies because virtual currencies can be transferred in various situations since they may, among others, correspond to a donation, a deposit, or an increase in a person's own assets, where all of these transfers represent changes in the capacity to build wealth. These issues associated with cryptocurrencies are of interest not only for those who have to pay taxes but also for studying how exchange rates in the cryptocurrency market behave, given the significant impact these rules can cause (Victor, 2021; Parsons, 2022; de Campos Amorim, 2024; Ferreira, 2022).

20.4.1. Directive on Administrative Cooperation

Regulation 2011/16/EU of the Council on administrative cooperation in the field of taxation was adopted in 2011 and gives authority to the EU member states to exchange certain information regardless of their domestic or partner jurisdictional secrecy rules in force. However, it should be noted that the scope of the information still depends on the relevant and specific tax treaties (Čunderlík & Szakács, 2023; Bełdzikowski, 2022; Kalus, 2023).

To put it simply, the Directive obliges the member state it is addressed to, to collect and send any specific non-public data necessary for enforcing a member

state's domestic taxes for the purposes of a tax agreement (such as taxable maturity, price or amount of the taxable items, and related cost categories necessary to apply the level of the relevant tax treaty or suggestion provided). National money, investment, transfer pricing, or monitoring regulation, and the method of transferring payments realized by participants in the taxation scheme while maintaining good secrecy. If necessary, the information must be sent in English (Słotwiński, 2022; Schmitz-Berndt & Schiffner, 2021; Finck & Mueller, 2023; Vogel & Lassalle, 2024).

In short, the Directive forces the addressee member state to exchange and provide any information necessary for applying national tax legislation of the applicant member state for the purposes of taxation and tax administration, procedure, criminal and civil issues (related to the non-payment of specific taxes and other related obligations of tax debts and costs and overhead costs associated with a more general fiscal result through a tax treaty or legislative suggestion that has been or is being executed by directive). The disclosed information must be exchanged in practice by the Protocol in English (Arnold et al., 2022; Dourado, 2022; Antov, 2023; Samsin et al., 2021; Christensen, 2021).

20.4.2. Value Added Tax (VAT)

In the FiCAS case, we find the Swiss Federal Tax Administration in its capacity as a Federal VAT Administration in the role of VAT subject and holder of bitcoins, while in the Skatteverket case, we see the Swedish Tax Agency in its capacity as a VAT subject and acquirer of bitcoins. Both situations are reminiscent of the EO case in that a tax administration acquires an asset that is in itself not 'related to economic activity within the meaning' of Article 9(1) of the VAT Directive and subsequently disposes of it. Here, the decisive interpretative question is whether the acquisition or the disposal constitutes an economic activity or taxable event within the meaning of Article 2 and Article 4 of the VAT Directive. Concerning the scope of the exemption, we find that both acquiring and disposing of the mined virtual currency in the T case are covered (Kuzhelko, 2022; Egorova et al., 2023; Budak & Yılmaz, 2022; Waerzeggers et al., 2023).

Regarding the qualification of the transfer, the CJEU is asked to consider whether there is a 'supply of services' within the meaning of Article 24(1) of the VAT Directive. The second MoF case is especially interesting in this respect. It is a milestones case in that it is the first decision of the CJEU on the VAT treatment of public administrative activities. It is a border bridge case in that it concerns the provision by a taxpayer of public administrative activities in conjunction with two other operators established in another. The New Zealand VAT cases

go a step further by testing the reach of Article 135(1) by introducing a novel category of exempted public administrative activities not expressly provided for by the VAT Directive (Zhang, 2022; Anagnostopoulou2023; Verschueren, 2021).

20.5. Taxation of Cryptocurrencies in Asia

Asia is home to various groups of government responses towards the increase in cryptocurrencies, from banning all to allowing them to flourish with minimal regulation. The digital asset market, including both cryptocurrencies and tokenization, is subject to insider trading policies and regulations around token issuance. Thus, the tax policies towards the new phenomenon – the digital asset market – will end up being quite crucial due to the identified controversies of all opinion layers in the previous discussions, and it could provide potential new revenue for the government. Currently, in Asia, only four countries have issued regulations on value-added tax on cryptocurrencies and their related transactions. In Asia, the regulations issued depend on the function adopted towards cryptocurrencies in each country, which has resulted in regimes that are not too consistent around the continent. Some threats arise from the categorization of cryptocurrencies as legally tax-exempt tokens and the transition of regulations towards digital financial assets, especially for those that were not equipped with similar paperwork to apply the new responsibilities required. First, it created regulatory confusion for developers, users, and merchants. Second, Japan has recognized more than a dozen private entities as the exclusively operating cryptocurrency exchanges under their Payment Services Act (Bachurin, 2022; Siddiquee & Saleheen2021; Brockmeyer et al., 2024).

20.5.1. Japan

Japan is one of the earliest countries to declare legal tender for digital assets, which determined the attitude toward cryptocurrencies, their regulation and taxation, and the approach of the authorities to their studies. However, only in its taxation system are digital assets recognized. As the form of settlement using digital assets is significant in the adaptation scale, the Japanese national tax system includes settlements involving digital assets. The selling, converting, and exchanging of cryptocurrencies in Japan are regulated by laws aimed at conducting transactions with cryptocurrency. The law does not provide guidance on how cryptocurrencies should be taxed, but the authorities analyzed the relations from a tax point of view regarding transactions with digital assets and announced a revised income tax treatment of digital assets, referring to it as operating income. Taxable operations can be divided into two categories,

depending on the purpose of acquiring digital technologies. In addition, it introduced a grace period and softened the taxation on some transactions under prescribed conditions (Heckel & Waldenberger, 2022; Yamaoka, 2022; Kirkpatrick et al., 2021; Kochergin, 2022).

20.5.2. South Korea

In South Korea, cryptocurrencies have never been officially banned or restricted by local law. However, their legal status is rather blurred, and the country's authorities have been trying to tighten their regulation for a long time. Moreover, they are mostly referred to as means of speculation, gambling, and money laundering. In recent years, the South Korean authorities expressed their intention to restrict local cryptocurrency trading sites or stop them completely, but this came to nothing in the end, focusing their efforts on the protection of investors instead. In early 2020, the local police raided branches of the largest local cryptocurrency trading site in connection with the disappearance of a significant amount of money from its clients' accounts, mostly involving a cryptocurrency. Meanwhile, a regulatory body that had been established to keep track of local cryptocurrency trading sites seems to have been shut down. It appears that the lack of strict regulation has revealed the dark side of cryptocurrencies as investments (Hwang, 2023; Alekseenko, 2022; Paesano & Siron, 2022; Courtois et al., 2021; Sonksen, 2021).

20.6. Taxation of Cryptocurrencies in Developing Countries

To overcome the digital divide that characterizes developing countries, 21st-century citizens are embracing the incredible innovations and possibilities that blockchain technology offers. Thus, it is crucial that these countries' tax regimes consider the treatment to be accorded to cryptocurrencies, particularly after the classification reached. Although conceptually similar, developed and developing countries have different considerations in terms of innovation, shadow economy, tax efficiency, and international best practices when increasing their tax bases (Hamukuaya, 2021; Mohammed et al., 2023; Howson & de Vries, 2022; Foster et al., 2021; Nguyen & Nguyen, 2024).

In Bitcoin's second decade, the problem associated with its tax treatment persists, independent of its classification as a digital asset, virtual currency, security token, utility token, payment token, or currency. The divergence of analysis methods between tax authorities and the distinct divisions inside government services compromises the determination of an equivalent taxation regime for the new financial landscape of future economies to come. Multiple

agents intervene in each cryptocurrency transaction, and most of the time, the members of this chain can only be identified with the indispensable intermediation of the others (Durdu & Üstün, 2024; Hougan & Lawant, 2021; Taskinsoy, 2021; Bakradze, 2021).

20.6.1. India

The 2018 report on cryptocurrencies did not provide any specific tax regime for cryptocurrencies. As observed above, the issue was addressed briefly and left the matter rather uncertain. According to the report, cryptocurrencies can be taxed under the Income Tax Act as assets. The taxability of such transactions under the Goods and Services Tax Act should be tested on a case-by-case basis depending on the facts and circumstances of each case, given that it is not possible to lay down general principles for the levy of tax in respect of the purchase or sale of cryptocurrency, as each transaction may be viewed distinctly and made under separate circumstances. Furthermore, it is evident that the party receiving cryptocurrency is outside the current threshold regime and may not be liable to pay GST on the sale of a service, goods, or both, or the interchange of goods and services (Budak & Yılmaz, 2022; Durdu & Üstün, 2024; Bakradze, 2021).

20.6.2. Nigeria

Nigeria is diverse in style of governance, currency systems, cooperative and fraternal organizations, and many other aspects of human society. The diversity often makes Nigeria unique and sometimes a source of conflict. The uniqueness and conflicts sometimes make Nigerians exceptionally innovative. An earlier form of crypto-type currencies is the transfer of value using cowry or other rare objects. The use of this type of currency goes back thousands of years before preferable cultural exchange or barter transactions. The magic in the transfer of value was the role cowries played in the development of Nigeria as a recognized global entity. The magical hold the central regulatory authority had on the cowries enabled it to control the citizens, collect taxes, and enforce regulation. A similar role is played by the modern central authority-supported currency (Arslanian, 2022; Johnson, 2022; Rosenswig, 2024).

Records of Nigeria's modern-day central currency tax system show a journey starting from as early as the sixteenth century. Colonial authorities attempted various forms of tax systems on both Nigerians and their businesses and imposed a modern form in 1903 after it gained legitimate control of the country in 1861. Current constitutional powers given to the central government in 1979 and 1999 give them the authority to impose and collect several forms of direct

and indirect taxes. Although a high level of emphasis is placed on direct and indirect taxes by the revenue authorities, some forms of CVC are collected when they are brought into the fiat currency domain. Advertising, digital economy, electronic bole, and some forms of housing taxes can be classified as CVC taxes as well and reflect the importance of CVC transactions in the Nigerian economy. In addition to those mentioned, there are other forms of electronic transaction taxes that characterize Nigeria. Currently, the focus of the authorities is on enforcing tax collection and promoting investments in the digital economy (Sá & Rodrigues Sanches, 2021; Elinson & Gould, 2022; Anayochukwu et al., 2022).

20.7. Case Studies

As I have pointed out above, the tax regulations on cryptocurrencies can help identify them as assets, electronic money, or foreign currency. Depending on this approach, such regulations might present better-detailed rules or a broader background for the taxation of the trading or the exchange of cryptocurrencies. A new type of analysis has to be performed in order to better clarify where specific operations or activities should fit in the tax systems of countries to avoid excessive distortions and inconveniences both for the tax authorities and the users of cryptocurrencies. In this context, case studies can allow for identifying the insights of cryptocurrencies within the tax systems of different countries. Also, case studies can help assess more complex issues, such as the characteristics of different tokens that can be created and exchanged within specific distributed ledgers, like the initial coin offerings. Similarly, case studies might clarify previously unknown effects of more common transactions that can be performed by using traditional currencies (Lazari & Vieru2023; Bakradze, 2021; Olabanji, 2023; Budak & Yılmaz, 2022).

20.7.1. Taxation of Bitcoin in the US

The rapid growth of Bitcoin during its initial years has provided investors and traders with substantial profits. As much of the economic significance of Bitcoin transactions is derived from its appeal as a speculative investment rather than from its fundamental use as a medium of exchange, many tax authorities struggle with the treatment of profits and losses derived from Bitcoin trading. Realizing the significance of this question for many Bitcoin traders and participants, the IRS has long declared that they regard cryptocurrencies as property and Bitcoin in particular as an asset within the purview of this statement. While the classification of Bitcoin as property is relatively unconventional, since many other tax authorities will instead combine properties and commodities with Bitcoin, the

tax treatment of property by the most important economy and legal system of the world carries some weight for tax professionals and the investment industry at large (Dumbroff, 2022; Lydy, 2021; Deng & Chan, 2023; Durdu & Üstün, 2024).

While this statement clarifies some ambiguities regarding the tax treatment of cryptocurrencies, it has failed to provide helpful guidance in many other details of the taxation of Bitcoin. While the tax treatment of most property transactions is relatively uncontroversial, the nature of Bitcoin as a currency has ambiguous implications in many instances. In the UK, the functional currency principle provides resolution and guidance in many cases. In the US, however, many difficult tax questions still await more detailed or even explicit guidance from the IRS. In the context of Bitcoin, the unique character of cryptocurrencies as a potential means of evading legislation and regulation, as well as cases of fraud in the traditional financial services sector, has caused some to adopt an adversarial stance against cryptocurrencies. Participants currently enjoy some benefits of regulatory permissiveness, as they are largely able to buy Bitcoin without being forced to disclose their identity or their trade on secondary markets. While this exciting feature is clearly resonating with libertarian circles, it has also made Bitcoin an extremely easy target for money laundering, tax evasion, and other illegal activities. The IRS is naturally concerned with the tax implications of Bitcoin, and in many cases, they will exert their collective wisdom and resources to help participants comply with the tax laws (Schwebke et al., 2024; Tiv, 2023; Akinadewo et al., 2023; Adhikari et al., 2021).

20.7.2. Taxation of Ethereum in the EU

The currency inside this blockchain is called Ether, or ETH. Not only does it allow for the development and execution of distributed applications based on smart contracts, but it also comes with a cryptocurrency in its own right. The fact that it performs functions far beyond being a mere cryptocurrency plays a major role in the assessment of its legal nature and the ways it is going to be classified in international practice. With minor variations, pending fraud protection, tax authorities in various countries have adopted an identical approach to the valuation of Ethereum. Generally, references are fixed on more well-known cryptocurrencies like Bitcoin. However, once you step aside from cryptoreality and turn back to the realm of non-virtual financial assets, different methods apply. In general terms, it is quite natural that a thing is priced and the prices are used for further transactions. In the realm of cryptocurrencies, one shall draw a clear distinction between the concepts of prices and valuation as economic categories (Bakradze, 2021; Parsons, 2022; Cipollini, 2024; Morton

& Curran, 2023; Budak & Yılmaz, 2022).

The rapid integration of the cryptocurrency market within the EU has stimulated the development of taxation models. Different countries traditionally apply different regulations in certain areas, and the taxation of transactions with cryptocurrencies is not an exception. The centralization of the EU countries' taxation systems is no more than a concept, which leads to differences even within the rather close Tax Directive. However, closer economic cooperation among member states, and even stronger globalization trends across the business world, encourage the development of harmonization principles and practices. The interest in taxation procedures was especially intensified after the European legislative initiatives aimed at the regulation of cryptocurrencies and blockchain technologies in general (Wronka, 2024; Korobtsova et al., 2023; Abdul et al., 2024; Özdemir, 2022).

Experts all over the world have discussed and are discussing some very difficult issues related to different sorts of coins. The presence of the legal owner is not a required factor; if a taxpayer holds the asset, like a cryptocurrency, the usual gamut of legal consequences applies. Although in some cases such a position may lead to the supplement of negative values, like in cases of unjustified enrichment or special confiscation after a particularly grave crime, in cases of most frequent daily economic life applications, the positive principles apply first. The basic ownership principles causing the consequences are the features, quality, or state of legal nature of the ownership. Although observation of costly and lengthy court procedures may seem superfluous, it is much more effective and ethical to address a qualified advisor and prevent the issue long before it is going to occur. Experience and expertise matter, even in such a feature-packed issue as the status of cryptocurrencies in tax realms (Adam & Miller, 2021; Aslam & Shah2021; Hendayana et al., 2021; Devereux et al., 2021).

20.8. Comparative Analysis of Taxation Approaches

The purpose of this chapter is to compare the regulation of cryptocurrencies in different jurisdictions, understanding the priorities of national authorities and to display a complex picture of what is happening in the world from the prism of tax regulation with regard to virtual currencies. Many countries should appreciate the prospects of the regulation of cryptocurrencies, using as an example the experience of various jurisdictions. Therefore, the aim of this study is to give concrete recommendations to the countries concerning the regulation of cryptocurrencies, aimed at the formation and improvement of government tax policy, taking into account the experience of leading world countries (Burgess, 2024; Uzougbo et al., 2024; Budkin & Budkin, 2023; Ozturk & Sulungur, 2021).

20.9. Conclusion and Future Trends

The main purpose of this chapter is to provide a comprehensive analysis of the regime of taxation in Portugal, Italy, the UK, Lithuania, Estonia, Germany, the Czech Republic, and Malta in relation to cryptocurrencies. The study aims to provide a comparative analysis against certain aspects of the tax treatment of virtual currencies from existing and future tax systems. The research provides a clear taxonomy of virtual currencies and, consequently, a clear definition of what is going to be studied. Furthermore, the paper outlines the steps that need to be taken before engaging with cryptocurrencies for better comprehensive knowledge and understanding. The comparative analysis showcases how diverse the perspectives and attitudes related to the topic of virtual currencies are throughout the EU (Andersson, 2022; Peláez-Repiso et al., 2021; Marek; Parsons, 2022).

Given the wide misunderstandings that circulate about cryptocurrencies, we revealed some relevant favored cases where cryptocurrencies may be used in order to shed light on the great potential of virtual currencies and, at the same time, pass on the message that these means of payment have a high economic impact and are not a 'niche asset' anymore. This work provides a very comprehensive view of existing tax treatments related to cryptocurrencies in Portugal, Italy, the UK, Lithuania, Estonia, Germany, the Czech Republic, and Malta and aims to set the path for future research and areas of improvement related to the upcoming technical and economic implications of using and owning virtual currencies. It focuses on actual problems related to the applicability of taxation to cryptocurrencies in various countries and some possible short-term solutions applying tax neutrality and promoting economic development. The work is also important in the sense that the knowledge from it could be useful to local and national authorities, as well as tax advisers, as they could deliver more reliable policies and services attempting to promote the success of national economies and society and their potential in the adoption of blockchain technologies. However, in the following future trends, we are going to give some recommendations derived from the conclusions of this chapter that need to be taken into account for further investigation and consideration (Chason, 2022; Bălăşoiu2021; Martinčević et al., 2022; Olabanji, 2023).

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VITAE

He was born in 1986 in Nizip district of Gaziantep. He completed his primary education at Cumhuriyet Primary School in 2000 and his high school education at Nizip Hasan Capan Anatolian High School in 2004. In 2005, he enrolled in the Department of Mathematics of Atatürk University, Faculty of Science, and in 2007, he took a double major program in Chemical Engineering for a while. In 2009, he started his graduate education in the Department of Mathematics at the Institute and as a high honor student and in the Department of Science at Atatürk Bilim University. After studying at Atatürk University, Graduate School of Science, he transferred to the Department of Algebra and Number Theory at Gaziantep University, Institute of Science. In the 2009-2010 academic year, he gave lectures at Gaziantep Vocational School as a school official last year. He started his Pedagogical Formation education at Gaziantep University in 2010 and completed this education in 2011. He started to work as a Mathematics Teacher at the Private High Schools of Gaziantep College Foundation, which is the first and oldest private school in Gaziantep, in 1963, in the 2011-2012 academic year. In the same year, he started to receive information in training courses in Gaziantep College Foundation Private Schools. In 2012, he started his undergraduate education at Anadolu University, Faculty of Business Administration, Department of Business Administration. While he was the Gaziantep College Foundation Information Manager in the 2012-2013 academic year, he worked for Gaziantep University Oğuzeli Vocational School in 2013. He started his doctoral studies with the thesis of "Software Defined Networking and Information Security" on Computer and Mathematics at South-West University "Neofit Rilski" (Bulgarian State University) as the Vice President of Management and Organization Department of Oğuzeli Vocational School in 2014 and with the bilateral agreement of Gaziantep University. He completed his Bachelor of Business Administration in 2015. In 2018, he completed his master's degree with thesis at Gaziantep University, Institute of Social Sciences, Department of Business Administration. He served as the Deputy Director of Gaziantep University Oğuzeli School (as a person), Head of the Computer Technologies Department (as a person), Head of the Law Department (by proxy), and Chairman of the Advisory Board. In 2019, Atatürk University AÖF Sociology Undergraduate and Gaziantep University Faculty of Law Faculty of Law were completed. In the

2017-2018 academic year, he started his Ph.D. in the Mathematics Department of the Graduate School of Sciences, Analysis and Theory of Functions. In the 2018-2019 academic year, TÜBİTAK won a doctoral scholarship abroad and made a transition to Gaziantep University Social Sciences Institute Department of doctoral education. She completed her Management Information Systems undergraduate education in 2021. 6 papers, 1 SCI-Extended (Q1) indexed article, 1 Scopus indexed (New Mexico University, USA) article and 3 national peer-reviewed articles.

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İLGİLİ MAKAMA

Cinius Sosyal Yayınları 1999 yılında kurulmuştur. Üniversiteler Arası Kurul Başkanlığı (ÜAK)'nın Aralık 2016 Dönemi Doçentlik Başvurusu şartlarında belirttiği tanıma göre Cinius Sosyal Yayınları *Tanınmış Uluslararası Yayınevi* statüsünde bir yayınevidir. ÜAK söz konusu tanımı şu şekilde yapmıştır: "Tanınmış Uluslararası Yayınevi: En az beş yıl uluslararası düzeyde faaliyet yürüten, yayımladığı kitaplar dünyanın bilinen üniversitelerinin kataloglarında yer alan ve aynı alanda farklı yazarlara ait en az 20 kitap yayınlamış olan yayınevi"dir.

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About the Book

In an era where digital currencies are reshaping the financial landscape, “Accounting, Integration into Computerized Accounting Programs, Seigniorage Rights, Taxation and Current Discussion Topics for Cryptocurrencies” stands as a comprehensive guide to understanding the complexities and opportunities presented by cryptocurrencies.

This book delves into critical topics such as Ponzi schemes and speculation in the cryptocurrency market, the use of digital currencies for political purposes, and the potential for central banks to hold cryptocurrencies as reserves. It also explores the concept of seigniorage rights within the realm of digital currencies, providing readers with a thorough understanding of the creation and distribution of value.

With detailed discussions on accounting principles and the integration of cryptocurrencies into computerized accounting systems, this book is an invaluable resource for accountants, financial professionals, and anyone interested in the transformative potential of digital currencies. The author presents a balanced and insightful view of the regulatory, technological, and economic debates that are shaping the future of cryptocurrencies.

Whether you are a seasoned professional or a curious newcomer, this book will equip you with the knowledge and tools needed to navigate the dynamic world of digital finance. Discover the intricacies of cryptocurrencies and stay ahead in the ever-evolving financial landscape.

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