KENNETH BOK

DECENTRALIZING FINANCE

HOW DEFI, DIGITAL ASSETS, AND DISTRIBUTED LEDGER TECHNOLOGY ARE TRANSFORMING FINANCE

FOREWORD BY TIMOTHY DRAPER
FOUNDER, DRAPER ASSOCIATES, DFJ AND DRAPER UNIVERSITY

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Additional Praise for *Decentralizing Finance*

Kenneth Bok's book *Decentralizing Finance* helps to demystify DeFi and goes further by explaining how traditional financial services are being unbundled by new technologies. We need more literature to explain why self-managed finance needs to be an integral component of the future digital economy.

—Linda Jeng, Head of Global Web3 Strategy at the Crypto Council for Innovation, Visiting Scholar on Financial Technology and Adjunct Professor at the Georgetown University Law Center's Institute for International Economic Law

Kenneth has displayed his vast experience, deep insights and thoughtful views on the fast-moving, often-misunderstood world of blockchain and distributed ledger technology, as well as digital/crypto assets with his notable knowledge and experience gained from traditional finance. His book, *Decentralizing Finance* is indeed valuable for not only the uninitiated who are seeking to learn more about this space, but also for the veteran who would gain much from Kenneth's opinions, reflections and forward-looking views, in this realm. Kenneth has managed to pack all that into less than 250 pages of clear and concise, systematic reading, which makes it so much more pleasurable to read. I would highly recommend this to anyone interested in this industry.

—Hsu Li Chuan, Senior Partner, Dentons Rodyk & Davidson LLP

In this book *Decentralizing Finance*, Kenneth Bok comprehensively and systematically covers the many areas that are evolving in this new world. What is clear is that the institutions and instruments in the world of finance are changing. How will it look going forward? How will it be different from the world we already know? These are the pertinent questions addressed in this book. The author gives the reader a timely and authoritative overview of how, as finance decentralizes, digital assets and distributed ledgers are bringing about fundamental change. An essential read for anyone who wants to have a competent grasp of the tools needed to analyze the new status quo.

—Joo Seng Wong, Founder and CEO at Spark Systems

In his book on decentralized finance, Kenneth unveils profound insights into this dynamic landscape. Kenneth's perspective on the evolving DeFi realm is truly enlightening, providing valuable understanding of trends, challenges, and opportunities. With his expertise and clarity, he demystifies DeFi's complexities, making it accessible to readers of all levels. A must-read for both novices and experts, Kenneth's book enriches our comprehension of this transformative space.

—Yi Ming Ng, CEO at Tribe

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How DeFi, Digital Assets, and Distributed Ledger Technology are Transforming Finance

Kenneth Bok

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Everyone who works towards the greater good

"Finance, at its best, does not merely manage risk, but also acts as the steward of society's assets and an advocate of its deepest goals. Beyond compensation, the next generation of finance professionals will be paid its truest rewards in the satisfaction that comes with the gains made in democratizing finance extending its benefits into corners of society where they are most needed. This is a new challenge for a new generation, and will require all of the imagination and skill that you can bring to bear. Good luck in reinventing finance. The world needs you to succeed."

—Professor Robert J. Shiller, Speech to Finance Graduates,
Finance and the Good Society

This book is dedicated to everyone working towards a more inclusive and efficient financial system.

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Acknowledgments

The creation of this book was a collaborative effort, enriched by the knowledge, support, and insights of many individuals and organizations. I extend my deepest gratitude to those who played a crucial role.

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Daniel Liebau: Thank you Dan for your support of this project. Your contribution to my journey in this DeFi path has been invaluable. I appreciate all the reports, introductions, and feedback you've sent my way.

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To my family, especially my mother, thank you for your love, encouragement, and understanding. Your belief in me has been a guiding force.

Timothy Draper, for being so generous with his time to speak at De/Centralize 2018 and writing the foreword for this book. The first time I had heard that Singapore was becoming a crypto hub was during an event at Draper University in San Mateo, California, back in 2014.

Special thanks to various professionals who have provided invaluable feedback and detailed commentary on the material, including Jeremy Kim, staff at the Monetary Authority of Singapore, and Lasse Clausen along with his team at 1kx.

Finally, thanks to all my colleagues, past and present, who supported me throughout this endeavor: Brandon Possin for editing and feedback on early chapters, Tim Han for previous support with De/Centralize, David Tan and Jennifer Lewis for constant encouragement and advice.

Glossary

There will be many terms that might be new to you if you are just starting out in DeFi. Crypto has a habit of reinventing itself semantically, and new terms like "web3" have emerged only recently. This can become even more confusing when we aim to cover both the crypto-native side and the regulated side of DeFi. To provide clarity, let me offer some definitions for the main terminology used in DeFi concerning assets and technology.

Blockchain: The underlying technology behind digital assets and crypto-assets. Examples: Bitcoin and Ethereum.

CeFi: Centralized Finance. These are crypto-native centralized exchanges and centralized yield platforms. They are predominantly custodial in nature. Sometimes also pointing to centralized TradFi.

Crypto: A general and informal term that commonly refers to cryptocurrency or crypto-assets. It traces its origins back to cryptography, the underlying technology that secures and encrypts these digital assets. Can also refer to the industry as a whole.

Crypto-asset: The most inclusive and general term used to describe various types of cryptographic assets. This encompasses both cryptocurrencies and utility tokens, representing a wide range of digital assets operating within the crypto ecosystem.

Cryptocurrency: A crypto-asset with specific functions as a currency within a smart contract network to pay for fees, or a crypto-asset such as Bitcoin whose dedicated function is to act as a money substitute. More commonly used than "crypto-asset," especially in the media.

DeFi: Decentralized Finance. From the Bank of International Settlements (BIS): "Decentralized Finance (DeFi) is a new financial paradigm that leverages distributed ledger technologies to offer services such as lending, investing, or exchanging cryptoassets without relying on a traditional centralized intermediary" (https://www.bis.org/publ/work1066.htm).

I define DeFi broadly as *DLT-based finance that replaces centralized databases and / or disintermediates centralized entities*. More relation to *crypto-native DeFi* but recently having relation with *DLT-enabled TradFi*, who has interest in *institutional DeFi*. A narrower definition of crypto-native DeFi would include elements of self-custody, uncensorability, and community-driven governance.

Digital Asset: A general term for any kind of asset represented on a distributed ledger. May or may not be regulated. Now often being used by the regulated world to differentiate from the speculative crypto side. Nonetheless encapsulates crypto-assets also.

Distributed Ledger Technology (DLT): The more general class of blockchains, some of whom may not have blocks or chains, and have different consensus mechanisms. Also a preferred term on the regulated side. Examples include: Corda.

"Distributed ledger technology (DLT) refers to the protocols and supporting infrastructure that allow computers in different locations to propose and validate transactions and update records in a synchronised way across a network." (BIS, https://www.bis.org/publ/qtrpdf/r_qt1709y.htm)

Token: Crypto-assets created on a specific blockchain (L1 / L2) such as Ethereum. For example, the ERC-20 token.

TradFi: Traditional Finance. The larger world of finance whose main nodes are central banks, commercial banks, and investment banks.

Web3: Another generalized collective term for the overarching vision of a decentralized, blockchain, and token-based internet. Where the Web2 is platform-based and centralized, Web3 is decentralized and uncensorable.

Foreword

Bitcoin holds promise. It is the promise of a wealthier world. The kind of wealth that changes everything for the people of the world. The kind of wealth that transforms the global economy to one that is faster, better, cheaper, and more frictionless than the one we have today. The kind of wealth that brings the people of the world together and allows them the freedom to operate with minimal hindrance from government regulation.

At the same time, Bitcoin holds the promise for better government. A government that can account for every profit, every transaction, and every asset without the need for more IRS agents. A government that keeps perfect records on the blockchain, so that everyone is treated fairly, and no one can cheat the system. A government that people can all be proud of: one that allows the trust and freedom of action to build a business without unnecessary restrictions or regulations, since the entire Bitcoin blockchain is perfectly transparent.

Bitcoin also holds great promise for the retailer and the shopper. A shopper that pays in Bitcoin can get a discount on the purchase, and the retailer can save on bank and credit card fees. Bitcoin and the blockchain will keep perfect records so the shopper and retailer will never have a dispute on what was purchased, when, and by whom.

Bitcoin holds great promise for the unbanked in society. The unbanked are also often the homeless, the weakest, the poorest, and the least hopeful. A Bitcoin economy can help the unbanked become a part of the global economy. The unbanked are those who have so little money that a bank cannot afford to open an account for them. Without an account, they cannot easily buy and sell anything, so they are hamstrung to operate with more friction and less technology. Bitcoin can change all that for them. A Bitcoin wallet can be opened for free. They can jump into the world economy with zero friction, and begin to get their life on a good wealthier path.

And Bitcoin holds great promise for a venture capitalist like me. I look forward to a time when I can raise money from LPs in Bitcoin, invest money in a startup in Bitcoin, have the startup pay their employees and suppliers all in Bitcoin, and have all the taxes computed and paid in Bitcoin. This walled

garden of business can allow perfect records without the need for an accountant, a bookkeeper, an auditor, a tax lawyer, a transfer agent, even a tax collector. Payments of return of capital and profits to LP investors and to the VC (GP) could all be done in a smart contract waterfall without the need of anyone in house checking the math. The entirety of that business could be frictionless, honest, and automated. The government would be paid, the investors would get exactly what is coming to them, and the cost of the operation could be decreased nearly entirely.

Bitcoin was and remains the origin of digital assets, DeFi, and distributed ledger technology. It combined cryptography, proof-of-work consensus mechanisms, and ingenious economic incentives to create the world's first decentralized digital asset independent of any government. It is no understatement to say that Bitcoin was the seed, and continues to be a vital part of the current ongoing revolution of the decentralization of finance.

A Bitcoin world is a world I want to live in. A wealthy world, a prosperous world, a trusting world, a free world, a fair world.

Enjoy Kenneth Bok's book. It will take you on a journey and teach you about the path to this great world we can envision together.

Timothy Draper
Founder, Draper Associates, DFJ,
and Draper University

Introduction

The genesis block of Bitcoin bears the inscription, "Chancellor on Brink of Second Bailout for Banks." This encoded message, imparted by Satoshi Nakamoto, signaled the advent of a paradigm shift in finance: distributed ledger technology. The distributed ledger transformation is not limited to crypto speculators; it is finally reaching the echelons of central banks and commercial banks.

Cryptocurrencies bear significant risk. The collapse of entities like FTX and Terra, coupled with extreme volatility and the largely unregulated nature of the crypto realm, suggest that it might not be an ideal investment avenue for the average consumer.

Despite these risks, the innovative technology behind cryptocurrency is undeniably powerful. It empowers anyone with internet access to transact and store their own crypto-assets, opening up promising possibilities for financial inclusion. It represents the precursor of an open, global financial system without intermediaries, operating 24/7 and challenging traditional financial structures, thus paving the way for a more accessible and inclusive financial landscape.

As we will explore, blockchain technology – more broadly referred to as *distributed ledger technology (DLT)* – is spearheading dramatic changes and advancements in finance. DLT enables for an efficient, secure, and interoperable financial ecosystem, enabling faster and more inexpensive experiences for consumers and businesses. Its potential to transform payments and capital markets is enormous, extending even to implications for geopolitical dynamics.

Decentralizing Finance: How DeFi, Digital Assets, and Distributed Ledger Technology Are Transforming Finance, First Edition. Kenneth Bok.

Decentralized Finance (DeFi) is finance operating on DLT. More accurately, I would define DeFi as DLT-based finance that replaces centralized databases and / or disintermediates centralized entities. In crypto-native DeFi, this definition may include self-custody, uncensorability, and community-based governance. In the regulated world of central banks and commercial banks, DLT is also playing a role in Central Bank Digital Currencies (CBDCs), tokenized assets, tokenized bank deposits, and institutional DeFi.

This book aims to unravel the complex world of DeFi and explore its transformative impact on finance, preparing finance and investment professionals for the future ahead.

I.1 Who Am I?

Allow me to introduce myself and how I came about writing this book.

My career began at Goldman Sachs in London, where I worked as an exchange-traded fund (ETF) trader on the Program Trading desk. My role involved using algorithms to hedge the firm's exposure to Eurozone ETFs in futures and equities markets, as well as executing orders for clients. Coincidentally, I bore witness to the unfolding of the global financial crisis in 2008 right from the trading floor. This first-hand experience with the global financial system's flaws sparked in me a conviction that substantial improvements can be made in the realm of finance.

My journey into the world of digital assets commenced in 2014, when I began researching Bitcoin and bought it for the first time. This exploration fortunately led me to invest in the Ethereum crowdsale, and also into investing my Ether into other Layer 1 platforms such as Cosmos and Tezos. Additionally, I organized a conference called De/Centralize in Singapore in 2018, bringing many world-class innovators in the industry to my home country.

Subsequently, I served as Head of Growth and Strategy at Zilliqa, a Singapore-based Layer 1 blockchain platform. During my time there, I led ecosystem and business development, supporting developers and startups looking to build on Zilliqa. I also spearheaded FinTech and DeFi strategy, fostering collaborations with FinTechs such as Xfers, which launched Singapore's first stablecoin, and HG Exchange, a regulated security token exchange.

I currently run my own boutique DeFi / FinTech advisory company Blocks.sg. I'm also an active trader and angel investor in the crypto and DeFi space. Since 2014, I've executed various strategies such as arbitrage, yield farming, and relative value in the DeFi space. On the long-only side, I've participated in numerous crowdsales, angel investments, and other kinds of advisory engagements. I'm also a pro bono mentor with R3, a leading financial DLT. Please reach out if you're building something interesting in the DeFi / FinTech space via my website: kennethbok.com

I.2 How This Book Is Organized

This book is organized into two main parts: *Crypto-native DeFi* and *DLT in Traditional Finance*.

Part I, *Crypto-native DeFi*, explores DeFi in its native setting: public blockchains on the internet. It operates in an unregulated environment, characterized by high risk, yet fosters remarkable innovation, global accessibility, and operates at a rapid pace.

Chapter 1, *What Is DeFi?*, provides an introduction to what DeFi is, offering a broad, top-down perspective and its unique characteristics, together with an examination of its size, key participants, and an exercise for you to try it yourself.

Chapter 2, *Infrastructure and Instruments*, examines the infrastructure of DeFi, with a focus on Ethereum. Basics of blockchains, cryptography, the difference between Bitcoin and Ethereum, L1s and L2s, how transactions work in DeFi, smart contracts, and types of crypto-assets.

Chapter 3, *Activities and Applications*, explores actual DeFi applications that run on L1s and L2s. Understanding how payments, trading, investing, lending, and borrowing work in DeFi. Delving into aggregation, governance/DAOs, real-world assets, and examining relevant case studies.

Chapter 4, *Risks and Mitigation*, discusses cybersecurity, software, operational and financial risks associated with DeFi and how they can be mitigated. It includes case studies. It considers the risks endemic to DeFi and the risks that DeFi poses to the broader financial system, from a global regulatory perspective.

Chapter 5, *Regulation*, considers the vital role that regulation plays in shaping DeFi's evolution. Considering DeFi's global nature, our focus lies on key standard-setting bodies like the BIS, FSB, IOSCO, and significant jurisdictions such as the US and EU. Additionally, we delve into DeFi-specific regulations related to stablecoins and decentralized exchanges.

Part II, *DLT in Traditional Finance*, delves into how DLT is being implemented by commercial banks, central banks, and other financial institutions in the highly regulated and supervised financial world, which transacts in volumes significantly larger than that of crypto-native DeFi. While innovation may move at a slower pace, this environment offers much greater integrity, stability, and consumer and business protection.

Chapter 6, *Central Bank Digital Currencies (CBDCs)*, views how CBDCs represent a highly significant development that holds the potential to transform the base layer of digital money, consequently reshaping the landscape of finance as we currently know it. The chapter includes historical context, central bank motivations for CBDCs, comparisons between retail and wholesale CBDCs, analysis of their benefits and risks, central bank preferences for

permissioned DLT, and highlights developments in Nigeria, the United States, and China regarding CBDC adoption.

Chapter 7, *Asset Tokenization*, notes how nearly any kind of financial asset can be tokenized on a DLT. We explore the what, why, and how of asset tokenization, understanding its significance and implications. We also look at the impact of DLT on capital markets, across five different segments: primary markets, secondary trading, clearing and settlement, custody, and asset servicing.

Chapter 8 considers *Deposit Tokens*, which refer to commercial bank deposits represented on a DLT. In this discussion, we distinguish between CBDCs, stablecoins, e-money, and deposit tokens, understanding their unique characteristics and roles. Additionally, we explore the advantages of deposit tokens and explore case studies on deposit token projects, including the Regulated Liability Network (RLN) and initiatives from Onyx by JP Morgan.

Chapter 9, *Institutional DeFi,* investigates the ongoing efforts of central banks and commercial banks in piloting DeFi innovations within a regulated environment. We delve into how they are integrating automated market makers (AMMs), smart contracts, CBDCs, tokenized deposits, and tokenized assets. Our exploration includes considerations for institutions seeking to participate in DeFi, along with examples of pilots. Additionally, we explore FX as a key asset class for AMMs and examine the BIS's concept of a Unified Ledger.

Chapter 10, Conclusion, provides an overview of the current DeFi situation and looks ahead to what the future of DeFi might be.

I.3 Scope of This Book

A brief note on the scope of this book, taking into account the wide-ranging topics of finance, technology, law, and regulation we are going to cover.

I.3.1 In Scope

1. *All types of DLT*: This includes both public blockchains and permissioned DLT.
2. *All types of finance*: This encompasses traditional finance and crypto finance, both regulated and unregulated.
3. *Infrastructure, applications and technology*: While it is impossible to encompass every aspect within this domain, I have endeavored to address the most significant themes and core technologies of DeFi.
4. *Law and Regulation*: The legal and regulatory landscape plays a central role in shaping the future prospects of DeFi. Recognizing the complexity of individual country specifics, I have taken a high-level approach to address the overarching themes in this domain.

I.3.2 Out of Scope

1. *Non-financial applications of DLT*: While DLT holds potential across various domains, such as supply chain management, healthcare, and transport, this book focuses solely on DLT applications within the finance-related context. Non-financial applications of DLT are considered out of scope for this work.
2. *Non-financial Web3 applications*: The emerging Web3 certainly has many overlaps with crypto-native DeFi, such as social media and gaming. In order to focus on our finance theme, this is also out of scope for this book.

I.4 Disclaimers

1. *No endorsement of specific DeFi apps*: The mention of any specific DeFi apps or crypto-assets are for educational purposes and do not constitute endorsements.
2. *Rapidly changing information*: The information in this book is subject to change quickly. The volatile, highly innovative and dynamic nature of crypto may mean that things mentioned in the book could be different by the time you read them.
3. *Author's positions*: At the time of writing, I may have positions in crypto-assets and some of the startups mentioned in the book. I hold a position in Credix, and I may also have some holdings in Bitcoin and Ether.
4. *Not financial advice*: This book is not financial advice. Please do your own research. The author takes no responsibility for any investment decisions or outcomes made based on the information provided.
5. *Views of the author only*: The views expressed in this book are solely those of the author and do not represent the views of any other organization, including any organizations mentioned.

I.5 Corrections

Please contact me at ken@blocks.sg for any corrections to the material.

Part I

Crypto-native DeFi