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DeFi

AND THE

Future *of* Finance

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DeFi and the FUTURE of FINANCE

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FOREWORD

DeFi is a cute acronym for “decentralized finance,” but it obfuscates its true potential: a new financial system built from the ground up. While DeFi is small today—containing, as of this writing, tens of billions of dollars in assets relative to the hundreds of trillions in the traditional financial system—it is growing rapidly. And while its rise will take decades, I believe DeFi will be the primary financial system of the world.

Why? DeFi is a true “internet of money.” The internet showed the power of a universal, open network for information. In 40 years the idea of a similarly open, global network for value transfer will seem obvious, which makes this a truth hiding in plain sight today.

As with any new technology, crypto and the new decentralized financial system built atop it will be different from its old-world analogue. DeFi is unique relative to the traditional financial system because it is permissionless, open access, global, composable, and transparent. No longer are centralized institutions needed for basic financial actions. In DeFi, you can be your own bank and get credit from code on a blockchain—no institution required!

Yet so little of the infrastructure of this ecosystem has been built. We are perhaps 1 percent, likely less, into DeFi as a phenomenon. A burgeoning ecosystem of developers around the world is currently constructing the financial building blocks of tomorrow. At our crypto investment firm Paradigm, we often ask ourselves, “If there were a periodic table of financial primitives, what has been built today and

what is left to fill in?” That is the opportunity for entrepreneurs.

DeFi, like the internet, will likely make financial services cheaper, faster, secure, personalized, and more. If YouTube grew the breadth of video content by orders of magnitude because it was free and easy for anyone to both create and use videos, what will DeFi do for financial products as it similarly allows anyone to create and use anything at near-zero cost?

That future has yet to be written. This book provides a peek into that future, and you, the reader, hold the power to create it.

Fred Ehrsam
Co-founder and Managing Partner, Paradigm
Co-founder, Coinbase

PREFACE

Decentralized finance (or DeFi) has always been a big part of what I hoped to see people build on Ethereum. Ideas around user-issued assets, stablecoins, prediction markets, decentralized exchanges, and much more had already been at the top of my mind as well as the minds of many others trying to build the next stage of blockchain technology in those special early days of 2013–14. But instead of creating a limited platform targeting a set of known existing use cases, as many others did, Ethereum introduced general-purpose programmability, allowing blockchain-based contracts that can hold digital assets and transfer them according to predefined rules, and even support applications with components that are not financial at all.

People in the Ethereum community started working on applications such as on-chain stablecoins, prediction markets, and exchanges almost immediately, but only after more than five years did the ecosystem truly start to mature. I believe that DeFi will create a new, easy-to-use and globally accessible financial system for the world. For example, applications like stablecoins are some of the most valuable innovations to come out of DeFi so far. They allow anyone in the world to benefit from the censorship resistance, self-sovereignty, and instant global accessibility of cryptocurrency while having the purchasing power stability of the dollar—or, if the dollar ever stops being stable, they enable people to quickly move their funds into another asset that does a better job of maintaining stability.

So why is DeFi important? Financial censorship continues to be a problem for marginalized groups, with restrictions and imposed hardships often going far beyond what is actually required by any law. This is doubly true once we

start looking beyond the relatively safe bubble of developed countries. DeFi greatly reduces the cost of experimentation, making it much easier to build a new application, and smart contracts with verifiable open-source code greatly reduce the barrier of needing to trust the founding team to manage funds. DeFi offers “composability,” allowing new applications to easily and immediately interoperate with any other applications that already exist. These are serious improvements over the traditional financial system, and ones that I believe remain under-appreciated.

In the book *DeFi and The Future of Finance*, the authors discuss many of the additional improvements DeFi offers over the traditional financial system. The authors also explain the in-depth workings of many of the most important DeFi protocols today, including stablecoins, automated market makers, and more. I recommend this book to anyone interested in learning more about Ethereum and DeFi protocols.

Vitalik Buterin
Co-founder of Ethereum

I INTRODUCTION

We have come full circle. The earliest form of market exchange was peer to peer, also known as barter.¹ Barter was highly inefficient because supply and demand had to be exactly matched between peers. To solve the matching problem, money was introduced as a medium of exchange and store of value. Initial types of money were not centralized. Agents accepted any number of items such as stones or shells in exchange for goods. Eventually, specie money emerged, a form in which the currency had tangible value. Today, we have non-collateralized (fiat) currency controlled by central banks. The form of money has changed over time, but the basic infrastructure of financial institutions has not.

However, the scaffolding is emerging for a historic disruption of our current financial infrastructure. DeFi, or decentralized finance, seeks to build and combine open-source financial building blocks into sophisticated products with minimized friction and maximized value to users utilizing blockchain technology. Given it costs no more to provide services to a customer with \$100 or \$100 million in assets, we believe that DeFi will replace all meaningful centralized financial infrastructure in the future. This is a technology of inclusion whereby anyone can pay the flat fee to use and benefit from the innovations of DeFi.

DeFi is fundamentally a competitive marketplace of decentralized financial applications that function as various financial “primitives” such as exchange, save, lend, and tokenize. These applications benefit from the network effects of combining and recombining DeFi products and

attracting increasingly more market share from the traditional financial ecosystem.

Our book details the problems that DeFi solves: **centralized control, limited access, inefficiency, lack of interoperability, and opacity**. We then describe the current and rapidly growing DeFi landscape and present a vision of the future opportunities that DeFi unlocks. Let's begin with the problems.

FIVE KEY PROBLEMS OF CENTRALIZED FINANCIAL SYSTEMS

For centuries, we have lived in a world of centralized finance. Central banks control the money supply. Financial trading is largely done via intermediaries. Borrowing and lending are conducted through traditional banking institutions. In the last few years, however, considerable progress has been made on a much different model: decentralized finance. In this framework, peers interact with peers via a common ledger not controlled by any centralized organization. DeFi offers considerable potential for solving the following five key problems associated with centralized finance: centralized control, limited access, inefficiency, lack of interoperability, and opacity.

1. ***Centralized Control.*** Centralization has many layers. Most consumers and businesses deal with a single, localized bank, which controls rates and fees. Switching is possible, but it can be costly. Further, the U.S. banking system is highly concentrated. The four largest banks have a 44 percent share of insured deposits compared with 15 percent in 1984.^{[2](#)} Interestingly, the U.S. banking system is less concentrated than other countries, such as the United Kingdom and Canada. In a centralized banking system,

one consolidated entity attempts to set short-term interest rates and to influence the rate of inflation.

This phenomenon reaches beyond the legacy financial sector to tech players like Amazon, Facebook, and Google, who now dominate industries like retail sales and digital advertising.

2. **Limited Access.** Today, 1.7 billion people are unbanked, making it very challenging for them to obtain loans and to operate in the world of internet commerce. Further, many consumers must resort to payday lending operations to cover liquidity shortfalls. Being banked, however, does not guarantee access. For example, a bank may not want to bother with the small loan that a new business requires. Instead, it may suggest a credit card loan, which carries with it a borrowing rate well above 20 percent per year – a high hurdle rate for finding profitable investment projects.
3. **Inefficiency.** A centralized financial system has many inefficiencies. Perhaps the most egregious example is the credit card interchange rate that causes consumers and small businesses to lose up to 3 percent of a transaction's value with every swipe due to the payment network oligopoly's pricing power. Remittance fees are 5–7 percent. Time is also wasted in the two days it takes to “settle” a stock transaction (officially transfer ownership). In the Internet age, this seems utterly implausible. Other inefficiencies include costly (and slow) transfer of funds, direct and indirect brokerage fees, lack of security, and the inability to conduct microtransactions, many of which are not obvious to users. In the current banking system, deposit interest rates remain very low and loan rates high because banks need to cover their brick-and-

mortar costs. The insurance industry provides another example.

4. ***Lack of Interoperability.*** Consumers and businesses deal with financial institutions in an environment that locks interconnectivity. It is well-known that the U.S. financial system is siloed and designed to sustain high switching costs. Moving money from one institution to another can be unduly lengthy and complicated. For example, a wire transfer can take three days to complete.

In an attempt to mitigate this issue within the world of centralized finance, in 2019 Visa tried to acquire Plaid,³ a product that allows any company to plug into an institution's information stack with the user's permission. Though this was a strategic move to help Visa buy some time, it did not address the fundamental problems with the current financial infrastructure.

5. ***Opacity.*** The current financial system is not transparent. Bank customers have very little information on the financial health of their bank and instead must place their faith in the limited government protection of FDIC insurance on their deposits. Further, it is difficult for them to know if the rate they are offered on a loan is competitive. Although the consumer insurance industry has made some progress with fintech services that offer to find the “lowest” price, the loan market is very fragmented – yet competing lenders all suffer from the system's inefficiencies. The result is that the lowest price still reflects legacy brick-and-mortar and bloated back-office costs.

IMPLICATIONS

The implications of these five problems are twofold. First, many of these costs lead to *lower economic growth*. For example, if loan rates are high because of legacy costs, high-quality investment projects may be foregone, as explained previously. An entrepreneur's high-quality idea may target a 20 percent rate of return – precisely the type of project that accelerates economic growth. If the bank tells the entrepreneur to borrow money on their credit card at 24 percent per year, this seemingly profitable project may never be pursued.

Second, these problems perpetuate or exacerbate *inequality*. Across the political spectrum, most people agree there should be equality of opportunity: a project should be financed based on the quality of the idea and the soundness of the execution plan and not by other factors. Importantly, inequality also limits growth when good ideas are not financed. Though purported to be the land of opportunity, the United States has one of the worst records in migrating income from the bottom quartile to the top quartile.⁴ Inequality of opportunity arises, in part, from lack of access to the current banking system, reliance on costly alternative financing such as payday lending, and the inability to buy or sell in the modern world of e-commerce.

These implications are far-reaching, and, by any calculations, this is a long list of serious problems endemic to our current system of centralized finance. Our financial infrastructure has failed to fully adapt to the digital era in which we are living. Decentralized finance offers new opportunities. The technology is nascent, but the upside is potentially transformational.

Our book has multiple goals. First, we identify the weaknesses in the current system, including discussion of some early initiatives that challenged the business models of centralized finance. Next, we explore the origins of

decentralized finance. We then discuss a critical component of DeFi: blockchain technology. Next, we detail the solutions DeFi offers and couple this with a deep dive on some leading ideas in this emerging space. We then analyze the major risk factors and conclude by looking to the future and attempt to identify the winners and losers.

NOTES

1. See Alan White, “David Graber's Debt: The First 5000 Years,” *Credit Slips*, June 24, 2020, <https://www.creditslips.org/creditslips/2020/06/david-graebers-debt-the-first-5000-years.html>.
2. Dean Corbae and Pablo D'Erasmus, “Rising Bank Concentration,” Staff Paper #594, Federal Reserve Bank of Minneapolis, March 2020, <https://doi.org/10.21034/sr.594> .
3. *Plaid*, <http://plaid.com>.
4. R. Chetty, N. Hendren, P. Kline, and E. Saez, “Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States,” *Quarterly Journal of Economics* 129, no. 4 (2014): 1553–1623; Amber Narayan et al., *Fair Progress?: Economic Mobility Across Generations Around the World, Equity and Development*, Washington, DC: World Bank, 2018.

II

THE ORIGINS OF MODERN DECENTRALIZED FINANCE

A BRIEF HISTORY OF FINANCE

Even as today's financial system is plagued with inefficiencies, it is far better than those of the past, where market exchanges were peer to peer and bartering required two parties' needs to match exactly. Out of this, an informal credit system emerged in villages whereby people kept a mental record of “gifts.”^{[1](#)}

Modern coinage came much later, first emerging in Lydia around 600 BCE and providing what we think of as today's functions of money: unit of account, medium of exchange, and store of value. Important characteristics of money included durability, portability, divisibility, uniformity, limited supply, acceptability, and stability. Bank notes, originating in China, made their way to Europe in the thirteenth century.

Nonphysical transfer of money originated in 1871 with Western Union. [Figure 2.1](#) shows a copy of an early transfer for \$300. Notice how the fees amount to \$9.34, or roughly 3 percent. It is remarkable that so little has changed in 150 years: money transfers are routinely more expensive, and credit card fees are 3 percent.

[Form B.]

WESTERN UNION TEL. CO.

TELEGRAPH TRANSFER. No.

RECEIVED of *C. C. Antoine*

to be paid to *Three Hundred*

at *Jas H Ingraham*

New York

Dated at *New Orleans Aug 25* 1873

Amount of Transfer, \$ *300 00*

* Premium 1 per cent. *3.00*

Cost of Telegram, *6.34* TOTAL, \$ *309 34*

*No Premium will be less than 25 Cents.

WESTERN UNION
Telegraph Office
AUG 25 1873
37 CENTS
100

MANAGER.

Figure 2.1 Western Union transfer from 1873

Source: Western Union Holdings, Inc.

The last 75 years has seen many firsts in the financial world: credit card in 1950 (Diners Club); automated teller machine (ATM) in 1967 (Barclays Bank); telephone banking in 1983 (Bank of Scotland); Internet banking in 1994 (Stanford Federal Credit Union); radio-frequency identification (RFID) payments in 1997 (Mobil Speedpass); chip-and-pin credit cards in 2005 (Mastercard); and Apple Pay with a mobile device in 2014 (Apple).

Importantly, all these innovations were built on the backbone of centralized finance. While there have been some technological advances, the structure of today's banking system has not changed much in the past 150 years. That is, digitization still supported a legacy

structure. The high costs associated with this legacy system has spurred further advances known as *fintech*.

FINTECH

When costs are high, innovation will arise to capitalize on inefficiencies. Sometimes, however, a powerful layer of middle people can slow this process. An early example of decentralized finance emerged in the foreign currency (forex) market 20 years ago. At the time, large corporations used their investment banks to manage their forex needs. For example, a U.S.-based corporation might need €50 million at the end of September to make a payment on some goods purchased in Germany. Its bank would quote a rate for the transaction. At the same time, another client of the bank might need to sell €50 million at the end of September. The bank would quote a different rate. The difference in the rate is known as the spread – the profit the bank makes for being the intermediary. Given the multitrillion-dollar forex market, this was an important part of bank profits.

In early 2001, a fintech startup offered the following idea.^{[2](#)} Instead of individual corporations querying various banks to get the best rate, why not have an electronic system match the buyers and sellers directly at an agreed upon price and *no* spread? Indeed, the bank could offer this service to its own customers and collect a modest fee (compared with the spread). Furthermore, given that some customers deal with multiple banks, it would be possible to connect customers at all banks participating in the peer-to-peer network.

You can imagine the reception. The bank might say: “Are you telling me we should invest in an electronic system that will cannibalize our business and largely eliminate a very