ONE RATE *to rule* THEM ALL

THE TREEHOUSE PROTOCOL

BRIDGING THE FIXED INCOME GAP IN DIGITAL ASSETS

BRANDON GOH

GAIA
RESEARCH
REPO
HYPERION
TRHX
ESR
TREEHOUSE

One Rate to Rule Them All

First published in Singapore in 2024 by
Treehouse Analytics Pte Ltd
treehouse.finance

eISBN: 978-981-94-0393-6

ONE RATE *to rule* THEM ALL

THE TREEHOUSE PROTOCOL
BRIDGING THE FIXED INCOME GAP IN DIGITAL ASSETS

BRANDON GOH

Contents

Prologue

In Liu Cixin's science fiction novel *The Dark Forest*, the ‘Dark Forest’ is a chilling metaphor for a universe where intergalactic civilizations must hide to avoid detection by hostile aliens. In the early days of Decentralized Finance (DeFi), the term was adopted by online communities to describe the perilous landscape of the blockchain—a realm where even the slightest misstep can awaken predatory bots that exploit vulnerabilities at any instance.

The term also inspired the name of one of Ethereum’s earliest games in 2019 and was subsequently mentioned in Paradigm’s 2020 medium article “Ethereum is a Dark Forest.” During my time at Morgan Stanley, ‘Dark Forest’ even made its way to the trading floor, serving as the code word for DeFi among a group of crypto enthusiasts.

Amidst the chaos of the 2020 DeFi summer, a group of friends and I, coming from both web2 and traditional finance, connected over our passion for crypto. Frustrated by the lack of solutions, we took matters into our own hands and developed our own Portfolio Management System (PMS) to track our positions. Recognizing the value of our system, we launched Treehouse—a name symbolizing a safe haven for crypto traders navigating the ‘Dark Forest.’ Through several iterations, our tool evolved into one of the world’s most sophisticated on-chain risk analytics systems, capable of querying any wallet's historical data and risk attribution across 400 protocols.

The past four years have been fruitful and hectic for Treehouse. Fruitful—as the firm grew to over 70 employees, raised $18 million in capital, and integrated over thirty data widgets into Hyperion, our institutional platform. Hectic—as we blitzed the space as one of the fastest growing infrastructure start-ups, experienced the growing pains of scaling, and weathered numerous crises. In 2022, the fall of industry titans like LUNA and FTX cast a heavy cloud over an industry already battered by inflation and tightening policy. Few foresaw this, and certainly not at the speed and scale. The drastic collapse drove many institutions away from crypto over the past two years, making it tough for digital asset companies. Despite the challenging environment, we saw an opportunity. At the core, Treehouse's mission is to build crypto infrastructure. In the aftermath of the market's tumult, we set out to address one of the most critical issues in the cryptocurrency market today—the absence of reference rates.

This book serves as the thesis for the Treehouse Protocol, our implementation of Treehouse Assets *(tAssets)* and Decentralized Offered Rates *(DOR)*. It is also a direct call for readers to join us in shaping a new digital asset ecosystem. Taking inspiration from political philosophy, traditional finance, and the principles of trust-minimization, *One Rate To Rule Them All* makes the case that a decentralized crypto benchmark rate can help to mature the digital asset financial markets and provide a springboard for meaningful institutional adoption. Part 1 focuses on the philosophical and historical context leading up to the advent of blockchain, while Part 2 dives into the current state of fixed income in crypto. Readers interested in the concepts of 'risk-free' in crypto and the Treehouse Protocol may directly jump to Parts 3 and 4 or to the technical paper.

Introduction

A Digital Asset Benchmark Rate

"

Even in this slightly less ambitious form – acting as an innovative irritant to incumbents and traditional technologies – cryptocurrencies and blockchain technology have already prompted real change and can continue to do so.

— Gary Gensler

Few innovations today rival the transformative potential of blockchain, yet adoption of the technology has been slow due to its inherent complexities. Since Bitcoin's founding in 2009, however, significant steps have been taken to reduce these technical barriers. One of the earliest breakthroughs in accessibility was the Grayscale Bitcoin Trust (GBTC). Launched in 2013, GBTC pioneered blockchain investing through the structure of a closed-end unit trust, one recognizable to the average investor. Within four years, the trust successfully amassed over $1 billion in assets under management (AUM). At the same time, Venture Capital (VC) interest surged, fueling adoption in the mid-to-late 2010s by funding innovations that laid the foundations of digital assets like Ethereum and Centralized Exchanges (CEX).

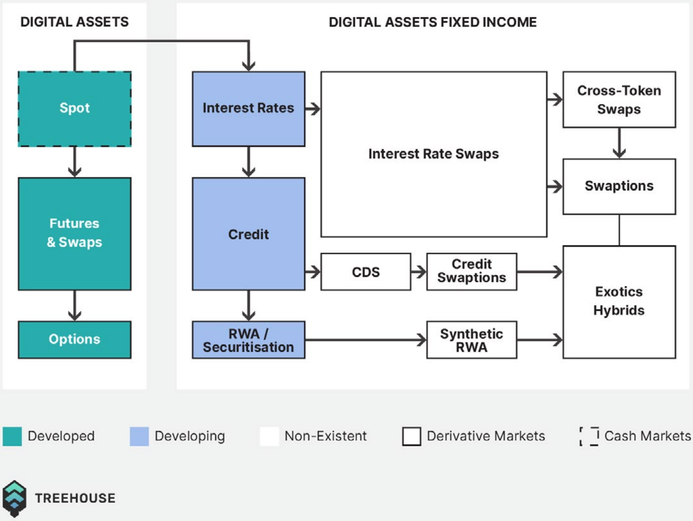
Figure 1: **Wojak's "Institutional Money Coming!" Meme**

TREEHOUSE

Despite the remarkable progress in institutional adoption, retail investors continue to dominate crypto activity up to this day. Many important eras in the industry, such as the 2017 Initial Coin Offering (ICO) frenzy and the 2020 DeFi summer, were primarily fueled by retail participation. Although the landscape is evolving, institutional involvement has remained relatively subdued; entry and timing into the more esoteric parts of the sector remains uncertain. For the early few that have entered the space, the focus has gravitated towards the more established and perceived safer facets of the technology, such as Real World Asset (RWA), Layer 2 (L2) infrastructure, and Zero-Knowledge (ZK), among others. Still, questions persist regarding the catalyst needed to breach the institutional threshold.

So far, the financial innovations witnessed in blockchain have closely mirrored the evolution of its traditional finance counterpart. Just as cash products like physical commodities and equity spot trading were among the first traditional finance innovations, spot trading emerged as the first offering in crypto. Similarly, derivative products like futures and options were relatively recent developments in traditional finance, and crypto markets have followed a similar trajectory, albeit at a much faster pace. But beyond these instruments, what could be the next possible leg of growth for the industry?

Figure 2: A Leading Indicator of the Stages of Growth for the Cryptocurrency Market



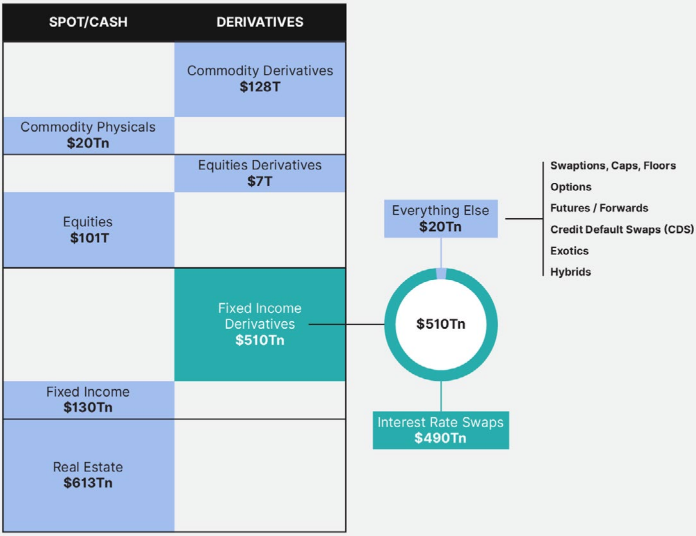
In the first half of 2024, institutional interest in Bitcoin surged, setting record inflows for the asset largely driven by the approval of Bitcoin Exchange Traded Funds (ETFs). However, expectations for institutions to expand their focus beyond benchmark cryptocurrencies in the near term remain modest. Deeper and more speculative segments of the technology, such as DeFi, are likely to be approached cautiously, if at all.

The flow of capital in greenfield investments typically starts from low to high beta, and the reality in crypto today is that institutions are only at the early stage where they are beginning to turn their attention from Bitcoin to Ethereum, the second largest digital asset. In anticipation of its own ETF approval, this flow of new capital would invariably open the door to institutions seeking opportunities for 'risk-free' returns on both assets, with fixed income emerging as the next logical step in institutional blockchain adoption.

Despite being one of the most important innovations in society, fixed income in crypto is still in its infancy compared to the traditional finance universe, where it reigns as the largest investable asset class—valued at over $620 trillion, six times larger than the equities market. In crypto, fixed income remains disproportionately underrepresented, with limited venues for retail investors and even fewer options for institutions to deploy capital meaningfully. In our view, the primary challenge to its growth is the absence of a consensus benchmark rate, a fundamental component of financial markets.

To unlock the fixed income market for digital assets, our team developed two new primitives over the past two years. First, *tETH*, a liquid restaking token (LRT) to converge the fragmented ETH interest rate on-chain markets. Second, the Treehouse Protocol, a decentralized consensus mechanism for benchmark rate setting that introduces Decentralized Offered Rates *(DOR)*. With *tETH* and *DOR*, we foresee a Cambrian explosion of new fixed income products emerging in digital assets, heralding a new era in cryptoeconomics.

Figure 3: **Fixed Income Sits as the Largest Asset Class in Traditional Finance**



Source: SIGMA, BIS, Statista. Values updated as of Nov 15, 2023

TREEHOUSE

1

The Smart Contract Theory

“

Man was born free, and he is everywhere in chains.

— Jean-Jacques Rousseau

To understand how blockchain can reshape the world, we need to start with the origins of society. Among the theories, one of the most widely cited is *Social Contract* Theory. The Greek philosopher Socrates first expounded on this concept in 400 B.C., notably expressed in Plato’s work *Crito*. Despite facing the death penalty in Athens, Socrates upheld the authority of the state’s legal system, viewing his compliance as part of an implicit contract forged with Athens, demonstrating his commitment to the collective good that transcends his personal interests.

It was only in the 16th and 17th century that *Social Contract* theory resurfaced through the works of philosophers like Thomas Hobbes, John Locke, and Jean-Jacques Rousseau. They each postulated various theories yet agreed that the social bonds formed between individuals made society possible. Like Socrates, Hobbes envisioned the *Social Contract* as an inherent choice. If humankind wanted to depart from the brutish *State of Nature*—a hypothetical world where humans lived in pure self-interest—we needed to abide by a *Social Contract*. Hobbes imagined the original cavemen forming rudimentary social norms, like refraining from violence, as the catalyst for the beginning of civilization.

Locke later expanded on Hobbes, presenting the *Social Contract* as the foundation for centralized government, influencing later political ideologies and even the founding of the United States. Similarly, Rousseau argued that society, by its nature, restricts individual freedom, but this restriction was necessary for the greater good and the protection of all members. His emphasis on the importance of popular sovereignty and the collective will of the people continues to resonate in debates about the nature of political authority and the principles of governance up to this day. As society evolved, these foundational principles morphed into explicit contracts, underpinning complex modern-day systems like money, legal frameworks, and governments today.

As we will explore, the emergence of *Smart Contracts*, enabled by blockchain technology, represents an evolutionary upgrade to the *Social Contract*. For the first time in history, programmatic code, supported by decentralized consensus mechanisms, can be used to supplant traditional societal contracts such as those governing modern-day government and currency: a new paradigm. As we will see in the subsequent sections, this is best showcased in how blockchain technology has reshaped society's understanding of money.

From Collectibles to Digital Currency

“

Well, Senator, a billion dollars just ain’t what it used to be.

— Nelson Bunker Hunt

The progression from the *State of Nature* to the creation of money reflects humanity's quest for efficiency and trust in economic transactions. Initially, the first humans relied on bartering to fulfill individual needs. Each specialized in different tasks and found reciprocity in trading goods and services through a social economy (read: contract). People carried on with their business, trading with neighbors and friends, but soon discovered its limitations. For barter to work, all parties needed to desire what the other possessed at the point of trade, a phenomenon known as the ‘double coincidence of wants.’ For example, for Wojak to trade for Derp’s unicorn, Derp needed to coincidentally want something of corresponding value from Wojak. This meant that viable trades often failed despite benefiting both parties.

Due to the inefficiencies that arose from barter, communities took forms of scarce and recognizable goods as universally accepted mediums of trust and convertibility, thus laying the first foundation of money. Initially, these goods, or commodity money, represented value and fostered efficient trading through the shared trust in the individuals using them. Over thousands of years, money evolved—from collectibles to inert metals, coins, and paper, and, more recently, through digital representations.

While money stands as one of humanity's most significant *Social Contracts*, not all money is created equal. Aristotle delved into this topic as early as 340 B.C. in *Nicomachean Ethic*, where he outlined the characteristics of sound money: durability, transferability, divisibility, fungibility, scarcity, and recognizability. The modern definition, articulated by the economists William Stanley Jevons and Karl Menger in the late 1800s, emphasized money’s essential features as a store of value, medium of exchange, and unit of account. In essence, ‘good’ money must endure, facilitate transactions effortlessly, and provide clear denominations for accounting purposes.

The pursuit of sound money is an exercise in optimization, and no leading currency has ever managed to embody all desirable attributes perfectly—not even the mighty U.S. Dollar. While the Dollar is durable, transferable, divisible, fungible, and recognizable, it is hardly scarce. Even in the unlikely setting of a prison cell, for example, cigarettes act as the better form of money for their durable, usable, and transferable features within the confines of a prison. However, like most widely used currencies throughout society, most face the same drawback—demanding either the trust in a physical form or the ceding of power to a centralized body.

Money Printer Goes "Brrrr"

"

History has shown us that we shouldn't rely on governments to protect us financially. On the contrary, we should expect most governments to abuse their privileged positions as the creators and users of money and credit for the same reasons that you might do these abuses if you were in their shoes.

— Ray Dalio

After two decades, the United States' presence in Afghanistan came to an abrupt end. Within twenty-four hours, the Taliban returned to the streets, overthrowing Kabul with little to no resistance. In terms of expenditure, the United States government poured an astonishing $2.313 trillion (for visualization purposes: $2,313,000,000,000) into the conflict over a span of twenty years, averaging $300 million per day. Such monumental spending deserves reflection. How do governments worldwide finance such large-scale operations? Spoiler: the modern monetary system.

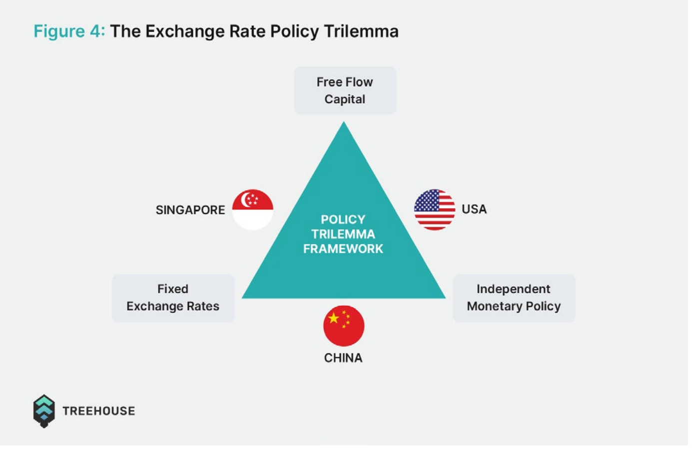
After a series of financial panics and scares, President Woodrow Wilson signed the Federal Reserve Act in 1913 to centralize the U.S.

banking system. Prior to this reform, private banks were responsible for printing the U.S. Dollar, issuing bank notes backed by precious metals. At its peak, several thousand private notes were in circulation, leading to frequent bank runs as the trust placed in these institutions was often misguided. The establishment of the Federal Reserve System aimed to rectify these issues. It was tasked by Congress to achieve three objectives for the people of the United States: to maximize employment, maintain stable prices, and moderate long-term interest rates. With these noble goals, the Fed set out in good spirit to pursue monetary policies over the years—protecting and bolstering its economy and citizens. In periods of financial duress, the Fed stepped in, combating economic stress and restoring the market to normalcy.

However, while the Fed's ability to cushion financial crises was good, its tools were also susceptible to misuse. By the 1970s, the United States government found itself in deficit amidst the Vietnam War and needed to sustain its spending. This was facilitated by borrowing money, essentially from itself. With the Bretton Woods system in place since World War II, an agreement made between forty-four nations to back the convertibility of gold to the U.S. Dollar, the government soon found itself printing more money than its gold reserves. Other nations saw the cracks in the Bretton Woods system and exited by converting their U.S. Dollar to gold. To 'save' the Dollar from a death spiral (LUNA, anyone?): President Nixon abandoned the gold standard in 1971, thereby turning the U.S. Dollar into fiat money. As the very translation of the Latin word 'fiat' suggests, fiat money had intrinsic value, 'by faith,' or just because.

While off-putting, this practice by the U.S. government made sense. When policymakers have unlimited money printers at their disposal to appease angry citizens, they simply keep "brrrr"ing. The same scenario usually plays out whenever policymakers need to intervene in crises—kicking the can down for the next nominee to worry about. Over the past forty years, this pattern unfolded during the Latin Debt Crisis, U.S. Savings and Loans Crisis, Russian Debt Crisis, Asia Financial Crisis, Subprime Mortgage Crisis, and the 2012 Taper Tantrum, to name a few.

The Policy Trilemma



Countries grapple with the policy trilemma as a result of the country's exchange rate, monetary policy, and foreign capital flow being intricately intertwined. The trilemma concept posits that monetary authorities can only control a maximum of two out of the three factors, rendering attempts to manage all three futile.

For instance, the Republic of Singapore maintains control over its exchange rates while welcoming capital flows. If the government decides to ease its monetary policy by reducing interest rates, this would trigger an outflow of foreign capital seeking higher returns elsewhere, leading to a corresponding decrease in demand for the Singapore Dollar and making the government's efforts to control their exchange rate ineffective.

In navigating the policy trilemma, nations worldwide adopt varying policy approaches tailored to their economic contexts. The United States, for example, prioritizes independent monetary policy and unrestricted capital flows over fixed exchange rates. This strategic alignment reflects the intricate balance countries strive to achieve amidst the complexities of the global financial markets.

For obvious reasons, the scenario described above is far from ideal for citizens who quickly witness the value of their currencies depreciate. All of a sudden, the cafe down the road that used to sell coffee for $2.80 now demands $4.70. But this is not a problem of the past: nearly 80% of all U.S. Dollars in circulation today were printed within the past four years. The magnitude of the problem is staggering: the U.S. Dollar 'M1' money supply, a key metric tracked by the Fed, surged to an all-time high of $20.6 trillion in March 2022—a fourteen-fold increase compared to January 1959. Moreover, the U.S. national debt now stands at a daunting $34.5 trillion, analogous to a medium-income family spending $20,000 more than its $70,000 annual income while already being $470,000 in debt.

Regrettably, this is not a problem unique to the U.S. History is littered with cases of governments resorting to printing money to cover deficits, which in turn causes spiraling inflation. Examples abound. Hyperinflation can be traced back to recent occurrences in countries like Zimbabwe in 2008, Germany in the 1920s, the French Revolution in 1795, China during the Yuan dynasty (1271-1368), and ancient Rome.

While history does not always repeat itself, it often rhymes. Persistent government debt woes frequently lead to currency devaluation, triggering capital flight. Governments naturally try to intervene: in some cases, they block the movement of capital entirely; in others, they indirectly make it harder to move wealth abroad, like banning investments in gold (or Bitcoin!). Policymakers have proven time and again to be unequipped to resolve the issue of spiraling debt, akin to the breaching of its *Social Contract* with its citizens.

Today, the U.S. Dollar remains the world's reserve currency, serving as a bastion against capital outflows and maintaining global faith in its system, bolstered by its economic prowess and, at times, geopolitical influence. Satoshi Nakamoto and his predecessors recognized the inherent flaws in centralized systems and diligently worked to develop an alternative solution.

Digital Money and Bitcoin

“

The root problem with conventional currency is all the trust that’s required to make it work. The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust. Banks must be trusted to hold our money and transfer it electronically, but they lend it out in waves of credit bubbles with barely a fraction in reserve. We have to trust them with our privacy, trust them not to let identity thieves drain our accounts.

— Satoshi Nakamoto

While money was a philosophical advancement for society, Bitcoin is a technological advancement for money. Born in 2009, Bitcoin’s concepts draw upon decades of cryptographic research. Its roots trace back to 1992, out of a mailing list of members known as the Cypherpunks, a remarkable community of individuals united by a shared concern over government overreach and digital censorship. The Cypherpunks were not just any group of cryptographers, however; dozens of its members would later go on to shape many critical computational discoveries—among them were industry visionaries like Marc Andreessen, the founder of SSL and HTTPS.

Recognizing the importance of privacy and autonomy in communication, the Cypherpunks embarked on developing a digital economy and currency, spurred by David Chaum's groundbreaking work on DigiCash in the 1980s. Back in 1985, Chaum put forth a dissertation on the first known blockchain protocol. While the company went bankrupt in 1998, its technology was revolutionary for its time, leaving a lasting imprint as the first payment system capable of enabling anonymous transactions.

E-gold: a digital attempt

Notably, the Cypherpunks were not the only ones building digital money. In 1996, Douglas Jackson and Barry Downey founded e-gold, a digital currency backed by gold coins. By 2009, e-gold had over five million unique users, but services were abruptly stopped when the U.S. government accused it of money laundering and the unlicensed operation of a money-transmitting business. The company ultimately went into a plea deal that required it to impose Know-Your-Customer (KYC) rules but had to shut down shortly after as it never got their licensing approval from the government.

Over the years, the Cypherpunks launched many other projects: MojoNation, a peer-to-peer payment system for distributed file sharing, Magic Money, and GhostMark, among others, but none really took off. Despite early setbacks, the Cypherpunks learned they needed to avoid both centralization and collateralization for their vision of digital money to work.

Three of the more critical Cypherpunk initiatives that laid the groundwork for Bitcoin were Hashcash by Adam Back in 1997, b-money by Wei Dai in 1998, and BitGold by Nick Szabo in 2005. Hashcash aimed to make email spam costly and resembled something like Bitcoin's Proof-of-Work (PoW) system; b-money and BitGold were only proposed in theory, but both used methods of distributing contracts among networks. Satoshi Nakamoto, the creator of Bitcoin, drew inspiration from these predecessors, even citing the latter two on the original Bitcoin website. In fact, prior to launching Bitcoin, he sought Wei Dai's help in reviewing his code. Then, on January 3rd, 2009, the first Bitcoin was mined.

Upon its launch in 2009, Bitcoin fell short of its most passionate supporters. It created, however, the first known trustless decentralized medium of exchange. Satoshi was keenly aware of the delicate balance required for the system's success and deliberately advocated for gradual adoption. When WikiLeaks proposed using Bitcoin as a form of donation on its website in 2010, Satoshi objected, stating: "The project needs to grow gradually so the software can be strengthened along the way [...] Bitcoin is a small beta community in its infancy. You would not stand to get more than pocket change, and the heat you would bring would likely destroy us at this stage."

Satoshi realized that for Bitcoin to be fully decentralized, he needed to disappear. In one of Satoshi's last emails, he, she, or it writes: "[I've] moved on to other things [...] It's in good hands." As Bitcoin gained traction, governments and regulatory bodies began expressing concerns about its disruptive potential, leading to various attempts to regulate or curb its usage—in 2013, the U.K. tax authority classified Bitcoin as private money, and nations like China have banned Bitcoin and crypto on at least nineteen occasions.

Over the years, adoption grew nevertheless, seeing the crypto-currency develop many of Aristotle's attributes of sound money and more. The Cypherpunks knew this all too well, as even the export of encryptions with more than 40 bits was banned and treated by the U.S. government as 'munition' until 1996 (encryption that could be easily brute-forced with any standard computer today).

Despite regulatory hurdles, Bitcoin's inherent nature ensured its resilience, echoing the Cypherpunks' vision of a currency beyond government control. Over time, Bitcoin flourished, as it simply could not be banned given its decentralized property: an attribute no other form of money had ever possessed, a concept overlooked by the great philosophers of past centuries.

On a technical level, Bitcoin successfully addressed the Byzantine Generals' Problem—a critical game theory problem that describes how difficult it is for dispersed parties to reach consensus without a trusted central authority. Yet, Bitcoin's defining characteristics extend beyond this achievement. Among others, Bitcoin is open-source, allows pseudonymity, and holds all of the attributes of Aristotle's sound money, with the exception of recognizability today. Tyler Winkerwoss, the founder of Gemini, underscored these points in his essay "The Case for $500K Bitcoin." In it, he compared Bitcoin to gold and the U.S. Dollar, demolishing the latter two in a challenge of scarcity, durability, portability, divisibility, counterfeitability, and security.

Figure 5: **The Iconic Reddit Advertisement on Bitcoin**

Source: Reddit, Feb 18, 2013

TREEHOUSE

The Smart Contract Model

“

Bitcoin is great as a form of digital money, but it's scripting language is too weak for any kind of serious advanced applications to be built on top.

— Vitalik Buterin

A few years after Bitcoin’s founding, a quirky and mathematically inclined individual by the name of Vitalik Buterin would frequent many of the Bitcoin conferences. Recognizing the need for a programmatic language to unlock the full potential of blockchain applications, Vitalik founded Ethereum, introducing the revolutionary concept of *Smart Contracts* to the world.

While Bitcoin created the first decentralized money, Ethereum created the first decentralized framework, proliferating the creation of all things: decentralized. Repicture Hobbes' *State of Nature*, but transposed into the digital realm: After previously only being able to barter for computer bits, the digital cavemen living now have digital money to transact. In the same vein, Ethereum’s emergence parallels the establishment of a digital society governed not by *Social Contracts* but by programmatic code.

Enabled by the *Smart Contract*, Ethereum fosters a trustless digital society where participation is voluntary and incentivized, free from coercive enforcement. Unlike traditional systems governed by centralized authorities, Ethereum allows its users to shape their own contracts through code without reliance on intermediaries.

At its core, Ethereum enables society to take out centralized intermediaries, often the Achilles' heel of many governance systems today. With it, blockchain can now enable not only money but also infrastructures such as storage (Filecoin), market-making (Uniswap), and beyond. When governed effectively, the benefits can be long-lasting, as seen in trailblazers like Maker and Compound.

In recent years, the adoption of blockchain and *Smart Contracts* in different domains has blurred the lines between individuals, institutions, and states—fostering an equal playing field where stakeholders adhere to a shared framework of rules while retaining the freedom to participate at will. Without a doubt, the advent of *Smart Contracts* represents the evolution of the *Social Contract*, offering a decentralized alternative to traditional governance.

In light of these advancements, we present a generic *Smart Contract* Model inspired by *Social Contract* philosophy to explain how *Smart Contracts* can facilitate decentralization in domains such as trading, governance, and, as we will see, fixed income.

General Model of The Smart Contract

Statement: **N** selects the mechanism for **D** to enforce **R** within **M**. By participating, **N*** implicitly supports **D**, which compels both **N*** and **N** to adhere to **R**. Where,

- **D:** A dynamic device of representation (e.g., the smart contract/code dictating **R**).

- **M:** The deliberative setting in which **D** enforces rules, principles, or norms (i.e., **R**).

- **N:** Individuals serving as representative choosers in the "device of representation," also known as model choosers, determining how **D** operates (e.g., those who write the code).

- **N*:** Individuals whose interactions are governed by the contract/ agreement specified by **D**, with a stake as model choosers to influence
- **R** according to the mechanisms outlined by **D**.

- **R:** Rules, principles, or norms dictated by **D**.

The *Smart Contract* Model introduces additional layers of implementation compared to the Social Contract. Utilizing D, an autonomous device of representation (the *Smart Contract*), both N and N* are obliged to adhere to R, dictated by D according to the mechanisms chosen by N, which can also be influenced by N*. Post-implementation, N* gains the ability to influence D to the same extent as N. Consequently, both N* and N share eventual responsibility in implementing R as dictated by D. The setting (M) determines how D implements R based on the mechanisms initially chosen by N.

In this model, individuals participating in the contract, whether initially N* or N, are no longer viewed as distinct from each other. Each participant holds an equal stake in influencing R based on the mechanisms outlined by D. D, the *Smart Contract*, and by extension, R, remain independent of other rules (R') set by additional model choosers (N'), such as legal systems, fiat conventions, or nation-states.

Both the *Social Contract* and *Smart Contract* acknowledge a higher authority or government, enabling societal functioning and appealing to Contractualist and Contractarianism principles. The paradigm shift in crypto lies in *Smart Contracts*' potential to serve as sovereign governing bodies. While blockchain technology has limitations, it can significantly improve outdated systems and conventions, such as those in the financial sector. Our implementation of the Treehouse protocol aims to establish a new social order catalyzing the digital assets fixed income market.

2

Fixed Income in Crypto

“

Bonds as an asset class will always be needed, and not just by insurance companies and pension funds but by aging boomers.

— Bill Gross

In Part 1, we explored a theory on the origins of money, proposing that society’s adoption of money arose from the inefficiencies of bartering. While other theories exist—some historians assert that credit, rather than barter, was the primary catalyst for the creation of money. Regardless of which theory one subscribes to, the introduction of credit, or the economic act of future favors, marked a pivotal moment in human history. With credit, individuals, businesses, and governments could borrow, facilitating increased spending, while lenders could earn returns on underutilized assets. This simple dynamic has solidified fixed income as a cornerstone of today’s financial markets—surpassing real estate and overshadowing both the equity and commodity markets, ranking it as the largest investible asset class in traditional finance.

As the title of this chapter suggests, Part 2 now delves into fixed income, the sector encompassing all investable assets classified as ‘risk-free’ and yield-bearing, hereon referred to interchangeably as 'credit,' 'debt,' ‘bond,’ ‘interest rates’ or 'borrowing and lending.' Before diving into the topic, let us briefly review the history of fixed income.

The History of Borrowing and Lending

“

Bond people pose the same problem to a cultural anthropologist as a non-literate tribe deep in the Amazon.

— Michael Lewis

Evidence of fixed income in historical records has been sparse, suggesting it may be a more recent phenomenon. Nonetheless, borrowing and lending likely existed since the earliest days of civilization, facilitated by reputational considerations and social repercussions within simple communities. If a caveman failed to return something of meaningful value, for example, the fear of getting sucker-punched by a neighbor was likely enough motivation to work on repayment. When scaled to the global economy, however, *Social Contracts* upholding the levees of credit become considerably more challenging to enforce, necessitating more explicit forms of contracts for the efficient functioning of the global debt markets.

While the concept of debt and financial agreements likely predates recorded history, the earliest known bond dates back to

2400 B.C. in Nippur, Iraq, where corn was used as currency. In ancient times, gain served as a common medium for loans, allowing borrowers to practically use what they borrowed to yield crops as repayment. By 1700 B.C., silver had supplanted grain as Mesopotamia's preferred medium of exchange. Due to its underlying nature, however, silver loans were problematic for the early borrowers. Unlike grain, silver metal could not directly yield more silver. In an effort to keep the credit markets functioning and to properly serve the complex needs of the economy, the 6th king of Babylon stepped in and issued a decree to centralize the price and borrowing rates of silver, establishing the first known interest rate convention in society.

Figure 6: The First Bond Recorded in History, Dating Back to 2400 B.C. in Nippur

Source: Surety

TREEHOUSE

From there, innovations in fixed income evolved gradually over centuries, with significant developments emerging around 300-400 B.C. In India, innovation took the form of letters of credit, facilitating sea-borne trade by insuring loans through third-party entities. Greece followed suit by pioneering collateralized loans, credit secured by underlying assets liable for seizure in the event of default. Later, in the

12th century, the first government loan was issued, marking a significant shift in financial history. Once government debt was established, it became the largest driver of the debt capital market, notably due to the hefty cost of wars—starting from Venice's prestiti in the 1100s, the Bank of England's first loan in the 17th century, to the issuance of the first U.S. Treasury bonds in 1917.

As recently as 2000 to 2007, the global fixed income market doubled in size, attributing its growth yet again to governments printing money to fund various projects. Today, nearly 60% of the global bond market consists of government debt. Underlying this development, the establishment of many market conventions in fixed income that was key to facilitating these periods of expansion.

Conventions in Fixed Income

“

It all comes down to interest rates. As an investor, all you’re doing is putting up a lump-sum payment for a future cash flow.

— Ray Dalio

Ever seen the mountain of legal covenants and disclaimers on an investment prospectus and decided to read it cover to cover? Most people’s answer would be no, the same reason that most bond portfolio managers—even those at the largest asset management firms—do not have the time to read the prospectus of every bond they purchase. Despite their length, each page in these prospectuses serves an important purpose in ensuring the modern fixed income market operates efficiently—painstakingly built by years of legal precedent and fundamentally backed by the same implicit and explicit contracts discussed in Part 1.

Consider a transaction involving a USD fixed income Tesla bond: all parties—the market maker, buyer, seller, and issuer—must collectively agree to the convention of pricing the bond as a spread over the closest active USD treasury bond, also referred to as the USD 'risk-free' rate (RFR). Whether the U.S. treasury bond curve is truly 'risk-free' or not (instances of near-default have occurred in recent years), it is as close to 'risk-free' any rate can get. Why? Because the U.S. government has the exclusive authority to print USD, and any resulting government default would precipitate larger, more systemic issues for society to worry about. Why assume the risk of Tesla, Inc. for any lower yield than the bond of the U.S. government when the U.S. government should inherently be safer? Or, put simply, why worry about the risk of default for Tesla in the apocalyptic event that the monetary system underpinning the U.S. government fails?

This convention holds global respect—USD-denominated fixed income instruments reference the U.S. treasury rate, while fixed income instruments in other currencies reference their respective government bond curves.

Figure 7: Major Global Risk-Free Rates

CURRENCY	SECURITY	MARKET SIZE	RISK-FREE RATE (1Y)	EXPLANATION
USD	US Treasury	$23 T	5.15%	Backed by the US government with the authority to print USD
EUR	German Bund	€12 T	3.15%	Backed by the European Central Bank and the stability of the Eurozone
JPY	Japanese Government Bond Yield (JGB)	¥1,200 T	0.05%	Supported by the Bank of Japan and Japan's monetary policy
GBP	UK Gilt	£2 T	4.42%	Backed by the Bank of England and the UK's monetary policy

Source: U.S. Department of the Treasury, Deutsche Bundesbank, Bank of Japan, Bank of England
Values updated as of May 2024

TREEHOUSE

Beyond ‘risk-free’ rates, the use of third-party private rating agencies is another widely accepted centralized convention in the fixed income market. Moody’s, S&P, and Fitch have cemented themselves as the de facto arbiters of creditworthiness today. As of June 2024, these institutions rate the U.S. government as Aaa (AAA) by Moody's, AA+ by Fitch, and AA+ by S&P Global Ratings, whereas Tesla, Inc. is rated lower at Baa3 by Moody's, BBB by Fitch, and BBB by S&P Global Ratings.

It is no market secret that rating agencies often react retrospectively to changes in creditworthiness and that the subprime mortgage crisis was partly driven by these agencies inflating the ratings of worthless bonds (a key driver that led to the Global Financial Crisis). Despite these shortcomings, investors, banks, and funds all over the world still heavily rely on these ratings.

Figure 8: **S&P, Moody’s, and Fitch — Credit Rating Scale**

Credit Risk ↓	CREDIT RATINGS		
	S&P	**Moody’s**	**Fitch**
	AAA	Aaa	AAA
	AA	Aa	AA
	A	A	A
	BBB	Baa	BBB
	BB	Ba	BB
	B	B	B
Speculative Grade	CCC	Caa	CCC
	CC	Ca	CC
	C	C	C
	D	D	D

Source: S&P, Moody’s, and Fitch

TREEHOUSE

The conventions do not stop here; fixed income history is rich with social and more explicit conventions, from market hours, quote conventions, and tick size to mandated settlement processes. The same principles extend beyond finance, too—societal systems worldwide rely on the collective trust in conventions to function. While nowhere perfect, as history has repeatedly shown, these standards are accepted as bearers of trust because society has embraced standardization for its role in enhancing productivity, efficiency, and convenience—key factors that have allowed the debt capital market to flourish.

The State of Crypto Fixed Income

"

Is a fixed income not a good thing?

Does not everyone love to count on a sure thing?

— Karl Marx

The current state of crypto fixed income can be effectively understood by comparing it to its traditional finance counterpart. While the verdict is clear (spoiler: crypto fixed income is still underdeveloped), the exercise is nevertheless useful.

A. Size

From a size perspective, both asset classes sit on different scales. Perhaps due to a several-thousand-year head start, one has a market value of over $600 trillion, while the other sits in the low double-digit billions. No prizes here for guessing which is which!

B. Product Innovation

What crypto fixed income lacks in size, it makes up for it in innovation. While limited mainly to products like overcollateralized loans or bilateral agreements, the former has been able to decentralize key aspects of the credit process, such as codifying clearing houses and enabling peer-to-peer (P2P) lending. Furthermore, the growth in crypto fixed income has been rapid, jumping through the product life cycles in months—the equivalent to centuries in traditional finance.

C. Volume and Liquidity

Inherently tied to its size, volume and liquidity for crypto fixed income products are tepid at best and monstrous for traditional finance. Consequently, pricing in the crypto space is fragmented, with most open interest bilateral in nature with little to no institutional participation.

D. Influence

Traditional finance fixed income is primarily governed by central banks and market dynamics. Crypto fixed income, in contrast, has no one-size-fits-all answer due to the diverse range of instruments and the absence of uniform standards.

A Spectrum: CeFi vs. DeFi

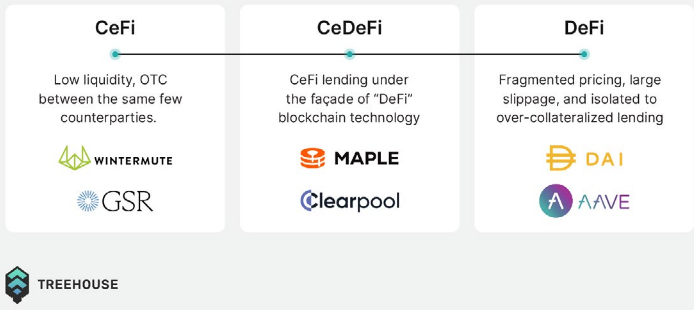
“

You have to understand decentralized finance, because it will be disruptive, and it very well may disrupt our industry, in our business in particular.

— Daniel Ivascyn

As previously highlighted, the adoption of fixed income within the crypto space has been slower compared to other asset classes. This delay primarily stems from the absence of essential infrastructure and the current limitations of *Smart Contracts*, challenges that the Treehouse Protocol was built to address. Despite these hurdles, participants still engage in borrowing and lending activities today, albeit in a more restricted manner compared to traditional finance and the other crypto asset classes. Within crypto, fixed income products can be classified along a spectrum based on their degree of centralization.

Figure 9: The State of Digital Assets Fixed Income



A. CeFi Fixed Income

The centralized approach to crypto borrowing and lending mirrors traditional finance practices grounded in legal precedents. Examples include market-makers, credit books, or hedge funds engaging in borrowing and lending with projects or one another through legal term sheets. Instruments that fall into this category encompass simple margin borrowing on CEX and over-the-counter (OTC) agreements between counterparties. Currently, the majority of crypto centralized fixed income transactions are bilateral in nature, characterized by unstandardized pricing. This setup resembles the ancient Mesopotamian market discussed in the previous section, where interest rates negotiated between parties follow the simple model of: "willing buyer (borrower), willing seller (lender)."

"CeDeFi," a hybrid under the façade of blockchain

Various fixed income instruments in crypto exist that hold properties of both sides of the spectrum. Under the hood, these agreements primarily rely on the same legal contracts and terms dictating our vanilla Tesla, Inc. bond example despite living on the blockchain. Maple Finance, for instance, uses the blockchain to facilitate the settlement of unsecured and secured loans to market-makers and hedge funds. For their credit model to work, Maple still depends on centralized bankruptcy remote brokerage accounts and prime brokers. In the event of default, such as Orthogonal Trading's failure to repay an unsecured loan in late 2022, Maple pursued recovery through traditional off-chain methods, including legal recourse.

B. DeFi Fixed Income

Instruments that predominantly operate on-chain, facilitated by Smart Contracts algorithmically defined by the interaction between loan demand and fund supply. Overall, the segment subsists in limited and fragmented ways, where the majority of instruments are restricted to simple agreements that can be facilitated as efficiently as in CeFi or traditional finance. At least until strong market conventions are established, the adoption of more complex on-chain credit systems like unsecured and under-collateralized lending remains distant.

Presently, the DeFi fixed income landscape is dominated by two primary models: Collateralized Debt Position (CDP) platforms like MakerDAO and lending protocols like AAVE. These platforms employ an over-collateralization model, with *Smart Contracts* acting as a decentralized clearing house. In the event of borrower default, sufficient collateral is held in escrow within the Smart Contract to cover the lender's losses, mirroring the historical evolution from trust-based credit systems to the over-collateralized model seen in traditional finance.

Case in Point. AAVE

Consider the largest on-chain borrowing and lending protocol AAVE: as of May 2024, lenders of the protocol's most liquid asset, ETH, receive 1.74% per annum (p.a.), while borrowers incur a variable 2.55% p.a., suggesting a mid-rate of 2.145% p.a. for ETH.

This contrasts sharply with traditional finance fixed income, where the spread between buying and selling the most liquid U.S. Treasury Bill is measured to a tick as tight as 1/128th of a point. Between lending protocols, interest rates vary greatly on the same asset, as depicted in Figure 10.

Figure 10: **ETH and USDC Defi Rates on Aave and Compound**

DEFI RATES	USDC			ETH		
	Supply	Borrow	Mid	Supply	Borrow	Mid
		3.495%			2.395%	
Aave V2	5.25%	7.26%	6.26%	1.19%	3.34%	2.27%
(30d realized)	3.32%	4.36%	-	-	-	-
Aave V3	4.73%	5.85%	5.29%	2.21%	3.35%	2.78%
(30d realized)	3.08%	3.87%	-	-	-	-
Compound	3.11%	4.05%	3.58%	1.44%	2.87%	2.16%
Average	4.36%	5.72%	5.04%	1.61%	3.19%	2.40%

Source: Aave, Compound, Arthur Hayes. Values updated as of Sep 2023

TREEHOUSE

In mature financial markets, capital flow typically starts with 'risk-free' and interest-bearing assets before migrating to higher beta instruments. However, the adoption of DeFi fixed income has been structurally the opposite, with retail investors leading the charge into the tail end of high-beta instruments. Beyond the two major categories mentioned, other DeFi fixed income solutions exist.

Pendle Finance, for example, pioneered the DeFi Separate Trading of Registered Interest and Principal of Securities (STRIPS), similar to the model used for Mortgage-Backed Securities (MBS) and U.S. Treasuries. Protocols like Exactly, Notional, and Yield also boast Total Value Locked (TVL). However, liquidity remains fragmented across these platforms, with wide pricing, bid-ask spreads, and high slippage, all due to the absence of standards or conventions between protocols.

Compared to traditional finance, where a single corporate issuer today can launch a bond offering equivalent to the TVL of the entire sector, crypto fixed income still has significant ground to cover. However, the progress made in this space is noteworthy, considering that it has already caught up with many aspects of traditional fixed income despite lacking essential infrastructures. As we will explore in Part 4, the implementation of Decentralized Offered Rates in crypto has the potential to unlock value across the full spectrum of fixed income assets.

3

Crypto Risk-Free Rate

“

I don't look to jump over seven-foot bars;

I look around for one-foot bars that I can step over.

— Warren Buffet

Imagine stepping into a newly erected skyscraper only to realize it was constructed by inexperienced 10-year-olds oblivious to building safety standards. Instinctively, you would yearn for the nearest exit. Whether the building’s foundation was fortified with reinforced concrete or the sturdiest steel in the world is irrelevant at this point—the concern lies in the absence of any standards to begin with!

Just as the foundation of a strong building is governed by its safety standards, the heart of a mature financial market lies in its benchmark ‘risk-free’ rate. In traditional finance, the ‘risk-free’ rate serves as a crucial metric for investors across asset classes and is used as the basis for pricing financial instruments, comparing returns, calculating the cost of carry, and much more. In crypto, no equivalent standard exists today, a missing layer that has hindered the overall growth of the space.

The ‘Risk-Free’ Case for Crypto

“

What Wall Street considers a “good” return will vary from year-to-year depending on what the yield on T-bills sits at. If the yield is zero, then taking risk and making a 5% annualized return is excellent. If the yield is 5%, then all of a sudden your efforts to take risk and still only capture a 5% return doesn’t look so hot. You could have received the same gain by throwing all your dough in T-bills and laying in a hammock on the beach all year.

— Tyler Craig

As emphasized in Part 2, the notion of a truly ‘riskless’ asset is a misnomer; risks are inherent in all aspects of life. However, society has recognized the importance of deriving a theoretical ‘risk-free’ return, evident in its widespread use in financial markets today.

Various academic methodologies exist to calculate this crucial benchmark. One approach involves the convergence of an asset's spot price and its corresponding futures contract, theoretically implying a ‘risk-free’ return for a specified time period through arbitrage. The formula, however, fails to capture the full nuances of the market, leading many investors to rely on alternative proxies in practice. Another popular method isolates and hedges out all tradable risks associated with an asset, revealing only its ‘risk-free’ component. In reality, the exercise becomes increasingly complex, especially when attempting to quantify non-tradable tail-end risks such as events like solar flares or the threat of nuclear war.

Over time, society has learned through collective input that a purely scientific approach to defining ‘risk-free’ is often impractical. Instead, the market has gravitated towards a preferred proxy, one rooted in social conventions and focused on elements that are sufficiently ‘risk-free’ yet also systemic, measurable, and practical.

In the case of the USD, the widely accepted ‘risk-free’ rate is the U.S. treasury curve’s yield to maturity (YTM). While not without its flaws, this convention persists because it assumes that the U.S. government's failure to honor its debt is both systemic and measurable.

‘Risk-Free’ through Implied Futures

The implied ‘risk-free’ rate method can be calculated using the cost of carry model when dealing with futures contracts.

$$\textbf{Implied rate} = (\textbf{Forward} / \textbf{Spot})^{1/\textbf{Time}} - 1$$

Where:

- **Forward** is the futures price.
- **Spot** is the spot price of the underlying asset.
- **Time** is the time until the expiration of the futures contract.

In the realm of digital assets, perspectives on what constitutes ‘risk-free’ vary considerably. Fiat-centric investors may lean towards the U.S. treasury curve, while native on-chain investors may view such attempts as contradictory to the ethos of DeFi. Regardless of perspective, the operation requires a blend of art and science.

To effectively propose a case for a crypto ‘risk-free’ rate, we must first establish a framework capable of classifying the spectrum of risk premiums present in crypto. Certain assumptions must also be made. First, the rate should ideally be independent of elements beyond crypto. This necessitates that a Bitcoin ‘risk-free’ rate, for instance, should only consider components within the Bitcoin ecosystem, avoiding reliance on external denominations or currencies. Second, drawing inspiration from traditional finance, we must identify what could serve as a sufficiently reliable equivalent to crypto's 'U.S. government,' recognizing the concept of ‘risk-free’ to be social, theoretical, and critical to enhancing productivity, efficiency, and convenience in the fixed income space.

Treehouse Crypto Risk Premia Framework

“

Risk premia stands for the expected return of an asset in excess of the risk-free rate of return. If a stock is expected to return 10% per annum (p.a.) while the risk-free rate is 2% p.a., the stock’s risk premium is 8% p.a.

— Treehouse Research

Risk and return are inherently linked, with any potential return contingent upon assuming certain risk premiums in an efficient manner. Even strategies commonly perceived as ‘risk-neutral,’ like arbitrage, are typically only market risk-neutral. Consider the scenario where ETH trades at a 2% price difference between two centralized exchanges; executing a simultaneous buy-low-sell-high trade would yield a market-neutral profit of 2%. The trader, however, is still exposed to certain inherent risks, such as the failure of withdrawal, settlement, or even a trade cancellation from either or both exchanges. Consequently, the 2% profit is paid out to arbitrageurs shouldering these risks, including but not limited to operational risks and Centralized Exchange (CEX) credit risks.

Figure 11: The Two Components That Make up Expected Returns

At the bottom of this section, we present Treehouse's Crypto Risk Premia Framework. As the framework can get quite technical, reading it is entirely optional. To understand it conceptually, however, drawing parallels with the traditional finance world is helpful, where blockchains can be likened to natural resources or countries. Within these systems, specific attributes of 'risk-free' exist, and their failure could lead to the systemic collapse of the asset in question.

At one end of our spectrum lies *Level 0* risks, which are profoundly systemic events akin to the collapse of the internet caused by a solar flare. These risks are equally applicable in the traditional finance realm and are notoriously difficult to quantify.

On the opposite end of the scale are *Level 2* risks, which are protocol-centric. They are comparable to creditworthiness assessments conducted by rating agencies for corporations within a country. In this analogy, protocols are akin to corporations building on top of blockchain, each with its own specific risks related to its operational and financial health.

Among the various risk premiums, *Level 1* risks, or chain-specific infrastructure risks, best resemble how traditional finance derives its 'risk-free' rate. It is important to note, however, that not all blockchains are the same; just like countries, governance structures vary, but risks at this level are generically measurable, systemic, and practical, making them suitable candidates for anchoring a framework for assessing crypto 'risk-free' rates.

Figure 12: Putting the Treehouse Risk Premia Framework to Test

LEVEL	LAYER	MEASURABLE?	SYSTEMIC?	PRACTICAL?	EXAMPLE
0	Internet Infrastructure	No	**Yes**	No	Nuclear War
	DeFi Infrastructure	No	**Yes**	No	Failure of MetaMask
1	Chain-Specific	**Yes**	**Yes**	**Yes**	Ethereum Proof-of-Stake
2	Smart Contract Risk	**Yes**	No	**Yes**	AAVE Protocol
	Bridge Risk	Not the easiest to hedge	Depends on scale and notional	No	Multichain
	Liquid Staking Protocols	Not the easiest to hedge	Depends on scale and notional	No	Lido

TREEHOUSE

Treehouse Crypto Risk Premia Framework

A. Level 0

Level 0 risks are implicitly borne by all DeFi investors. Such risks are deemed extremely unlikely but exist nevertheless and thus do not generate meaningful investment returns. Examples include:

1. Internet Infrastructure: Proof-of-Stake chains exist fully in the digital domain and rely on at least some global internet infrastructure to remain operational. Example: if major providers of internet infrastructure (e.g., Cloudflare) go down, digital assets may become inaccessible and even worthless.

2. DeFi Infrastructure: DeFi ecosystems use similar building blocks, which, if down, could impact the value of assets that rely on them. Infrastructures such as wallets and stablecoins fit into this category.

- For an in-depth read on stablecoin design mechanisms, refer to our Treehouse Research article: “Stablecoins in Flux: Growth, Challenges, and the Future of Crypto Stability.”

B. Level 1

At this level, investors begin to get paid meaningful returns for taking relevant risk premiums.

- **Chain Infrastructure:** Staking yield is the primary return rewarded to investors exposed to chain infrastructure. Stakers might lose their principal in events of slashing and major chain malfunctioning (e.g., an entire chain shuts down for a prolonged period, a chain hard forks with less than one-to-one payouts of the new tokens, validator corruption, etc.). Some chains incentivize ecosystem participation with bonus tokens (e.g., AVAX Rush) at the early stage of deployment. Investors who harvest (“farm”) these returns also get compensated for taking chain infrastructure risks, as they sign up as early adopters who risk losing capital in the event of an ecosystem malfunction.

C. Level 2

Rewards paid out by protocols to attract users can be viewed as another set of risk premiums.

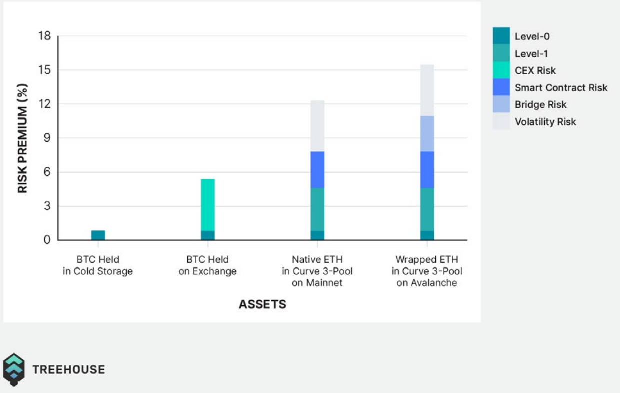
1. Smart Contract Risks include, but are not limited to:

- **Oracles:** Malfunctioning of oracles could result in incorrect liquidations, protocol exploits, and many more issues.
- **Protocol Developer Credit Risk:** Rug pull risks are important to consider when conducting due diligence, as the impact on capital drawdown is severe and usually irrecoverable.
- **Bugs, Hacks, and Malfunctions:** Even for well-developed protocols with credible teams behind them, dApps can still be exploited due to previously undiscovered glitches.
- **Tokenomics Design Deficiencies:** Do credible developer teams and triple code audits guarantee a successful token performance? Not necessarily. Failure in designing sustainable tokenomics is an inherent risk that investors take when having exposure to newly founded protocols that give out generous token rewards.

2. Bridges: Crossing chains is a common but potentially risky endeavor. Bridge hacks are not uncommon, and liquidity-based bridges can see wrapped tokens stuck on a chain without liquidity inflow. Risk premiums associated with bridges are currently hard to isolate, even with proxies.

3. Liquid Staking Protocols: Although liquid staking protocols are one-to-one and hence will not face actual insolvency, loss of parity between liquid staked and native tokens can still happen. In essence, liquid staking is akin to an auto-rolled short position on native token liquidity. Price differentials between liquid staked and native tokens reflect the price of such liquidity. If the market panics and overpriced liquidity, liquid staked positions will suffer mark-to-market losses, even though these losses are unrealized until holders decide to (or are forced to) sell.

Figure 13: Visualization of Inherent Risk Premia Behind Crypto Assets' Returns



Traditional Finance Risk-Premia

In traditional finance, many types of risk-premia exist. Two of the more relevant ones common in fixed income are:

A. Credit Risk

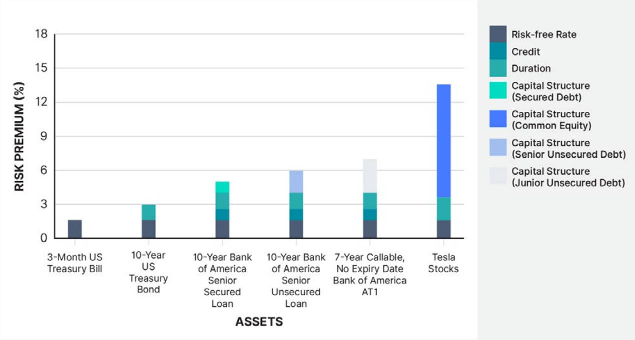
Credit risk, or default risk, is a risk premium that compensates lenders who lend money to anyone other than the U.S. federal government. It reflects the market pricing of a particular borrower's default probability. Common types of commercial borrowers who are not 'risk-free' include municipalities, corporates, supranational agencies (e.g., African Development Bank), and foreign governments (specific to their USD borrowings). Personal borrowers are also treated with different rates depending on their credit history when borrowing via mortgages, applying for credit cards, etc. In traditional finance, credit bond spreads and Credit Default Swaps (CDS) are standard instruments market participants trade to express their views on credit risk premiums.

B. Duration Risk

Duration risk mainly comes from the probability of borrower default and the opportunity cost of locking up capital for extended periods. The longer the lending term until repayment, the larger the likelihood of borrower default. Imagine if a borrower had a 5% probability of default every year, i.e., a 95% probability not to default, then the likelihood of the borrower not defaulting after 5 years will roughly be 0.95 ^ 5 = 77%. This is why the market requires a risk premium to take on more duration risk. The opportunity cost of locking up capital can also be explained as follows. If $100 is lent to a borrower for 5 years at 2% p.a., the lender will miss out on the yield upside for this $100 if the prevailing market rate (for the same borrower's creditworthiness and lending terms) rises to 5% p.a. In fixed income jargon, duration risk premium is also referred to as term structure or yield curve. Even long-term U.S. Treasury bonds without perceived issuer default risks have duration risk premia priced into their curves.

Besides the above two, other risk-premiums exist, such as those related to capital structure, volatility, and factorization. It is also important to note that while traditional finance risk premiums may be relevant to crypto, the reverse is not always true. Readers who are interested in doing a deeper dive can read our full analysis "Deconstructing DeFi Returns: Harvesting Risk Premia," on the Treehouse Research website.

Figure 14: An Oversimplified Visualization of Risk Premiums Summing up Assets' Expected Return



TREEHOUSE

The Satoshi Reserve

“

Bitcoin is a swarm of cyber hornets serving the goddess of wisdom, feeding on the fire of truth, exponentially growing ever smarter, faster, and stronger behind a wall of encrypted energy.

— Michael Saylor

Armed with the insights from the preceding sections, we are now prepared to evaluate a crypto ‘risk-free’ rate. Let us begin our analysis with Bitcoin (BTC) and Ethereum (ETH), as these two cryptocurrencies collectively represent 70% of the crypto market capitalization, capturing the majority of institutional interest. As we will see, Bitcoin's mechanisms align more with those of a commodity, whereas Ethereum exhibits characteristics akin to a nation-state.

Bitcoin: The Gold Standard

Bitcoin, the King of Crypto, owes its existence to the Proof-of-Work (PoW) mechanism. This system incentivizes miners to validate transactions on the blockchain and uphold decentralization by dedicating computational power to the network. In return for their efforts, miners receive Bitcoin rewards.

When assessing Bitcoin's PoW mechanism in the context of a ‘risk-free’ evaluation, it initially appears to meet crucial criteria. Firstly, PoW is undeniably systemic; without it, Bitcoin would effectively cease to exist, as there would be no miners to compute transactions on the network. Additionally, the rewards provided by Bitcoin’s PoW are measurable, and the yield earned by the median Bitcoin miner could potentially serve as a reasonable proxy for the currency’s ‘risk-free’ rate.

However, upon closer examination, complications arise. Bitcoin’s source of yield generation is primarily dependent on variables external to the asset itself, such as the computational power, or hash rate, deployed by miners.

This situation mirrors the gold mining industry. To mine Gold naturally, one needs to buy mining machinery, among others, and expend effort to find an accessible plot of land (ideally with a lot of Gold). Not all lands are the same, however, and the associated costs and rewards of mining Gold across geographies can vary significantly. This is why it is not common practice for market participants to talk about a Gold ‘risk-free’ rate, nor is it readily used to calculate returns for the asset given the intricacies of the factors mentioned.

In both scenarios, achieving a yield depends on factors not intrinsic to the asset itself, such as labor and machinery costs. This reliance on external variables and the potential variance in cost and rewards detracts from the independence criteria necessary for establishing a trustable benchmark, making it impractical. Consequently, Bitcoin's PoW system falls short of meeting these criteria.

The Nation of Gwei

“

In order to have a decentralized database, you need to have security.
In order to have security, [...] you need to have incentives.
— Vitalik Buterin

Ethereum and the United States

Conducting the same assessment of Ethereum’s mechanism reveals a different story. Since its transition from Proof-of-Work (PoW) to Proof-of-Stake (PoS) in September 2022, Ethereum’s PoS system has taken on a structure reminiscent of (caveat: some) sovereign economies. The similarities are striking, with both systems exhibiting identical structures and functions of a democratic government.

For instance, both Ethereum and sovereign economies feature independent currencies. Within Ethereum, gas tokens serve as the native currency for transactions within the blockchain ecosystem, analogous to fiat currencies used in national economies. This currency facilitates the execution of smart contracts and transactions within the

Ethereum network.

Similarly, both systems incorporate mechanisms for governance participation. In Ethereum's PoS system, holders of Ethereum stake their tokens to participate in the network's governance, similar to citizens voting in national elections to influence policy decisions.

Mechanisms for tracking the inflow and outflow of assets also exist, identical to current accounts monitoring Total Value Locked (TVL) in the blockchain ecosystem. Additionally, both ecosystems host sophisticated financial institutions, including decentralized exchanges, money markets, and derivatives platforms, facilitating a wide range of economic activities.

At present, Ethereum's PoS mechanism has over $100 billion worth of ETH staked, representing approximately 5% of the total cryptocurrency market value. This substantial stake underscores Ethereum's prominence and influence within the broader crypto landscape, akin to the significance of the United States in traditional finance. *TL;DR*: what Bitcoin is to Gold, Ethereum is to the United States.

Figure 15: Monetary System Comparison: Ethereum vs. the United States

	ETHEREUM	UNITED STATES
Unit of Account: Currency	ETH	USD
Systemic: Monetary System	Proof-of-Stake (PoS)	Federal Reserve
Measurable: "Safest" Instrument	PoS Rewards	US Treasury
Independence: Key Factors	Priority Fees, Number of Validators, MEV, Users, etc	FOMC, market supply and demand of USD, etc

TREEHOUSE

Comparing Ethereum's mechanisms to those of the U.S., certain fundamental aspects align. Both entities have their native currencies as the basis for monetary exchange, and their financial systems are controlled by respective systems that come with a clear associated return. While Ethereum's PoS governance system does not perfectly mirror the Federal Reserve, or more precisely, the Federal Open Market Committee (FOMC), parallels can be drawn in their objectives. For instance, the FOMC adjusts rates to regulate the circulation of money in the economy, while PoS staking rates are influenced by transaction volumes and other factors.

Ultimately, the case for Ethereum's 'risk-free' rate hinges on staking ETH to earn more ETH, with the stability of PoS directly linked to predeterministic factors related to Ethereum's network usage and security. A failure of the PoS mechanism would invariably expose Ethereum to systemic risk, akin to the U.S. Treasury's role in traditional finance.

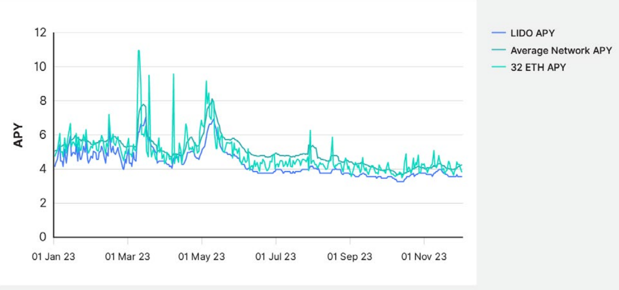
Comparing Overnight Federal Funds to ETH PoS

Ethereum's PoS rewards are distributed block-by-block, leading to varying returns depending on a staker's job. Several roles pay an outsized return, and a user's chances of being chosen increase with the quantity of ETH staked, making it hard for small stakers to compete. As a result, the yield earned across staker profiles in the short term can be volatile.

In December 2020, however, the introduction of Lido changed this as the protocol pooled ETH across stakers, normalizing the probability of PoS return. Today, Lido's ETH (stETH) holders comprise the largest proportion of ETH PoS stakers, receiving both a consistent median yield and the highest expected yield for stakers who utilize its services.

Without Lido, the expected return profile of individual stakers with the minimum amount of ETH versus the overall yield paid out from a network level can be drastically different. Lido's stETH has helped to reduce this variance, as seen in the illustration below.

Figure 16: Comparison of Lido APY, Network APY, and Self-Staked APY



Source: Dune Analytics

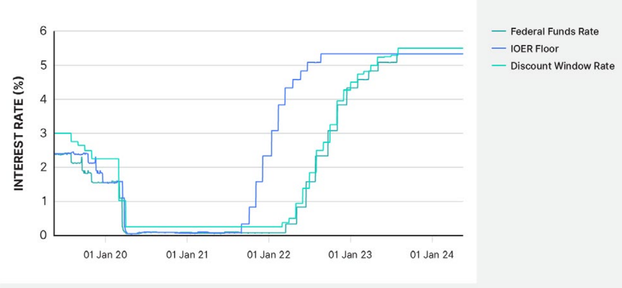
TREEHOUSE

To draw an analogy to traditional finance, consider the U.S. overnight federal funds rate, which represents the interest rate at which depository institutions lend reserve balances to other institutions overnight on an uncollateralized basis. The FOMC typically announces a target range for the federal funds rate after each meeting, serving as a guide for actual market trading. At the same time, the Federal Reserve can indirectly set the upper and lower range of the federal funds rate through instruments under its belt.

Specifically, the Federal Reserve can directly control the Interest on Excess Reserves (IOER) rate, which functions as the effective floor for the federal funds rate, as it is the interest rate paid by the Federal Reserve to depository institutions on excess reserves held at Federal Reserve Banks. Additionally, the discount window provides a lending facility for eligible institutions to borrow funds directly from the Federal Reserve, typically at a higher interest rate than the federal funds rate target range set by the FOMC, thereby acting as a ceiling for the federal funds rate.

While not a perfect comparison, this analogy offers insight into how the mechanisms of the PoS system operate similarly to those of a governing country, with its own economic dynamics and governance structure. The U.S. federal fund rates and the ETH PoS return can be considered essential short-term interest rates for their respective economies.

Figure 17: Comparison of Federal Funds Rate, IOER Floor, and Discount Window Rate



Source: US Federal Reserve, FRED, Federal Reserve Bank of St. Louis

TREEHOUSE

Protocol Monetary System, A Case Study on Sushi

Protocols exhibit unique attributes that sometimes resemble a country's monetary system. Three years ago, the Treehouse Research team attempted to make sense of Sushi's governance system in a three-part analysis.

Part 1 Part 2A Part 2B

The argument suggests that Ethereum's Proof-of-Stake (PoS) rewards can serve as its 'risk-free' rate. To illustrate this on-chain, consider the AAVE example again, where the mid-rate for borrowing and lending ETH is 2.15% p.a. If we assume an ETH PoS rate of 3.5% p.a., lenders of ETH would fare better by staking it through PoS rather than lending it on AAVE, as PoS *(Level 1 Risk)* is considerably and theoretically safer compared to lending on AAVE *(Level 2 Risk)*.

Drawing parallels to the example with Tesla, Inc. bonds, individuals typically demand higher yields for taking on additional risks, with the 'risk-free' rate acting as a floor. From an investment standpoint, any risky activity involving ETH assets on-chain should yield at least 3.5% p.a.

While this analogy of Ethereum's PoS and U.S. treasuries aligns with the concept of risk and return, it does not perfectly mirror each other, a key difference being that the U.S. Treasury market has an entire yield curve, with bonds active up to 30-year tenors. In contrast, Ethereum's PoS only exists at the spot time frame with no duration or time element priced into the instrument, reflecting only the *current* 'risk-free' rate on a block frequency basis.

4

The Treehouse Protocol

“

Cryptographic truth is a superior way for the entire world to operate. Once you experience the transparency, personal control and lower risks of a world powered by truth, rather than a world backed only by "just trust us" ideas, you simply cannot go back.

— Sergey Nazarov

In the previous chapters, we examined how fixed income formed a colossal segment of traditional finance and determined that the potential for this asset class in crypto is equally vast. We built a case for *Smart Contracts* as an upgrade to conventional societal contracts and explored fixed income and ‘risk-free’ rates in the context of digital assets. In Part 4, we bring everything together to introduce the Treehouse Protocol, a decentralized application that aims to unlock the digital asset fixed income market through two new financial primitives: Treehouse Assets *(tAssets)* and Decentralized Offered Rates *(DOR)*.

The Fragmentation of On-Chain Spot Rates

"

Prices are important not because money is considered paramount but because prices are a fast and effective conveyor of information through a vast society in which fragmented knowledge must be coordinated.

— Thomas Sowell

Prices are essential indicators of an economy, reflecting its openness, cost of living, regulations, and more. In established markets like equities, observable price differences are rare because bots and traders are incentivized to quickly eliminate them—a feedback loop that ensures an asset's price closely reflects its market value.

Despite significant investment in new on-chain fixed income solutions, adoption and innovation in the space has been lackluster. Several factors contribute to this sluggishness: the complexity of fixed income concepts, the predominantly retail-heavy nature of the digital assets ecosystem, and the lack of standardization across platforms—all of which have resulted in a fragmented interest rates market.

What is market fragmentation?

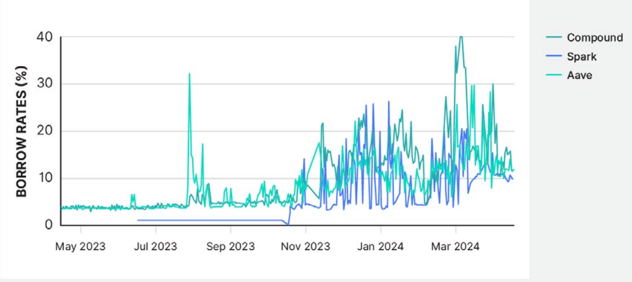
Market fragmentation refers to the division of a market into smaller segments, often leading to inefficiencies where the same asset may be priced differently across various platforms or locations. It can also take different forms, including price or interest rate fragmentation.

Imagine visiting a fruit market where you initially buy branded apples for what you thought was a discounted price of $10. Later, you discover the same apples being sold elsewhere for $5, leaving you feeling disappointed. The next day, you find the price at the first shop has changed to $8.5, while a neighboring store is selling them for $15. This inconsistent pricing might lead you to decide against buying apples altogether!

In the context of on-chain markets, interest rate fragmentation manifests as significant differences in interest rates for the same asset across various platforms. A user looking to borrow or lend USDC or ETH, for instance, might find drastically different interest rates depending on the platform they use. Ideally, consensus would look like everyone buying and selling apples—or, in our case, lending and borrowing at the same price or rate.

However, in reality, borrowing and lending rates can fluctuate widely across platforms like Aave and Spark, creating uncertainty for users. This variability makes it challenging for participants to confidently determine the best terms for borrowing or lending, as illustrated in Figure 18 below.

Figure 18: Fragmented Borrowing Rates Over Time (USDC)

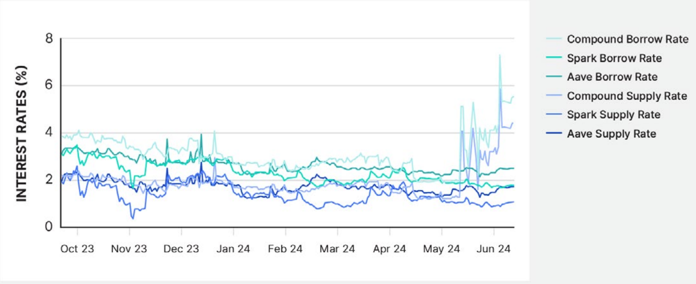


Source: Dune Analytics

TREEHOUSE

Unfortunately, interest rate fragmentation is a systemic issue, with the problem being most prevalent in the on-chain market for ETH. Figure 19 below illustrates ETH's borrowing and lending rates across the top protocols over a nine-month period from 2023 to 2024, revealing significant fragmentation. This issue is not confined to the spot time frame but also affects duration-based interest rate instruments, which partly explains the scarcity of tenor-based instruments in the market.

Figure 19: Fragmented Lending and Borrowing Rates Over Time (wETH)



Source: Dune Analytics

TREEHOUSE

tETH: Converging ETH Interest Rates

“

Arbitrage will take place whenever there is an imbalance created in one or more markets that are similar.

— John Gutfreund

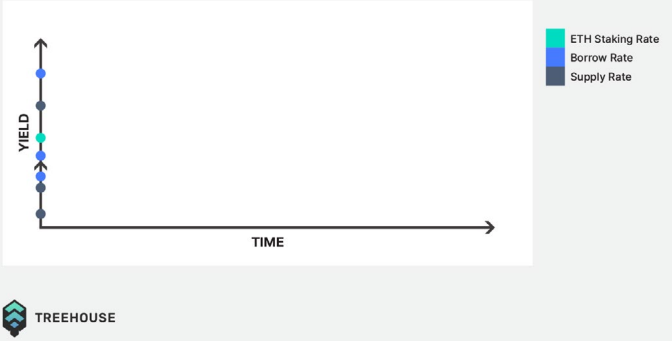
The need to converge on-chain borrowing and lending rates across platforms is evident; otherwise, the fixed income space will likely take many more years to mature. We introduce the Treehouse Protocol and its key component, Treehouse ETH *(tETH)* to address this fragmentation head-on.

Introducing *tETH*

tETH is a liquid restaking token (LRT) designed to unify Ethereum's fragmented interest rates, allowing holders to earn real yield through interest rate arbitrage. By leveraging Ether (ETH) and other liquid staking tokens (LST) like stETH (Lido staked ETH), *tETH* is built to be easily accessible and resonate with the average block-chain user.

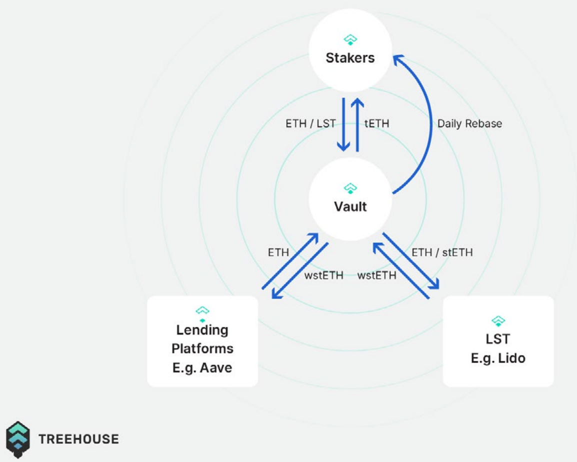
The strategy of *tETH* can be condensed into borrowing Ethereum at a lower rate (akin to buying apples at a low price) and then staking it to earn a higher return (selling those apples at a higher price). By utilizing this strategy, we can influence interest rates on lending platforms, effectively converging these rates towards the theoretical ETH 'risk-free' rate.

Figure 20: Convergence of ETH Interest Rates



As explained in Part 3, the Ethereum Staking Rate is essentially Ethereum's version of a 'risk-free' rate. It is like knowing the benchmark or market consensus price at which you can always sell apples. *tETH* works on the premise that the ETH staking rate—i.e. Ethereum's 'risk-free' rate—acts as the baseline for any yield on ETH, and no ETH investment should rationally offer a lower return. This is because the staking rate represents the minimum return an investor can expect by simply staking ETH in the Ethereum network's Proof of Stake (PoS) mechanism. As such, an arbitrage opportunity arises when borrowing ETH is cheaper than the yield earned from staking it into PoS. By doing so, the utilization of the pool increases, along with the borrowing rate, converging interest rates toward the Ethereum 'risk-free' rate. This convergence helps enhance market confidence and provide return predictability, similar to setting a standard for pricing apples.

Figure 21: tETH Diagram



The key functions of *tETH*

• **Ensuring On-Chain Interest Rate Efficiency:**
Holders of *tETH* play a crucial role in shaping on-chain markets by converging rates to Ethereum's 'risk-free' rate. This ensures borrowing and lending rates across various platforms align more closely, reducing arbitrage opportunities and stabilizing the market.

• **Democratizing Access to Fixed Income Arbitrage:**
Traditionally, arbitrage strategies in fixed income markets are accessible only to institutional investors. *tETH* changes this by allowing retail investors to participate in these strategies, promoting a fairer market environment.

• **Powering Decentralized Offer Rates (DOR):**
By holding *tETH*, users contribute to the cryptoeconomic security of the Treehouse Actively Validated Service (AVS), supporting the stability and reliability of decentralized offer rates within the ecosystem.

While savvy investors today employ fixed income arbitrage strategies in the crypto market, these efforts alone are insufficient to stabilize the market. Significant mispricings still persist, and achieving convergence requires a substantial capital base amounting to hundreds of millions of dollars. That is why we need you. By holding *tETH*, users participate in Treehouse's push towards interest rate convergence, which is vital in ensuring on-chain interest rate market efficiency.

The introduction of *tETH* marks the beginning of a broader expansion of *tAssets*—a new primitive designed to facilitate interest rate convergence across the digital asset space. We plan to develop other *tAssets* in the near future, further unifying and stabilizing interest rates across the DeFi landscape. The expansion will enable investors to capitalize on interest rate arbitrage opportunities on a larger scale, fostering a more efficient and integrated financial ecosystem.

tETH
Documentation
Refer to the tETH docs by scanning the QR code below for more information.

DOR: Decentralized Offered Rates

"

Blockchain technology isn't just a more efficient way to settle securities. It will fundamentally change market structures.

— Abigail Johnson

In the previous section, we discussed how *tETH* is fundamental to establishing Ethereum's 'risk-free' rate. To further play on our apple analogy, *tETH* resembles an apple-picking robot—part harvester, part savvy trader. This terminator of a robot not only plucks apples from your tree (Ether) but also zips off to the inefficient apples market to play the arbitrage game. But that is not all—once borrowing and lending rates converge to Ethereum's 'risk-free' rate, Decentralized Offered Rates *(DOR)* comes into the picture.

In the context of financial markets, interest rates serve as crucial indicators of credit risk. They reflect the compensation lenders demand for the risk associated with lending capital. Typically, lenders expect borrowers to pay interest rates throughout the contract period and repay the principal amount at maturity. These rates are often structured on top of reference rates that anchor the base cost of borrowing, but this framework is largely absent in digital assets today.

Introducing *DOR*

Decentralized Offered Rates *(DOR)* are reference rate curves that protocols and platforms can use to underpin interest rate financial products. *DOR* functions as a consensus mechanism, incentivizing a consortium of stakeholders to establish robust benchmark rates across various time horizons.

Figure 22: The Treehouse Protocol Stakeholders

ROLE	TASKS ASSIGNED
Operators	Initiate DOR feeds, recruit and coordinate Panelists, and manage the overall functioning and integrity of DORs.
Panelists	Use proprietary models and software to provide rate data or forecasts, and participate in the consensus mechanism.
Referencers	Integrate DOR feeds into their services or products, and use DORs in pricing or settling financial instruments.
Delegators	Delegate tAssets to Panelists, allowing them to fulfill DOR duties, while retaining ownership and earning potential rewards.
End Users	Utilize financial products and services that incorporate DORs, such as loans and derivatives, tailored to manage risks and enhance financial planning.

TREEHOUSE

How does all of this work?

At its core, *DOR* operates by aggregating data from multiple stakeholders, including operators, panelists, referencers, and delegators, who each play a critical role in determining the final rate. Operators establish the parameters for rate calculations and maintain system integrity, while panelists submit interest rate forecasts based on their proprietary models. Referencers integrate these rates into financial products, and delegators support the system by delegating their assets to trusted panelists, enhancing rate accuracy and reliability.

The process begins with operators defining the rate and setting parameters for panelists to forecast. Panelists, armed with their models and insights, provide their interest rate predictions, which are then aggregated by the *DOR* system. Outlier values that could skew the data are removed to ensure fairness and accuracy, and the remaining data is used to calculate a consensus mean rate. This consensus rate is published as the *DOR*, which can then be used as a benchmark for various financial products within the DeFi ecosystem.

A Theatrical Analogy

• **Operators** are like the theater directors, setting the stage, coordinating the actors, and overseeing the entire production. They set the tone and direction for the show, much like setting the parameters for the DOR.

• **Panelists** are akin to the scriptwriters, devising the storyline – in this case, the forecasted rates. Their scripts (predictions) are crucial for the play (financial ecosystem) to be believable and engaging.

• **Delegators** resemble the investors in the production. They fund the play, hoping it will be a hit. Their support allows the scriptwriters (panelists) to develop and refine the script (rate predictions).

• **Referencers** are the critics and promoters. They publicize the play and provide an accessible interpretation (benchmarks) for the audience. They rely on the script's quality (accuracy of the rates) to attract the public and endorse the play.

- **End Users** are the audience, buying tickets and filling the seats. Their demand for an entertaining evening reflects the market within the financial system for reliable and functional products tied to the DOR.

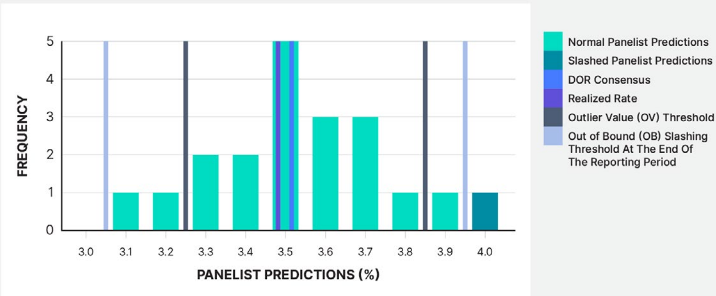
Every role is interconnected in each step of the production: without a director's (operator's) vision, there's no structure; without a scriptwriter's (panelists) story, there's nothing to perform; without investors (delegators), there's no funding for the show; without critics and promoters (referencers), there's no buzz to draw the public; and without an audience (end users), there's no one to appreciate and sustain the play.

One of *DOR's* key features is its slashing and incentive structure. Stakeholders are rewarded for providing accurate data and penalized for submitting erroneous or manipulated information. This incentivization aligns participants' interests with the system's integrity, fostering a self-regulating ecosystem where data accuracy is paramount and biases are minimized. By embedding these incentives, *DOR* addresses the limitations of traditional financial benchmarks and enhances transparency in the DeFi ecosystem.

Slashing Mechanism

DOR uses 'slashing' to deter and penalize panelists whose rate submissions deviate significantly from the consensus. Slashing helps maintain the integrity and accuracy of the *DOR* by enforcing penalties on panelists whose predictions fall outside an acceptable range. This range is typically defined by the standard deviation from the realized rate over an observation period. When a panelist's submission diverges too much from the consensus, their staked assets are partially or fully confiscated, known as slashing.

Figure 23: **Slashing Thresholds Example**



TREEHOUSE

Slashing: Back to Treehouse Theater

Going back to the theater analogy, imagine that to maintain high standards, the director (Operator) implements a rule. If the storyline created by the scriptwriters (Panelists) receives significantly negative reviews (deviates too far from the consensus rate predictions), they may lose part of their performance bonus (slashing their staked assets). This rule ensures that all scriptwriters put in their best effort to maintain the integrity of the performance. Similarly, in the *DOR* system, panelists who submit predictions far from the consensus are penalized.

Incentive Mechanism

As mentioned, the *DOR* system not only penalizes incorrect predictions but also incentivizes accurate and well-considered submissions, which is crucial for maintaining system integrity and motivating participants. When panelists provide accurate data, they are rewarded with incentives from a designated reward pool. These rewards can take the form of tokens or other financial incentives, which encourage panelists to continue submitting precise and well-researched predictions.

For other roles, incentives are aligned to ensure active participation and high performance:

- **Operators** are rewarded for the successful maintenance, marketing, and integrity of the *DOR* system. Their incentives are tied to the overall performance and reliability of the rate-setting process.

- **Delegators** earn a share of the rewards by delegating their assets to trusted panelists. This not only supports the system but also enhances the accuracy and reliability of the rates. The better the performance of the panelists they support, the higher their rewards.

- **Referencers** who integrate *DOR* feeds into their financial products can earn incentives based on the adoption and usage of these rates in their offerings. The more their products rely on and benefit from accurate rates, the more they stand to gain.

Treehouse's incentivization structure ensures that all participants are motivated to contribute to the accuracy of *DOR*.

Comparison to TradFi

In traditional finance, reference rates like LIBOR (London InterBank Offered Rate) and SOFR (Secured Overnight Financing Rate) have been instrumental in providing benchmarks for a wide range of financial instruments over recent decades. LIBOR, introduced in the 1980s, originally represented the average rate at which major global banks were willing to lend to each other on the interbank market for short-term loans. This rate was determined through daily submissions by a panel of banks, reflecting their estimates of borrowing costs for unsecured funds from other banks. The methodology relied on subjective opinions to gauge the interbank borrowing landscape and predict future interest rates.

Since LIBOR enabled the creation of rates based on collective opinions about future interest rates, it was susceptible to manipulation. In June 2012, Barclays admitted to manipulating LIBOR and agreed to pay $450 million in fines as part of a settlement with U.S. and U.K. regulators. This revelation led to a broader investigation involving many other banks, which resulted in significant fines and regulatory changes aimed at preventing further misconduct. This, together with the lack of clear incentives for honest reporting, has led to its replacement by SOFR in June 2023.

SOFR, by contrast, is based on transaction data from the overnight repurchase agreement (repo) market, providing a more transparent and objective measure of borrowing costs. It aims to reduce the risks of manipulation associated with opinion-driven benchmarks like LIBOR, marking a significant improvement in the reliability and trustworthiness of financial benchmarks in traditional finance.

SOFR, as an overnight rate, provides a historical perspective on borrowing costs rather than anticipating future interest rate movements. To address this limitation, efforts have been made to develop forward-looking Term SOFR rates. Entities like the Chicago Mercantile Exchange (CME) calculate these rates using SOFR futures and market data, offering a forward-looking benchmark suitable for longer-term financial derivatives. For instance, companies with floating-rate loans tied to SOFR can hedge against rising rates by entering into SOFR swaps on the CME. In such swaps, the company receives a floating rate based on Term SOFR and pays a fixed rate, thereby stabilizing their interest payments over time.

Despite these advancements from LIBOR, issues related to centralization persist with SOFR. The Federal Reserve oversees the publication of SOFR overnight rates, but there are no direct incentives for ensuring accurate reporting. This lack of direct incentives contrasts with natural systems where cooperation is incentivized to achieve optimal outcomes. As discussed in Part 1, Hobbes's *State of Nature* theory suggests that without structured incentives akin to *Social Contracts*, self-interest tends to dominate, potentially leading to suboptimal results for the broader community.

Relying solely on centralized authorities can be risky, as demonstrated by past financial benchmarks like LIBOR. Instead, we should establish a structure that incentivizes good behavior regardless of the circumstances. The *DOR* framework addresses these concerns by leveraging *Smart Contracts* and embedding an incentive structure within its consensus mechanism. This approach motivates stakeholders to provide accurate data by rewarding good behavior and penalizing deviations, ensuring transparency and integrity in rate determination.

DOR combines elements of both LIBOR's opinion-driven methodology and SOFR's transaction-based approach. While SOFR mitigates risks associated with centralization, *DOR* enhances this by decentralizing the process, thereby reducing the potential for manipulation and ensuring fairness in benchmark rate determination. This hybrid approach benefits from the transparency and resilience of decentralized frameworks while incorporating the reliability and historical context provided by traditional financial benchmarks.

By harnessing decentralized consensus and stakeholder incentives, *DOR* establishes a scalable framework for generating decentralized benchmark rates.

***DOR* Documentation**

Refer to the DOR docs by scanning the QR code below for more information.

First Application: The Ethereum Staking Rate

“

Money and bond markets function most efficiently when market participants agree on certain instruments that serve as references – or benchmarks – for the pricing of other securities.

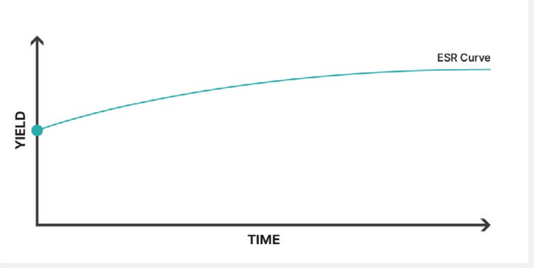
— Lawrence Kreicher

Treehouse’s very first application of *DOR* is the Ethereum Staking Rate (ESR) Curve. Implementing the ESR Curve will enable us to plot out a yield curve for the Ethereum ‘risk-free’ rate, providing a comprehensive view of interest rates over different maturities.

As discussed in Part 3, once lending rates converge with Ethereum PoS rate, the rate inferred by *tETH* is only reflective of the spot time frame. No duration or time element is priced into the instrument, thereby reflecting only the current ‘risk-free’ rate on a block frequency basis. The introduction of the ESR Curve aims to address this limitation by incorporating multiple data inputs from *DOR* across varying maturities. This approach transforms the spot rate into a comprehensive time-series curve, as depicted in Figure 24.

The ESR Curve serves a critical role for Ethereum by establishing a transparent benchmark rate over different durations, akin to the yield curves prevalent in traditional finance, essential for facilitating accurate pricing, effective risk management, and broader financial applications within the Ethereum ecosystem.

Figure 24: ESR Curve



TREEHOUSE

DOR in Action: Interest Rate Swaps

Creating a reference rate like the ESR Curve can facilitate the introduction of financial instruments such as Interest Rate Swaps (IRS) in the DeFi space. Since their inception in 1981, IRS have become indispensable tools for managing institutional balance sheets, evolving into the largest and most widely used derivative contracts globally, with outstanding contracts totaling over $500 trillion. This vast market presents an opportunity for significant growth within DeFi, offering stakers new tools to stabilize and optimize their returns.

Efforts to bridge this gap have included both on-chain and off-chain initiatives aimed at developing fixed income derivatives, such as staking rate swaps. Market makers and protocols have experimented with float-to-fixed staking swaps, and various projects have raised substantial capital to innovate in this area. However, these efforts have faced challenges in gaining traction, evidenced by low trading volumes and limited adoption based on their TVLs.

Understanding the distinction between fixed and floating rates is crucial when considering IRS. Fixed income investments typically provide regular interest payments that can be either *fixed* or *floating*. Consider a Tesla bond with a fixed rate of 5% p.a.; barring any defaults, the investor would receive steady payments reflecting this 5% p.a. return over the bond's lifespan. In contrast, a Tesla bond with a floating rate provides varying returns, with interest payouts adjusted periodically based on prevailing market rates at each settlement.

Case in Point

Imagine you're the CEO of a company called Squirrel, specializing in selling nuts. Squirrel has taken out a loan with a fixed interest rate of 5% p.a. Over time, it becomes evident that the company's revenues are insufficient to cover these fixed 5% p.a. interest payments. Upon closer analysis, you discover a correlation between Squirrel's revenue and interest rates: when interest rates increase, so does the company's revenue, and vice versa.

After careful consideration, you decide that navigating through financial fluctuations is preferable to being stuck on a fixed branch. Squirrel decides to enter into an IRS.

As a result of the swap, the company's interest expenses now fluctuate with its revenue patterns. When interest rates rise, causing both revenue and interest expenses to increase, Squirrel can manage the higher payments. Conversely, when interest rates and revenues decline, the company benefits from reduced interest expenses, maintaining a more stable financial position overall.

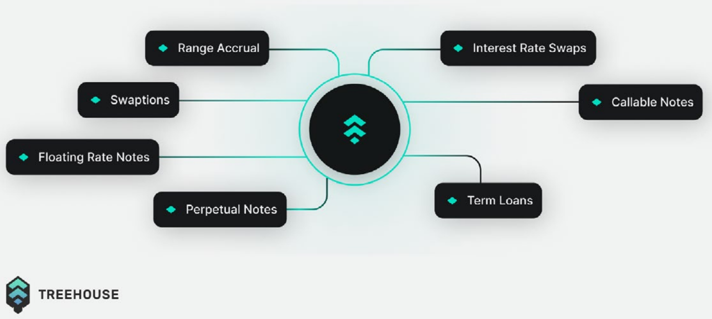
In essence, picture a squirrel clutching a large acorn nut on a tree branch. When the tree shakes due to changing economic conditions (interest rates), the squirrel adjusts its grip (interest rate payments) rather than risking a fall.

The Opportunity at Hand

With over $100 billion worth of ETH staked currently, Ethereum's PoS has become the largest yield-bearing native instrument within the crypto space. This mechanism operates akin to a floating rate, where stakers earn rewards based on the network's activity at each block, resulting in variable returns over time. This variability poses a challenge for stakers seeking stable returns on their Ethereum investments, as they lack tools to effectively lock in their cash flows.

The introduction of *DOR* can bridge this gap by establishing accurate benchmark rates such as the ESR Curve. These benchmarks are essential for enhancing market efficiency and enabling improved risk management practices. While IRS are an initial application, the potential extends to a variety of new fixed income instruments. These include floating rate notes, range accruals, swaptions, perpetual notes, callable notes, term loans, and more—not just in Ethereum, but across all major L1s!

Figure 25: Enabling a Suite of New On-Chain Interest Rate Products



Conclusion

Perched Above The Dark Forest

“

If crypto succeeds, it’s not because it empowers better people, it’s because it empowers better institutions”

— Vitalik Buterin

Blockchain is a canvas enabling new forms of value creation that were previously impossible. Just as decentralized exchanges (DEXs) revolutionized finance by introducing a mechanism for decentralized price discovery, *DOR* introduces a new mechanism for decentralized rate discovery.

Thus the birth of the Treehouse Protocol. As with any groundbreaking innovation, we anticipate initial challenges and resistance from established players. Yet, we are confident that what we have developed will define the future of finance. Crypto is often depicted as a ‘Dark Forest,’ a dangerous place resembling Hobbes' State of Nature. While it cannot alter the laws of human nature, it can redefine incentives. Crypto embodies the essence of democracy, driven by trustless consensus—an uncharted digital domain that is unscathed by partitioned interests for the first time. Crypto is a ‘Dark Forest,’ yet it shines so brightly.

Epilogue

“

Many forms of Government have been tried, and will be tried in this world of sin and woe. No one pretends that democracy is perfect or all-wise. Indeed it has been said that democracy is the worst form of Government except for all those other forms that have been tried from time to time.

— Winston Churchill

What is next? DeFi is premised on the removal of inefficient intermediaries; but for the Treehouse to flourish, there needs to be a degree of governance to determine processes and give voice and correct incentives to parties, especially one that avoids gridlock.

Drawing from historical precedents, we advocate for a governance model inspired by democratic societies and corporate governance structures. This model will distribute power across various bodies of authority, empowered by the Treehouse token. Smart Contracts will also play a pivotal role in shaping these governance interactions, minimizing bureaucratic inefficiencies common in traditional organizations.

The speed and evolution of the DeFi landscape require us to stay flexible and vigilant. As such, the devolution of decision-making power will be gradual as we believe in being able to react quickly during the protocol's early stages. Over time, the use of token-based governance will assume greater responsibility and we will fully transition when Treehouse has matured to a point where it is ready to be self-sustaining.

Notes

Prologue

Baydakova, A. (2023, June 6). Gary Gensler's Evolving Position on Crypto – in Quotes. Cointelegraph. https://www.coindesk.com/consensus-magazine/2023/06/06/gary-genslers-evolving-position-on-crypto-in-quotes/

Cna. (2024, April 30). Binance's former CEO sentenced to 4 months prison in money laundering violations. CNA. https://www.channelnewsasia.com/world/binances-former-ceo-sentenced-4-months-prison-money-laundering-violations-4304596/

Ethereum is a Dark Forest. (2020, August 28). Paradigm. https://www.paradigm.xyz/2020/08/ethereum-is-a-dark-forest/

Huang, C. (2024, January 22). Singapore-based Terraform Labs files for bankruptcy in US after $53.6 billion crypto crash. The Straits Times. https://www.straitstimes.com/business/singapore-based-terraform-labs-files-for-bankruptcy-in-us-after-536-billion-crypto-crash/

Liu, C. (2015). The Dark Forest. Bloomsbury Publishing.

Part 1

Agorist, M. (2022, January 20). 80% OF all US dollars in existence have been printed in just the past two years - the Washington Standard. The Washington Standard. https://thewashingtonstandard.com/80-of-all-us-dollars-in-existence-have-been-printed-in-just-the-past-two-years/

Aristotle. (2010). Nicomachean ethics. https://openlibrary.org/books/OL7668954M/Nicomachean_Ethics/

BBC News. (2021, September 24). China declares all crypto-currency transactions illegal. https://www.bbc.com/news/technology-58678907/

Bryan Taylor, Chief Economist, Global Financial Data. (2018, November 7). A billion dollars just ain't what it used to be. Global Financial Data. https://globalfinancialdata.com/a-billion-dollars-just-aint-what-it-used-to-be/

Buterin, V. (2014). Ethereum: a Next-Generation smart contract and decentralized application platform. In ethereum.org. https://ethereum.org/content/whitepaper/whitepaper-pdf/Ethereum_Whitepaper_-_Buterin_2014.pdf/

Committee for a Responsible Federal Budget. (2023, September). National debt reaches $33 trillion. https://www.crfb.org/press-releases/national-debt-reaches-33-trillion-adds-1-trillion-debt-3-months/

Cryptography's role in securing the information Society. (1996). In National Academies Press eBooks. https://doi.org/10.17226/5131/

Dale, O. (2018, January 17). A history of cryptography and the rise of the CypherPunks. Blockonomi. https://blockonomi.com/cryptography-cypherpunks/

Dalio, R. (2021). Principles for Dealing with the Changing World Order: Why Nations Succeed and Fail. Simon and Schuster.

Decrypt Media. (2021, November 20). MIT professor Gary Gensler to be appointed chair of US SEC. Forkast. https://forkast.news/gary-gensler-appointed-us-sec-chair/

Federal Reserve Act. (1913). https://www.federalreserve.gov/aboutthefed/fract.htm/

Financial Cryptography: The Mojo Nation Story. (2005). https://www.financialcryptography.com/mt/archives/000571.html/

Graves, M. H. S. (2024, April 22). Who is Satoshi Nakamoto, The Creator of Bitcoin? Decrypt. https://decrypt.co/resources/satoshi-nakamoto/

Hamacher, A. (2022, April 6). How David Chaum went from inventing digital cash to pioneering digital privacy. Decrypt. https://decrypt.co/95109/david-chaum-from-inventing-digital-cash-to-pioneering-digital-privacy/

Hayes, A. (2023, July 3). Pumping Iron - Arthur Hayes - Medium. Medium. https://cryptohayes.medium.com/pumping-iron-ae8a54a32ea2/

Hobbes, T. (2018). Chapter 13. In Leviathan. Strelbytskyy Multimedia Publishing.

How are cryptocurrencies taxed in the UK and EU? | Binance blog. (n.d.). Binance Blog. https://www.binance.com/en/blog/all/how-are-cryptocurrencies-taxed-in-the-uk-and-eu-421499824684902104/

Human and budgetary costs to date of the U.S. war in Afghanistan, 2001-2022 | Figures | Costs of war. (2022). The Costs of War. https://watson.brown.edu/costsofwar/figures/2021/human-and-budgetary-costs-date-us-war-afghanistan-2001-2022/

Jevons, W. S. (1875). Money and the mechanism of exchange.

Lopp, J. (2023, June 17). What are the Key Properties of Bitcoin? Nakamoto.com. https://nakamoto.com/what-are-the-key-properties-of-bitcoin/

M1 Money Supply. (2024, April 23). https://fred.stlouisfed.org/series/M1SL/

Magic Money. (n.d.).
https://redirect.cs.umbc.edu/~woodcock/cmsc482/proj1/magmoney.html/

Manne, R. (2019). Cypherpunk Revolutionary: On Julian Assange.

Menger, C. (1950). Principles of economics. Ludwig von Mises Institute.

Peter G. Foundation. (n.d.). What is the U.S. national debt right now — and why is it so high?
https://www.pgpf.org/national-debt-clock/

Pocket Bitcoin. (2023, March 9). The emergence of Cypherpunks and Bitcoin.
https://pocketbitcoin.com/learn/bitcoin/cypherpunks-explained/

Qureshi, H. (2020a, January 10). The Cypherpunks. Nakamoto.com.
https://nakamoto.com/the-cypherpunks/

Qureshi, H. (2020b, January 14). The history of modern banking. In a brief history of money. Nakamoto.com.
https://nakamoto.com/a-brief-history-of-money/

Qureshi, H. (2020c, June 9). Introduction to cryptocurrency. NAKAMOTO.
https://nakamoto.com/introduction-to-cryptocurrency/

Qureshi, H. (2021, February 14). Hashcash. Nakamoto.com.
https://nakamoto.com/hashcash/

Rousseau, J. (1893). The social contract: Or, Principles of Political Law. Also, A Project for a Perpetual Peace.

Sapiens: a brief history of humankind. (2015). Choice/Choice Reviews, 52(11), 52–5967.
https://doi.org/10.5860/choice.190494/

Shrestha, A. (2024, January 15). Bitcoin's technical contribution: Solving Byzantine Generals Problem | by Ajay Shrestha | Nov, 2022 | Towards Data Science | Towards Data Science. Medium.
https://towardsdatascience.com/bitcoins-technical-contribution-solving-byzantine-general-s-problem-f04499973437c/

Social Contract Theory | Internet Encyclopedia of Philosophy. (n.d.).
https://iep.utm.edu/soc-cont/

Stanford Encyclopedia of Philosophy. (2018, April 20). Contractualism.
https://plato.stanford.edu/entries/contractualism/#:~:text=Contractualism%20offers%20an%20alternative%20to,their%20own%20interests%20to%20pursue/

Stanford Encyclopedia of Philosophy. (2021a, September 27). Contemporary approaches to the social Contract.
https://plato.stanford.edu/entries/contractarianism-contemporary/#ModPar/

Stanford Encyclopedia of Philosophy. (2021b, September 27). Part 2 - Modeling the Parties. In Contemporary approaches to the social Contract.
https://plato.stanford.edu/entries/contractarianism-contemporary/#ModPar/

Stanford Encyclopedia of Philosophy. (2021c, September 30). Contractarianism.
https://plato.stanford.edu/entries/contractarianism/

The Bretton Woods system. (n.d.). World Gold Council.
https://www.gold.org/history-gold/bretton-woods-system/

TheBitcoinNews. (2019, November 7). Bitcoin History Part 19: WikiLeaks and the Hornet's Nest - The Bitcoin News. The Bitcoin News - Blockchain and Bitcoin News.
https://thebitcoinnews.com/bitcoin-history-part-19-wikileaks-and-the-hornets-nest/

US Department of Justice. (2007, April). #07-301: 04-27-07 Digital currency business E-Gold indicted for money laundering and illegal money transmitting.
https://www.justice.gov/archive/opa/pr/2007/April/07_crm_301.html/

Winklevoss Tyler. (2020, December 22). The problem with the U.S. dollar. In the case for $500K bitcoin. Winklevoss Capital.
https://winklevosscapital.com/the-case-for-500k-bitcoin/

Part 2

Amery, A. (2019, December 18). History of Loans: Business Lending Through the Ages | Become. Become.
https://www.become.co/blog/a-brief-history-of-loans-business-lending-through-the-ages/

Badman, R. (2021, October 22). 'It may disrupt our industry': $2.2 trillion asset manager Pimco delves into crypto. Stockhead.
https://stockhead.com.au/cryptocurrency/it-may-disrupt-our-industry-2-2-trillion-asset-manager-pimco-buys-deeper-in-crypto/

Bank of England. (n.d.). Bank of England founded. In History.
https://www.bankofengland.co.uk/about/history/

BIS. (2023, May 17). OTC derivatives statistics at end-December 2022.
https://www.bis.org/publ/otc_hy2305.htm/

Bromberg, B. (1942). The Origin of Banking: Religious finance in Babylonia. The Journal of Economic History, 2(1), 77–88.
https://doi.org/10.1017/s002205070005230x/

Cheah, S., & Lee, J. (2022, December). Global fixed income markets - New Year 2024 | RBC Global Asset Management - Institutional.
https://institutional.rbcgam.com/en/us/research-insights/article/global-fixed-income-markets-new-year-2024_i/detail/

Cotrugli Business School. (2023, October 11). Banking in Ancient Greece. COTRUGLI.
https://cotrugli.org/banking-in-ancient-greece/

Lewis, M. M. (1990). Liar's poker: Rising Through the Wreckage on Wall Street. Penguin (Non-Classics).

Marx, K. (1973). Grundrisse. In "Bastiat and Carey" (pp. 809-810). http://ci.nii.ac.jp/ncid/BA04830240/

Nasdaq. (2018, July 17). 5 investment rules from Ray Dalio. Nasdaq. https://www.nasdaq.com/articles/5-investment-rules-ray-dalio-2018-07-17/

Olivelle, P. (2006). Between the empires: Society in India 300 BCE to 400 CE. In Zenodo (CERN European Organization for Nuclear Research). https://doi.org/10.5281/zenodo.6464321/

Pendle Finance. (n.d.). Minting. In Pendle documentation. https://docs.pendle.finance/ProtocolMechanics/YieldTokenization/Minting/

Sandor, K. . (2022, December 6). FTX Contagion Spreads as Orthogonal Trading Gets Default Notice for $36M Debt on Maple Finance. CoinDesk. https://www.coindesk.com/markets/2022/12/05/maple-finance-severs-ties-with-orthogonal-trading-alleging-it-misrepresented-financial-position/

SIFMA. (2023, July 24). Capital Markets Fact Book, 2023 - SIFMA. https://www.sifma.org/resources/research/fact-book/

Solutions, S. (2022, October 10). Historical significance of surety bonds. Surety1. https://surety1.com/history-surety-bonds/

Statista. (2024). Real Estate - Worldwide | Statista market forecast. https://www.statista.com/outlook/fmo/real-estate/worldwide/

The Editors of Encyclopaedia Britannica. (2024, May 25). Code of Hammurabi | Summary & History. Encyclopedia Britannica. https://www.britannica.com/topic/Code-of-Hammurabi/

Part 3

Benwilliams. (2021, September 10). 5 features of Trusted Bitcoin Brokers - about Manchester. About Manchester. https://aboutmanchester.co.uk/5-features-of-trusted-bitcoin-brokers/

CFA Institute. (2021). The Arbitrage-Free Valuation Framework. https://www.cfainstitute.org/en/membership/professional-development/refresher-readings/arbitrage-free-valuation-framework/

Cmt, T. C. (2019, July 10). Options Theory: The Risk-Free Rate | Tackle Trading. Tackle Trading. https://tackletrading.com/options-theory-the-risk-free-rate/

Nathan, & Nathan. (2024, January 3). 2024 Cryptocurrency market Outlook: Key developments - CMS Prime. CMS Prime.

https://cmsprime.com/blog/2024-cryptocurrency-market-outlook-key-developments/

Nelson, D. (2021, September 14). Michael Saylor: Bitcoin's Cyber Hornet. CoinDesk. https://www.coindesk.com/markets/2020/12/08/michael-saylor-bitcoins-cyber-hornet/

Treehouse Finance. (2022, July). Deconstructing DEFI returns: Harvesting risk premia - Insights - Treehouse research. Treehouse. https://www.treehouse.finance/insights/deconstructing-defi-returns-harvesting-risk-premia/

Part 4

American Enterprise Institute. (2014, April). Quotations of the Day from Thomas Sowell. https://www.aei.org/carpe-diem/quotations-of-the-day-from-thomas-sowell-2/#:~:text=Thomas%20Sowell%20quotes%3A,fragmented%20knowledge%20must%20be%20coordinated./

BIS Data Portal. (2023). OTC derivatives statistics publication table: BIS,DER_D7,1.0. https://data.bis.org/topics/OTC_DER/tables-and-dashboards/BIS,DER_D7,1.0/

Federal Reserve Bank of New York. (2024). Repo and Reverse Repo Agreements. https://www.newyorkfed.org/markets/domestic-market-operations/monetary-policy-implementation/repo-reverse-repo-agreements/

International Churchill Society. (2021, September 10). The worst form of government. https://winstonchurchill.org/resources/quotes/the-worst-form-of-government/

Kreicher, L. L., McCauley, R. N., & Wooldridge, P. (2017, March 6). The bond benchmark continues to tip to swaps. https://www.bis.org/publ/qtrpdf/r_qt1703h.htm/

Metaverse Post. (2023, November 14). Sergey Nazarov, co-founder of Chainlink | Metaverse Post. https://mpost.io/people/sergey-nazarov-co-founder-of-chainlink/

Quote.org. (n.d.). John Gutfreund's Quotes. https://quote.org/quote/proprietary-stockindex-arbitrage-is-but-one-aspect-227188/

Rizzo, P. (2021, September 11). Fidelity CEO talks "Love" for Bitcoin, Why Blockchain will "Change" markets. CoinDesk. https://www.coindesk.com/markets/2017/05/23/fidelity-ceo-talks-love-for-bitcoin-why-blockchain-will-change-markets/


GAIA
REPO
1RTRTA
LEARN DEFI
HYPERION
tETH
TRHX

ONE RATE TO RULE THEM ALL

EMPOWERING THE WORLD TO CONFIDENTLY NAVIGATE DIGITAL ASSETS

The Treehouse Protocol addresses a critical gap in the fixed income digital asset market by establishing a standard for decentralized reference rates. As the digital asset ecosystem expands, interest rate fragmentation and the absence of a benchmark rate have hindered the development of robust financial instruments comparable to those in traditional finance. The Treehouse Protocol aims to bridge this gap by leveraging smart contracts and a decentralized consensus mechanism to create two new financial primitives: Treehouse Assets *(tAssets)* and Decentralized Offered Rates *(DOR)*.

TREEHOUSE

Treehouse Labs is the parent brand of TRHX and Treehouse. The firm builds products that provide infrastructure, data, and standards, enabling people to invest in digital assets with confidence and foresight. Established in 2021, our team spans five locations and offers extensive expertise in traditional finance, digital assets, and data. By setting new benchmarks and creating robust financial tools, Treehouse aims to bridge the gap between traditional finance and digital assets.

Treehouse Labs

ISBN 978-981-94-0393-6

90000 >

9 789819 403936