

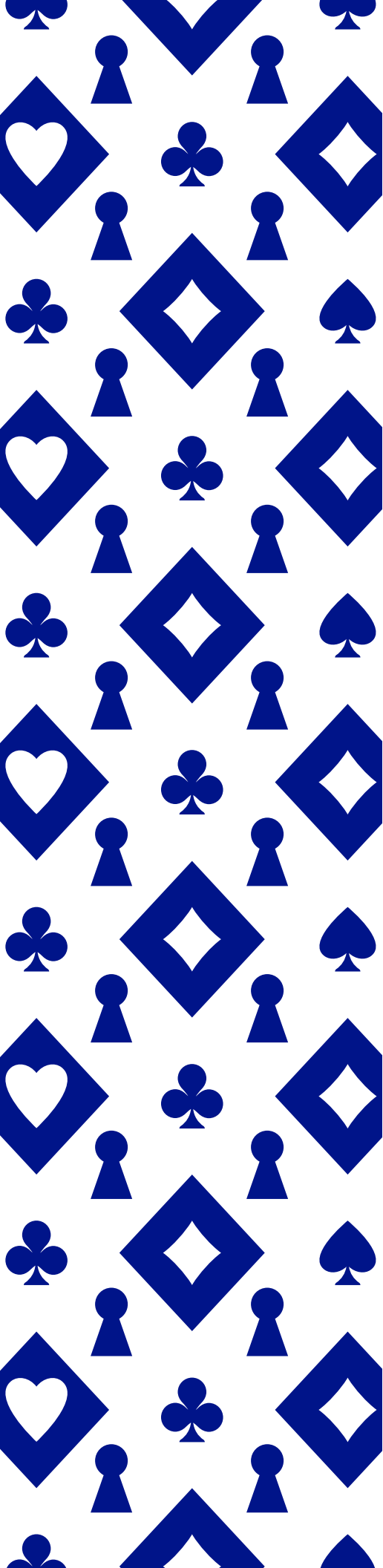
On Impossible Things Before Breakfast

A post-mortem on Terra, a pre-mortem on DeFi, and a glimpse of the madness to come



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“The Swiss National Bank is prepared to buy the Euro in unlimited amounts.”

- Swiss National Bank, announcing the Swiss Franc/Euro peg, September 2011

“Deploying more capital – steady lads.”

- Do Kwon, Terraform Labs, May 2022

“The Swiss National Bank concluded that enforcing the exchange rate for the Euro is no longer justified.”

- Swiss National Bank, abandoning the Swiss Franc/Euro peg, January 2015

“I am the master of stablecoins and I do not approve of this reality.”

- Do Kwon, Terraform Labs, May 2022

“You keep using that word. I do not think it means what you think it means.”

- Inigo Montoya, *The Princess Bride* on “yield” in DeFi

“Phase 1: Collect Underpants
Phase 2: ?
Phase 3: Profit”

- The underpants stealing gnomes, South Park on the economic fundamentals of DeFi

In 2011, the Swiss National Bank (SNB) introduced an exchange rate peg to the Euro, pledging to buy Euros in “unlimited amounts”, via printing Swiss Francs and trading them for Euros, to maintain a 1.2/1.0 exchange rate. Three years and approximately \$500 billion of printed Francs and purchased Euros later, markets forced one of the most powerful and respected central banks in the world to abandon the peg, instantly destroying an enormous amount of Swiss national treasure. At one point during the day of the de-peg, the Euro – including the staggering amount then owned by the SNB – crashed 30%.

What happened? The SNB’s reversal revealed the folly of currency pegs, joining a long list of well-intentioned, but poorly engineered, attempts to achieve a political outcome in defiance of financial gravity. Simply stating “the Euro is as good as the Franc” does not make it so, even if it was the SNB doing the talking.

In 2019, Terraform Labs founder Do Kwon introduced an exchange rate peg as part of a new (non) stablecoin, TerraUSD (UST). Via a dual mechanism, \$1 worth of UST could always be exchanged for \$1 worth of LUNA – the crypto token native to the Terra blockchain – and “unlimited amounts” of LUNA could always be printed and exchanged for UST. Kwon’s ecosystem shrouded itself in familiar terms such as “yield”, “deposits”, and “reserves” but the design was brittle. Three years and approximately \$60 billion worth of Luna and UST valuation later, a panicked market realized the peg’s fragility and abandoned it, destroying an enormous amount of wealth in the process. The value of UST and LUNA combined crashed 99%.

What happened? Kwon’s project revealed the folly of currency pegs, yet again. Like the monetary policies that ultimately blew apart the pegs of the US dollar (vs. gold in August 1971), the Thai baht (vs. USD in July 1997), the Argentina peso (vs. the USD in December 2001), and many others, LUNA’s monetary policy represented financial alchemy, certain to end in tears. Algorithmically permitting the printing of LUNA in “unlimited amounts” was the fatal design flaw, guaranteeing, *in advance*, that a UST bank run – and corresponding LUNA hyperinflation – was a possibility and, via Gresham’s Law, an inevitability. Simply stating “UST is as good as USD” does not make it so, even if a self-proclaimed (non)stablecoin master did not approve of that reality.

Prior to Terra’s implosion, observers distracted by the low hanging fruit of algorithmic stablecoins’ obvious design flaws may have missed the larger point about DeFi. Let’s get laser focused.

“YOU KEEP USING THAT WORD. I DO NOT THINK IT MEANS WHAT YOU THINK IT MEANS.”

The only sustainable source of yield is sustainable economic return, which in turn depends on the positive-sum game of employing capital to meet consumer needs in the real economy. Whether

distributed to investors or not, yield is the generated *flow* above maintenance costs or depreciation of the carrying capacity of some *stock* of economically productive assets. The revenue of any new business must eventually and sustainably exceed its expenses to provide the raw material for distributable yield. There is no other source. Calling something “yield” does not make it yield.

The most popular Terra-related product was Anchor, a lending protocol that advertised a 19.5% “yield” to “depositors” and which held about 75% of UST supply. Anchor’s “yield” was not sourced from sustainably profitable economic activity. Rather, Terra’s parent company periodically transferred portions of its \$30 billion treasury to Anchor. This meant that unless Terra could raise enormous sums of new funding indefinitely, it would eventually run out of money to pay Anchor’s promised “yield” to UST investors. Health warning: if the source of “yield” in a DeFi project is not obvious, sustainable, and easily explainable – and especially not **“money from future investors”** – do not invest. Phase 2 cannot be “?”.¹

Because exactly 100% of start-ups are initially unprofitable, generating true yield *always* takes time and requires the development of differentiated, profitmaking skills. The laws of financial gravity operate such that no true yield can be generated instantaneously upon a firm’s launch, yet that is precisely how DeFi projects begin. This also means that DeFi “deposits” bear risk more akin to early-stage venture capital than debt, a distinction critically important for two reasons. First, DeFi “deposits”, despite their equity-like risk, have capped upside – the “yield” – so necessarily under-participate in a future project success state. Second, because of the preceding observation, “deposits” in DeFi have credit risk, which require in-depth credit analysis in a way that TradFi (“traditional finance”) deposits, nominally, do not.

Though we each bear responsibility for our own investment decisions, DeFi’s use of the TradFi term “deposit” naively or maliciously discourages necessary investor credit work. The appropriate risk-adjusted Anchor/UST “yield” might have been 50% or 75% or more, not merely 19.5%. Labelling DeFi’s equity-like investments as “deposits” soothingly under-warns investors of project risks while structurally causing upside under-participation.

To be clear, a 19.5% no-vol return has never, will never, and can never exist in finance. That’s simply not how markets work. Even Bernie Madoff only offered a 10% “yield”, and he had the deviant humility to sprinkle in some (made up) vol along the way.

¹ On the *Bloomberg Odd Lots* podcast, April 25, 2022, Sam Bankman-Fried provides an insightful, charming, and intellectually honest description of DeFi’s “?”, which includes the single most hilarious and searingly accurate context-setting sentence about DeFi projects we’ve ever heard: “Maybe for now ignore what it actually does or pretend it does literally nothing.” In completeness, Mr. Bankman-Fried went on to say, and we agree, that DeFi itself doesn’t automatically doom a project to failure. A project is a startup like any other and, at least conceptually, a good enough project may be able to overcome DeFi’s fundamental shortcomings. We’re skeptical.

There are other importantly misleading examples of DeFi's chosen terminology, not unique to the Terra project, which exacerbate DeFi system-wide fragility. We'll highlight two: The "De" in DeFi itself and the "Value" in Total "Value" Locked.

"If there's no meaning in it, that saves a world of trouble...as we needn't try to find any."

- The King, *Alice's Adventures in Wonderland*, on TradFi terms used in DeFi

If no individual or small group can affect fundamental system design and related market activity, we can reasonably call a system decentralized. In the calm before a DeFi project's storm, this state of decentralization is untestable, and the interim price level of any associated token is a signal-less indicator of system solvency and stability. If, when the bullets are flying, those in charge can invoke "Emergency Powers" and change important system design elements in Hail Mary attempts at salvation, the system is not decentralized.

DeFi is not decentralized.

The Terra ecosystem was not decentralized.

Terra initially sourced funding from LUNA token issuance apportioned to Terraform Labs at inception. Also funded by Terraform Labs, the Luna Foundation Guard (LFG) was a Singapore "non-profit" set up to help maintain the functioning of the UST system. Despite its innocuous sounding mission to "serve as a vital nexus of resources and guidance for an emerging DeFi technology stack," the LFG explicitly administered the system under Kwon's direction, with its centralized role growing as disorder unfolded.

During the UST/LUNA crisis, Kwon encouraged and directed LFG to liquidate its reserves to support the peg, un-throttle the governor on the pace of LUNA issuance,² and halt the underlying blockchain

² Packy McCormick, *Not Boring*, offered a priceless description of this specific challenge, in the context of the broader system design flaws:

"Imagine a bunch of monkeys standing in a cage on one end of a see-saw. Above them is a deadly flame, which they can all plainly see, but are a safe distance from. They look at each other and say, 'Well we're making 20% per year standing in this cage. If we all just stand on this side together, we'll be okay!' And all is well and good.

Occasionally someone does go to the other side of the seesaw, redeeming their funds. But the seesaw looks rock-solid, because for every monkey who walks to the other side of the see-saw the True Believers recruit someone new to the True Believer side, giving them a 20% APR pamphlet with Do Kwon's face on it. Then one day, a REALLY FAT, MEAN monkey stomps across the see saw to the other side. He's so fat, and so mean in his stomping, that in fact the seesaw tips upward just a tiny bit. 'Hey,' someone says, 'it's getting a little warm in here.' It's not like they're consumed by flames, but everyone in the room is reminded if just for a split second that there is Raging Hellfire above their heads.

Another monkey takes the chance to get out. The seesaw tips up a little more. The room gets a little warmer. More monkeys run out. Eventually, so many monkeys leave the room that the see-saw starts going weightless. Do Kwon and the designers of Luna foresaw such a situation. Their solution was to build a rate-limiter into redemptions, or slow the pace at which funds can be redeemed.

This is akin to putting a turnstyle on the cage, and allowing only 3 monkeys out per day. You can of course see the problem. The monkeys inside the cage are screaming their heads off. Their scalps are close to the flames, the skin is melting off their foreheads. They're shaking the bars, desperate to escape. They see the few monkeys getting out, and they want out too. Now—you're Do Kwon and you have the key to the cage. What do you do? If you open the floodgates, any monkeys left on the seesaw will get incinerated. If you lock the cage, the monkeys scream ever louder, panicking that they'll never get out, calling your project a ponzi, ruining the day they ever entered the cage.

And that's Terra-Luna in a nutshell."

itself via simple coordination of a small node validator set. As is so often the case in DeFi, peacetime **decentralized** governance swiftly gives way to wartime **centralized** governance when a crisis arises. Under duress, character emerges.

Centralizing decision making of purportedly decentralized DeFi systems should not be surprising for any project built on non-Bitcoin blockchains, given Ethereum's "original sin." When the Ethereum DAO was exploited in June 2016 and 3.6 million ether tokens were stolen, the centralized nature of the protocol allowed for a reversal of the timechain and therefore a reversal of the theft. So much for decentralization.³

In any organization, culture starts at the top. The 2016 Ethereum reversal set the standard for all DeFi behavioral norms to follow. Ethereum's wartime pivot to centralization forever normalized purportedly decentralized – but actually centralized – reversals of any non-approved realities, a power used and abused by DeFi repeatedly ever since, most recently by Kwon. These periodic, and predictable, attempts at reality reversal represent daytime theft by the rulers of the ruled, no different or better than the crisis playbooks of central banks. Decentralization for thee, not for me.

“Gotta pump those numbers up. Those are rookie numbers in this racket.”

- Mark Hanna, *Wolf of Wall Street*, on “Total Value Locked” in DeFi

Perhaps the most common metric employed to appraise and value DeFi tokens, “Total Value Locked” (TVL), represents neither “total”, nor “value”, nor “locked.” 0 for 3. Focusing on “value”, first recall that collateral means something pledged as security for the repayment of a loan and is *always* an asset, never a liability. A canonical example of collateral is the home in the context of a mortgage. The value of the home is the V in the Loan-to-Value (LTV) ratio and the size of the mortgage is the L. Rehypothecating the home itself – the collateral – is not a thing.

In contrast, DeFi projects often represent, and rely on, a series of rehypothecations. The “collateral” in one application can be used in others, ad infinitum. Thus, the “V” in TVL refers to gross, system-wide *notional* value – achieved via unboundedly numerous, and necessarily opaque, rehypothecations – entirely unrelated to the concept, and indeed essentially the opposite, of true collateral.

Without an accounting of true collateral, DeFi allows no possible tracking of the degree of resultant

³ Ethereum's currently proposed changes to staking, and the addition of sharding, may further centralize the network. Staking empowers large institutions and individuals holding the most coins to control the network, and staking pools, especially, would concentrate power. Sharding makes node operation costlier while increasing the difficulty of recording the state of the network, reducing accessibility and individual (i.e., non-institutional) impact. The changes are akin to imposing a massive regulatory burden on an industry, which disproportionately benefits the largest firms, often the key objective when industries surreptitiously lobby for *more* regulation.

system-wide leverage, only the gross notional. A larger gross notional, “V”, is perversely perceived as a sign of system strength, insidiously attracting more and more fresh capital into the project. This is akin to measuring the health of a bank by its assets, not its equity. In 2008, for a moment, the acquisitive RBS (Royal Bank of Scotland) was proudly the “biggest bank in the world.” By assets. Insolvent at the time, RBS’s shareholders subsequently lost 87%.⁴

In the “words do not mean what we think they mean”-world of DeFi, investor attraction to a high “V” can perversely sow the seeds of a project’s demise. A high “V” alerts hackers to the decentralized prize (see Ronin [2022], Poly [2021], Wormhole [2022], BitMart [2021], Beanstalk [2022], Compound [2021], Vulcan [2021], Cream [2021], and Badger [2021] for recent thefts over \$100mm), while, in a different context, “V”-driven ecosystem leverage primes algorithmic stablecoins to topple at their first true test of fragility (besides Terra [2022], see Nubits [2018], Empty Set Dollar [2020], Basis Cash [2020], Iron/Titan [2021], with more to come).

Coming back full circle to Anchor’s 19.5% “yield”: because the total ecosystem leverage is un-audited and *un-auditable*, the appropriateness of the “yield” level is un-underwritable. There is simply no way of knowing if the “yield” is sufficient compensation for the credit risk. This makes DeFi un-investable.

“It was all very well to say ‘Drink Me,’ but...I’ll look first and see whether it’s marked ‘Poison’ or not.”

- Alice, *Alice’s Adventures in Wonderland*, on why she passed on Terra-related investment opportunities

Other aspects of the LUNA/UST set-up, *in foresight*, were even worse than the inadequate 19.5% Anchor “yield.” For example, investors needed to first buy LUNA to subsequently mint UST, and only then could they deposit the UST in Anchor. In this process, some LUNA is burnt (i.e., supply decreased) putting upward pressure on LUNA’s price and temporarily masking the fundamental insolvency of the system. As long as LUNA’s price went up and UST’s “yield” was being paid, Anchor and the entire ecosystem *appeared* to be working. LUNA’s hyperinflationary spiral hadn’t (yet) been triggered, and there was no difficulty maintaining the UST peg.

There is a nuanced circularity to this process. LUNA’s price rise sent a false signal that “all is well” which, combined with Anchor’s 19.5% “yield” attracted more and more capital into the system, further strengthening LUNA’s floor price through its burning process. Rinse, wash, repeat.

⁴ A centralization-enabled bailout confiscated earned wealth from the unfavored general public and bestowed it on the favored RBS shareholders, saving them the remaining 13%, thereby institutionalizing, incentivizing, and rewarding moral hazard of those closest to the fiat monetary spigot, yet again.

The reverse of that process – a so-called “death spiral” – was inevitable. Any time the immeasurably over-levered global fiat monetary system, *for whatever reason*, experienced one of its periodic external shocks that skyrockets immediate demand for actual US dollar liquidity, UST investors would demand USD liquidity faster than the brittle and fundamentally flawed Terra ecosystem could provide. At some point, one UST would be worth materially less than one USD, further rattling investors and kicking off a classic bank run. *Worse, with algorithmic certainty, the UST bank run would be accelerated by a corresponding hyperinflation in LUNA.*⁵

This is exactly what happened. Just as the global capital market shocks of March and April 2020 drove sudden, insatiable demand for USD liquidity, the shocks of April and May 2022 did as well. As the most levered risk assets crashed, USD liquidity demand skyrocketed, and Terra’s systemic weaknesses were revealed. UST collapsed from \$1 to \$0.05 while LUNA collapsed from a high of \$116 to zero. And...it’s gone.

“What do you mean you’re going to pass? The only people making money passing are NFL quarterbacks and I don’t see a number on your back.”

- Seth Davis, *Boiler Room*, pitching LUNA on Twitter

Several sophisticated financial institutions profited enormously from this penny-stock-like “pump and dump”, with old school boiler room promotional phone calls to unsuspecting retail buyers replaced by “look how cool I am” Twitter brags from the principals of the institutions propelling the pump. The institutions, of course, sold before the dump.

Sadly, on behalf of Terra’s retail believers, the wisdom of P.T. Barnum has aged well. Sadly, on behalf of Terra’s institutional exploiters, the teachings of the Golden Rule have not. The common theme among the nine-figure fortune-makers was expert grounding in macro trading and deeper knowledge of currency pegs than their average Twitter disciple. Even the peg-blowing hedge funds in 1992 (British pound) and 1997 (Thai baht) didn’t *pump* the currencies of the pegs they destroyed.

A critique of the many current critiques of the UST/LUNA debacle is that they merely represent *after-the-fact*, “I told you so” piling on. That’s false. *Well in advance*, many commentators, including the authors, shared UST/LUNA warnings via Twitter, blogs, private emails, and the masterpiece⁶ *Only the Strong Survive*, notably published in September 2021, which – from first principles –

⁵ Indeed, LUNA token supply went from 725 million to about 7 trillion in less than two weeks, including the addition of 6.7 trillion in a single day. For perspective, the worst two-week periods of the Weimar Republic or Zimbabwe hyperinflations never approached this debasement pace.

⁶ Adjective selected by Carter and Stevens.

powerfully and presciently warned of forthcoming DeFi blowups. In the harrowing words of Harry Markopolos,⁷ “no one would listen.”

So we’ll repeat, again in advance: no matter how well intentioned, *all algorithmic stablecoins will fail* and the vast majority – possibly all – of DeFi’s current versions will fail, where “fail” here means not gaining sufficient critical mass to matter, being hacked, blowing up, or being altered by regulation to the point of non-viability.

In the end, the Terra project could control the supply of its money, but it couldn’t make its people value it. A printing press was the only (non)answer. Sound familiar? Lacking a lender of last resort, DeFi (re)creates the problems solved by central banks. Bitcoin solves the problems created by central banks.

“THE FUTURE’S SO BRIGHT, I GOTTA WEAR SHADES.”

- Timbuk 3 on DeFi LiFi

Imagine an ecosystem in which the building blocks of financial and capital markets are freely accessible to all without navigation of technical bottlenecks or economic middlemen; in which their workings are transparently inspectable and auditable on the basis of free and open-source code; in which the architecture of all marketplaces operate on these principles; in which this constitution lends itself naturally to programmability at origin and interoperability thereafter; and, in which, due to the combination of the aforementioned factors, no individual or entity can maliciously or politically impact market activity in any form, including advantaging themselves or disadvantaging others.

The *concept* of decentralized finance is powerful, noble, and worthy of a lifetime of focused effort.

Such a financial system would be censorship resistant and secure, with collateral that *is collateral*, and sustainably low transaction fees. Yield would mean yield. Deposits would mean deposits. A is A.

“It’s no use going back to yesterday, because I was a different person then.”

- Alice, *Alice’s Adventures in Wonderland*, on why she’s now coding LiFi applications

The Lightning Network will allow anyone – individuals, SMEs, institutions, etc. – to send domestic or international payments of any size, with unlimited frequency, without bank intermediaries, nearly instantly, and essentially for free. It does this via a network of payment channels (visually think

⁷ Markopolos valiantly spent almost a decade repeatedly warning the SEC, and institutional investors, that Madoff was a Ponzi scheme. His riveting book recounting his failure is titled, *No One Would Listen: A True Financial Thriller*.

“tubes of moving money”) that settle balances between users on the Bitcoin network only when those channels close. Lightning node operators process transactions through these channels and collect small fees for doing so. Like the telephone, Lightning is a “network effect” technology. The more users, the better the user experience.

Lightning facilitates the development of an emerging ecosystem of Lightning-based financial products, called LiFi (“Lightning Finance”), which leverage the security, transparency, and decentralized nature of Bitcoin. For example, liquidity marketplaces built on Lightning allow users to remain in control of their funds at all times, *even when term-borrowed by others*, eliminating counterparty risk. In this set up, credit-risk-free yield *is* available – with cryptographic payment certainty – purely as compensation for forgone liquidity access. Lightning’s market-driven yield curve, therefore, represents the true time value of sound money. Also, rehypothecation of collateral within the system, as in our canonical home-as-collateral example earlier, is not a thing, *and mechanically cannot be a thing*: bitcoin committed to a Lightning channel is cryptographically escrowed working capital. There’s a lot to like.

Lightning payments have historically been thought of as *data relaying encrypted payment instructions*. However, we can turn the network’s original purpose on its head and consider the ground-breaking possibility of *payments relaying encrypted data*. This solves the problem in distributed systems of who sustainably subsidizes the means of achieving privacy. Lightning achieves this natively given sufficient demand for payments which, in turn, allows for creatively limitless native and programmable digital asset issuance.

Three powerful, emerging LiFi asset issuance use cases are stablecoins, NFTs, and tokenized securities. First, considering stablecoins, note that non-Bitcoin stablecoins like Tether or USDC jump around from chain to chain – “Solana and Ether and TRON, oh my!” – based solely on highly varying transaction fees, underscoring the fragility of those chains. While certain existing stablecoins have achieved scale and proof of concept, all non-Bitcoin protocol designs necessitate stablecoin transaction fees that increase with use. Token “supply” cannot come online to ease fee pressure. Lack of supply response to increased demand, of course, is precisely the reason DeFi tokens can have even temporary value in the first place.

In sharp contrast, Lightning represents a bootstrapped and decentralized fee market. As usage increases and transaction fees rise, return-seeking idle bitcoin is enticed onto the Lightning network. A routing market spontaneously organizes driving prices down to the point they satisfy the lowest marginal idle bitcoin contributor to the network, *growing in response to demand*. This incentive system, combined with Lightning’s brilliant obviation of a global consensus mechanism, enables

sustainably lower payment fees,⁸ a game-changer in developing economies, where large – and unpredictably very large – non-LiFi stablecoin fees make very small payments non-economical or impossible altogether.

Bitcoinizing the dollar – making it truly decentralized, private, secure, and nearly free to digitally move – would be life changing for the billions of people living under authoritarian regimes, and/or those suffering from double or triple-digit inflation. As long as US dollars are relevant, a goal is to have them as far outside of local government pressure or control as possible but rendered digitally for safety and ease of transport. Stablecoin purchasing power will never be fully outside of government influence due to debasement, but USD today is the globally leading FX brand, and far better than any local currency in high inflation, authoritarian neighborhoods. Designed for “all of the countries you can’t name”, USD-based stablecoins on Lightning represent LiFi’s most urgent use case and can serve as a bridge money while at-risk individuals climb the Bitcoin knowledge and adoption curve.

Second, consider truly decentralized tokenized securities, leveraging Bitcoin’s decentralization and digital scarcity. For example, imagine a future in which centralized custody and settlement – a \$20 billion anachronistic industry – is irrelevant to securities trading, with error-free automated payouts requiring only code, replacing costly administrative overhead. Or imagine transaction royalties on trades that a) subsidize decentralized venues, or b) subsidize liquidity providers, or c) any utilization of programmable value creatively imaginable. For example, a higher royalty could, with precision, incentivize longer term holding periods, re-routing capital back from financial markets to the real economy.

Finally, consider NFTs. Think beyond JPEGs and imagine a global transportation layer and ownership technology for intangible assets of all kinds: collectibles, art, gaming, brands, culture, memes, metaverse. NFTs leveraging Lightning – including off-chain minting, on-chain confirmation, and powerfully customizable M of N key management – can deliver superior creator economics. This can drive a self-reinforcing, positive selection process, as the best creators have the most confidence in their work and resulting consumer appeal; appropriately, they want to keep maximum economics for themselves. Time is of the essence because path dependency matters, and decentralization is profoundly important for a better digital world. Meta’s proposed take rate on their metaverse is 47.5%. Ugh. It’s time to get going with haste.

⁸ Lightning allows unboundedly many transactions between the opening and closing on-chain fees, effectively amortizing the on-chain costs across all in-between Lightning transactions. In addition, Lightning nodes can be run on commoditized hardware or in the cloud, very inexpensively. In contrast, transactions on other non-Bitcoin chains incur the full on-chain network fees each time.

"ONE CAN'T BELIEVE IMPOSSIBLE THINGS"

- Alice, *Alice's Adventures in Wonderland*, noting that Bitcoin changed her worldview

True decentralization removes reliance on trusted intermediaries, enabling the sacred ethos of *not your keys, not your coins*. The corollary – *your keys, your coins* – eliminates obfuscated rehypothecation, reliance on a “founding team”, or liabilities of any kind. Combining the characteristics of pure equity and a self-custodied bearer asset, Bitcoin – now enhanced by LiFi – delivers creatively limitless asset issuance opportunities, supported by uncatchably efficient transport. We find ourselves bursting with wonder, believing impossible things, and bracing for the awesome madness to come.

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