BANCA D'ITALIA

EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

What if Ether Goes to Zero?
How Market Risk Becomes Infrastructure Risk in Crypto

by Claudia Biancotti

January 2026

Number 74

BANCA D'ITALIA
EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

What if Ether Goes to Zero?
How Market Risk Becomes Infrastructure Risk in Crypto

by Claudia Biancotti

Number 74 – January 2026

The papers published in the 'Markets, Infrastructures, Payment Systems' series provide information and analysis on aspects regarding the institutional duties of the Bank of Italy in relation to the monitoring of financial markets and payment systems and the development and management of the corresponding infrastructures in order to foster a better understanding of these issues and stimulate discussion among institutions, economic actors and citizens.

The views expressed in the papers are those of the authors and do not necessarily reflect those of the Bank of Italy.

The series is available online at www.bancaditalia.it.

Printed copies can be requested from the Paolo Baffi Library: richieste.pubblicazioni@bancaditalia.it.

ISSN 2724-6418 (online)
ISSN 2724-640X (print)

Banca d'Italia
Via Nazionale, 91 - 00184 Rome - Italy
+39 06 47921

Designed and printing by the Printing and Publishing Division of the Bank of Italy

WHAT IF ETHER GOES TO ZERO? HOW MARKET RISK BECOMES INFRASTRUCTURE RISK IN CRYPTO

by Claudia Biancotti*

Abstract

Permissionless blockchains, the most common type of settlement infrastructure for crypto, continue to attract increasing attention from within the traditional financial system. Using these types of blockchain may have the added advantage of lower cost and higher speed as compared with their legacy solutions. There is, however, an oft-overlooked, close link between volatile crypto prices and infrastructure availability and security. Permissionless blockchains are operated by decentralized sets of independent validators, usually compensated in unbacked crypto-assets – known as native tokens. Should such tokens incur a substantial and persistent loss in market value, validators might cease operations. Transaction settlement could slow or stop, and the infrastructure's exposure to cyberattacks could increase.

JEL Classification: G15, G23, O30.

Keywords: permissionless blockchains, cryptoassets, financial infrastructure, cyber risk.

Sintesi

Le blockchain permissionless, le infrastrutture di regolamento più comuni nell'ecosistema cripto, suscitano crescente interesse nel settore finanziario; la loro adozione potrebbe offrire vantaggi in termini di costi e velocità rispetto alle soluzioni tradizionali. Esiste però un legame stretto, spesso trascurato, tra la volatilità dei prezzi delle criptoattività e la disponibilità e la sicurezza di queste infrastrutture. Le blockchain permissionless sono gestite su base decentralizzata da una collettività di validatori tra loro indipendenti, di solito remunerati in criptoattività non garantite note come token nativi. Se tali token dovessero subire una perdita sostanziale e persistente di valore di mercato, i validatori potrebbero decidere di cessare le proprie attività. Il regolamento delle transazioni potrebbe rallentare o fermarsi del tutto e l'esposizione dell'infrastruttura agli attacchi informatici aumenterebbe.

* Bank of Italy, Directorate General for Information Technology.

CONTENTS

1. Introduction 7

2. Economic incentives in permissionless blockchains: the case of Ethereum 7

3. Impact of prices on validator activity 12

4. What happens on the way down? 14

5. Conclusions 16

1. Introduction[1]

Permissionless blockchains (henceforth, PBs) are the most common type of settlement infrastructure in the crypto space. There are several competing PBs, each of them supporting transactions in a set of assets (tokens). These sets can overlap, with the biggest assets – including large stablecoins – exchanged on many PBs. There is some degree of interoperability across PBs.

If a PB stops working for any reason, all assets it supports are affected. This may seem like an obvious consideration, true of any settlement infrastructure. In crypto, however, it carries a different weight, because the correct functioning and security of PBs can be affected by the market price of certain unbacked crypto assets. For example, in an extreme scenario where the price of the unbacked ether (ETH) token goes to zero, all assets on the popular Ethereum PB – including fully-backed stablecoins – could become impossible to transfer. Even if the infrastructure remained operational, some safeguards against transaction manipulation would be weakened, possibly enabling malicious actors to spend the same tokens multiple times. In other words, on PBs market risk for unbacked assets can morph into settlement and cyber risk for assets that are generally considered safer, such as stablecoins and tokenized stocks and bonds.

This paper explains why and briefly discusses the implications.[2]

2. Economic incentives in permissionless blockchains: the case of Ethereum

PBs are voluntary efforts. They only work until enough independent entities, the validators, decide to contribute to the network's operation and security (in the context of PBs, "network security" is often used as a synonym of "transaction integrity"). Anyone can be a validator, hence "permissionless".[3] Participation in validating transactions generally results in collecting rewards paid out in each PB's so-called native token, an unbacked cryptoasset.

In the following, we outline the economic incentive mechanisms for validators on Ethereum, the longest-standing multi-asset PB. The key concepts generalize to other widely used PBs, such as Solana, Tron, and BNB Chain. While the exact mechanisms differ, the underlying logic is similar.[4,5]

---

[1] I would like to thank Giuseppe Galano, Matteo Nardelli, Giovanni Veronese, Michele Savini Zangrandi, Giuseppe Zingrillo, and an anonymous referee for comments and suggestions. The opinions expressed in this paper are the author's and should not be attributed to the Bank of Italy. All data on the Ethereum ecosystem are current as of September 23, 2025.

[2] Governance, technology, and legal risks of PBs have been addressed in Basel Committee for Banking Supervision (2024), Novel Risks, Mitigants and Uncertainties with Permissionless Distributed Ledger Technology, BIS Working Paper 44. Potential benefits and risks of PB adoption in the traditional financial sector are also discussed in Bindseil, U. and O. Malekan (2025), Public Crypto Networks as Financial Infrastructures, SSRN, and a large number of online venues. To our knowledge, however, no existing work focuses on the link between volatility in crypto prices and infrastructure availability and security.

[3] There is some debate as to whether "permissionless" should be taken to mean that anyone can validate transactions, or that anyone can participate in any network activity, e.g. transactions and creation of smart contracts. In this note, we follow the most restrictive interpretation. For details see Basel Committee on Banking Supervision, *ibid*.

[4] Economic incentives are not the only factor driving the decision to become a validator. Indeed, in the early days of crypto, most validators were likely motivated by idealism and reputational considerations. These components still play a part today. This paper focuses on the economic drivers for validator behavior.

[5] A minority of PBs, e.g. XRP Ledger and Stellar, do not offer rewards in native tokens. In these cases, validators provide resources for securing the network without getting a direct payment in return. They may – and do – still contribute either because they have a direct economic interest in the infrastructure running smoothly (e.g. providers of on-chain financial services) or because they have non-economic motivations. Transaction volumes on PBs of this type are currently negligible when compared to PBs that follow the token reward model.

2.1 Background on Ethereum

The Ethereum PB was launched in 2015 by Russian-Canadian developer Vitalik Buterin and others. It was the first major turning point in crypto history after Bitcoin's 2009 launch.

While the stated aim of Bitcoin's creators was the introduction of a peer-to-peer payment system, Ethereum leverages the same technology to build a "world computer".[6] The Bitcoin blockchain only supports very simple operations, chiefly the creation and transfer of bitcoin tokens.[7] Ethereum does that with ETH ("native"[8]) tokens, but also enables the upload and execution of computer code (smart contracts) on the blockchain. Very popular use cases for this functionality are the issuance of new assets, for which Ethereum provides technical standards[9] and a simple procedure, and the provision of financial services – say, a smart contract can control a lending protocol, where users can deposit collateral in one cryptoasset and receive a loan in another without intermediaries, or a decentralized exchange.

At the time of writing, over 1.7 million different assets existed on the Ethereum blockchain,[10] although most had no market value.[11] Total capitalization on the PB amounted to over $800bn and was concentrated in the top 20 assets, which include the ETH token itself ($490bn) and two large dollar stablecoins ($140bn when combined). The Ethereum network was run by approximately 10,000 servers ("nodes") distributed over more than thirty countries, with the United States and Germany in the lead.[12]

A node is physical infrastructure that maintains a copy of the blockchain, i.e. the database containing all transactions that ever happened on Ethereum. Entities running nodes can be anonymous, just as ordinary users can, although on Ethereum and other large PBs it is quite common for industry players to run identified pools of nodes.

2.2 Transaction settlement: rules and economic incentives[13]

Besides hosting a copy of the blockchain, node operators can choose to participate in the process of transaction validation, which equates to settlement in traditional finance. This requires the creation of software agents known as validators. A node and a validator are not the same thing. A node can manage zero, one, two, or even thousands of validators. For example, US-based exchange Coinbase runs 120,000 of them. The total number of validators in the world is currently estimated at over one million.[14]

---

[6] See e.g. P. Apostolicas (2021), Explaining Ethereum: an Interview with Vitalik Buterin, Harvard International Review.

[7] This is the reason why in this note we do not discuss the Bitcoin PB, although it was the first – and, so far, remains the most technically robust – example of a settlement system secured on a decentralized basis through economic incentives. The 2021 Taproot Assets Protocol, a Bitcoin network upgrade, theoretically enables the issuance and transfer of other tokens on the Bitcoin PB. So far, however, it has seen little use. A dramatic fall in the price of Bitcoin would likely have a significant impact on the whole crypto ecosystem, including on the security and availability of other PBs, but not in the straightforward way described here for Ethereum and other PBs that are explicitly designed to support multiple assets.

[8] A native token is the original asset issued on a PB. It constitutes the unit of account for any costs and rewards related to participating in blockchain activity. On most PBs, it is the only token that can be used to pay transaction fees.

[9] Examples are the ERC-20 and the ERC-721 standards, respectively covering general-purpose fungible tokens and non-fungible tokens (NFTs).

[10] Source: Etherscan ERC-20 Token Tracker. The figure listed in the tracker provides a lower bound for the total number of existing assets, since it only refers to tokens that meet the ERC-20 standard.

[11] Anyone can issue a cryptoasset on a PB at very low cost, and most such assets end up failing, without being listed on any trading venue. According to recent estimates, the total number of existing cryptoassets issued across all PBs surpasses 37 million, but specialist data providers only track between ten and twenty thousand.

[12] Source: Ethernode. Both the number and the geographical distribution of nodes vary depending on the day.

[13] In the following, some technical and economic details are going to be simplified or omitted for the sake of clarity. For technical documentation see Ethereum.org. For a discussion of economic incentives see John, K., B. Monnot, P. Mueller, F. Saleh, and C. Schwarz-Schilling (2025), The Economics of Ethereum, Journal of Corporate Finance 91.

[14] Source: Beaconcha.in.

As user transactions are sent to the Ethereum network, they enter a queue called the mempool. Validators look at the mempool on a continuous basis and assemble pending transactions into blocks, or groups that will be settled simultaneously. Roughly every 12 seconds, or about 7,200 times per day, a validator is chosen at random to propose a new block, which is broadcast to the rest of the network and submitted to rotating sets of randomly selected validators for integrity checks ("attestation").[15] Once a qualified majority of the attesters have confirmed the proposed block's integrity, the block can be written to the blockchain.[16] This means that the transactions in that block are settled, i.e. become irreversible, and the network is ready for the next block.

What happens during block creation and settlement is crucial for understanding the relationship between ETH value and network availability and security. In this phase, two separate sets of incentives are at work – one drives participation in validation, which results in availability; the other keeps validators honest, which results in security.

Where participation is concerned, what matters are per-block rewards, also known as staking rewards (see below). Upon inclusion of a block in the blockchain, validators earn ETH from three sources. First, whenever a new block is created, the network issues some new ETH tokens and distributes them across both proposer and attesters for that block.[17,18] Second, the proposer appropriates the total fees ("gas") paid by users to submit transactions included in the block.[19] Third, the proposer appropriates profit created by leveraging the power to select and order pending transactions, e.g. by performing arbitrage across different exchanges.[20] This is called maximum extractable value (MEV). Both gas fees and MEV are, again, in ETH.

---

[15] Integrity checks include the verification of cryptographic signatures and verification that the proposer is not proposing contradictory transactions, such as the use of the same tokens for two different payments.

[16] Since several blocks can be validated at the same time, at any time there can be different competing blockchains, of which the longest one is chosen as a source of truth.

[17] Before a major network upgrade in 2022, this amount was fixed at 2 ETH. It now increases proportionally to the square root of total validators active on the network, implying that potential per-validator rewards go down as the size of the validator set increases.

[18] Excessive growth in ETH supply ("token inflation") is avoided by permanently destroying ("burning") a share of transaction fees paid for each block. The circulating supply has been stable at approximately 120 million tokens since September 2022. Token inflation is an ideologically charged issue in the crypto community. Bitcoin originally emerged from a cultural context deeply suspicious of traditional monetary and financial systems, and especially critical of central banks' power to increase money supply. Indeed, the total supply of bitcoin tokens is algorithmically fixed at 21 million. Some cryptoassets, such as Litecoin, replicate this scheme. Others, such as Ethereum and BNB, pursue a similar goal through burn rules. There is, however, a tension between keeping supply tightly limited and rewarding validators for their efforts with new issuance, irrespective of token price dynamics. A few popular protocols, such as Solana, have programmed inflation and no supply cap.

[19] Gas is measured in Gwei, a unit corresponding to 10^{-9} ETH. Each block can contain fees for a maximum of 30 million Gwei.

[20] For example, a validator may see that one user wants to sell 1 ETH against the USDC stablecoin on a certain decentralized exchange, where the going rate is $4,200 per ETH. Another user wants to buy 1 ETH with USDC on a different decentralized exchange, where the going rate is $4,202 per ETH. By inserting their own transactions on either side of the users', i.e. buying the ETH for $4,200 and reselling it for $4,202, the validator can appropriate the $2 difference net of any transaction fees. MEV is problematic because validators, besides arbitraging, can also engage in activity that resembles insider trading. One example is the so-called sandwich attack. For example, a user will place a buy order for a given token at a price of $10, indicating tolerance for "slippage", or price variation, of 2%. The validator may front-run the transaction, inserting their own buy of the same number of tokens right before the user's. If the token's liquidity is low enough, this will result in a price increase right after the validator's transaction. If the price increase is within the slippage margin, the validator will immediately resell the tokens to the user, appropriating the difference. According to recent estimates, at least $1bn of MEV was extracted on Ethereum over the course of 2024. For an institutional view on MEV see Auer, R., J. Frost, and J.M. Vidal Pastor, 2022, Miners as Intermediaries: Extractable Value and Market Manipulation in Crypto and DeFi, BIS Bulletin 58.

Network security is incentivized through the mechanism governing eligibility for validation duties. Each validator is created by depositing between 32 ETH ($134,000 at current prices) and 2048 ETH[21] ($8.58m) to an address managed by a smart contract. This is called staking.[22,23] Validators constantly monitor each other for malicious or negligent behavior, e.g. attempts to actively tamper with transaction data or failing to participate in attestations when selected. If any validator is caught cheating, a quota of its stake is removed ("slashed") and then destroyed ("burned"). Lesser offenses, such as prolonged downtime, are punished with smaller penalties.[24]

Malicious behavior is still possible if enough validators collude. A proposer can broadcast blocks with conflicting information and have them included in the blockchain if enough attesters are complicit. The most significant threat is double spending, whereby an actor sends tokens to a counterparty, obtains something valuable in return, and then reverses the payment by altering transaction history. This is easiest if the "something valuable" is off-chain – a good or service, or fiat money resulting from e.g. the sale of tokens on an exchange.[25]

This type of attack can work only if colluders make up over 50 per cent of all active validators for a sustained period, meaning that they must control over 50 per cent of all staked ETH. This value is called the "economic security budget" of Ethereum, i.e. the minimum investment necessary to attack the network successfully.[26,27] At the time of writing, the economic security budget amounts to about ETH 17m, or over $ 71bn, making an attack extremely unlikely.[28,29]

---

[21] Before the May 2025 Pectra upgrade, the stake was fixed at 32 ETH.

[22] This validation framework is called proof-of-stake, and it is different from the Bitcoin proof-of-work method in that it does not require extensive energy consumption. Ethereum was born as a proof-of-work network, then transitioned to proof-of-stake in September 2022. Solo staking, or running a validator node directly, implies a large upfront investment for the stake itself, one-time hardware costs that some estimates put at around $1,200, and recurring operational costs for energy and connectivity that vary across geographies and time but are generally trivial ($20-$30 per month in the US). Cybersecurity costs also must be factored in; in the absence of regulatory requirements, security choices and associated expenses can vary greatly. Large stakers with thousands of nodes can profit from economies of scale on all operational costs. Those who are not able or willing to stake at least 32 ETH to run a node can either participate in liquid staking (see note 32) or buy staking as-a-service for any amount of ETH. This is a form of financial investment, and it entails intermediation fees but not direct operational costs. Another possibility that eliminates the upfront cost of the stake is renting a node.

[23] The staked ETH cannot be withdrawn until a validator is retired from activity.

[24] Both slashing and lesser penalties are historically rare, because network participants are aware of the rules.

[25] Double-spending in the context of token swaps, e.g. a sale of ETH for stablecoins, is very difficult. Swaps in crypto are generally atomic, meaning that the two assets involved are transferred simultaneously. Even with a majority of validation power, it is not possible to reverse only one of the two transfers composing an atomic swap. Double-spending can still happen for non-atomic swaps, although it would be significantly more complex than double-spending when one leg of the transaction is off-chain.

[26] Sometimes, total staked ETH (without dividing by two) is used as a metric of security.

[27] The economic security budget references the cost of a double-spending attack. There are other possible types of attack requiring either 34 per cent or 67 per cent of aggregate stake. Some of them are equally, if not more, dangerous. For a deep dive on attack techniques, see this guide at Ethereum.org.

[28] While some state actors may have the resources to stage such an attack, it would be of interest only if the goal was disruption and loss of public trust in the Ethereum ecosystem, possibly coupled with profits from taking short positions on ETH and other tokens. Simple theft could hardly net the attackers more than the initial investment, also considering the difficulty of laundering proceeds on such a large scale.

[29] For an alternative reading, suggesting that large-scale adoption of permissionless blockchains may come with security costs in the order of tens of trillions, see E. Budish (2025), Trust at Scale: the Economic Limits of Cryptocurrencies and Blockchains, Quarterly Journal of Economics 140(1): 1-62. The author notes that "the economic security of a permissionless consensus protocol should be thought of not as a 0-1 variable that simply breaks at a threshold ρ, as in the classic distributed-consensus literature […], but as an incentive-compatibility constraint." For a permissionless blockchain to be secure, the flow cost of trust support (i.e. the amount of resources that validators are willing to commit

2.3 Validator profitability and market prices

Rewards from participating in validation can be quite volatile. On the one hand, a validator's expected earnings in ETH are affected by several factors – the total number of validators, which determines the probability of being selected as a proposer at any time[30]; gas fees, which are a function of variable demand for transactions; constantly changing opportunities for MEV; and variation in protocol rules. On the other hand, and more importantly, the dollar price of ETH is subject to sharp fluctuations.

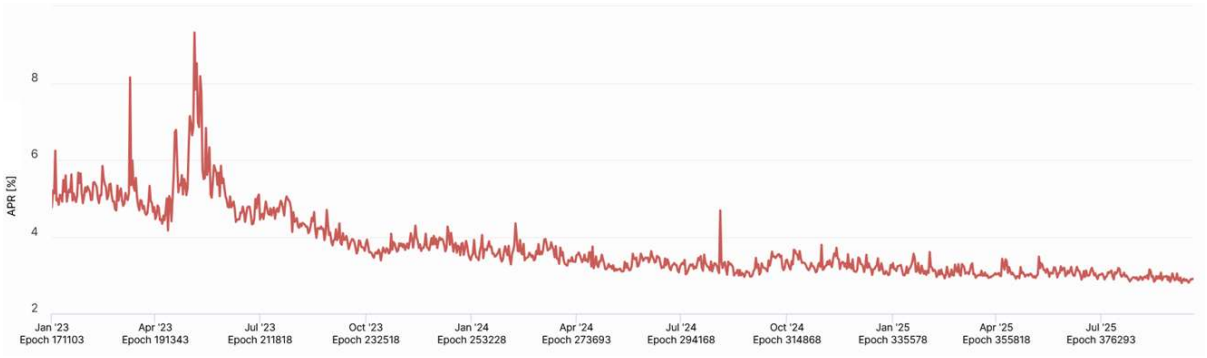
Figure 1 shows daily Ethereum block rewards (excluding MEV[31]) in percentage of total staked ETH for Lido Finance, a decentralized protocol that allows users to deposit ETH and collect staking rewards.[32] Lido accounts for roughly one quarter of all staked ETH. The trend shown in Figure 1 is representative of all centralized providers and decentralized protocols whose validator pool is large enough to smooth out glitches from randomness in proposer selection.[33]

Annual rewards were considerably higher at the start of the selected period, peaking at over 9 per cent in 2023 because of network congestion induced by a memecoin launch, and increased transaction fees. Over time, rewards fell as more validators came online and competition increased. Today, they have stabilized at around 3 per cent, or about 1 ETH per validator for the minimum stake of 32 ETH, although the path forward is unclear as Ethereum evolves.

On its own, annual return in the range of 3 per cent would probably not be interesting for a typical risk-loving crypto investor.[34] And, indeed, the volatility in ETH prices has largely overshadowed any oscillations in staking rewards.

Figure 1

Annual percentage return on staking (ETH), Lido Finance, January 2023 – September 2025



Source: beaconcha.in. "Epoch" on the X axis refers to Ethereum's internal calendar system (see note 29).

to secure the network) should always be relatively large compared to the expected value of an attack. In our framework, assuming that the value of an attack is measured in fiat currency – e.g. because the attacker double-spends stablecoins that are then converted into fiat – this would imply a constantly increasing value of a PB's native token as assets on the PB grow.

[30] The probability of being selected as an attester is fixed at exactly once every set of 32 blocks, or "epoch".

[31] Per-block MEV statistics for this operator were not available. The chart is therefore only based on rewards from block proposals/attestations and from gas fees. MEV can be expected to add a further 0.5-1% to total rewards, but today it is distributed across a complex supply chain and only a part of it accrues to the validators (see John et al, *ibid*).

[32] Once deposited into Lido's smart contracts, user-provided ETH are transferred for actual staking to professional node operators. For each ETH (or fraction thereof) deposited, users receive a so-called liquid staking token which accrues staking rewards. Liquid staking tokens are tradable. The protocol accounts for almost one third of all staked ETH.

[33] Often, these actors sell shares in their validators ("liquid staking tokens") to consumers who do not have or want to stake at least 32 ETH, and proportionally distribute staking rewards, minus an intermediation fee.

[34] In crypto circles, ETH staking rewards are often called "the risk-free rate" of the ecosystem.

Figure 2 shows the dollar price of ETH in the same time interval. An investor who bought 32 ETH to set up a validator in January 2023 and operated it throughout the period would now be sitting on an unrealized 250 per cent capital gain on the staked ETH. Conversely, an investor who bought and staked the 32 ETH at peak December 2024 prices would be suffering an unrealized 15 per cent capital loss.[35]

Figure 2

USD per ether, January 2023 – September 2025

Source: Investing.com.

3. Impact of prices on validator activity

In its first few months of life, back in 2015, ETH traded between $ 0.50 and $ 2. After several boom-and-bust cycles, partly following Bitcoin's fortunes and partly driven by idiosyncratic factors, the token achieved an all-time high of nearly $5,000 in November 2021. The 2022 crypto crisis brought the price below $ 1,000 again. As shown in Figure 2, strong volatility persisted into the following years.

3.1 Historical evidence

So far, turbulence in prices does not seem to have affected overall validator activity. Figure 3 shows that in the past two years the number of validators grew steadily, only to stabilize in H2 2024. Short-term volatility sometimes coincides with unusually high turnover in the validator set, but establishing causality is not straightforward, and the phenomenon remains modest in quantitative terms.[36]

There are a few possible explanations for this. Markets for unbacked crypto assets are driven mostly by investor confidence since there are no traditional fundamentals to anchor the price. In industry parlance, the steadfast conviction that "number go up", i.e. value will rise indefinitely in the long run, plays a key role.[37]

---

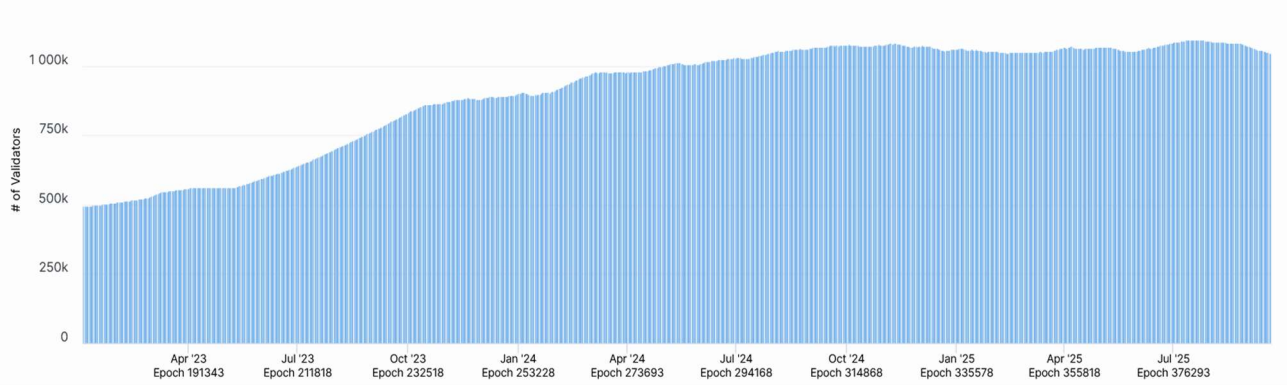
[35] A precise analysis of individual validator profitability, at least after Ethereum's 2022 transition to proof-of-stake, is theoretically possible because most necessary data are public, but it would be very resource-consuming.

[36] Recent validator queue data show that ordinary turnover is very low, with exit and entries combined involving fractions of percentage points of total staked ETH on an average day. Exceptional volatility appears to affect validator behavior non-linearly. Rapid token appreciation, for example, was followed by a surge in entries in both 2024 and 2025, but in the latter period there was also a surge in exits, peaking at an unprecedented 8 per cent of total staked ETH in Q3 2025. This suggests that price growth may make staking more attractive to some through an effect on expectations, while triggering immediate profit-taking behavior for others. Over the same period, price slumps were not accompanied by significant validator churn. Further work would be needed to disentangle price effects from other factors (source: Ethereum Validator Queue).

[37] This is most evident for Bitcoin, and also true for other tokens that are perceived by some as a store of value. Blockchain data shows that in May 2024 about 45 per cent of bitcoin and 32 per cent of ether had not been moved for

Figure 3

Total number of validators on Ethereum, January 2023 – September 2025



Source: beaconcha.in. "Epoch" on the X axis refers to Ethereum's internal calendar system (see note 29).

This may be especially true for token holders who also choose to run validators, reflecting a knowledge of and belief in the ecosystem exceeding that of casual participants. As long as their long-term expectations remain positive, they will keep staking even during highly uncertain times.[38] At present, while a repeat of the 2015-2025 2,000-fold growth seems unlikely, price expectations are likely to be optimistic on account of the pro-crypto US policy pivot, which also includes a drive for the adoption of PBs.[39]

As a secondary factor, the mechanism whereby per capita staking rewards increase as the validator pool thins may play a part in stabilizing the pool in the short run. Moreover, given market dynamics in the past ten years, very long-term ETH holders are still operating at a profit, and the price would need to crash quite dramatically for them to incur losses.

3.2 Possible triggers of confidence loss

A reasonable baseline prediction is that Ethereum will keep operating smoothly in the foreseeable future. Yet, especially as integration with the traditional financial system proceeds, edge cases must be accounted for.

A single market crash is unlikely to lead to validator exodus, if price recovery is expected.[40] On the other hand, a deep confidence crisis that affects long-term expectations could. Potential triggers may be:

at least three years, despite dramatic price changes. This is not a precise estimate, because it does not account for moves across different pseudonymous addresses controlled by the same entity, or for trades that happen within centralized exchanges. An exact comparison between Bitcoin and Ethereum is hard to draw because here are more reasons for an investor to move ether around compared to bitcoin (e.g. to post it as collateral on DeFi apps), so for Ethereum the share of unmoved coins is even more imperfect a proxy for actual holding times. Note that a share of those coins could be lost forever, on account of original holders not having access to their cryptographic keys any longer.

[38] ETH and other native tokens for popular PBs have a use value for transaction fees, they can trigger income flows via staking, and to some they may proxy for the perceived value of the infrastructure, even if they do not confer any claim on it. Still, as shown above, market price movements are what matters most in determining how profitable participating in the network is, and big swings historically were not driven by demand for transactions.

[39] See White House, Executive Order on Strengthening American Leadership in Digital Financial Technology, January 23, 2025; Office of the Comptroller of the Currency, Interpretive Letter 1183, March 7, 2025.

[40] The mechanism of expectation formation might change if traditional financial players enter the staking space. Such players might be more reactive to actual price signals and less motivated by the belief that crypto will ultimately succeed.

(a) internal to Ethereum, e.g. governance difficulties leading to instability in network rules and a perception of unreliability; [41]
(b) external to Ethereum but internal to the crypto ecosystem, e.g. a serious loss of confidence in Bitcoin, which ripples across the whole ecosystem,[42] or the emergence of a strong competitor in the space of multi-asset PBs, which performs significantly better than Ethereum in crucial areas such as scalability, settlement speed, or settlement cost;
(c) external to the crypto ecosystem, such as a major macroeconomic shock diverting capital flows from risk assets over the medium term, or a technological development providing a superior, non-blockchain alternative to PBs.

Triggers of different types might occur together and reinforce each other.

4. What happens on the way down?

4.1 From confidence to infrastructure crisis

In the event of a downward price spiral accompanied by persistent negative expectations, it is likely that stakers would want to sell their ETH as quickly as possible. This requires unstaking the coins, i.e. turning validators off. Asymptotically, no validators means that the network does not work anymore – users could keep on submitting transactions, but those would never be settled. Assets would still live on-chain, but they would be immovable.

This situation would not materialize immediately, because unstaking in Ethereum is not instant (see Section 4.2). In the interim, as the economic security budget went down and attacks became cheaper, malicious actors could take control of the network with the goal of double-spending assets or otherwise compromising transaction integrity. ETH with next to no value would not be desirable prey, but stablecoins and tokenized stocks or bonds would, especially if issuers were legally bound to reimburse them at face value. Malicious actors would eventually leave as well, leading back to the network halt scenario.

In practice, the consequences of a confidence crisis for ordinary holders of assets other than ETH would depend heavily on how orderly the unwind of the network is. This is quite difficult to predict. On the one hand, over the years crypto has shown some ability to spontaneously re-organize and come back even at very critical junctions, including major cyberattacks. On the other, nothing on the scale of major infrastructure breakdown has ever happened.

4.2 Limits of mitigation strategies

Since PBs are not subject to any regulatory framework, at present the possibility of an orderly unwind would depend entirely on technical safeguards built into the system and voluntary actions of participants.

The Ethereum protocol has built-in minimum unstaking times, which lengthen as more validators join the queue to get out.[43] In uneventful periods, unstaking and withdrawing the 32 ETH stake takes approximately 28 hours. Should many stakers join the queue at the same time, expected withdrawal times would be counted in weeks, or even months, because there is a daily cap to exits.[44] This would buy some time for network

[41] See, for example, The Ethereum Roadmap Wars, *Bankless* podcast. Governance is generally considered one of the weak points of PBs (BCBS, *ibid.*)
[42] This could go both ways depending on the cause of the loss of confidence. Bitcoin is perceived as the anchor for the broader crypto system, and so far the rest of the market has mostly echoed the token's gyrations. However, if the Bitcoin crisis was triggered by a highly idiosyncratic factor – say, the massive sale of coins that have so far been locked in wallets belonging to the mysterious creator(s) Satoshi Nakamoto –, Ethereum could benefit if perceived as a safer alternative.
[43] This mechanism was born as a security device, to prevent malicious actors from amassing massive stakes just to conduct an attack and liquidate them right after, thus minimizing losses related to any post-attack price fall.
[44] At present, the network can process about 3,600 validator exits per day.

availability,[45] and perhaps also for security, as it may slow price movements down. At this point, however, network participants would need to take action to forestall extensive damage.

Since there is no formal lender of last resort or crisis resolution mechanism in crypto, the choice of what to do would be left entirely to the incentives of individual actors. Ideally, all asset custodians, issuers, and even small owners would need to co-ordinate, to transfer their operations and holdings in an orderly fashion to another functioning PB before Ethereum is attacked, halts, or both – in a world where settlement is not intermediated, a flight to safety means a switch in infrastructure. There are, however, three roadblocks.

First, technology for such a transfer is indeed available, in the form of so-called bridges, but it is famously vulnerable to cyber attacks,[46] and it may not have the capacity to sustain a massive exodus.[47] Second, coordination of all participants in a decentralized network such as Ethereum, which spans the globe and includes actors with conflicting interests,[48] is not a realistic prospect. Third, about $85bn worth of various assets are locked in DeFi protocols,[49] whose governance mechanisms might prevent fast decisions.[50]

Deep-pocketed industry actors, such as top exchanges or stablecoin issuers, might also attempt to create a backstop – say, an emergency rescue fund to stabilize the price of ETH via massive buys. This would be very unlikely to work, especially if the confidence crisis was triggered by technological inferiority of Ethereum vis-à-vis a competing PB, or any other issue that is difficult to fix in short order. The market could doubt the credibility of the fund, or even outright attack it. Should the fund bleed out billions in the span of hours, sponsors would leave.

4.3 A possible outcome

Considering the history and current characteristics of crypto, one possible outcome would be staggered failure with partial asset recovery. The Ethereum Foundation, a non-profit which plays a loose steering role in Ethereum, and large corporate stakers might publicly commit resources to keep enough validators up at least for a given time span, which would be communicated transparently to prevent panic. This measure would supplement the automatic delays in validator exit and might have some success in keeping the network running for some weeks or months. Yet, it would not be enough to change the direction of the confidence crisis, so investors in ETH would eventually face significant capital losses.

During this period some centralized exchanges and issuers of assets, including stablecoins and RWAs, would be able to bridge at least part of their operations to other PBs, but the process could be very fraught. It would take time, and cyber attacks on bridges would multiply. Until clear signals emerge that a certain asset is safely living on another PB, it would be speculated against, possibly even leading to de-pegging of weaker stablecoins. In general, larger entities that already have multi-chain operations and nimble, technically

[45] Settlement issues, however, could start emerging even in an early phase. If many stakers just turned off their machines while waiting to be cleared for unstaking, settlement finality might be compromised.

[46] Most bridges work by locking or burning assets on a source PB, and minting them on the destination PB. This requires a complex architecture, featuring smart contracts on each of the PBs, and off-chain components that enable communication between the two sets of smart contracts. Vulnerabilities in even one of these components have resulted in large hacks. See Belenkov, N., V. Callens, A. Murashkin, K. Bak, M. Derka, J. Gorzny, and S.-S. Lee (2023), A Review of Cross-Chain Bridge Hacks in 2023, arXiv 2023: 2501.03423v1.

[47] Bridge throughput is capped by transaction-per-second limits for the slowest of the linked PBs, plus any congestion of the bridge itself. There is no historical data on how bridges perform under extreme stress, but chances are that they would strain under pressure, since they often rely on small internal validator sets.

[48] Saving the network may look like a goal that is worthy to all participants. In crypto, however, speculation is the norm and can prevail over common interest. Some actors might be looking to profit from the chaos and make a quick exit.

[49] Source: DefiLlama.

[50] The governance mechanism of choice for DeFi protocols is the Decentralized Autonomous Organization (DAO), where holders of certain tokens are eligible to vote on which direction development should take.

advanced frontier players would fare better compared to middling actors. A large share of value locked in DeFi would be lost to either liquidation of leveraged positions or hesitation in decisions to leave.

Should any malicious actor gain control of more than 50 per cent of the network, the first line of defense would be asset freezes and blacklisting. Centralized actors routinely block the circulation of stolen assets, either spontaneously or at the behest of law enforcement. Double-spending could be contained in a similar way. This is mostly not done on-chain and could therefore work even if the network was under attack. Still, freezes are only somewhat effective because money laundering in crypto is easy.

The Ethereum Foundation could intervene with a heavier hand by trying to impose a hard fork, or an authoritative overwrite of the blockchain, which would reverse illicit transactions. This may work one or two times, but persistent attacks followed by hard forks would dent confidence even more, also by inducing profound rifts in the crypto community.[51]

5. Conclusions

In this paper, we discussed how on PBs market risk for unbacked assets can morph into settlement and cyber risk for backed assets, using Ethereum as an example.

The implications for policymakers are not straightforward. Part of the financial industry is looking at adopting permissioned blockchains, where only authorized entities can run validators, and unbacked cryptoasset do not play a role. Such schemes also simplify compliance with AML/CFT regulation. Still, they come with higher costs compared to just plugging into Ethereum or Solana, and at least some adoption of PBs in their current form cannot be excluded – indeed, it already exists.[52]

Regulators have two options. The first is deeming PBs entirely unsuitable for adoption on the part of supervised intermediaries, on account of reliance on the prices of native tokens. The second option is permitting PB adoption, while putting risk mitigation measures in place. This stance is more favorable to innovation, yet it comes with significant challenges. Despite the existence of loose steering groups, PBs are decentralized by nature and can hardly be transformed into traditional infrastructure providers. Central banks cannot be expected to prop up the price of native tokens that are privately issued and subject to speculation just to keep the infrastructure running and secure.

Perhaps the best shot would entail putting obligations on the issuers of backed assets such as stablecoins – say, the adoption of business continuity plans, as suggested by the Basel Committee on Banking Supervision[53], whereby an off-chain database of asset ownership is kept, and a contingency chain is pre-selected for porting assets in case of disruption. There may be prohibitions on the adoption of PBs that do not meet certain in terms of economic security budget, or diversification of the validator set. Such measures do not come without their own costs and risk, such as artificially favoring legacy PBs over newer ones, which may even exacerbate risks inherent to a confidence crisis triggered by obsolescence.

Further work is needed to develop a consistent and effective policy approach.

[51] There is an important precedent for this. In 2016, a smart contract living on Ethereum was hacked, leading to large-scale theft of ETH. A hard fork reinstated the pre-hack situation, but also alienated Ethereum from a part of the crypto community, because hard forks imposed by a centralized entity do not sit well with pure-decentralization crypto ethics.
[52] See, for example, the BlackRock BUIDL Fund, a tokenized money market fund available on Ethereum and Solana. Total capitalization is still small, at under $3bn.
[53] *Ibid.*

Recently published papers in the 'Markets, Infrastructures, Payment Systems' series

n. 37 Smart Derivative Contracts in DatalogMTL, *by Andrea Colombo, Luigi Bellomarini, Stefano Ceri and Eleonora Laurenza*

n. 38 Making it through the (crypto) winter: facts, figures and policy issues, *by Guerino Ardizzi, Marco Bevilacqua, Emanuela Cerrato and Alberto Di Iorio*

n. 39 The Emissions Trading System of the European Union (EU ETS), *by Mauro Bufano, Fabio Capasso, Johnny Di Giampaolo and Nicola Pellegrini* (in Italian)

n. 40 Banknote migration and the estimation of circulation in euro area countries: the italian case, *by Claudio Doria, Gianluca Maddaloni, Giuseppina Marocchi, Ferdinando Sasso, Luca Serrai and Simonetta Zappa* (in Italian)

n. 41 Assessing credit risk sensitivity to climate and energy shocks, *by Stefano Di Virgilio, Ivan Faiella, Alessandro Mistretta and Simone Narizzano*

n. 42 Report on the payment attitudes of consumers in Italy: results from the ECB SPACE 2022 survey, *by Gabriele Coletti, Alberto Di Iorio, Emanuele Pimpini and Giorgia Rocco*

n. 43 A service architecture for an enhanced Cyber Threat Intelligence capability and its value for the cyber resilience of Financial Market Infrastructures, *by Giuseppe Amato, Simone Ciccarone, Pasquale Digregorio and Giuseppe Natalucci*

n. 44 Fine-tuning large language models for financial markets via ontological reasoning, *by Teodoro Baldazzi, Luigi Bellomarini, Stefano Ceri, Andrea Colombo, Andrea Gentili and Emanuel Sallinger*

n. 45 Sustainability at shareholder meetings in France, Germany and Italy, *by Tiziana De Stefano, Giuseppe Buscemi and Marco Fanari* (in Italian)

n. 46 Money market rate stabilization systems over the last 20 years: the role of the minimum reserve requirement, *by Patrizia Ceccacci, Barbara Mazzetta, Stefano Nobili, Filippo Perazzoli and Mattia Persico*

n. 47 Technology providers in the payment sector: market and regulatory developments, *by Emanuela Cerrato, Enrica Detto, Daniele Natalizi, Federico Semorile and Fabio Zuffranieri*

n. 48 The fundamental role of the repo market and central clearing, *by Cristina Di Luigi, Antonio Perrella and Alessio Ruggieri*

n. 49 From Public to Internal Capital Markets: The Effects of Affiliated IPOs on Group Firms, *by Luana Zaccaria, Simone Narizzano, Francesco Savino and Antonio Scalia*

n. 50 Byzantine Fault Tolerant consensus with confidential quorum certificate for a Central Bank DLT, *by Marco Benedetti, Francesco De Sclavis, Marco Favorito, Giuseppe Galano, Sara Giammusso, Antonio Muci and Matteo Nardelli*

n. 51 Environmental data and scores: lost in translation, *by Enrico Bernardini, Marco Fanari, Enrico Foscolo and Francesco Ruggiero*

n. 52 How important are ESG factors for banks' cost of debt? An empirical investigation, *by Stefano Nobili, Mattia Persico and Rosario Romeo*

n. 53 The Bank of Italy's statistical model for the credit assessment of non-financial firms, *by Simone Narizzano, Marco Orlandi and Antonio Scalia*

n. 54 The revision of PSD2 and the interplay with MiCAR in the rules governing payment services: evolution or revolution?, *by Mattia Suardi*

n. 55 Rating the Raters. A Central Bank Perspective, *by Francesco Columba, Federica Orsini and Stefano Tranquillo*

n. 56 A general framework to assess the smooth implementation of monetary policy: an application to the introduction of the digital euro, *by Annalisa De Nicola and Michelina Lo Russo*

n. 57 The German and Italian Government Bond Markets: The Role of Banks versus Non-Banks. A joint study by Banca d'Italia and Bundesbank, *by Puriya Abbassi, Michele Leonardo Bianchi, Daniela Della Gatta, Raffaele Gallo, Hanna Gohlke, Daniel Krause, Arianna Miglietta, Luca Moller, Jens Orben, Onofrio Panzarino, Dario Ruzzi, Willy Scherrieble and Michael Schmidt*

n. 58 Chat Bankman-Fried? An Exploration of LLM Alignment in Finance, *by Claudia Biancotti, Carolina Camassa, Andrea Coletta, Oliver Giudice and Aldo Glielmo*

n. 59 Modelling transition risk-adjusted probability of default, *by Manuel Cugliari, Alessandra Iannamorelli and Federica Vassalli*

n. 60 The use of Banca d'Italia's credit assessment system for Italian non-financial firms within the Eurosystem's collateral framework, *by Stefano Di Virgilio, Alessandra Iannamorelli, Francesco Monterisi and Simone Narizzano*

n. 61 Fintech Classification Methodology, *by Alessandro Lentini, Daniela Elena Munteanu and Fabrizio Zennaro*

n. 62 The Rise of Climate Risks: Evidence from Expected Default Frequencies for Firms, *by Matilde Faralli and Francesco Ruggiero*

n. 63 Exploratory survey of the Italian market for cybersecurity testing services, *by Anna Barcheri, Luca Bastianelli, Tommaso Curcio, Luca De Angelis, Paolo De Joannon, Gianluca Ralli and Diego Ruggeri*

n. 64 A practical implementation of a quantum-safe PKI in a payment systems environment, *by Luca Buccella and Stefano Massi*

n. 65 Stewardship Policies. A Survey of the Main Issues, *by Marco Fanari, Enrico Bernardini, Elisabetta Cecchet, Francesco Columba, Johnny Di Giampaolo, Gabriele Fraboni, Donatella La Licata, Simone Letta, Gianluca Mango and Roberta Occhilupo*

n. 66 Is there an equity greenium in the euro area?, *by Marco Fanari, Marianna Caccavaio, Davide Di Zio, Simone Letta and Ciriaco Milano*

n. 67 Open Banking in Italy: A Comprehensive Report, *by Carlo Cafarotti and Ravenio Parrini*

n. 68 Report on the payment attitudes of consumers in Italy: results from ECB SPACE 2024 survey, *by Gabriele Coletti, Marialucia Longo, Laura Painelli, Emanuele Pimpini and Giorgia Rocco*

n. 69 A solution for cross-border and cross-currency interoperability of instant payment systems, *by Domenico Di Giulio, Vitangelo Lasorella, Pietro Tiberi*

n. 70 Do firms care about climate change risks? Survey evidence from Italy, *by Francesca Colletti, Francesco Columba, Manuel Cugliari, Alessandra Iannamorelli, Paolo Parlamento and Laura Tozzi*

n. 71 Demand and supply of Italian government bonds during the exit from expansionary monetary policy, *by Fabio Capasso, Francesco Musto, Michele Pagano, Onofrio Panzarino, Alfonso Puorro e Vittorio Siracusa*

n. 72 Statistics on tokenized financial instruments: A challenge for central banks, *by Riccardo Colantonio, Massimo Coletta, Riccardo Renzi*

n. 73 Credit Risk Assessment with Stacked Machine Learning, *by Francesco Columba, Manuel Cugliari, Stefano Di Virgilio*