Reorganization and Participation in Decentralized Platform Ecosystems: Evidence from Blockchain Forking

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Abstract

Like any organizational system, platform ecosystems reorganize to update its alignment with the internal and external environments. However, unlike reorganizations of centrally managed platforms performed by the owners, reorganizations of decentralized platforms ecosystems do not rely on formal authority. Instead, the network self-reorganizes to renew the structure, rules, and information to evolve. Little is known about how self-reorganizations influence the participation of various types of networks. In this study, we investigate nine reorganization events on Ethereum, a blockchain-based decentralized smart contract platform, to unpack how self-reorganization related to hard forking influence participation in the development, validation, transaction, and complementor networks. We find that, while participation increases across all networks show a small increase after hard forking events, more complex dynamics are at play within each network that builds on delicate trade-offs between participation structure, configuration, and incentives. Our findings have implications for blockchain research as well as for start-ups building decentralized applications on top of decentralized smart contract platforms.

Keywords: Blockchain, reorganization, Ethereum, platform ecosystems, self-organizing.

1. Introduction

All organizational systems necessarily reorganize. Reorganizations refer to the periodic re-grouping, restructuring or reconfiguration of key dimensions—task division, task allocation, reward allocation, and information flow of an organization design (Puranam, 2018; Tushman & Nadler, 1978). Reorganizations are necessary because they renew the strategy, structure, and configuration of an organizational system to various degrees to ensure efficiency and effectiveness. Note that reorganizations are ubiquitous and are not limited to hierarchical organizational systems (e.g., corporations), whose reorganizations are typically administered from the top down through managerial authority (e.g., Raveendran, 2020; Baker & Cullen, 1993).

Platform ecosystems, as a collaborative organizational form, also regularly reorganize to fit the internal and external environments (Bearson, Kenney & Zysman, 2021; Gulati, Puranam & Tushman, 2012; Kenny & Zysman, 2016; Kretschmer, Leiponen, Schilling & Vasudeva, 2020). While building on a relatively stable architectural core, digital platforms keep their components flexible and, in some cases, modular, to allow for viable and regular updates (Henderson & Clark, 1990; Boudreau, 2010, 2012; Fjeldstad, Snow, Miles, & Lettl, 2012). Consistent with literature on reorganization, which mostly focuses on corporate-led reorganizations at the subunit (Raveendran, 2020) and top management (e.g., Baker & Cullen, 1993) levels, platform ecosystem reorganizations are typically led by platform owners as the "leaders" in a centralized way (Gawer & Cusumano, 2002). While scholars have discussed how actors in a platform ecosystem coevolve with the architecture (Tiwana, Konsynski & Bush, 2010), and how platform reorganization can reconfigure value creation among complementors and in related industries as a whole (Chen, Yi, Li, Tong, 2021), little is known about the substantive nature of platform ecosystem reorganizations and their implications for participants (e.g., complementors).

Unsurprisingly, even less understood is the reorganization of non-hierarchical, self-organized, and decentralized platform ecosystems enabled by decentralization technologies such as blockchain. Consistent with the meta-organization literature, we define decentralized platform ecosystems as an organizational system with autonomous actors not

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linked through form al contracts or managerial authority (Gulati et al., 2012). In the absence of a central "leader", reorganizations of decentralized platform ecosystems rely on collective action to migrate the network of actors from one state to the next. Decentralized coordination and reorganization are difficult, as disagreements can lead to a network splits not just at the technical level, but at an organizational level, affecting the health of the ecosystem (Arrow, 1951/2012; Simcoe & Watson, 2019).

In this study, we focus on non-hierarchical platform ecosystems that self-reorganize, and the implications of self-reorganizations for actors' participation in various networks in the ecosystem. Intriguingly, despite the absence of a platform leader, reorganizations of decentralized platform ecosystems are also ubiquitous. Similar to a corporate reorganization, an ecosystem self-reorganization can take place to various extents and in different parts of the network. Ecosystem reorganizations can be fundamental and architectural, for instance, pertaining to migrating the entire network to a new design that involves a distinct set of rules, routines, and processes. On the other hand, ecosystem reorganizations can also be incremental and peripheral, which do not require consensus from participants (Puranam, 2018: 123-124)[1]. Timing also matters (Raveendran, 2020). Some reorganizations are short bursts of inconsistencies, while others can have a prolonged impact before and after the actual shift happens. Arguably, decentralized platform ecosystems consist of interdependencies that make reorganization complex, as there will be more realignments to be performed in any reorganization attempt.

In particular, decentralized platform ecosystems such as ecosystems supported by blockchain infrastructure, depart from our understanding of orchestrated ecosystems in that they are not managed by corporations. No one has unilateral power over the evolution of the platform, even the developers and validators who contribute work to building and sustaining the infrastructure cannot impose changes to the entire ecosystem. Changes are enacted based on consensus regardless of the scale and scope. Thus, self-reorganization of decentralized platform ecosystems reveals several gaps.

First, literature on reorganization almost solely focuses on corporate reorganization at the business-unit level (e.g., Karim, 2009; Raveendran, 2020). However, reorganization should be relevant to *any* type of organization (by default, as long as there is organizing taking place). This narrow scope limits the potential for studying a broad range of reorganizations that take place within alternative organizational forms such as decentralized platform ecosystems.

Second, platform designs are said to influence the financial and innovation outcomes. Specifically, ecosystem reorganizations have implications for participants through different interdependencies that underpin the alignment and realignment between infrastructure and applications layers. As a result, we expect different performance outcomes for the various types of networks identified: transaction (demand-side users), development, validation, and complementor (supply-side users) networks. However, we know little about how *changes* in platform design influence the interactions among participants, and in turn, lead to distinct outcomes.

Third, self-reorganizations and their outcomes are likely to vary in nature and must be examined separately to reveal the underlying mechanisms at work. That is, while some participants may be more motivated to migrate to the new system, others may be reluctant.
These gaps motivate our research question: How do decentralized platform ecosystem self-reorganizations at the infrastructure level influence participation in different layers of the network?

To answer this question, we study the Ethereum blockchain ecosystem as our empirical setting. Ethereum is a decentralized platform ecosystem with a native cryptocurrency called Ether. In addition to supporting a financial system with a cryptocurrency, the Ethereum platform also supports a second layer of code to enable smart contracts, which in turn, underlies a wide range of decentralized applications (i.e., DApps), decentralized finance (i.e., DeFi), non-fungible tokens (NFTs), and special purpose tokens (e.g., Initial Coin Offerings, ICOs; Decentralized Autonomous Organizations, DAOs) enabled by smart contracts—among many other decentralized products and services. Ethereum is, by far, the largest platform that supports a decentralized ecosystem with a market capitalization of $400Bn, 1.5 Mn daily transactions that consist of cryptocurrency, smart contract tokens, and DAO transactions.

[1] Puranam (2018:123-124) identifies three levels of reorganization. Level zero reorganizations involve "a fundamental change in the solutions to the basic problems of organizing—the pattern of both task division and task allocation… [and] also the pattern of information provision and reward distribution" (Puranam, 2018:124). Level 1 reorganizations pertain to changes in task allocation and subsequent information provision and reward distribution, without changing the task division. And Level 2 reorganization "leaves both task division and task allocation unchanged but alters the pattern of information provision and reward distribution (typically through changes in administrative grouping structures (Puranam, 2018:124)." The degree and substantiveness of change decreases from Level 0 to Level 2.

Our research contributes to establishing a deeper understanding of ecosystem self-reorganization, which is currently largely missing in the literature (see e.g., Andersen & Bogusz, 2019; Hsieh, Vergne, Anderson, Lakhani, & Reitzig, 2018; Hsieh, Vergne, & Wang, 2017; Lovejoy, 2020).

We collected longitudinal data on Ethereum, the largest blockchain-based smart contracts decentralized platform, over the period of 2015 (i.e., the founding year) to 2020, which covers 9 major reorganization events (i.e., hard forks)[2]. We conducted pre/post tests on four layers of network that form the decentralized architecture: transaction, development, validation, and complementor networks to see how participation changes before and after hard forks.

Our results show that first, while major reorganizations positively influence participation across all networks, self-reorganization sparks more intricate participation dynamics within each blockchain network. Our study contributes to prior literature in several ways. First, we contribute to the organization design literature by unpacking the little-understood reorganization process and its implications for participation in different network layers of a decentralized platform ecosystem. The ecosystem-level analyses extend theory by re-conceptualizing the idea of reorganization beyond corporate or centralized settings to platform ecosystems that do not rely on centralized authority. Second, we contribute to the platform literature by identifying an alternative form of reorganization to the one orchestrated by corporations without a platform leader or owner. Third, this study contributes to the ecosystem research by examining factors that influence ecosystem performance during organizational changes. Finally, our study has practical implications for entrepreneurial activities built on decentralized platform ecosystems—an empirical setting that has attracted a growing body of literature to understand what it means by building applications on decentralized platform ecosystems, and what it means for developers and entrepreneurs when faced with decentralized reorganizations.

2. Research context

2.1. Forking as self-reorganizing

The past decade has seen the emergence a new type of decentralized platform ecosystem powered by the blockchain technology. While Bitcoin marks the first real-world blockchain implementation that facilitates the peer-to-peer, decentralized coordination, and exchange of value without relying on centralized authority, innovations have built on the blockchain infrastructure to provide programmable blockchains that, not only serve as cryptocurrencies but support second-layer smart contracts that enable decentralized platform ecosystems of DApps, DeFi and a wide range of applications (Leiponen, Thomas, & Wang, 2022). Unlike corporate platform ecosystems orchestrated by platform owners, decentralized platform ecosystems rely on participants to self-reorganize through a process called “forking” (Andersen & Bogusz, 2019). Forking entails upgrades of protocol encoded in the blockchain software, which migrates the platform ecosystem with tens of thousands of nodes to a set of new rules and routines—without a centralized authority. A hard fork, specifically, is a backward incompatible protocol change that can take weeks to complete, yet it is the only means by which decentralized platform ecosystems can evolve. Hard forks thus represent a key self-reorganization mechanism which involves shifts of the network landscape, for example, the loss or increase of participants due to the migration. Reorganization in decentralized platform ecosystems is an emergent process (instead of an orchestrated one) enabled by forking the blockchain platform protocol (Light, 2022).

2.2. Network layers of blockchain ecosystems

A blockchain-based ecosystem consists of four distributed network layers: validation, development, transaction, and complementor networks, within each of which different classes of participants perform distinct organizational functions. While the validation network refers to the network of validators who perform competitive bookkeeping to earn rewards for validating transactions (Yermack, 2017), the development network consists of the developer community that propose, communicate and jointly decide on code modifications. The transaction network refers to the network of exchanges that have been validated and recorded in the blockchain ledger. Finally, the complementor network includes participants who interact with smart contracts to build their decentralized applications. We argue that forking will likely have implications for participation in these network layers due to the interdependencies inherent between the networks and the blockchain infrastructure.

[2] We do not consider soft forks as reorganizations because they do not require consensus of the network. Updates are automatic and backward compatible, thus do not lead to potential network split. In contrast, hard forks and blockchain reorganizations involve disagreement and realignment of network consensus. Failure in migrating the entire network results in a network split.

3. Theoretical background

3.1. Reorganizations and renewal

Reorganization traditionally refers to the "dissolution and reformation of internal organizational boundaries [that] allows for improved partitioning and re-integration of activity within the firm" (Gulati & Puranam, 2009: 422). Reorganizations help organizational systems evolve through renewals (Romanelli, 1991; Romanelli & Tushman, 1994). Reorganization serves as an important tool for organizational systems to channel resources (Gulati & Puranam, 2009), centralize or decentralize decision-making power (Raveendran, 2020), promote innovation (Karim, 2009), facilitate organizational ambidexterity (Gulati & Puranam, 2009), and adjust patterns of collaboration (Raveendran, 2020).

Reorganizations often create inconsistencies that, intriguingly, facilitate organizational renewal through re-aligning members' actions with organizational goals (Gulati & Puranam, 2009). Inconsistencies generated in the process of reorganization, for example, between formal and informal organizational structures, re-channel organizational resources and re-focus information processing to its shifting goal (Gulati & Puranam, 2009). Reorganizations on the one hand, result in inconsistencies that break the internal and external "fit" of an organization and represent a potential risk of performance downturn. On the other hand, no organizations stay in the same form for the entire life span. Instead, organizations oscillate between centralization and decentralization (Nickerson & Zenger, 2002), between various forms, sizes and degrees of hierarchy (Raveendran, 2020). Therefore, reorganization is a necessary part of any organization to adapt to changes through learning, realignment of incentives, and readjustment of coordination structure (Evans & Doz, 1990; Puranam, 2018).

A reorganization can be radical or incremental, pertaining to restructuring and reconfiguration respectively (Girod & Whittington, 2017). Further, reorganizations are said to be discontinuous and manifested as "punctuated equilibrium" (Romanelli & Tushman, 1994) in organizational transformation. The type and timing of reorganizations are also shaped by current organizational structure (Raveendran, 2020). For example, a heterogeneous structure is likely to take more time to reorganize due to the additional effort require for employees to interact and reconciliate (Raveendran, 2020).

Trade-offs prevail in reorganizations—between renewal and stability, and in resource allocation between radical and incremental changes. Further, reorganizations can happen at various levels and often change the composition of participants in the ecosystem, thereby changing the interdependent relationships due to participant exit/entry. Reorganization and reconfiguration can serve as mechanisms by which reorganizations of the ecosystem structure influence the resource distribution and information flow, which in turn, influence the participation of contributors in the ecosystem.

Reorganizations bring about new waves of change (Hannan et al., 2003a; Hannan et al., 2003b). Literature suggests that while more restructuring promotes performance outcomes, more reconfiguration is associated with negative performance, as "[p]erturbation rather than accumulation is more likely to trigger subsequent discontinuous change" (Girod & Whittington, 2017; Girod, & Whittington, 2015). However, reorganizations (e.g., the adoption of M-form) can negatively impact the performance of a firm. Prior strategy matters for the transition and the time needed as a period of recovery (Lamont, Williams, & Hoffman, 1994).

In this study, we focus on restructuring with architectural changes that are backward incompatible structural recombination (e.g., splitting and merging of modules) (Albert, 2018). Architectural changes often induce subsequent changes, leading to "cascade of changes" in subordinate units (Hannan et al., 2003a; Hannan et al., 2003b).

3.2. Reorganization and participation in platform ecosystems

The participation structure is key for a platform ecosystem as it reflects the extent to which various levels and types of contribution are expected in the ecosystem (Fjeldstad et al., 2012; Wareham, Fox, & Giner, 2014; West & O'Mahony, 2008). The structure (i.e., who gets to participate) and configuration (i.e., how contributions are put together) address the diverse interests of and tensions inherent in an ecosystem. The participation structure has important implications for performance, especially for start-up entrepreneurs building their products and services on top of the platform ecosystem, in that the interdependencies between start-up firms and the platform ecosystem depend on the level and nature of participation in various network layers.

In particular, platform ecosystems rely heavily on a large install base to generate network effects (Gawer, 2009). As a platform ecosystem reorganizes, changes in the rules, structure and information flow will shift its participation structure from one equilibrium to another. Participants at various networks may leave or join the ecosystem, thereby reshaping collaboration relations in the system.

Reorganization refers to the restructuring and reconfiguration of activities related to organizing (Girod & Whittington, 2017). We adopt this broad definition as reorganizations on the ecosystem level involve more diverse and complex relationships than corporate reorganization (Teece, 2018). Ecosystem actors coevolve with the network they are embedded in, which co-evolves with the platform architecture and the external environment (Tiwana, Konsynski, & Bush, 2010a). Ecosystem reorganization entails the restructuring and reconfiguration of structure, rules and relationships. However, ecosystem reorganizations differ from corporate reorganizations in non-trivial ways, in that the interdependencies and complementarities between the platform infrastructure and subsystems (i.e., complementors) are not orchestrated by a central actor (Tiwana, Konsynski, & Bush, 2010b; Wareham et al., 2014). Yet, little is known about the implications of ecosystem reorganization for participation.

While the ecosystem reorganizations of corporate platforms are typically orchestrated by the firms sponsoring and providing the platform infrastructures, for decentralized platform ecosystems, reorganizations emerge as an autonomous process, which we call "self-reorganization". As noted, self-reorganizations are an emergent process enabled by forking of the platform protocol. Whether a change can be successfully implemented relies on participants reaching consensus and implementing the new protocol such that the entire platform migrates to the new rules. Given the growing body of work on decentralized platform infrastructure and subsequently, decentralized applications built on top of them using smart contracts, there is a pressing need for academics to understand the deeper implications of self-reorganizations for participation in different levels (Andersen & Bogusz, 2019; Hsieh et al., 2018; Hsieh et al., 2017; Leiponen et al., 2021).

4. Data collection and analysis

In order to assess the impact of hard forks on participation in each blockchain dimension, we conducted a pre-post analysis of nine hard forks on the Ethereum blockchain protocol. To obtain sufficient relevant data, we collected data consisting of 1.798 daily data points across 89 variables from various sources including Etherscan, CoinGecko, Etherchain, Github, reddit, and twitter, covering a period of five years from 2015 to 2020.

Each hard fork was analyzed using 14-day windows before and after each hard fork. To determine the appropriate size of the window and avoid conflating results related to self-reorganizing and forking with other subsequent events, we plotted observations for each variable on a larger timeframe and observed the window of effects directly associated with each hard fork. We then validated this with online sources and analyst reports.

Using this time window, we selected relevant variables for each blockchain network based on whether they relate to mining, development, transactions, or smart contracts (i.e., as a proxy for participation by complementors). For each network, we analyzed the effects of reorganization manifested through the identified hard forks, on participation variables associated with each network layer using paired t-tests with a 95% confidence level. We then estimated the effect sizes by computing Cohen's d for each variable within the network.

5. Findings

Our findings show how self-reorganization manifested through hard forks in the Ethereum blockchain has affected participation in each of its network layers.

Across all nine hard forks, we found a significant positive effect of forking on participation in all dimensions ($t = 2.17$, $p < 0.03$, $d = 0.0426$). However, the small effect size suggests that there are more complex dynamics at play in each network that might balance out the overall effects.

5.1. Self-reorganizing and participation in the validation network

Self-reorganization in the form of forking leads to a small yet significant increase in participation in the validation network in terms of the number of distinct miners ($t = 0.26$, $p = 0.004$, $d = 0.26$). By splitting up the validation network and forcing larger miners and mining pools to adopt one of two alternative versions of the protocol, forking means that smaller miners or individuals stand a chance to win validation rights, thus increasing the pool of unique miners that are available in the network at large. More miners competing for validation rights in turn increase block difficulty ($t = 6.57$, $p < 0.001$, $d = 0.59$), i.e., the complexity of the tasks involved in mining each block, meaning that smaller miners with less computing power will have less success winning validations. Despite more available miners, we find that the higher difficulty leads to a decrease in hash rate by about one third ($t = -3.70$, $p = 0.003$, $d = -0.33$), meaning that the time it takes to validate each block increases, thereby slowing the rate at which mining rewards are available. Together, falling hash rates and increasing difficulty means that the rewards that miners receive for validating blocks on a given day decreases (t = -5.76, p < 0.0001, d = -0.52). As miners receive less rewards at a lower rate, the value of mining rewards for individual miners might become less than the operating cost of electricity and cooling at which point mining hardware will turn off leading to less active miners in the network.

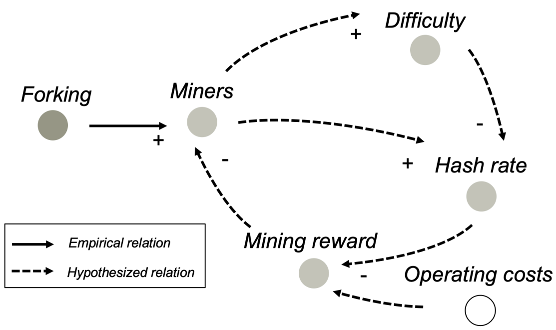

Figure 1. Causal loop diagram of self-reorganization and participation in the validation network.

In this way, our findings show how forking triggers complex reorganizing dynamics in the mining network by increasing mining difficulty and decreasing network hash rates resulting in lower mining rewards and therefore profitability for some miners. As illustrated in Figure 1, we find that the significant increase in difficulty as a result of forking overpowers the expected positive effect of more miners to drive down hash rates, decreasing available mining rewards. Based on our findings, and considering the architecture of Ethereum, these effects could be hypothesized to lower mining profitability, thus balancing out the initial increase in unique miners.

5.2 Self-reorganizing and participation in the development network

As forking originates from the developer network, it expectedly did not have a significant effect on the number of developers that are active on the Github code base (t = -0.47, p = 0.64, d = 0.05), just like forking activity (t = -0.39, p = 0.7, d = 0.04) and number of commits (t = 1.61, p = 0.1, d = 0.19) on the code base both showed non-significant drops. This indicates that forking has no discernible effect on the structure of the development network. However, our results also show small decreases in number of participants and increases in activity per user in the communication channels used to coordinate between developers and communicate new developments to the wider Ethereum community. Specifically, participation in terms of both active accounts on the Ethereum subreddit community (t = -8.26, p < 0.0001, d = -0.75) and twitter followers (t = -6.50, p < 0.0001, d = -0.63) decreased significantly. At the same time, our analysis shows an increase in average account activity on the Ethereum subreddit (t = 3.53, p < 0.001, d = 0.32) suggesting that the remaining developers play a key role in coordinating reorganizations.

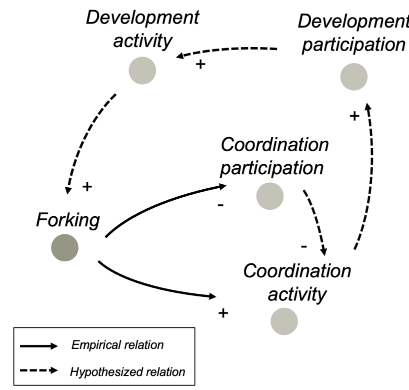

Figure 2. Causal loop diagram of self-reorganization and participation in the development network.

Based on our analysis, we can hypothesize that our insignificant results on development participation and activity surrounding hard forks is a result of actual development taking place well before deployment each fork, meaning it is more an antecedent than an effect of forking as illustrated in Figure 2.

5.3 Self-reorganizing and participation in the transaction network

Forking generally drove down participation in the transaction network. Specifically, forking results in a dramatic decrease in the number of daily active transaction users (t = -10.5, p = p < 0.0001, d = -0.94) resulting in a decrease in daily transactions (t = -3.03, p = 0.003, d = -0.33) and a small negative effect on transaction growth (t = -3.28, p = 0.001, d = -0.92). We also observed an increase in transaction fees after forking (t = 2.20, p = 0.03, d = 0.20). This might be due to higher network utilization (t = 7.34, p < 0.0001, d = 0.65) as well as influences from increases in gas price and usage observed in the complementor network (see below). As illustrated in Figure 3, increased transaction fees, along with the effects of dividing the blockchain through forking, can help to explain the decrease in transactions after forking.

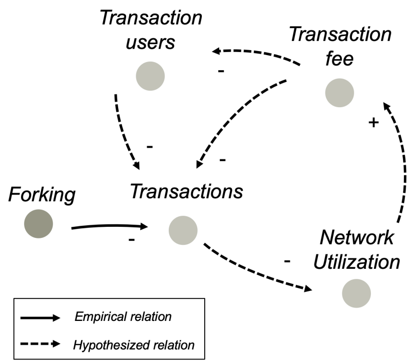

Figure 3. Causal loop diagram of self-reorganizing and participation in the transaction network.

These results can be interpreted in terms of complex dynamics in which a feedback loop driven by diminishing transaction fees as a result of increased network utilization caused by a decrease in transactions balances out a negative feedback of user churn driven by transaction fees.

5.4 Self-reorganizing and participation in the complementor network

Forking has a generally negative effect on participation in the complementor network. As complementor projects are closely linked to smart contract use, we measure participation and activity in the complementor network through smart contract activity. Specifically, we measure expected smart contract use as daily gas limit, actualized activity through gas used, and smart contract development activity by sampling ERC20 token transfers.

Forking negatively affected expected smart contract participation manifested in gas limit set by smart contract developers ($t = -4.16$, $p < 0.0001$, $d = -0.37$). This negative effect is also reflected in the actual gas used ($t = -3.91$, $p < 0.001$, $d = -0.35$). As gas usage decreases, the number of daily ERC20 token transfers is also minimally affected ($t = -2.05$, $p = 0.04$, $d = -0.18$). This could be an indication of fewer new complementor solutions are initiated, although our results show no significant change in the number of verified contracts before and after hard forks.

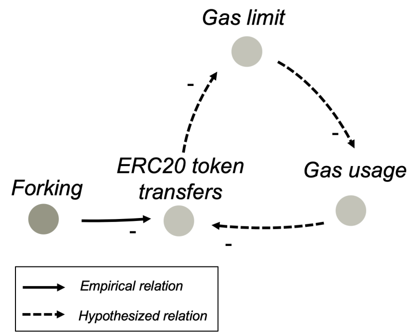

Figure 4. Causal loop diagram of self-reorganizing and participation in the complementor network.

Figure 4 illustrates the negative self-reinforcement mechanism driving down participation in the complementor network where a decrease in smart contract token transfers leads to lower expected smart contract use measured through gas limit, which in turn leads to lower actual participation and so on.

In summary, our findings reveal that the effects of self-reorganization manifested in hard forks in blockchain ecosystems are best explained in terms of complex dynamics within each network. This internal dynamics within each network also explains the relative resilience of the Ethereum blockchain ecosystem in the face of hard forking.

6. Discussion

Our study contributes to a deeper understanding of reorganization in blockchain platform ecosystems in the following ways. First, instead of treating all nodes as homogeneous, we identify four network layers that capture participation of different natures. We maintain that it is important to make this distinction because different networks may be influenced by the same hard fork in very different ways. While participation in the validation and development networks contribute directly to the design and operations of the platform infrastructure, participation in the transaction and complementor networks reflect the outer layer of applications that interact with the infrastructure as well as end users at the same time. A self-reorganization implemented as a hard fork will likely have heterogeneous effects on each layer, which is consistent with our findings.

Second, our results point to significant pre-post differences (except for the development network) associated with self-reorganizations. Our rich data enables us to study the causal loops within each layer and explore plausible mechanisms by which a hard fork can influence participation. Intriguingly, while self-reorganizations increase participation in the validation network, they reduce participation in the in transaction and complementor networks. More work is to be done to tease out the potential interdependencies and tradeoffs between various network layers.

Third, we show how complex dynamics are at play within each blockchain network layer as shown in Figures 1-4. The common theme is that, within each network, the pre-post change in participation appears to be triggered by a shift in the rules, routines, and governance structure of the specific fork. Fine-grained analyses are necessary for us to unpack the mechanisms driving the complex dynamics observed in each network.

Finally, our findings have managerial implications for decision makers who build product and services on blockchain-based decentralized platforms. In particular, what forking at the platform infrastructure level means to smart contract-based enterprise applications such as DeFi, DApps, or NFTs warrants managerial attention to the self-reorganization of decentralized platforms.

7. Limitations and further research

Though our study has implications for research and practice, it also has several limitations that should be ameliorated through future research. While our findings show significant effects of self-reorganizing on participation across nine hard forks, further research should tease out the idiosyncratic effects of different types of forking in a more fine-grained analysis.

Also, though our study builds on a rich dataset, our data analysis is focused on establishing effects of self-reorganization on participation in each of the network layers separately. Our study thus focuses on the internal dynamics within each blockchain network layer, disregarding the system-level interactions between the networks. Further research should focus on analyzing or simulation the system-level dynamics of self-reorganization and participation in blockchain platform ecosystems.

In this regard, future research has the potential to employ longitudinal research designs to explain the the long-term effects of self-reorganizing both at the level of individual variables, within each network layer, and at the system-level on the entire blockchain platform ecosystem.

In conclusion, we hope that our study of self-reorganization and participation in blockchain platform ecosystems will provide a first foundation and inspire future research.

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