DAO Governance

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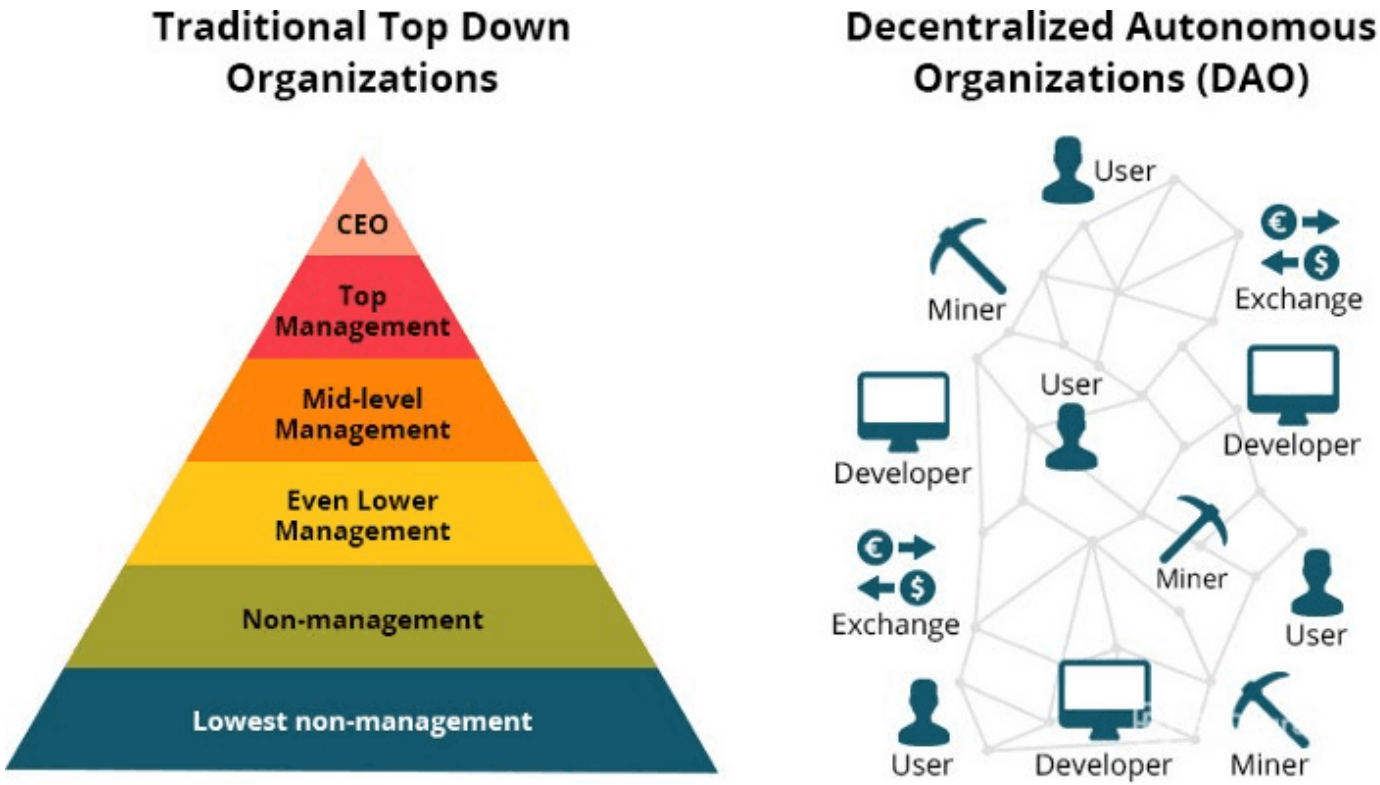
What is a Decentralized Autonomous Organization (DAO)?

A new type of organization that runs as "smart contracts" on a (public) blockchain.



Source: Medium

Corporations vs. DAOs

Corporations

- Centralized governance
- Delegated control by agents
- Managerial leadership
- Expert-driven decision-making
- Regulation

DAOs

- Decentralized governance
- Automation by smart contracts
- Direct token-holder democracy
- The wisdom of crowds
- Absence of regulation

DAOs and Their Governance

- DAOs have experienced rapid growth in recent years, with the number of DAOs increasing by 300% in 2022 alone (Pixelplex, 2023).
- Despite the emerging popularity of DAOs, there is a lack of understanding of DAO governance.
- Successful example: Uniswap, a decentralized exchange (DEX), uses a two-step governance structure to make decisions on new liquidity pools and fee structures.
  - Participants first discuss and debate proposed changes in an off-chain "temperature check" before voting on a proposal via the Ethereum blockchain.
  - This bottom-up governance structure allows for harnessing collective wisdom that enables the platform to grow.

Governance Failure and Conflicts of Interest

- "Rug pulls": large holders (e.g., developers) make changes to a platform for private benefits, which harm minority token holders.
  - YAM Finance incident: the developers created a bug in the smart contract that caused the entire project to collapse and led to investor losses.
- These incidents highlight potential *conflicts of interest* between large token holders ("whales") and small holders.
  - The autonomous nature of a DAO means that no monitoring agent controls the organization.
  - But whales could capture control and enjoy private benefits under "one token, one vote."
- We study this issue using a theoretical model and empirical analyses based on novel voting data.

Main Results

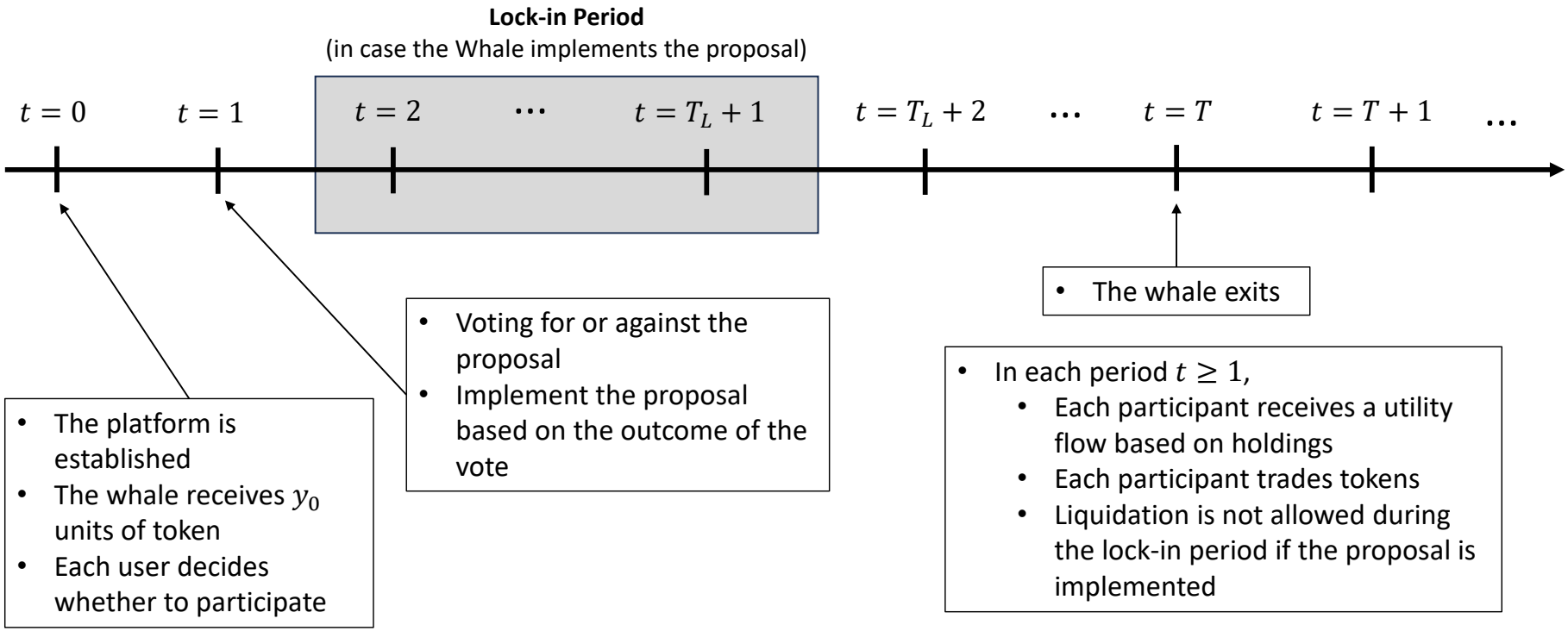
- The value of a DAO is negatively associated with whales' ownership concentration, exhibiting concavity (**Prediction 1**).
- Such a negative effect is mitigated if
  - The platform has a higher service value (**Prediction 2**).
  - Tokens are illiquid and subject to a higher price impact (**Prediction 3**).
- Alternative governance mechanisms that induce long-term incentives for whales (e.g., a staking model) can mitigate governance risk, improving the platform's valuation and growth (**Prediction 4**).

Main Results – Empirics

Using proposal-level voting data for 207 DAOs during July 2020–July 2022, we find:

- A DAO's weekly growth rate of Total Value Locked (TVL) is negatively correlated with past week's voting power concentration, and positively associated with the squared term (**Prediction 1**).
  - HHI of voting power and top-three holders' total votes proxy for voting power concentration.
- Such a negative effect of voting power concentration is mitigated by
  - a higher lagged TVL (**Prediction 2**),
  - and higher token illiquidity (**Prediction 3**).
- Using an event-study framework, we find that platforms switching from a one-token-one-vote model to a staking model (e.g., vote escrow model) experience faster growth, relative to the control group (**Prediction 4**).

Model Setup



- Participants are risk neutral with a discount factor $\delta = 1/(1 + r_f)$.
  - N users who are long-lived.
  - The whale has a finite investment horizon T.

Technology

- Holding X_t tokens yields utility in each period $t \geq 1$:

$$U(X_t) = A(a)NX_t$$

where $A(a)$ is technology component; N captures the network effect of user participation (Cong, Li, and Wang 2021).

  - $A(a)$ is *endogenously* determined by the vote outcome $a \in \{R, I\}$.

- Convex cost of trading ΔX units of tokens:

$$C(\Delta X) = \frac{\lambda}{2}\Delta X^2,$$

where λ is the magnitude of illiquidity.

Token-Based Voting

- At $t = 1$, the platform implements a proposal $(a = I)$ if

$$\underbrace{\mathbb{1}\left(a_w = I\right) y_1}_{\text{whale's vote}} + \underbrace{\int_{\mathcal{U}} x_{i,1} \mathbb{1}\left(a_i = I\right) di}_{\text{users' vote}} \geq \underbrace{\bar{x}}_{\text{minimum threshold}}$$

- To explore potential conflicts between users and the whale, we focus on a proposal that is value-destroying for users:

$$A(R) > A(I)$$

- But the whale enjoys a private benefit of B if the proposal is implemented.
- B becomes public information in $t = 1$ and users correctly infer the vote outcome.

Users' and the Whale's Problems

- Given the price process $\{P_s^a\}_{s=t}^{\infty}$ and the platform's action a, a (symmetric) user's value function can be written as

$$V_t^a(x_{t-1}) = \max_{\Delta x_t} A(a)Nx_t - P_t^a \Delta x_t - \frac{\lambda}{2}\Delta x_t^2 + \delta V_{t+1}^a(x_t),$$

- Interpretation: utility flow $-$ cost of acquiring additional tokens $-$ trading cost $+$ continuation value.
- Similarly, the whale maximizes its expected utility by strategically trading tokens (incorporating the price impact):

$$V_{w,t}^a(y_{t-1}, a) = \max_{\Delta y_t} A(a)N(y_{t-1} + \Delta y_t) - P(a)\Delta y_t - \frac{\lambda_w}{2}\Delta y_t^2 + \delta V_{w,t+1}^a(y_{t-1} + \Delta y_t)$$

with a boundary condition $y_T = 0$.

Equilibrium Voting by the Whale

- The value for the whale when implementing the proposal is

$$V^I_{w,1}(y_0) = \underbrace{B}_{\text{Private benefit}} + \underbrace{P(I)y_0}_{\text{Intrinsic value}} \underbrace{-\frac{\lambda_w}{2}\Delta y_1^2 - \delta^{T_L+1}\frac{\lambda_w}{2}\frac{(y_0+\Delta y_1)^2}{\Gamma(2+T_L,T)}}_{\text{Trading costs}}.$$

- The value when choosing to reject the proposal is

$$V^R_{w,1}(y_0) = \underbrace{P(R)y_0}_{\text{Intrinsic value}} \underbrace{-\frac{\lambda_w}{2}\frac{y_0^2}{\Gamma(1,T)}}_{\text{Trading costs}}.$$

- The whale implements the proposal if and only if $V^I_{w,1} - V^R_{w,1} > 0$
  - That is, private benefit $B > \overline{B}$, where $\overline{B}$ is the threshold.

Likelihood of Accepting a Value-Destroying Proposal

- **Proposition 1**: A hump-shaped relationship between ownership concentration and the likelihood of value-destroying vote outcomes.

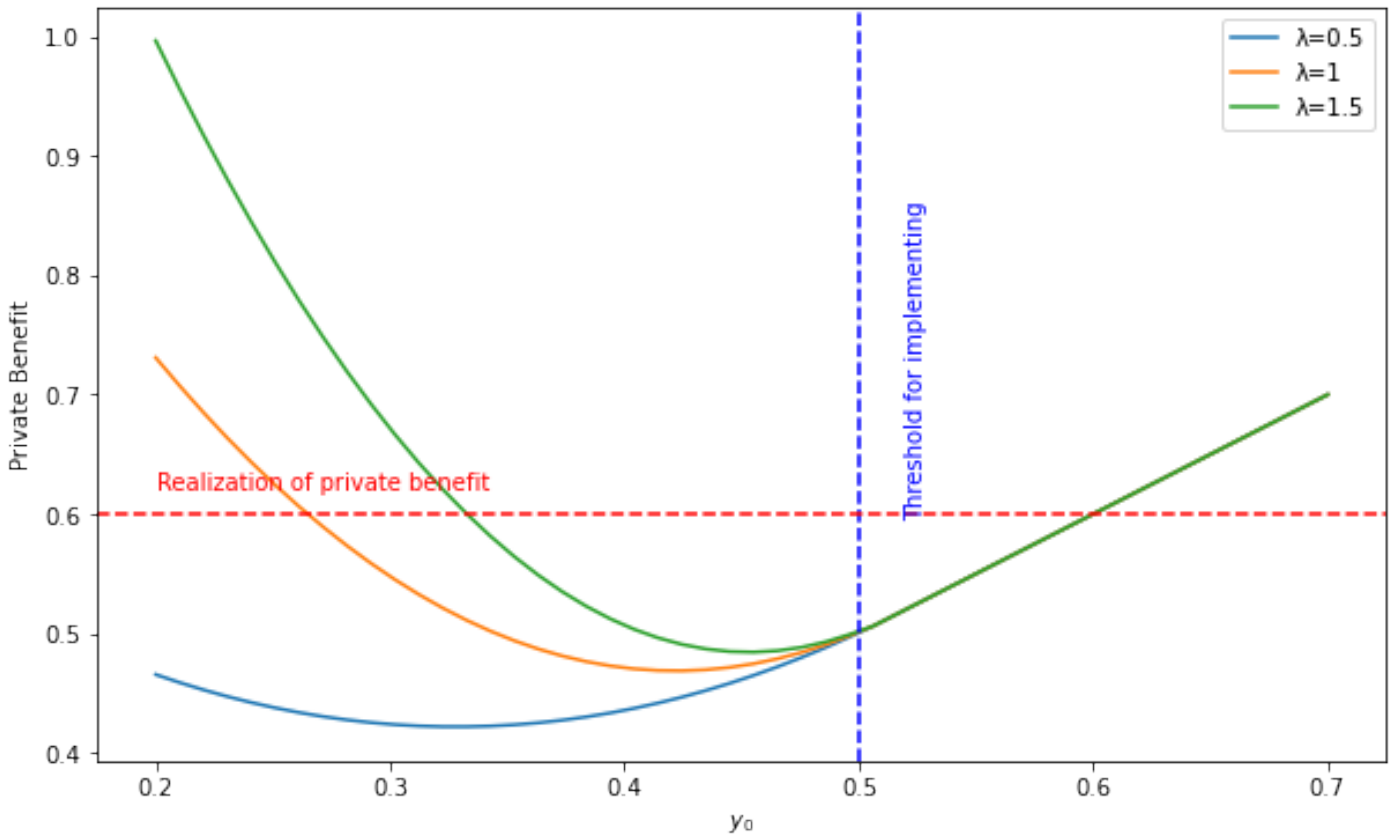
$$\frac{\partial \overline{B}}{\partial y_0} < 0 \quad \text{for a small } y_0; \frac{\partial^2 \overline{B}}{(\partial y_0)^2} < 0 \quad \text{for } y_0 < \overline{x}.$$

- **Proposition 2**: The likelihood decreases in a platform's service value and token illiquidity.

$$\frac{\partial \overline{B}}{\partial A(R)} > 0;$$

$$\frac{\partial \overline{B}}{\partial \lambda} > 0.$$

Equilibrium Vote Outcomes



A higher illiquidity parameter λ increases the threshold $\overline{B}$

Delaying the Whale's Token Liquidation

- **Proposition 3** The likelihood of value-destroying vote outcomes decreases in a longer lock-in period:

$$\frac{\partial \overline{B}}{\partial T_L} > 0$$

- The whale suffers from a tighter liquidation schedule, making it more costly to implement the proposal.

Triangular Relationship: Value, Ownership Concentration, and Token Liquidity

- Token illiquidity can shield users against negative effects of bad governance.
  - This seemingly paradoxical result hinges on the fact that active monitoring is unnecessary due to DAOs' autonomous nature.
  - Liquidity can have a beneficial effect on corporate governance by facilitating blockholder monitoring (Bolton and Von Thadden, 1998).
  - Imposing a lock-in period can be understood as **targeted illiquidity** for whales.
- Lastly, we endogenize user participation and show a feedback channel between governance and participation.
  - More participation prevents value-destroying proposals, enhancing governance.
  - Enhanced governance induces more users to participate, increasing platform value.

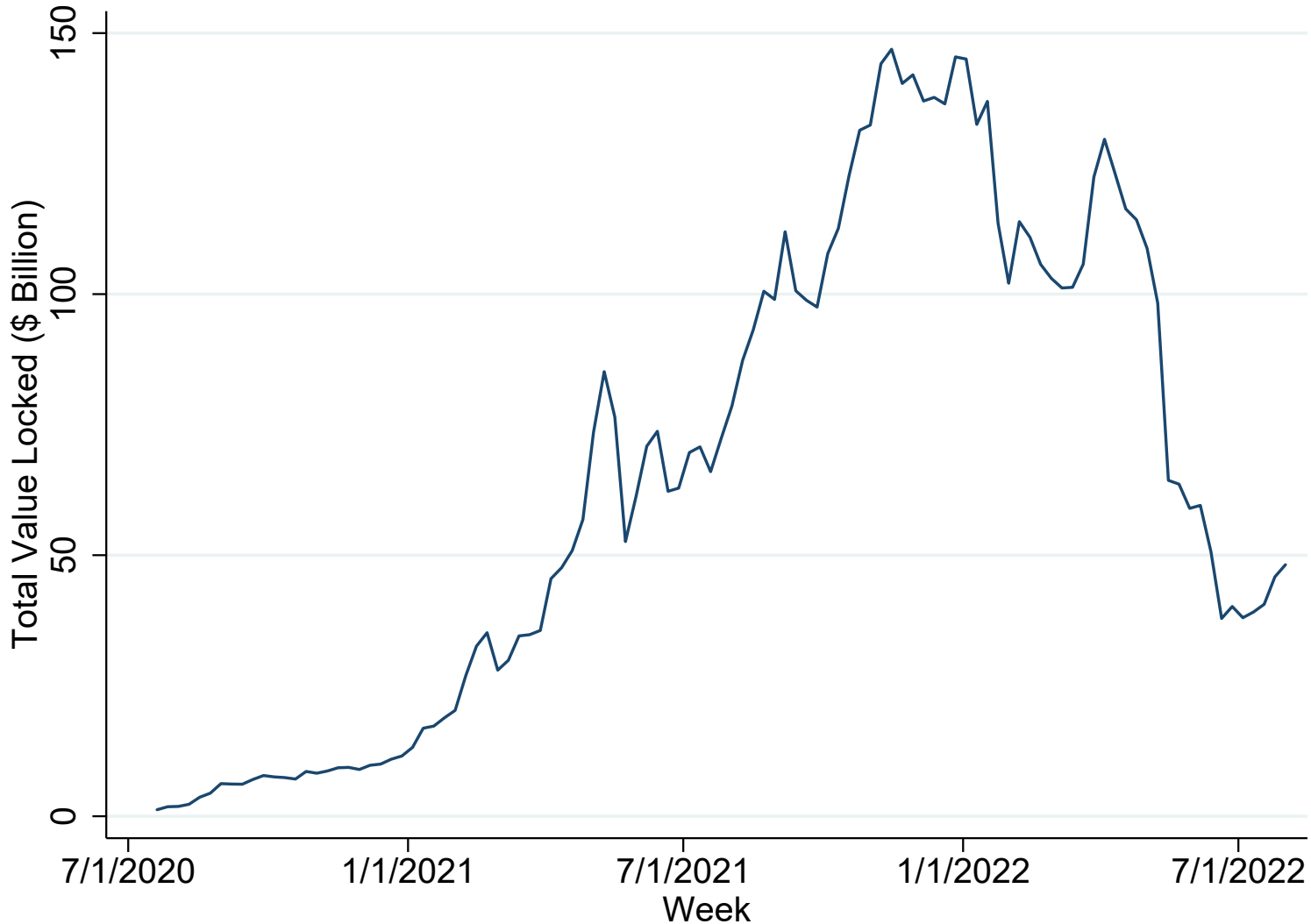
Testable Predictions

- The value of a DAO is negatively associated with whales' ownership concentration, exhibiting concavity (**Prediction 1**).
- Such a negative effect is mitigated if
  - The platform has a higher service value (**Prediction 2**).
  - Tokens are illiquid and subject to a higher price impact (**Prediction 3**).
- Alternative governance mechanisms that induce long-term incentives for whales (e.g., a staking model) can mitigate governance risk, improving the platform's valuation and growth (**Prediction 4**).

Data

- 207 DAOs from July 20, 2020 through July 31, 2022.
- Individual DAO members' voting records from voting platform Snapshot, which enables gas-free voting.
- Token price and trading volume data from CoinMarketCap.
- Total Value Locked (TVL) data from DefiLlama, a TVL aggregator and analytics dashboard for DeFi protocols.
  - Tracking protocols from more than 80 blockchains (Ethereum, BNB Chain, Polygon, Avalanche, Fantom, etc.).
- Manually collect whether a platform has adopted a staking model (e.g., vote escrow).
- Proposals do not occur on a daily basis and we convert voting data into weekly series.

Total Value Locked Over Time



Descriptive Statistics

	Average (1)	25th percentile (2)	Median (3)	75th percentile (4)	Std. Dev. (5)	Obs. (6)
TVL ($ billion)	1.209	0.013	0.103	0.601	3.163	2860
TVL growth	-0.009	-0.088	-0.009	0.075	0.233	2860
Crypto return	-0.043	-0.159	-0.035	0.079	0.265	2701
HHI	0.286	0.119	0.215	0.375	0.239	2860
Top 3 ownership	0.665	0.492	0.680	0.866	0.237	2809
No. of participants	212.1	15.4	46	150.5	556.4	2860
Age	0.508	0.159	0.425	0.781	0.411	2860
Amihud illiquidity	0.112	0.004	0.017	0.054	0.725	2650

- Main dependent variable is TVL growth.
- Main independent variables are the HHI and Top 3 ownership.

Ownership Concentration and Platform Growth

	Dependent variable: TVL growth					
	(1)	(2)	(3)	(4)	(5)	(6)
HHI	-0.048**	-0.341***	-0.057**	-0.036	-0.038	0.004
	(-2.14)	(-4.48)	(-2.35)	(-1.44)	(-1.49)	(0.13)
HHI^2		0.311***				
		(4.27)				
HHI × Lagged VL			0.007**			
			(2.28)			
Lagged TVL			-0.016***		-0.013***	
			(-4.72)		(-4.41)	
HHI × Amihud illiquidity				0.029***	0.030***	0.029***
				(2.88)	(3.03)	(3.14)
Amihud illiquidity				-0.013***	-0.013***	-0.013***
				(-2.79)	(-2.86)	(-2.95)
log(No. of participants)						-0.015**
						(-2.31)
Observations	2,860	2,860	2,860	2,650	2,650	2,650
R-squared	0.12	0.13	0.13	0.13	0.13	0.13
DAO FEs	Y	Y	Y	Y	Y	Y
Week FEs	Y	Y	Y	Y	Y	Y

Platforms' Long-Term Incentives and Growth

	Dependent variable: TVL growth			
	(1)	(2)	(3)	(4)
Implementing staking	0.083**	0.069**	0.080**	0.077**
	(2.44)	(1.98)	(2.35)	(2.39)
Lagged TVL	-0.002	-0.003	-0.002	-0.002
	(-1.05)	(-1.12)	(-0.77)	(-0.89)
HHI	0.009			
	(0.15)			
Top 3 ownership		0.036		
		(0.57)		
log(No. of participants)			-0.005	
			(-0.73)	
Age				-0.025
				(-0.49)
Observations	884	881	884	910
R-squared	0.15	0.16	0.15	0.16
DAO FEs	Y	Y	Y	Y
Week FEs	Y	Y	Y	Y

Conclusion

- We theoretically and empirically show that ownership concentration has an adverse effect on a DAO's value but that can be mitigated by token illiquidity.
- Long-term incentives of "whales" reduce the negative correlation between platform growth and ownership concentration.
  - Imposing a lock-in period can be understood as **targeted illiquidity** for "whales."
- We also endogenize user participation and show a feedback channel between governance and participation.