

Research Objective

We investigated the degree to which DAOs are decentralized. We measured decentralization using the [Gini Coefficient](#), the amount an individual with the largest voting power contributes to each proposal, and the average number of individuals required to achieve 51% of voting power for a DAO. We also were interested in analyzing trends in centralization and decentralization over time. To do this we evaluated a variety of DAOs using the above-mentioned metrics over time to determine if any insightful trends were discovered. Additionally, plots and descriptive statistics were created to better understand key features of DAO participation.

This project was produced with The Nova School of Business and Economics Data Science Knowledge Center by students Jona Weishaupt, Ari Kimelman, and Priyanshu Yadav. The professors supervising this research were Susana Lavado, Joao Oliveira, and Daniel Obermeier. For more information about NOVA SBE Data Science Knowledge Center see the link below.
<https://www.novasbe.unl.pt/en/data-science/overview>

Background

DAOs are a new method of governance that requires decentralized consensus about the changes made to an organization. DAOs are used to govern different types of decentralized applications in Web 3.0 from decentralized financial services to blockchain bridging services. DAOs offer an opportunity to democratize applications removing the need for a trusted party to make decisions on behalf of the users of the application. The efficacy of DAOs has been put into question as DAO participation is typically low and community consensus creates a bottleneck when implementing changes to adjust to market trends. We seek to better understand the degree to which DAOs are in fact decentralized.

Data

The data analyzed was published by researchers at the Institute of Knowledge Technology, Universidad Complutense de Madrid, Spain. The dataset contains information about individuals' voting behaviours, voting proposals, DAOs, DAO platforms, and proposal outcomes. While this dataset was limited in information about the subject of the vote itself, it was sufficient for our purposes. Further research accounting for the topic being voted upon may be an interesting area to explore.

Method

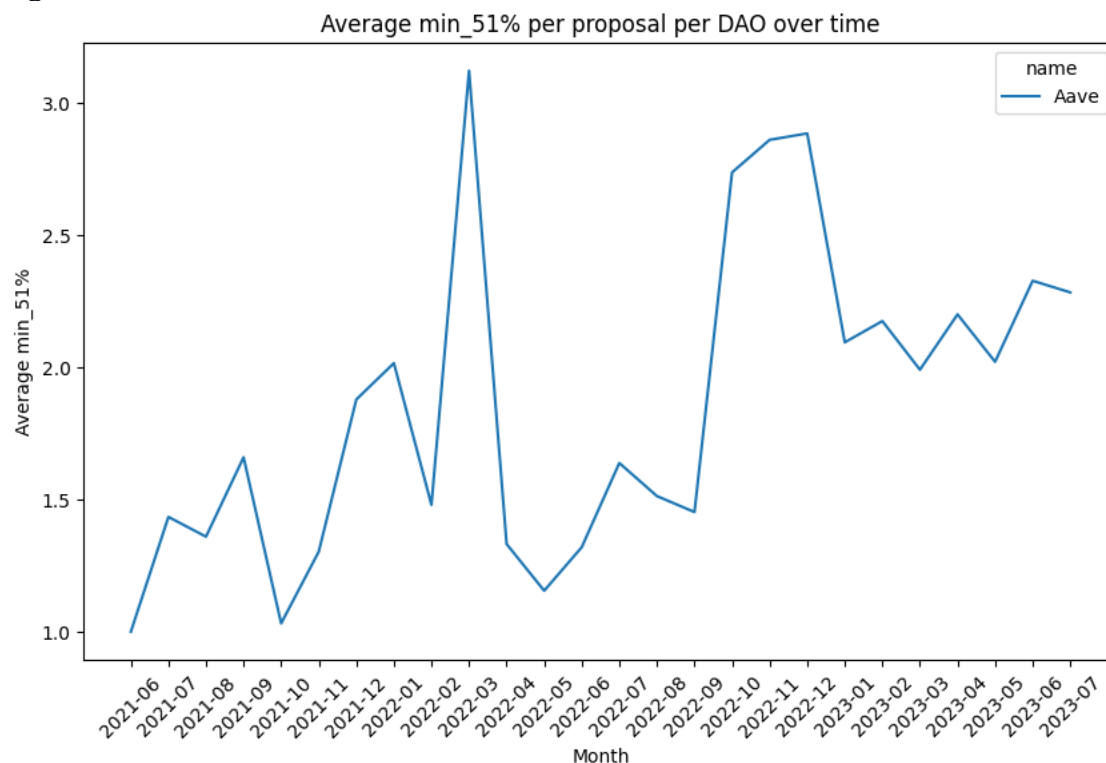
We chose to only include DAOs on the platform Snapshot for our investigative process. Our code may act as a tool for researchers and platform users to better understand trends in DAO activity pertaining to decentralization. The platform Snapshot allows for voting without fees furthering access to voting for people who don't want to pay to participate in a DAO. We also only included voting on yes/no proposals as there are proposals that offer multiple options to choose from. DAOs have different requirements for votes to pass. Some DAOs have simple voting schemes like passing a proposal if it has the most tokens allocated to passing it, while others like Aave require less than a 15% difference in yes/no weight to pass a proposal. A DAO's unique requirement to pass or fail proposals was not considered in our analysis nor the considerations of voting distribution (quadratic vs one token one vote) was included. The impacts of these rules are interesting for further research. Our analysis includes a variety of plots and graphs to represent the activity of a DAO including the participation rate of a DAO, and the

degree of decentralized measured by the Gini coefficient over time. As a result of the data being too large to import, we used [DuckDB](#) to query the dataset. For our displayed analysis, we chose Aave, although we explored DAOs like Compound, Ribbon, Uniswap, Lido, Morpho, and Angle, during our analysis.

Results

Our analysis suggests that DAOs are insufficiently decentralized with a high concentration of voting power among a few individuals over the course of several years for a given DAO. While these addresses may change, the concentration of voting power is typically high. This is better represented by the number of people necessary to achieve 51% of the voting power in our analysis for a given DAO in our analysis (Figure 1). Trends in ‘progressive decentralization’ appear to differ between popular DAOs, but a high concentration of voting power is typically consistent in popular DAOs.

Figure 1.0



Discussions & Limitations

Our findings support the hypothesis that DAOs appear to be insufficiently decentralized. Our finding suggests that over time DAOs tend to grow more decentralized, although not decentralized enough to justify a DAO governance design. The inadequacy of DAOs may put into question the utility of governance tokens as a sufficient use-case or justify its implementation as an investment vehicle to bootstrap a project. As some DAOs demonstrate a small increase in decentralization over time, this may be indicative of DAOs growing decentralized over a long timeframe.

One limitation is that we assume the DAO activity began the date the DAO moved to Snapshot therefore not including proposals before then. This may not represent the entirety of a DAOs' lifecycle, although, better represents how DAOs currently operate as voting before moving to Snapshot typically required fees to be paid. Another limitation is that DAOs have different purposes. Some DAOs are responsible for making minimal changes to protocols while others can change a protocol's design. The choice of how to filter DAOs for one's analysis should consider these differences. Our code can be used by researchers and users to better understand how a specific DAO compares to another and acts as a basis for further research into specific DAOs. This information can also be used to assist investors when deciding how confident they are in a DAO's ability to make good decisions on their behalf.

Conclusion

Our analysis provides an exploratory approach into DAOs' decentralization and a method to allow individuals to investigate a DAO degree of decentralization over time. This can provide insights into whether a DAO is increasingly becoming centralized or decentralized, and if steps should be taken to improve participation or consider new voting requirements to pass proposals.

References

Peña-Calvin, A., Arroyo, J., Schwartz, A., & Hassan, S. (2024). Concentration of Power and Participation in Online Governance: the Ecosystem of Decentralized Autonomous Organizations. Companion Proceedings of the ACM Web Conference, 13–17, 2024, Singapore, doi: <https://doi.org/10.1145/3589335.3651481>