

## **Quadratic Funding: Funding the Future through Niche Projects**

### **Abstract**

A distinctive feature of public goods is that many people benefit from their use, and limiting their use is impossible or inappropriate. Examples include public roads, security, research, and open-source software. As a rule, producing such goods is not profitable for individuals, which often leads to insufficient production (free rider effect). In some cases, governments and other organizations (such as philanthropic foundations) take over the production, but the lack of complete information about consumers' preferences for public goods and other problems associated with centralized decision-making lead to inefficient spending of funds. In such cases, it would be more appropriate to create a system where consumers of public goods would have the opportunity to vote for specific options for their provider directly. However, when voting using the principle of "one person - one vote," the participants cannot show how important this or that option is for them, which can lead to suboptimal public goods production. Actocracy sees quadratic funding as the solution. This approach combines the advantages of market mechanisms and democratic governance but is less prone to their shortcomings. It is based on the idea of matching funding (co-financing), in which people make direct donations to various projects that they consider to be of social benefit, and some prominent donor (for example, a charitable foundation) undertakes to add a proportional amount to each donation. This creates an additional incentive to participate and allows the sponsor to allocate funds effectively without having expertise in the area being funded. The peculiarity of quadratic funding is that the calculation of the added amounts is carried out similarly to the calculation of results in quadratic voting. This type of voting implies that participants can buy votes and allocate them to various solutions. The purchase cost increases proportionally to the square of the number of votes purchased. This allows participants to express their preferences and strengths, which is impossible with one-person-one-vote voting.

### **Introduction**

Innovation is a high-cost and risky activity associated with attracting significant financial resources for their direction and use at various stages of the innovation process. This factor significantly limits the list of enterprises capable of innovative development. In addition, emerging markets are characterized by macroeconomic risks (financial instability, weakness of the financial sector, underdevelopment of financial instruments) that make it challenging to finance IE. There is also limited access to external sources of financing, which become too high in cost.

All this requires potential participants in the innovation process, primarily small and medium-sized enterprises, private entrepreneurs at the local level, and start-ups, to search for non-traditional sources of financial resources. Yes, we are all well aware of various crowdfunding platforms (Freitas & Maldonado, 2021). However, this funding format is not an investment in the traditional sense since investors are generally ready to invest in projects that are already profitable and need further development. However, projects of a creative, social nature and ideas whose authors are only taking their first steps are rarely of interest to investors (Freitas & Maldonado, 2021). In this sense, crowdfunding can be considered a more effective tool for obtaining funding. The project on the platform does not involve sponsors intervening in creative and business processes or transferring company shares, deducting percentages from future product sales, etc. However, the governance models used by blockchain platforms are becoming increasingly important due to their ability to influence user engagement, platform performance, and attractiveness (Freitas & Maldonado, 2021). One of the biggest challenges blockchains have faced when it comes to governance is the potential for dominance to emerge. These "dominant positions" will consist of users who will control many or even a majority of votes. This would give this group of users unprecedented control over platform development issues. Such a concentration of votes and voting rights would no doubt disturb others on the platform (Pasquini, 2020a). However, the new quadratic voting method that has recently found its way into the social decision race is a possible solution to the dilemma plaguing blockchain platforms.

### **The Power of Quadratic Funding**

While crowdfunding over the internet is nothing new, Gitcoin works differently than Web2 platforms like Kickstarter and GoFundMe, not just because donors have to send Ethereum tokens. Gitcoin pioneered quadratic funding, a concept coined by Ethereum's Buterin, Zoe Hitzig, and E. Glen Weil (Freitas & Maldonado, 2021). With traditional funding, projects often have significant supporters who increase the total amount of funds raised from the amount provided by donors. Meanwhile, quadratic funding uses an appropriate pool based on the number of donations, not the size. In other words, a project that receives \$100 grants from 100 donors will receive more than a project that receives one \$100 grant from one donor. Quadratic funding is optimized according to the preferences of the many, not the rich few (Freitas & Maldonado, 2021).

The rejection of the status quo of the traditional system in favor of the "many" sums up the whole view of cryptocurrencies. While Web3 is currently known for the speculative hype cycles that have enriched the savviest DeFi and NFT users, decentralized technologies have more to offer the world than ponziomics and images of apes (Freitas & Maldonado, 2021). He says he's excited to help ordinary people make a better living as the space moves closer to mainstream adoption. These efforts aim to create a world where DAOs increase revenue, so we have a systemic incentive to work on the commons and our communities (Freitas & Maldonado, 2021).

While Web3 still has a bad rap from prominent tech entrepreneurs, bitcoin enthusiasts, and blockchain naysayers, many argue that it is better than the modern internet because it helps create a more pluralistic world (Dimitri, 2022). The latest Web3 boom was fueled by a surge of interest in art-based NFT projects like CryptoPunks and Bored Ape Yacht Club, but ETH is currently down about 75% from its highs, which is most of the speculative hype that is common in 2021, the

crypto is dead. However, for Gitcoin, it doesn't matter (Dimitri, 2022). Everyone in the space needs software developers, whether it's a boom or bust cycle. Gitcoin is in a good position because it helps developers find these ecosystems.

### Quadratic Funding Theory

With quadratic funding, each donation by a member to a project is considered a purchase of votes for the distribution of funds in favor of this project from the general match fund. Suppose that participant  $i$  donated project  $p$  in the amount ( $c_p$ ). Then the weight of his voice ( $w_p$ ) will be equal to the square root of the size of his contribution (Dimitri, 2022):

The amount of matching funding  $F_p$  that project  $p$  will receive is then calculated based on the sum of votes for this project among all participants (Dimitri, 2022):

If, as a result of the vote count, the total amount of funding exceeds fixed budget  $B$ , then the amount of matching funding for each project is adjusted according to its share among all projects (Dimitri, 2022):

Such a mechanism ensures optimal financing of public goods. Even small donations, if made by many people, result in a significant amount of matching funding (such a result is typical for public goods) (Dimitri, 2022). In contrast, significant contributions from a small number of donors result in a smaller amount of matching funding (such a result indicates that the good is likely to be private).

### Gitcoin

The quadratic funding mechanism was first tested in early 2019 as part of the Gitcoin Grants program on the Gitcoin platform, which specializes in supporting open-source projects. In the first round of funding, 132 donors donated cryptocurrency to develop 26 infrastructure projects in the Ethereum ecosystem (GitCoin, 2022). The total donations amounted to \$13,242, in addition to which \$25,000 was allocated from a matching fund created by several major donors. In the future, participation in the program was open to everyone, the criteria for projects falling under the definition of public goods of the Ethereum ecosystem were expanded, and a division into categories such as "technology" and "media" appeared (GitCoin, 2022). As of December 2022, there have already been 16 rounds, during which more than 3,392 projects have received more than \$51.17 million in funding, with a median donation of \$1.14 (GitCoin, 2022).

The Gitcoin Grants program has shown that the quadratic funding mechanism works following the theoretical framework and provides funding for public goods according to the preferences of community members (GitCoin, 2022). However, this mechanism, like many electronic voting systems, is vulnerable to some attacks that the platform developers had to face during the experiments:

- Attack of the Sibyl. To carry out this attack, an attacker can register many accounts and, by voting with each of them, redistribute funds from the matching fund in his favor.
- Bribe. To bribe users, it is necessary to be able to monitor their compliance with the agreement, which becomes possible due to the openness of all transactions in the public Ethereum blockchain. Like the Sibyl attack, user bribery can be used to reallocate funds from the general fund to the attacker, provided that the benefit from the reallocation exceeds the cost of bribery.

To prevent a Sibyl attack, a GitHub account is required during user registration, and the introduction of phone number verification via SMS was also considered. Bribery attempts were tracked through vote-buying announcements on social media and blockchain transactions (groups of donors who were paid from the same source were identified) (GitCoin, 2022). However, these measures do not guarantee complete protection, and with sufficient economic incentives, attackers can bypass them, so developers are looking for other possible solutions.

In addition, there was the problem of curating the list of projects receiving funding. In some cases, funding applications came from projects that were not public goods or did not fit into eligible project categories. There have also been cases when fraudsters placed applications on behalf of other projects. The manual verification method of funding recipients worked well with a small number of applications, but its effectiveness decreased with the growing popularity of the Gitcoin Grants program (GitCoin, 2022). Another problem of the Gitcoin platform is centralization, which implies the need to trust its administrators in the correctness of their vote count.

### clr.fund

The objective of the clr.fund project is to create a secure and scalable quadratic funding fund, taking into account the experience of the Gitcoin Grants program. The fund will operate with minimal trust in its administrators and will be managed in a decentralized manner (Dimitri, 2022). To do this, the accounting of donations, the calculation of the amount of matching funding, and the distribution of funds must be performed using smart contracts. Using secret ballots with the possibility of voice substitution will hinder vote buying. User registration will be through a social verification system and a community-driven funder registry with a built-in dispute resolution mechanism (Dimitri, 2022).

### Secret ballot

The secrecy of the vote when voting using a public blockchain can be preserved using zero-knowledge protocols, which allow checking the correctness of mathematical operations on encrypted data without revealing this data (Pasquini, 2020b). In clr.fund, the size of individual donations will be hidden, and the zk-SNARK system called MACI (Minimum Anti-Collusion Infrastructure, minimum infrastructure to counter cooperation) will be used to calculate the amount of

matching funding. It allows for secret quadratic voting and protects voters from bribery and coercion, provided that the processing of votes and the tabulation of results is carried out by a trusted person called a coordinator (Pasquini, 2020b). The system is designed so the coordinator can facilitate bribery because he can transcribe votes. Still, one cannot eliminate or substitute votes and cannot falsify the vote count results.

The process begins with users generating an EdDSA key pair, registering with the MACI smart contract, and writing down their public key. Then voting begins, during which users can write two types of encrypted messages to the smart contract: messages containing a vote and messages that change the key (Pasquini, 2020b). Messages are signed with the user's key and then encrypted using another key generated by the ECDH protocol from the user's unique one-time key and the public key of the coordinator in such a way that only the coordinator or the user himself can decrypt them. Suppose the attacker is trying to bribe the user. In that case, he can ask him to send a message with a voice and provide the contents of the message along with a one-time key, with which the attacker will restore the encrypted message and make sure by verifying the transactions in the blockchain it was really sent (Pasquini, 2020b). However, before sending the vote, the user can secretly send a message that changes the EdDSA key and then sign the message with the vote with the old key, invalidating it. Since the user cannot prove that the key has not been replaced, the attacker will not be sure that the vote in his favor will be counted, making bribery pointless (Pasquini, 2020b).

After voting is completed, the coordinator decrypts the messages, counts the votes, and verifies two zero-knowledge proofs through the smart contract: the proof of correct message processing and correct vote counting. At the end of the procedure, the vote results are published, but the individual votes are kept secret (Pasquini, 2020b).

### **Social Verification**

Although the reliable identification of users in distributed networks remains an unsolved problem, to prevent a Sybil attack, it is enough to complicate this attack so that the cost of its implementation becomes more significant than the potential benefit. One such solution is BrightID, a decentralized identity system that works like a social network where users can create profiles and connect by choosing their trust level. In this system, each user is assigned a unique identifier, and information about the relationship with other identifiers is recorded in a graph database, stored at the computing nodes of the BrightID network, and synchronized between them (Dimitri, 2022). No personal data is stored in the database but only transferred between users when establishing contacts so that the system can be used anonymously. Computing nodes of the BrightID network analyze the social graph and, using various techniques, try to distinguish genuine users from fake ones. The standard configuration uses the SybilRank algorithm, which calculates a rating for each identifier, indicating the probability that a unique user corresponds to it (Dimitri, 2022). However, identification techniques may vary. If necessary, application developers can combine the results obtained from different nodes, or run their own node, which will use optimal algorithms for their user base.

### **Dispute Resolution**

Participation in quadratic funding will be open, but projects will be required to register in a special register. To be added to it, representatives of the project will have to pay a deposit, which they can pick up after a certain period (Dimitri, 2022). Users can challenge its addition if the project does not meet the registry criteria. Arbitrators will consider removing the project from the registry in a decentralized dispute resolution system. In case of a favorable decision, the user who reported the violation will receive a part of the deposit as a reward. Such a mechanism would make the registry of public goods self-regulating (Dimitri, 2022).

The Kleros system, built using smart contracts, is used to resolve disputes. In it, anyone can become an arbitrator, and the justice of the decisions made is achieved with the help of economic incentives (Dimitri, 2022). The system automatically selects several arbitrators by drawing lots when a dispute is initiated. The arbitrators consider the evidence provided and vote in favor of one of the parties using the commitment scheme: votes are encrypted. They are disclosed only after the end of voting. Arbitrators in the majority receive a reward, and those in the minority pay a fine (Dimitri, 2022). Due to the unpredictability of the composition of the jury and the concealment of votes, coordination between arbitrators is complex, and they are forced to anticipate each other's actions and choose the option that others are most likely to choose. Otherwise, they risk losing money. It is assumed that such an option (focal point) will be the fairest decision since, in the absence of information, the rational choice will be to make a decision based on well-known ideas about fairness (Dimitri, 2022). If one of the parties to the dispute disagrees with the decision, then appeals are scheduled, during which more and more arbitrators are successively selected.

### **Autonomous Ecosystems**

The listed technological solutions should make the mechanism less dependent on administrators and guarantee its reliable operation with small amounts of distributed funds. As technology advances, some components may be replaced to provide better protection against vote buying and other attacks, with the ultimate goal being a fully autonomous quadratic funding fund (Posner & Weyl, 2014).

In existing implementations such as Bitcoin Grants, the production of public goods is subsidized by large donors, but the funds may come from other sources instead. Some cryptocurrencies, such as Zcash and Decred, use inflationary funding: part of the reward for creating blocks goes to the development team to support their further work to improve the infrastructure. Suppose a quadratic funding mechanism is created that works reliably and does not require centralized administration. In that case, part of the block reward can be sent to it for subsequent distribution with the participation of the community. Thus, an autonomous ecosystem is being formed, where the production of public goods will be a completely self-sufficient process and will not depend on the will of sponsors and managing organizations (Posner & Weyl, 2014).

Gitcoin was launched in late 2017 at the height of the retail mania in the cryptocurrency market. While sketchy projects have used Ethereum to raise funds through crypto-crowdfunding, known as initial coin offerings, Gitcoin has made it its mission to support the builders that have begun to emerge in the ecosystem. It succeeded early (Dimitri, 2022). The Ethereum Foundation funded the project's first seven grant rounds before key decentralized finance projects such as Yearn.Finance joined the board to support its subsequent funding rounds.

### **Impact DAO support with Gitcoin**

Apart from Gitcoin, we are most interested in crypto projects with positive externalities and increasing their resources over time. He cites the Proof of Humanity universal basic income and decentralized carbon token initiative KlimaDAO as examples of what he calls "powerful DAOs," groups known as decentralized autonomous organizations that have demonstrated a commitment to creating a positive impact on the world around them (Dimitri, 2022).

Gitcoin funds such projects, and we help them find each other and share resources and ideas. The potential for this is that DAOs of Influence increase every income on the planet to help everyone support their communities and make ends meet. Influential DAOs can use NFT technology to accomplish tasks, but not necessarily through JPEG digital images (Dimitri, 2022). Instead, he envisions a world where DAOs issue tokenized "impact certificates" to propagate their message. Impact certificates can create a business model for DAOs, allowing wealthy donors to demonstrate virtue and flexibility in spending on important causes. Most importantly, when people create value for the world, they can get paid for it (Dimitri, 2022).

Crypto has long rewarded users for good deeds. Early backers of the project often receive governance tokens for initial liquidity. In recent years, Ethereum projects such as Optimism have distributed tokens by giving away tokens to Gitcoin donors. This creates a feedback loop that says, "Oh wait, good deeds are good karma, and it will come back to me."

While Gitcoin was already a success in its early years, many are excited about the project's next phase. The company is moving towards a decentralized structure that will reveal its current hierarchy with the ultimate goal of putting development and project economics entirely in the hands of the DAO community (Dimitri, 2022). Once Web3 is big enough to take over the world, we can move into related categories of grants and hackathons for everyone. But for now, these are niche Web3 projects.

### **Actocracy as a Niche Project**

Actocracy can too be considered a niche project that appeared as part of the overall trend of DAO appearance implementing the rules of quadratic financing. However, what makes Actocracy stand out is that this is not a social network platform nor a platform for blogging. Actocracy is a game of the world covering the span of the entire Earth, aiming to provide existing users with the opportunity to receive interactive geo- and community-related content. By providing the opportunity to gain NFT Lands, each user can get a sovereign autocratic State with its own economic, social, and political life, entirely governed by its population of residents, citizens, and regularly elected Government. The game aims to monetize referral activity, involves users in collective assets distribution and decision-making, and increases the competitive level in the cultural and political life of the individual, at the same time generating higher user retention rates and, consequentially, higher revenues from all in-game activities as well as business advertising.

Actocracy is a novel social platform that merges gaming components and blockchain-based rewards to incentivize users to take part in developing a virtual world and contributing to public goods for local communities. By utilizing quadratic funding, Actocracy creates an environment where users can generate, possess, and exchange virtual real estate and other in-game properties, and benefit from collective decision-making and asset allocation. Actocracy's blockchain-based services offer a secure and transparent form of governance, while also facilitating a more democratic decision-making process. The platform's democratic model enables users to participate in decision-making and provides incentives for voting.

Actocracy, which refers to the horizontal, distributed form of digital democracy where power is derived from action, was conceptualized in the mid-2000s after a surge in scientific research on Internet-based participatory democracy that influenced real economic and political processes (de Rosnay, 2014; de Rosnay, 2016). Unlike vertical forms of democratic representativity, where elected people are delegated power, actocratic systems allow the person willing to do the work to lead the movement. The Actocracy is based on the theoretical concept of self-governed decentralized communities that interact while impacting their surroundings.

Actocracy's decision-making models are applicable to the Quadratic Funding model. This system involves allocating a certain amount of money to a project, which is then split into two pools. The first pool is made up of users who have pledged a specific amount of money to crowdfund the initiative, while the second pool is distributed among the top projects according to those who voted in favor. This guarantees that all users have a say in the decision-making process.

Quadratic funding incentivizes individual voters to donate to a fund so that they can vote on projects they deem valuable. This system benefits both the project and the individual, as projects have access to a larger funding pool while individuals can participate in the decision-making process. This approach enables projects to be funded without relying on a central authority or the traditional one-person-one-vote model.

This is another example of when a game has been transformed into a platform allowing all users to earn and be involved as community members in developing the platform. There is a zero entry barrier; all existing online communities can monetize their audiences due to the out-of-competition concept; real-life trends of volatility and deflation; a Sybil-resistant attitude toward all users, as well as a high level of security. Naturally, there are in-game fees for the minting and sale of land and property, taxes from marketplaces, Game-Fi fees, and precise business tools for reaching out to the audience. In short, Actocracy has adopted a user-business-user platform model, where the users are encouraged to participate in the life and development of the platform. In contrast, businesses are encouraged to participate in all activities with the users. This is a win-win situation that quadratic financing is all about.

How quadratic voting works in Actocracy. Fair voting is based on market principles, with each voter allocated a specific vote budget that they can spend to influence the outcome of crucial discussions. If voters strongly support or oppose a particular decision, they may allocate additional votes to demonstrate their level of support or disagreement with the particular decision. The cost of additional votes is determined using the vote pricing rule, with each vote becoming more expensive than the previous one. The rising cost of voter credit demonstrates the degree of support or opposition to a particular decision. People in Actocracy use the DACT (Digital Activity Convertible Token) and the DIMP (Direct Impact Monetary Piece). These are converted into real income, representative power, and multiple benefits for the individual and the community. This mechanism was one of the possible solutions to the governance problems faced by blockchain platforms and communities, preventing one group from seizing power while protecting the interests of minority groups. Tokens are cast as votes are evenly redistributed among voters at the end of each governance cycle. The group will need several voting cycles and high costs to gain control of the platform.

Quadratic funding is one of the most innovative socio-economic experiments out of the crypto ecosystem. It is positioned as the mathematically optimal way to finance public goods in democratic communities by increasing donations made by a large community compared to small groups. But what are public goods? Public goods are goods or services available to all members of society.

Despite its potential, there are challenges that need to be addressed for the successful implementation of a quadratic funding system. The technology is complex, and its advantages must be communicated clearly. Furthermore, the system must be secure and transparent to guarantee fairness in decision-making. Finally, appropriate incentives must be in place to motivate voters to contribute to the fund. The concept of utilizing quadratic funding and blockchain-based services is gaining attention from both real-world and digital democratic institutions.

Quadruple voting is a voting system that enables citizens to express their preferences and intensity. This system has the potential to revolutionize the management of communities by safeguarding the interests of small minority groups and local communities. Additionally, it can effectively distribute social and charity funds, and provide fair yet competitive crowdfunding opportunities for independent contractors such as social workers, inventors, creative collectives, associations, thematic clubs, gaming clans, and other types of communities.

Quadruple funding helps solve a problem called the "tragedy of the commons." This is an economic problem where each person has the incentive to consume resources at the expense of others. At the same time, there is no way to exclude anyone from resource consumption, which leads to overconsumption and resource depletion. Quadruple funding focuses on the number of donations, not the donation size. Projects that generate more donations are public goods that serve a large group of users, which makes communities worse off.

This can be seen in the number of projects that are currently exploring the possibility of quadratic funding, such as Gitcoin Grants, clr.fund, and the innovative Actocracy.

### **The funding mechanism**

At the heart of the quadratic funding mechanism is a quadratic voting function, enabling a fair and democratic allocation of resources within a large community. This function is based on a straightforward principle: the more individuals who vote for a specific project, the more resources it will receive. Consequently, this ensures that all initiatives are granted resources proportionate to their level of support.

How quadratic voting works in Actocracy. Fair voting is based on market principles, with each voter allocated a specific vote budget that they can spend to influence the outcome of crucial discussions. If voters strongly support or oppose a particular decision, they may allocate additional votes to demonstrate their level of support or disagreement with the particular decision. The cost of additional votes is determined using the vote pricing rule, with each vote becoming more expensive than the previous one. The rising cost of voter credit demonstrates the degree of support or opposition to a particular decision.

The quadratic funding mechanism utilizes two tokens: DIMP and DACT. DIMP represents a user's balance, which they can pledge to directly fund their selected initiative. On the other hand, DACT is a token for quadratic voting, which allows users to cast votes in the decision-making process. The number of votes a user can cast depends on the value of their DACT balance, with higher balances giving users more influence in the voting process. Whilst, the amount of DACT a user can obtain is derived from user's overall activity and participation in decision-making in nearby areas. This weighting ensures fairness in decision-making, as those with higher token balances can't monopolize the voting process. The cost of casting additional votes is determined by the vote pricing rule, with the cost increasing as more votes are cast for a particular project. This encourages users to carefully consider their vote allocation, ensuring that votes are distributed in a fair and democratic manner.

This mechanism was one of the possible solutions to the governance problems faced by blockchain platforms and communities, preventing one group from seizing power while protecting the interests of minority groups. Tokens are cast as votes are evenly redistributed among voters at the end of each governance cycle. The group will need several voting cycles and high costs to gain control of the platform.

After the voting process, the matching pool distributes additional DIMP resources to the projects supported by the community, ensuring that resources are allocated in a fair and democratic manner, without any one group having too much power. Moreover, the increasing cost of voting credit prevents individuals from casting too many votes, ensuring equitable distribution of votes among participants.

By incorporating quadratic voting, Actocracy empowers users to influence the outcomes of critical discussions, and the cost of additional votes ensures fair distribution of resources among participants. Blockchain-based services can transform the way public goods are financed and governance decisions are made. Therefore, it is apparent that further research is necessary to unleash its full potential.

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### Conclusion

Traditionally, modern democracies have used the one-person-one-vote method, while corporations have adopted slightly more sophisticated voting mechanisms. However, more democratic voting systems, such as ranked and proportional voting, have failed to catch on due to the complexity involved. Quadruple voting, which allows voters to express their preferences and intensity, helps protect the interests of small groups within communities.

Although a relatively new concept, Quadruple funding has had a significant impact. A growing number of projects are exploring the possibility of quadratic funding, the most famous of which are Gitcoin Grants, clr.fund, and the innovative Actocracy. The new concept could radically change how blockchain protocols are managed and funded.

### References

- de Rosnay, M. D. (2014, July). The digital rights and access to knowledge movements: the rise of a networked democracy. *In International Political Science Association Conference 2014*.
- de Rosnay, M. D. (2016). Peer to party: Occupy the law. *First Monday*, 21(12).
- Dimitri, N. (2022). Quadratic Voting in Blockchain Governance. *Information*, 13(6), 305.
- Freitas, L. V., & Maldonado, W. L. (2021). *Quadratic funding with incomplete information*. FEA/USP.
- GitCoin (2022). Results. *GitCoin*. <https://gitcoin.co/results>
- Pasquini, R. A. (2020a). A Note on Quadratic Funding under Constrained Matching Funds. *arXiv preprint arXiv:2010.01193*.
- Pasquini, R. (2020b). Quadratic Funding and Matching Funds Requirements. *Available at SSRN 3702318*.
- Posner, E. A., & Weyl, E. G. (2014). Quadratic voting as efficient corporate governance. *The University of Chicago Law Review*, 81(1), 251-272.