# Diversify Voting Influence

***PHOTREK***

Research Notes as of August 27, 2021

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**CARDANO IDEASCALE PROPOSAL: DIVERSIFY VOTING INFLUENCE**

**STEPS, GETTING INSIGHT AND GOALS**

*Literature Review*
*Get inside Cardano voting environment (rules and interactions)*
*Governance of decentralized autonomous organizations*
*Diversity and inclusion*

** liberal radicalism*
** Weight votes according to votes of a community*
** Uses sum of squares*
** Here is the working paper on Liberal Radicalism match funding. [https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3243656](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3243656) (Liberal Radicalism: A Flexible Design For Philanthropic Matching Funds)*

*Voting schemes:*
*1 person = 1 vote*
*1 coin = 1 vote*
*Quadratic Voting and its generalizations*
*Square-root Voting and its generalizations*

*Governance*
*Providing voting systems for organizations*

*Cardano Networks and Smart Contracts dev*

*13/AGO*
*Convicting/committed voting - stake money for a time (you don't have access to it)*
*Ideally you don't want to vote. Voting is not necessarily a great way for making decisions*
*You shouldn't spend your money on voting.*
*The treasure would be used as a guarantee as a final payment. But users should collaborate too.*

Look at the distribution of ADA wealth

Get data of governance voting on other cryptocurrency projects
(articles about decentralized economic organizations - data about voting - contact them about the data availability)

Give your voting power to other individual - Delegation

**CARDANO IDEASCALE PROPOSAL: DIVERSIFY VOTING INFLUENCE**

**STEPS, GETTING INSIGHT AND GOALS**

# 1 LITERATURE REVIEW

## 1.1 Cardano voting environment (rules and interactions)

Pending…

## 1.2 Governance of decentralized autonomous organizations

Quadratic Voting

1. Eric A. Posner and E. Glen Weyl. "Quadratic Voting as Efficient Corporate Governance", Coase-Sandor Working Paper Series in Law and Economics, University of Chicago Law School Chicago Unbound, 2013.

2. Steven P. Lalley and Glen Weyl. "Quadratic Voting: How Mechanism Design Can Radicalize Democracy", Aea Papers and Proceedings, Vol. 108, 2018.
   *In this work, the authors present the quadratic voting mechanism and demonstrate how it equates the marginal benefit with the marginal cost of voting. They also explore other possibilities for the cost of voting (power-law cost of voting) and show how to obtain from the model the democratic 1p1v and dictatorship voting schemes.*
   *key insights: power-law cost, voting schemes, 1p1v vs dictatorship, marginal benefit, marginal cost.*

3. Eric Posner and E. Glen Weyl. "Quadratic Voting and the Public Good: Introduction", 172 Public Choice 1, 2017.
   *This article provides an opinionated narrative summary of the contents and surveys the broader literature related to Quadratic Voting (QV), proposed by one of us (Weyl, 2012; Lalley and Weyl, 2016) building off earlier work by Groves and Ledyard (1977) and Hylland and Zeckhauser (1980), where individuals buy as many votes as they wish by paying the square of the votes they buy using some currency.*
   *key insights:*

4. Vitalik Buterin, Zoë Hitzig and E. Glen Weyl. "Liberal Radicalism: A Flexible Design For Philanthropic Matching Funds", Arxiv preprint, 2020.
   *In this work, the authors present the details for a flexible design for funding public goods where Citizens make public goods contributions to projects of value to them. The amount received by each project is proportional to the square of the sum of the square roots of contributions received. Under the "standard model" this mechanism yields first best public goods provision. Groups can gain nothing by splitting or combining projects with the same group of participants.*
   *key insights: voting design, square voting mechanism, voting representation.*

Square-Root Voting

5. Werner Kirsch, On Penrose's Square-Root Law and Beyond, in Power, Voting, and Voting Power: 30 Years After, Heidelberg: Springer, 2013.

6. K. Życzkowski and W. Słomczyński, "Square Root Voting System, Optimal Threshold and π," in *Power, Voting, and Voting Power: 30 Years After*, Berlin, Heidelberg: Springer Berlin Heidelberg, 2013, pp. 573–592.

Correlation Functions

7. S.Braun. "Correlation Functions", Encyclopedia of Vibration, Elsevier, 2001.

Governance Theory

8. M. J. Holler and H. Nurmi, Eds., "Power, Voting, and Voting Power: 30 Years After." Heidelberg: Springer, 2013.

9. André L. M. Vilela and H. Eugene Stanley. "Effect of Strong Opinions on the Dynamics of the Majority-Vote Model", Scientific Reports, Nature, 2018.
*In this work, we investigate how the presence of individuals with strong voting opinions affects a network of social interactions based on the majority-vote model. We find that such a weighted voting mechanism weakens the consensus of the network, imposing a fragile social-ordered regime, where opposing voting states dominate.*
*key insights: voting interactions, weighted voting, consensus robustness.*

10. André L. M. Vilela; Chao Wang; Kenric P. Nelson; H. Eugene Stanley. "Majority-vote model for financial markets", Physica A - Statistical Mechanics and its Applications, Elsevier, 2018.
*In this work, we propose a heterogeneous agent-based two-state sociophysics model to simulate the opinion dynamics on financial markets. Focusing on stock market trader dynamics, we propose a model with two kinds of individuals in which local and global interactions govern the dynamics of buying and selling investors. Despite its simplicity, our model presents such stylized facts of real financial markets and provides us insights regarding the voting dynamics influence on the stock market prices.*
*key insights: voting interactions, voting strategies, market opinion dynamics.*

## 2 VOTING MECHANICS OF QUADRATIC VOTING

### 2.1 Quadratic Voting Model

Consider a society of $N$ voters $i = 1,\dots, N$, where many binary collective decisions (e.g. referenda or choice of leaders) arise. To create the opportunity for market trade, each voter is endowed with a **large stock of voice credits** that they may spend influencing the outcome of these decisions.

*"As in the theory of fair resource allocation (Varian, 1974), we assume that voice credits have been distributed in a manner (such as equal division) considered fair by the relevant society in the sense that maximizing total equivalent continuation value in units of voice credits defines social optimality."*
*Quadratic Voting - How Mechanism Design Can Radicalize Democracy*

### 2.2 Voice Credits

Consider some particular decision. Call $G_i$ the value that a voter $i$ would yield to the voting system (or receive in units of voice credits) for seeing alternative A prevail over alternative B, with negative values indicating a preference for B over A.

### 2.3 Voting System

The community votes to determine which alternative is implemented, with each voter $i$ choosing a continuous number of votes $v_i$ either positive or negative depending on which alternative she favors. Call λ the **vote influence** amount regarding a particular decision.

For a regular election among options A and B, $\lambda = 1$ and every citizen has only one vote, so $v_i = 1$, for all $i$ in $N$. Thus, a voter $i$ obtain $G_i = \lambda v_i = 1$ amount of votes in the direction of her selection (candidate A or B).

*Comment: If $\lambda = 2$, every time that the voter $i$ cast a vote in A, the system would update the total count as two votes for candidate A since $G_i = \lambda v_i = 2$ for $v_i = 1$, for instance.*

In this context, the function λ represents the **weight** of a particular vote, and its shape may be discussed later.

### 2.4 Quadratic Voting Mechanism

Each voter pays a cost $C_i$ of voice credits for her votes, where $C_i(x)$ is differentiable, convex, even and strictly increasing in $|x|$ to a central clearing house. We describe $C_i = C(v_i)$ as a **vote pricing rule.**

*Central idea: quadratic functions are the only ones with linear derivatives and thus the only functions where a voter buying votes equates her marginal benefit and cost at a number of votes proportional to her value.*

Consider the class of vote pricing rules $C(v_i) = v_i^n$ for $n \geq 1$. Then, consider $L_i$ as the **liquid influence** for a voter $i$ with $v_i$ votes:

$$L_i = G_i - C_i,$$

$$L_i = G(v_i) - C(v_i),$$

Thus, using $G_i = \lambda v_i$ and a general power-rule voting of order $n$ for the voting price cost $C(v_i) = \alpha v_i^n$, we obtain:

$$L_i = \lambda v_i - \alpha v_i^n,$$

where $\alpha$ may represent the **cost adjustment factor** for casting $v_i$ votes. We focus our discussion on the $\alpha = 1$ case. Hence, one may maximize its liquid influence gain by choosing a precise number of votes to cast $v_i^*$. Then, taking its first order derivative on $v_i$ of $L_i$, we obtain the inflection point for $L_i$

$$dL_i / dv_i = 0, \text{ at } v_i = v_i^*.$$

$$\lambda - n(v_i^*)^{n-1} = 0,$$

Then, we get

$$v_i^* = (\lambda / n)^{1/(n-1)},$$

as the optimal number of votes to cast in order to optimize the voter influence $L_i$. Let us discuss several scenarios yielded for each value of $n$.

### 2.5 Dominance of the Wealthier $n = 1$

For this case, there is no optimal number of votes $v_i^*$ since the last equation diverges. Nevertheless, we can write

$$L_i = \lambda v_i^* - v_i^* = v_i^*(\lambda - 1).$$

For this scenario, note that the liquid influence **grows at the same rate** of the number of votes cast

$$L_i \sim v_i \sim \lambda.$$

The optimization requirement allows $v_i^*$ free. Since the cost of voting is fixed, one may cast as many votes as he wants, thus dominating the election and suppressing the minority. The marginal influence $g(v_i)$ and marginal cost $c(v_i)$ are defined by

$$g(v_i) = dG_i / dv_i,$$

$$c(v_i) = dC_i / dv_i,$$

Then, we write $g(v_i) = \lambda$ and $c(v_i) = 0$. These results indicate that the **marginal (additional) gain is fixed, while the marginal cost is zero.** So one may vote as much as he wants and the one with the major voting power dominates the result.

### 2.6 Quadratic Voting $n = 2$

In this special case, we have

$$L_i = \lambda v_i^* - (v_i^*)^2 = v_i^*(\lambda - v_i^*),$$

also known as the **Logistic map**, where the liquid influence grows until the optimal maximum value, achieved for

$$v_i^* = \lambda / 2 \ ,$$

and in this case,

$$v_i^* \sim \lambda,$$

where each vote counts for obtaining λ amount of gain. This result also yields

$$L_i(max) = L_i^* = \lambda^2 / 4,$$

Note that any other value of $v_i$ will generate a smaller liquid influence on the voting dynamics (since $L_i$ is a parabola that opens downward) . For the marginal quantities, we obtain

$$g(v_i) = \lambda,$$

$$c(v_i) = 2v_i,$$

where the results may be combined to obtain also the optimal number of votes

$$g(v_i^*) = c(v_i^*) \Rightarrow v_i^* = \lambda / 2,$$

where the difference (marginal) obtained in gain is equal to the difference (marginal) in price to cast a vote. Thus, one may optimize his voting power to not cast votes which will have a decreased influence over an increased cost.

### 2.7 Quadratic Voting $n = 3$

For this case

$$v_i^* = (\lambda / 3)^{1/2}$$

And now, one reads

$$v_i^* \sim \lambda^{1/2}$$

In this case, note that each vote has a decreased influence reflected on the power-law for $\lambda$ since the cost of voting is already bigger than the gain for the minimum amount of votes $v_i = 1$

$$G(v_i = 1) < C(v_i = 1)$$

Using voting power in this scenario is always a bad economic decision (since you pay more than the voting expression that you want to count in the voting process *"pay two, take one home"*). Plus,

$$L_i^* = \lambda^{3/2} (\sqrt{3}/3 - 1),$$

And now the optimal value for the liquid influence weakens the weight of a vote by the power of 1.5, instead of 2 for the quadratic voting.

### 2.8 General Scenario $n > 3$

We recover a result discussed previously

$$v_i^* = (\lambda / n)^{1/(n-1)}.$$

In other words,

$$v_i^* \sim \lambda^{1/(n-1)},$$

where the voting influence decreases even more since $n > 3$**.**

$$L_i^* = \lambda^{n/(n-1)} [1 - \lambda^{1/(n-1)}],$$

which also presents a even more reduced liquid influence when comparing with the $n = 3$ case.

### 2.9 Democratic Regime $n \to \infty$

For the democratic model, we have

$$v_i^* = (\lambda / n)^{1/(n-1)},$$

$$v_i^* \sim \lambda^{1/(n-1)} \to 0, n \to \infty.$$

$$L_i^* \to 0, n \to \infty.$$

**This result represents the limiting 1p1v** case where each agent cast one vote (and sometimes zero votes when being absent) with limiting zero influence over $N$ voters.