

# QUADRATIC VOTING AND BLOCKCHAIN GOVERNANCE

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## I. INTRODUCTION

The blockchain revolution of the last decade has created a multi-billion-dollar industry. However, the lack of efficient governing mechanisms has created fault lines in the industry, often leading to forks and wasted production. Many current blockchains have adopted extant governance mechanisms ill-suited for public blockchains, i.e., blockchains that serve both a public and private purpose.<sup>1</sup> Quadratic voting (“QV”) has the potential to “bring the logic of the market”<sup>2</sup> to blockchain governance and, in so doing, allow blockchain to better meet the needs of their stakeholders.

QV is a relatively new governance tool, that allows participants to express how strongly they prefer an outcome rather than simply rationing voting in traditional one-person, one-vote mechanisms (“1p1v”). Instead, QV voters can express their preference by acquiring extra votes. To link the number of votes and the intensity of QV voters’ preferences, the cost of extra votes increases by the square of the number of votes acquired. For example, if the currency is U.S. dollars, the cost of one vote would be \$1, the cost of two votes would be \$4, the cost of three votes would be \$9, and so on.<sup>3</sup> QV is based on two premises: (1) the more voters prefer an outcome, the more willing they will be to pay to try to achieve that outcome, and (2) a mechanism is needed to balance the weak preferences of a majority with the intense preferences of a minority.<sup>4</sup> The quadratic cost function in QV is just such a mechanism.

Empirically, QV looks to be a significant improvement over existing governance mechanisms, particularly when both a public and a private purpose are involved.<sup>5</sup> Broadly, existing governance mechanisms are structured either for

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\* Del Wright [Fill in later]. This article originated from a podcast, based on a paper by Vitalik Buterin (the founder of Ethereum ) and others, about how implementing QV-based mechanisms could “create little democracies everywhere.” The podcast is available at <https://unchainedpodcast.com/how-blockchains-can-help-create-little-democracies-everywhere/>.

<sup>1</sup>Praveen Jayachandran, *Blockchain Explained: The difference between public and private blockchain*, BLOCKCHAIN PULSE: IBM BLOCKCHAIN BLOG (May 31, 2017), <https://www.ibm.com/blogs/blockchain/2017/05/the-difference-between-public-and-private-blockchain/>. (“A public blockchain network is completely open and anyone can join and participate in the network. The network typically has an incentivizing mechanism to encourage more participants to join the network.”)

<sup>2</sup>Eric A. Posner & E. Glen Weyl, *Quadratic voting and the public good: introduction*, 172 PUB. CHOICE, no. 1, 2017, at 1, 2. <https://doi.org/10.1007/s11127-017-0404-5>.

<sup>3</sup>Eric A. Posner & E. Glen Weyl, *Quadratic voting and the public good: introduction*, 172 PUB. CHOICE, no. 1, 2017, at 1, 6. <https://doi.org/10.1007/s11127-017-0404-5>.

<sup>4</sup> See Steven P. Lalley & E. Glen Weyl, Quadratic voting (Dec. 2016) (Available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2003531](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2003531)). Lalley and Weyl, authors of many of the foundational research papers on QV, admit that using the square of the number of votes ( $N^2$ ) as a pricing mechanism may not produce the optimal outcome, but that it is simpler to understand and implement than the other mechanisms..

<sup>5</sup> See Steven P. Lalley, and E. Glen Weyl, Quadratic Voting (Dec. 2016). Available at

market or state purposes.<sup>6</sup> In market governance, profit serves as the primary incentive, and decision-making mechanisms have evolved mainly to maximize profits. However, that incentive is inadequate for entities with a shared public and private purpose.

For such entities, other goals, such as increasing “social welfare”<sup>7</sup> often factor into the decision-making process, and scholars have been researching how to integrate those goals into governance for years. That research led to a Nobel Prize for Elinor Ostrom, whose work examined diverse governance mechanisms for common-pool resources, a type of public good that benefits a group of people, but provides diminishing benefits the more it is used.<sup>8</sup> A public pasture is an example of a common-pool resource, where every farmer gets an immediate benefit from allowing her animals to graze on the land, but the community suffers from overgrazing.<sup>9</sup>

Ostrom’s work has recently been extended to the blockchain, where scholars have examined commons-based peer production (“CBPP”) communities,<sup>10</sup> an “emergent model of socio-economic production in which a group of individuals cooperate with each other to produce shared resources without a traditional hierarchical organization.”<sup>11</sup> That description fits public blockchains perfectly.

On the other end of the governance continuum is state governance, in which political decisions are made for political purposes. Generally, state governance operates on a spectrum between democratic or hierarchical.<sup>12</sup>

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<https://econpapers.repec.org/RePEc:bfi:wpaper:2016-13>.

<sup>6</sup> Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641, at 641 (2010).

<sup>7</sup> An increase in social welfare is generally understood to mean seeking to increase well-being of a population or community subject to whatever constraints are relevant. *See, e.g.*, Kenneth J. Arrow, ., *A Difficulty in the Concept of Social Welfare*, 58 J. POL. ECON., 328, at 328 (1950) (Available at <http://links.jstor.org/sici?sici=0022-3808%28195008%2958%3A4%3C328%3AADITCO%3E2.0.CO%3B2-R>).

<sup>8</sup> ELINOR OSTROM, *GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION* (Cambridge University Press, 1990).

<sup>9</sup> Garrett Hardin, *The Tragedy of the Commons*, 162 *Science* 1243, at 1244 (1968).

<sup>10</sup> The term CPBB refers to an emergent model of socio-economic production in which groups of individuals cooperate with each other to produce shared resources without a traditional hierarchical organization. *See* Yochai Benkler, *Coase’s Penguin, or, Linux and The Nature of the Firm*, 112 *YALE L.J.* 369, 375 (2002); *see also* YOCHAI BENKLER, *THE WEALTH OF NETWORKS: HOW SOCIAL PRODUCTION TRANSFORMS MARKETS AND FREEDOM* (Yale U. Press, 2006).

<sup>11</sup> David Rozas, Antonio Tenorio-Fornes, Silvia Diaz-Molina & Samer Hassan, *When Ostrom Meets Blockchain: Exploring the Potentials of Blockchain for Commons Governance* (July 30, 2018) (available at SSRN: <https://ssrn.com/abstract=3272329> or <http://dx.doi.org/10.2139/ssrn.3272329>)

<sup>12</sup> At the extremes, those paradigms are dictatorship and majority rule. *See generally* Steven P. Lalley & E. Glen Weyl, *Quadratic Voting: How Mechanism Design Can Radicalize Democracy*, 1 *Am. Econ. Assn. (PAPERS & PROC.)* 1 (2017) (Available at SSRN: <https://ssrn.com/abstract=2003531> or <http://dx.doi.org/10.2139/ssrn.2003531>).

*“A democracy is two wolves and a sheep voting on what’s for dinner.”*<sup>13</sup>

Democratic governance, typically employing 1p1v and majority rule, rests power in the participants, who rule either directly or through elected representatives. The 1p1v system is premised on the belief that all voters should be treated equally.<sup>14</sup>

By design, democratic governance is inclusive, because, notwithstanding voter suppression issues,<sup>15</sup> all eligible voices may be heard. However, 1p1v systems ration voting influence, set a minimum and maximum share in public decision-making, and prevent voters from expressing the “widely different intensities with which they hold their respective political convictions and opinions.”<sup>16</sup>

Economic researchers have examined 1p1v systems and have asked whether “the basic problem underlying existing collective decision procedures is that they rely on the principle of rationing (viz., every individual is rationed a single vote on each political contest or issue) rather than on the market principle of trade (viz., individuals can exchange influence on issues less important to them for influence on those more important to them).”<sup>17</sup> QV research addresses that question directly.

Through democratic governance, participants make decisions either about a specific issue, such as the Brexit,<sup>18</sup> or about the decision makers, such as the election of the U.S. President. However, such democratic decisions often have led to sub-optimal results, and hindsight has shown those decisions often fail to provide socially beneficial outcomes.<sup>19</sup> One long-understood reason for the

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<sup>13</sup> Edwin Feulner, *Preventing “The Tyranny of the Majority,”* THE HERITAGE FOUNDATION (Mar. 7, 2018), <https://www.heritage.org/conservatism/commentary/preventing-the-tyranny-the-majority>.

<sup>14</sup> See, e.g., JOHN LOCKE, TWO TREATISES OF GOVERNMENT, (Peter Laslett ed., Cambridge Univ. Press 1988) (1690).

<sup>15</sup> See, e.g., Danny Hakim & Michael Wines, *They Don’t Really Want Us to Vote’: How Republicans Made It Harder*, N.Y. TIMES (Nov. 3, 2018),

<https://www.nytimes.com/2018/11/03/us/politics/voting-suppression-elections.html>; Kevin Morris & Myrna Pérez, *North Carolina’s Election Fiasco Is About Voter Suppression, Not Voter Fraud*,

BRENNAN CTR. JUST.: BLOG (Dec. 6, 2018), <https://www.brennancenter.org/blog/north-carolinas-election-fiasco-about-voter-suppression-not-voter-fraud>; Jamil Smith, *Why Republicans are Suppressing Black Votes*,

ROLLING STONE (Oct. 12, 2018, 8:00 AM),

<https://www.rollingstone.com/politics/politics-news/republicans-suppressing-black-votes-738059/>.

<sup>16</sup> Steven P. Lalley & E. Glen Weyl, *Quadratic voting* (Dec. 2016) (Available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2003531](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2003531)) (citing ALBERT O. HIRSCHMAN, *SHIFTING INVOLVEMENTS: PRIVATE INTEREST AND PUBLIC ACTION* (Princeton U. Press, 1982).

<sup>17</sup> Eric A. Posner & E. Glen Weyl, *Quadratic voting and the public good: introduction*, 172 PUBLIC CHOICE, no. 1, 2017, at 1, 2. <https://doi.org/10.1007/s11127-017-0404-5>.

<sup>18</sup> The June 23, 2016 United Kingdom European Union membership referendum, also known as the Brexit referendum, which polled UK and Gibraltar voters on whether they wanted to remain a member of the European Union (EU) under the provisions of the European Union Referendum Act 2015 and also the Political Parties, Elections and Referendums Act 2000.

<sup>19</sup> Eric A. Posner & Alan O. Sykes, *Voting Rules in International Organizations*, 15 CHI. J. INT’L L. 195, 224 (2014).

sometimes poor performance of democratic voting is that many voters are ill-informed, and often make poor voting choices based on distorted information provided by a motivated minority.<sup>20</sup>

An additional concern of democratic governance is the naturally tendency toward tyranny by the majority, whereby the electorate places the majority's interests over the minority's.<sup>21</sup> Tyranny by the majority is characterized by (i) the Millsian concept of a violation of individual liberty,<sup>22</sup> and (ii) the Madisonian concept of factionalism, that is, a majority group pursuing goals contrary to the rights of others or "the permanent and aggregate interest of the community."<sup>23</sup> One solution, introduced by the creators of the U.S. democracy, based in part on those Madisonian principles,<sup>24</sup> was to augment majority rule with constitutional constraints that protect "certain"<sup>25</sup> minorities.<sup>26</sup> In practice, however, those constraints often limit the efficiency of government, and may allow a powerful minority to tilt the system in its favor.<sup>27</sup>

A related problem with 1p1v systems is that while they may capture preference, they fail to capture the intensity of preference. As a result, without factoring in the intensity of voter preferences, 1p1v systems tend to capture the median instead of the mean voter,<sup>28</sup> and the median voter may not represent the

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<sup>20</sup> See, e.g., ILYA SOMIN, *DEMOCRACY AND POLITICAL IGNORANCE: WHY SMALLER GOVERNMENT IS SMARTER* (Stan. U. Press, 2<sup>nd</sup> ed. 2013).

<sup>21</sup> See generally, ALEXIS DE TOCQUEVILLE, *DEMOCRACY IN AMERICA*, (1835).

<sup>22</sup> See Struan Jacobs, *John Stuart Mill on the Tyranny of the Majority*, 28 *AUSTL. J. OF POL. SCI.* 306-321 (1993); see also JOHN STEWART MILL, *ON LIBERTY* (1859).

<sup>23</sup> THE FEDERALIST NO. 10 (James Madison); Eyal Baharad & Shmuel Nitzan, *Ameliorating Majority Decisiveness through Expression of Preference Intensity*, 96 *Am. Pol. Sci. Rev.* 745, (2002),

<sup>24</sup> See THE FEDERALIST PAPER NO. 10 (James Madison) (which "pertains to the orientation of personal appetites toward public ends, which include both the common good and private rights. The essay recognizes that these appetites cannot be conquered, but they can be conditioned. Madison's solution to the problem of faction — a solution he confines to the four corners of majority rule — is to place majorities in circumstances that encourage deliberation and thus defuse passion."); see also Greg Weiner, *After Federalist No. 10*, NATIONAL AFFAIRS, (Fall 2017), <https://www.nationalaffairs.com/publications/detail/after-federalist-no-10>. <https://www.nationalaffairs.com/publications/detail/after-federalist-no-10>.

<sup>25</sup> That protection did not extend to the people Madison enslaved. Madison, one of many slavers to contribute to the founding documents of the country, believed those protections should only be afforded to white men. Madison owned over one hundred slaves on his Virginia plantation, brought enslaved people to the White House, and ultimately sold them for personal profit. See, Paris Amanda Spies-Gans, *James Madison*, PRINCETON & SLAVERY (accessed July 24, 2019), <https://slavery.princeton.edu/stories/james-madison>.

<sup>26</sup> Madison sought to create a constitutional order that sought to create obstacles for "unjust and interested" majorities. See, THE FEDERALIST NO. 10 (James Madison).

<sup>27</sup> See Arthur M. Schlesinger Jr., *The Runaway Presidency*, THE ATLANTIC, (Nov. 1973), <https://www.theatlantic.com/magazine/archive/1973/11/the-runaway-presidency/306211/1973> ("In the end, the way to control the presidency may have to be not in many little ways but in one large way. In the end, there remains, as Madison said, the decisive engine of impeachment. ... This is, of course, the instrument provided by the Constitution. But it is an exceedingly blunt instrument.").

<sup>28</sup> The "median voter theorem" was coined by Anthony Downs, a senior fellow at the Brookings Institute, in 1957. See, ANTHONY DOWNS, *AN ECONOMIC THEORY OF DEMOCRACY* (1957).

considered opinion of the population.<sup>29</sup> Moreover, economic research has demonstrated that, from an efficiency standpoint, the “median is often a poor approximation of the mean,” and basing decisions on the median voter has often led to sub-optimal funding of public goods, systematic biases against minority groups and communities, and fractionalization.<sup>30</sup> In the last decade, QV research has been theoretically shown to produce decisions that are less likely to suffer from these flaws, and to produce “better”<sup>31</sup> outcomes, particularly as the population of voters grows.<sup>32</sup>

Hierarchical governance, on the other hand, puts the decision making in the hands of a control group, usually of individuals whose interests are aligned with interested stakeholders. Most businesses operate under some form of this system, where owners select directors or managers who set and implement policies on the owners’ behalf. Such systems give the control group both autonomy and flexibility in reaching consensus. However, by delegating decisions to a control group, the decisions are, by nature, undemocratic. Moreover, the agency relationship created in hierarchical systems exposes entities to significant risks, including “lack of transparency, corruption, regulatory capture, misuse of power and even regression into authoritarianism, due to the concentration of power in the hands of few.”<sup>33</sup>

Both democratic governance and hierarchical governance offer, as they have developed throughout history, both advantages and disadvantages. However, the needs of blockchains may not fit well into either paradigm, and existing governance mechanisms may not best serve the needs of current and future blockchain applications.

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<sup>29</sup> See, e.g., Grant M. Hayden, *The False Promise of One Person, One Vote*, 10 MICH. L. REV. 213 (2003), [https://scholarlycommons.law.hofstra.edu/faculty\\_scholarship/562..](https://scholarlycommons.law.hofstra.edu/faculty_scholarship/562..)

<sup>30</sup> See Vitalik Buterin, Zoe Hitzig & E. Glen Weyl, *Liberal Radicalism Formal Rules for a Society Neutral among Communities*, (Sept. 17, 2018). (Available at SSRN: <https://ssrn.com/abstract=3243656> or 30. <https://arxiv.org/pdf/1809.06421.pdf>).

<sup>31</sup> The use of “better” in this article, with respect to outcomes, generally refers to decisions that are more economically efficient. In the research relied upon in this article, that efficiency has been described using Pareto optimality, and Nash or a Bayes-Nash equilibrium. Pareto-optimality, in simplified form, infers there is no alternative that would make some people better off without making anyone worse off. Bayes-Nash equilibrium is a strategy that maximizes the expected utility given the sequential actions of other players and the beliefs about those other players. Nash equilibrium refers to a set of strategies that can be self-enforcing, in that no player has incentive to change his or her strategy given what the other players are doing. See, e.g., ROBERT AUMANN & SERGIU HART, HANDBOOK OF GAME THEORY WITH ECONOMIC APPLICATIONS (North-Holland, 1<sup>st</sup> ed. 2002); H. SCOTT BIERMAN & LUIS FERNANDEZ, GAME THEORY WITH ECONOMIC APPLICATIONS, Reading, Mass.: Addison Wesley; AVINASH K. DIXIT AND BARRY J. NALEBUFF, THINKING STRATEGICALLY: THE COMPETITIVE EDGE IN BUSINESS, POLITICS, AND EVERYDAY LIFE (W.W. Norton & Co. 1991).; NORTON; JOHN EATWELL, MURRY MILGATE & P. NEWMAN, THE NEW PALGRAVE: GAME THEORY (NORTON, 1989) ; ROBERT GIBBONS, GAME THEORY FOR APPLIED ECONOMISTS (Princeton U. Press. 1992).

<sup>32</sup> *Supra* note 3.

<sup>33</sup> Marcella Atzori, *Blockchain Technology and Decentralized Governance: Is the State Still Necessary?* 6 J. OF GOVERNANCE AND REG., 45, 47. [http://dx.doi.org/10.22495/jgr\\_v6\\_i1\\_p5](http://dx.doi.org/10.22495/jgr_v6_i1_p5).

Previous technological revolutions had little impact on governance. But some suggest that our new technological era enables a potentially-emergent “collaborative commons” in which society is motivated by collaborative interests rather than individual gain.<sup>34</sup>

Whether QV is “good enough,”<sup>35</sup> for the blockchain in these collaborative commons is what this article begins to explore. It begins with a discussion of governance issues, explaining those issues in the broader context of governance research, and reflecting on how QV could be used to make better decisions. It then discusses distributed governance generally, analyzing the two broad categories of blockchain governance in existence today: on-chain v. off-chain. The article next examines QV, discussing both its theoretical underpinnings and practical challenges in implementation. The article concludes with a discussion of a promising QV application and a call for further research.

## II. GOVERNANCE

Governance as a concept may mean different things to different people. It is “difficult to capture in a single definition,” and a “highly contextual concept whose meaning cannot be captured using one monolithic definition. As such, the process and practices that will apply will vary significantly given the environment in which they are applied.”<sup>36</sup>

A workable definition in the public sphere is that “governance refers to a process whereby elements in society wield power, authority and influence, . . . enact policies and [make] decisions concerning public life and social upliftment.”<sup>37</sup> What is missing from that definition is a governance goal.

I posit that any such goal is *sui generis*, and, ultimately, determined at least in part, by a society’s dominant elements. While most would agree that security, freedom and equality are goals of almost any government, the relative preferences of those goals manifest themselves differently across the globe. Moreover, because “freedom and equality are sworn and everlasting enemies,” any goal will necessarily involve tradeoffs.<sup>38</sup>

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<sup>34</sup> See UK GOV’T CHIEF SCI. ADVISER, DISTRIBUTED LEDGER TECHNOLOGY: BEYOND BLOCKCHAIN, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/492972/gs-16-1-distributed-ledger-technology.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf), (citing Rifkin J ‘The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism’ 2014. New York, Palgrave Macmillan).

<sup>35</sup> See Vlad Zamfir, *Against on-chain Governance*, MEDIUM (Dec. 1, 2017), [https://medium.com/@Vlad\\_Zamfir/against-on-chain-governance-a4ceacd040ca](https://medium.com/@Vlad_Zamfir/against-on-chain-governance-a4ceacd040ca).

<sup>36</sup> JOSEPHINE N. ARASA, MUNYAE M. MULINGE & VIOLET WAWIRE, THE STATUS OF STUDENT INVOLVEMENT IN UNIVERSITY GOVERNANCE IN KENYA: THE CASE OF PUBLIC AND PRIVATE, 38 (Codesria, 2017) (available at [https://www.codesria.org/IMG/pdf/3-\\_the\\_governance\\_of\\_higher\\_education.pdf?8662/af6940f7bbfef129fbb5117e9b2a9341b3e1ea69](https://www.codesria.org/IMG/pdf/3-_the_governance_of_higher_education.pdf?8662/af6940f7bbfef129fbb5117e9b2a9341b3e1ea69)).

<sup>37</sup> UNDERSTANDING THE CONCEPT OF GOVERNANCE, [www.gdrc.org/u-gov/governance-understand.html](http://www.gdrc.org/u-gov/governance-understand.html) (accessed on July 24, 2019).

<sup>38</sup> See WILL DURANT & ARIEL DURANT, THE LESSONS OF HISTORY (Simon and Shuster, 2010).

For example, the North Korean and Saudi governments appear to manifest a primary goal of security over freedom,<sup>39</sup> while the Israeli government appears to manifest a primary goal of security over equality.<sup>40</sup> Many European and quasi-socialist governments appear to manifest a primary goal of equality over freedom, and the U.S. government appears to manifest a primary goal of freedom over equality.<sup>41</sup> Regardless of the merits of those goals, a governance mechanism, at least in the democratic states, should be structured to help reach them.

The goals of most businesses are to maximize shareholder value,<sup>42</sup> and “corporate governance is the mechanism by which business organizations oversee, execute, and maintain a complex series of interacting agreements between the organization’s different stakeholders.”<sup>43</sup> Similarly, although a goal of some participants in blockchain technologies is to maximize value, other more public-minded goals also play a significant role.<sup>44</sup>

One defining characteristic of blockchain technologies is their ability to blur the lines between economic/business issues and social/community issues, based on the fact that many blockchain applications operate in between the public and business spheres.<sup>45</sup> On the extremes, some applications, such as Ripple, aim to serve primarily business purposes,<sup>46</sup> while others, such as Agora, aim to serve

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<sup>39</sup> See *North Korea*, FREEDOM HOUSE, <https://freedomhouse.org/report/freedom-world/2014/north-korea#.VKoHQivF-Sp>.

<sup>40</sup> Israel enacted a law that the right to national self-determination in Israel is unique to the Jewish people, not all citizens. See David M. Halbfinger & Isabel Kershner, *Israel Passes Law Anchoring Itself as Nation-State of the Jewish People*, N.Y. TIMES, (Jul. 19, 2018), <https://www.nytimes.com/2018/07/19/world/middleeast/israel-law-jews-arabic.html>.

<sup>41</sup> Peter H. Schuck, *James Q. Wilson and American Exceptionalism*, 310 Yale L. Sch., Pub. L. (2013) (available at SSRN: <https://ssrn.com/abstract=2330375>).

<sup>42</sup> However, that may be changing. Recently in France, government ministries published a report challenging the view that maximizing shareholder value was the only goal for a business. Rather, they argued, a business enterprise should have a “*raison d’être*” beyond simply profit maximization, and should base its “governance on that concept.” That report began with a quote from Peter Drucker, the noted U.S. management consultant, stating that “[P]rofit is not an end in itself” for a company.” See Notat, N., & Senard, J., *L’entreprise, objet d’intérêt collectif*, Rapport aux Ministres de la Transition écologique et solidaire, de la Justice, de l’Économie et des Finances, ainsi que du Travail, [https://www.entreprises.gouv.fr/files/files/directions\\_services/politique-et-enjeux/entrepreneuriat/entreprise-objet-interet-collectif.pdf](https://www.entreprises.gouv.fr/files/files/directions_services/politique-et-enjeux/entrepreneuriat/entreprise-objet-interet-collectif.pdf).

<sup>43</sup> Carla L. Reyes, Nizan Geslevich Packin, & Benjamin P. Edwards, *Distributed Governance* 59 WM. & MARY L. REV. ONLINE 1. 4, 7 (2017) (available at <https://ssrn.com/abstract=2884978> or <http://dx.doi.org/10.2139/ssrn.2884978>) (other citations omitted).

<sup>44</sup> See ERIC A. POSNER & E. GLEN WEYL, *RADICAL MARKETS, UPROOTING CAPITALISM AND DEMOCRACY FOR A JUST SOCIETY*, (Princeton Univ. Press 2018).

<sup>45</sup> David Kish & Danielle Stanko, *How Blockchain Can Accelerate Social Impact*, THE NEXT EVOLUTION (Sep. 6, 2018), <http://www.thenextevolution.com/2018/09/06/how-blockchain-can-accelerate-social-impact/>.

<sup>46</sup> Ripple is a real-time global settlement system, currency exchange and remittance network. See Shawn Gordon, *What is Ripple?*, BITCOIN MAG. (accessed on July 24, 2019), <https://bitcoinmagazine.com/guides/what-ripple/>. See also <https://ripple.com/use-cases/>.

primarily public purposes.<sup>47</sup> However, in that vast middle, where Bitcoin and Ethereum have laid their claims, the goals are not simply to make a profit, but, like the internet generally, to create a public good.<sup>48</sup>

One thing that has become clear is that the goals of most blockchain applications is not simply to maximize profits. Some have theorized that “by redefining business value in context of social issues, decentralized technologies like blockchain can create new social economies that fund social causes, stimulate social innovation and enable individuals to make a living through social impact.”<sup>49</sup>

Bitcoin was founded on the ideology that unpaid contributors would offer code to the world free of charge with a vision of using technology to escape from the failures of human politics. However, existing blockchain governance models replicated many of those failures, and led to hard forks, recriminations and disarray.<sup>50</sup> In addition, not all stakeholders share the founding ideology, and without a clearly defined shared ideology or mission, finding consensus on needed improvements has proven difficult.

For bitcoin holders (“hodlers” in the world of crypto)<sup>51</sup> and miners, the primary goal may be a higher price; however, for founders, developers, and the broader public, the primary goal may be an increase in network utility (as a store of value and medium of exchange) and adoption. An efficient governance system should provide stakeholders transparent criteria for selecting the protocol’s goals, allow changes to those goals as the protocol matures, and incentivize developers to assist in reaching those goals. To date, such a system has not been discovered.

While most would agree that the broad goals of public blockchains are both economic (profit) and social (public welfare), most existing governance mechanisms treat economic and social issues as “separate and distinct.”<sup>52</sup> For

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<sup>47</sup> Agora, a project originating out of the Swiss Federal Institute of Technology Lausanne, has created a blockchain voting platform dedicated to ensuring transparent and verifiable elections around the world. See AGORA, <https://www.agora.vote/about>.

<sup>48</sup> Mathew Di Ferrante, *Blockchains as a Public Good*, MEDIUM.COM (Sept. 10, 2018), <https://medium.com/@matthewdif/blockchains-as-a-public-good-17764de19b3f>.

<sup>49</sup> David Kish and Danielle Stanko, *How Blockchain Can Accelerate Social Impact*, THE NEXT EVOLUTION (SEP. 6, 2018), <http://www.thenextevolution.com/2018/09/06/how-blockchain-can-accelerate-social-impact/>

<sup>50</sup> See, e.g., Anton Muehleemann, *The Bitcoin Cash Hash War: ABC vs SV*, MEDIUM.COM (Nov. 19, 2018), <https://medium.com/ironchain-capital/the-bitcoin-cash-hash-war-abc-vs-sv-afef73a569dc>; Stephen O’Neil, *ABC vs SV: Assessing the Consequences of the Bitcoin Cash War*, COINTELEGRAPH.COM (Nov. 26, 2018), <https://cointelegraph.com/news/abc-vs-cv-assessing-the-consequences-of-the-bitcoin-cash-war>; Vitalik Buterin, *Governance, Part 2: Plutocracy Is Still Bad*, VITALIK.CA (Mar. 28, 2018), <https://vitalik.ca/general/2018/03/28/plutocracy.html>.

<sup>51</sup> Hodlers refer to people who hold bitcoins. HODL is defined as a misspelling of “hold.” It has evolved into a shortened form of “Hold On for Dear Life”. The term originated as a misspelling of “hold,” and became a popular term among those who buy cryptocurrencies. A person who does this is known as a “Hodler.” See Sudhir Khatwani, *What is “HODL” in the Cryptocurrency World? + Must Know Cryptocurrency Terms*, COINSUTRA.COM (last updated June 30, 2019), <https://coinsutra.com/hodl-popular-cryptocurrency-terms/>.

<sup>52</sup> See David Kish & Danielle Stanko, *How Blockchain Can Accelerate Social Impact*, THENEXTEVOLUTION.COM (Sept. 6, 2018), <http://www.thenextevolution.com/2018/09/06/how->

businesses, social goals are, at best, ancillary, and the second goal is often reducing agency costs and preventing moral hazard to ensure the profits flow to the owners instead of the managers.<sup>53</sup> The 2008 mortgage crisis, which many believe served as a significant motivation for Bitcoin,<sup>54</sup> is a prime example of the failure of some business governance mechanisms to combat moral hazard. During the crisis, financial institutions, mortgage brokers, real estate agents, and some home buyers gamed the system to transfer wealth to themselves at the expense of their shareholders and, more broadly, U.S. taxpayers.<sup>55</sup>

Communities, on the other hand, generally seek to improve public welfare. However, because of the tragedy of the commons, many objectively beneficial activities are never undertaken because they have “little recognizable business value.”<sup>56</sup> In addition, because of the tensions between group interest and self-interest, decisions on public goods often are difficult. The current debate about climate change is an example, whereby despite overwhelming credible evidence of the harm of global warming, in the U.S., most attempts to enact policies to combat climate change have been thwarted by business groups and the politicians who serve them. Admittedly, however, it is those businesses that will bear the direct cost of those policies, while the benefits will be shared by society.

Reaching consensus on mixed economic and social issues is a complex task, made even more so in a blockchain community where, in addition to the issues above, the community is virtual, there are few barriers to entry or exit, and membership is pseudonymous. While QV does not herald a perfect solution, it may be an improvement.

### III. DISTRIBUTED GOVERNANCE

*“Instead of a hierarchical structure managed by a set of humans interacting in person and controlling property via the legal system, a decentralized organization involves a set of humans interacting with*

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blockchain-can-accelerate-social-impact/.

<sup>53</sup> See, e.g., Goshen, Zohar & Squire, Richard C., *Principal Costs: A New Theory for Corporate Law and Governance* 117 Colum. L. Rev., 767, (2017) (available at SSRN: <https://ssrn.com/abstract=2571739> or <http://dx.doi.org/10.2139/ssrn.2571739>).

<sup>54</sup> Noogin, *The Financial Crisis and History of Bitcoin*, MEDIUM.COM (May 15, 2018), <https://medium.com/@noogin/the-financial-crisis-and-history-of-bitcoin-27ebdb932b99>.

<sup>55</sup> According to research from the Federal Reserve Bank of San Francisco, the 2008 mortgage crisis, and the recession it triggered, will cost the average U.S. citizen \$70,000 over the course of a lifetime. See Regis Barnichon, Christian Matthes & Alexander Ziegenbein, *The Financial Crisis at 10: Will We Ever Recover?*, FRBSF.ORG (Aug 13, 2018), <https://www.frbsf.org/economic-research/publications/economic-letter/2018/august/financial-crisis-at-10-years-will-we-ever-recover/>.

<sup>56</sup> *Supra* note 52.

*each other according to a protocol specified in code, and enforced on the blockchain.”*

- Vitalik Buterin, *Founder of Ethereum*<sup>57</sup>

Distributed governance has been described as “the specification of principles and methods which enable scalable coordination for forming consensus and to legitimate decisions.”<sup>58</sup> Two primary components in distributed governance are the decision makers and their incentives.<sup>59</sup> Using the Bitcoin ecosystem as an example, each of those components is discussed below.

### A. Decision Makers

The decision makers in the Bitcoin are the developers, the miners, token holders, node operators and users. Each plays a part in managing and improving the network through the Bitcoin Improvement Proposal (“BIP”), the mechanism used to improve the Bitcoin protocol.<sup>60</sup> As of the date of this article, there have been 322 BIPs.<sup>61</sup>

The BIP process generally begins with a developer submitting an improvement proposal. If deemed worthy, the proposal (i) becomes a draft, (ii) is sent to the Bitcoin core developers<sup>62</sup> for review, and (iii) is added to the GitHub repository for BIPs, where it is discussed in the greater community.<sup>63</sup>

Once accepted as a draft, the proposal can be either (i) deferred or withdrawn by the author, or (ii) rejected or accepted by the community of node operators. Once a BIP makes it to the “accepted,” stage, it cannot be finalized unless miners show 95% support for it.<sup>64</sup> Lastly, once finalized, the node operators

<sup>57</sup> Vitalik Buterin, *DAOs, DACs, DAs and More: An Incomplete Terminology Guide*, ETHEREUM BLOG (May 6, 2014), <https://blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-anincomplete-terminology-guide/>

<sup>58</sup> Max Semenchuk, *What is Distributed Governance?* MEDIUM.COM (Oct. 23, 2019), <https://medium.com/dgov/what-is-distributed-governance-3b103eb082c0>.

<sup>59</sup> Brian Curran, *What is Blockchain Governance? Complete Beginner’s Guide*, BLOCKONOMI.COM (Sep. 21, 2018), <https://blockonomi.com/blockchain-governance/>.

<sup>60</sup> A Bitcoin Improvement Proposal (BIP) is a design document for introducing features or information to Bitcoin. The BIP should provide a concise technical specification of the feature and a rationale for the feature. This is the standard way of communicating ideas since Bitcoin has no formal structure. See BITCOIN WIKI (last visited July 24, 2019), [https://en.bitcoin.it/wiki/Main\\_Page](https://en.bitcoin.it/wiki/Main_Page).

<sup>61</sup> GITHUB, <https://github.com/bitcoin/bips>.

<sup>62</sup> See BITCOIN CORE, <https://bitcoin.org/en/development#spec> for a list of the Bitcoin core developers.

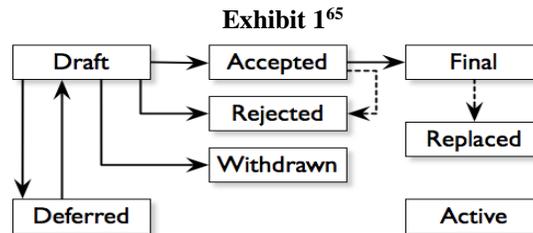
<sup>63</sup> Vladimir Ciobica, *What is a BIP? The Most Famous Bitcoin Improvement Proposals*, COINDOO (Nov. 4, 2018), <https://coindoo.com/what-is-a-bip-the-most-famous-bitcoin-improvement-proposals/>

<sup>64</sup> In order for a BIP to become accepted and labeled as Final, each of the following conditions must be met:

Follows the correct format as specified by BIP-1

Includes code implementations of the proposed changes to the protocol

must upgrade to the new iteration of the protocol which includes the BIP before the BIP is fully integrated into the Bitcoin blockchain. The chart below describes the process:



The multiple approvals of the core developers, the miners and the node operators ensure that no one bad actor or group can make changes to the protocol detrimental to the community.

## B. Incentives

*“Show me the incentive, I’ll show you the outcome”*

*- Charlie Munger.<sup>66</sup>*

While most would agree that network security and scalability are goals of the all public blockchains, precisely defining those terms is difficult and involves tradeoffs for different stakeholders. Thus, proposed changes require human inputs and a means for the stakeholders to determine the “best” solution, i.e., governance.

In the Bitcoin environment, the stakeholders are the miners, core developers, and node operators, yet those stakeholders have vastly different incentives. Miners are incentivized by block rewards to both secure the network and reduce network instability. Many view the miner’s incentive structure as Bitcoin’s most significant innovation, in that it found a clever game-theoretic solution to the classic Byzantine Generals’ Problem, by paying the generals (here, miners) a salary (the block reward) so long as they act honestly, but garnishing that salary if they are caught trying to cheat.<sup>67</sup> Moreover, Bitcoin’s open-source nature “ensures that an organized attack is not very lucrative, by enabling stakeholders to recognize the attack and defect to other chains.”<sup>68</sup>

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Has 95% support from the last 2,016 miners (~14 days worth of mining with 10 min blocks).

<sup>65</sup> See GITHUB, <https://github.com/bitcoin/bips/blob/master/bip-0001/process.png>.

<sup>66</sup> Charles Thomas Munger is an American investor, businessman and philanthropist. He is vice chairman of Berkshire Hathaway, the conglomerate controlled by Warren Buffett.

<sup>67</sup> Elab Verbin, *Behavioral Crypto-Economics: The Challenge and Promise of Blockchain Incentive Design*, MEDIUM (Mar. 16, 2018), <https://medium.com/berlin-innovation-ventures/behavioral-crypto-economics-6d8befbf2175>.

<sup>68</sup> *Id.*

Bitcoin also incentivizes its developers, but indirectly. Bitcoin developers, unlike other platforms such as Ethereum, do not have a direct financial incentive in the protection and development of the protocol.<sup>69</sup> Instead Bitcoin, as an open-source project, relies on “developers who are most philosophically-aligned with the cypherpunk ethos of Bitcoin, [and] are motivated to work on it on their own free time.”<sup>70</sup> Although Bitcoin developers may not receive direct financial remuneration, they do earn experience and credentials that can be monetized, particularly with the demand for blockchain developers growing exponentially.<sup>71</sup>

Bitcoin node operators are also indirectly incentivized by increases in network utility and the price of bitcoin.<sup>72</sup> The role of a node operators is to “harness the power of everyday computers to run an overlaying security protocol that polices the blockchain. . . . As more nodes enter the system, the more secure the governance layer becomes, increasing efficiencies and fortifying trust.”<sup>73</sup> However, there is no direct benefit to node operators – they do not receive any part of the miners’ block rewards, nor do they receive the credit for improvements made by the core developers. Nevertheless, without their participation, the network would come to a grinding halt.

While miners, core developers and node operators all have incentives, those incentives are not aligned, which helps to explain why there have been relatively few BIPs implemented (approx. 35),<sup>74</sup> and many have been hotly contested.<sup>75</sup> To be successful, all three parties must achieve a high degree of consensus around any proposal. This is an area QV may offer an improvement, by

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<sup>69</sup> See SFOX, *Miners, Developers, and Users: The Checks and Balances of Bitcoin*, MEDIUM (Aug. 23, 2018), <https://blog.sfox.com/miners-developers-and-users-the-checks-and-balances-of-bitcoin-d9fb242ce2fe>.

<sup>70</sup> The skills needed to develop improvements or applications for any blockchain include expertise in mechanism design, cryptography, computer science, engineering, behavioral economics and public policy. See *supra* note 67; see also Hugo Nguyen, *Bitcoin’s Incentive Scheme and the Rational Individual*, MEDIUM (Dec. 24, 2018), <https://medium.com/@hugonguyen/bitcoins-incentive-scheme-and-the-rational-individual-dc20effa4715>.

<sup>71</sup> See Johnny Uzan, *Developer Incentives in Bitcoin and the Freerider Problem*, MEDIUM (July 17, 2018), [https://medium.com/@Johnny\\_Uzan/developer-incentives-in-bitcoin-and-the-freerider-problem-93123a0734bf](https://medium.com/@Johnny_Uzan/developer-incentives-in-bitcoin-and-the-freerider-problem-93123a0734bf).

<sup>72</sup> Node operators did have an incentive structure in the early days of Bitcoin. In April 2013, a Bitnodes Project was launched with a goal of providing incentives to node operators “until 2015 or until 10,000 nodes are running.” Joe Dalais, *Bitnodes Project Issues First Incentives for Node Operators*, BITCOIN MAGAZINE (Mar. 16, 2015), <https://bitcoinmagazine.com/articles/bitnodes-project-issues-first-incentives-node-operators-1426544155/>.

<sup>73</sup> Rob Viglione, *The Benefits of Incentivizing Node Operators in Public Blockchains*, BITCOIN MAGAZINE (May 25, 2018), <https://bitcoinmagazine.com/articles/op-ed-benefits-incentivizing-node-operators-public-blockchains/>.

<sup>74</sup> See Велеслав (Veslavs), GITHUB (June 13, 2019), <https://github.com/bitcoin/bips/blob/master/README.mediawiki>.

<sup>75</sup> See Oscar Williams-Grut & Rob Price, *A Bitcoin civil war Is threatening to tear the digital currency in 2—here’s what you need to know*, BUSINESS INSIDER (Mar. 26, 2017, 4:55 AM), <https://www.businessinsider.com/bitcoins-hard-fork-bitcoin-unlimited-segregated-witness-explained-2017-3>.

providing a better mechanism for achieving consensus by taking into account the intensity of preferences among the stakeholders.

#### IV. BLOCKCHAIN GOVERNANCE

*How people respond to changes in the code or the “social layer on top of the math” has become increasingly critical for the success of blockchain projects.*<sup>76</sup>

Blockchain governance, as a subset of distributed governance, is the process whereby participants agree on a set of parameters for changing the protocol, resolving disputes, sanctioning rulebreakers and enforcing penalties.<sup>77</sup> Blockchain governance is divided into two camps:

- Off-Chain, in which decision-making takes place first on a social level and is later encoded into the protocol by developers; and
- On-Chain, in which decision-making rules are encoded into the protocol and any decision that is approved is automatically incorporated into the protocol.<sup>78</sup>

Each mechanism shares the same goal: to create a “better” blockchain, but go about it in different ways.

Whether blockchain governance is an abstract design problem or an applied social problem is an open question. Some contend that blockchain governance may be “best approached by using governance to set the right incentives for people to solve them.”<sup>79</sup> Others contend that because of “pre-existing constraints on participants’ ability to coordinate to adopt any proposed governance solutions,” blockchain governance is “an applied social problem ... in the context of [the] existing governance structure, ...current information and incentives”<sup>80</sup> Thus, because of “unpredictable and emergent phenomenon... it cannot be fully

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<sup>76</sup> Pool of Stake, *A Short History of Blockchain Governance or How to Deal with Unexpected Conflict*, MEDIUM (May 14, 2018), <https://medium.com/@poolofstake/a-short-history-of-blockchain-governance-or-how-to-deal-with-unexpected-conflict-e727e596d5ed>.

<sup>77</sup> See .David Yermack., *Corporate Governance and Blockchains*, REVIEW OF FINANCE (Nov. 28, 2016), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2700475](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2700475).

<sup>78</sup> See Pool of Stake, *Revisiting the On-Chain Governance Vs. Off-Chain Governance Discussion*, MEDIUM (May 22, 2018), <https://medium.com/@poolofstake/revisiting-the-on-chain-governance-vs-off-chain-governance-discussion-f68d8c5c606>; Fred Ehram, *Blockchain Governance: Programming Our Future*, MEDIUM (Nov. 27, 2017), <https://medium.com/@FEhram/blockchain-governance-programming-our-future-c3bfe30f2d74>; *On-Chain Governance*, DISTRICT0X EDUCATION PORTAL, <https://education.district0x.io/general-topics/what-is-governance/on-chain-governance/>.

<sup>79</sup> Ehram, *supra* note 78.

<sup>80</sup> Vlad Zamfir, *Against On-Chain Governance*, MEDIUM (Dec. 1, 2017), [https://medium.com/@Vlad\\_Zamfir/against-on-chain-governance-a4ceacd040ca](https://medium.com/@Vlad_Zamfir/against-on-chain-governance-a4ceacd040ca).

engineered in advance and has to keep the flexibility of unplanned occurrences.”<sup>81</sup>

### A. Off-Chain Governance Mechanisms

Off-chain governance mirrors the governance structure of most private institutions. In an off-chain structure, “individuals who are trusted by the community come together and form a group, which is responsible for blockchain’s governance and well-being. That group is tasked with fixing bugs and security vulnerabilities, adding features and improving scalability, representing the blockchain in public discussions, and maintaining the right balance of power among users, companies, and miners.”<sup>82</sup>

While many off-chain governance mechanisms exist, a useful model, as set forth above, is Bitcoin’s BIP, if for no other reason than it has existed longer than any other mechanism. Bitcoin’s BIP governance has been compared to the system of checks and balances in the U.S. government,<sup>83</sup> whereby the developers, like the U.S. congress, submit proposals (akin to drafting legislation), but others, including the core developers, miners, and node operators (akin, in no particular order, to the executive, the judiciary and the people) play a role in deciding the merit and propriety of those proposals. Ultimately, however, it is the users (akin to voters) who are the ultimate decision-makers, because they can vote with their feet and “revolt and switch protocols or sell their tokens” if they are unhappy with any changes.<sup>84</sup>

One benefit of off-chain governance is informational. “Assuming a responsible and knowledgeable authority is in charge,” the decision-makers will have “all relevant information to make informed decisions which serve the community’s best interests.”<sup>85</sup> Another benefit involves the decrease in the likelihood of errors. “With a higher degree of human involvement and little use of code for decision making purposes,” the risk of “code-based and data import mistakes” is reduced.<sup>86</sup>

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<sup>81</sup> *Id.*

<sup>82</sup> Hasib Qureshi, *Blockchains Should Not Be Democracies*, HACKERNOON (Apr. 26, 2018), <https://hackernoon.com/blockchains-should-not-be-democracies-14379e0e23ad>.

<sup>83</sup> See Brandon Arvanaghi, *Is the U.S. Constitution “Bitcoin in practice”?*, MEDIUM (Nov. 12, 2018), <https://medium.com/@brandonarvanaghi/is-the-u-s-constitution-bitcoin-in-practice-3fed2d5ab12f>; see also Ryan Selkis, *Bitcoin’s Constitutional Crisis and Why I Support the UASF*, MEDIUM (June 21, 2017), <https://medium.com/tbis-weekly-bits/bitcoins-constitutional-crisis-why-i-support-the-uasf-5b0ab325d8b6>.

<sup>84</sup> Pool of Stake *supra* note 78; Ehram, *supra* note 78.

<sup>85</sup> Willem-Jan Smits, *Blockchain Governance: What Is It? What Types Are There, and How Does It Work in Practice?*, WATSON LAW (Oct. 24, 2018), <https://watsonlaw.nl/en/blockchain-governance-what-is-it-what-types-are-there-and-how-does-it-work-in-practice/>.

<sup>86</sup> *Id.*

However, any off-chain governance process involves a certain amount of centralization,<sup>87</sup> which is contrary to the ethos of the blockchain.<sup>88</sup> In the last year, many, including U.S. regulators, have identified the centralization of the Bitcoin network as a potential problem.<sup>89</sup>

In addition to centralization, the participants in off-chain governance systems often have asymmetrical incentives. In the BIP process, for example, miners have a direct financial incentive to increase future cumulative transaction fees based, in part, on the block rewards, and their behavior will seek to maximize those fees. Developers, on the other hand, have weak financial incentives, because they do not earn a direct financial reward for BIPs that are implemented.<sup>90</sup> That has led a number of developers to switch to development work on the Ethereum protocol, which provides more clear financial rewards for developers through the Ethereum foundation. Over the long term, that incentive structure could damage the protocol.

## B. On-Chain Governance Mechanisms

On-chain governance is a formal system that determines changes to the protocol on the blockchain itself.<sup>91</sup> Most on-chain voting mechanisms allocate decision-making to holders of native tokens on the blockchain. Those mechanisms are often based on a “one token, one vote” (“1t1v”) mechanism<sup>92</sup> or some derivation thereof, or a “stake-based governance” system whereby, in general, token holders must put some tokens at risk in order to have a role in governance.<sup>93</sup>

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<sup>87</sup> See Sarah Azouvi, Mary Maller & Sarah Meiklejohn, *Egalitarian Society or Benevolent Dictatorship: The State of Cryptocurrency Governance*, 22ND INT’L CONF. ON FIN. CRYPTOGRAPHY AND DATA SECURITY (Mar. 2018), <https://smeiklej.com/files/bitcoin18b.pdf>.

<sup>88</sup> See, e.g., Primavera De Filippi & Benjamin Loveluck, *The invisible politics of Bitcoin: governance of a decentralised infrastructure*, 5 INTERNET POLICY REVIEW 1 (2016) (available at <https://policyreview.info/articles/analysis/invisible-politics-bitcoin-governance-crisis-decentralised-infrastructure>).

<sup>89</sup> See Candice Greaux, *Media finally notices that Bitcoin and Ethereum are actually VERY centralized*, MODERN CONSENSUS (Sept. 5, 2018), <https://modernconsensus.com/cryptocurrencies/bitcoin/bitcoin-ethereum-centralized/>; see also James Wang, *The Bitcoin Centralization Narrative with Yassine Elmandjra*, ARK INVEST (Jan. 27, 2019), <https://ark-invest.com/research/podcast/bitcoin-centralization>; Shiva S., *Why bitcoin is becoming centralized*, BLOCKONOMICS (Sep. 17, 2018), [https://blog.blockonomics.co/why-bitcoin-is-becoming-centralized-41f62cc15e91](https://blog.blockonomics.co/why-bitcoin-is-becoming-centralized-41f62cc15e91;);

<sup>90</sup> Ehram, *supra* note 78.

<sup>91</sup> Richard Red, *What is on-chain cryptocurrency governance? Is it plutocratic?*, MEDIUM (June 20, 2018), <https://medium.com/@richardred/what-is-on-chain-cryptocurrency-governance-is-it-plutocratic-bfb407ef6f1>.

<sup>92</sup> These 1t1v are loosely-based on 1p1v systems, however, because there is no current viable way to determine identity on the blockchain, 1t1v is broadly regarded as a next-best solution.

<sup>93</sup> *Supra* note 91.

In either case, decisions that are approved are automatically encoded into the protocol.

Two blockchains that use on-chain governance mechanisms are Decred and Tezos, and those are described briefly below:

#### Decred

Decred describes itself as open, progressive, and self-funding cryptocurrency with a system of community-based governance integrated into its blockchain.<sup>94</sup> In Decred, holders of tokens can time-lock (stake) their tokens in exchange for tickets, that allow ticket holders to participate in governance in two on-chain (and one off-chain), governance mechanisms. The on-chain portion allows votes to (1) approve or reject, with a 75% approval rating, a proposed change to the consensus rules of the protocol, and (2) approve the work of the miners, which will allow the miners to earn their block reward.<sup>95</sup>

#### Tezos

Tezos describes itself as a “platform to create smart contracts and build decentralized applications that cannot be censored or shut-down by third parties.”<sup>96</sup> In Tezos, all stakeholders are permitted to participate in governance, and the protocol provides an election cycle that “provides a formal and systematic procedure for stakeholders to reach agreement on proposed protocol amendments.” Tezos also incorporates an explicit improvement mechanism into the blockchain, providing developers with a clear reward framework, and giving token holders the ability to evaluate the merits of a proposal and determine whether the proposal will improve the protocol.<sup>97</sup>

A number of problems with on-chain governance have been identified. A full-throated exploration of those problems is beyond the scope of this article, but some frequently-discussed, and linked, problems are:

- 1) Plutocracy and Collusion: A plutocracy is government by the wealthy.<sup>98</sup> In an on-chain system, a plutocracy indicates control by individuals or entities who hold a significant percentage of the tokens, which allows them to collude and act primarily in their own interest, to the detriment of those with fewer resources.<sup>99</sup>
- 2) Mutability: One of the most important features of blockchain technologies is the inability to change transactions recorded on what

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<sup>94</sup> See Introduction to Decred Governance, DECRED DOCUMENTATION (2019), <https://docs.decred.org/governance/introduction-to-decred-governance/>.

<sup>95</sup> *Id.*

<sup>96</sup> Learn [more about](https://tezos.com/learn-about-tezos) Tezos. TEZOS (2019), <https://tezos.com/learn-about-tezos>.

<sup>97</sup> *Supra* note 96; Pool of Stake, *supra* note 78.

<sup>98</sup> *Plutocracy*, Merriam-Webster Dictionary (11<sup>th</sup> ed, 2003).

<sup>99</sup> Qureshi, *supra* note 82.

is supposed to be a permanent ledger. In an on-chain governance system, a vote can be taken to “undo” a transaction or series of transactions, and roll back and edit the history of the ledger.

- 3) Excluded Stakeholders: In many on-chain governance systems, non-token holders are excluded from governance. However, by excluding those voices, their participation in governance becomes “completely unnecessary,” and removes “an important check to balance against the power” of the token holders.<sup>100</sup>

The remainder of this article explores QV and examines whether it may better serve the interests of blockchain protocols.

## V. QUADRATIC VOTING

*“Determining a socially desirable means of making collective decisions is perhaps the oldest and largest open problem in the social sciences.”<sup>101</sup>*

The general concept of QV originated in economic research published in 1977, where it was proposed as a tool to allow for distribution of “the optimal level of continuous public goods under complete information”<sup>102</sup> that would be robust and avoid the fragility of other methods.<sup>103</sup> In 2012, QV was first proposed as a mechanisms to solve binary collective decision-making problems, suggesting it could lead to better decisions.<sup>104</sup> Later, QV research was extended to solve problems involving “defined sets of collective choices.”<sup>105</sup>

QV may offer “a better way to make collective decisions that avoids the tyranny of the majority by allowing people to express how strongly they feel about an issue rather than just whether they are in favor of it or opposed to it.”<sup>106</sup> QV achieves that by allowing voters to express how strongly they believe in a decision by acquiring more votes, thus forcing voters to weigh the cost and benefits of doing so.

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<sup>100</sup> Zamfir, *supra* note 80.

<sup>101</sup> *Supra* note 3.

<sup>102</sup> Lalley, *Quadratic Voting*, p.2., (citing the work of Groves and Ledyard). See Theodore Groves, *Incentives in Teams*, 47 *ECONOMETRICA* 61 (1973); John Ledyard, *Optimal Allocation of Public Goods: A Solution to the “Free Rider” Problem*, 45 *ECONOMETRICA* 783 (1977); Theodore Groves & John O. Ledyard, *Some Limitations of Demand Revealing Processes*, 29 *PUB. CHOICE*, 107 (1977).

<sup>103</sup> For a full exploration of fragility in context see NASSIM NICHOLAS TALEB, *THE BLACK SWAN: THE IMPACT OF THE HIGHLY IMPROBABLE*, (Random House, 2007); NASSIM NICHOLAS TALEB, *ANTIFRAGILE: THINGS THAT GAIN FROM DISORDER* (Random House, 2014).

<sup>104</sup> E. Glen Weyl, *Quadratic Vote Buying*, (2012), <http://goo.gl/8YEO73>.

<sup>105</sup> *Supra* note 3.

<sup>106</sup> See Eximchain, *What makes Quadratic Voting an effective Democratic Voting Mechanism*, MEDIUM, (August 17<sup>th</sup>, 2018), <https://medium.com/eximchain/what-makes-quadratic-voting-an-effective-democratic-voting-mechanism-d7a555de8f6b>.

Generally, QV allows voters to acquire as many votes as they wish, by paying the sum of the squares of the number of votes.<sup>107</sup> In some implementations of QV, to avoid the problems inherent in vote buying, the system is designed to allow votes to be purchased from a central authority, with the amount collected from the sale of votes distributed to all voters on a per capita or lottery basis.<sup>108</sup> In others, an artificial currency is used to reduce the power of wealth, and to try to ensure the integrity of the voting process.<sup>109</sup>

Outside of the blockchain governance arena, economic theory suggests QV may lead to greater Pareto efficiency.<sup>110</sup> In research, QV has been shown to achieve not only greater welfare maximization in large populations, but also a more robust mechanism to address concerns such as collusion and voter interest problems.<sup>111</sup> Moreover, the research also suggests that as the population of voters grows, the QV tends to create better outcomes.<sup>112</sup>

As part of Ostrom's work relating to commons governance, she identified the benefits of collective choice arrangements that would allow people who are affected by rules to be able to participate in the modification of those rules at a low cost.<sup>113</sup> Other researchers, in the spirit of Ostrom applied to the blockchain, have observed that token-based governance mechanisms like QV have the ability to "readdress latent power relations" in CBPP communities.<sup>114</sup> Examples of CBPP communities include Wikipedia, as well as many open source software platforms, including blockchains, that are decentralized, use shared resources, and often rely on non-money motivations.<sup>115</sup>

QV may enable those CBPP communities to better capture the preferences of stakeholders, and reduce the likelihood of tyranny of the majority and rent seeking behaviors by moderating the influence of wealth and power in a community. Structured correctly, blockchains employing well-structured QV

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<sup>107</sup> *Supra* note 3.

<sup>108</sup> Alastair Berg, Chris Berg & Mikayla Novak, *Crypto Public Choice* (August 30, 2018) (available at <https://ssrn.com/abstract=3236025> or <http://dx.doi.org/10.2139/ssrn.3236025>).

<sup>109</sup> See Josiah Ober, *Democracy's Wisdom: An Aristotelian Middle Way for Collective Judgment*, 00 *Am. Pol. Sci. Rev.* (2013); Ben, Laurence & Itai Sher, *Ethical Concerns with Quadratic Voting*, 172 *PUB. CHOICE* 195 (2017); Josiah Ober, *Interests/Preferences, Equality/Efficiency. Historical Notes on Quadratic Voting*, 172 *PUB. CHOICE* no. 1/2 at 1, 9 [https://bfi.uchicago.edu/wp-content/uploads/Ober\\_Historical-notes-on-QV-160321.pdf](https://bfi.uchicago.edu/wp-content/uploads/Ober_Historical-notes-on-QV-160321.pdf) .

<sup>110</sup> Berg, *supra* note 108.

<sup>111</sup> *Supra* note 5.

<sup>112</sup> *Id.* "We prove that in any symmetric Bayes-Nash equilibrium of a private values environment where valuations are drawn independently and identically according to any smooth distribution with bounded support, the welfare loss of QV converges as  $N \rightarrow \infty$  to a fraction 0 of potential welfare, at a rate  $1/N$  for generic value distribution parameters (viz. so long as the mean of the value distribution is not equal to 0)."

<sup>113</sup> See Rozas, *supra*, note 11.

<sup>114</sup> *Id.*

<sup>115</sup> See Hassan, Samer, *Distributed technologies to bootstrap the sharing economy*, OPEN ACCESS GOVERNMENT (Dec. 19, 2019), <https://www.openaccessgovernment.org/distributed-technologies-sharing-economy/56010/>.

mechanisms could act as a “‘crypto-leviathan,’ . . . enforcing a social contract between inherently selfish and power-seeking individuals.”<sup>116</sup>

QV also has the potential to address problems inherent in traditional blockchain-related voting mechanisms, such as vulnerability to Sybil or sockpuppet attacks. Those attacks attempt to subvert reputation systems in peer-to-peer networks, such as a blockchains, by creating pseudonymous identities (sockpuppets) to gain influence.<sup>117</sup> In a blockchain-based voting system, a sockpuppet attack may be deployed to fake community support or criticism beyond the actual level of support or criticism in the community. In the real world, the 2016 U.S. Presidential election had elements of a sockpuppet attack, because Russian bots were deployed to inflame passions to influence the election in favor of the eventual winner.<sup>118</sup> In the blockchain context, excessive vote buying from sockpuppet accounts could leave the system vulnerable to manipulation, which could destroy the integrity of the voting process.

At first blush, QV would appear to exacerbate sybil-related vulnerabilities, because wealthy parties could acquire individual votes outside of the QV system, thereby gaming the system by colluding to “overcome the convexity of the quadratic function”<sup>119</sup> by buying votes outside of the QV system at cost versus buying them in the QV system at an exponentially higher price. For example, a wealthy party could collude with others to buy 10 - \$1 votes outside of the QV system for \$10, versus 10 votes inside the QV system for \$100.

However, research suggests that economic and social forces “may impose strong limits on the effectiveness of collusion.”<sup>120</sup> Briefly, those forces are (1) detection of the collusion, which, if broadcast to the population of voters, could provoke a reaction in the rest of the community which would defeat the collusion, and (2) a strong incentive to defect by vote sellers and not vote pursuant to the vote

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<sup>116</sup> See also Rozas, *supra*, note 11 p. 134-151.

<sup>117</sup> See Douceur, J., *The Sybil Attack*, MICROSOFT RESEARCH, available at <https://www.freehaven.net/anonbib/cache/sybil.pdf>; see also Matt Demirbas & Youngwhan Song, *An rssi-based scheme for sybil attack detection in wireless sensor networks*, Advanced Experimental activities ON WIRELESS networks and systems (EXPONWIRELESS) Workshop (as part of WOWMOM), pp. 564–570, 2006.

<sup>118</sup> See, e.g., Adam Badawy et al, *Analyzing the Digital Traces of Political Manipulation: The 2016 Russian Interference Twitter Campaign*, 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM), available at <https://arxiv.org/pdf/1802.04291.pdf>; Boot, M., *Without the Russians, Trump wouldn't have won*, Washington Post (Jul. 24, 2018); Shane, S., *The Fake Americans Russia Created to Influence the Election*, New York Times (Sep. 7, 2017); *How Russian Twitter Bots Pumped Out Fake News During The 2016 Election*, All Things Considered, National Public Radio (Apr. 3, 2017), available at <https://www.npr.org/sections/alltechconsidered/2017/04/03/522503844/how-russian-twitter-bots-pumped-out-fake-news-during-the-2016-election>.

<sup>119</sup> See Posner, *supra* note 2 pp. 1-22.

<sup>120</sup> See E. Glen Weyl, *The Robustness of Quadratic Voting*, 172 PUB. CHOICE (Oct. 23, 2016) (available at SSRN: <https://ssrn.com/abstract=2571012> or <http://dx.doi.org/10.2139/ssrn.2571012>); Philip Daian, *Vote Buying, On-Chain Governance, and Quadratic Plutocracy*, PHIL DOES SECURITY (Jun. 11, 2018), <https://pdaian.com/blog/vote-buying-on-chain-governance-and-quadratic-plutocracy/>.

buying arrangement.<sup>121</sup> Thus, while there is certainly the possibility of collusion, a robust QV system may be structured with economic incentives to defeat the conspiracy.<sup>122</sup> Moreover, by enabling “the strength of voters’ point of view on a position to be taken into account in the voting process and ensure that the cost of buying many votes is prohibitive,” QV could limit the ability of colluders to disproportionately affect outcomes.<sup>123</sup>

QV has been criticized as a mechanism for collective decisions because its vote buying mechanism, by default, underweights the interests of the poor “or otherwise budget-constrained.”<sup>124</sup> Thus, a wealthy minority could buy votes and skew the results, which would disintegrate the equity embedded in the democratic process.<sup>125</sup> As a result, unless voter preferences are independent of wealth, QV systems would be less utilitarian than 1p1v systems and overweight the preferences of the wealthy.<sup>126</sup>

Whether wealth is a serious problem is unclear. Some argue that because society rewards the accumulation of wealth “despite the inequality it produces,” there are circumstances in which wealth should not automatically be excluded in collective decisions.<sup>127</sup> The merits of that proposition are beyond the scope of this article. In any case, however, a number of modifications of QV are available to reduce the power of wealth. For example, as noted above, by using an artificial currency distributed to the population of voters, votes could only be bought or sold with the artificial currency, limiting the amount of currency in circulation and thereby limiting the power of wealthy interests to have a disproportionate impact.<sup>128</sup> In addition, QV could be “adopted in conjunction with other reforms that would compensate the less-wealthy for any losses they would incur.”<sup>129</sup> Ultimately, any QV mechanism must be tailored to accomplish the goals of the community it serves, and it will be up to that community to make that determination.

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<sup>121</sup> See Weyl, *supra* note 120..

<sup>122</sup> See Posner, *supra* note 2 p. 7. p. 7.

<sup>123</sup> *Supra* note 6.

<sup>124</sup> See Lalley, *supra* note 4, p. 5.

<sup>125</sup> *Supra* note 6.

<sup>126</sup> See Ben Laurence & Itai Sher, *Ethical Considerations on Quadratic Voting*, 172 PUB. CHOICE (Jul. 2017).

<sup>127</sup> See Posner, *supra* note 2 p. 12.

<sup>128</sup> This idea is based on research by Hylland and Zeckhauser, and later adopted into QV scholarship by Posner and Weyl. see Eric A. Posner & E. Glen Weyl, *Quadratic Voting And The Public Good: Introduction*, 172 PUB. CHOICE, no. 1 at 1,5, (citing Hylland, A. and Zeckhauser, R., A mechanism for selecting public goods when preferences must be elicited, Kennedy School of Government Discussion Paper D, (1980)).

<sup>129</sup> See Posner, *supra* note 2, p. 12.

## VI. CONCLUSION

*Where does all of this leave us regarding the practical promise of QV in promoting the public good?*<sup>130</sup>

This article's purpose is to describe QV in the context of blockchain governance, and spur further the research related to the above quote. Vitalik Buterin, the founder of Ethereum, has noted that a QV-based system could "allow (near) optimal provision of a decentralized, self-organizing ecosystem of public goods."<sup>131</sup> That potential, however is still being tested. One area that has special promise, however, is funding decisions.

Many blockchains have foundations or similar organizations that provide incentives for developers to improve the technology. Those foundations "derive their funding from varied sources, but tend to direct those funds and other support to the adoption of their technology, as well as distributed ledger technology in general."<sup>132</sup> However, despite the general goal for improvement, because the foundations are controlled by a relatively small group, they "can also act as powerful interest groups with the ability to derive concentrated benefits in comparison to smaller holders of those tokens."<sup>133</sup>

Without adequate mechanisms in place to limit rent seeking behavior, a concentrated majority will often seek rents through changes in governance to their narrow benefit.<sup>134</sup> A QV mechanism could help limit that power by giving a broader array of stakeholders a vote, yet ensuring that the intensity of preferences is captured by such a vote. To date, the research suggests that such votes, using a QV-based system,<sup>135</sup> will likely be "better."

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<sup>130</sup> See Posner, *supra* note 2, p. 20.

<sup>131</sup> See Buterin, *supra* note 30, p. 1.

<sup>132</sup> See Berg, *supra* note 108, p. 16.

<sup>133</sup> Social loss through the use of resources to influence politically or administratively assigned privileged benefit, known as 'rent seeking', is an idea proposed by Gordon Tullock (1922-2014), founder of the public-choice school of economics and of the journal *Public Choice*. In a 2014 study, it was estimated that the annual cost of rent seeking behavior in the U.S. was somewhere between \$1 trillion and \$3.5 trillion dollars, and that represented a deadweight loss to the economy. See Arye L. Hillman & Heinrich W. Ursprung, *Rent seeking: The idea, the reality, and the ideological resistance*, Dept. Econ., Int'l Trade and Dev. Seminar, (Oct. 7, 2015); See also Anne O. Krueger, *The political economy of the rent-seeking society*, 64 *Am. Econ. Rev.* 291 (1974); Gordon Tullock, *The welfare costs of tariffs, monopolies, and theft*. *Econ. Inquiry* 5 (3):224-232 (1967). Berg, Alastair and Berg, Chris and Novak, Mikayla, *Crypto Public Choice* (August 30, 2018). Available at SSRN: <https://ssrn.com/abstract=3236025> or <http://dx.doi.org/10.2139/ssrn.3236025>; Mitchell, M. D. *The Pathology of Privilege: The Economic Consequences of Government Favoritism*, Mercatus Center at George Washington University (2015).

<sup>134</sup> See William J. Baumol, *Entrepreneurship: Productive, unproductive, and destructive*, 98 *J. of Pol. Econ.*, 893 (1990).

<sup>135</sup> Lalley & Weyl's results are based primarily on binary votes. Further research is needed on whether the same holds true when multiple issues are up for vote. See Posner, E.A. & Weyl, E.G., *Quadratic Voting and the Public Good: Introduction*, 172 *PUB. CHOICE* (2017), <https://doi.org/10.1007/s11127-017-0404-5>, p. 15; Daniel Benjamin, Ori Heffetz, Miles Kimball & Derek Lougee, *The relationship*

