Multiparty Democracy in Decentralized Autonomous Organization (DAO): Evidence from MakerDAO

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Abstract

Decentralized Autonomous Organization (DAO) provides a decentralized governance solution through blockchain, where decision-making process relies on on-chain voting and follows majority rule. This paper focuses on the most influential DAO, namely MakerDAO, and we find voters fall into different ‘voting parties’ after applying clustering algorithm to voting history. The significant voting power controlled by voting parties is a signal of governance centralization in DAO, and voting parties have complicated influence on Maker protocol, which is governed by MakerDAO. This paper presents empirical evidence of multiparty democracy in DAO and further contributes to the contemporary debate on whether decentralized governance is possible.

Keywords: governance; Decentralized Autonomous Organization (DAO); voting

¹ The online appendices can be accessed: https://drive.google.com/file/d/1NqyBfD5FWPaJMUa-Z2kWgGtGvyw6t0q/view?usp=sharing
1. Introduction

Is decentralized governance possible? Benefiting from blockchain technology, Decentralized Autonomous Organization (DAO) is proposed as a feasible attempt (Jentzsch, 2016). In DAO, all members are both the owners and managers, and any suggested changes to DAO should be jointly decided by DAO members. The voting power depends on the amount of voters’ governance token, which are usually tradable cryptocurrency, and the proposal that gets most voting power will be implemented. Benefiting from the transparency and accuracy of blockchain, voting results are publicly visible and hard to be tampered.

Currently, various blockchain-based applications enter the scene. Among all innovative and imaginative applications, Decentralized Finance (DeFi) attracts most attention, and DeFi protocols are usually governed by DAO. Briefly, DeFi can replicate most financial activities in traditional finance, and the future of these on-chain financial systems relies on the decisions made by DAO. Though DAO-governed DeFi seems more decentralized than traditional financial institutions, tricky problems still exist. For example, on-chain illegal activities may have negative externality, and in some cases, illiquidity can occur in DeFi (Carapella et al., 2022; Qin et al., 2021; Foley, Karlsen and Putniņš, 2019). Therefore, DAO governance is crucial for both the use cases and reliability of DeFi.

Among all potential risks in DAO, governance centralization is an inevitable problem. First, blockchain itself is safe haven for decentralization. Buterin (2021), as the co-founder of Ethereum blockchain, proposes blockchain trilemma, where complete decentralization is impossible if blockchain pursues scalability and securities at the same time. Sai et al. (2021) presents comprehensive summary of centralization in different layers of blockchain. One of the well-known problems is mining concentration, meaning that validation of transactions on blockchain is controlled by a small group of validators (Gervais et al., 2014; Cong et al., 2021). And, a few key developers propose most changes to blockchain (Hsieh et al., 2017; Yermack, 2017). Furthermore, DAO does not avoid governance centralization. By investigating voting history of leading DeFi protocols, DAO governance is controlled by several dominant voters, and their centralized power has complicated influence (Sun, Stasinakis and Sermpinis, 2022; Fritsch, Müller and Wattenhofer, 2022), which resembles a double-edged sword.

The previous studies mainly focus on centralization problems based on individual-level behavior, however, DAO governance is more likely to be battlefield of ‘voting parties’ with different interests. Given the fact that voting is all about social choice functions (Arrow, Sen and Suzumura, 2011; Kelly, 1988; Plott, 1976; Schwartz, 1986), voters with similar interests and other characteristics can possibly form coalitions (Downs, 1957; Enelow and Hinich, 1994), while voters with different beliefs will vote against each other (Abramson et al., 2009; Adams, Merrill and Grofman 2005). Furthermore, the democratic contexts show that coalitions in multiparty democracy can influence voters’ choice (Duch, May and Armstrong, 2010; Meffert and Gschwend, 2011). Therefore, DAO voters should not be studied as isolated individuals, and the interlinks between voters can help to depict DAO governance.
This paper aims to examine if DAO governance is multiparty democracy and how voting parties influence the underlying DeFi protocols. We choose the most influential DAO, i.e., MakerDAO, which manages the Maker protocol. Maker protocol issues Dai (DAI) stablecoin, which is soft-pegged to US dollar. To some extent, Maker protocol is a multi-collateral DAI system, where any agents can borrow DAI by locking collateral. Currently, Maker protocol is a leading DeFi, while MakerDAO sets industrial standards for decentralized governance, where ‘one share – one vote’ principle is applied. To better understand the governance structure in MakerDAO, we retrieve voting history of governance polls from 15th August 2019 to deployed on 25th July 2022, where all voters’ choices and voting power are publicly visible. After applying clustering algorithm to MakerDAO dataset, we identify five distinguished ‘voting parties’, and the largest voting party, mentioned as voting party 0, has the most voters and contribute to most total votes. Though the other four voting parties have only a few voters, they can win governance polls of Maker protocol, implying that MakerDAO governance is battlefield for these parties.

To better investigate how voting parties influence Maker protocol, we apply a series of factor analysis, which focuses on DAI volatility, total revenue and new users of Maker protocol. When voting share of party 0 is higher, DAI will be more volatile, and total revenue of Maker protocol will decrease. However, party 2 and party 3 have the opposite effects. Theoretically, ‘one share – one vote’ mechanism is optimal only when several agents compete (Burkart and Lee, 2008), and more decentralized governance may lead to less extreme outcomes (Sah and Stiglitz, 1986, Sah and Stiglitz, 1991; Sah, 1991; Sah and Stiglitz, 1988). But for the case of MakerDAO, it is hard to define optimal decisions or outcomes. Moreover, given voters’ heterogeneous interests, competition in DAO governance is not only about centralized ownership (Adam, Hermalin and Weisbach, 2010; Allen and Gale, 1999; Garlappi et al., 2017), but also about more complicated interlinks between voting parties.

Then, we focus on group cohesion of voting parties by calculating Agreement Index (AI) (Hix, Noury and Roland, 2005). A higher AI means that members within the same voting party tend to choose the same option, while AI will be close to 0 if voting power of the same party is equally distributed among all available options. Empirical studies point out that more cohesive teams can contribute to better firm performance (Hogg, 1992; Pepitone and Reichling, 1955; Schachter et al., 1951). In DAO, by utilizing AI as a proxy of voters’ cohesion, we expect to observe similar results. Surprisingly, DAI will be more stable when party 0 is more cohesive, while cohesive party 4 can bring more volatility. Therefore, in DAO, the influence of group cohesion should be considered together with uncertainty of voting outcomes. As the largest voting party, party 0’s winning will be more certain when they concentrate voting power on the same option, and the outcomes will be more predictable. As a result, crypto markets can be more prepared to the changes to Maker protocol and DAI, which helps DAI remain stable. On the other hand, smaller voting parties are not the usual winner, their decisions may introduce more uncertainty (Allen and Gale, 1999; Garlappi et al., 2017), so DAI will be more volatile.
We also consider the interlinks between Maker protocol and crypto market. DAI, as a primary stablecoin, can be traded in various blockchain-based platforms. Here we choose five destinations of financial flows of DAI, including Centralized Finance (CeFi), Decentralized Exchanges (DEXes), Lending Protocols (LPs), External Owned Address (EOA), and bridges. Our findings show that voting parties can drive DAI flows in differently ways. For example, voting party 0 and party 2 can lead to less DAI transferred to LPs, while party 3 has the opposite effects. The findings prove that these parties have dissimilar interests, but some voting parties can (unconsciously) form coalitions if they have certain similar preference, e.g., where to transfer DAI. So, the collaboration and competition between voting parties make DAO resemble multiparty democracy.

Finally, we attempt to find potential opinion leaders in the largest voting party, i.e., voting party 0. Given the public identity and trading activities of voters, the voters can be labeled. Here, we consider six labels, including Ethereum Name Service (ENS) owners, Twitter users, DEX traders, liquidity providers, Non-fungible token (NFT) traders, and whales. ENS is a unique identifier of Ethereum address, therefore, we believe ENS owners are probably more enthusiastic about blockchain and on-chain activities. By manually searching for ENS on Twitter, Twitter users in voting party 0 can be matched. Since Twitter is mainstream social platform used by crypto community, voters’ discussion on Twitter may affect other voters. After repeating the empirical analysis, our findings show that ENS owners and Twitter users are potential opinion leaders in voting party 0, and their leadership may be from large voting power.

The remainder of our paper is organized as follows. Section 2 provides a summary of DAO governance and other necessary background knowledge. The dataset for MakerDAO, clustering algorithm, and measurements of group cohesion are defined in section 3. The main empirical results are presented in section 4 and section 5, while section 6 provides robustness checks. Section 7 concludes.

2. Background/Governance in the Maker protocol
2.1 Decentralized Finance (DeFi) and Decentralized Autonomous Organization (DAO)

Powered by programmable blockchain, any agents can replicate financial activities on blockchain, where the third party is not necessary component. Simply, Decentralized Finance (DeFi) refers to blockchain-based financial applications without any centralized intermediaries. DeFi can replicate most traditional financial systems, such as trading platforms and borrowing and lending marketplaces, and the rapid growth of DeFi brings forward both opportunities and challenges. For more details of DeFi and its potential risks, we refer readers to Werner et al. (2021), Makarov and Schoar (2022), and Carapella et al. (2022).

Beside financial risks inherently existed in DeFi, another inevitable plain point is: how to govern DeFi? Without relying on any third party, DeFi naturally tends to expand such decentralization to its governance. Among all novel solutions to decentralized governance, the most widely adopted organizational form is Decentralized Autonomous Organization (DAO), which is first proposed by
Jentzsch (2016). In practice, a DeFi protocol will be governed by a DAO (e.g., Maker protocol is governed by MakerDAO), and DAO will usually issue their own governance token, which resembles shares in corporate finance. If there are any suggested changes to the DeFi protocol, governance token holders can state their opinions via voting, and their voting power relies on the amount of governance token. Benefiting from underlying blockchain, voting records can be documented on blockchain, and on-chain voting is more precise and transparent than decision-making process in corporations (Hsieh, Vergne and Wang, 2017).

2.2 MakerDAO and Maker protocol
Created in 2014, MakerDAO has grown up to the most successful DAO (MakerDAO, 2020). Governed by MakerDAO, Maker protocol has adopted large market share in on-chain lending. Maker protocol issues two native cryptocurrencies, namely Dai (DAI) and Maker (MKR). DAI is a stablecoin soft-pegged to the US dollar, and people can borrow DAI by locking collaterals (usually cryptocurrencies accepted by Maker protocol). In a way, Maker protocol is a Multi-Collateral Dai (MCD) system. MKR is the governance token, and any MKR holders can participate in on-chain voting in Maker protocol. For more details of the governance structure in MakerDAO, we refer readers to Sun, Stasinakis and Sermpinis (2022).

Currently, Maker protocol applies ‘one token – one vote’ rule, therefore, voters with more MKR will have more decision-making power. Empirically, a small group of voters control most voting power in MakerDAO, and governance centralization can be witnessed in other DAOs as well (Fritsch, Müller and Wattenhofer, 2022). Surprisingly, though governance centralization is not intention of DAO believers, centralized decision-making power can have positive effects on the underlying DeFi protocol (Sun, Stasinakis and Sermpinis, 2022). In this paper, we dive more deeply into the voting history of MakerDAO, and beside individual level of governance centralization, more information can be revealed by considering potential coalitions of voters.

2.3 Governance centralization
Governance has received intensive study in different subjects, and decentralized governance can be an intersection, where both theoretical models and empirical studies can be examined again.

First, DAO governance relies on voting, and theoretical studies have proved that voting can help multi-agent systems or organizations work better (Pitt et al., 2005). Among all voting procedures, most DAO chooses Plurality voting procedure, meaning that only the candidate who gets votes more than any other counterparty will be elected (Arrow, Sen and Suzumura, 2011). In DAO, given a proposal, only the option that get the most votes will be deployed. As for voting principle, though quadratic voting exists, most DAOs adopts ‘one token – one vote’. Such a voting mechanism will be optimal only when several agents compete (Burkart and Lee, 2008). To examine this theoretical argument in DAO, we first need to figure out the competitors and how to define ‘optimal outcomes’.

Since Maker protocol allows users to borrow and lend cryptocurrencies, functionally, Maker protocol resembles banks in traditional finance. In banking literature, governance centralization is regarded as
a double-edge sword. If the ownership is more centralized, banks will have better capital buffers (Klein, Maidl and Woyand, 2021), and powerful CEOs can lead to better performance banks (Mollah and Liljeblom, 2016). However, advantages of centralized control can be weaken by certain cases, e.g., more strict regulation (Klein, Maidl and Woyand, 2021). And, if bank CEOs have dominant decision-making power, more risk-taking decisions will be made, and unacceptable outcomes can happen (Mollah and Liljeblom, 2016; Dbouk et al, 2020).

In corporate finance, governance centralization also attracts discussion. Large governance token holders are similar to blockholders for corporations, and active blockholders can have complicated influence (Shleifer and Vishny, 1997; Iannotta et al., 2007, Laeven and Levine, 2009). For example, interest alignments and monitoring is easier when decision-making is not highly dispersed, while blockholders can have self-serving actions (Burkart and Lee, 2008). On the other hand, smaller voters in DAO resemble smaller stakeholders in corporations. Usually, small stakeholders do not have enough incentives to collect information and study details of every proposal, therefore, they may not participate in governance very actively (Burkart and Lee, 2008). Currently, DAOs suffer from similar problems, i.e., low participation of governance, so large voters actually have more control over DAO and the underlying DeFi protocol. Moreover, shareholders can collude with managers for their private benefits. Such collusion behavior has both positive and negative effects (Becht, 1999; Becht et al., 2008; Berglof and Burkart, 2003; Comment and Schwert, 1995; Gompers, Ishii, and Metrick, 2003; Kadyrzhanova and Rhodes-Kropf, 2011; Klein, 1998; Shivadasani and Yermack, 1999; Faleye et al., 2011).

Besides, the contexts of organization economics show that centralized governance is related to firm performance. Theoretically, decentralized decision-making power can lead to less extreme decisions and outcomes (Sah and Stiglitz, 1986, Sah and Stiglitz, 1991; Sah, 1991; Sah and Stiglitz, 1988). But, more dispersed governance can bring less predictable outcomes, since decision makers have more proposals (Allen and Gale, 1999). As a result, some organizations will suffer from lack of decision consistency (Garlappi et al., 2017). Overall, centralized governance have complex effects on firm performance (Bernile et al., 2018; Giannetti and Zhao, 2019; Tran and Turkiela, 2020).

In the era of DAO, various voting procedures and principles can be applied, and voting records are publicly available. Therefore, DAO can be an ideal laboratory for researchers from both political science and corporate finance. Previous studies (e.g., Hermelin and Weisbach, 2003; Adam, Hermelin and Weisbach, 2010) argue that the internal structure of governance has not been well explored, which may be caused by data limitations. In this paper, given the transparent and precise voting history of MakerDAO, we expect to illustrate internal structure of DAO governance and complex interlinks between voters. Hypothetically, if potential coalitions of voters exist, the effects should be complicated, and new insights into governance can be presented.

3. Data collection and clustering algorithm

3.1 Data Collection
The details of governance polls and voting history are publicly available. In *Maker Governance Portal*, poll details, including titles, review of proposals, and options can be found. For each poll, several labels, e.g., ‘risk parameter’ and ‘collateral onboard’ are shown for better understanding the content of governance polls. To get the voters’ addresses, their choices and voting power, we query the voting history from *MCD Voting Tracker*. We investigate governance polls from Poll 16 (deployed on 15\textsuperscript{th} August 2019) to Poll 838 (deployed on 25\textsuperscript{th} July 2022). Poll 16 is the first governance poll that MKR holders can participate in. Some polls failed\(^2\), so they are not documented in the portal. Hence, the dataset consists of a total of 809 successful governance polls. After retrieving voters’ addresses, 1717 unique voters are found, and the voters’ public names and their labels can be manually collected by searching for their addresses on *Maker Governance Portal* and *Watchers.pro*.

### 3.2 Data pre-process

The first step of data pre-process is to replace textual options with numerical values. Most Maker governance polls have three options, including “Yes”, “No”, and “Abstain”. For this type of polls, we will assign 1, -1, 0 to “Yes”, “No”, and “Abstain”, respectively. For other polls, online appendix 1 presents value assignment. Noticeably, in all governance polls, we assign 0 to “Abstain”.

Another question is how to assign value if a voter (e.g., voter \(i\)) does not participate in a certain poll (e.g., poll \(j\)). In the context of clustering algorithms, such cases will bring forward missing values, i.e., \(NA\) in the dataset. Two common solutions are (1) to delete observations with NAs and (2) to fill NAs with mean, however, these two solutions are not the best choices here. The first solution will delete voters who do not participate all voting polls, as a result, few voters will be preserved. The second solution will misinterpret the nature of not participating. If we fill NAs with mean, in a way, we ‘make decisions’ on behalf of the voters who do not vote. But their actions, i.e., not voting, imply that they abstain. Therefore, we will assign 0 to NAs, meaning that voter \(i\) that does not participate in poll \(j\) will choose “abstain”.

Before applying clustering algorithm, we need to pre-process voting datasets, including data standardization and dimension reduction. Given a dataset \(X\), the formula of transferring \(x \in X\) is

\[
x = \frac{x - \bar{X}}{X_{\text{std}}} 
\]  

(1)

Where \(\bar{X}\) is the mean of dataset \(X\) and \(X_{\text{std}}\) refers to the standard deviation.

In the context of clustering algorithm, each poll in voting datasets is a feature. With more than 800 polls, the dataset for voting history is high-dimensional, and we need to reduce dimensions for better modelling. Here, we choose *Principal Component Analysis (PCA)* for dimensionality reduction. Simply, PCA can compute the principal components of a dataset and only keep the first few ones. In this way, a high-dimensional dataset can be transferred to a lower-dimensional dataset without losing much of data’s information. Generally, the new dataset generated by PCA should keep at least 95\% of variance in the original dataset, therefore, we preserve 115 principal components and 95.01\% of

\(^2\)Poll 28, 39, 47, 69, 78, 183, 282, 284, 286, 500, 604, 769, 818 and 821 failed.
variance is contained in the lower-dimensional dataset.

### 3.3 K-means clustering

To detect voters with similar voting patterns, we choose K-means, which is a widely adopted clustering algorithm. Given a set of voters’ voting history \((v_1, v_2, ..., v_n)\), where each voting history is a \(d\)-dimensional real vector, K-means aims to cluster voters into \(k(\leq n)\) sets \(V = \{V_1, V_2, ... V_k\}\) so as to minimize the within-cluster sum of squares (WCSS).

Formally, the objective is to find

\[
\arg\min_{V} \sum_{i=1}^{k} \sum_{v \in S_i} ||v - \mu_i||^2 = \arg\min_{V} \sum_{i=1}^{k} |V_i| VarV_i \tag{2}
\]

Where \(\mu_i\) is the mean of points in \(V_i\).

In our case, \(v_i\) is a vector that records voter \(i\)’s choices in all governance polls, and \(d\) denotes the number of governance polls in the MakerDAO dataset. Given a poll \(j\) and voter \(i\), if the voter do not participate in poll \(j\), then \(v_{i,j} = 0\), which has the same value as “Abstain”. Assuming that K-means can generate \(k\) sets, i.e., \(V = \{V_1, V_2, ... V_k\}\), each \(V_i\) can be regarded as a ‘voting party’, where voters share similar voting patterns.

To run K-means, the number of clusters, i.e., the parameter \(k\) should be optimally chosen. Two common criteria are elbow method and silhouette score, and more formal introduction can be found in Malik and Tuckfield (2019). Simply, an optimal cluster number, i.e., \(k^*\), should have high silhouette score, and the curve of distortion score flattens when \(k\) is larger than \(k^*\). Combing information in Figure 1, we choose \(k^* = 5\).

[Figure 1 here]

### 3.4 Measurement of group cohesion

Given a voting party, their members may have split opinions on certain governance polls. Intuitively, less division of opinions implies better group cohesion of a voting party. To measure group cohesion of voting parties, we introduce the modified index of Agreement Index (AI).

Previously, Rice (1928) develops an index to measure the rate of ‘not voting identically’, however, this index can only describe ‘yes’ – ‘no’ option. Then, Hix, Noury and Roland (2005) introduce Agreement Index (AI), which can be applied to polls with three options, i.e., “yes”, “no”, and “abstain”. Formally, AI of voting party \(i\) can be calculated as

\[
AI_i = \frac{\max\{Y_i, N_i, A_i\} - \frac{1}{2}[(Y_i + N_i + A_i) - \max\{Y_i, N_i, A_i\}]}{Y_i + N_i + A_i} \tag{3}
\]

where \(Y_i, N_i, A_i\) denote the number of “yes”, “no” and “abstain” votes, respectively.

Similarly, we can expand AI to polls with \(j(\geq 3)\) options as below
\[ AI_i = \max\{\text{Option}_1, \ldots, \text{Option}_j\} - \frac{1}{j-1} \left[ \left( \text{Option}_1 + \cdots + \text{Option}_j \right) - \max\{\text{Option}_1, \ldots, \text{Option}_j\} \right] \]

(4)

where \( \text{option}_j \) denote the number of votes of option \( j \).

Given a voting poll and voting party \( i \), \( AI_i \) will be a numeric value between 0 and 1. A higher \( AI_i \) means better group cohesion. For example, if all members of voting party \( i \) choose the same option, \( AI_i \) should equal to 1. However, if the votes of voting party \( i \) are equally divided among all available choices, \( AI_i \) will be 0.

4. Detect voting parties in MakerDAO

This section summarizes the empirical results of this study. The first sub-section presents the descriptive statistics of both polls and voting parties. Then, we illustrate the voting power of voting parties, implies MakerDAO is governed by dominant voting parties. The second sub-section focuses on the internal structure of voting parties to investigate if opinion leaders exist.

4.1 Governance polls in the Maker protocol

Table 1 presents descriptive statistics of Maker governance polls (from poll #16 to poll #838), and we illustrate total votes and the number of voters (See figures 2 and 3). Though total votes gradually increase, the number of voters volatiles. Most polls only have less than 60 voters, which is a small group comparing with the total users of Maker protocol. To some extent, the decision-making power is controlled by voters who frequently participate in voting and have large balance of MKR. If voting parties exist, then Maker governance is an example of multiparty democracy on blockchain.

[Table 1 here]

[Figures 2 and 3 here]

4.2 Voting parties in MakerDAO

After applying K-means clustering algorithm, Table 2 shows that 5 voting parties are detected. Voting party 0 has the most members and much more total votes than the other four parties. However, in most governance polls, only less than 40 voters from party 0 state their opinions, implying that the significant total votes of party 0 are actually from a small group of core members (See figure 4). Since voting party 0 started voting in 2017, they participated in most governance polls. On the other hand, though voting parties 1-4 are smaller, their total votes should not be ignored. As voting parties 1-4 emerged after 2019, they may get more control over Maker governance if they get more voters with large MKR balance.

[Table 2 here]

[Figure 4 here]

Based on all polls in our sample, figure 5 shows the distribution of votes from different voting parties, and voting party 0 contributed to more than a half of total votes. To better illustrate decision-making
power of different voting parties, we calculate their voting share. Not surprisingly, as the largest voting party, voting party 0 shows high voting share in most polls, whereas they only accounted for less than 20% of total votes in some polls (See figure 6). The voting share of other four voting parties also varies, and in certain polls, these four parties accounted dominant voting share (See online appendix 2). So, Maker governance polls are charged by different parties by turns, since most polls could be decided by a single voting party.

[Figures 5 and 6 here]

4.3 Group cohesion of voting parties in MakerDAO

After calculating AI of the five voting parties, Table 3 shows that group cohesion of all voting parties is usually high, though the minimum of AI is a signal of opinion differences in certain voting polls. The figure below further illustrate that the votes of the same voting party can be distributed among different options in a single poll3.

[Table 3 here]

[Figure 7 here]

According to the contents of polls, Maker governance polls fall into different categories. To help Maker community better understand the importance of polls, Maker Governance Portal labels all governance polls4. A natural conjecture is that group cohesion in different types of polls may differ, since managers tend to avoid making difficult decisions (Bertrand and Mullainathan, 2003). For example, polls with the label ‘risk Parameter’ are related to key parameters, e.g., interest rates of loans of certain cryptocurrencies, while polls with the label ‘delegates’ could be about introducing new voting delegates. Though voters in the same party share similar voting pattern, they can have interest conflicts in certain cases. Therefore, we are interested that if opinions are more likely to diverge in certain types of polls. By taking voting party 0 as an example, we illustrate their AI for the polls with three labels, namely ‘risk parameter’, ‘greenlight’, and ‘MIP’5. The figures below show that opinion differences exist within a voting party, implying that solidarity and cooperation of members in a voting party are suspicious. In other words, a high level of uncertainty for voting results in MakerDAO still exists, though voting party 0 has the most voters and largest total votes.

[Figure 8-10 here]

4.4 Internal structure of voting parties in MakerDAO

Beside voting share and group cohesion, the identities of voters in different voting parties are of particular interest. The contexts of corporate finance show that more diverse boards can have complicated influences (Bernile et al., 2018; Giannetti and Zhao, 2019). So, we attempt to reveal more information of components of voting parties.

3 The figures for AI of voting parties 1–4 are in online appendix 3.
4 Appendix 1 introduces labels of Maker governance polls.
5 We also illustrate group cohesion of other voting parties in different types of polls, where only the labels that show in more than 30 polls are considered. The figures are presented in online appendix 4.
To describe a voter more comprehensively, we first collect voters’ Ethereum Name Service (ENS) names shown on Maker Governance Portal. Simply, ENS is a unique identifier for a blockchain address. Then, we will search for ENS on Twitter, because some blockchain users will use ENS as their Twitter account. Though most blockchain users prefer anonymity, ENS owners and Twitter users may be more publicly known.

Based on voters’ historical transactions, we can create labels to describe their behavior, including DEX trading, liquidity providing, Non-fungible token (NFT) trading. Moreover, we also consider if MakerDAO voters are ‘whales’, which are entities that hold the significant amount of tokens. Benefiting from data on watchers.pro, we can scan all voters’ historical activities and attach right labels.

Table 4 gives the first look at the composition of voting parties. Not surprisingly, most known users (users with ENS names or Twitter accounts) are in voting party 0, implying that the communication costs for voting party 0 are lower. Since most delegates are in voting party 0 as well, opinions leaders’ suggestions can be more easily taken via both forum of Maker protocol and social media (e.g., Twitter). Furthermore, voting party 0 has the most whales, and these wealthy users may influence Maker protocol by participating Maker governance. Noticeably, there are 6 MKR whales in party 0, including a16z and other 5 anonymous voters, and the existence of MKR whales is a part of dominant voting power of party 0.

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5. How voting parties influence Maker protocol

This section investigates how voting parties influence Maker protocol. Previously, governance centralization in blockchain (Sai et al., 2021) has been proposed as an inevitable problem, and DAO governance is also centralized (Fritsch, Müller and Wattenhofer, 2022; Sun, Stasinakis and Sermpinis, 2022). Furthermore, the dominant voters in MakerDAO show complicated effects (Sun, Stasinakis and Sermpinis, 2022). Here, voting share of voting parties can be also a signal of governance centralization, while group cohesion introduces more uncertainty when considering DAO governance.
as collective decision-making process.

To comprehensively describe the performance of Maker protocol, we focus on DAI volatility, total revenue of Maker protocol, and new users. To apply regression analysis, two poll-level measurements, i.e., voting share and AI of voting parties, can be transferred to daily measurements by taking weighted average, where weights are total votes of polls. The descriptive statistics of voting share and AI on daily basis are given in appendix 2.

5.1 Voting share

First, we are curious about how voting share controlled by voting parties, especially the largest voting party 0, is related to performance and growth of Maker protocol. In the contexts of banking, centralized ownership can have complicated effects on firm performance, e.g., better capital buffers (Klein, Maidl and Woyand, 2021) and more risk-taking decisions (Dbouk et al., 2020). In fact, firms with centralized governance structure have strong performance volatility (Giannetti and Zhao, 2019; Tran and Turkiela, 2020). Therefore, we expect to see centralized governance as a double-edged sword for Maker protocol.

Since DAI is a stablecoin pegged to US dollar, price stability is a primary goal for MakerDAO, and Maker protocol aims to have more users and make more profits for long-term growth. Therefore, we expect to observe positive relationship between voting share of the largest party, i.e., voting party 0, and total revenue and new users. If higher voting share of party 0 contributes to more predictable decisions, lower volatility of DAI price should be observed. In order to examine our hypotheses, we estimate the following regressions:

\[
factor_t = \beta_0 + \beta_1 voting\ share_{it} + \beta_2 total\ asset_t + \beta_3 ETH_t + \beta_4 Dai\ volume_t \\
+ \beta_5 Mkr\ price_t + \beta_6 Total\ MakerDAO_t + \beta_7 Surplus\ buffer_t + \varepsilon_t
\]

Where:
- \(i = \{\text{party 0}, \text{party 1}, \text{party 2}, \text{party 3}, \text{party 4}, \text{party 5}\}\)
- \(factor = \{\text{DAI volatility}, \text{Total revenue}, \text{New MakerDAO}\}\)

Beside voting share, we also consider key variables that can affect Maker protocol\(^7\). First, the value of total assets locked in Maker protocol for lending directly decides liquidity in Maker, and we consider the value of locked Ether (ETH) since ETH is the underlying cryptocurrency of Ethereum blockchain. Daily volume of DAI, to some extent, can reflect on the demand of DAI and how frequently DAI is traded. Higher volume usually implies optimistic prospects of a cryptocurrency. MKR, as the governance token of Maker protocol, resembles stocks in corporate finance. So, MKR price can be a signal of market valuation of Maker protocol, which may relate to measurements of performance of Maker protocol. For Maker protocol, more total users are crucial for better network adoption, while

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\(^7\) The definitions of variables related to Maker protocol are given in appendix 3
more surplus buffer makes the protocol safer.

The empirical results bring forward some interesting findings. First, DAI price is more volatile when voting party 0 has more voting share, while the voting share of party 2 and party 3 shows negative relationship with DAI stability. Though higher voting share implies higher winning possibility of a voting party, it does not mean that DAI will be more stable when a party is more likely in charge. The findings are consistent with Bernile et al. (2018), i.e., centralization can cause higher volatility.

Theoretically, ‘one share – one vote’ mechanism will be optimal only when several bidders compete (Burkard and Lee, 2008). But in this case, more stable DAI may not be optimal choice for a certain voting party.

Another explanation on the relationship between DAI volatility and voting party 0 is based on uncertainty of voters’ choices within the same party. Though voting party 0 is the most powerful voting party, their dominant control can work well only if most members choose the same options of a governance poll. But, if the governance poll is controversial, voting party 0 could suffer from more dispersed opinions. We will dive into this conjecture more deeply in the next sub-section.

Furthermore, we observe voting party 2 can contribute to DAI stability. A potential explanation is based on the number of voters in these two parties (party 2 has 12 members, while party 3 has 14 members). For voters in party 2 and 3, they can be in agreement more easily, and their significant voting power will help them to win polls. In this case, the options supported by these two parties are easier to win, and the results of a governance poll are more predictable. As a result, the future of DAI is more certain, and the price stability will also increase.

For the case of total revenue of Maker protocol, higher voting share of parties 0 and 5 can decrease the total revenue, and parties 2 and 3 show the opposite effects. The findings here are first an instance of results of multiparty democracy, where voting parties can be either good or bad. In the contexts of corporate finance, active blockholders may or may not be beneficial (Shleifer and Vishny, 1997), which are consistent with our findings.

Another possible explanation is that the voting parties do not share the same beliefs. Total revenue, as one of the most crucial financial indicators, can reflect on the status of Maker protocol and benefits of Maker users. Usually, Maker protocol benefits from more total revenue. However, if Maker governance is battlefield of voting parties for their own interests, both positive and negative outcomes can happen, and the decreasing total revenue be a signal of some certain party’s victory. Berglof and Burkard (2003) discuss similar issues in corporations. When shareholders have their own interests, they may attempt to pursue private benefits by diverting corporate resources, and the influences are complicated. Since most suggested changes to Maker protocol are decided via voting process, voters may collude with each other for winning a poll, and the outcomes can be either beneficial or harmful. Besides, we do not observe relationship between voting parties and new users of Maker protocol.

5.2 Group cohesion
After investigating the influence of voting parties, we find centralized voting power of voting parties does not appear to be beneficial. A possible reason is that the members of the same voting party can have different opinions sometimes, though they share similar voting history. In other words, even Maker governance seems to be multiparty democracy, uncertainty exists. Therefore, group cohesion of voting parties matters.

Beside winning possibility, group cohesion has deeper influences on a team. Previous studies show that more cohesive team members may bring more positive characteristics to the team (Hogg, 1992; Schachter et al., 1951), and team members themselves will continuously benefit from group cohesion (Dovidio and Gaertner, 1999; Karau and Williams, 1997; Pepitone and Reichling, 1955). Though it is hard to track voters’ characteristics, factors specific to Maker protocol can be a proxy of voters’ utility, and we expect to see positive relationship between group cohesion and protocol performance. In order to examine our hypotheses, we estimate the following regressions:

\[
\text{factor}_t = \beta_0 + \beta_1 \text{agreement index}_{i,t} + \beta_2 \text{total asset}_t + \beta_3 \text{ETH}_t + \beta_4 \text{Dai volume}_t + \beta_5 \text{Mkr price}_t + \beta_6 \text{Total MakerDAO}_t + \beta_7 \text{Surplus buffer}_t + \epsilon_t
\]

Where:
- \(i = \{\text{party 0, party 1, party 2, party 3, party 4, party 5}\}\)
- \(\text{factor} = \{\text{DAI volatility, Total revenue, New MakerDAO}\}\)

Our findings here further prove the explanation on the relationship between DAI volatility and voting parties. When agreement index of party 0 is higher, DAI price is less volatile. Combing with the negative relationship between voting share of party 0 and DAI volatility, we show that both the voting share and group cohesion are crucial to the influence of a given voting party. Moreover, group cohesion of party 0 does contributes to Maker protocol, since DAI stability is a primary goal.

Beside party 0, other parties’ group cohesion, e.g., party 4, shows relationship with DAI volatility. The opposite effects of these two parties depict multiparty democracy in Maker protocol, since DAI volatility undoubtedly relates to Maker governance. Furthermore, the case of party 4 proves again the importance of group cohesion. With a few members and less overwhelming voting power, party 4 can win only if they act as a tightly knitted group. And, if a minority voting party wins, their decisions may not be consistent with former decisions (Garlappi et al., 2017). As a result, the crypto market may react to the inconsistency, and DAI volatility will increase. Another explanation is that, voters in party 4 may only focus on own interests, which have conflicts with DAI stability.

For the case of total revenue of Maker protocol, voting parties’ group cohesion has different effects. For party 3, their agreement index shows positive relationship with total revenue. But when parties 3 and 4 are more united, Maker protocol will suffer from less revenue, which further enhances our guesses about potentially selfish profit-seeking goals of voting parties.
5.3 Where is DAI?

As DAI is primary cryptocurrency issued by Maker protocol, the decision-making process of MakerDAO probably has influence on DAI. Beside price stability of DAI, we also investigate if voting parties can affect financial flows of DAI, i.e., where DAI is. Given the destination of DAI flows, we can have preliminary guesses of functions of DAI. Here, we consider five destinations of financial flows of DAI, including Centralized Finance (CeFi), Decentralized Exchanges (DEXes), Lending Protocols (LPs), External Owned Address (EOA), and bridges. In this paper, CeFi refers to blockchain-based financial applications run by centralized companies. Usually, the centralized companies play the role of a trusted third party, and two well-known examples are Binance\(^8\) and Coinbase\(^9\). For more detailed comparison between CeFi and DeFi, we refer readers to Qin et al. (2021). DEXes are crypto exchange platforms without any centralized third party, while LPs resemble banks in crypto ecosystem, and any agents can borrow and lend cryptocurrencies via interacting with LPs. Since there is no trusted third party in DEXes or LPs, all transactions will be processed and executed by smart contracts. For more introduction to the two categories of DeFi, we refer readers to Harvey et al. (2021) and Werner et al. (2021). As for EOA, we can simply regard it as Ethereum addresses controlled by human beings instead of computers. Besides, bridges refer to technical design that helps to achieve cross-chain transactions. Chen et al. (2020) and McCorry et al. (2021) provide more technical description for EOA and bridges, respectively.

Given the functions of different destinations of DAI financial flows, the roles of DAI can vary. For example, if DAI is transferred to LPs, it may be locked as collateral, or deposited as available liquidity. If more DAI is held in EOA, DAI is probably a part of less risky cryptoassets in the portfolio. The addresses included in the five categories are presented in online appendix 6. To investigate the effects of voting parties on DAI flows, we estimate the regressions below:

\[
Dai\text{ transferred}_t = \beta_0 + \beta_1 \text{voting share}_t + \beta_2 \text{total asset}_t + \beta_3 \text{ETH}_t + \beta_4 \text{Dai volume}_t + \beta_5 \text{Mkr price}_t + \beta_6 \text{Total MakerDAO}_t + \beta_7 \text{Surplus buffer}_t + \epsilon_t (7)
\]

Where:

- \( i = \{\text{party 0, party 1, party 2, party 3, party 4, party 5}\} \)
- \( \text{Dai transferred} = \{\text{CeFi, DEX, LP, EOA, Bridge}\} \)

For each voting party, we present how their voting share relates to DAI financial flows (see Tables 11-15), and Table 16 summarizes our findings. Not very surprisingly, voting party 0, as the largest voting party, shows significant influence on DAI financial flows. When voting party 0 has higher voting

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\(^8\) Binance.com
\(^9\) Coinbase.com
share, there will be more DAI transferred to DEXes and EOA, but the amount of DAI that flow to LPs and bridges will decrease.

Voting parties 1-4 can also increase and decrease DAI flows to certain blockchain-based applications, and the complicated relationship implies potential conflicts between different parties. For example, voting party 2 has similar influence on DAI flows to LPs and EOAs with voting party 0. However, voting party 3 has completely opposite effects. In this case, voting party 2 is an ‘ally’ of voting party 0, while voting party 3 is the common ‘enemy’ of party 0 and party 2. By observing the complex relationship between voting parties and DAI flows, we show that voting parties can either cooperate or defy each other, and cooperation is not always solid.

In the context of political science, coalition-directed voting exists in multiparty democracy. Duch, May and Armstrong (2010) argue that voters’ choices rely on coalition, and Meffert and Gschwend (2007) show that coalition signals can inform strategic voters’ choices in multiparty systems. The case of MakerDAO can expand the previous political studies to DeFi. First, MakerDAO is a multiparty system, and all suggested changes are proposed and decided by the Maker community. Then, DAI flows can be driven by competition of voting parties. For example, when voters feel unsatisfied with status quo of DAI, e.g., the distribution of DAI among CeFi and DeFi, some voters can propose certain changes, e.g., bans of transferring DAI to certain platforms. With different intention and preference, voting parties naturally have dispersed opinions on DAI and will vote accordingly. In this way, varying flows of DAI are both a reason and evidence of multiparty democracy.

6. Robustness checks

6.1 Are certain types of governance polls more important

In all governance polls, there are three most frequently shown labels, including ‘risk parameter’, ‘MIP’ and ‘greenlight’. We suspect that these three types of governance polls may be more crucial, and beside more dispersed opinions, some voters may avoid to participated in these polls (Bertrand and Mullainathan, 2003). So, it will be intriguing to examine that how voting parties’ behavior in certain types of governance polls can affect Maker protocol.

For each voting party, we first calculate voting share and AI based on the selected three types of governance polls. Then, we estimate regressions (5) and (6) again, and results in appendix 4 bring forward some interesting findings. First, for the cases of DAI volatility and new users, we do not observe significant results. But, when focusing on the total revenue of Maker protocol, higher voting share of smaller voting parties still has positive influence, while higher voting share of party 0 in ‘greenlight’ polls can decrease total revenue.

Surprisingly, group cohesion in certain types of governance polls matters. Consistent with prior discussion, DAI will be less volatile when voting party 0 has better group cohesion in ‘risk parameter’ and ‘greenlight’ polls. However, for other smaller parties, the findings may not hold. Therefore, the importance of governance polls cannot be evaluated by only labels. And, the influence of voting
parties should be studied based on full voting records.

6.2 Who are the potential opinion leaders

A natural question about the largest voting party, i.e., voting party 0, is that: are there potential opinion leaders? Theoretically, herd behavior exists in voting and can affect the voting outcomes (Ali and Kartik, 2012; Dekel and Piccione, 2000). The first natural idea is influencers, e.g., influencers on social media. Here, we will consider voters who are ENS owners and Twitter users. If a user owns an ENS name, we believe she is probably more enthusiastic about Ethereum, and crypto people may track ENS owners’ transactions. On Twitter, people can discuss everything about blockchain and cryptocurrency, and influencers’ opinions can be spread. The finance contexts (e.g., Colla and Mele, 2010; Ozsoylev and Walden, 2011; Pedersen, 2022; Walden, 2019) prove how influential investors can affect markets via social networks.

Beside social media, the trading activities of voters can have extreme variation. Cohen, Frazzini and Malloy (2008) and Han, Hirshleifer and Walden (2021) discuss how investors’ strategies are related to network. To describe voters’ activities, we consider four categories of DeFi users, including DEX traders, liquidity providers, Non-fungible token (NFT) traders, and whales. For different types of voters from party 0, we calculate voting share and AI again, and appendix 5 shows the descriptive statistics.

Then, for each type of voters in party 0, we estimate regressions (5) – (7) again, and ENS owners and Twitter users are possible leaders in voting party 0. For example, for the case of these two types of voters, the relationship between Maker protocol and their voting is consistent with prior findings. However, when focusing on group cohesion, no significant evidence is found. So, the leadership of ENS owners and Twitter users is probably from their voting power.

Then, we also examine how DAI flows are driven by different types of voters in party 0. For the cases of ENS owners, Twitter users, and DEX traders, the results for DAI flows to EOA and Bridges are similar to prior results. The only difference is that, for ENS owners and Twitter users, higher voting share can decrease DAI flows to CeFi, but the effects of DEX traders are opposite. Besides, liquidity providers in party 0 show the opposite influence on DAI flows, compared to the results for all voters in party 0. By classifying voters in party 0, we partly reveal their dissimilar interests, e.g., where DAI is transferred, and the difference may be from their various trading activities in DeFi.

Overall, ENS owners and Twitter users are potential opinion leaders in voting party 0, and their influence is probably from their voting power. But, in the voting party 0, some voters, e.g., liquidity providers, can have different interests from others, which can be a reason for low AI in certain polls. Similar to arguments by Hermalin and Weisbach (2003) and Adam, Hermalin and Weisbach (2010), we need more exploration on internal structure of decision-makers in DAO.

[Tables 17-23 here]

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10 For different types of voters from party 0, online appendices 5 and 6 present the figures of voting share and AI, respectively.
7. Conclusion

This paper attempts to answer a controversial question: can blockchain technology help to achieve decentralized governance? In the era of DeFi, DAO is the mainstream choice of organizational form, which is believed to be a novel and feasible solution to decentralized governance. Naturally, DAO governance attracts scrutiny, and empirical studies (Sun, Stasinakis and Sermpinis, 2022; Fritsch, Müller and Wattenhofer, 2022) reveal potential centralization, e.g., centralized voting power. However, we ignore possible collaboration and competition between DAO members, if DAO members are regarded as isolated individuals. To detect potential interlinks between voters, we choose MakerDAO and Maker protocol as a case study. By retrieving datasets for governance polls from poll 16 (deployed on 15th August 2019) to poll 838 (deployed on 25th July 2022), we find some voters share similar voting patterns. After applying K-means clustering algorithm, voters can fall into five distinct ‘voting parties’, and the internal structure, e.g., the proportion of known voters, varies among the five parties, implying voting parties have dissimilar interests. The clusterable voters show that the nature of DAO governance may be multiparty democracy, where voters with similar profit-seeking goals work together (Abramson et al., 2009; Adams, Merrill and Grofman 2005; Downs, 1957; Enelow and Hinich, 1994).

Intuitively, voting parties can drive Maker protocol in different ways, and their effects can be even more unforeseeable when no dominant party exists. Though voting party has both the most voters and highest total votes, they do not have complete control over Maker governance because of possible opinion differences. As a result, given a voting poll, smaller parties can win when they concentrate on the same option. Therefore, for a voting party both voting power and group cohesion are crucial, and we investigate how these two measurements are related to the performance of Maker protocol.

Our findings support the perspective that centralized governance has negative influence on the underlying financial system (e.g., Burkart and Lee, 2008; Dbouk et al, 2020; Galai and Masulis, 1976; Mollah and Liljeblom, 2016; Shleifer and Vishny, 1997). For example, when the largest voting party has higher voting share, DAI, aiming for price stability, will be more volatile, and the total revenue of Maker protocol will decrease. But, the existence of multiple voting parties introduces more complexity. When smaller parties are more likely to win governance polls, Maker protocol will benefit from better DAI stability and more revenue. So, we cannot completely copy theory in corporate finance in DAO, and more comparative studies between DAO and corporate governance should be presented.

Theoretically, MakerDAO is a multi-agent system where ‘one share – one vote’ principle applies. In such systems, optimal outcomes happen only when several agents compete (Burkart and Lee, 2008). Though only five voting parties exist in MakerDAO, in some cases, Maker protocol suffers from their competition in governance. The gap between theoretical model and empirical evidence is not surprising. First, ‘optimal outcomes’ is opaque for DAO. DAO members have diversified interests, so we cannot easily define good outcomes or bad outcomes. For example, voting parties can drive DAI
to different blockchain-based applications, whereas we cannot tell where is the best destination for DAI. And, ‘several’ is also vague. Most DAOs are growing rapidly, and the number of voters varies even in governance polls. So, even if theoretical models can describe DAO very well, we do not know when equilibria can achieve.

More information is revealed by considering group cohesion of voting parties. Within a voting party, voters can have opinion differences and then choose different options, and the voting party can lose because of diluted voting power. So, group cohesion is related to uncertainty of voting results, and ripple effects on Maker protocol should be observed. We find that, when party 0 is more cohesive, or smaller parties are less cohesive, DAI will be more stable. An explanation is that voting results will be more predictive when the largest party is more cohesive, and more certainty contributes to DAI stability. The findings here are consistent with Allen and Gale (1999) and Garlappi et al. (2017), where centralized control power leads to less extreme outcomes.

Furthermore, collaboration and competition exist between voting parties. By investigating DAI flows, we find that voting parties tend to drive DAI to different blockchain-based applications, showing that voting parties have diversified interests in utilizing DAI. If voting parties drive DAI in the similar way, the parties are coalitions to some extent. For example, party 0 and party 2 prefer DAI flows to LPs and EOAs, while voting party 3 is their common ‘enemy’. Backward, voting parties that work as coalition may have an agreement on voting in certain polls (May and Armstrong, 2010; Meffert and Gschwend, 2007). Therefore, the interlinks between voting parties are crucial for understanding DAO. Although our findings appear conceptually and empirically robust, they should be interpreted with their limitations in mind. First, we cluster voters based on their voting records from poll 16 to poll 838, and such voting parties are not political parties, where party membership is very clear. But we should realize that DAO community will not reveal their vulnerability by committing the potential coalitions of voters. Second, it is difficult to detect the opinion leaders in voting parties. Because of anonymity of blockchain, not all voters can be matched with an entity in real life. In this paper, we detect some voters that have publicly known identities, e.g., ENS names and Twitter, and these voters may be opinion leaders in voting party 0. Further studies may attempt to reveal more information of DAO voters, and the leaders in DAO will be a intriguing research topic. Third, we do not investigate why voting parties’ voting share and group cohesion change. Voters, beside their activities in DAO, can have more complex activities, and their beliefs should not be identical. Therefore, given a poll, voters’ participation willingness and voting strategy are unpredictable. To address this problem, motivations of participating in DAO should be studied. Finally, assuming that voting parties exist, voters can turn to different voting parties. Therefore, the influence of multiparty democracy on DAO and its underlying protocol should be more complicated than the discussion in this paper.
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**Tables**

### Table 1. Descriptive statistics of Maker governance polls

|               | Total votes | Total voters | Breakdown votes | Breakdown ratio | Vote share of the largest voting party |
|---------------|-------------|--------------|-----------------|-----------------|---------------------------------------|
| **Mean**      | 47934.36    | 25.97        | 40492.13        | 0.88            | 0.74                                  |
| **Median**    | 37477.47    | 22           | 34011.03        | 0.98            | 0.72                                  |
| **Maximum**   | 293911.44   | 158          | 176846.86       | 1               | 1.00                                  |
| **Minimum**   | 259.74      | 5            | 232.80          | 0.35            | 0.37                                  |
| **Std**       | 33940.98    | 15.92        | 26878.17        | 0.17            | 0.16                                  |

### Table 2. Descriptive statistics of voting parties in MakerDAO

| Voting party  | Number of voters | Involved polls | Total votes | First poll |
|---------------|------------------|----------------|-------------|------------|
| Voting party 0| 1674             | 787            | 22235328.27 | 2017-12-18 |
| Voting party 1| 8                | 627            | 2885765.90  | 2019-04-11 |
| Voting party 2| 12               | 438            | 4353640.14  | 2020-11-14 |
| Voting party 3| 14               | 484            | 2488075.43  | 2019-06-04 |
| Voting party 4| 9                | 406            | 6712065.12  | 2019-08-22 |

Notes: For all voting parties, we exclude voters whose total votes equal to zero. Though these voters stated their opinions, they do not influence the results of voting.

### Table 3. Descriptive statistics of Agreement Index (AI) of voting parties

| Voting party | Mean | Median | Maximum | Minimum | Std   |
|--------------|------|--------|---------|---------|-------|
| Voting party 0| 0.84 | 0.91   | 0.96    | 0.96    | 0.93  |
| Voting party 1| 0.99 | 1      | 1       | 1       | 1     |
| Voting party 2| 1    | 1      | 1       | 1       | 1     |
| Voting party 3| 0    | 0.17   | 0.44    | 0.45    | 0     |
| Voting party 4| 0.26 | 0.18   | 0.10    | 0.12    | 0.23  |
The definitions of the variables are given in Table 4.4. and ***, denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics.

| Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|---------------|---------------|---------------|---------------|---------------|
| ENS owner     | 344           | 0             | 5             | 2             | 0             |
| Twitter user  | 149           | 0             | 3             | 1             | 0             |
| DEX trader    | 873           | 4             | 3             | 3             | 3             |
| Liquidity provider | 414       | 2             | 1             | 1             | 0             |
| NFT trader    | 622           | 4             | 2             | 3             | 0             |
| Whale         | 79            | 0             | 0             | 0             | 1             |
| Delegate      | 64            | 0             | 4             | 0             | 0             |
| Total voters  | 1674          | 8             | 12            | 14            | 9             |

Table 4. Internal structure of voting parties

| (1)          | (2)         | (3)          | (4)          | (5)          |
|--------------|-------------|--------------|--------------|--------------|
| Voting share | 0.12**      | -0.12        | -0.20**      | -0.17**      | 0.05         |
|              | (2.03)      | (-1.54)      | (-2.44)      | (-2.19)      | (0.77)       |
| Total_asset  | 0.19        | 0.16         | 0.47**       | 0.17         | 0.22         |
|              | (0.87)      | (0.72)       | (1.96)       | (0.79)       | (1.00)       |
| ETH          | -0.26       | -0.25        | -0.21        | -0.26        | -0.23        |
|              | (-1.56)     | (-1.49)      | (-1.32)      | (-1.58)      | (-1.37)      |
| Dai_volume   | 0.14        | 0.18         | 0.22         | 0.18         | 0.22         |
|              | (0.77)      | (1.02)       | (1.24)       | (1.01)       | (1.19)       |
| Mkr_price    | -0.40***    | -0.33**      | -0.55***     | -0.33**      | -0.41***     |
|              | (-3.08)     | (-2.31)      | (-4.15)      | (-2.46)      | (-3.04)      |
| Total_MakerDAO | 0.07     | -0.02        | -0.08        | -0.05        | -0.10        |
|              | (0.61)      | (-0.18)      | (-0.86)      | (-0.52)      | (-0.87)      |
| Surplus_buffer | -0.08 | 0.00         | -0.05        | 0.03         | 0.03         |
|              | (-0.46)     | (-0.03)      | (-0.32)      | (0.17)       | (0.18)       |
| N            | 174         | 174          | 174          | 174          | 174          |
| Adj. R-sq    | 0.23        | 0.23         | 0.24         | 0.24         | 0.22         |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of DAI volatility. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

| (1)          | (2)          | (3)          | (4)          | (5)          |
|--------------|--------------|--------------|--------------|--------------|
| Voting share | -0.11***     | 0.26***      | 0.24***      | 0.00         | -0.09***     |
|              | (-3.58)      | (7.00)       | (5.79)       | (0.10)       | (-2.36)      |
| Total_asset  | 0.07         | 0.18         | -0.26**      | 0.04         | 0.03         |
|              | (0.59)       | (1.58)       | (-2.18)      | (0.36)       | (0.29)       |
| ETH          | 0.66***      | 0.67***      | 0.62***      | 0.63***      | 0.63***      |
|              | (7.56)       | (8.47)       | (7.50)       | (6.99)       | (7.12)       |
| Dai_volume   | 0.10         | 0.07         | 0.02         | 0.04         | 0.01         |
|              | (1.02)       | (0.86)       | (0.18)       | (0.44)       | (0.11)       |
| Mkr_price    | 0.33***      | 0.14**       | 0.51***      | 0.37***      | 0.32***      |
|              | (4.90)       | (2.01)       | (7.58)       | (5.02)       | (4.48)       |
| Total_MakerDAO | -0.02 | 0.01         | 0.13***      | 0.10         | 0.17***      |
|              | (-0.37)      | (0.29)       | (2.64)       | (1.77)       | (2.75)       |
| Surplus_buffer | -0.12 | -0.18**      | -0.13        | -0.19**      | -0.24***     |
|              | (-1.37)      | (-2.40)      | (-1.60)      | (-2.11)      | (-2.70)      |
| N            | 174          | 174          | 174          | 174          | 174          |
| Adj. R-sq    | 0.84         | 0.87         | 0.86         | 0.83         | 0.83         |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of total revenue of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.
Table 7. The relationship between new users of Maker protocol and voting share of voting parties

|                  | (1)       | (2)       | (3)       | (4)       | (5)       |
|------------------|-----------|-----------|-----------|-----------|-----------|
| Voting share     | 0.01      | 0.01      | 0.00      | 0.00      | -0.02     |
|                  | (0.42)    | (0.30)    | (0.06)    | (-0.06)   | (-0.71)   |
| Total_asset      | 0.01      | 0.01      | 0.01      | 0.01      | 0.01      |
|                  | (0.08)    | (0.15)    | (0.07)    | (0.10)    | (0.08)    |
| ETH              | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      |
|                  | (-0.07)   | (-0.01)   | (-0.03)   | (-0.04)   | (-0.03)   |
| Dai_volume       | -0.01     | -0.01     | -0.01     | -0.01     | -0.01     |
|                  | (-0.20)   | (-0.12)   | (-0.13)   | (-0.13)   | (-0.23)   |
| Mkr_price        | 0.01      | 0.00      | 0.01      | 0.01      | 0.00      |
|                  | (0.29)    | (0.05)    | (0.23)    | (0.23)    | (0.02)    |
| Total_MakerDAO   | -0.34***  | -0.35***  | -0.35***  | -0.35***  | -0.33***  |
|                  | (-8.44)   | (-10.04)  | (-10.18)  | (-10.26)  | (-8.51)   |
| Surplus_buffer   | -0.01     | -0.01     | -0.01     | -0.01     | -0.01     |
|                  | (-0.10)   | (-0.01)   | (-0.00)   | (-0.00)   | (-0.20)   |
| N                | 174       | 174       | 174       | 174       | 174       |
| Adj. R-sq        | 0.58      | 0.58      | 0.58      | 0.58      | 0.58      |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of new users of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table 8. The relationship between DAI volatility and group cohesion of voting parties

|                  | (1)       | (2)       | (3)       | (4)       | (5)       |
|------------------|-----------|-----------|-----------|-----------|-----------|
| Agreement Index  | -0.25***  | -0.08     | -0.09     | 0.02      | 0.32**    |
|                  | (-3.61)   | (-0.89)   | (-1.00)   | (0.19)    | (2.12)    |
| Total_asset      | 0.28      | -0.37     | 0.32      | 0.85*     | -2.16     |
|                  | (1.27)    | (-0.38)   | (1.49)    | (1.78)    | (-1.01)   |
| ETH              | -0.24     | 0.41      | -0.28*    | -0.39     | 0.39      |
|                  | (-1.43)   | (0.89)    | (-1.82)   | (-1.42)   | (0.23)    |
| Dai_volume       | 0.24      | 0.02      | 0.27      | 0.09      | -0.36***  |
|                  | (1.36)    | (0.10)    | (1.63)    | (0.64)    | (-0.09)   |
| Mkr_price        | -0.43***  | -0.59***  | -0.27**   | -0.37***  | 0.19      |
|                  | (-3.37)   | (-2.95)   | (-2.04)   | (-2.76)   | (0.24)    |
| Total_MakerDAO   | 0.02      | -0.07     | -1.31     | -0.06     | 0.14      |
|                  | (0.15)    | (-0.64)   | (-0.55)   | (-0.74)   | (0.59)    |
| Surplus_buffer   | -0.12     | 0.12      | 0.16      | -0.43     | -0.20     |
|                  | (-0.71)   | (0.17)    | (0.53)    | (-1.41)   | (-0.10)   |
| N                | 166       | 121       | 107       | 102       | 67        |
| Adj. R-sq        | 0.27      | 0.29      | 0.23      | 0.27      | 0.14      |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of DAI volatility. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table 9. The relationship between total revenue of Maker protocol and group cohesion of voting parties

|                  | (1)       | (2)       | (3)       | (4)       | (5)       |
|------------------|-----------|-----------|-----------|-----------|-----------|
| Agreement Index  | 0.00      | -0.03     | 0.22***   | -0.13**   | -0.04**   |
|                  | (0.07)    | (-0.74)   | (3.62)    | (-2.16)   | (-2.07)   |
| Total_asset      | 0.07      | -1.26***  | -0.08     | -1.70***  | 2.32***   |
|                  | (0.56)    | (-2.72)   | (-0.56)   | (-5.67)   | (9.22)    |
| ETH              | 0.61***   | 1.46***   | 0.66***   | 1.30***   | -0.43**   |
|                  | (6.69)    | (6.50)    | (6.35)    | (7.14)    | (-2.21)   |
| Dai_volume       | 0.02      | -0.12     | -0.01     | -0.05     | -1.76***  |
|                  | (0.15)    | (-1.48)   | (-0.09)   | (-0.47)   | (-3.92)   |
| Mkr_price        | 0.36***   | 0.51***   | 0.30***   | 0.32***   | 0.04      |
|                  | (5.10)    | (5.34)    | (3.34)    | (3.60)    | (0.49)    |
| Total_MakerDAO   | 0.11**    | 0.12**    | 1.46      | 0.24***   | -0.12**   |
|                  | (2.07)    | (2.29)    | (0.91)    | (4.11)    | (-4.06)   |
| Surplus_buffer   | -0.21**   | 0.19      | -0.27     | 0.88***   | 0.71***   |
|                  | (-2.34)   | (0.57)    | (-1.32)   | (4.36)    | (2.95)    |
| N                | 166       | 121       | 107       | 102       | 67        |
| Adj. R-sq        | 0.82      | 0.89      | 0.72      | 0.83      | 0.97      |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of
Table 10. The relationship between new users of Maker protocol and group cohesion of voting parties

|               | (1)   | (2)   | (3)   | (4)   | (5)   |
|---------------|-------|-------|-------|-------|-------|
| Agreement Index | 0.00  | -0.01 | 0.00  | -0.01 | -0.02 |
| Total_asset    | 0.01  | 0.37  | **0.02** | -0.02 | 0.77  |
| ETH           | 0.00  | -0.13 | 0.00  | 0.01  | -0.48 |
| Dai_volume    | -0.01 | -0.02 | -0.01 | -0.01 | 1.22  |
| Mkr_price     | 0.01  | 0.07  | 0.00  | 0.00  | 0.06  |
| Total_MakerDAO | **-0.35** | ***-0.39*** | **-1.30*** | ***-0.35*** | **-0.36*** |
| Surplus_buffer | 0.00  | -0.28 | **0.10*** | 0.02  | -0.38 |
| N             | 166   | 121   | 107   | 102   | 67    |
| Adj. R-sq     | 0.58  | 0.53  | 0.84  | 0.55  | 0.56  |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of new users of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table 11. The relationship between DAI flows and voting share of voting party 0

|               | (1)   | (2)   | (3)   | (4)   | (5)   |
|---------------|-------|-------|-------|-------|-------|
| Voting share  | 0.07  | 0.13*** | -0.21*** | 0.05** | -0.11*** |
| Total_asset   | **0.94*** | **1.16*** | **0.50*** | **0.32*** | **1.92*** |
| ETH           | **-0.56*** | **0.34*** | **0.14** | -0.02 | -0.40*** |
| Dai_volume    | 0.21* | 0.05  | -0.15 | 0.04  | 0.00  |
| Mkr_price     | **0.31*** | **-0.32*** | **0.64*** | -0.02 | **-0.19*** |
| Total_MakerDAO | **-0.35*** | **0.52*** | **0.22** | **0.07*** | **-0.25*** |
| Surplus_buffer | -0.27** | -0.14** | 0.18** | 0.17** | 0.17** |
| N             | 174   | 161   | 173   | 174   | 170   |
| Adj. R-sq     | 0.71  | 0.97  | 0.88  | 0.99  | 0.97  |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of voting party 0. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.

Table 12. The relationship between DAI flows and voting share of voting party 1

|               | (1)   | (2)   | (3)   | (4)   | (5)   |
|---------------|-------|-------|-------|-------|-------|
| Voting share  | **0.24*** | -0.01 | -0.01 | 0.00  | -0.02 |
| Total_asset   | **1.05*** | **1.15*** | **0.51*** | **0.32*** | **1.92*** |
| ETH           | **-0.46*** | **0.35*** | **0.12** | -0.01 | **-0.42*** |
| Dai_volume    | **0.22*** | 0.07  | -0.18 | 0.05  | -0.01 |
| Mkr_price     | -0.00 | **-0.35*** | **0.73*** | -0.04 | **-0.13*** |
| Total_MakerDAO | -0.02 | -0.10 | 0.40** | 0.05** | **-0.21*** |
| Surplus_buffer | -0.14 | **-0.45*** | 0.10  | **0.80*** | **-0.81*** |
### Table 13. The relationship between DAI flows and voting share of voting party 2

|           | (1)       | (2)       | (3)       | (4)       | (5)       |
|-----------|-----------|-----------|-----------|-----------|-----------|
| Voting share | 0.10***  | 0.04      | -0.37***  | 0.08***   | 0.12***   |
|           | (1.94)    | (1.50)    | (-8.69)   | (6.29)    | (6.19)    |
| Total_asset | 0.82***   | 1.11***   | 0.96***   | 0.22***   | 1.77***   |
|           | (5.31)    | (15.22)   | (7.36)    | (5.66)    | (28.78)   |
| ETH       | -0.57***  | 0.34***   | 0.19**    | -0.03     | -0.43***   |
|           | (-5.31)   | (6.78)    | (2.06)    | (-0.99)   | (-10.11)  |
| Dai_volume | 0.20*     | 0.07      | -0.13     | 0.03      | -0.03     |
|           | (1.73)    | (1.16)    | (-1.27)   | (1.12)    | (-0.72)   |
| Mk_price  | 0.37***   | -0.33***  | 0.36***   | 0.04***   | -0.08     |
|           | (3.94)    | (-7.22)   | (4.50)    | (1.69)    | (-0.88)   |
| Total_MakerDAO | 0.19*** | (2.89)    | -0.03     | -0.16***  | 0.06***   |
| Surplus_buffer | -0.23**  | (-2.22)   | (0.09)    | 0.80***   | -0.79***  |
|           | (-9.80)   | (0.98)    | (3.73)    | (18.88)   |
| N         | 174       | 161       | 173       | 174       | 170       |
| Adj. R-sq | 0.72      | 0.96      | 0.91      | 0.99      | 0.97      |

### Table 14. The relationship between DAI flows and voting share of voting party 3

|           | (1)       | (2)       | (3)       | (4)       | (5)       |
|-----------|-----------|-----------|-----------|-----------|-----------|
| Voting share | 0.05     | -0.04**   | 0.15***   | -0.03***  | -0.01     |
|           | (1.29)    | (-2.25)   | (4.33)    | (-3.47)   | (-0.78)   |
| Total_asset | 0.95***   | 1.14***   | 0.57***   | 0.30***   | 1.92***   |
|           | (6.66)    | (17.04)   | (4.14)    | (7.87)    | (30.38)   |
| ETH       | -0.55***  | 0.35***   | 0.14      | -0.02     | -0.41***   |
|           | (-5.10)   | (6.92)    | (1.33)    | (-0.56)   | (-8.72)   |
| Dai_volume | 0.23*     | 0.06      | -0.16     | 0.04      | -0.02     |
|           | (1.91)    | (1.15)    | (-1.39)   | (1.25)    | (-0.33)   |
| Mk_price  | 0.26***   | -0.35***  | 0.64***   | -0.02     | -0.15***   |
|           | (3.08)    | (-8.63)   | (7.87)    | (-0.84)   | (-3.87)   |
| Total_MakerDAO | 0.16*** | (-2.47)   | -0.02     | -0.14**   | 0.06***   |
| Surplus_buffer | -0.25**  | (-2.36)   | 0.06      | 0.81***   | -0.79***   |
|           | (-8.78)   | (0.55)    | (28.10)   | (-16.94)  |
| N         | 174       | 161       | 173       | 174       | 170       |
| Adj. R-sq | 0.71      | 0.96      | 0.89      | 0.99      | 0.96      |

### Table 15. The relationship between DAI flows and voting share of voting party 4

|           | (1)       | (2)       | (3)       | (4)       | (5)       |
|-----------|-----------|-----------|-----------|-----------|-----------|
| Voting share | -0.15*** | 0.05**    | -0.03     | -0.02***  | 0.05**    |
|           | (-3.03)   | (2.01)    | (-0.55)   | (-1.81)   | (2.25)    |
| Total_asset | 0.93***   | 1.16***   | 0.52***   | 0.37***   | 1.93***   |
|           | (6.68)    | (17.32)   | (3.55)    | (8.01)    | (31.04)   |
| ETH       | -0.56***  | 0.35***   | 0.12      | -0.01     | -0.41***   |
|           | (-5.30)   | (6.99)    | (1.13)    | (-0.48)   | (-8.79)   |
| Dai_volume | 0.17      | 0.09      | -0.19     | 0.04      | 0.00      |
|           | (1.44)    | (1.55)    | (-1.59)   | (1.12)    | (0.05)    |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of voting party 1. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of voting party 2. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of voting party 3. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of voting party 4. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.
Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of voting party 4. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.

Table 16. The relationship between voting parties and DAI flows

|                  | CeFi | DEX | LP | EOA | Bridge |
|------------------|------|-----|----|-----|--------|
| Voting share 0   | +    | -   | +  | -   | -      |
| Voting share 1   | +    |     |    |     |        |
| Voting share 2   | +    | -   | -  | +   |        |
| Voting share 3   | -    | +   |    | -   |        |
| Voting share 4   | -    | +   |    | -   | +      |

Note: This table reports how voting share of voting parties is related to DAI flows. ‘+’ means higher voting share will be positively related to DAI flows to a certain destination, while ‘-’ means higher voting share will decrease DAI flows to the destination.

Table 17. The relationship between DAI volatility and voting share of different types of voters from party 0

|                  | (1)  | (2)  | (3)  | (4)  | (5)  | (6)  |
|------------------|------|------|------|------|------|------|
| Voting share     | 0.25*** | 0.47*** | -0.14* | -0.14 | -0.15 | -0.13 |
|                  | (2.91) | (3.74) | (-1.79) | (-0.58) | (-1.25) | (-1.02) |
| Total_asset      | 0.15 | 0.13 | 0.22 | 0.21 | 0.22 | 0.21 |
|                  | (0.70) | (0.59) | (1.03) | (0.96) | (0.98) | (0.98) |
| ETH              | -0.33** | -0.44*** | -0.24 | -0.23 | -0.23 | -0.24 |
|                  | (-1.98) | (-2.60) | (-1.45) | (-1.39) | (-1.38) | (-1.42) |
| Dai_volume       | 0.19 | 0.17 | 0.28 | 0.19 | 0.20 | 0.19 |
|                  | (1.04) | (0.96) | (1.49) | (1.04) | (1.10) | (1.06) |
| Mkr_price        | -0.29** | -0.18 | -0.42*** | -0.43*** | -0.44*** | -0.42*** |
|                  | (-2.18) | (-1.23) | (-3.26) | (-3.30) | (-3.44) | (-3.21) |
| Total_MakerDAO   | -0.02 | -0.01 | -0.12 | -0.05 | -0.11 | -0.10 |
|                  | (-0.18) | (-0.06) | (-1.15) | (-0.53) | (-1.03) | (-0.92) |
| Surplus_buffer   | -0.18 | -0.17 | -0.02 | 0.00 | 0.00 | 0.00 |
|                  | (-1.05) | (-1.05) | (-0.14) | (0.03) | (0.03) | (0.02) |
| N                | 174 | 174 | 174 | 174 | 174 | 174 |
| Adj. R-sq        | 0.25 | 0.28 | 0.23 | 0.22 | 0.22 | 0.22 |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of DAI volatility. Columns (1) – (6) presents results for ENS owners, Twitter users, DEX traders, liquidity providers, NFT traders, and whales from voting party 0, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table 18. The relationship between total revenue of Maker protocol and voting share of different types of voters from party 0

|                  | (1)  | (2)  | (3)  | (4)  | (5)  | (6)  |
|------------------|------|------|------|------|------|------|
| Voting share     | -0.33*** | -0.33*** | 0.06 | -0.09 | 0.01 | 0.02 |
|                  | (-8.43) | (-5.01) | (1.38) | (-0.66) | (0.14) | (0.26) |
| Total_asset      | 0.13 | 0.11 | 0.04 | 0.04 | 0.04 | 0.04 |
|                  | (1.29) | (0.95) | (0.33) | (0.33) | (0.36) | (0.36) |
| ETH              | 0.77*** | 0.78*** | 0.64*** | 0.63*** | 0.63*** | 0.63*** |
|                  | (9.96) | (8.76) | (7.09) | (6.98) | (7.01) | (7.01) |
| Dai_volume       | 0.06 | 0.07 | 0.01 | 0.04 | 0.04 | 0.04 |
|                  | (0.73) | (0.71) | (0.10) | (0.38) | (0.44) | (0.44) |
| Mkr_price        | 0.18*** | 0.19*** | 0.37*** | 0.39*** | 0.38*** | 0.37*** |
|                  | (2.81) | (2.52) | (5.27) | (5.48) | (5.44) | (5.29) |
| Total_MakerDAO   | 0.04 | 0.06 | 0.12** | 0.10* | 0.10* | 0.10* |
Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of total revenue of Maker protocol. Columns (1) – (6) presents results for ENS owners, Twitter users, DEX traders, liquidity providers, NFT traders, and whales from voting party 0, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

### Table 19. The relationship between new users of Maker protocol and voting share of different types of voters from party 0

|                        | (1)     | (2)     | (3)     | (4)     | (5)     | (6)     |
|------------------------|---------|---------|---------|---------|---------|---------|
| **Voting share**       | 0.00    | 0.01    | -0.02   | 0.00    | -0.10** | 0.05    |
|                        | (0.08)  | (0.17)  | (-0.63) | (-0.06) | (-2.39) | (1.26)  |
| **Total_asset**        | 0.01    | 0.01    | 0.01    | 0.01    | 0.01    | 0.01    |
|                        | (0.09)  | (0.08)  | (0.12)  | (0.10)  | (0.10)  | (0.11)  |
| **ETH**                | 0.00    | -0.01   | 0.00    | 0.00    | 0.00    | 0.00    |
|                        | (-0.05) | (-0.08) | (-0.06) | (-0.03) | (-0.05) | (0.03)  |
| **Dai_volume**         | -0.01   | -0.01   | 0.00    | -0.01   | -0.01   | -0.01   |
|                        | (-0.13) | (-0.14) | (0.02)  | (-0.14) | (-0.12) | (-0.09) |
| **Mkr_price**          | 0.01    | 0.01    | 0.01    | 0.01    | 0.01    | 0.00    |
|                        | (0.24)  | (0.27)  | (0.30)  | (0.23)  | (0.32)  | (-0.03) |
| **Total_MakerDAO**     | -0.35***| -0.35***| -0.36***| -0.35***| -0.38***| -0.33***|
|                        | (-10.16)| (-10.14)| (-9.87) | (-10.25)| (-10.49)| (-8.93) |
| **Surplus_buffer**     | 0.00    | 0.00    | 0.00    | 0.00    | 0.01    | 0.00    |
|                        | (-0.04) | (-0.05) | (-0.05) | (-0.01) | (0.10)  | (-0.07) |
| **N**                  | 174     | 174     | 174     | 174     | 174     | 174     |
| **Adj. R-sq**          | 0.58    | 0.58    | 0.58    | 0.58    | 0.59    | 0.58    |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of new users of Maker protocol. Columns (1) – (6) presents results for ENS owners, Twitter users, DEX traders, liquidity providers, NFT traders, and whales from voting party 0, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

### Table 20. The relationship between DAI volatility and group cohesion of different types of voters from party 0

|                             | (1)     | (2)     | (3)     | (4)     | (5)     | (6)     |
|-----------------------------|---------|---------|---------|---------|---------|---------|
| **Agreement Index**         | -0.03   | -0.07   | -0.16*  | -0.10   | -0.05   | -0.33***|
|                            | (-0.37) | (-0.70) | (-1.66) | (-0.95) | (-0.54) | (-2.88) |
| **Total_asset**             | 0.21    | 0.24    | 0.44*   | 0.35    | 0.39    | 0.59    |
|                            | (0.87)  | (1.08)  | (1.69)  | (1.14)  | (1.40)  | (1.57)  |
| **ETH**                    | -0.24   | -0.27   | -0.40** | -0.34   | -0.43*  | -0.19   |
|                            | (-1.34) | (-1.56) | (-2.00) | (-1.48) | (-1.87) | (-0.79) |
| **Dai_volume**             | 0.17    | 0.21    | 0.19    | 0.18    | 0.19    | 0.10    |
|                            | (0.86)  | (1.13)  | (0.97)  | (0.88)  | (0.99)  | (0.63)  |
| **Mkr_price**              | -0.47***| -0.31** | -0.38** | -0.41** | -0.31** | -0.38** |
|                            | (-3.20) | (-2.05) | (-2.64) | (-2.56) | (-1.99) | (-2.67) |
| **Total_MakerDAO**         | -0.01   | -0.12   | -0.05   | -0.10   | -0.02   | -0.10   |
|                            | (-0.04) | (-0.81) | (-0.48) | (-0.82) | (-0.22) | (-1.04) |
| **Surplus_buffer**         | -0.03   | 0.02    | -0.12   | -0.06   | -0.07   | -0.35   |
|                            | (-0.19) | (0.12)  | (-0.66) | (-0.27) | (-0.35) | (-1.34) |
| **N**                      | 131     | 104     | 154     | 128     | 128     | 80      |
| **Adj. R-sq**              | 0.22    | 0.18    | 0.23    | 0.24    | 0.21    | 0.33    |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of DAI volatility. Columns (1) – (6) presents results for ENS owners, Twitter users, DEX traders, liquidity providers, NFT traders, and whales from voting party 0, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.
Table 21. The relationship between total revenue of Maker protocol and group cohesion of different types of voters from party 0

|                      | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Agreement Index      | -0.05        | -0.07        | 0.02         | 0.01         | 0.01         | 0.13         |
|                      | (0.28)       | (-1.20)      | (0.38)       | (0.12)       | (0.31)       | (1.56)       |
| Total_asset          | 0.07         | 0.10         | 0.01         | -0.04        | -0.05        | -0.33        |
|                      | (0.55)       | (0.74)       | (0.07)       | (-0.26)      | (-0.33)      | (-1.18)      |
| ETH                  | 0.61***      | 0.62***      | 0.60***      | 0.61***      | 0.59***      | 0.82***      |
|                      | (6.48)       | (6.20)       | (5.95)       | (5.31)       | (4.87)       | (4.49)       |
| Dai_volume           | -0.01        | -0.02        | -0.01        | -0.02        | -0.02        | -0.04        |
|                      | (-0.12)      | (-0.19)      | (-0.05)      | (-0.20)      | (-0.17)      | (-0.32)      |
| Mkr_price            | 0.29***      | 0.24***      | 0.41***      | 0.41***      | 0.46***      | 0.32***      |
|                      | (3.73)       | (2.75)       | (5.58)       | (5.20)       | (5.63)       | (3.11)       |
| Total_MakerDAO       | 0.15**       | 0.16**       | 0.12**       | 0.16***      | 0.12**       | 0.17**       |
|                      | (2.24)       | (1.96)       | (2.15)       | (2.49)       | (2.28)       | (2.27)       |
| Surplus_buffer       | -0.24**      | -0.30***     | -0.17*       | -0.16        | -0.14        | -0.05        |
|                      | (-2.46)      | (-2.86)      | (-1.78)      | (-1.54)      | (-1.38)      | (-0.26)      |
| N                    | 131          | 104          | 154          | 128          | 128          | 80           |
| Adj. R-sq            | 0.80         | 0.76         | 0.83         | 0.81         | 0.83         | 0.81         |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of total revenue of Maker protocol. Columns (1) – (6) presents results for ENS owners, Twitter users, DEX traders, liquidity providers, NFT traders, and whales from voting party 0, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table 22. The relationship between new users of Maker protocol and group cohesion of different types of voters from party 0

|                      | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Agreement Index      | -0.01        | 0.00         | 0.02         | 0.01         | 0.04         | 0.00         |
|                      | (-0.31)      | (0.03)       | (0.62)       | (0.65)       | (1.05)       | (-0.05)      |
| Total_asset          | 0.01         | 0.00         | 0.02         | 0.02         | 0.01         | 0.01         |
|                      | (0.10)       | (0.02)       | (0.16)       | (0.33)       | (0.10)       | (0.06)       |
| ETH                  | 0.00         | 0.01         | -0.01        | -0.01        | -0.02        | 0.00         |
|                      | (-0.02)      | (0.08)       | (-0.11)      | (-0.17)      | (-0.18)      | (-0.03)      |
| Dai_volume           | -0.01        | -0.02        | -0.01        | -0.01        | -0.02        | -0.03        |
|                      | (-0.16)      | (-0.28)      | (-0.20)      | (-0.36)      | (-0.20)      | (-0.67)      |
| Mkr_price            | 0.01         | -0.01        | 0.01         | 0.01         | 0.01         | -0.02        |
|                      | (0.16)       | (-0.23)      | (0.19)       | (0.20)       | (0.22)       | (-0.46)      |
| Total_MakerDAO       | -0.38***     | -0.43***     | -0.35***     | -0.31***     | -0.36***     | -0.27***     |
|                      | (-8.81)      | (-7.94)      | (-9.48)      | (-13.26)     | (-8.74)      | (-10.00)     |
| Surplus_buffer       | 0.00         | 0.01         | -0.01        | -0.01        | 0.00         | -0.03        |
|                      | (0.05)       | (0.07)       | (-0.10)      | (-0.33)      | (0.02)       | (-0.38)      |
| N                    | 131          | 104          | 154          | 128          | 128          | 80           |
| Adj. R-sq            | 0.61         | 0.56         | 0.57         | 0.76         | 0.57         | 0.77         |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of new users of Maker protocol. Columns (1) – (6) presents results for ENS owners, Twitter users, DEX traders, liquidity providers, NFT traders, and whales from voting party 0, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table 23. The relationship between DAI flows and different types of voters from party 0

|                      | (1)          | (2)          | (3)          | (4)          | (5)          |
|----------------------|--------------|--------------|--------------|--------------|--------------|
| Voting share         | -0.24***     | 0.00         | 0.05         | 0.02         | -0.08***     |
|                      | (-5.18)      | (0.05)       | (0.78)       | (1.53)       | (-3.42)      |
| Total_asset          | 1.01***      | 1.16***      | 0.50***      | 0.31***      | 1.95***      |
|                      | (7.54)       | (16.98)      | (3.46)       | (7.81)       | (31.80)      |
| ETH                  | -0.44***     | 0.35***      | 0.11         | -0.02        | -0.38***     |
|                      | (-4.30)      | (6.71)       | (0.95)       | (-0.76)      | (-8.07)      |
| Dai_volume           | 0.23**       | 0.07         | -0.19        | 0.04         | -0.014       |
|                      | (2.12)       | (1.26)       | (-1.55)      | (1.35)       | (-0.20)      |
| Mkr_price            | 0.12         | -0.36***     | 0.74***      | -0.02        | -0.20***     |
|                      | (2.13)       | (-0.65)      | (-1.36)      | (2.93)       | (-7.46)      |
| Total_MakerDAO       | 0.13**       | -0.04        | -0.09        | 0.05***      | -0.24***     |
|                      | (2.13)       | (-0.65)      | (-1.36)      | (2.93)       | (-7.46)      |
|                       | Surplus_buffer |       |       |       |       |
|-----------------------|----------------|-------|-------|-------|-------|
|                       | -0.05          | -0.45*** | 0.07  | 0.78*** | -0.74*** |
|                       | (-0.43)        | (8.28)  | (0.59) | (24.87) | (-15.33) |
| N                     | 174            | 161    | 173   | 174   | 170   |
| Adj. R-sq             | 0.75           | 0.96   | 0.87  | 0.99  | 0.97  |

|                       | Voting share   |       |       |       |       |
|-----------------------|----------------|-------|-------|-------|-------|
|                       | -0.25***       | 0.07  | -0.07 | 0.06*** | -0.12*** |
|                       | (-3.02)        | (1.63) | (-0.87) | (2.58) | (-3.41) |
| Total_asset           | 0.98***        | 1.14*** | 0.53*** | 0.31*** | 1.95*** |
|                       | (7.01)         | (16.92) | (3.64) | (7.76) | (31.80) |
| ETH                   | -0.44***       | 0.32*** | 0.16  | -0.04  | -0.36*** |
|                       | (-3.94)        | (5.99)  | (1.37) | (-1.29) | (-7.33) |
| Dai_volume            | 0.24**         | 0.07   | -0.18 | 0.04   | -0.01  |
|                       | (2.03)         | (1.18)  | (-1.49) | (1.28) | (-0.13) |
| Mkr_price             | 0.14           | -0.33*** | 0.67*** | 0.00  | -0.22*** |
|                       | (1.49)         | (-7.16) | (6.88) | (-0.04) | (-5.38) |
| Total_MakerDAO        | 0.15**         | -0.02  | -0.11 | 0.06*** | -0.24*** |
|                       | (2.29)         | (-0.45) | (-1.58) | (3.11) | (-7.46) |
| Surplus_buffer        | -0.15          | -0.47*** | 0.13  | 0.78*** | -0.75*** |
|                       | (-1.38)        | (-9.03) | (1.13) | (25.72) | (-16.04) |
| N                     | 174            | 161    | 173   | 174   | 170   |
| Adj. R-sq             | 0.72           | 0.96   | 0.87  | 0.99  | 0.97  |

|                       | Voting share   |       |       |       |       |
|-----------------------|----------------|-------|-------|-------|-------|
|                       | 0.13***        | -0.01 | -0.06 | 0.03** | -0.06*** |
|                       | (2.58)         | (-0.39) | (-1.09) | (2.32) | (-2.84) |
| Total_asset           | 0.93***        | 1.16*** | 0.52*** | 0.32*** | 1.93*** |
|                       | (6.61)         | (17.10) | (3.59) | (8.03) | (31.35) |
| ETH                   | -0.54***       | 0.35*** | 0.12  | -0.01  | -0.42*** |
|                       | (-5.12)        | (6.85)  | (1.10) | (-0.36) | (-9.01) |
| Dai_volume            | 0.15           | 0.08   | -0.15 | 0.03   | 0.02   |
|                       | (1.22)         | (1.32)  | (-1.23) | (0.82) | (0.41) |
| Mkr_price             | 0.26***        | -0.36*** | 0.73*** | -0.04** | -0.14*** |
|                       | (3.13)         | (-8.94) | (8.56) | (-1.81) | (-3.78) |
| Total_MakerDAO        | 0.23***        | -0.13* | 0.06** | -0.26*** |
|                       | (3.43)         | (-0.70) | (-1.77) | (3.40) | (-7.56) |
| Surplus_buffer        | -0.22**        | -0.45*** | 0.09  | 0.80*** | -0.81*** |
|                       | (-2.10)        | (-8.85) | (0.86) | (27.47) | (-17.61) |
| N                     | 174            | 161    | 173   | 174   | 170   |
| Adj. R-sq             | 0.72           | 0.96   | 0.88  | 0.99  | 0.96  |

|                       | Voting share   |       |       |       |       |
|-----------------------|----------------|-------|-------|-------|-------|
|                       | -0.09          | -0.15** | 0.64*** | -0.18*** | -0.03 |
|                       | (-0.55)        | (-1.97) | (4.16) | (-4.26) | (-0.42) |
| Total_asset           | 0.93***        | 1.15*** | 0.54*** | 0.31*** | 1.92*** |
|                       | (6.51)         | (17.19) | (3.91) | (8.20) | (30.51) |
| ETH                   | -0.56***       | 0.35*** | 0.14  | -0.02  | -0.41*** |
|                       | (-5.14)        | (6.87)  | (1.37) | (-0.65) | (-8.70) |
| Dai_volume            | 0.21*          | 0.06   | -0.14 | 0.03   | -0.02  |
|                       | (1.79)         | (1.08)  | (-1.21) | (1.06) | (-0.32) |
| Mkr_price             | 0.29***        | -0.35*** | 0.65*** | -0.02  | -0.15*** |
|                       | (3.44)         | (-8.64) | (7.95) | (-0.75) | (-3.95) |
| Total_MakerDAO        | 0.17***        | -0.02  | -0.12* | 0.05** | -0.23*** |
|                       | (2.68)         | (-0.53) | (-1.86) | (3.08) | (-6.78) |
| Surplus_buffer        | -0.24**        | -0.45*** | 0.10  | 0.80*** | -0.80*** |
|                       | (-2.23)        | (-8.97) | (0.97) | (28.39) | (-17.07) |
| N                     | 174            | 161    | 173   | 174   | 170   |
| Adj. R-sq             | 0.71           | 0.96   | 0.89  | 0.99  | 0.96  |

|                       | Voting share   |       |       |       |       |
|-----------------------|----------------|-------|-------|-------|-------|
|                       | 0.01           | -0.04 | 0.05  | -0.02  | -0.04 |
|                       | (0.12)         | (-0.58) | (0.66) | (-0.73) | (-1.09) |
| Total_asset           | 0.94***        | 1.16*** | 0.52*** | 0.32*** | 1.93*** |
|                       | (6.53)         | (17.07) | (3.56) | (7.96) | (30.66) |
| ETH                   | -0.55***       | 0.35*** | 0.13  | -0.01  | -0.41*** |
|                       | (-5.12)        | (6.88)  | (1.15) | (-0.45) | (-8.72) |
|                | Dai_volume | Mkr_price | Total_MakerDAO | Surplus_buffer | \(N\) | Adj. R-sq |
|----------------|------------|-----------|----------------|----------------|-------|----------|
|                | 0.22*      | 0.28***   | 0.18***        | -0.24**        | 174   | 0.71     |
|                | (1.84)     | (-9.04)   | (2.47)         | (-2.23)        |       |          |
|                | 0.07       | 0.71***   | -0.04          | -0.45***       | 161   | 0.96     |
|                | (-1.53)    | (8.43)    | (-0.70)        | (-8.86)        |       |          |
|                | -0.18      | 0.03      | -0.08          | 0.10           | 173   | 0.87     |
|                | (-1.50)    | (-1.50)   | (-1.05)        | (0.89)         |       |          |
|                | 0.05       | 0.04**    | 0.71***        | 0.80***        | 174   | 0.99     |
|                | (1.38)     | (2.19)    | (26.99)        | (-26.93)       |       |          |
|                | (-0.27)    | (-6.62)   | (-17.03)       | (-17.06)       |       |          |
|                | 0.07       | 0.03      | -0.02          | 0.02           | 170   | 0.96     |
|                | (1.27)     | (-1.43)   | (-1.53)        | (1.37)         |       |          |
|                | -0.18      | -0.11     | -0.11          | -0.02          | 174   | 0.99     |
|                | (-1.53)    | (-1.43)   | (-1.53)        | (1.37)         |       |          |
|                | 0.05       | 0.80***   | 0.80***        | -0.79***       | 170   | 0.96     |
|                | (1.37)     | (26.93)   | (-26.93)       | (-17.06)       |       |          |
|                | -0.02      | -0.02     | -0.02          | -0.02          | 170   | 0.96     |
|                | (-1.53)    | (-1.43)   | (-1.53)        | (1.37)         |       |          |
|                | 0.80***    | -0.79***  | -0.79***       |                |       |          |
|                | (26.93)    | (-26.93)  | (-26.93)       | (-17.06)       |       |          |
|                | 0.99       | 0.99      | 0.99           | 0.96           |       |          |
|                | 0.96       | 0.96      | 0.96           |                |       |          |
|                |           |           |                |                |       |          |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses. Columns (1) – (5) presents results for DAI flows to CeFi, DEXes, LPs, EOA and Bridge, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The details of different categories of blockchain-based applications are given in Table A.5.

**Figures**

**Figure 1.** Elbow method and silhouette score

![Figure 1](image1.png)

**Figure 2.** Voters of Maker governance polls (Poll #16 – Poll #838)

![Figure 2](image2.png)
Figure 3. Total votes of Maker governance polls (Poll #16 – Poll #838)

Figure 4. Voters from voting party 0

Figure 5. Total votes from different voting parties
Figure 6. Voting share of voting party 0

Figure 7. Agreement Index (AI) of voting party 0

Figure 8. Agreement Index (AI) of voting party 0 for ‘Risk Parameter’
Figure 9. Agreement Index (AI) of voting party 0 for ‘Greenlight’

Figure 10. Agreement Index (AI) of voting party 0 for ‘MIP’
Figure 11. Activities of voters in different voting parties
Appendices

Appendix 1. Labels of Maker governance polls

Table A.1. Labels of Maker governance polls

| Number of polls | Total voters | Total votes |
|-----------------|--------------|-------------|
| Risk Parameter  | 297          | 6125        | 11620405.21 |
| Ratification Poll | 103        | 3180        | 9191601.36  |
| Inclusion Poll  | 71           | 1514        | 2419753.25  |
| Collateral Onboarding | 63       | 1370        | 2864764.94  |
| Collateral Offboarding | 19    | 298         | 1381079.48  |
| Greenlight      | 173          | 5549        | 7894197.78  |
| Real World Asset| 37           | 1051        | 2271616.02  |
| Misc Governance | 29           | 1108        | 1844854.05  |
| Misc Funding    | 14           | 569         | 1480519.35  |
| MakerDAO Open Market Committee | 22 | 476       | 1294594.31  |
| MIP             | 182          | 4800        | 11667401.86 |
| Budget          | 61           | 1636        | 4511723.76  |
| Oracle          | 42           | 761         | 1383196.90  |
| System Surplus  | 10           | 263         | 721589.11   |
| DAI Direct Deposit Module | 10 | 215       | 820019.35   |
| Multi-chain Bridge | 5       | 126         | 385882.47   |
| Technical       | 20           | 429         | 914487.67   |
| Auction         | 23           | 421         | 715394.51   |
| Delegates       | 5            | 53          | 338567.60   |
| Peg Stability Module | 14    | 252         | 643171.78   |
| Core Unit Onboarding | 29    | 899         | 1888838.96  |
| Dai Savings Rate| 28           | 662         | 959804.04   |
| Black Thursday  | 4            | 172         | 265698.72   |
| Multi-Collateral DAI Launch | 5 | 165        | 192941.15   |
| Prioritization Sentiment | 2  | 55          | 54826.02    |

Note: There are several labels related to oracle. For convenience, we merge these labels into one category, namely ‘oracle’.

Appendix 2. Descriptive statistics of daily measurements

Table A.2. Descriptive statistics of voting share of voting parties

| Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|----------------|----------------|----------------|----------------|----------------|
| Mean           | 0.56           | 0.12           | 0.08           | 0.06           | 0.18           |
| Median         | 0.66           | 0.03           | 0.02           | 0.00           | 0.00           |
| Maximum        | 1.00           | 0.89           | 0.36           | 0.69           | 0.99           |
| Minimum        | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Std            | 0.34           | 0.21           | 0.12           | 0.13           | 0.31           |

Table A.3. Descriptive statistics of Agreement Index (AI)

| Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|----------------|----------------|----------------|----------------|----------------|
| Mean           | 0.82           | 0.91           | 0.94           | 0.97           | 0.92           |
| Median         | 0.91           | 0.97           | 1.00           | 1.00           | 1.00           |
| Maximum        | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |
| Minimum        | 0.02           | 0.27           | 0.47           | 0.63           | 0.05           |
| Std            | 0.22           | 0.13           | 0.10           | 0.06           | 0.15           |

Appendix 3. Definitions of variables related to Maker protocol

Table A.4. Definitions of variables

| Definitions                               |
|-------------------------------------------|
| Total_asset                               | The value of total assets locked in Maker protocol for lending |
| Total_revenue                             | Total interest revenue from total assets locked for lending |
| ETH                                       | The value of Ether (ETH) locked in Maker protocol for lending |
| Dai_volatility                            | Volatility of DAI |
| Dai_volume                                | Transaction volume (in USD) of DAI daily |
| Mkr_price                                 | Price (in USD) of Maker (MKR) |
| Surplus_buffer                            | The maximum amount of DAI that can accrue to the protocol from Stability Fee revenue prior to FLAP auctions being triggered |
| Total_MakerDAO                            | The number of the users who borrow from Maker protocol |
| New_MakerDAO                              | Daily new users who borrow from Maker protocol |

Note: More introduction to surplus buffer can be found: [https://makerdao.world/en/learn/governance/param-](https://makerdao.world/en/learn/governance/param-)
Appendix 4. Voting share and Agreement Index (AI) based on different types of governance polls

Table A.5. Descriptive statistics of voting share of voting parties

|                  | Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| **Panel A: Risk Parameter** |                |                |                |                |                |
| Mean             | 0.06           | 0.02           | 0.01           | 0.01           | 0.02           |
| Median           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Maximum          | 1.00           | 0.89           | 0.36           | 0.69           | 0.99           |
| Minimum          | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Std              | 0.21           | 0.08           | 0.04           | 0.04           | 0.13           |

|                  | Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| **Panel B: MIP**  |                |                |                |                |                |
| Mean             | 0.02           | 0.01           | 0.00           | 0.00           | 0.01           |
| Median           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Maximum          | 0.97           | 0.87           | 0.36           | 0.60           | 1.00           |
| Minimum          | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Std              | 0.10           | 0.06           | 0.03           | 0.03           | 0.07           |

|                  | Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| **Panel C: Greenlight** |                |                |                |                |                |
| Mean             | 0.02           | 0.01           | 0.00           | 0.00           | 0.01           |
| Median           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Maximum          | 0.97           | 0.87           | 0.36           | 0.60           | 1.00           |
| Minimum          | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| Std              | 0.10           | 0.06           | 0.03           | 0.03           | 0.07           |

Table A.6. Descriptive statistics of Agreement Index (AI) of voting parties

|                  | Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| **Panel A: Risk Parameter** |                |                |                |                |                |
| Mean             | 0.85           | 0.90           | 0.98           | 0.97           | 0.92           |
| Median           | 0.93           | 0.98           | 1.00           | 1.00           | 1.00           |
| Maximum          | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |
| Minimum          | 0.00           | 0.27           | 0.75           | 0.59           | 0.02           |
| Std              | 0.20           | 0.16           | 0.06           | 0.08           | 0.20           |

|                  | Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| **Panel B: MIP**  |                |                |                |                |                |
| Mean             | 0.88           | 0.96           | 0.96           | 0.97           | 0.91           |
| Median           | 0.99           | 1.00           | 1.00           | 1.00           | 1.00           |
| Maximum          | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |
| Minimum          | 0.46           | 0.76           | 0.77           | 0.82           | 0.33           |
| Std              | 0.16           | 0.07           | 0.06           | 0.05           | 0.18           |

|                  | Voting party 0 | Voting party 1 | Voting party 2 | Voting party 3 | Voting party 4 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| **Panel C: Greenlight** |                |                |                |                |                |
| Mean             | 0.74           | 0.87           | 0.90           | 0.93           | 0.93           |
| Median           | 0.83           | 0.94           | 1.00           | 0.98           | 0.98           |
| Maximum          | 1.00           | 1.00           | 1.00           | 1.00           | 1.00           |
| Minimum          | 0.06           | 0.51           | 0.47           | 0.63           | 0.69           |
| Std              | 0.28           | 0.16           | 0.16           | 0.10           | 0.10           |

Table A.7. The relationship between DAI volatility and voting share in different types of polls

|                  | (1)          | (2)          | (3)          | (4)          | (5)          |
|------------------|--------------|--------------|--------------|--------------|--------------|
| Voting share     | 0.02         | -0.06        | -0.01        | -0.09        | 0.06         |
| Total_asset      | **0.40***    | **0.40***    | **0.40***    | **0.40***    | **0.40***    |
| ETH              | -0.28***     | -0.28***     | -0.27***     | -0.28***     | -0.27***     |
| Total_MakerDAO   | -0.06        | -0.06        | **-0.06***   | **-0.06***   | **-0.07***   |
| Mkr_price        | -0.41***     | -0.41***     | -0.41***     | -0.41***     | **-0.41***   |
| Dai_volume       | **0.47***    | **0.47***    | **0.47***    | **0.47***    | **0.47***    |
| ETH              | -0.28***     | -0.28***     | -0.27***     | -0.28***     | -0.27***     |
| Total_MakerDAO   | -0.06        | -0.06        | **-0.06***   | **-0.06***   | **-0.07***   |
| Mkr_price        | -0.41***     | -0.41***     | -0.41***     | -0.41***     | **-0.41***   |
The relationship between total revenue of Maker protocol and voting share in different types of polls

| Variable      | Panel A | Panel B | Panel C |
|---------------|---------|---------|---------|
| Surplus_buffer | -0.18*** | 0.40*** | -0.18*** |
| (2.52)        | (4.28)  | (-3.78) | (-2.53) |
| N             | 973     | 0.22    | 973     |
| Adj. R-sq     | 0.22    | 0.22    | 0.22    |

**Panel A: Risk Parameter**

| Voting share | 0.02 | -0.03 | -0.02 | -0.05 | -0.05 |
|--------------|------|-------|-------|-------|-------|
| (0.38)       | (-0.37) | (-0.28) | (-0.44) | (-0.60) | |

**Panel B: MIP**

| Voting share | Total_MakerDAO | Dai_volume | Mkr_price | Total_MakerDAO | Surplus_buffer |
|--------------|---------------|------------|-----------|---------------|----------------|
| 0.02         | -0.31***      | 0.73***    | 0.46***   | 0.47***       | -0.18***       |
| (2.52)       | (4.28)        | (4.30)     | (4.11)    | (4.10)        | (-2.53)        |
| N            | 973           | 973        | 973       | 973           | 973            |
| Adj. R-sq    | 0.22          | 0.22       | 0.22      | 0.22          | 0.22           |

**Panel C: Greenlight**

| Voting share | Total_MakerDAO | Dai_volume | Mkr_price | Total_MakerDAO | Surplus_buffer |
|--------------|---------------|------------|-----------|---------------|----------------|
| -0.08        | -0.11         | -0.12**    | -0.10     | -0.10         | -0.06*         |
| (-1.48)      | (-0.95)       | (-1.90)    | (-1.06)   | (-1.06)       | (-1.62)        |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of DAI volatility. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Table A.8. The relationship between total revenue of Maker protocol and voting share in different types of polls
### Table A.9. The relationship between new users of Maker protocol and voting share in different types of polls

#### Panel A: Risk Parameter

|          | (1)   | (2)   | (3)   | (4)   | (5)   |
|----------|-------|-------|-------|-------|-------|
| Voting share | 0.01  | 0.01  | 0.00  | 0.01  | -0.01 |
|           | (0.99) | (0.28) | (0.02) | (0.22) | (-0.92) |
| Total_asset | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
|           | (0.39) | (0.41) | (0.40) | (0.41) | (0.40) |
| ETH      | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 |
|          | (-0.29) | (-0.26) | (-0.27) | (-0.27) | (-0.26) |
| Dai_volume | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  |
|           | (0.44) | (0.49) | (0.50) | (0.50) | (0.49) |
| Mkr_price | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
|          | (0.14) | (0.10) | (0.12) | (0.10) | (0.05) |
| Total_MakerDAO | -0.32 | -0.32 | -0.32 | -0.32 | -0.32 |
|          | (-25.63) | (-25.95) | (-25.98) | (-25.98) | (-25.73) |
| Surplus_buffer | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 |
|           | (-0.42) | (-0.42) | (-0.43) | (-0.43) | (-0.47) |
| N       | 980   | 980   | 980   | 980   | 980   |
| Adj. R-sq | 0.62  | 0.62  | 0.62  | 0.62  | 0.62  |

#### Panel B: MIP

|          | (1)   | (2)   | (3)   | (4)   | (5)   |
|----------|-------|-------|-------|-------|-------|
| Voting share | -0.01 | 0.01  | 0.00  | 0.00  | 0.00  |
|           | (-0.46) | (0.45) | (0.03) | (0.09) | (0.02) |
| Total_asset | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of total revenue of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.
|                        | ETH     | Dai_volume | Mkr_price | Total_MakerDAO | Adj. R-sq |
|------------------------|---------|------------|-----------|----------------|-----------|
|                        | (0.42)  | (0.42)     | (0.40)    | (0.41)         | (0.40)    |
|                        | (-0.28) | (-0.27)    | (-0.27)   | (-0.27)        | (-0.27)   |
|                        | (0.49)  | (0.49)     | (0.50)    | (0.50)         | (0.50)    |
|                        | (0.12)  | (0.11)     | (0.12)    | (0.11)         | (0.12)    |
| Total_MakerDAO         | -0.32***| -0.32***   | -0.32***  | -0.32***       | -0.32***  |
|                        | (-25.95)| (-25.98)   | (-25.98)  | (-25.98)       | (-25.89)  |
| Surplus_buffer         | -0.01   | -0.01      | 0.02      | -0.02          | 0.02      |
|                        | (-0.42) | (-0.43)    | (-0.43)   | (-0.43)        | (-0.43)   |
|                        | (980)   | 980        | 980       | 980            | 980       |
| Adj. R-sq              | 0.62    | 0.62       | 0.62      | 0.62           | 0.62      |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of new users of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

**Table A.10. The relationship between DAI volatility and group cohesion in different types of polls**

**Panel A: Risk Parameter**

|                        | (1)    | (2)    | (3)    | (4)    | (5)    |
|------------------------|--------|--------|--------|--------|--------|
| AgreementIndex         | -0.08***| -0.07* | -0.31***| 0.00   | 0.08*  |
|                        | (-2.49)| (-1.95)| (-2.58)| (-0.07)| (1.75) |
| Total_asset            | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
|                        | (0.06) | (-0.54)| (0.23) | (0.57) | (0.63) |
| ETH                    | 0.00   | 0.00   | 0.00   | 0.00   | 0.00*  |
|                        | (0.04) | (0.92) | (-0.24)| (-0.51)| (1.72) |
| Dai_volume             | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
|                        | (0.73) | (0.33) | (0.99) | (0.73) | (-1.32)|
| Mkr_price              | 0.00   | **0.00***| **0.00**| **0.00**| 0.00   |
|                        | (-3.33)| (-2.34)| (-2.40)| (-2.06)| (-0.94)|
| Total_MakerDAO         | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
|                        | (0.67) | (-0.12)| (-0.08)| (-0.40)| (-0.24)|
| Surplus_buffer         | 0.00   | 0.00   | 0.00   | 0.00   | **0.00***|
|                        | (0.36) | (0.38) | (0.34) | (-0.25)| (-1.91)|
| N                      | 104    | 86     | 52     | 64     | 51     |
| Adj. R-sq              | 0.22   | 0.24   | 0.29   | 0.23   | 0.20   |

**Panel B: MIP**

|                        | (1)    | (2)    | (3)    | (4)    | (5)    |
|------------------------|--------|--------|--------|--------|--------|
| AgreementIndex         | -0.09  | -0.04  | 0.01   | 0.01   | 0.07   |
|                        | (-0.84)| (-0.46)| (0.04) | (0.06) | (0.47) |
| Total_asset            | **1.25***| 1.56 | **1.17***| **1.56***| -1.28 |
|                        | (3.25) | (0.76) | (2.72) | (4.05) | (-0.31)|
| ETH                    | **-0.81***| -0.17 | **-0.76***| -0.39 | 5.76 |
|                        | (-2.33)| (-0.21)| (-1.97)| (-0.97)| (1.72)|
| Dai_volume             | **2.20***| 0.78 | 2.03   | 0.87   | -0.10 |
|                        | (1.93) | (0.62) | (1.46) | (1.02) | (-0.02)|
| Mkr_price              | -0.21  | -0.44  | -0.27  | -0.35  | -2.14 |
Table A.11. The relationship between total revenue of Maker protocol and group cohesion in different types of polls

| Parameter | Panel A: Risk Parameter | Panel B: MIP |
|-----------|-------------------------|-------------|
| Agreement Index | (-0.07) | (-0.07) |
| Total_asset | (0.12) | (0.12) |
| ETH | (4.11) | (4.11) |
| Dai_volume | (2.09) | (2.09) |
| Mkr_price | -0.07 | -0.07 |
| Total_MakerDAO | 0.12 | 0.12 |
| Surplus_buffer | -0.72** | -0.72** |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of DAI volatility. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.
| N  | 35  | 26  | 25  | 21  | 16  |
|----|-----|-----|-----|-----|-----|
| Adj. R-sq | 0.83 | 0.92 | 0.82 | 0.72 | 0.99 |

### Table C: Greenlight

| Agreement Index | (1) | (2) | (3) | (4) | (5) |
|-----------------|-----|-----|-----|-----|-----|
|                 | -0.01 | -0.09 | **0.17** | -**0.19** | 0.00 |
|                  | (-0.12) | (-1.33) | (2.17) | (-2.45) | (0.01) |
| Total_asset      | 0.20 | -3.90*** | 0.07 | -3.36*** | **3.01** |
|                  | (0.73) | (-2.14) | (0.58) | (-4.01) | (2.81) |
| ETH             | **0.52** | 2.49*** | **0.54** | 2.13*** | -0.83 |
|                  | (2.55) | (3.30) | (2.59) | (5.46) | (-1.44) |
| Dai_volume      | **1.28** | -1.20 | **1.26** | 0.46 | -1.94 |
|                  | (1.74) | (-0.86) | (1.74) | (0.42) | (-0.98) |
| Mkr_price       | **0.28** | 0.22 | **0.30** | 0.15 | 0.05 |
|                  | (1.99) | (0.86) | (2.05) | (1.42) | (0.16) |
| Total_MakerDAO  | 0.32 | 0.78 | 1.60 | -0.52 | -0.33 |
|                  | (0.95) | (1.66) | (0.47) | (-0.63) | (-1.25) |
| Surplus_buffer  | **-0.38** | 1.98 | -0.37 | **1.92** | 0.73 |
|                  | (-1.86) | (1.59) | (-0.83) | (3.69) | (0.96) |
| N               | 37  | 25  | 30  | 23  | 14  |
| Adj. R-sq       | 0.75 | 0.84 | 0.69 | 0.87 | 0.98 |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of total revenue of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

### Table A.12. The relationship between new users of Maker protocol and group cohesion in different types of polls

#### Panel A: Risk Parameter

| Agreement Index | (1) | (2) | (3) | (4) | (5) |
|-----------------|-----|-----|-----|-----|-----|
| N               | 104 | 86  | 52  | 64  | 51  |
| Adj. R-sq       | 0.52 | 0.46 | 0.89 | 0.48 | 0.56 |

#### Panel B: MIP

| Agreement Index | (1) | (2) | (3) | (4) | (5) |
|-----------------|-----|-----|-----|-----|-----|
| N               | 35  | 26  | 25  | 21  | 16  |
| Adj. R-sq       | 0.76 | 0.48 | 0.95 | 0.62 | 0.08 |

#### Panel C: Greenlight

| Agreement Index | (1) | (2) | (3) | (4) | (5) |
|-----------------|-----|-----|-----|-----|-----|
| N               | 37  | 25  | 30  | 23  | 14  |
| Adj. R-sq       | 0.75 | 0.84 | 0.69 | 0.87 | 0.98 |
| Variable          | Coefficient | Std. Error | T-statistic | p-value |
|-------------------|-------------|------------|-------------|---------|
| Total_asset       | -0.01       | 0.48       | 0.04        | 0.22    |
| ETH               | 0.00        | 0.18       | 0.00        | 0.08    |
| Dai_volume        | 0.11        | 0.36       | 0.00        | 0.32    |
| Mkr_price         | -0.03       | 0.09       | -0.01       | -0.33   |
| Total_MakerDAO    | -0.21**     | 0.10       | -1.31****   | -0.36***|
| Surplus_buffer    | -0.03       | 0.29       | 0.09**      | 1.21    |
| N                 | 37          | 25         | 30          | 23      |
| Adj. R-sq         | 0.57        | 0.42       | 0.69        | 0.75    |

Note: This table reports the regression coefficients and standard t-statistics in the parentheses for the case of new users of Maker protocol. Columns (1) – (5) presents results for voting parties 0 – 4, respectively. *, **, and *** denote significance levels at the 10%, 5%, and 1% levels based on the standard t-statistics. The definitions of the variables are given in Table A.4.

Appendix 5. Different types of voters in voting party 0

Table A.13. Descriptive statistics of different types of voters in party 0

| Panel A: total votes from different types of voters in party 0 |
|------------------|------------------|------------------|------------------|------------------|
|                  | ENS              | Twitter user     | DEX trader       | Liquidity provider | NFT trader |
| Mean             | 16521.71         | 9773.58          | 5667.47          | 663.50            | 986.57     |
| Median           | 13.29            | 0.58             | 1521.44          | 81.94             | 50.04      |
| Maximum          | 133502.20        | 70592.90         | 40639.55         | 9052.15           | 40442.53   |
| Minimum          | 0                | 0                | 0                | 0                 | 0          |
| Std              | 28271.24         | 16668.50         | 1173.70          | 335.23            | 6769.23    |

| Panel B: voting share of different types of voters in party 0 |
|------------------|------------------|------------------|------------------|------------------|
|                  | ENS              | Twitter user     | DEX trader       | Liquidity provider | NFT trader |
| Mean             | 0.20             | 0.12             | 0.16             | 0.02              | 0.04       |
| Median           | 0.00             | 0.00             | 0.03             | 0.00              | 0.00       |
| Maximum          | 0.97             | 0.95             | 0.99             | 0.59              | 0.98       |
| Minimum          | 0                | 0                | 0                | 0                 | 0          |
| Std              | 0.32             | 0.20             | 0.25             | 0.05              | 0.12       |

| Panel C: Agreement Index (AI) of different types of voters in party 0 |
|------------------|------------------|------------------|------------------|------------------|
|                  | ENS              | Twitter user     | DEX trader       | Liquidity provider | NFT trader |
| Mean             | 0.82             | 0.87             | 0.91             | 0.90              | 0.91       |
| Median           | 1.00             | 1.00             | 1.00             | 1.00              | 1.00       |
| Maximum          | 1.00             | 1.00             | 1.00             | 1.00              | 1.00       |
| Minimum          | 0.00             | 0.03             | 0.05             | 0.00              | 0.05       |
| Std              | 0.27             | 0.23             | 0.19             | 0.20              | 0.20       |