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Quadratic Voting – An improvement for democracy?

EXPERIMENTAL STUDY

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Blockchain Economics and Radical Markets

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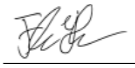
Study program: M. Sc. Economics

Declaration of Independence:

I hereby affirm that I have written the present paper and coded the experiment independently and without unauthorized help from others and that all passages of this paper, taken literally or in spirit from publications, are individually identified by citing the source.

Heidelberg, 22.07.2021



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Content

1. Introduction

A recent study by the university of Cambridge has shown that the percentage of people worldwide dissatisfied with democracy has risen continuously since the mid-90s and has reached 57,5% in 2020. This dissatisfaction is seen as a rational reaction to the failures of policies: In the west, democratic institutions are increasingly perceived as unbalanced, short-sighted and ineffective, whilst new democracies in developing and emerging countries are often struggling with corruption and instability. Ultimately, despite participating in the voting process, a large number of citizens does not feel that their views or needs are being reflected in the governance of their country.

Though political systems differ from country to country, almost all of them have one thing in common: They rely on the Majority Rule. In direct democracies, a majority of voters has to support a decision for it to be implemented, whilst elected parliaments vote on legislature and government in representative democracies. Each voter has one vote, which is seen as a guarantee for just and fair representation. But this feature of the so-called "Majority Voting" (MV) also bears its shortcomings : Individuals making the choice to vote for/against something (e.g. a new president/leaving the EU) can only express their preference direction, *not* their preference strength. This leads to the question if there might be a better way to turn opinions, needs and preferences into policy.

In "Quadratic Voting" (QV), a new mechanism - allowing voters to express their preference strength - is gaining popularity amongst academics, politicians, and voters. Here, individuals are able to spend multiple votes on an election.

This study investigates the differences between MV and QV by conducting an experiment regarding political decision making and empirically evaluating the collected data. It will address concerns about QV as well as the main purpose of installing a new voting mechanism: *Will QV generate an outcome that increases satisfaction amongst voters compared to Majority Voting?*

2. Quadratic Voting

How does QV work? The principle, explained by Posner and Weyl (2018) in their book "Radical Markets" is very simple: Individuals have a certain endowment of credits, with which they can buy a number of votes to spend on an election. The cost in credits of the votes cast on a specific election is the square of the number of votes the individual casts:

$$Cost = Votes^2$$

The votes are then being summed up against each other to determine the outcome. The quadratic costs ensure that the costs per vote increase with the number of votes, thereby punishing individuals for focusing too much on one issue/one election. Take for example a period with three elections concerning immigration, taxes and transgender rights, where each individual can spend a total of 9 credits. Someone only interested in Transgender rights could spend all their 9 credits on that issue, thereby casting 3 votes. At the same time, someone who cares about all three issues approximately equally could choose to spend 4 credits (2 votes) on immigration, 4 credits (2 votes) on taxes and 1 credit(1 vote) on transgender rights, thereby casting a total of 5 votes instead of just 3.

At the same time, it is now possible that a minority of voters is winning a certain election against a majority because they decide to spend more credits and thereby cast more votes. This feature can prevent the "Tyranny of the Majority"(Nyirkos, 2011), in which a minorities needs are suppressed within an election, despite their individual utilities being affected stronger by the respective outcome than the ones of the majority. If we extend the example above to a world with only 3 voters, we can conclude that even if 2 persons would object an improvement for transgender rights, if they would both not care enough to spend more than one credit on that issue, a person being stronger effected by the issue (possibly someone who is transgender) could overspend them by using all of his/her credits to vote for the improvement.

Weyl and Lalley(2015) argue that in a market for collective decision making, a QV mechanism can approximately achieve similar efficient results as a linear pricing mechanism does in a market for private goods. Individuals maximize their utility by setting the marginal cost of spending more credits on an issue - not having those credits available for other issues - equal to their marginal benefits - their individual valuation of raising the possibility of a positive outcome. Since the quadratic costs ensure that the marginal costs of the next vote grow proportionally to the number of votes cast, individuals will allocate their credits in proportion to how important certain issues are to them compared to others. Therefore, as Posner and Weyl (2018) conclude, QV theoretically approximately achieves pareto efficiency just like an auction can achieve pareto efficiency on the free market.

As in a free market for private goods, the concept of rational and selfish individuals is a significant precondition for this theory to hold. Individuals that are influenced by social pressure and misinformation or confused by the variation in costs per vote might not allocate their resources in order to maximize their own expected utility. Also, Posner and Weyl (2014) establish that "…*QV's efficiency relies on all voters perceiving the chance of their changing the outcome with an additional vote as the same. When the number of voters is large, such a perception is (approximately) accurate. If it is small, it is less so*".

These realizations ultimately create a need for use-cases and experiments with a large number of participants to investigate the benefits of QV beyond the theory. Here, the blockchain technology becomes a useful tool for implementation, as it brings advantages regarding transparency, anonymity and prevention of large-scale fraud or manipulation. The pan-European party *Volt* used blockchain to let its members vote under QV on different topics in their party manifesto. Other examples for QV are the Taiwanese e-democracy platform join, or the Democratic Caucus of the Colorado State House of Representatives vote on bill funding in 2018. These applications showed how QV can be used to successfully prioritize issues. They have yet shown though whether QV can actually lead to more desirable welfare-results in comparison to MV when applied to various essential policy-decisions in a large-scale democratic process. This experiment therefore uses a new approach, letting a large set of voters participate in QV and MV elections and then presenting them the aggregated result to find out which one they might prefer.

3. Experiment

3.1 Goal

As explained above, the experiment aims at investigating collective decision making under QV in a political context. The goal is to generate further insights into voting behavior and investigate whether the use of QV produces more satisfying results than the current alternative MV. In essence, the goal

of quadratic voting is to achieve the greatest possible good for the greatest number of people. This is of course difficult to measure, but what can be done is to directly compare results of a QV-Election with the results of a MV-Election whilst holding both the topics and the participants constant. The theory would suggest that participants would overall be happier with the former than with the latter. The experiment does this in a "clear" environment, which means the design deliberately allows no role for credit mismanagement, collusion, or fraud.

3.2 Setup and Execution

The experiment was programmed mainly in the Python programming language. As the experiment consists of web pages with interactive functions, HTML and Java-Script are being used for the individual pages. The framework used on the basis of Python is oTree (Chen et al., 2015), which is a common open-source and online software for online experiments. The experiment was deployed on the Heroku server. The Code is uploaded on GitHub. A demo version can be played under this link.

The total experiment consists of 2 time-separate asynchronous surveys. In the first survey, participants are briefly introduced to the two different voting mechanisms "Majority Voting" and "Quadratic Voting". They are being presented 18 policy proposals from different areas.

Table 1

Q1	Increase the minimum wage from 9,50 Euros to 12 Euros
Q2	Abolish the dual system (private and public insurance) and replace it with one general insurance system
Q3	Introduce a wealth tax of 2% with a tax allowance of 1Million Euros (2% tax only applies to every Euro of property above 1Million)
Q4	There should be a general rent cover (adjusted to city and district)
Q5	2% goal for defence spending should be fulfilled within the next election period
Q6	Arms exports from Germany should be completely forbidden
Q7	Re-establish the compulsory military service (first year after graduation with option for civil service instead)
Q8	Establish a mandatory women's quota (40%) in management of big companies
Q9	Lower legal voting age to 16 years
Q10	The full-face veil (German: Vollverschleierung, e.g. Burka) should be forbidden in the public space
Q11	There should be a general speed-limit on the German Autobahn
Q12	An annual upper limit is to apply to the admission of new asylum seekers
Q13	Make vaccination against infectious diseases mandatory for children
Q14	The controlled sale of Cannabis should be legal for people above the age of 21
Q15	Inner-country flights should generally be forbidden
Q16	Increase petrol prices in Germany by 16ct (like proposed by green candidate)
Q17	To reduce dependency on coal: move partially back to nuclear energy production
Q18	In order to protect the rights of transsexual young people, at least one unisex toilet should be built at every secondary school.

For each proposal, the participants can declare whether they support it, reject it or are neutral on the issue. Thereby they cast their votes on 18 different elections under Majority Voting. After that, they have the chance to vote on those of the issues which they just supported or rejected under Quadratic Voting. An endowment of 100 credits is given to each participant. The participant can allocate these credits by choosing how many votes to cast on each issue. The User Interface is designed to transparently display the costs per issue as well as the credits which the user has left to spend. Also,

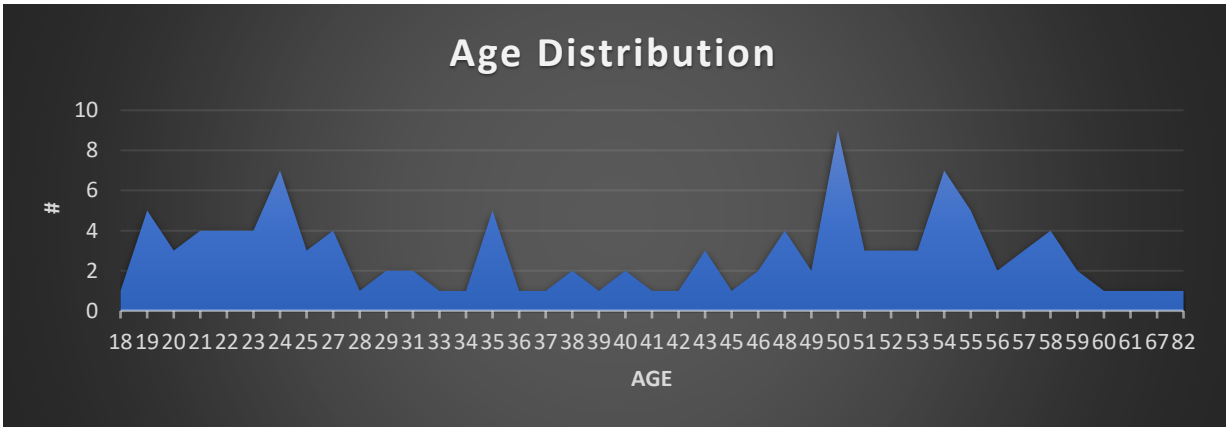
all QV questions are on one webpage to make the allocation as easy as possible and give the participant an overview as well as the chance to change their allocation choices as long as they are on the page. To ensure a good understanding of the voting process, a short video is provided where the steps to vote are being demonstrated. At the end of the first survey, some personal information is being gathered about the participants.

The second survey is being presented to a subset of participants of the first one, a few weeks after closing the first one. Participants are asked to evaluate and compare the results of the first part of the experiment: Two different outcomes, of which one came to effect under the aggregated votes cast under MV and the other came to effect under the aggregated votes cast under QV. Their answer will be used to determine whether one mechanism leads to higher welfare and satisfaction than the other.

3.3 Participants

Overall, 114 of 122 participants completed the survey. Only 16% of the participants had some form of experience or prior knowledge of quadratic voting beforehand. The sample consists primarily of Germans (93%). The Average Age of participants was 40 years. The youngest was 18, whilst the oldest was 82. As can be seen below, a large number of participants was either between 18 and 28, or between 49 and 59. This can be partly explained by the fact that many participants were recruited either over student networks or over the intrafirm discussion forum of a German software company. This age structure might not be fully representative of the whole population, yet it still manages to include members from different generations and therefore achieves an average age not too far away from the actual average age of the German population (44).

Figure 1



Three quarters of participants were men, which again might hurt the representative power of the study. However, a detailed view shows the voting behavior only strongly differs between men and women concerning the one issue that affects them completely differently: The women's quota.

MV Vote on women's quota (Q8) :

Table 2

Gender	Yes	neutral	no
Female	43%	21%	36%
Male	15%	26%	58%
prefer not to say	50%	0%	50%
Total	23%	25%	53%

This supports one of the main assumptions behind Quadratic Voting, which is that people vote according to their own preferences, which are influenced by their individual characteristics. Most women would presumably profit more from a women's quota than men.

3.4 Results Overview

Table 3 shows the total results if the 18 policy-decisions were made under Majority Voting or Quadratic Voting.

Table 3

		MV Outcome	QV Outcome
Q1	Increase the minimum wage from 9,50 Euros to 12 Euros	Yes	Yes
Q2	Abolish the dual system (private and public insurance) and replace it with one general insurance system	Yes	Yes
Q3	Introduce a wealth tax of 2% with a tax allowance of 1 Million Euros (2% tax only applies to every Euro of property above 1 Million)	Yes	Yes
Q4	There should be a general rent cover (adjusted to city and district)	Yes	Yes
Q5	2% goal for defence spending should be fulfilled within the next election period	Yes	Yes
Q6	Arms exports from Germany should be completely forbidden	No	Yes
Q7	Re-establish the compulsory military service (first year after graduation with option for civil service instead)	No	No
Q8	Establish a mandatory women's quota (40%) in management of big companies	No	No
Q9	Lower legal voting age to 16 years	Yes	Yes
Q10	The full-face veil (German: Vollverschleierung, e.g. Burka) should be forbidden in the public space	No	No
Q11	There should be a general speed-limit on the German Autobahn	Yes	Yes
Q12	An annual upper limit is to apply to the admission of new asylum seekers	No	No
Q13	Make vaccination against infectious diseases mandatory for children	Yes	Yes
Q14	The controlled sale of Cannabis should be legal for people above the age of 21	Yes	Yes
Q15	Inner-country flights should generally be forbidden	No	Yes
Q16	Increase petrol prices in Germany by 16ct (like proposed by green candidate)	Yes	Yes
Q17	To reduce dependency on coal: move partially back to nuclear energy production	No	No
Q18	In order to protect the rights of transsexual young people, at least one unisex toilet should be built at every secondary school.	No	Yes

As we can see, Quadratic Voting leads to a different outcome than Majority Voting in three of the 18 cases. Specifically, regarding the issues of inner-country flights, unisex toilets, and arms exports. In all three cases, the rejection occurred under MV and the acceptance occurred under QV. This suggests that voters put a stronger emphasis on the issues they support than on those they reject. On average, a voter spent 97,35 credits, therefore almost fully using his/her endowment of 100 credits.

3.5 Voting behavior

The explanation on the user interface seems to have achieved a smooth voting process. Only few participants (9%) had overspend/forgot to cast their votes at the first try and had to correct this. This might also explain why, when asked which voting experience they preferred at the end of the first survey, 52% chose the more time-consuming QV with only 31% preferring simple Majority Voting. This supports the effectiveness of the experiment because it strongly suggests that confusion or a general dislike of a more complex voting process did not influence the results. Looking at the results in detail, we can see that the number of credits spend on the different issues varies strongly.

Table 4

				MV Votes		QV Votes	
ID	**Area**	**Policy-proposal**	**Average credits spend**	**Yes**	**No**	**Yes**	**No**
Q1	Econ	Increase the minimum wage from 9,50 Euros to 12 Euros	6,9	75	15	201	19
Q2	Econ	Abolish the dual system (private and public insurance) and replace it with one general insurance system	11,2	74	24	259	36
Q3	Econ	Introduce a wealth tax of 2% with a tax allowance of 1Million Euros (2% tax only applies to every Euro of property above 1Million)	6,7	51	40	130	80
Q4	Econ	There should be a general rent cover (adjusted to city and district)	5,2	51	42	122	58
Q5	foreign	2% goal for defense spending should be fulfilled within the next election period	2	38	30	55	37
Q6	foreign	Arms exports from Germany should be completely forbidden	2,3	29	45	53	51
Q7	Social	Reestablish the compulsory military service (first year after graduation with option for civil service instead)	3,9	23	74	42	114
Q8	Social	Establish a mandatory women's quota (40%) in management of big companies	5,6	26	60	54	118
Q9	Social	Lower legal voting age to 16 years	4,8	53	49	102	79
Q10	Social	The full-face veil (German: Vollverschleierung, e.g. Burka) should be forbidden in the public space	3,7	34	59	62	73
Q11	Social	There should be a general speed-limit on the German Autobahn	12,3	71	31	232	96
Q12	Social	An annual upper limit is to apply to the admission of new asylum seekers	5,2	31	60	67	113
Q13	Social	Make vaccination against infectious diseases mandatory for children	3,8	53	35	105	43
Q14	Social	The controlled sale of Cannabis should be legal for people above the age of 21	4,3	61	32	113	49
Q15	environment	Inner-country flights should generally be forbidden	4	37	50	97	53
Q16	environment	Increase petrol prices in Germany by 16ct (like proposed by green candidate)	6	51	38	142	57
Q17	environment	To reduce dependency on coal: move partially back to nuclear energy production	7	37	60	94	140
Q18	social	In order to protect the rights of transsexual young people, at least one unisex toilet should be built at every secondary school.	2,2	36	42	62	38

A closer examination of the data shows: Individuals tend to spend their credits on topics which affect their life on a day-to-day basis. The 2 policy proposals on which the most credits were being spend were Q2 and Q11, which concern a change in the insurance system and a speed-limit on the Autobahn. The former might have a significant organizational and financial effect on all insured persons (which, in Germany, is everyone), especially on those privately insured. The latter affects all people who drive

on the Autobahn regularly, which again can be expected to be the case for a large number of participants. On the other side of the spectrum, we can see that Q5, Q6 and Q18 were the least important to the voters. Arms exports, as well as military spending are not directly influencing the daily lives of the average person. Unisex toilets at schools only affect schoolchildren (of which there are few to none in the sample) as well as non-binary individuals (none of the participants chose the "gender" option "divers").

The three topics which differ in outcome by voting system have received an amount of credits that was below average. This made them more vulnerable to being overturned by a minority. Knowing this raises the question if there are patterns in the prioritization of different topics. Below we can see that policy proposals concerning economic issues were the most important to participants. At the same time, foreign policy was not deemed as important to vote on. Again, the assumption that individuals spend their credits on the issues they deem the most important for their personal utility seems to be a good explanation.

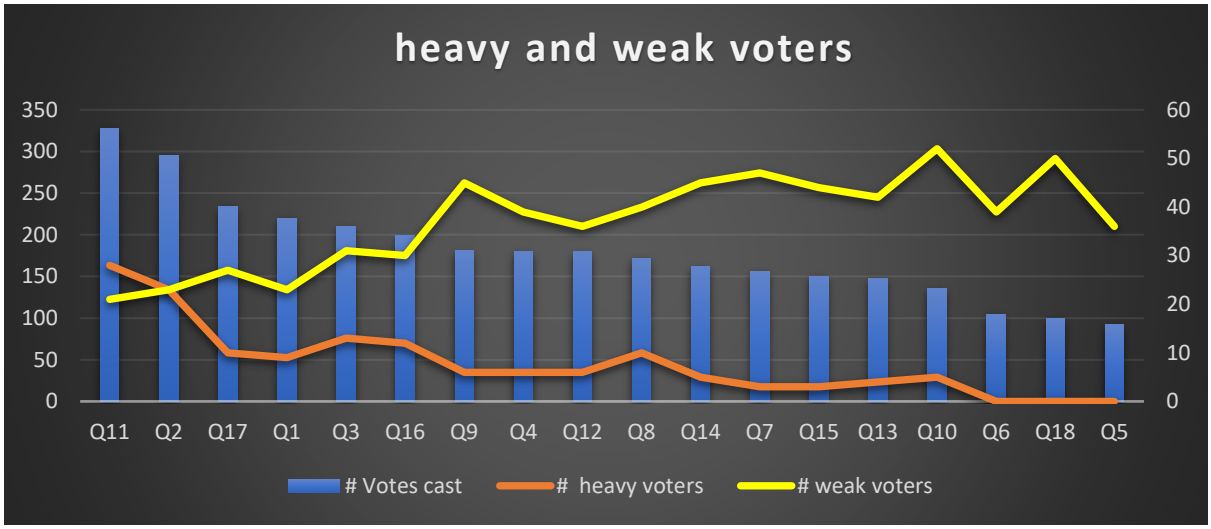
Table 5

	AVERAGE Credits spend PER ISSUE
Econ	7,5
Environment	5,7
Foreign	2,2
Social	5,1

This insight might be supporting the assumption of selfish voters, but it also gives a hint at a potential risk of QV. Whilst foreign policy might not be perceived as relevant for the individual utility as a higher tax might be, it still is important. Here, we can encounter policy proposals, that, whilst not strongly affecting the people who *do* vote, might be important to groups of people who *do not* vote – citizens of foreign countries. Take for example the 2015 German Bundestag vote on the recognition of the Armenian genocide, committed in 1915 by the Ottoman Empire. Let's assume a vast majority of Germans support this recognition. Yet, within a QV-referendum on the issue, it might be possible that a minority of supporters of Turkish president Erdogan might overrule them. While this – from a standpoint of utility maximization – must not necessarily be a problem, it does raise the question: Should certain policy areas of strategic importance, such as foreign policy, be protected against the power of a minority? Ultimately, a differentiation concerning policy-areas has to be investigated further in studies which are specifically set up for such a purpose.

To further investigate the role of credit management, we are now defining a voter as "heavy voter" (HV) on an issue if he chooses to cast more than 4 votes on that issue under QV. A "weak voter"(WV) on the other hand is someone who did also vote "yes" or "no" under MV, but then chose to cast only 0 or 1 vote under QV on this issue. Figure 2 shows how many QV-votes were cast on each issue in total as well as the number of heavy and weak voters for that issue. The number of HVs seems to follow the trend of the total vote count. This shows that individual intense priorities did generally align with cumulative priorities. Interestingly, all three outcomes that changed when switching from MV to QV have a below average share of HVs. In fact, if we look at the number WVs, we can observe that they are above average (37) for Q6, Q15 and Q18. The changes in outcome seem to not be driven by a small group of individuals with very strong preferences, but rather by the relative indifference of a large majority.

Figure 2



3.6 Differing welfare evaluation

As explained, a follow-up survey was conducted with a random subset – 54 of the individual 114 participants – to evaluate the results. They were being shown the two different societies, "X" and "Y" with their differing policy rules. To prevent any form of bias, they were not being told which rules came to effect under which voting system. The information about these societies simply consisted of the 3 policy rules which differed by voting system.

In the case of society X, where decisions were made by quadratic voting, that meant:

- A complete ban on arms exports
- A general ban on inner-country flights
- The mandatory duty of secondary schools to provide a unisex toilet for their students

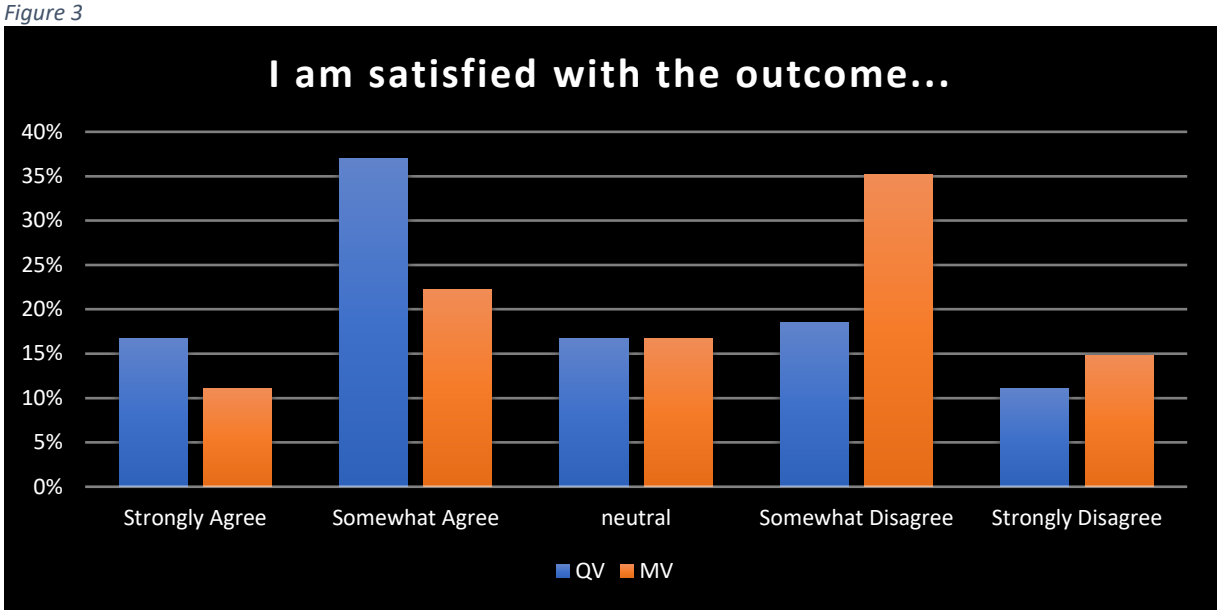
In society Y, decisions were made by Majority Voting:

- No complete ban on arms exports
- No general ban on inner-country flights
- It is not the mandatory duty of secondary schools to provide a unisex toilet for their students

Participants were then asked to rate each society on a Likert scale, depending on how satisfied they were with the respective 3 policy outcomes. They were also asked to compare the societies directly with each other.

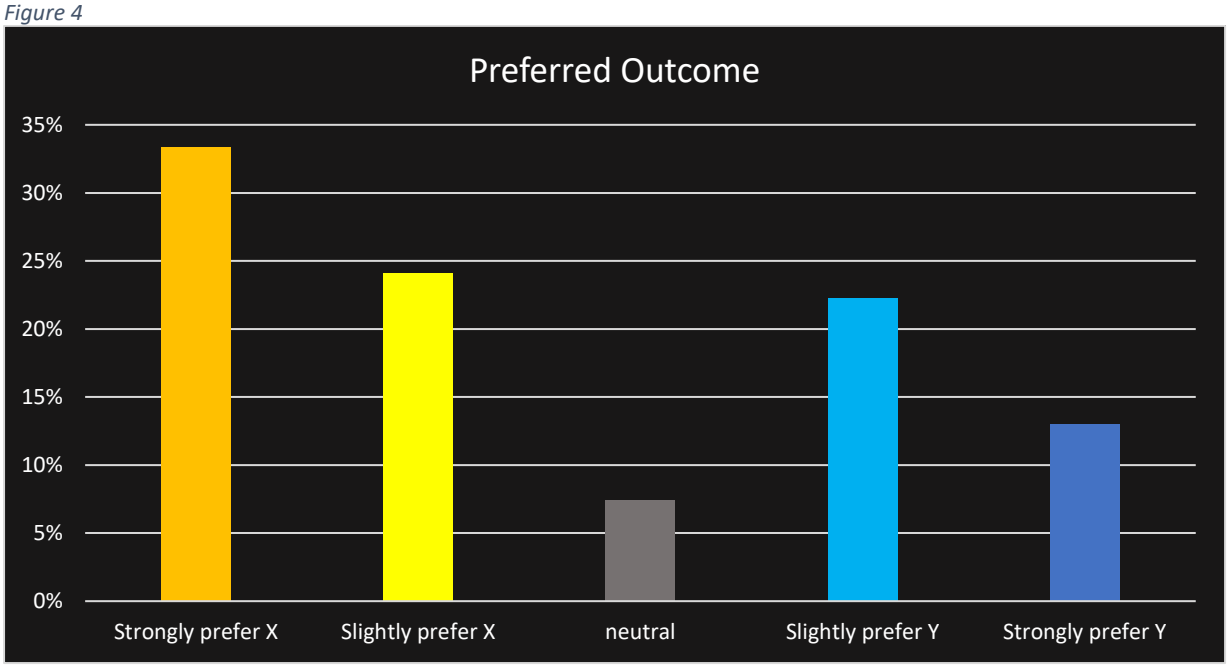
The results show a clear picture: A majority (54%) was somewhat or strongly satisfied with the outcome under QV, whilst only 33% were somewhat or strongly satisfied with the outcome under MV (Figure 3). As QV outperforms MV both in terms of weak satisfaction and strong satisfaction and generates less discontent, different weighting schemes of strong and weak preferences for welfare calculation would all lead to the same result: QV generates more welfare compared to MV.

Figure 3



This is being confirmed by the direct comparison, where a third of participants strongly preferred QV to MV. Both weak and strong preference for the results of QV surpass those for MV.

Figure 4



These results show the strength of QV as well as they demonstrate the weakness of MV. Obviously, many participants were satisfied with *some* of the three outcomes of MV as well as some others of the three outcomes of QV. But as they do not prioritize those three issues equally, some of them might have been preferring a result where only 1 of three outcomes reflected their MV-vote. Take for example someone who cares about the environment and therefore believes it is important to ban inner country flights, as was done under QV. This person might oppose the ideas of unisex toilets or a ban on weapon exports, but not really care too much about these two issues. Therefore, when given the choice in which society to live, she/he might choose X (QV) over Y (MV). As has been explained, the initial thought behind the Quadratic Mechanism is to give such a person the possibility to prioritize.

3.7 Subset Evaluation

As Figure 1 showed, the participant sample consisted of two large sub-populations: a large number of participants was either between 18 and 28 (group A), or between 49 and 59(group B). We can use the results of the survey to compare them:

Table 6

	A (age: 18-28)		B (age: 49 – 59)	
Issue	MV	QV	MV	QV
Q1	Yes	Yes	Yes	Yes
Q2	Yes	Yes	Yes	Yes
Q3	Yes	Yes	Yes	Yes
Q4	Yes	Yes	No	No
Q5	Yes	Yes	Yes	Yes
Q6	No	Yes	No	Yes
Q7	No	No	No	No
Q8	No	No	No	No
Q9	No	No	Yes	Yes
Q10	No	No	No	No
Q11	Yes	Yes	Yes	Yes
Q12	No	No	No	No
Q13	Yes	Yes	Yes	Yes
Q14	Yes	Yes	Yes	Yes
Q15	Yes	Yes	No	Yes
Q16	Draw	Yes	Yes	Yes
Q17	No	Draw	No	No
Q18	Yes	Yes	No	No

Unsurprisingly, the results differ significantly between those two subgroups. We must highlight that in two out of the three issues which differed by voting mechanism in the vote of all participants(Table 3), the results of groups *A* and *B* differ from each other under at least one of the two voting mechanisms (Q15 and Q18). The sheer number of relatively older participants (group *B*) being against the unisex toilets and the ban on inner-country flights dominates the MV results, whilst the relatively younger participants (group *A*) outvote them with their preference strength in the QV election[1]. This supports the general assumption that the more heterogenous the group, the more likely is the outcome going to change when changing the voting mechanism, as different voting blocks can form majorities or minorities on issues. But the heterogeneity does not automatically lead to a change in the total outcome under QV and MV. In Q4, the participants between the ages of 49 and 59 - who are less likely to be tenants and more likely to be landlords than those between the ages of 18 and 28 – opposed a general rent cover but could not outvote group A in either voting mechanism. More surprisingly, the participants between the ages of 49 and 59 supported lowering the voting age, while the participants between the ages of 18 and 28 opposed this proposition (Q9).

Since the questions concern issues of German politics, we might also check if the implications of the study change when excluding the 7% of English-speaking participants. The answer to this question is that they don't. The *only-German* sample produces exactly the same outcomes under both voting mechanisms, with one small exception: The MV election on a lower voting age results in a stalemate.

[1] Note that this is an obvious oversimplification, of course there were people in their 50s who also voted "progressive" on this issue

3.8 Critical Evaluation

Before conducting a final conclusion, a critical evaluation will lay out potential points for improvement and critique for future experiments.

Though the recruitment process achieved the goal of N>100, the sample is in some ways not representative of the German population. Even if the gender proportionality mentioned in 3.3 is being overlooked, almost all participants have one thing in common: They are academics. This is again due to the recruitment process, which did not reach working class and lower income households. Therefore, insights generated by this experiment should not blindly be transferred as insights regarding a voting process with a more diverse population. It can be expected that preferences and opinions within the general German population might be less homogenous than in the sample, which might produce more concentrated minority voting blocks.

Another point to improve robustness is the order of the voting mechanisms: Because in this experiment, voters always voted under MV before voting under QV, they might be more familiar with their preferences once they cast their QV vote. They would then allocate their votes more congenial to these preferences under QV then under MV, which could partially explain why they would prefer the QV outcome more. A solution for this risk of bias would be to randomize the order of the voting mechanisms.

Also, one might criticize that a real-world application of QV would let voters spend their credits over a longer time-period in several referenda/elections rather than allocating all credits within one page. The experiment purposely eliminated the potential of credit mismanagement though. But as stated above, it is to assume that in a long-term deployment of Quadratic Voting within a society, people would learn to plan ahead with their credits and therefore prevent over/underspending. Because this experiment is conducted with people who mostly never have heard of QV before, the influence of credit mismanagement would be vastly overstated by allowing for a design in which users would not have all questions on a single voting interface.

To improve the robustness of the welfare results, it would be beneficial to have 100% of participants of the first survey to also participate in the second one. However, since participation in this experiment was voluntary and unpaid, this was difficult to realize without bias. Because it would have been necessary to contact all participants of round 1 to send them the second survey, some of their personal data would have had to be collected[2]. Ultimately, this might shy participants away due to data-privacy concerns. Also, making such a provision of contact details and thereby the participation in the second survey optional would lead to a biased subset for the welfare-evaluation. This subset would be a sample of people who are less concerned about data-privacy issues and might lean towards a certain political direction or ideology. Their views on the outcomes of the elections would therefore not be representative of those of the complete group.

Finally, the welfare evaluation does not allow for a numeric calculation of the benefit which QV creates (e.g. welfare increased by …%).

[2] For example a field which asks participants to type in their e-mail address on the page for personal data gathering (see References)

4. Conclusion

The experiment has been successful in both creating a QV-environment for a large number of people as well as generating new insights on the topic. One conclusion is the understanding that policy decisions under QV are not just driven by the strong preference of a minority, but also by the relative indifference of a majority. Issues of less general interest are more likely to change in outcome when switching from MV to QV. Also, voters tend to prioritize proposals they support stronger than those they reject. Most significantly, Posner and Weyls (2018) hypothesis that rational individuals can increase their utility by using QV instead of MV for collective decision-making is strongly supported by the empirical data conducted in this study. The results of the Quadratic Voting process proved to be more satisfying to participants.

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University of Cambridge center For the Future of democracy (2020): “Global Satisfaction with Democracy” https://www.cam.ac.uk/system/files/report2020_003.pdf

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Additional Resources

- oTree documentation: https://otree.readthedocs.io/en/latest/
- Git-project: https://github.com/FlorianH-cyper/qv

Appendix

Figure 5

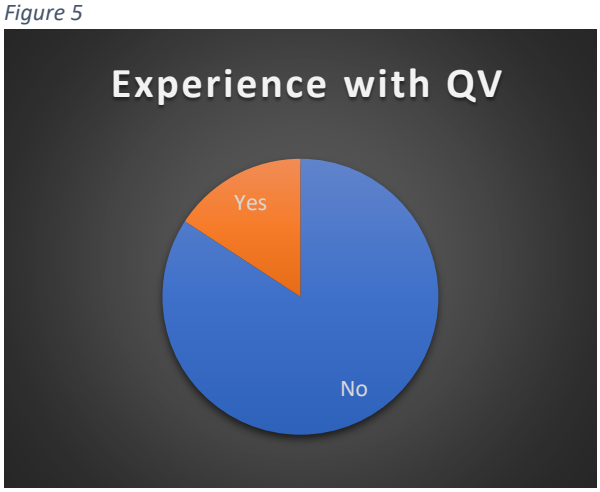


Figure 6

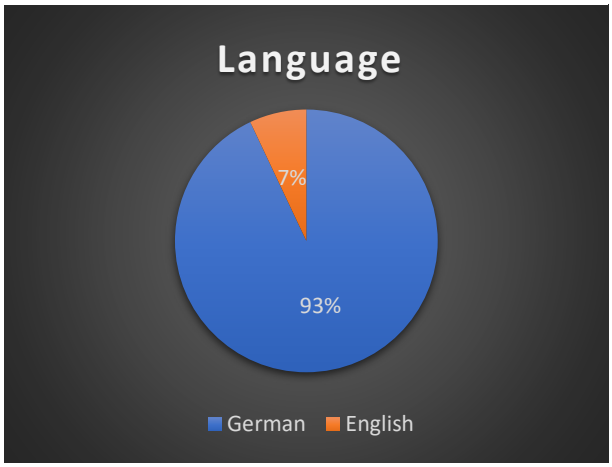


Figure 7

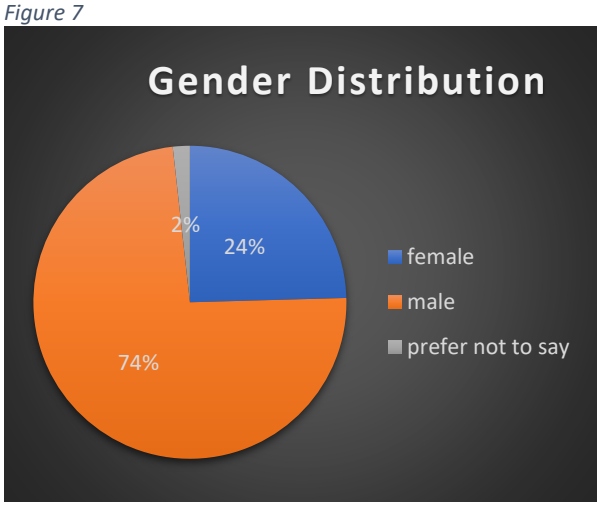


Figure 8

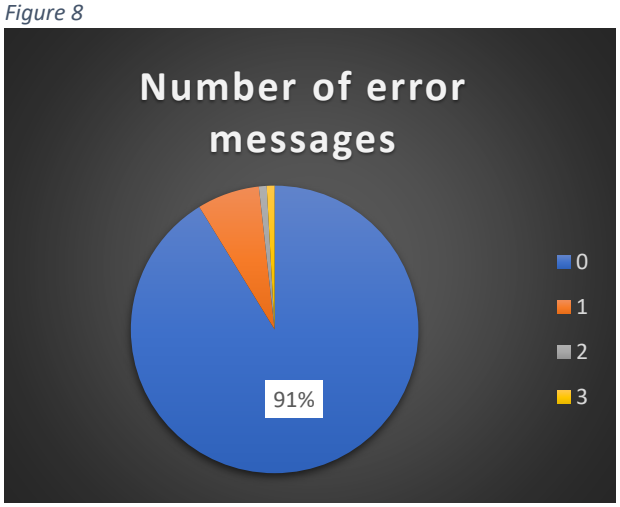
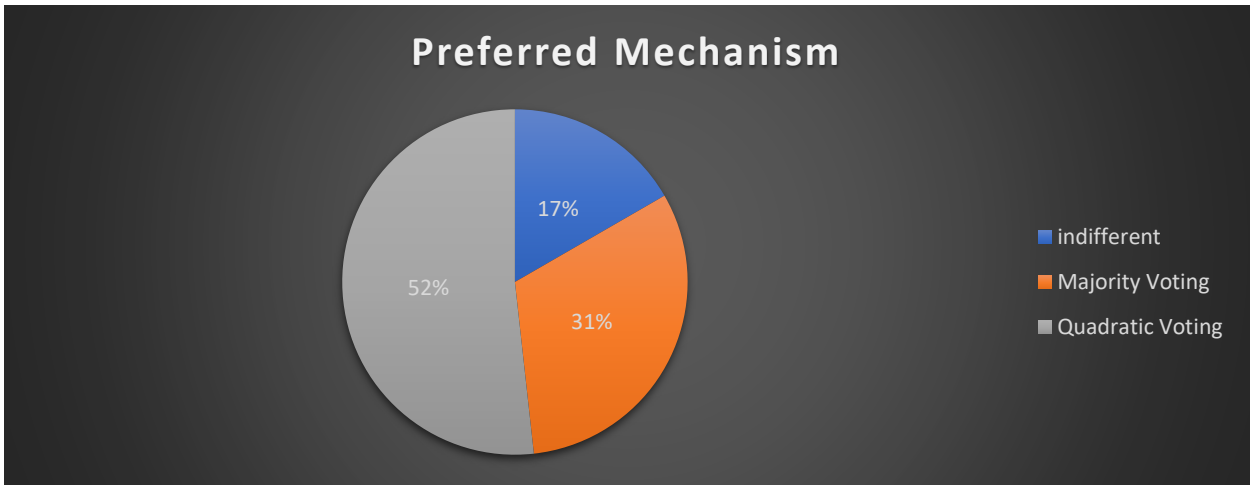


Figure 5



First Survey:

Introduction:

Introduction

Welcome to this experiment!

The following experiment is carried out as part of a seminar paper at Heidelberg University. Your personal data will be anonymized and not passed on.

You are about to contribute to the comparison of two voting mechanisms by voting on a number of policy proposals:

1. Majority Voting:

Everybody gets one vote per election, the majority of people decides.

2. Quadratic Voting:

Multiple votes can be cast for one issue. If a proposal receives more votes for then against, it will be implemented, regardless of the number of people who actually voted for/against it.

Next

QV interface:

Quadratic Voting

You have a total of **100 credits** to spend on the issues below.

Steps to follow:

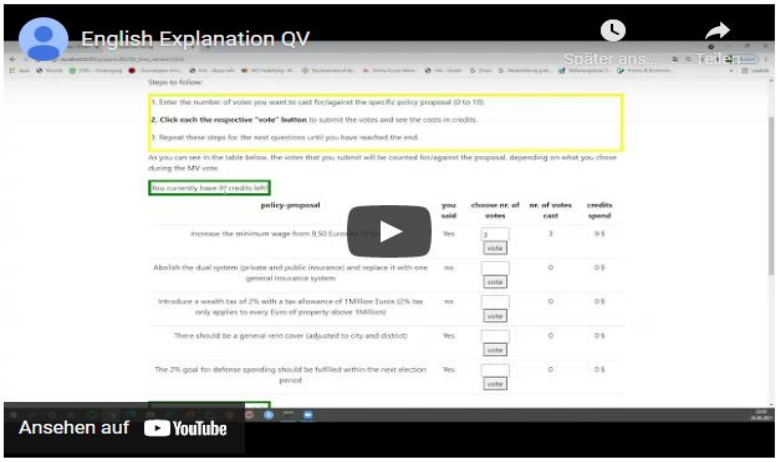
1. Enter the number of votes you want to cast for/against the specific policy proposal (0 to 10).

2. Click each the respective "vote" button to submit the votes and see the costs in credits.

3. Repeat these steps for the next questions until you have reached the end.

As you can see in the table below, the votes that you submit will be counted for/against the proposal, depending on what you chose during the MV vote.

Video Explanation:



You currently have 45 credits left!

policy-proposal	you said	choose nr. of votes	nr. of votes cast	credits spend
Abolish the dual system (private and public insurance) and replace it with one general insurance system	no	4 vote	4	16 §
Introduce a wealth tax of 2% with a tax allowance of 1Million Euros (2% tax only applies to every Euro of property above 1Million)	no	3 vote	3	9 §
There should be a general rent cover (adjusted to city and district)	Yes	5 vote	5	25 §
The 2% goal for defense spending should be fulfilled within the next election period	Yes	2 vote	2	4 §
Reestablish the compulsory military service (first year after graduation with option for civil service instead)	no	1 vote	1	1 §

Personal data gathering:

Almost finished!

just a little information about yourself:

your gender:

○ female ○ divers ○ male ○ prefer not to say

your age:

Did you already know the voting mechanism of 'Quadratic Voting' before this experiment?

Which voting mechanism did you like more?

Next

Follow-up Survey:

Introduction:

Welcome!

In this very short survey you will evaluate the differing results of the elections from the first survey.
At the end, you will be able to see the complete results of the first survey, if you are interested in those.

Your data is of course being treated confidentially.

Next

Outcome evaluation:

Comparison

Below, you can see two societies, *X* and *Y*, which differ only in the following three points:

Society *X*:

- Ban on inner country flights
- Ban on arms exports
- Mandatory for secondary schools to provide an unisex toilet

Society *Y*:

- **NO** ban on inner country flights
- **NO** ban on arms exports
- **NOT** mandatory for secondary schools to provide an unisex toilet

Please evaluate the two societies on the basis of these three issues:

I am satisfied with the three policy-rules in society ...

X	○ Strongly Agree ○ Somewhat Agree ○ Neutral ○ Somewhat Disagree ○ Strongly Disagree
Y	○ Strongly Agree ○ Somewhat Agree ○ Neutral ○ Somewhat Disagree ○ Strongly Disagree

Please indicate which society you prefer in comparison with the other:

○ I strongly prefer X ○ I slightly prefer X ○ No difference ○ I slightly prefer Y ○ I strongly prefer Y

Next