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Decision Costs and Welfare Effects of Democratic Voting Rules: an Experimental Analysis**

Abstract: What impact do majority rule and unanimity rule have on welfare and decision costs? According to Buchanan and Tullock ([1962] 1999) the unanimity principle must be regarded as a democratic norm, because it guarantees Pareto-efficient welfare effects. We present experimental results from a public goods game, which demonstrate in contrast to this assumption that majority rule can produce greater welfare effects than unanimity rule. This result suggests a critical revision of theoretical approaches which narrow the legitimacy of majority rule in this respect.

Keywords: common good; decision costs; laboratory experiment; majority rule; unanimity rule

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1 Introduction

In *Legitimation by Procedure* Luhmann ([1969] 1989: 196) addresses a major problem of democratic theory by asserting: "The majority principle is not a way of legitimation, rather it is a stopgap".[1] Its primary feature is practicality, which

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1 The original German title of Luhmann's book, which is the version from which we quote, is *Legitimation durch Verfahren*. Translations by the authors.

is why simple majority rule is viewed as the most efficient procedure of political decision-making in established democracies (Guttman 1998: 190). Nevertheless, majority rule is not easy to justify, given its exclusionary effects. A loophole is seen in the assumption that the rule is only supposed to guarantee that everyone in the electorate receives a fair opportunity to enforce her preferences by majority vote every time a new ballot is held; thus it may be considered sufficient if the individual voter only occasionally profits from the rule. However, this perspective does not diminish the complication that minority rights cannot readily be protected by the majority principle. Because of this, unanimity rule is consistently regarded as the more legitimate variant of democratic voting procedures, as it grants individual veto power to all participating actors (Buchanan and Tullock [1962] 1999). From another perspective, the veto option means that the larger groups become, the more rewarding strategic behavior appears. This escalates decision costs and leads to deadlock situations. Although unanimity played an important role in Europe's pre-democratic era (von Gierke 1915; Heinberg 1932: 454–456), it has become marginalized in modern democratic voting procedures because of this effect. Even in consensus democracies, most decisions are taken by majority votes. Accordingly, Lijphart explains: "Consensualists can argue that they are not against majority rule as such but that they favor broad instead of narrow majority rule" (Lijphart 2008: 126).

However, theoretical analyses of decision rules uphold the unanimity principle despite its low practicality: in comparison to majority rule it is believed to produce better welfare effects (Buchanan and Tullock [1962] 1999: 85–96). Results from empirical case studies (Conrad 2003) and diverging model assumptions (Guttman 1998; critical on this Buchanan 1998; Arrow 1998), however, cause disagreement on the actual occurrence of these positive welfare effects. In this study we seek to gain more clarity on this matter. Our research question can be framed as follows: What *decision costs* and which *welfare effects* evolve under majoritarian and unanimous democratic voting rules?

The theoretical starting point of this analysis derives from the ideas of Wicksell (1896) on the unanimity principle, and especially from the public choice model based on Wicksell's considerations developed by Buchanan and Tullock ([1962] 1999). According to this, the decision costs and welfare effects induced by voting rules constitute a trade-off relation. By means of a laboratory experiment, we demonstrate empirically that this assumed trade-off is not inevitable. We will further elaborate the implications of this finding for democratic theory, in particular the legitimacy of the majority principle.

If the influence of decision rules is to be scrutinized more reliably than by case study design, data on individual behavior are needed. Although not very common in German political science, an experimental research design seems most appropriate

for such an analysis. Accordingly, we shall discuss how experiments can be carried out in political science and what specific value this method adds to our research.

We begin by examining classical perspectives on the problem as they have been elaborated in decision theory and democratic theory. In this context we will sketch out our own theoretical assumptions. Next, we outline the experimental method and our own experimental design and results. Finally, we will draw some theoretical conclusions from our findings. Full details of the experiment (instructions for subjects deciding under majority rule) are presented in an online appendix to this article.[2]

2 Theoretical Discussion and Main Thesis

The main thesis of this study is that under specific conditions (defined below) majority rule causes both better welfare effects and lower decision costs than unanimity rule, which is why the two decision rules do not necessarily constitute a trade-off relation. It is therefore sustainable to restrict the assumption of the unanimity rule as the norm (Buchanan and Tullock [1962] 1999: 96) and to legitimate majority rule in ways different from the argument which draws exclusively on its efficiency with respect to decision costs.

2.1 Theoretical Arguments from Decision Theory on Democratic Voting Rules

The argument in decision theory, according to which unanimous decision procedures create better welfare effects than majoritarian procedures, was originally elaborated by Knut Wicksell, whose *Studies in the Theory of Public Finance* (1896) is concerned with just taxation. Wicksell starts with the assumption that tax payment and the provision of public goods can be described as a barter transaction between citizens and the state. Each tax payment should therefore be minimally equivalent to the benefit from the resulting public policy. Historically, this assumption was motivated by the observation that the representation of the working class, if it existed at all, was quite low in European parliaments at the end of the 19th century:

> "it may therefore easily happen ... that those decisions [of the parliamentary majority], even if universal suffrage exists, will not express the will of a majority of the population; and

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2 The appendix can be downloaded at www.pvs.nomos.de

that, of course, must be even more the case, where law making and tax approval (as with us in Sweden) rest exclusively in the hands of the propertied classes" (Wicksell 1896: 109).[3]

This under-representation of the working class brought about a discriminatory tax policy, because elected delegates voted to advantage a class-specific clientele. Thus indirect taxes were particularly high in Sweden at this period, causing a disproportional strain on lower-income groups. Hence even increasing direct taxation could not bring them sufficient relief.

Wicksell concludes that parliamentary procedures for tax approval would only generate a just distribution of taxation: if universal suffrage were introduced; if members of parliament were elected by a proportional electoral system; and if they voted under "relative unanimity" (Wicksell 1896: 122–123). In fact, this decision rule is equivalent to qualified majority rule; nevertheless, Wicksell calls it unanimity in order to stress that from a theoretical view it would create greater benefits, and that deviations should be only for reasons of practicality.

His argument on voting rules is therefore not only derived from the historical representation of lower-income groups (which can change over time anyway), but is based on the theoretical idea that just taxation cannot be sufficiently secured by a certain degree of progressive taxation. Instead, he sees just taxation as being dependent on democratic procedures. Because progressive taxation does not determine which particular public goods are provided in what quantity (Wicksell 1896: 104, 106), citizens' benefits from taxes remain undefined. However, individual, or at least class-specific, preferences would be taken into account in the distribution of the tax burden, if individual veto rights existed. This rule would ensure that "everyone benefits" from the exchange (Wicksell 1896: 113): individuals would only be made better off if this would put no one else in a worse position. From this perspective, unanimity rule leads to a Pareto-efficient solution in tax policy, and more generally, in the provision of public goods. This basic idea led to the assumption in decision theory that unanimity rule creates better welfare effects than majority rule. Wicksell in fact denied such a relation between unanimity rule and the Pareto-criterion, but subsequent scholars agree that Wicksell's general critique of the Pareto-criterion results from a misconception on his part, influenced by the ideological distance between his theory on welfare and Paretian economics; today the Pareto-criterion and the unanimity principle are viewed as being logically equivalent (Hennipman 1980, 1982: 55–57).

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3 The quote is from the German version of *Studies in the Theory of Public Finance* entitled *Finanztheoretische Untersuchungen*. Translations by the authors.

In their major contribution to public choice theory, *The Calculus of Consent*, Buchanan and Tullock ([1962] 1999) emphatically pointed to this logical equivalence. However, unlike Wicksell's analysis, theirs is not restricted to a certain policy. It more generally asks which public decision-making structures may legitimately replace private agreements. Their concept thus lies in the tradition of the classical theories of social contracts (Locke [1690] 1977; Hobbes [1651] 1996); within it, however, decision rules are of major importance.

Buchanan and Tullock assume a two-tiered system of rules for a democratic political system: 1) on the constitutional level, decisions about the rules on which society is based should be taken by unanimity; 2) on the level of "everyday politics" voters should only deviate from unanimity as dictated by decision costs. Unlike classical theories of social contracts, no normative objectives or at least fairness aspects (Rawls 1975) are developed beyond this system of rules which could guide the contractors. The contract is presented less as an historical thought-experiment (Kersting 1994) than as a real declaration of consent between economically and socially unequal subjects. Its conservative impact probably originated from the authors' ideological convictions, but is far from being a negligible detail of their study. It matches their assumption on methodological individualism and the idea that individual freedom needs to be protected categorically when collective decisions are taken.

Even if collective agreements enable individuals to experience the well-ordered supply of certain public goods, Buchanan and Tullock consider it mistaken to enforce participation in investment for their provision without individual consent. Because individual preferences may differ with respect to both ordering and intensity (Buchanan and Tullock [1962] 1999: 125–131), individual benefits from the supply of public goods will always diverge. Consequently, an interpersonal utility comparison seems to be impossible to achieve. In line with this argument, it appears quite futile to search for an objective criterion determining common welfare; this serves to reveal the consistent procedural logic of the model.

While Arrow (1963) continued to explore the conditions of possibility for a social welfare function, Buchanan and Tullock completely deny the possibility of such a function under any condition, defending this premise as an important liberal element in their theory (Petersen 1996: 62–63). To acknowledge allegedly objective common welfare, they plead, would only allow authoritarian coalitions to impose their special interests on the community (Buchanan [1975] 1984: 233). Majority rule would probably assist such forces in their usurpation and could thus deploy features of tyranny.

In contrast to a concept which is centered on allegedly objective common welfare, Buchanan and Tullock view the Pareto-criterion as an alternative

principle of justice. They present the unanimity rule as a practical rule of enforcement. Petersen (1996: 88) examines "the actual innovation of the 'Calculus of Consent'" in the theoretical conjunction between unanimity rule, Pareto-criterion, and a "subjective concept of benefit". Nevertheless, even in this study the unanimity rule serves rather as an orientation to enable the determination of an optimal decision rule applicable under practical considerations. Such an optimal decision rule for everyday politics appears ascertainable, according to Buchanan and Tullock, by discounting the welfare effects induced by the decision rule from the decision costs in an economic cost-benefit analysis (Kaiser 2007). In this respect the approach embodies a consequential expansion of the economic theory of democracy (Downs 1957).

This discounting procedure is based on the further assumption that welfare effects and decision costs are inversely proportional interdependent; they are therefore called interdependence costs.[4] This trade-off, amongst others, emerges because private proprietors often create costs for third parties. For instance, private enterprises may pollute the environment and displace ensuing costs to communes and their private households.[5] To reduce external costs the actors involved may come to a voluntary collective agreement or else delegate this task to the state, for instance by a legal commitment on standards for environmental protection. Even these agreements or laws may cause external costs; but the more actors involved in deciding the final collective regulation the lower the costs (Buchanan and Tullock [1962] 1999: 64–68). A dictator is likely to create the highest external costs for the population, while the inclusion of all citizens reduces external costs to zero, as individuals would not consent to a binding agreement which would disproportionately shift external costs to them.

Majority rule cannot guarantee to avoid such unequal distributions of costs. For instance, some communes could agree by majority vote to build a wastewater

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4 In their study Buchanan and Tullock use the following terms: on the one hand they talk about decision costs and on the other about external costs, arguing that both constitute a trade-off relation. We adopted the term decision costs. However, we only talk about external costs, if we express the outcome of a collective decision negatively. In contrast we use the terms common welfare or welfare effects, if we express this outcome positively. As we are interested in the conditions under which groups show a stronger tendency to cooperate (thus creating larger welfare) we mostly use the terms common welfare or welfare effects. Only in this paragraph we use the term external costs to clarify that our considerations are analogous to those by Buchanan and Tullock.
5 The environmental policy example is given to illustrate a certain dilemma situation. In their study Buchanan and Tullock refer to problems in health policies. The two examples are actually exchangeable – for our purposes the less complex example of environmental policy is more appropriate.

treatment plant to clean a polluted river in their area. No one would deny the common welfare resulting from this measure. However, such plants can create quite considerable noise disturbance and odor nuisance for residents nearby. Under majority rule little attention would be paid to such effects and consequently, some residents would be forced to shoulder the burden of these external costs alone – a Pareto-inefficient solution. Under unanimity rule the plant would only be built where it would cause no disturbance to anyone in the communes concerned.

According to this public choice argument, deviation from the norm of unanimity can only be legitimized if it minimizes interdependence costs (Buchanan [1975] 1984: 138), so that ballots are held as inclusively as possible (welfare) and as exclusively as necessary (decision costs). Practically, this legitimizes majority rule as the most efficient decision rule, but with respect to welfare gains oriented towards the Pareto-criterion, it remains a stopgap. Wicksell defined this deviation in a rather indeterminate fashion, by introducing the principle of "relative unanimity". In contrast, the concept of interdependence costs presented by Buchanan and Tullock constitutes a clear-cut theoretical account to determine a "good" (efficient) decision rule which, however, entirely omits a substantial identification of common welfare.

Nevertheless, from our point of view, this strong procedural logic leads to major difficulties of justification in democratic theory. Moreover, we assume that only the introduction of a minimalist criterion for the evaluation of welfare effects will show that not unanimity rule but majority rule will produce more convincing results. This cannot be valid for each and every case. For our analysis it will be entirely sufficient to present a case in which the interdependence relation mentioned above does not exist. From our perspective, such a case appears conceivable, because unanimity rule is theoretically indeterminate with regard to its effects on welfare. In the next paragraph we sketch out the critique of this problem which has emerged in democratic theory. Subsequently, we will show that the results of our laboratory experiment support this critique empirically.

2.2 Theoretical Arguments from Democratic Theory on Democratic Voting Rules

The idea that unanimity rule can be regarded as a norm corresponds to the strong plea for the concept of consensus democracies as it has been developed in empirical research on democracies – although the organizational principle of this type of democracy is actually grounded on the qualified majority principle, as explained in the introduction. In response to the question, who is supposed to govern in

consensus democracies, Lijphart says: "as many people as possible" (Lijphart 1999: 2). The main difference between the public choice model and Lijphart's theoretical concept consists in the fact that the benefits of bargained decisions are not compared to their costs (Bohrer 2001). So the debates over which type of democracy is superior and over optimal decision rules do not exactly focus on identical problems. This does not come as a surprise, because empirical research on democracies pays more attention to the questions of whether decision rules are adequately designed to respond to a certain societal conflict structure and whether they produce efficient policy outcomes under these particular circumstances. This strand of literature does not offer a satisfying answer to the question of which decision rule promotes the more efficient results *ceteris paribus*.

In normative democratic theory and political philosophy, however, this question has long been considered highly relevant (Dewey 1954; Sartori 1987; Habermas 1992). Discussions in this field of research were often influenced by political and societal change in Western democracies. In the 1980s, for instance, some advocates of the peace and environmental movements expressed their doubts concerning the legitimacy of the majority rule, viewing it as enabling problematic decisions in energy and security policy, which in turn threatened the wellbeing of mankind (Guggenberger and Offe 1984).

Buchanan, too, was writing in reaction to the changing political climate of the USA during the 1960s and 1970s. He diagnosed a tendency towards excessive and ineffective public policies which had caused an enormous public debt. At the root of this crisis, Buchanan thought, lay an increasing dissolution of the functional separation of powers promoted by a well-meaning elite. Judges in federal courts, for instance, made rulings "according to their own idealized convictions" (Buchanan [1975] 1984: 245), transgressing the borders of their judicial authority. Thus the alleged implementation of an elitist agenda determining common welfare damaged democratic procedures.

The danger perceived by Buchanan had resulted from a normatively contestable mixture of two different fields of public activities: on the one hand, the state needs to guarantee legal protection; on the other, to provide public services. Legal norms designed to secure individual freedom should never be sacrificed for the provider state and should not be arbitrarily interpreted to implement ideas about common welfare, no matter how they were brought to mind. After all, citizens had not decided such matters unanimously, though they had to bear the costs of this extremely inefficient and expansive public financial conduct. This kind of public policy illegitimately restricted individual freedom. In contrast, unanimity is viewed as securing these constitutionally warranted individual rights.

Against this claim for a theoretical superiority of the unanimity rule, Kersting (1994) has raised some important objections, which are highly relevant for our

laboratory experiment and its underlying assumptions. The critique is twofold: first, he states that the argument based on contract theory would lead into a blind alley, because Buchanan and Tullock assumed a lifelike point of departure. While, for instance, the Hobbesian state of nature would not be characterized by asymmetrical threats, as Hobbes assumes that men are created equal by nature, Buchanan and Tullock's public choice model rested on "down-to-earth" and therefore normatively unsubstantial assumptions about the pre-contractual situation. According to Buchanan and Tullock, human beings are unequally endowed with skills. This causes an unequal distribution of resources and property, which would be contractually sealed on the basis of nothing but the involved actors' individual preferences. In so far as the contract mirrors these preferences, it is considered to be just. Under these conditions, the critics say, a strong and aggressive actor would only engage in a contract if it guaranteed the retention of goods acquired in a pre-contractual situation, no matter how illegitimate their possession might appear under different principles of justice. A weaker and less aggressive actor, however, must fear the absence of collective agreements much more than her stronger counterpart. Under such conditions, a contract, even an oppressive one, which at least protects her from cruelty, will probably be accepted by the underdog (Kersting 1994: 343). A contract based on this public choice model must therefore be regarded as "immoral" from a normative point of view.

This leads to the second critique of Buchanan and Tullock's approach: the allegation that the contractual concept, as well as the unanimity rule, would have to be regarded as an "empty criterion" (Kersting 1994: 349–351). The unanimity rule provides no criterion by which to determine how a group arrives at an agreement to solve a specific collective action problem (Feldmann 1997: 524). This can be illustrated by returning once again to the example of the construction of a wastewater treatment plant: it is conceivable that the communes agree to build it where it can cause no disturbance to any of the residents. However, it is also conceivable that a single actor votes against it to save the costs, so that the river remains polluted. Buchanan and Tullock's theory provides neither an external criterion of efficiency (a superior moral or economic category) which would allow us to measure welfare, nor any orientation for a specific policy solution: everything depends on the preference of the most patient veto player. She may be a downright egoist or altruist – on the basis of the decision rule alone, however, any prediction about which actor comes out on top is completely impossible. Hence, it appears unclear how a cooperation dilemma will be resolved under unanimity, whether self-interested or shared objectives will be achieved.

One may argue that this critique assumes the possibility of measuring efficiency externally, although the public choice model only focuses on the greatest possible accordance between the interests of voters and the policy outcome.

As a matter of fact, one could respond to Kersting's critique that it applies additional moral categories, which will not be shared by every individual actor. The indeterminacy of the unanimity rule may thus be welcomed rather than rejected by advocates of public choice theory. However, we assume that Kersting's critique is essentially qualified. Certainly, any reference to external criteria such as fairness, or even policies such as a clean environment, renewable energy, economic equality and the like, may be rightly refused by the model's advocates by pointing to the fact that individual preferences may be shaped to oppose such policies. According to the premises of the theory, a veto by the respective actors over corresponding environmental or redistributive measures appears quite legitimate.

The only acceptable criterion which allows measuring the actors' welfare externally can be derived from the premises of the public choice theory. It must not be one which depicts social preferences, the prevailing tendency in studies on common welfare. It needs rather to be a criterion which allows testing to what extent stakeholders act against their own interests under unanimity rule. From the rational actor assumption in public choice theory arises a simple yet substantial standard of evaluation for the welfare effects of voting procedures. It says: "More money is better than less".

An increase in efficiency, and accordingly a positive effect on common welfare, is achieved if the return on investment in a public good improves the position of the individual voter. If the hypothesis on the superiority of unanimity rule with respect to its welfare effects is to be supported, an empirical analysis of the question of which rule creates greater welfare should demonstrate that this minimal condition is fulfilled. This means a larger material benefit for every actor involved is better than a smaller, no matter how individual preferences are shaped to contribute to this result. Should the advocates of public choice theory refuse even this minimal condition, it is not clear what gain in knowledge their approach could achieve.

With the assumptions presented here we do not intend to make any kind of generalized statement on whether policy positions concerning common welfare can actually be recognized, for instance deliberatively (Habermas 1992), or evaluated. In our experimental research design such an evaluation is possible, because welfare can be expressed in measurable monetary terms. In a corresponding real-world situation this would probably lead to an argument as to which collective goods should be financed in what quantity by this fund. The experimental design allows us to ignore this issue, and also, pragmatically, to exclude other debates on common welfare: for instance, considerations based on discourse theory are not necessary, because we do not test the influence of communication in our experiment.

The subsequent analysis thus only seeks to test whether groups playing a public goods game (see below), in which they have to decide the size of the investment in a public good, invest more or less money (welfare) under majority rule than under unanimity rule. We also analyze whether group members voted more or less frequently to arrive at an agreement (decision costs).

We assume that the unanimity veto will lead to higher decision costs than the majority principle. On this point we agree with Buchanan and Tullock. However, we also assume that the openness of the unanimity rule, as it has been portrayed in Kersting's normative critique, does not allow us to predict whether egoists or altruists will come out on top of this cooperation game. Because of this, we will analyze empirically whether welfare decreases or increases under unanimity. In order to falsify the hypothesis on interdependence costs empirically, we must demonstrate a case in which it decreases. This led us to develop the following experimental research design.

3 Experimental Methods in Political Science

An experiment is a purposeful intervention into the data-generating process aiming at manipulating single elements of this process systematically (Morton and Williams 2010: 42). Experiments can be run in the laboratory, but also in the field, i.e., the natural environment of subjects. In order to test a theory experimentally, the experimenter varies an independent variable – in our case the decision-making rule – and observes the effects of this variation in an otherwise constant setting. Experiments thus have enormous potential in unveiling causal effects between variables (Kinder and Palfrey 1993; McDermott 2002a,b).

As with all other methods in the social sciences, experiments have certain limitations which have to be considered carefully. For instance, confounding variables may interfere with the experimenter's intended manipulation of the data-generating process, thus preventing the identification of causal effects. Insofar as the confounding variables are observable, holding them constant provides a possible remedy. However, some variables, like personal traits or emotions, cannot be observed directly or with great difficulty at best. In such cases, assigning subjects randomly to the different treatments of the experiment offers a way of preventing biased inferences.

In comparison, when employing research designs relying on field data, researchers do not have systematic influence on the data generating-process. Instead, in order to test a theory, researchers select from relevant, already existing data. However, individuals do not act under the researcher's scrutiny and

perhaps not even under the exact conditions relevant for the theory. Lacking the ability to manipulate the data-generating process and thus controlling confounding factors, researchers can only select data which appear as useful as possible for the analysis. Thus, causal relationships cannot be revealed with the high degree of certainty possible in laboratory experiments.

There are different types of experiments in political science. In survey experiments, for instance, the experiment is embedded in a questionnaire. These experiments usually study individual decision making which is not the outcome of an interaction between subjects. In contrast, field experiments offer a way to study such interactions between subjects. However, the experimenter loses some control over the data-generating process because the experiment is conducted in the subjects' natural environment. Conducting a laboratory experiment provides for a maximum of control because the experimenter purposefully designs the setting in which subjects interact.

Our study is inspired by the methodology usually employed in experimental economics. Laboratories used in experimental economics consist of a certain number of networked computer workstations. To preserve subjects' anonymity and prevent uncontrolled communication between them, subjects sit in cubicles during the experiment. Most subjects are students of various disciplines, recruited online via email, who receive real money for participating in the experiment. The exact amount depends on the subject's own decisions and the decisions of other interacting subjects (for an overview see Glassmann 2007). The payoff scheme thus sets the incentives for the participants in the experiment, i.e., payoffs induce individual preferences (Smith 1976). The experimenter sets up a game allowing subjects to interact via the computer network. Laboratory experiments can thus be used to study questions relevant for political science, such as bargaining or social dilemma situations (Palfrey 2006). Data collected in laboratory experiments exhibit a high degree of internal validity. However, critics argue that the results of laboratory experiments may be biased because the majority of participants are students and hence not representative of the wider population in terms of education levels or other characteristics. This, and the artificiality of the laboratory setting, might reduce the external validity of experimental findings.

Morton and Williams (2010: 255) define external validity as follows: "The approximate truth of the inference or knowledge claim for observations beyond the target population studied". This concerns the generalizability of experimental results. However, the question of generalizability is of great relevance in all empirical studies. Generalizing findings on the basis of one population to other populations faces the same problems regardless of whether the original data were collected in the field or in the laboratory. Even random sampling does not solve these problems (Morton and Williams 2010: 264). If the sample comprises people from

a single country, results are not automatically valid for other countries as well. The fact that subjects in a laboratory experiment are usually not representative in terms of a random sample does not imply that experimental results cannot be generalized. For example, in a meta-analysis of framing experiments, Kühberger (1998) shows that the behavior of students does not differ significantly from other subjects. Moreover, experiments comparing behavior in different cultures can be used to assess the generalizability of experimental results (Roth et al. 1991).

The artificiality of the laboratory environment also has important advantages. The researcher knows the conditions under which data are generated very precisely and is therefore able to describe the limits of generalizability of her results very accurately. Moreover, follow-up experimental studies allow varying particular aspects later on in order to analyze their effects on the study variable.

3.1 Experimental Design

We design two treatments called *Unanimity Treatment* (UT) and *Majority Treatment* (MT). In both treatments subjects play a public goods game (explained in detail below). They are divided into groups of three. We thus start with the smallest possible group size to test the influence of different decision-making rules. Conceivably, group size can exert an independent effect on cooperation levels in the public goods game, and is thus a potential additional variable of interest. Subsequent experiments could increase group size in order to test the effects of this variable systematically.[6]

In our study we focus on the within-group decision-making stage as the decisive level of action. The public goods game is a generalization of a multi-person prisoner's dilemma game (Eckel 2007). In the experiment each group receives an endowment of 20 points and has to decide how many to contribute to a public good. In order to create a decision situation mirroring Buchanan and Tullock's theoretical considerations, the game has to constitute a social dilemma. To induce such a dilemma situation, we created communities each made up of four groups. In our experiment the return from the public good depends not on the contribution of one group, but on the contributions of all four groups forming a community.

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6 We tested the effect of increasing group size on cooperation levels, conducting MT with five-person groups. Our findings show that cooperation levels do not decline with increasing group size under majority rule. Therefore, these findings support the results presented in this study. However, we cannot rule out the possibility of the dynamic of group decision-making changing as groups grow in size. Such questions are for future studies.

The social dilemma originates from an incentive to free ride on the other groups' contributions. Such an incentive is absent in a simple group experiment in which groups make their decisions without between-group interactions. In our experiment each group decides over the group's contribution to the public good by a voting of the three group members. Individual subjects only act during this phase of intra-group decision making. Once a group has reached a decision, it is final, and the decision outcomes of the four groups are aggregated automatically at the community level. Even though subjects do not act on the community level, the existence of communities is very important for our experimental design because it creates the incentive to free ride on the other groups' contributions to the public good. The free-riding incentive is further strengthened by the fact that communities are made up of four groups instead of the sufficient minimum of two.

At the beginning of the experiment, subjects receive instructions informing them of the rules of the experiment. Throughout, we use neutral language. For instance, the public good is labeled "common project", thus avoiding suggesting a specific purpose for it. If we had framed the experiment with a real-world policy example (e.g., environmental protection), we would have run the risk of subjects expressing individual preferences over the policy associated with the common project.

The game is played repeatedly over 15 rounds. In each round, groups decide whether to contribute the whole endowment of 20 points to the project, part of it, or nothing. Hence, the contribution of the group i to the project in round t is $n_{i,t}$ $(0 \leq n_{i,t} \leq 20)$. All points not contributed to the project are automatically transferred to the group's private account. The income $y_{i,t}$ of group i in round t can be calculated with the following equation:

$$y_{i,t} = 20 - n_{i,t} + 0.5 \sum_{k=1}^{4} n_{k,t} \tag{1}$$

The income $y_{i,t}$ consists of two components. Firstly, the group receives all points from the private account not contributed to the project ($20 - n_{i,t}$); secondly, it receives income from the public good ($0.5 \sum_{k=1}^{4} n_{k,t}$). In a round all group members receive $y_{i,t}$ points. The return from the common project is 50% of the contributions of the whole community of four groups.[7] Each group receives the same amount,

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7 In communities consisting of four actors, groups have an incentive to free ride if the marginal return from the public good is between 0.25 and 1. Hence, from the theoretical perspective the concrete parameterization of this variable does not matter as long as the same value from the specified interval is used in both treatments of the experiment. Most comparable public goods experiments employ a marginal return rate between 0.4 and 0.6.

irrespective of its contribution to the public good. Under the common assumptions of rationality and selfishness, an individual group should contribute nothing to the project and profit from the other groups' contributions instead. However, all groups would be better off if they all contributed their entire endowment to the public good. In this situation the welfare of the community doubles. Monetary incentives are held constant throughout the whole experiment. We use a *partner-matching procedure* implying constant composition of groups and constant composition of communities. Hence, an individual subject belongs to the same group and accordingly to the same community throughout the experiment. Thus, in our experimental design a community forms a statistically independent observation.

The two treatments differ only in the intra-group decision-making rule. In MT group actors decide by majority rule over their contribution $n_{i,t}$ to the project. In UT groups decide by unanimity rule. In both, each subject has one vote in each ballot. In a ballot, all group members cast their vote simultaneously. In MT, at least two group members have to vote for the same contribution to the public good in order to reach a decision in a round. If no two group members enter an identical $n_{i,t}$ in the first ballot of round t, all group members receive information on how the other group members have just voted, and a new ballot is held. This procedure is repeated until at least two group members vote for an identical $n_{i,t}$. Analogously, in UT all three group members have to vote for the same contribution to the project because they have effective veto power. If they cannot reach a unanimous decision in the first ballot of a round, the voting procedure will be repeated until the group reaches a unanimous decision with all three voting for an identical contribution to the project.

At the end of each round, after having reached a binding group decision, individual group members receive information about the decisions of the other groups. They learn the contribution of their own group and the contributions of the other groups in their community. Consequently, subjects also learn the number of points earned in the round. A new round then starts. By studying subjects repeatedly over 15 rounds we can detect whether cooperation rates increase or decrease in the course of the experiment.[8] We expect that the decision-making rule will influence behavior over time. For example, subjects receive information

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We choose 0.5 for pragmatic reasons: employing a factor of 0.5 simplifies the calculation of profits, and we thus minimize the risk that participants commit computational errors which might bias our experimental results.

8 Generally, we expect that the repeated interaction over 15 rounds offers a strategic incentive to contribute substantial amounts in the early rounds of the experiment. The incentive to cooperate gets weaker in later rounds (Andreoni 1988, 1995).

about the way other group members build voting coalitions or use their veto power.

We ran our experiments in the Cologne Laboratory for Economic Research at the University of Cologne. Subjects interacted via a computer network. Communication between subjects was limited to voting over their desired contribution to the project. We prevented all other ways of between-subject communication to avoid any independent effect on cooperation (Ostrom et al. 1992; Sally 1995). The experiment was programmed and run using the software z-Tree (Fischbacher 2007). We recruited subjects per email using the online recruitment software ORSEE (Greiner 2004).[9] At the beginning of the experiment, subjects were randomly assigned to a cubicle in the laboratory. Written instructions informed them of the rules of the experiment. We used a short questionnaire to test whether all participants understood the instructions correctly. In this questionnaire subjects were also asked to calculate the payoffs resulting from several hypothetical numerical examples of contributions to the project to make sure that they completely understood the game's dilemma structure. At the end of the experiment, subjects filled in a second questionnaire asking them about demographical data such as gender, age, and field of study.

Overall, we conducted 12 sessions from November 2008 to January 2009. A total of 288 subjects participated in our experiment. We studied 12 communities, comprising 144 participants in each treatment. Subjects were paid individually and privately. Payoffs depended on the subject's group behavior and the contribution of the other groups to the subject's community. Subjects received €0.10 per six points earned during the experiment. On average, subjects earned €10.46, including a show-up-fee of €2.50. Each session took about an hour.[10]

3.2 Results

Figures 1 and 2 show the main results of our experiment. Figure 1 depicts mean contributions to the project per round in both treatments. As mean contributions and mean payoffs are equivalent, we use Figure 1 to compare welfare effects between the two treatments. Figure 2, showing the mean number of ballots

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9 Overall, the subject pool comprises 2700 registered individuals. Nearly all of them are students from the University of Cologne, the majority studying at the Faculty of Management, Economics, and Social Sciences.

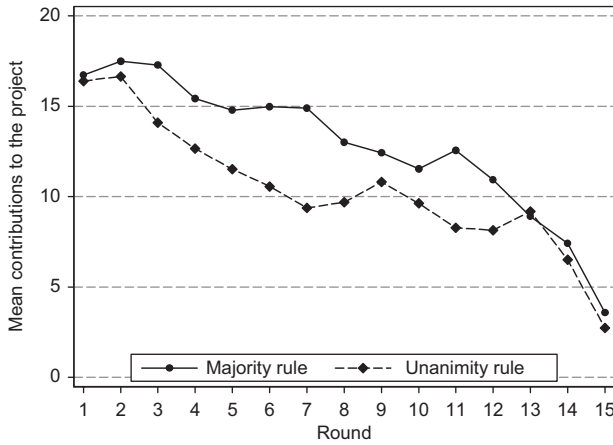**10** On average, a session in MT took 60 minutes, and in UT 70 minutes.

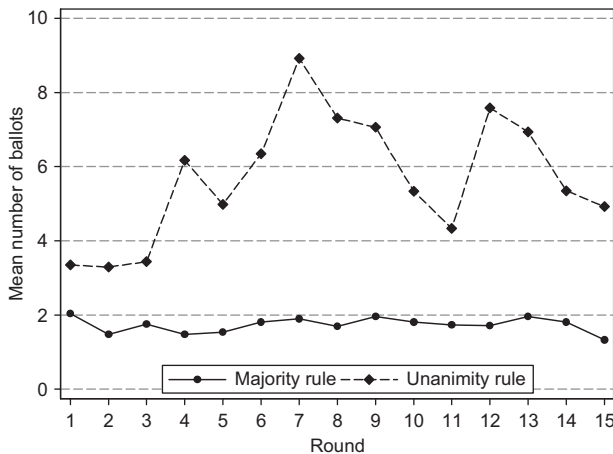**Figure 1:** Welfare gains measured by mean contributions to the common project.

Figure 2: Decision-making costs measured by the mean number of ballots per round.

necessary to reach a decision in a round, gives information about the decision costs in both treatments.

Our main finding can be summarized as follows: on average, groups deciding by unanimity rule contribute less to the common project than those deciding by majority rule. If we accept the premise that more money is better than less, we find that groups deciding by unanimity rule produced less welfare, thus bene-fiting less from the public good than participants deciding by majority rule. In conclusion, when intra-group decision-making is carried out by unanimity rule

communities depart from a Pareto-optimal solution, compared to groups deciding by majority rule.

Our results are in stark contrast to the public choice theory arguing for welfare-enhancing effects of unanimous decision-making. However, we find empirical support for the claim that unanimity rule substantially increases decision-making costs (Figure 2). Required to reach a unanimous decision, subjects need considerably more ballots and therefore more time (on average 10 minutes) to reach a binding group decision than under majority rule. On the basis of our experimental results we can reject the thesis of an interdependent relation between welfare and decision costs. On both counts majority rule is superior to unanimity rule.

Looking more closely at the experimental data we note that subjects reach quite high levels of cooperation, probably for several reasons. For example, the return from the common project is 50%, hence providing a strong incentive to cooperate. It is not unusual to observe high cooperation rates in the public goods game. In the first public goods experiment ever published, Bohm (1972) found the same pattern. Thus, while standard economic theory predicts egoistical behavior with zero contributions in all rounds of the experiment, experimental research has revealed a completely different picture. In the first round of a repeatedly played public goods game, subjects usually contribute on average between 40% and 60% of the endowment (Ledyard 1995; Sally 1995; Zelmer 2003). Cooperation rates go down in the course of the experiment before collapsing rapidly in the last rounds of the game. These experimental findings came as a surprise to proponents of traditional rational choice theory because the strong free-riding-hypothesis was clearly rejected (Sell 2007).

Our data also reveal patterns typical of the public goods game. As in other experimental studies, we find average contribution levels to the public good constantly decreasing. Starting from 16.56 points in the first round of the experiment, average contributions decline to 9.53 point in round 12. In the final three rounds, because of an endgame effect, contributions drop still more rapidly, so that groups in both treatments contribute on average only 3.16 points in the last round of the experiment (Figure 1).

As the endgame effect probably conceals important differences between the treatments, we only analyze average contributions in the first 12 rounds of the experiment. In MT, groups contribute on average 14.33 points to the common project, while groups in UT contribute only 11.48 points. The difference between MT and UT is (weakly) significant (p=0.089; two-sided Mann–Whitney U-test). This result shows that in our laboratory experiment, compared to majority rule, unanimity rule promotes egoistic behavior. However, further analyses of our experimental data are necessary to confirm this conclusion.

If unanimity rule is more conducive to the development of egoistic behavior than majority rule, we should expect more zero contributions and fewer instances of full cooperation in UT than in MT. Confirming this expectation, zero contributions are more frequent in UT (24.58%) than in MT (19.58%). Comparing the extent of full cooperation in the two treatments, we also come to the conclusion that egoistic behavior is more pronounced in UT than in MT. In MT 40.42% of all group decisions result in groups contributing the entire endowment of 20 points to the public good, whereas groups in UT reach full cooperation only in 24.72% of the decisions. As a consequence, the number of communities able to maintain full cooperation between groups also varies. In MT we find two communities cooperating fully throughout the whole experiment, whereas in UT only one community is able to do so.

In MT especially, we see that communities which reach high levels of cooperation in early rounds of the experiment are likely to maintain these levels throughout a substantial number of consecutive rounds. In both treatments, behavior of individual group members is heterogeneous. Nevertheless, we are able to identify some common patterns: Group decision-making in MT is dominated by the median player – i.e., the group member whose desired contribution to the project lies somewhere between the highest and the lowest desired contribution in the group. Hence, we find a moderating tendency in MT leading to medium contributions. In UT, however, the most egoistic group member has a greater influence on group decision-making than in MT. As a consequence, we find a tendency towards lower contributions in UT.[11]

In our analysis of decision-making costs we also find a strong effect of unanimity rule, which assigns veto power to all group members. In MT, groups need on average 1.73 ballots to reach a binding group decision in a round. In UT, however, participants have to vote 5.69 times in every group decision. The difference is statistically significant ($p<0.001$; two-sided Mann-Whitney U-test). Hence, our results support the claim frequently found in the

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11 The analysis of the dynamics of intra-group decision-making also reveals some interesting findings. If individuals alter their votes during the within-group decision-making period, these adjustments are frequently transmitted into a change of initial votes in the following round. We observe this behavior in both treatments. Moreover, we find a systematic relation between a group's contribution in the current round and the contributions of the other groups in its community in the prior round. Hence, individuals in both treatments decrease (increase) their desired contributions over two rounds if the contribution of their own group exceeds (is below) the mean contribution of the three other groups in the community. As a consequence, contribution levels of groups in a community converge over the course of the experiment.

public choice literature that unanimity rule is impracticable for "everyday" decision-making.

However, there is some variance in the behavior of groups in UT. Some groups reach a binding group decision in the first ballot of a round, albeit fewer than in MT. Hence, decision-making rules do not fully determine final decisions, because they do not necessarily impose different logics of play on the subjects. The process of intra-group decision making also depends on the individual group members' willingness to cooperate. This might differ substantially among subjects. We control for this possible influence by assigning subjects randomly into groups. In our view, individual willingness to cooperate is a psychological trait describing the propensity to act in accordance with the community's interest in a social dilemma situation. Unfortunately, we are not able to observe this disposition directly. However, we suspect that an interaction effect between psychological traits of the group members and formal intra-group decision-making rules drives our experimental results. In the following, we will describe this mechanism in greater detail.

Majority rule induces a strong incentive for cooperation by generating competition between the more egoistic and the more cooperative group member to reach an agreement with the group's median cooperator. The median player can enforce her desired contribution level by just waiting for the other group members to adjust to her will, thus diminishing the more extreme players' influence. Hence, majority rule encourages group members to search for a solution strategy for the social dilemma situation. Unanimity rule, however, assigns veto power to all group members; thus the question remains how more egoistic group members use their veto power more effectively to influence the outcome of the decision-making process. We think the most likely answer is that the indeterminacy of unanimity opens an opportunity space for psychological factors which promote the development of group egoism to take effect. In contrast, majority rule exhibits a dynamic pushing the outcome of group decision making towards the median cooperator's desired contribution level. Hence, in MT the formal decision-making institution exhibits strong incentives which dampen the influence of factors which in UT lead to lower contributions to the public good.

The Pareto-efficiency of unanimity rule implies that groups do not take actions putting individual group members in a worse position. However, ending up with in an inferior collective outcome is a constant risk in social dilemma settings. So the most striking result of our study is that unanimity rule promotes tendencies that move outcomes away from a Pareto-efficient solution. Our experimental findings thus challenge normative claims of unanimity rule's being an optimal decision-making rule because it guarantees Pareto-optimal outcomes of group decision-making.

4 Conclusions

In this study we asked whether unanimity rule can be viewed as a democratic norm and whether majority rule must be considered a "second-best solution". This assumption underlies several studies on democratic theory (Luhmann [1969] 1989) and decision theory (Buchanan and Tullock [1962] 1999). In our analysis we mainly focus on decision theory, in particular the concept of interdependence costs as promoted by Buchanan and Tullock ([1962] 1999). This concept allows us to sharpen our research question with respect to the trade-off between decision costs and welfare effects of unanimous and majority decision rules, as it is assumed in public choice theory. While Buchanan and Tullock suppose that the unanimity rule is superior to majority rule with respect to its welfare effects, and that in "everyday politics" it should only be deviated from unanimity to the extent that doing so lowers decision costs, we were able to demonstrate in a laboratory experiment that the theoretically hypothesized interdependence between external effects and decision costs does not inevitably exist. In the laboratory we randomly assigned individuals into groups and let them decide in a public goods game how much they wanted to invest in a common project. Subjects contributed less under unanimity rule than under majority rule. At the same time, decision costs, measured by number and durability of votes, were higher under unanimity rule than under majority rule. The latter evidence is in line with a hypothesis derived from public choice theory on decision costs. Thus, in our experiment majority rule created more efficient results than unanimity rule, contradicting received wisdom based on public choice theory and democratic theory regarding majority rule as a "stopgap".

Empirical case studies hint at the fact that veto power stemming from unanimity rule causes political failure. Thus, in his well-known analysis of the joint-decision trap, Scharpf (1985) has demonstrated for German educational policy and EU agricultural policy that the necessity of obtaining consent at the lower level of government, if this consent is to be formed by unanimity rule, leads to deadlock and sub-optimal policy outcomes in vertically interdependent decision systems. Scharpf rejects Buchanan and Tullock's assumptions as well: "However, I consider unanimity rule as the major cause of the problem-solving deficits on both levels ..." (Scharpf 1985: 337).[12] This view is supported by Conrad (2003), who analyzes the effects of unanimity rule in the council of ministers on the basis of a case study on the subsidy race in EU steel policy. He concludes "... that unanimous voting can lead to unexpected political interdependence and reduced problem-solving capacity" (Conrad 2003: 158).

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12 Translation by the authors.

The results of these studies correspond to our insights into the effects of unanimity rule. However, these empirical studies have to deal with many intervening variables. This means that reluctance to cooperate among the actors involved cannot be attributed exclusively to the decision rule, even though the authors claim that this is the major causal variable. Our laboratory experiment allows us to control for these intervening variables, which is why we can reliably state that the different decision rules are the causal variable for diverging welfare effects. However, these experimental results do not provide an argument for an overall superiority of the majority rule. Instead, we assume that decision rules interact with other variables which dampen or amplify the demonstrated effect. Many other variables have to be considered: for instance, communication, group size, sanctions available to actors, asymmetrical power relations among individuals, multi-level structures, trust relations, the time horizon for interaction, social norms with regard to cooperative behavior, etc. The result of this experiment should not be arbitrarily transferred to real-world situations. Nevertheless, this is not a methodological disadvantage. The experimental method allows to control systematically for additional variables such as group size or communication. Hence, the analysis of democratic decision rules can be put into mutable contexts, allowing a precise determination of its causal influence. We believe that the experimental method can be considered a useful "toolbox" for the analysis of many important questions in modern political science.

What conclusions can be drawn from our laboratory results for decision theory and democratic theory? Two aspects appear to be of major importance: First, the concept of interdependence costs fails, shown by the observable voting behavior in the laboratory; and secondly, these empirical results strengthen a normative view in democratic theory which criticizes the unanimity rule for providing an "empty criterion". While Buchanan and Tullock primarily suspect majority rule of potentially leading to political tyranny, we find evidence that veto power based on unanimity rule has the same potential. Thus, Buchanan and Tullock escape this theoretical argument by their assertion that any alternative draft of their model would ultimately be based on an external measurement of welfare effects and efficiency. Such a position appears sustainable. However, to avoid this problem we introduce the simple ancillary condition that more money is better than less. One may argue extensively about the general possibility of specifications for a common good in a multi-dimensional policy space. However, to assert that – in the absence of alternative options for investments – a higher material gain should be less valuable than a lower material gain infringes the rationality assumption of Buchanan and Tullock's public choice model. Thus, we have not developed a criterion for the normative superiority of majority rule, but we can suggest that the concept of normative superiority of unanimity rule fails under

specific empirical circumstances. This upholds advocates of a normative position that unanimity rule is an "empty criterion" which creates problematic deadlocks, by providing a further argument for the plausibility of their assumption. It remains the task of scholars engaged in normative democratic theory, however, to develop a less defensive approach to vindicate majority rule.

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