Why Votes Have a Value*

Ingolf Dittmann[a] Dorothea Kübler[b]

Ernst Maug[c] Lydia Mechtenberg[d]

December 11, 2010

Abstract

We perform an experiment where subjects bid for the right to participate in a vote and where the theoretical value of the voting right is zero if subjects are fully rational. We find that experimental subjects are willing to pay for the right to vote and that they do so for instrumental reasons. A model of instrumental voting behavior is consistent with our results if individuals are overconfident, overestimate the errors of other players, and also overestimate how often they themselves are pivotal for the outcome. Eliciting beliefs about pivotality shows that individuals value the right to vote more, the more they overestimate their probability of being pivotal. Eliciting beliefs about pivotality reduces the willingness to pay for the right to vote.

JEL Classification: C92, D72, G32

Keywords: Voting, paradox of voting, experimental economics, instrumental voting, expressive voting, voter turnout

---

* We are grateful to Dana Novotny and Jana Stöver for research assistance as well as to Dietmar Fehr, Wei Min Wang, and Mark Henninger for their help with conducting the experiments. The paper has benefited from discussions with seminar audiences in Berlin, Copenhagen, Frankfurt/Main, Helsinki, Konstanz, London, Mannheim, Munich, Princeton, Tübingen, Warwick, and Vienna. We also thank Roland Bénabou, Thomas König, Beni Lauterbach, and Wendelin Schnedler for their comments on an earlier draft of this paper. This project was funded by the Rudolf von Bennigsen-Foerder foundation and by Deutsche Forschungsgemeinschaft through the collaborative research center 649 "Economic risk" at Humboldt University, Berlin, and through the collaborative research center 504 "Rationality concepts, decision behavior, and economic modeling" at the University of Mannheim.

[a] Erasmus University Rotterdam, P.O. Box 1738, 3000 DR, Rotterdam, The Netherlands. E-mail: dittmann@ese.eur.nl. Tel.: +31 10 408 1283.

[b] Social Science Research Center Berlin (WZB), Reichpietschufer 50, 10785 Berlin, and Technical University of Berlin, Faculty of Economics and Management, Straße des 17. Juni 135, 10623 Berlin. E-mail: d.kuebler@ww.tu-berlin.de, Tel.: +49 30 25491 440.

[c] University of Mannheim, Department of Business Administration, 68131 Mannheim, Germany. E-mail: maug@bwl.uni-mannheim.de. Tel: +49 621 181 1952.

[d] Social Science Research Center Berlin (WZB), Reichpietschufer 50, 10785 Berlin. Email: .mechtenberg@wzb.eu,, Tel.: +49-30-25491-446.

1 Introduction

In this paper we investigate experimentally why individuals value the right to vote. Observations in different areas of economics suggest that individuals are willing to incur some costs in order to vote even if the benefits from voting appear negligible. For political elections (see Matsusaka and Palda (1993)) and votes on worker representation (see Farber (2010)) it is difficult to rationalize observed turnout rates.[1] For shareholder votes, the value of the voting right is reflected in stock market data and has been shown to be substantial (see Adams and Ferreira (2008)). However, no generally accepted explanation of this phenomenon has emerged. The literature identifies different types of potential benefits from voting that fall into two categories: instrumental explanations hold that voters value the right to vote only as a means to an end, whereas non-instrumental explanations posit that voters attach a value to the right to vote in itself.[2] Other papers recognize that the costs of voting might outweigh the benefits and argue that behavioral biases and systematic mistakes in individuals' calculations induce them to overvalue the right to vote.[3]

We perform an experiment to distinguish between these hypotheses. Our main contribution is the use of an experimental setup with three distinguishing features: First, it allows us to elicit individuals' willingness to pay for the right to vote and we use these estimates to distinguish between competing explanations of the value that people attach to their voting right. Second, we frame our experiment as shareholder voting, which leaves little room for non-instrumental explanations and thereby considerably reduces the number of potential explanations for the value of voting. Shareholder voting also provides a natural context for eliciting individuals' valuation of the right to vote. Finally, we use a common value framework with symmetric information and thereby preclude conflicts of interest, asymmetric information, or private benefits from control. As a consequence, the theoretical probability of being pivotal is zero even in small groups, and

[1] Farber (2010) finds turnout rates between 80% and 95% for votes among employees in U.S. private sector firms on whether or not they want to be represented by a union. Similar rates (between 75% and 80%) are observed for elections of worker representatives in German private sector firms (see Böckler Impuls 16/2006, http://www.boeckler.de/32014_84303.html).

[2] In political science the instrumental voting hypothesis is associated with the rational choice approach (Downs (1957), Riker and Ordeshook (1968)). We trace the non-instrumental approach back at least to Fiorina (1976), who credits Butler and Stokes (1969) with the distinction between instrumental and non-instrumental voting.

[3] See Dhillon and Peralta (2002) for a finer categorization of these behavioral explanations.

the value of a vote is zero in our setting. Yet, we find that individuals are often willing to pay for the right to vote.

The framework is one of a firm with two classes of shares, which are auctioned off at the beginning. One class of shares has the right to vote and the other class has no voting right. After observing a signal about the quality of the current manager, those experimental subjects who bought the voting shares decide on the replacement of the manager. The quality of the manager in charge after the vote determines the size of a dividend that is paid out to shareholders. Non-voting shares receive exactly the same dividends as voting shares, information is symmetric, and there is no conflict of interest between the holders of the two classes of shares. There are also no private benefits of control or any other features (e.g., moral considerations, a perceived duty to vote) that would lead participants in the experiment to intrinsically value the right to vote.[4]

We apply two solution concepts to this game, which both fall into the category of instrumental voting with rationality. The first is Nash Equilibrium, which assumes full rationality. The second solution concept is the Quantal Response Equilibrium model (QRE) by McKelvey and Palfrey (1995, 1998) where individuals make random mistakes and follow strategies that are best responses in such a context. Both solutions predict that there should be no voting premium in equilibrium. In our experiments, however, individuals attach a significant value to the right to vote. The predictions of the instrumental voting hypothesis with rationality are therefore rejected by our experimental findings.

Our first departure from instrumental voting with rationality tests whether individuals value the voting right for non-instrumental reasons, even though our setup provides little scope for such non-instrumental reasons. More specifically, we consider the *expressive voting hypothesis* that individuals value the right to vote because they enjoy the status of being a voter and expressing themselves, even if the outcome of the vote has no material consequences for them. We test this hypothesis with two treatments where the decision voters take have no material consequences for them, so that all instrumental reasons for voting are absent in these treatments. We find that the premium on voting shares compared to non-voting shares vanishes in both treatments. This finding is inconsistent with expressive voting.

[4] In our experiment, there is no difference between the value of the vote and the willingness to incur costs in order to vote (i.e., turnout) and we therefore use these two terms interchangeably in this paper. In more complex situations the two concepts differ although they remain closely related.

Our second departure from instrumental voting with rationality considers behavioral biases that we introduce step by step. Our point of departure is the QRE model, in which voters make random mistakes, but formulate best responses to the mistakes of other players. We introduce overconfidence into this model by assuming that individuals believe that all other participants in the game make random errors, while they themselves can completely avoid errors. In this case we obtain a voting premium, but it is orders of magnitude smaller than the voting premium in our experimental data. The reason is that a single investor is pivotal only with a relatively small probability, so even an overconfident investor should not be willing to pay much for a voting right.

In a further departure from rationality, we assume that subjects, in addition to being overconfident, overestimate the probability that other subjects make errors in the voting stage of the game. We employ the level-k model that has been introduced by Stahl and Wilson (1995) and Nagel (1995). We find that this model is able to explain much higher voting premiums than the QRE model with overconfident players. The level-k model generates an upper bound of the voting premium that is about half of the premium we observe in the baseline treatment.

The partial success of the level-k model is largely attributable to the implicit beliefs individuals hold about their pivotality according to this model. We investigate this matter further in a treatment in which we elicit the beliefs experimental subjects hold about their pivotality. Three findings emerge from this treatment. First, the voting premium paid in the auction falls by about 60% relative to the baseline treatment without belief elicitation, even though the premium remains large and statistically significant. Second, on average individuals suffer from an illusion of control and believe that they are pivotal with a much larger probability than the empirical probability for being pivotal in the experiment. Third, subjects’ beliefs about being pivotal vary markedly across subjects, and the premium they are willing to pay for the right to vote is highly correlated with their beliefs about being pivotal. In fact, a significant minority of our experimental subjects believe to be pivotal with a probability of 0.5, which is higher than what any theoretical model predicts. Based on this observation and the fact that a minority of subjects can determine the equilibrium price in our experiment, we set the marginal bidder’s belief about his or her pivotality equal to 0.5 in an ad-hoc calibration. This calibration yields predictions for the voting premium that match our experimental observations relatively closely.

We conclude that instrumental voting can explain the voting premium in the presence of three behavioral biases: subjects (1) are overconfident and assume that only the other players make mistakes, (2) overestimate the error rates of others, and (3) overestimate their own probability of being pivotal. All three departures from rationality are needed at the same time. Overconfidence itself can explain very little, but without overconfidence there is no voting premium. Similarly, the overestimation of error rates of others can explain, together with overconfidence, only about half of the observed voting premium. Hence, individuals' difficulty in formulating realistic beliefs about their pivotality is critical for understanding the experimental results.

We contribute to the literature on voting by showing that individuals are willing to pay for the right to vote even in a setup where non-instrumental reasons are absent. We also contribute by eliciting individuals' willingness to pay for the right to vote and by showing exactly which behavioral biases are needed in order to explain the voting premium.

A number of experimental studies investigate behavioral aspects of voting in the political sphere. The pivotal voter model by Palfrey and Rosenthal (1983) has been used by Schram and Sonnemans (1996a, 1996b) who test its comparative static predictions. In contrast to these papers and a number of earlier contributions, Palfrey and Rosenthal (1985) and Levine and Palfrey (2007) introduce heterogeneous costs, which lead to a unique equilibrium of the pivotal voter model. The study closest to ours is Duffy and Tavits (2008) who also elicit subjects' beliefs and find that subjects overestimate the probability of being pivotal. Several other experimental papers vary the probability of being pivotal to test the theory of expressive voting. This theory holds that voters tend to vote more expressively the less they believe their vote to be decisive (see Brennan and Hamlin (1998) and Brennan and Lomasky (1993)). Feddersen, Gailmard, and Sandroni (2009) and Shayo and Harel (2010) support this hypothesis whereas Tyran (2004) as well as Kamenica and Egan (2010) contradict it. However, none of these studies relates pivotality to the value individuals attach to the right to vote. In all studies voters differ in their preferences over the outcome of the vote, which admits non-instrumental interpretations, unlike our setup.

Another set of papers analyzes voter turnout when there is asymmetric information (Feddersen and Pesendorfer (1996, 1998, 1999) and Guarnaschelli, McKelvey and Palfrey (2000)). Battaglini, Morton and Palfrey (2006) provide a test of the swing-voter model by Feddersen and Pesendorfer (1996) and find that less informed voters delegate voting to better informed voters.

In contrast to these studies, participants in our experiment have symmetric information, which simplifies strategic considerations.

We know of only one field experiment on the value of voting. Güth and Weck-Hannemann (1997) try to elicit the value of the voting right in the context of a political election. Schram's (1997) comment highlights the difficulties of this approach. Apart from this paper, none of the studies on voting behavior attempts to gauge the subjects' valuation of the right to vote, which is one of the main contributions of our experiment.

The remaining part of the paper is structured as follows. Section 2 develops the model and derives the equilibrium under instrumental voting with full rationality. Section 3 describes the experimental setup. Section 4 discusses the experimental evidence in the light of instrumental voting with full rationality. Section 5 shows that individuals are not willing to pay for the right to vote in treatments that do not include instrumental reasons for voting. Section 6 investigates the QRE model with overconfident voters, and Section 7 analyzes the level-k model and the treatment with belief elicitation. Section 8 concludes. The appendix gathers some technical material.

2 The model

2.1 Setup of the model

General setup. The game has N risk-neutral investors with an initial endowment of cash who can bid for shares in a company. There are two classes of shares: A-shares, which give shareholders voting rights in the company, and otherwise identical B-shares without voting rights. A-shares and B-shares are both entitled to the same dividends per share and the number of A-shares and the number of B-shares is $M < N$ for each class. At the beginning investors bid for shares in the company, and each investor can buy at most one share of each class. Then there are two periods $t = 1, 2$, and the firm pays a dividend D_t in each period. Dividends depend on the quality of the manager and on a state of nature. This basic setup is the same for both periods. After observing the dividend paid in the first period, shareholders vote on whether the manager will run the firm again in the second period or whether she will be replaced by a new manager.

Technology and dividends. Managers are drawn from a pool, and the number of good managers and bad managers in the pool is the same. If the manager is good, then the dividend in period t is high ($D_t = H$) with probability $p \geq 0.5$. In the complementary state, the dividend is low ($D_t = L < H$) with probability $1 - p$. If the manager is bad, then $D_t = L$ with probability p and $D_t = H$ with probability $1 - p$. Investors know the probability p, but not the quality of the manager. Since firms draw a good manager or a bad manager from the pool with equal likelihood, the posterior probability of having a good manager is therefore p if $D_t = H$ and $1 - p$ if $D_t = L$.

Voting. Shareholders observe the dividend in the first period and then vote on the replacement of the manager by majority vote. Only owners of A-shares vote. They have one vote per share and cannot abstain from voting. For simplicity, we assume that M is odd, so the manager will be replaced whenever at least $(M+1)/2$ votes are cast for the replacement of the manager. Then a new manager is drawn from the same pool for the second period, so the new manager is again good or bad with equal probability. If fewer than $(M+1)/2$ votes are cast for the replacement of the manager, then the old manager stays in charge.

Initial allocation of shares. At the beginning, each investor can simultaneously submit a bid for an A-share and another bid for a B-share. No investor is allowed to bid for multiple shares of the same class.[5] It is impossible not to bid, but it is possible to bid zero. The auctioneer collects the N bids for each class of shares. The shares for each class are then allocated to the investors who submitted the M highest bids. Investors pay a price equal to the $M+1^{st}$ bid submitted for this class of shares. If several investors submit identical bids so that the M^{th} bid is not unique, then the auctioneer allocates the shares by lot among these investors.

Sequence of events. We obtain the following extensive form of the game:

1. Nature draws the quality of the manager who runs the firm. Investors bid for shares in the firm.
2. The auctioneer allocates the shares of the firm to investors and sets prices. Investors pay the price for the shares they receive.
3. The dividend for the first period is realized, becomes observable to all investors, and is paid to all shareholders.

5 We impose this restriction for several reasons. At the bidding stage, this assumption greatly simplifies the potential bids of the investors, and (together with a sufficiently high budget) makes sure that investors always have enough resources to bid for all the shares they want. At the voting stage, this restriction makes sure that there are always M voters, so that it is not possible to buy a majority of votes.

4. A-shareholders vote on the replacement of the manager.
5. The dividend for the second period is realized, becomes observable to all investors, and is paid to all shareholders.

The game is the simplest setup that allows us to separate the different versions of the instrumental voting hypothesis and the non-instrumental voting hypothesis. We need a minimum of two periods, so that individuals can make inferences from the first dividend regarding the quality of the manager, and then make appropriate decisions contingent on these inferences. We use two classes of otherwise identical shares in order to control for unobservable factors that might affect individuals' valuations. In particular, our setup is robust to risk-aversion, because risk-aversion affects the prices of the two types of shares, but not the price difference, which is the quantity we are most interested in.

We frame the game as a shareholder vote to rule out many reasons why individuals might value the voting right in practice. Our aim is *not* to model the microstructure of trading in dual-class shares. In real-world markets, individuals who act more rationally may act as arbitrageurs and take advantage of individuals who overvalue the right to vote, and this may lead to different pricing results.

In our experiment, there are no information asymmetries, no conflicts of interest, and no private benefits from having the right to vote. Hence, the incentives of all subjects are fully aligned and there is no scope for interest groups. Our setup also rules out the "voter's illusion" (see Quattrone and Tversky (1984)), where the voter believes that if he incurs the costs of voting, others will do so as well. In our setting, the number of voters (or the "turnout") is always constant and the question is not *how many* individuals vote, but *who* votes. Finally, our setup precludes notions of civic duty or social status that may otherwise affect voting behavior.

In our model, the value of the vote is identical to the costs individuals are willing to pay to participate in the vote. The reason is that there is only a single vote that all voting shareholders must attend. In general, the right to vote is an option to participate in any future vote. Hence, individuals might value the right to vote while never actually participating in a vote. We do not make this distinction in this paper.

2.2 Nash equilibrium

In this section we derive theoretical predictions for the voting premium implied by the instrumental voting hypothesis with full rationality.

Voting. In the first period, and also after a replacement of the manager in the second period, the quality of the manager is good or bad with equal probability. If the manager is good, the expected dividend is $pH+(1-p)L$; if she is bad, it is $(1-p)H+pL$. Denote by $\delta\in\{R,K\}$ the decision to replace (*R*) or to keep (*K*) the manager. The expected dividend is then:

$$E(D_1)=E(D_2|D_1=H,\delta=R)=E(D_2|D_1=L,\delta=R)=\frac{H+L}{2}. \tag{1}$$

After observing a high dividend, the posterior probability of the manager to be good is *p*. Hence, if the manager is kept, we obtain:

$$\begin{aligned}E(D_2|D_1=H,\delta=K)&=p\left(pH+(1-p)L\right)+(1-p)\left(pL+(1-p)H\right)\\&=\frac{H+L}{2}+2\left(\frac{1}{4}-p(1-p)\right)(H-L).\end{aligned} \tag{2}$$

Similarly, if the manager is kept after observing a low dividend:

$$\begin{aligned}E(D_2|D_1=L,\delta=K)&=p\left(pL+(1-p)H\right)+(1-p)\left(pH+(1-p)L\right)\\&=\frac{H+L}{2}-2\left(\frac{1}{4}-p(1-p)\right)(H-L).\end{aligned} \tag{3}$$

Note that $p(1-p)\le 1/4$, with equality only if $p=1/2$. It follows from (1), (2), and (3) that if $p>1/2$, then A-shareholders wish to replace the manager if D_1 = *L* and they wish to keep the manager if D_1 = *H*. If $p=1/2$, they are indifferent between replacing and keeping the manager. In principle there are many asymmetric equilibria of this game where no shareholder is pivotal for the decision. For example, in one equilibrium (*M* + 1)/2 + 1 A-shareholders always vote to replace the manager and (*M* - 1)/2 – 1 A-shareholders always vote to keep her. However, there is no central coordinating mechanism in this game to allocate different roles to shareholders. In the unique symmetric equilibrium in weakly undominated strategies, all A-shareholders vote for replacing the manager if D_1 = L and for keeping her if D_1 = H as long as $p > 1/2$.[6] We focus on this equilibrium here and ignore the asymmetric equilibria of the voting game. We also ignore non-responsive symmetric equilibria where all shareholders always vote for the same alternative. Note that these equilibria are not in weakly undominated strategies.

Bidding and valuation. Using equations (1) to (3), we obtain from the equilibrium replacement decision:

$$\begin{aligned} V_{Nash} &= E(D_1) + \frac{1}{2}E\left(D_2 \middle| D_1 = H, \delta = K\right) + \frac{1}{2}E\left(D_2 \middle| D_1 = L, \delta = R\right) \\ &= H + L + \left(\frac{1}{4} - p(1-p)\right)(H - L)\,. \end{aligned} \tag{4}$$

Whenever $p > 1/2$, we have $V_{Nash} > H + L$, whereas without voting $V_{Nash} = H + L$. The second term in equation (4) therefore reflects the benefits from voting to shareholders, which are zero if $p = 1/2$. The intrinsic value V_{Nash} is the same for A-shares and for B-shares. The auction is a standard multi-unit Vickrey auction, so it is a weakly dominant strategy for each risk-neutral investor to bid the intrinsic value V_{Nash} for an A-share and also for a B-share. If all investors do this, then the unique price for the A-shares is P_A = V_{Nash}, and, similarly for the B-shares P_B = V_{Nash}. There is therefore no price difference between the two classes of shares. Since all investors bid the same amount, the auctioneer allocates the shares by lot.

3 Experimental setup

We implement the model in an experiment in order to test if individuals value the right to vote and to distinguish between different theories of voting. All treatments have N = 8 investors. There are M = 5 A-shares and 5 B-shares, and the dividends are H = 20 and L = 0. There are five treatments:

BASE: The <u>baseline treatment</u> has p = 80%. With this parameter value, the difference between the good manager (generating an expected dividend of E(D) = 16) and the bad manager (with

6 In order to see this note that in any completely mixed strategy profile there is a positive probability for each A-shareholder to be pivotal. But then the expected second period dividend is strictly higher when the manager is replaced compared to when she is kept (given that $D_1 = L$ and $p > 1/2$) and voting to replace her is then a strictly dominant strategy for each shareholder.

E(D) = 4) is substantial. We attach the translation of the experimental instructions for the baseline treatment at the end of this document.

NU: In the no-uncertainty treatment p = 100%. Then E(D) = 20 with a high quality manager and E(D) = 0 with a low quality manager, so that the stakes have increased relative to the base treatment. In addition, the inference problem in this treatment is much simpler than in BASE, which should reduce the number of shareholders who erroneously vote against their interest. This treatment therefore serves as a robustness check on the baseline treatment.

NI: In the non-influential manager treatment p = 50%. Then E(D) = 10 independently of the quality of the manager, and voting is inconsequential for the value of the firm. The inference problem is trivial. While A-shareholders have an impact on whether the manager is kept or replaced, they cannot influence the distribution of future dividends with their vote. We use this treatment to test for non-instrumental explanations of voting and bidding behavior.

BH: In the blockholder treatment, p = 80%, just as in the baseline treatment. However, in addition to the 5 A-shares auctioned off at the beginning, there is a blockholder who owns 6 A-shares and who always votes in favor of the incumbent manager. As a result, it will never be possible to replace the manager, no matter how the 5 A-shareholders vote. This treatment is similar to the non-influential manager (NI) treatment with respect to the instrumental value of the vote, which is zero. We use it also to investigate non-instrumental theories of voting.

The non-influential manager treatment and the blockholder treatment also allow us to address a potential criticism of the experiment, which holds that subjects pay for the right to vote for the mere entertainment value of voting: They might value the right to vote simply to avoid looking at a blank screen while the other participants in the experiment vote. If this is true, then participants should also be willing to pay a premium in treatment NI and treatment BH, where their vote has no impact on the outcome. We show below that there is no reason for this concern in our experiment.

BE: In the belief-elicitation treatment, p=80%. The only difference to the baseline treatment is that in every round investors are asked for their beliefs about whether they are pivotal in the vote. Investors receive an additional payout according to the quadratic scoring rule, so that they receive higher payoffs the closer their stated beliefs are to the true probability of being pivotal. This treatment allows us to measure by how much subjects overestimate the probability to be pivotal and how they are influenced by having to think about pivotality.

The groups in our experiment are small; only five players participate in a vote. Therefore, our experiment probably generates beliefs about the probability of being pivotal that are higher than an experiment with larger groups would have done. However, another feature of our experiment, the common interest setting, significantly reduces the probability of being pivotal compared to studies with larger groups but conflicting interests. The observed probability of being pivotal in our experiment is between 5.3% and 13.9% and therefore lower than the corresponding number of 14.9% in Duffy and Tavits (2008) for instance.

[Insert Table 1 here.]

Table 1 provides an overview of the five different treatments and gives the parameter values for each treatment. The table also shows the Nash value of the shares from equation (4). Shares are most valuable in treatment NU with V_{Nash} = 25 and least valuable in treatments NI and BH with V_{Nash} = 20. The table also shows the benefit ΔU from making the correct decision relative to making an incorrect decision (from the payoffs in (1), (2), and (3) above):

$$\Delta U = 2\left(\frac{1}{4} - p\left(1-p\right)\right)\left(H-L\right) \geq 0 \tag{5}$$

We ran 10 sessions per treatment, and each session lasted for about 90 minutes. There were eight subjects per session, and no subject participated in more than one session. The participants played the same game (treatment) for 30 rounds, and no participant played more than one of the treatments. Subjects' average earnings were 28 Euros, including a show-up fee of 3 Euros. The currency in the experiment was "points," which were exchanged into real money at the end of the experiment at the exchange rate of 1 point = 3 cent. The exchange rate was known to all participants. At the beginning of the experiment, each participant was given a budget of 150 points. In order to prevent investors from running out of money after a series of zero dividends and to avoid frustration from receiving a payoff of zero in several rounds, each individual received an additional 16 points at the end of each round.

All experiments were carried out in the computer lab at Technical University Berlin between January 2006 and May 2010. We used the software tool kit z-Tree to program the experiments

(Fischbacher (2007)). Participants were students from different universities in Berlin.[7] After the experiment, students were asked to fill in a questionnaire, and the vast majority of them stated that they did not have any experience with investing in the stock market. Therefore, we are confident that most students were not aware of the price difference between voting and non-voting shares in listed companies. It is unlikely that they simply imitated behavior they had observed outside the lab.

4 Experimental results

In this section, we present our experimental results and test whether the Nash equilibrium derived in Section 2.2 provides a good description of our findings. Nash equilibrium presupposes that individuals are rational and do not attach a value to the voting right itself: they see the voting right only as a means to obtain a higher payoff. Testing the implications of Nash equilibrium is therefore equivalent to testing instrumental voting under full rationality. We consider non-instrumental explanations in Section 5 and bounded rationality models in Section 6.

4.1 Learning in the baseline treatment

We first check to what extent our experimental subjects learn to play the game during the experiment. Figure 1 shows the prices of voting and non-voting shares over time, and Figure 2 displays the frequency of incorrect votes, i.e. the frequency that A-shareholders vote for replacing the manager after a high dividend or for keeping the manager after a low dividend. Both figures refer to the BASE treatment.

[Insert Figure 1 and Figure 2 here.]

The figures indicate that subjects display some learning in the course of the experiment: prices increase over time and voting errors decrease over time. Figure 1 shows that learning with respect to prices takes place only during the first 10 periods; after period 10, average prices do not vary by much anymore. Figure 2 shows that there is little learning with respect to voting decisions. After observing a high dividend, the error rate falls from an average of about 18% during the first

---

7 Drehmann, Oechssler and Roider (2005), Cipriano and Guarino (2009), and Alevy, Haigh and List (2007) compare students to consultants or financial market professionals and do not observe differences in behavior. Coval and Shumway (2005) analyze the behavior of traders on the Chicago Board of Trade and find many behavioral biases that have previously been documented in laboratory experiments. We therefore believe that our results generalize beyond students.

10 periods to about 12% during the last 10 periods. After a low dividend, there is hardly any change at all.[8] In the following analysis, we always report averages across the last 15 periods, when learning processes seem to have converged.

4.2 Prices in the baseline treatment

Table 2 shows statistics for the prices of voting and non-voting shares (P_A and P_B) as well as for the voting premium $P_A - P_B$ and the relative voting premium $(P_A - P_B) / V_{Nash}$. We scale prices because the intrinsic values of the shares vary across treatments. The prices P_A and P_B are very volatile and therefore unsuitable for scaling, so we scale by the risk-neutral value of the shares in Nash equilibrium from (4), which is 21.80 in the baseline treatment. Prices might be correlated within each session, so we average prices across the last 15 rounds for each session and present the results on these 10 independent observations in Panel A. For completeness, we also report the same results for all 300 observations (10 sessions with 30 rounds each) in Panel B, where we treat every round as if it were an independent observation. Within a session, our subjects observe other subjects' behavior indirectly via the outcome of the voting game and the prices of the two types of shares. Therefore, the observations of prices and bids within a session cannot be treated as independent observations. The same remark applies to subsequent tables.

[Insert Table 2 here.]

With the results from Table 2, we can clearly reject the hypothesis that the voting premium is zero. Individuals do value the right to vote. The voting premium is 2.91 on average with a median of 2.63. If we look at the entire sample of all 300 rounds, then the voting premium is only slightly different with a mean of 2.82 and a median of 2.00. These voting premiums are different from zero at all conventional significance levels, and, at about 13.4% of the expected value of the shares, they are also economically significant.

The average (median) price for an A-share is 18.52 (18.27), the average (median) price of a B-share is 15.61 (17.37). Hence, average prices are substantially below the risk-neutral Nash-equilibrium value of 21.80 in the baseline treatment (15% for A-shares, 28% for B-shares), and

[8] The difference for individual errors τ between periods 1 to 15 and periods 16 to 30 is statistically highly significant for votes after a high dividend (χ^2-test with p-value 0.8%). All other differences between the first 15 periods and the last 15 periods in the figures are not statistically significant.

this difference is highly significant. One interpretation of this finding is that individuals are risk-averse and therefore value the shares at less than their risk-neutral values.

4.3 Bids in the baseline treatment

Our analysis of bids arrives at the same qualitative conclusions as the analysis of prices. Table 3 shows descriptive statistics for the 80 average bids across the last 15 rounds for each subject in Panel A. Panel B displays the results for 2,400 individual bids (10 sessions with 8 subjects and 30 rounds). Bids are much more volatile than prices: Their standard deviation is six to eight times higher than the standard deviation of prices. Bids vary between 0 and 300, and there are no systematic changes over time (not shown in the tables) similar to those we observe for prices and for voting behavior (see Figure 1 and Figure 2). Given that the maximum payout per share is 40 (if both dividends turn out to be high), any bid above 40 appears irrational at first glance. However, the five winners in the auction do not pay their own bids but the sixth highest bid, so bidding more than the intrinsic value of the share (or more than 40) is merely a weakly dominated strategy. The equilibrium price is consistently lower than the average payoff of the shares. Subjects who make extremely high bids then typically receive high payouts and have little incentive to refrain from making bids that seem irrationally high. We therefore only interpret the median of the bids to give less weight to these outliers.

[Insert Table 3 here.]

Median bids are by construction higher than (average or median) prices, because prices equal the sixth highest bid, i.e. the 25^{th} percentile of all bids. Table 3, Panel B reveals that 53.8% of all 2,400 pairs of bids feature a positive voting premium and only in 10.8% of all cases do subjects bid less for an A-share than for a B-share. The remaining bids (35.4%) have the same price for both shares. Again, voting premiums are positive and statistically significant at all conventional significance levels and we conclude that our experimental subjects value the right to vote. Overall, we conclude that the Nash equilibrium described in Section 2.2 yields poor predictions for the bids and prices observed in the experiment.

4.4 Voting behavior in the baseline treatment

We now turn to the voting stage to check whether voting behavior is in line with the unique symmetric perfect Nash equilibrium. Denote the probability that an A-shareholder deviates from the equilibrium prediction when voting on the dismissal of the manager by τ_{D_1}. So τ_L is the probability that a shareholder votes against a dismissal after observing a low dividend, and τ_H is the probability that a shareholder votes for dismissal after observing a high dividend. Assuming that these deviations or errors are independent of each other, the voting outcome now involves a certain probability of a mistake, namely:

$$e_L = \Pr\left(\delta = K \mid D_1 = L\right) = \sum_{i=(M+1)/2}^{M} \binom{M}{i} \tau_L^i \left(1-\tau_L\right)^{(M-i)}, \tag{6}$$

$$e_H = \Pr\left(\delta = R \mid D_1 = H\right) = \sum_{i=(M+1)/2}^{M} \binom{M}{i} \tau_H^i \left(1-\tau_H\right)^{(M-i)}. \tag{7}$$

[Insert Table 4 here.]

Table 4 reports these errors for all treatments. The table shows that in the baseline treatment, A-shareholders vote for keeping the manager after observing a low dividend 18.3% of the time, averaged over the last 15 rounds. The frequency e_L that after a low dividend more than two A-shareholders vote against replacing the manager is 7.1%. After a high dividend, 11.8% of A-shareholders vote incorrectly (that is, for replacing the manager), which results in an actual dismissal in 3.0% of all cases. Shareholders make more mistakes after a low dividend than after a high dividend (the p-value for the χ^2-test is 1.4%, for the Wilcoxon test it is 14.8%).[9] Subjects are potentially more reluctant to fire a good manager than to keep a bad manager (even though they have been told that the manager's role is played by the computer).[10]

We further analyze the voting errors of subjects who participate in the vote at least once during the last 15 rounds. In the base treatment, 37% of these never make an error, 44% have a positive error rate that is smaller or equal to 33%, and only 19% make errors in more than 33% of the cases. These results are not reported in the tables. It therefore seems that most individuals experiment once in a while when they vote or that they become inattentive and make errors.

[9] Throughout the paper, Wilcoxon p-values are calculated from the exact distribution when the sample size is smaller or equal to 20. Otherwise, we use the t-approximation.

[10] Our error rates of 18.3% and 11.8% are somewhat higher than those found by Guarnaschelli, McKelvey, and Palfrey (2000) who find error rates in the range of 5% to 12%. In their experiment, every voter has a piece of privileged information and it is therefore important for the final outcome that everyone votes correctly. In our setting, there is no information asymmetry and the outcome is not affected by occasional errors. Our experimental setup therefore invites more inattentiveness than the setup in Guarnaschelli, McKelvey, and Palfrey (2000).

There is little evidence that there is a group of individuals who persistently make errors when they vote. We also checked whether the voting premium increases after an erroneous decision has been made in the previous period, but we do not find any significant relation here, most likely because erroneous decisions are rare. Likewise, we find no relation between the number of wrong votes and the subsequent voting premium. We also searched for a relationship between voting errors and the premium in offers, but due to the high variation in offers did not find anything.

4.5 The no-uncertainty treatment

We repeat the experiment with $p = 1$, i.e., a good manager generates a high dividend with certainty and a bad manager generates a low dividend with certainty. Therefore, the inference problem at the voting stage is greatly reduced, and we expect fewer errors at the voting stage. Table 4 shows that there are indeed fewer errors in treatment NU than in BASE. After a low dividend, 18.3% of the subjects vote for keeping the manager in the baseline treatment while only 11.0% do so in the no-uncertainty treatment. However, the difference is only marginally significant in a one-sided Wilcoxon test (p-value: 7.2%).[11] Moreover, in BASE we observe inefficient voting outcomes after a low dividend in 7.1% of all cases while we do not observe any inefficient voting outcomes in NU. This difference is significant with a p-value of 0.5%. After a high dividend, error rates are also lower in NU than in BASE, but here the differences are not statistically significant. Interestingly, the reluctance of some shareholders to fire the manager after a low dividend, observed in BASE, is lower in treatment NU, where there is no difference between τ_L and τ_H. Note that in NU, it is certain that the manager is bad after a low dividend whereas in BASE there is still a probability of 20% that the manager is good. This might explain the lower propensity to fire the manager after a low dividend in BASE but not in NU.

[Insert Table 5 here.]

Table 5 shows descriptive statistics for prices (Panel A) and bids (Panel B) averaged across the last 15 rounds for the no-uncertainty treatment. Given that the Nash value of the shares is higher in the no-uncertainty treatment than in the baseline treatment, it is not surprising that prices and bids are also generally higher. However, the differences between prices in BASE and NU are never significant. The mean (median) relative price premium of voting shares is 16.0% (12.5%)

---

[11] We calculate for each session the error probability τ_L and then apply a two-sample Wilcoxon signed rank test for equality of these error probabilities across treatments. The results of this test are not shown in the tables.

in Table 5, Panel A, which is higher than in the baseline treatment, where it is 13.4% (12.1%, see Table 2, Panel A), although the difference is also not significant. Mean and median bids are slightly lower in NU than in BASE (compare Table 5, Panel B with Table 3, Panel A), but the difference is again not significant. We conclude that the results for the no-uncertainty treatment are similar to those in the baseline treatment.

We conclude from the discussions of the treatments BASE and NU that our results contradict the predictions of Nash Equilibrium. In the next three sections we therefore investigate several avenues where we relax the assumptions of Nash Equilibrium.

5 Non-instrumental voting

The first departure from Nash Equilibrium we consider allows for non-instrumental motivations to vote. Instrumental voting presumes that individuals value the right to vote only because voting affects their own payoffs. However, our experimental subjects may attach a direct value to the right to vote for a range of alternative, non-instrumental reasons, and we consider two such reasons in this section.

The first non-instrumental voting hypothesis we consider is expressive voting, which posits that voters enjoy voting because it gives them the opportunity to "make their voice heard." The outcome and the ultimate effect of one's own vote on the outcome are secondary in this case. Brennan and Hamlin (1998) epitomize the expressive motivation to vote as "voter participation just *is* the act of consumption that brings the voter to the poll" (p.156).[12] Our framework does not provide much scope for expressive voting and is not intended as a test of expressive voting more generally, but we have to consider expressive voting as a potential explanation for our results.

With expressive voting we should observe that investors value the voting right independently of how much influence voting has on their payoffs, but conditional on there being a meaningful issue on which opinions can be built and expressed. In particular, investors should be willing to pay a premium for voting shares in the blockholder treatment BH, but not in the non-influential manager treatment NI. In both treatments, the vote of the A-shareholders does not affect the

[12] Here, we refer only to the general definition of expressive voting by Brennan and Hamlin (1998) and Brennan and Lomasky (1993). Their so-called low-cost theory of expressive voting according to which voters tend to vote more expressively the more they identify with the issue that is voted on and the less they think their vote matters, is not applicable to our setup.

expected second period dividend. However, in treatment NI voting has no influence because the quality of the manager does not affect dividend payments, so that there is no meaningful issue on which opinions could be expressed. By contrast, in treatment BH the vote has no influence because the manager is never replaced, but since management quality affects payoffs, the issue of the vote is meaningful.

The second non-instrumental explanation for our results is that subjects value the entertainment value of voting, because they prefer to engage in some activity rather than watching a blank computer screen while other subjects vote. Subjects may also value voting shares because they are labeled ‘A,’ which they may consider a label of superiority.[13] If this explanation is true, subjects should pay a premium also in treatments BH and NI.

[Insert Table 6 and Table 7 here.]

Table 6 shows the results for the non-influential manager treatment (NI) and Table 7 shows those for the blockholder treatment (BH). Both tables are structured like Table 5, Panel A. From both tables we can see that the voting premium becomes very small and statistically indistinguishable from zero. The voting premium is as low in treatment BH as it is in treatment NI, and it is significantly smaller under either treatment than under the baseline treatment. Therefore, the results from Table 6 and Table 7 do not lend any support to the two non-instrumental voting hypotheses discussed above.[14]

We conclude that individuals are not willing to pay for the right to vote when the votes of all participants do not have any material consequences. The voting premium vanishes whenever the instrumental value of the vote is zero, either because the issue decided by the vote has no impact on individuals’ payoffs, or because individuals’ votes can never become decisive. This observation lends strong support to instrumental voting.

[13] All our experimental subjects were undergraduate students at a German university and were therefore not conditioned on US-style letter grades. This explanation is therefore less plausible in our context.

[14] Another non-instrumental explanation for a voting premium may be that individuals enjoy voting for the winner (see Bartels (1988), Callander (2007), Fiorina (1974), and Schuessler (2000)). If this is the case, then we should see that individuals do vote for the winner and that they value votes more if they have a better chance of voting for the winner. Treatment BH should arguably be very attractive for individuals who want to vote for the winner, because the winner is known for sure. However, we do not observe a voting premium in this treatment and Table 4 shows that individuals do not vote for the winner. Therefore, we also do not find any support for this variant of non-instrumental voting.

6 The QRE model and overconfidence

The central result of the previous two sections is that neither the Nash solution nor non-instrumental voting can explain our experimental results. In this section and in the next one, we return to the assumption of instrumental voting, but we now consider models that deviate from full rationality.

The first deviation from Nash Equilibrium is based on the presumption that participants in experiments take into account the possibility that other players make mistakes. McKelvey and Palfrey (1995, 1998) develop the concept of Quantal Response Equilibrium (QRE), which incorporates this aspect and which has been successfully applied to the analysis of experimental results.[15] A QRE is based on the assumption that players' strategies are best responses to the mistakes they anticipate other players to make. We first develop the standard version of QRE and show that the valuation of the two classes of shares is still the same as long as errors are symmetric across players and these errors are common knowledge. We then extend the argument to the case where investors are overconfident.

Rationality with errors. We first derive the value of one share when individuals make errors. Using the probabilities e_H and e_L that the vote results in a wrong decision (see equations (6) and (7)), the manager is kept after a high dividend with probability $(1 - e_H)/2$. In this case, the expected dividend in the second period is $E\left(D_2 \middle| D_1 = H, \delta = K\right)$ as given in equation (2). With probability $(1 - e_L)/2$ the manager is replaced after a low dividend, and with probability $e_H/2$ the manager is replaced after a high dividend. In both cases the expected dividend in the second period equals $(H + L)/2$ from equation (1). With probability $e_L/2$ the manager is kept after a low dividend and the expected dividend is $E\left(D_2 \middle| D_1 = L, \delta = K\right)$ as given in equation (3). The value of one share is therefore:

$$V_{QRE} = H + L + \left(\frac{1}{4} - p(1-p)\right)(H - L)\,(1 - e_L - e_H). \tag{8}$$

For the case without errors, we have $e_L = e_H = 0$, and the value of the shares in QRE becomes equal to V_{Nash} as in (4). If we plug our estimates from Table 4 into equations (6), (7), and (8), we

[15] See, for example, Guarnaschelli, McKelvey, and Palfrey (2000) for an application of QRE to a voting game.

obtain V_{QRE} = 21.69 (compared to V_{Nash} = 21.80), so the reduction in value caused by the observed voting errors is small.

The probability of making a mistake is symmetric across players and common knowledge by assumption. It follows that equation (8) applies to both classes of shares and $P_A = P_B = V_{QRE}$, so there is no price difference between voting A-shares and non-voting B-shares. This argument holds for any model with symmetric errors that are common knowledge. QRE with rationality can therefore not explain the voting premium found in Section 4.

Quantal response equilibrium predicts that subjects make fewer errors when the utility difference between a correct and a wrong vote is larger. As a consequence, subjects who own an A-share and a B-share should make fewer errors than subjects who only own an A-share. We find the opposite: A-shareholders who do not own a B-share make errors with probability 12.4% while the probability is 16.4% for A-shareholders who also own a B-share, but the difference is not statistically significant. We can also test this prediction across treatments, because the utility difference ΔU equals 3.6 for the BASE treatment and 10 for the NU treatment (see Table 1). In line with the prediction, observed errors are higher in BASE (7.1% after a low and 3.0% after a high dividend) than in NU (0.0% after a low and 1.4% after a high dividend, see Table 4). However, if we follow Guarnaschelli, McKelvey, and Palfrey (2000) and estimate the responsiveness coefficient, our estimates do not differ significantly between treatments (results not shown in the tables).

Overconfidence. We now go one step further and assume that investors are overconfident in the following sense. At the voting stage they make errors as described above, and the probability of making a mistake is the same for all investors. However, the symmetry of errors is no longer common knowledge. Instead, each investor believes that only the other shareholders will make mistakes by making random choices at the voting stage, whereas he himself can make the correct judgment without fail. We assume this extreme form of overconfidence as it will provide us with an upper bound on the voting premium. Overconfident investors value being pivotal at the voting stage because according to their beliefs it helps them to avoid the errors other investors would make. But behavior at the voting stage is not affected by overconfidence, and the actual error probabilities are still given by τ_L and τ_H.

With overconfident investors, the valuation formulae for the expected dividends and therefore the intrinsic valuation of a share in (8) do not change. However, overconfident investors anticipate that they can improve on this valuation if they own a voting share and are pivotal in the voting game. We denote the probability of any A-shareholder to be pivotal conditional on the dividend payment D_1 by π_{D_1}:

$$\pi_{D_1} = \binom{M-1}{(M-1)/2} \tau_{D_1}{}^{(M-1)/2} \left(1-\tau_{D_1}\right)^{(M-1)/2} = \binom{4}{2} \tau_{D_1}^2 \left(1-\tau_{D_1}\right)^2 . \tag{9}$$

Table 4 displays these probabilities for the individual treatments. An overconfident investor believes that whenever he is pivotal, he can change the probability of replacing the manager if $D_1 = L$ from $1-\tau_L$ to 1 and, if $D_1 = H$ he can change it from τ_H to 0. Hence, an overconfident investor overvalues each share conditional on being able to vote by ω:

$$\omega = \tfrac{1}{2}\left(\pi_H \tau_H + \pi_L \tau_L\right) \Delta U, \tag{10}$$

where ΔU is given in equation (5). Thus, ω denotes the increase in intrinsic value of a share from participating in the vote from the point of view of an overconfident investor. This will generally not be the voting premium in equilibrium because an investor's valuation of the B-shares depends on his ability to obtain an A-share in the auction.[16] An overconfident investor also values the non-voting share above its intrinsic value (8) conditional on obtaining an A-share, because whenever he owns a voting share, this also increases his valuation of the non-voting share. The interdependence makes the analysis of the equilibria of the auction game somewhat tedious, and a complete characterization of these equilibria is beyond the scope of this paper.[17] In the following proposition, which we prove in the Appendix, we only summarize the theoretical results that are relevant for our empirical analysis.

[16] For interdependent valuations, auction theory recommends a combinatorial auction, where participants can bid on each possible bundle of the two shares. In such a setup truthful bidding remains the optimal strategy even in the presence of complementarities or substitution effects (Varian and MacKie-Mason (1995); for a survey see de Vries and Vohra (2003)). We decided against such a design because of its complexity and because a combinatorial auction could have an unwanted framing effect. When making a bid on the bundle of an A-share and a B-share, subjects could have been led to believe that A-shares and B-shares are complementary, i.e. the framing could have induced incorrect beliefs.

[17] A complete analysis of all pure-strategy equilibria of the auction game with overconfident players is available from the authors upon request.

Proposition 1: *Assume that each investor believes that the value of a share of the company increases by ω if he owns one A-share. Then: (i) There exists no symmetric equilibrium in pure strategies. (ii) There exists a continuum of asymmetric equilibria in weakly undominated pure strategies where the voting premium satisfies $0 \le P_A - P_B \le 2\omega$.*

Intuitively, Proposition 1 can be understood as follows. Investors are willing to pay $2(V_{QRE} + \omega)$ for both shares together. Prices below V_{QRE} cannot be sustained in equilibrium for any B-share, and, similarly, prices below $V_{QRE} + \omega$ cannot be sustained for any A-share. The reason is that those investors who bid low and receive no shares in equilibrium would otherwise be better off by bidding high for one type of share. However, the additional value ω of the B-share can be allocated in any possible way between the A-share and the B-share. The highest premium of 2ω results when the price of the A-share reflects the whole increase in value of both shares while the price of the B-share is just equal to V_{QRE}. Conversely, both shares may be priced at $V_{QRE} + \omega$ in equilibrium, so that the voting premium is zero. Any intermediate case is also possible, which gives rise to a continuum of equilibria.

[Insert Table 8 here.]

Table 8, Panel A displays the upper bound 2ω from Proposition 1 for the treatments BASE and NU. We offer two alternative estimates of this upper bound: One estimate is based on the *theoretical pivotality* where we calculate the probabilities π_L, π_H with equation (9) from the empirical error probabilities τ_L, τ_H, and the other estimate is based on the *empirical pivotality*, where we use the frequency that shareholders were indeed pivotal in each treatment. The empirical pivotality is also shown in Table 4. We obtain a maximum premium of $2\omega = 0.12$ for the BASE treatment if we use equation (9) and $2\omega = 0.14$ if we use the empirical probability of being pivotal. Both values are less than 5% of the average observed premium of 2.91, and the observed premium is significantly higher than this upper bound at the 1% level. The disparity between predicted and observed values is even larger for treatment NU. We conclude that overconfidence cannot explain a meaningful portion of the observed voting premium.

7 The level-k model and illusion of control

The previous section shows that the QRE model fails to explain the observed voting premium in our experiment. A potential reason is that this model does not incorporate sufficient deviations from rationality, and we therefore consider two further deviations. First, we introduce the possibility that subjects might hold false beliefs about the likelihood that other subjects make mistakes. Second, we investigate subjects' beliefs of being pivotal, which may not conform to equation (9).

7.1 The level-k model

In the level-k model, subjects believe that they are more sophisticated than other players. According to the formulation by Stahl and Wilson (1995), there are a number of possible player types. Level-0 types randomize uniformly over all possible actions. Level-1 types believe that all other players are level 0 and choose a best response based on this belief. All other types are of some higher level k and play a best response based on the belief that the other players are level k–1 or lower, with all lower-level types occurring with positive probability.

Again, we proceed by deriving an upper bound for the voting premium. Level-0 types randomize both at the voting stage and at the bidding stage. Therefore, level-0 types do not pay a premium on voting shares (on average) as the prices of A- and B-shares will be the same in expectation. Level-1 types respond to the voting behavior of level-0 types by always voting correctly, that is keeping the manager after a high dividend and replacing her after a low dividend. As they believe that all other players randomize, they believe that $\tau_H = \tau_L = 0.5$. Level-1 players therefore believe they can prevent an error in 50% of all cases in which they are pivotal and that they are pivotal with a probability of $\pi_H = \pi_L = 3/8$, which follows from equation (9) for $\tau = 0.5$. Therefore, level-1 players believe that, when they own a voting share, each share of the firm is worth more by the premium $\omega = 3/8 \times 1/2 \times \Delta U$. For level-2 types, the reasoning is similar to that for level-1 types in that they will always vote correctly. But the value of a voting share is lower for level-2 types than for level-1 types, because level-2 types believe that a certain proportion of players is level 1 and therefore votes correctly. Thus, the perceived average probability of mistakes by the other players is lower for level-2 types than it is for level-1 types. The same argument applies to all players with levels higher than 2. Therefore, we obtain the highest premium in the level-k model under the assumption that all players are level-1. From equation (10) and Proposition 1, the maximum voting premium is then $2\omega = 2 \times 3/16 \times \Delta U = 1.35$. However, this upper bound is not tight because it assumes that an investor who buys an A-share expects to get a B-share with certainty. Moreover, the upper bound is based on counterfactual beliefs: Level-1 players assume that all other players vote incorrectly with a probability of 50%, whereas our experimental subjects vote incorrectly with a probability of only 15.1%. Subjects play the game for 30 rounds, and they get feedback about the voting behavior of the other subjects in every round. They must completely ignore this information to maintain their beliefs.

Panel B of Table 8 shows this upper bound of the level-k model for treatments BASE and NU. The upper bound of 1.35 in treatment BASE is still significantly smaller than the observed median premium of 2.63, and the Wilcoxon test rejects the hypothesis that the upper bound holds with a p-value of 5.3%. For NU the upper bound implied by the level-k model is much higher and statistically indistinguishable from the observed premium. Given that the upper bound is based on a number of extreme assumptions, we conclude that the level-k model cannot explain the size of the premium, although it fits the experimental results much better than the QRE model.

7.2 Eliciting beliefs about pivotality

The QRE model and the level-k model both assume that subjects form beliefs about their pivotality from equation (9), which suggests beliefs in the range from 10% (QRE model) to 37.5% (level-k model). However, previous authors have established that voters suffer from an "illusion of control" and tend to overestimate their own influence on the outcome of the vote, i.e., their probability of being pivotal.[18] We therefore hypothesize that our experimental subjects pay a voting premium because they overestimate their pivotality by more than what the level-k model implies for level-1 players. These level-1 players believe that all other players randomize, which gives rise to the highest possible error probability of 50%. Hence, according to our hypothesis, subjects hold beliefs about their pivotality that cannot be rationalized for any feasible error probability, or, put differently, they are unable to correctly calculate their pivotality as shown in equation (9). To test this hypothesis, we investigate subjects' beliefs about their pivotality in treatment BE.

Treatment BE differs from BASE only in that we elicit the beliefs our experimental subjects hold about their own probability of being pivotal. In each round, we ask our subjects to report their beliefs about being pivotal after they placed their bids for the A-shares and B-shares but before they learn the outcome of the auction. Each subject has to indicate the probability that his vote will be decisive for the outcome if he wins an A-share.

Subjects are paid for their statements about their beliefs according to the quadratic scoring rule. Subjects who do not win an A-share and who therefore do not participate in the vote are assigned the role of the subject with the lowest bid among those who actually obtain an A-share. A subject who has indicated an estimate p of his probability of being pivotal receives a payoff $4\left(1-\left(p-d\right)^2\right)$, where the dummy d is one when he is pivotal and zero otherwise.[19]

[Insert Figure 3 here.]

The histogram in Figure 3 shows that subjects in the BE treatment hold very divergent beliefs: While a majority of 61% believe that they are never pivotal, a large minority of 25% believe to become pivotal with probability 0.5. Only a relatively small group of 10% holds beliefs between zero and 0.5. Beliefs are stable: 71.3% of all subjects always state the same belief during the last 15 rounds. The average belief is 17.8% and clearly exceeds the actual average frequency of being pivotal which is 11.8%. This difference is statistically significant; we can reject the hypothesis that beliefs are correct on average at the 5% level for the t-test and at the 10%-level for the Wilcoxon test. We concur with previous findings that subjects considerably overestimate the probability of being pivotal, but note that beliefs are very heterogeneous so that the average belief is of little consequence.[20]

[Insert Table 9 here.]

Table 9 shows the results for the pricing outcomes in treatment BE and has the same structure as Panels A in Table 5, Table 6, and Table 7. The average voting premium is then only 1.11 (median: 1.00) and therefore much lower compared to BASE and NU. The voting premium is

---

[18] For example, Duffy and Tavits (2008) elicit the belief of being pivotal from their experimental subjects and find that their subjects systematically overestimate their pivotality and believe that it is about twice as large as their objective pivotality.

[19] In the experiment, subjects enter p in percentage points as a number between 0 and 100.

[20] The numbers in this paragraph are not reported in the tables. We also checked for differences in beliefs due to gender or field of study, but did not obtain any significant results.

still statistically different from zero at the 5% level, but is now less than half of the premium we observe in BASE and less than one third of the premium in NU, where the difference with NU is significant at the 5%-level. We conclude that asking subjects about their beliefs about being pivotal reduces the voting premium dramatically.[21]

There are two potential explanations for this finding. Subjects may hold the same beliefs about being pivotal in BASE and BE, but asking them may force them to bring the issue of pivotality to their attention and prompts them to reflect on the relationship between the value of voting and their pivotality. Alternatively, reflecting on their pivotality and explicitly rewarding this reflection may reduce subjects' exaggerated estimates of their pivotality. Both explanations account for why belief elicitation leads to a lower voting premium and both support the conclusion that voting premiums are at least partially explained by the fact that individuals do not correctly understand the issue of pivotality.

From the last line of Table 4 it emerges that voting behavior itself is not affected by belief elicitation: comparing subjects' error rates τ_L and τ_H in treatment BE with those in BASE shows that voting behavior does not differ between these treatments. Also, the probabilities of being pivotal are very similar if we compare treatments BASE and BE. Hence, while subjects' likelihood of being pivotal is unchanged, either their beliefs about being pivotal or their recognition of the relevance of pivotality must have changed through belief elicitation.

[Insert Table 10 here.]

Table 10 investigates the connection between subjects' beliefs about their pivotality and their bidding behavior further. Based on the definitions of the level-k model we classify subjects into level-1 players and level-2 players, where we subsume all level-3 and higher players under level 2. The level-k model implies that level-1 players believe to be pivotal with a probability of 37.5% while level-2 and higher players believe to be pivotal with a lower probability, which can be as low as zero. We therefore classify players with high stated beliefs as level-1 and those with low stated beliefs as level-2. We then test our hypothesis that the difference in offers between voting A-shares and non-voting B-shares is higher for level-1 players than for level-2 players.

[21] Other experiments also show that belief elicitation can affect the behavior of experimental subjects. See Ruström and Wilcox (2009) and the references cited therein.

In Table 10 we use two classifications of players, which we label “complete” and “exact.” The complete classification assigns a subject to level 1 if he or she has stated average beliefs larger than or equal to 25% during the last 15 periods of the game, all other subjects who stated on average less than 25% during the last 15 periods are then level 2.[22] According to this rule, 29 of the 80 subjects that played the BE treatment are classified as level-1 and the remaining 51 as level-2. The exact classification uses the same threshold of 25%, but requires that level-1 (level-2) subjects state beliefs of more than (less than) 25% in each of the last 15 rounds. With the exact classification, we have 18 level-1 subjects and 39 level-2 subjects, and the remaining 23 subjects cannot be classified because they sometimes stated beliefs below and sometimes above 25%.

Panel A of Table 10 looks at the offer premium separately for level-1 subjects and level-2 subjects. According to the complete classification, the offer premium of 12.98% is much higher for level-1 subjects than for level-2 subjects, for whom it is virtually zero, and the difference is significant at the 1% level (t-test) or at the 5% level (Wilcoxon test). The corresponding results for the exact classification are qualitatively similar, but statistically somewhat weaker. This result justifies our classification according to the level-k model and supports our hypothesis that only subjects who overestimate their pivotality offer a high premium for A-shares.

Next, we investigate whether the higher premiums offered by level-1 subjects are also responsible for the outcomes of the auction game. If we assume that all level-1 subjects place the same bid as do all the level-2 subjects, then there will be a positive voting premium in prices if and only if there are at least three level-1 subjects in a session. The reason is that empirically, level-2 subjects do not offer a premium (as shown in Table 10) and that the sixth highest bid determines the prices of the shares in the auction. If there are at least three level-1 subjects, one of them will therefore be the marginal bidder.[23] To test this hypothesis, we compute the number of level-1 subjects for each session and calculate the Pearson coefficient of correlation between the number of level-1 subjects and the average price premium across sessions. Panel B of Table 10 displays the results. We find that the correlation between the number of level-1 players and the

[22] We use a cutoff of 25% because it is halfway between the two modal points 0 and 50% (see Figure 3). The figure also shows that a variation in the cutoff value is unlikely to change the classification and our results much.

[23] When we drop the assumption that players of the same type place the same bids, then a single level-1 player who bids a premium is sufficient to generate a voting premium. To see this, consider an example where 5 players offer 20 for both types of shares, another 2 players offer 15 for both types of shares, and one player offers 20 for A-shares and 15 for B-shares.

voting premium is 68% for the complete and 80% for the exact classification, which is economically large and statistically significant; it is even highly significant for the exact classification. The experimental results for treatment BE therefore support the prediction of the level-k model that there should be a relationship between the voting premium and the number of players who believe to be pivotal with high probability.

The discussion of Table 9 and Table 10 suggests that subjects' mistaken beliefs about their pivotality go a long way to explaining the voting premiums we observe. Panel B of Table 8 analyzes to what extent exaggerated beliefs about pivotality can explain the voting premiums in treatments BASE, NU, and BE. The tests in Table 8 compare the observed voting premium with the maximum voting premium, which is equal to 2ω from Proposition 1. As before, ω is calculated from equation (10). For each of the three treatments the table shows a test where subjects' beliefs about their pivotality are equal to $\pi_H = \pi_L = 37.5\%$, which is the highest belief about their pivotality that subjects can possibly hold according to the level-k model if all other subjects make errors with 50% probability (i.e., $\tau_H = \tau_L = 50\%$). Under these assumptions, the maximum premium is 1.35 for treatments BASE and BE and 3.75 for treatment NU. As discussed above, we can reject this model for the BASE treatment. In the BE treatment, the voting premium is much lower than in BASE, so that we cannot reject the hypothesis that it is smaller or equal to the upper bound.

Panel B of Table 8 also shows a test where we set subjects' beliefs equal to $\pi_H = \pi_L = 50\%$. This ad-hoc assumption is based on Figure 3, which shows that a significant number of subjects believe their pivotality to be 50%, combined with the analysis in Table 10 above, which suggests that a few players per session who overestimate their pivotality are sufficient to generate a sizeable voting premium. If we continue to assume $\tau_H = \tau_L = 50\%$, this ad-hoc model produces upper bounds for the voting premium of 1.80 for treatments BASE and BE and 5.00 for treatment NU. Our test cannot reject the null hypothesis that the actual voting premium is smaller than this upper bound for any of the three treatments.

To conclude, the level-k model goes furthest in explaining the experimental evidence, but even this model cannot rationalize all experimental observations. Assuming a probability of being pivotal of 50% cannot be based on any theoretical model, but with this ad hoc assumption we can effectively account for all of the evidence. We therefore conclude that exaggerated beliefs about pivotality are a critical issue when interpreting our experimental results.

8 Conclusion

In this paper we perform an experiment in which experimental subjects pay for the right to vote. The setting features no conflicts of interest, no asymmetric information, and no features that could trigger non-instrumental reasons for voting like a perceived civic duty or expressive motives. We find that individuals are willing to pay a significant premium for the right to vote, even though standard game theory based on Nash Equilibrium or Quantal Response Equilibrium suggests that the value of a voting right is zero.

If we change the experiment such that there is no instrumental reason for voting at all, the voting premium vanishes and we conclude that individuals pay for voting rights for perceived instrumental reasons. Experimental subjects may be overconfident and believe that they can contribute to better voting decisions by voting themselves rather than allowing other participants in the experiment to vote. However, a version of the QRE model adapted to include this aspect can explain only 4% to 5% of the voting premium we observe in our experiments.

These findings suggest that only stronger departures from rationality can explain our results. We show that individuals in a level-k model, who believe that other experimental subjects vote randomly, infer that they themselves have a significant probability of being pivotal. Accordingly, we can explain most of the experimental evidence if we combine the following assumptions: subjects (1) are overconfident and believe that they do not make mistakes that other subjects make, (2) overestimate the actual probability that other subjects make mistakes, and (3) overestimate their own probability of being pivotal. In one of the treatments we elicit subjects' beliefs about being pivotal and show that the third assumption is critical: only subjects with excessively large beliefs of being pivotal are willing to pay for the right to vote and we obtain large premiums for the voting shares if these individuals become the marginal bidders in the auction. Moreover, if individuals have to reflect on their pivotality, their willingness to pay for the right to vote declines by 60%, although it remains large and significant.

While we choose an experimental design that rules out many potential reasons for valuing the right to vote, like asymmetric information, conflicts of interest, or moral considerations, we do not argue that these reasons are less important than the behavioral biases we identify. Our contribution is to show that a sizeable voting premium can occur even without any of these reasons.

References

Adams, Renée and Daniel Ferreira (2008): One Share-One Vote: The Empirical Evidence, *Review of Finance* 12, 51-91.

Alevy, Jonathan, Michael Haigh and John List (2007): Information Cascades: Evidence from a Field Experiment with Financial Market Professionals, *Journal of Finance* 62, 151-180.

Bartels, L.M. (1988): *Presidential Primaries and the Dynamics of Public Choice.* Princeton (Princeton University Press).

Battaglini, Marco, Rebecca Morton and Thomas R. Palfrey (2006): The Swing Voter's Curse in the Laboratory, *Review of Economic Studies* 77, 61-89.

Brennan, Geoffrey and Alan Hamlin (1998): Expressive voting and electoral equilibrium, *Public Choice* 95, 149-175.

Brennan, Geoffrey and L. Lomasky (1993): *Democracy and Decision*, Cambridge (Cambridge University Press)

Butler, David and Donald Stokes (1969): *Political Change in Britain*, New York (St. Martins).

Callander, Steven (2007): Bandwagons and Momentum in Sequential Voting, *Review of Economic Studies* 74, 653-684.

Cipriani, Marco and Antonio Guarino (2009): Herd Behavior in Financial Markets: An Experiment with Financial Market Professionals, *Journal of the European Economic Association* 7, 206-233.

Coval, Joshua D. and Tyler Shumway (2005): Do behavioral biases affect prices?, *Journal of Finance* 60, 1-34.

Dhillon, Amrita, and Susana Peralta (2002): Review: Economic Theories of Voter Turnout, *The Economic Journal* 112, F332-F352.

Downs, Anthony (1957): *An Economic Theory of Democracy*, New York (Harper)

Drehmann, Mathias, Jörg Oechssler and Andreas Roider (2005): Herding and Contrarian Behavior in Financial Markets: An Internet Experiment, *American Economic Review* 95, 1403-1426.

Duffy, John and Margit Tavits (2008): Beliefs and Voting Decisions: A Test of the Pivotal Voter Model, *American Journal of Political Science* 52, 603-618.

Farber, Henry S. (2010): Rational choice and voter turnout: Evidence from union representation elections, Working paper, Princeton University.

Feddersen, Timothy, Sean Gailmard and Alvaro Sandroni (2009): Moral bias in large elections: Theory and experimental evidence, *American Political Science Review* 103, 175-192.

Feddersen, Timothy J. and Wolfgang Pesendorfer (1996): The Swing Voter's Curse, *American Economic Review* 86, 404-424.

——— (1998): Convicting the Innocent: The Inferiority of Unanimous Jury Verdicts under Strategic Voting, *American Political Science Review* 92, 23-36.

——— (1999): Abstention in Elections with Asymmetric Information and Diverse Preferences, *American Political Science Review* 93, 381-398.

Fiorina, Morris P. (1974): *Representatives, Roll Calls, and Constituencies*, Lexington (Lexington Books)

——— (1976): The Voting Decision: Instrumental and Expressive Aspects, *Journal of Politics* 38, 390-413.

Fischbacher, Urs (2007): Z-Tree: Zurich Toolbox for Ready-Made Economic Experiments, *Experimental Economics* 10, 171-178.

Guarnaschelli, S., R. D. McKelvey and T. R. Palfrey (2000): An Experimental Study of Jury Decision Rules, *American Political Science Review* 94, 407-423.

Güth, Werner and Hannelore Weck-Hannemann (1997): Do People Care About Democracy? An Experiment Exploring the Value of Voting Rights, *Public Choice* 91, 27-47.

Kamenica, Emir and Louise Egan (2010): Voters, Dictators, and Peons: Expressive Voting and Pivotality, Working paper, University of Chicago.

Levine, David K. and Thomas R. Palfrey (2007): The Paradox of Voter Participation? A Laboratory Study, *American Political Science Review* 101, 143-158.

Matsusaka, John G. and Filip Palda (1993): The Downsian Model Meets the Ecological Fallacy, *Public Choice* 77, 855-878.

McKelvey, Richard D. and Thomas R. Palfrey (1995): Quantal Response Equilibria for Normal-Form Games, *Games and Economic Behavior* 10, 6-38.

——— (1998): Quantal Response Equilibria for Extensive Form Games, *Experimental Economics* 1, 9-41.

Nagel, Rosemarie (1995): Unraveling in Guessing Games: an Experimental Study, *American Economic Review* 85, 1313-1326.

Palfrey, Thomas R. and Howard Rosenthal (1983): A Strategic Calculus of Voting, *Public Choice* 41, 7-53.

——— (1985): Voter Participation and Strategic Uncertainty, *American Political Science Review* 79, 62-78.

Quattrone, George A. and Amos Tversky (1984): Causal versus Diagnostic Contingencies: On Self-Deception and on the Voter's Illusion, *Journal of Personality and Social Psychology* 46, 237-248.

Riker, William H. and Peter C. Ordeshook (1968): A Theory of the Calculus of Voting, *American Political Science Review* 62, 25-42.

Ruström, E. Elisabeth, and Nathaniel T. Wilcox (2009): Stated beliefs versus inferred beliefs: A methodological inquiry and experimental test, *Games and Economic Behavior* 67, 616-632.

Schram, Arthur (1997): Do People Care About Democracy? Comment, *Public Choice* 91, 49-51.

Schram, Arthur and Joep Sonnemans (1996a): Voter Turnout as a Participation Game: An Experimental Investigation, *International Journal of Game Theory* 25, 385-406.

——— (1996b): Why People Vote: Experimental Evidence, *Journal of Economic Psychology* 17, 417-442

Schuessler, Alexander A. (2000): Expressive Voting, *Rationality and Society* 12, 87-119.

Shayo, Moses and Alon Harel (2010): Non-Consequentialist voting, Working paper, Hebrew University of Jerusalem.

Stahl, Dale O. and Paul W. Wilson (1995): On Players' Models of Other Players: Theory and Experimental Evidence, *Games and Economic Behavior* 10, 218-254.

Tyran, Jean-Robert (2004): Voting When Money and Morals Conflict: An Experimental Test of Expressive Voting, *Journal of Public Economics* 88, 1645-1664.

Varian, Hal and J. K. MacKie-Mason (1995): Generalized Vickrey auctions, Technical report, University of Michigan.

de Vries, Sven and Rakesh Vohra (2003): Combinatorial Auctions: A Survey. *INFORMS Journal on Computing* 15, 284-309.

Appendix: Proof of Proposition 1

Denote by Π^i the profits of investor *i* and by α^i, β^i the probability that the i^{th} investor obtains an A-share, respectively, a B-share in the auction. We denote bids by B_A^i and B_B^i and equilibrium prices by P_A and P_B. Then equilibrium profits for each investor can be written as:

$$\Pi^i = \alpha^i \left(V + \omega - P_A\right) + \beta^i \left(V + \alpha^i \omega - P_B\right) \quad . \tag{11}$$

Part 1: Non-existence of symmetric pure strategy equilibria.

We prove this part by contradiction. Hence, assume that a symmetric pure strategy equilibrium exists where each investor bids the equilibrium prices P_A and P_B. Then each investor is rationed in equilibrium, and $\alpha = \beta = M / N$. Also, it must be the case that $\partial \Pi / \partial \alpha = \partial \Pi / \partial \beta = 0$. If $\partial \Pi / \partial \alpha < 0$ ($\partial \Pi / \partial \alpha > 0$), then the investor has an incentive to reduce (increase) his bid for the A-share, and analogously for the B-share. We therefore obtain the following prices for the conjectured equilibrium from (11):

$$\begin{aligned} \frac{\partial \Pi}{\partial \alpha} &= 0 \Rightarrow P_A = V + \left(1 + \frac{M}{N}\right)\omega \ , \\ \frac{\partial \Pi}{\partial \beta} &= 0 \Rightarrow P_B = V + \frac{M}{N}\omega \ . \end{aligned} \tag{12}$$

For any other set of prices, each investor would have an incentive to deviate from the conjectured equilibrium strategy. However, with these prices, we obtain $\Pi = -\left(M / N\right)^2 \omega < 0$. Hence, all investors would make negative profits. This cannot be the case, because each investor has the option not to bid in the auction and receive zero profits.

Part 2: Existence of asymmetric pure strategy equilibria.

Denote by $\varepsilon > 0$ the smallest increment by which investors can increase their bids. We now construct an asymmetric pure strategy equilibrium as follows.

$$\begin{aligned} B_A^i &= V + \left(1+\gamma\right)\omega + \varepsilon \ , \ i = 1...M, \quad B_A^i = V + \left(1+\gamma\right)\omega \ , \ i = M+1...N, \\ B_B^i &= V + \left(1-\gamma\right)\omega + \varepsilon \ , \ i = 1...M, \quad B_B^i = V + \left(1-\gamma\right)\omega \ , \ i = M+1...N, \end{aligned} \tag{13}$$

where $0 \le \gamma \le 1$. The parameter γ describes how the valuation premium for the B-share is allocated between the price for B-shares and the price for A-shares. Then $\alpha^i = \beta^i = 1$ for the M highest bidders, $i=1...M$, who win all the shares in equilibrium. Also, $\alpha^i = \beta^i = 0$ for the M-N other bidders, $i=M+1...N$, who never win a share in any auction. The profits of the winners in the auction are then:

$$\Pi = V + \omega - \left(V + \left(1+\gamma\right)\omega\right) + V + \omega - \left(V + \left(1-\gamma\right)\omega\right) = 0 \quad . \tag{14}$$

The losers in the auctions make zero profits, too. The profits of a winner who would deviate by reducing his bid below the stipulated equilibrium price in one of the auctions (and without changing the strategy in the other auction) would be:

$$\begin{aligned} &\Pi^{Winner}\left(\text{bid} < B_B^{M+1}\right) = V + \omega - \left(V + \left(1+\gamma\right)\omega\right) = -\gamma\omega \le 0 \\ &\Pi^{Winner}\left(\text{bid} < B_A^{M+1}\right) = V - \left(V + \left(1-\gamma\right)\omega\ \right) = -\left(1-\gamma\right)\omega \le 0. \end{aligned} \tag{15}$$

Bidding lower in both auctions results in profits of zero. If winners increase their bids above those in (13), this has no consequence unless one of the losing bidders also increases his price, in which case they would overpay. Hence, bidding higher is a weakly dominated strategy.

The losers of the auction could bid higher in one or both auctions. In order to win, they would have to increase their bids at least to B_A^M and B_B^M (then they would be rationed) or by an increment ε higher to win with probability one. The payoffs from bidding B_A^M and B_B^M are (note that ε, α, and β are all strictly positive):

$$\begin{aligned} \Pi\left(\text{bid } B_A^M \text{ for A}\right) &= \alpha^i\left(V + \omega - \left(V + \left(1+\gamma\right)\omega + \varepsilon\right)\right) \\ &= -\alpha^i\left(\gamma\omega + \varepsilon\right) < 0 \\ \Pi\left(\text{bid } B_B^M \text{ for B}\right) &= \beta^i\left(V - \left(V + \left(1-\gamma\right)\omega + \varepsilon\right)\right) = -\beta^i\left(\left(1-\gamma\right)\omega + \varepsilon\right) < 0 \\ \Pi\left(\text{bid } B_A^M \text{ and } B_B^M\right) &= \alpha^i\left(V + \omega - \left(V + \left(1+\gamma\right)\omega + \varepsilon\right)\right) + \beta^i\left(V + \alpha^i\omega - \left(V + \left(1-\gamma\right)\omega + \varepsilon\right)\right) \\ &= -\alpha^i\left(\gamma\omega + \varepsilon\right) - \beta^i\left(\left(1-\gamma-\alpha^i\right)\omega + \varepsilon\right) < 0. \end{aligned} \tag{16}$$

Bidding above B_A^M and B_B^M increases the probability of winning to one and generates even lower payoffs. Hence, the losers of the auction have no incentive to deviate by bidding higher for either the A-share or the B-share or both. Thus, the voting premium is

$$P_A - P_B = B_A^{M+1} - B_B^{M+1} = 2\gamma\omega\,. \tag{17}$$

Since γ can be any number in the unit interval, it holds that $0 \le P_A - P_B \le 2\omega$.

Figure 1: Prices over time in the baseline treatment

This figure shows, for each period of the BASE treatment, the prices P_A and P_B of voting A-shares and non-voting B-shares (averaged across the 10 sessions). In addition, the plot shows a cubic spline that smoothes the observations across periods. The solid line represents the smoothed price of a voting A-share, and the broken line the smoothed price of a nonvoting B-share.

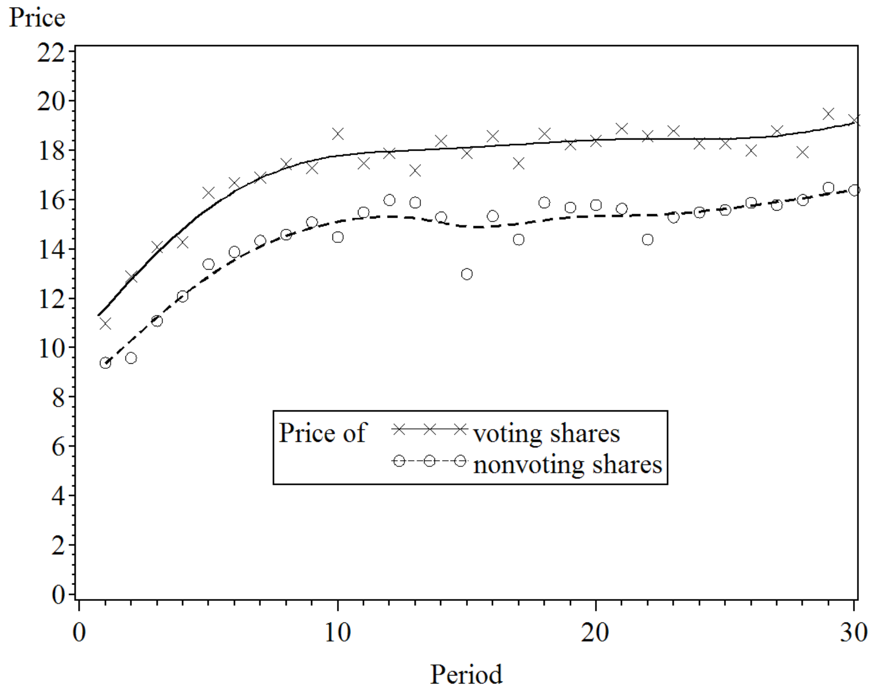

Figure 2: Incorrect votes over time in the baseline treatment

This figure shows, for each period of the BASE treatment, the frequency τ of wrong votes conditional on the observed first dividend D_1. In addition, the plot shows a cubic spline that smoothes the observations across periods. The solid line represents the smoothed error rate after a low dividend, and the broken line represents the smoothed error rate after a high dividend.

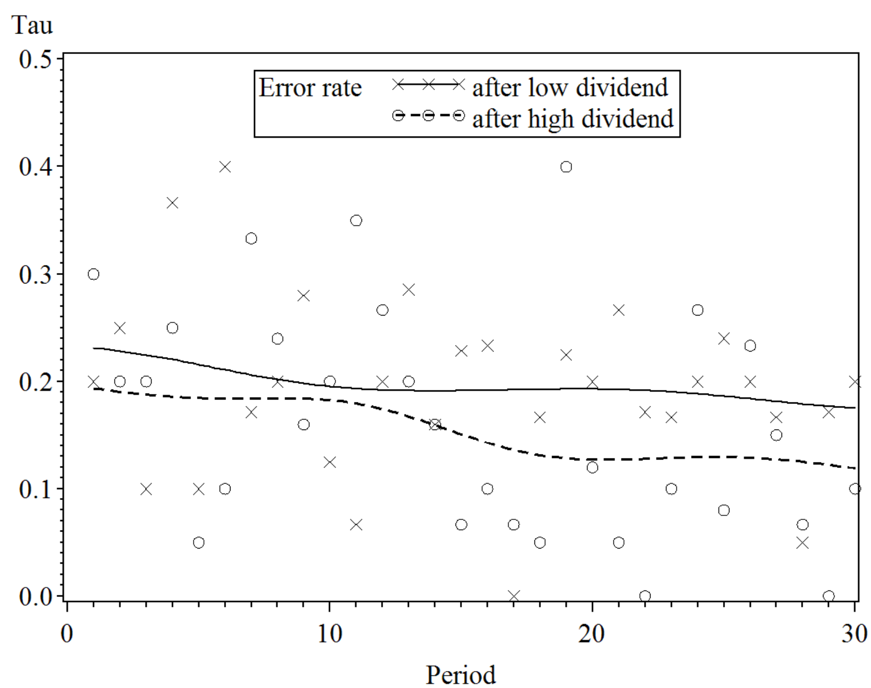

Figure 3: Distribution of beliefs stated in treatment BE

Subjects were asked in treatment BE to indicate their beliefs about the probability that they themselves are pivotal in the upcoming vote. This figure shows the histogram of the beliefs during the last 15 rounds.

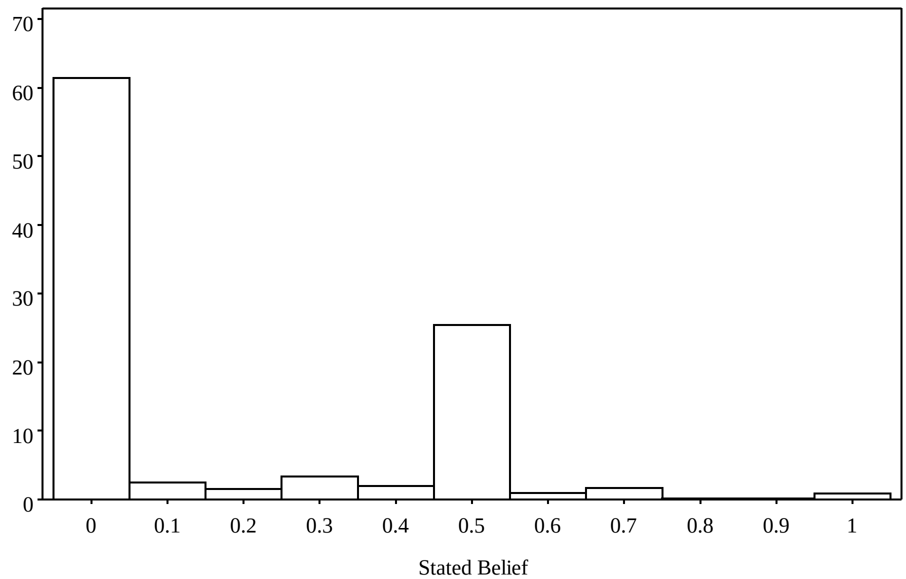

Table 1: Overview of the different treatments

This table shows the three defining parameters for each treatment, i.e., the probability *p* that the dividend is high (low) when the manager is good (bad), the number of shares held by a blockholder who always votes in favor of the manager, and whether beliefs are elicited. In addition, the table shows the utility gain or loss ΔU from equation (5) that is at stake in the vote, the Nash value of the shares, V_{Nash}, from equation (4), the number of sessions, the number of rounds per session, and the number of subjects per session.

Treatment	Link *p* between skill and dividend	Shares held by blockholder	Belief Elicitation	ΔU	V_{Nash}	Sessions	Rounds per session	Subjects per session
Baseline treatment (BASE)	80%	0	No	3.6	21.8	10	30	8
No uncertainty (NU)	100%	0	No	10.0	25.0	10	30	8
Non-influential manager (NI)	50%	0	No	0.0	20.0	10	30	8
Blockholder (BH)	80%	6	No	0.0	20.0	10	30	8
Belief Elicitation (BE)	80%	0	Yes	3.6	21.8	10	30	8

Table 2: Prices in the baseline treatment (BASE)

This table contains statistics on four variables for the baseline treatment: the price of voting A-shares, the price of non-voting B-shares, the difference between these two prices (the premium), and the premium scaled by the Nash value of the shares (the relative premium). The table shows mean, median, standard deviation, and the p-values of two tests, the t-test for zero mean and the Wilcoxon signed rank test for zero median. For the prices of voting and non-voting shares, the table also shows the mean difference between the price and the Nash value, and the p-value of the t-test for this difference to be zero. In Panel A, we first calculate one value of the respective variable for each session by averaging the variable across the last 15 rounds of the session. In the second step, we calculate the statistics across the 10 sessions. Panel B shows the results for the pooled sample of all sessions and rounds.

Panel A: Average of last 15 rounds

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	Difference to Nash	
							Mean	T-test p-value
Voting A-share	10	18.52	18.27	4.65	0.000	0.002	3.28	0.053
Non-voting B-share	10	15.61	17.37	5.41	0.000	0.002	6.19	0.006
Premium	10	2.91	2.63	2.50	0.005	0.004		
Relative premium	10	13.4%	12.1%	11.5%	0.005	0.004		

Panel B: All rounds

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	Difference to Nash	
							Mean	T-test p-value
Voting A-share	300	17.41	18.00	4.63	0.000	0.000	4.39	0.000
Non-voting B-share	300	14.60	15.76	5.30	0.000	0.000	7.20	0.000
Premium	300	2.82	2.00	3.31	0.000	0.000		
Relative premium	300	12.9%	9.2%	15.2%	0.000	0.000		

Table 3: Bids in the baseline treatment (BASE)

This table contains statistics on four variables for the baseline treatment: the bid for voting A-shares, the bid for non-voting B-shares, the difference between these two bids (the premium), and the premium scaled by the Nash value of the shares (the relative premium). The table shows mean, median, standard deviation, and the p-values of two tests, the t-test for zero mean and the Wilcoxon signed rank test for zero median. For the premium, the table also shows the frequencies that the premium is negative or, respectively, positive. In Panel A, we first calculate one value of the respective variable for each subject by averaging the variable across the last 15 rounds. In the second step, we calculate the statistics across the 80 subjects. Panel B shows the results for the pooled sample of all subjects and rounds.

Panel A: Average of last 15 rounds

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	Frequency	
							negative	positive
Voting A-share	80	29.41	20.17	37.81	0.000	0.000		
Non-voting B-share	80	23.95	18.40	33.58	0.000	0.000		
Premium	80	5.46	1.67	13.91	0.001	0.000	16.3%	70.0%
Relative premium	80	25.0%	7.6%	63.8%	0.001	0.000		

Panel B: All rounds

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	Frequency	
							negative	positive
Voting A-share	2,400	27.76	20.00	36.43	0.000	0.000		
Non-voting B-share	2,400	22.65	18.00	32.18	0.000	0.000		
Premium	2,400	5.11	1.00	17.39	0.000	0.000	10.8%	53.8%
Relative premium	2,400	23.4%	4.6%	79.8%	0.000	0.000		

Table 4: Voting behavior

This table describes the voting outcomes for all five treatments based on data from the last 15 rounds of the sessions. The table shows for each treatment (1) the frequency τ_L that A-shareholders vote for keeping the manager after a low dividend, (2) the frequency e_L that a manager is actually kept after a low dividend, (3) the probability π_L of an individual to be pivotal after a low dividend (4) the frequency τ_H that A-shareholders vote for replacing the manager after a high dividend, (5) the frequency e_H that a manager is actually replaced after a high dividend, and (6) the probability π_H of an individual to be pivotal after a high dividend. In addition, the table shows the p-value of the χ^2-test and the Wilcoxon signed rank test that τ_L equals τ_H. The χ^2-test assumes that every vote cast is an independent observation. The Wilcoxon test allows for dependence within a session. Here we calculate for each session the difference between the percentage of wrong votes after a high dividend and the percentage of wrong votes after a low dividend, and apply the Wilcoxon test to these 10 differences per treatment.

Treatment	τ_L	e_L	π_L	τ_H	e_H	π_H	P-value for $\tau_L = \tau_H$	
							χ^2	Wilcoxon
Baseline treatment (BASE)	18.3%	7.1%	16.4%	11.8%	3.0%	7.3%	0.014	0.148
No uncertainty (NU)	11.0%	0.0%	3.8%	10.6%	1.4%	5.8%	0.836	0.625
Non-influential manager (NI)	56.3%	64.5%	43.4%	21.9%	8.1%	18.6%	0.000	0.010
Blockholder (BH)	31.2%	15.1%	29.3%	23.8%	7.8%	23.4%	0.025	0.742
Belief Elicitation (BE)	18.8%	1.2%	12.6%	15.1%	5.8%	9.6%	0.180	0.359

Table 5: Prices and bids in the no-uncertainty treatment (NU)

This table describes prices (Panel A) and bids (Panel B) for the no-uncertainty treatment (NU). Panel A shows statistics on the price of voting A-shares, the price of non-voting B-shares, the difference between these two prices (the premium), and the premium scaled by the Nash value of the shares (the relative premium). The table shows mean, median, standard deviation, and the p-values of two tests, the t-test for zero mean and the Wilcoxon signed rank test for zero median. In addition, it shows the p-values of the two-sample t-test and the two-sample Wilcoxon signed rank test that the location of the distribution is identical under treatments NU and BASE. We first calculate one value of the respective variable for each session by averaging the variable across the last 15 rounds of the session. In the second step, we calculate the statistics across the 10 sessions. Panel B displays the same statistics for individual bids.

Panel A: Average prices of the last 15 rounds

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	P-value two-sample comparison with BASE	
							T-test	Wilcoxon
Voting A-share	10	20.90	20.77	4.37	0.000	0.002	0.254	0.289
Non-voting B-share	10	16.91	17.37	2.96	0.000	0.002	0.518	0.796
Premium	10	3.99	3.13	3.27	0.004	0.002	0.417	0.393
Relative premium	10	16.0%	12.5%	13.1%	0.004	0.002	0.640	0.684

Panel B: Average bids of the last 15 rounds

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	P-value two-sample comparison with BASE	
							T-test	Wilcoxon
Voting A-share	80	25.89	22.70	17.21	0.000	0.000	0.450	0.203
Non-voting B-share	80	22.16	19.77	13.23	0.000	0.000	0.659	0.127
Premium	80	3.72	1.53	17.42	0.060	0.000	0.487	0.766
Relative premium	80	14.9%	6.1%	69.7%	0.060	0.000	0.338	0.567

Table 6: Prices in the non-influential manager treatment (NI)

This table describes prices for the non-influential manager treatment (NI). It shows statistics on the price of voting A-shares, the price of non-voting B-shares, the difference between these two prices (the premium), and the premium scaled by the Nash value of the shares (the relative premium). The table shows mean, median, standard deviation, and the p-values of two tests, the t-test for zero mean and the Wilcoxon signed rank test for zero median. In addition it shows the p-values of the two-sample t-test and the two-sample Wilcoxon signed rank test for the hypothesis that the location of the distribution is identical in treatments NI and BASE (NU). We first calculate one value of the respective variable for each session by averaging the variable across the last 15 rounds of the session. In the second step, we calculate the statistics across the 10 sessions.

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	P-value two-sample comparison with BASE		P-value two-sample comparison with NU	
							T-test	Wilcoxon	T-test	Wilcoxon
Voting A-share	10	16.38	17.03	2.63	0.000	0.002	0.225	0.159	0.014	0.014
Non-voting B-share	10	15.98	16.47	2.72	0.000	0.002	0.851	0.565	0.475	0.424
Premium	10	0.40	0.28	0.67	0.089	0.158	0.012	0.015	0.007	0.001
Relative premium	10	2.0%	1.4%	3.3%	0.089	0.158	0.013	0.018	0.008	0.001

Table 7: Prices in the blockholder treatment (BH)

This table describes prices for the blockholder treatment (BH). It shows statistics on the price of voting A-shares, the price of non-voting B-shares, the difference between these two prices (the premium), and the premium scaled by the Nash value of the shares (the relative premium). The table shows mean, median, standard deviation, and the p-values of two tests, the t-test for zero mean and the Wilcoxon signed rank test for zero median. In addition it shows the p-values of the two-sample t-test and the two-sample Wilcoxon signed rank test for the hypothesis that the location of the distribution is identical in treatments BH and BASE (NU). We first calculate one value of the respective variable for each session by averaging the variable across the last 15 rounds of the session. In the second step, we calculate the statistics across the 10 sessions.

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	P-value two-sample comparison with BASE		P-value two-sample comparison with NU	
							T-test	Wilcoxon	T-test	Wilcoxon
Voting A-share	10	13.14	12.97	4.08	0.000	0.002	0.013	0.024	0.001	0.000
Non-voting B-share	10	12.85	12.73	4.02	0.000	0.002	0.212	0.123	0.020	0.030
Premium	10	0.29	0.33	0.93	0.346	0.219	0.010	0.034	0.006	0.001
Relative premium	10	1.5%	1.7%	4.7%	0.346	0.219	0.011	0.042	0.007	0.001

Table 8: Tests of instrumental voting models with behavioral biases

This table tests predictions on the upper bound of the voting premium against the observed voting premium for treatments BASE, NU, and BE. Panel A generates predictions from the Quantal Response Equilibrium model (QRE) with overconfidence. Panel B generates predictions from the level-k model and based on ad hoc assumptions about pivotality. Theoretical probabilities of being pivotal are generated from equation (9). Empirical probabilities of being pivotal are the observed frequencies of being marginal in the vote. The upper bound 2ω follows from Proposition 1 and equation (10). In Panel A individuals' error probabilities τ_L and τ_H are equal to the observed frequencies, in Panel B τ_L and τ_H are set equal to 50%. The actual premiums are repeated from Tables 2, 5, and 9. The table also displays the p-value of the one-sided Wilcoxon signed rank test that the observed voting premium does not exceed the upper bound.

Panel A: QRE model with overconfidence

Treatment	Model	Pivotality	Upper bound on premium	Actual premium		p-value
				Mean	Median	
BASE	QRE	theoretical	0.12	2.91	2.63	0.003
NU	QRE	theoretical	0.12	3.99	3.13	0.001
BASE	QRE	empirical	0.14	2.91	2.63	0.007
NU	QRE	empirical	0.10	3.99	3.13	0.001

Panel B: Voting premiums with illusion of control and overconfidence

Treatment	Model	Pivotality	Upper bound on premium	Actual premium		p-value
				Mean	Median	
BASE	level-k	37.5%	1.35	2.91	2.63	0.053
BASE	ad-hoc	50.0%	1.80	2.91	2.63	0.138
NU	level-k	37.5%	3.75	3.99	3.13	0.461
NU	ad-hoc	50.0%	5.00	3.99	3.13	0.884
BE	level-k	37.5%	1.35	1.11	1.00	0.696
BE	ad-hoc	50.0%	1.80	1.11	1.00	0.950

Table 9: Prices in the Belief Elicitation treatment

This table describes prices for the belief elicitation treatment (BE). It shows statistics on the price of voting A-shares, the price of non-voting B-shares, the difference between these two prices (the premium), and the premium scaled by the Nash value of the shares (the relative premium). The table shows mean, median, standard deviation, and the p-values of two tests, the t-test for zero mean and the Wilcoxon signed rank test for zero median. In addition it shows the p-values of the two-sample t-test and the two-sample Wilcoxon signed rank test for the hypothesis that the location of the distribution is identical in treatments BE and BASE (NU). We first calculate one value of the respective variable for each session by averaging the variable across the last 15 rounds of the session. In the second step, we calculate the statistics across the 10 sessions.

Variable	Obs.	Mean	Median	Standard deviation	T-test p-value	Wilcoxon p-value	P-value two-sample comparison with BASE		P-value two-sample comparison with NU	
							T-test	Wilcoxon	T-test	Wilcoxon
Voting A-share	10	17.14	16.97	5.17	0.000	0.002	0.537	0.382	0.097	0.066
Non-voting B-share	10	16.03	15.80	4.68	0.000	0.002	0.854	0.796	0.625	0.393
Premium	10	1.11	1.00	1.31	0.025	0.035	0.064	0.109	0.024	0.014
Relative premium	10	5.1%	4.6%	6.0%	0.025	0.035	0.064	0.109	0.033	0.027

Table 10: Beliefs, offers, and prices in the Belief Elicitation treatment

In this table we classify the subjects in the BE treatment as 'level-1' and 'level-2' in two different ways. In the complete classification, a subject is level-1 (level-2) if his or her average stated belief during the last 15 periods is higher (lower) than 25%. In the exact classification, a subject is level-1 (level-2) if his or her average stated belief during the last 15 periods is *always* higher (lower) than 25%. Panel A shows the number of level-1 and level-2 players for each classification, the average and median offer premium within each group, and the p-values of the t-test and the Wilcoxon signed rank test for zero mean or, respectively, median. The last two rows of Panel A show the p-values of the two-sample t-test and the two-sample Wilcoxon test that the mean (respectively median) offer premium is identical across the two groups. Panel B shows the average number of level-1 (level-2) players per session, the Pearson correlation coefficient across sessions between this number and the voting premium, and the p-value of the t-test for zero correlation.

Panel A: Relation between beliefs and offers

Statistic	Complete		Exact	
	Level-1	Level-2	Level-1	Level-2
Number of players	29	51	18	39
Mean offer premium	12.98%	0.01%	8.94%	0.12%
Median offer premium	0.61%	0.00%	0.46%	0.00%
P-value t-test	0.004	0.998	0.030	0.969
P-value Wilcoxon test	0.000	0.049	0.017	0.105
P-value two-sample t-test	0.010		0.075	
P-value two-sample Wilcoxon test	0.044		0.147	

Panel B: Relation between beliefs and prices

Statistic	Complete		Exact	
	Level-1	Level-2	Level-1	Level-2
Average number per session	2.9	5.1	1.8	3.9
Correlation with premium	0.679	-0.679	0.800	-0.800
P-value	0.031	0.031	0.005	0.005

Instructions for the baseline treatment (not for publication)

This appendix contains a translation of the German instructions given to our experimental subjects. To conserve space, we only present the instructions for the baseline treatment. For the other three treatments we changed as little as possible. For instance for the treatment NI, we merely replaced the probability 0.8 of the baseline treatment with the probability 0.5.

Welcome! This is an experiment in behavioral economics. You and the other participants in the experiment will participate in a situation where you have to make a decision. In this situation, you can earn money that will be paid out to you in cash at the end of the experiment. How much you will earn, depends on the decisions that you and the other participants in the experiment make.

These instructions describe the situation in which you have to make a decision. The instructions are identical for all participants in the experiment. It is important that you read the instructions carefully so that you understand the decision-making problem well. If something is unclear to you while reading, or if you have other questions, please let us know by raising your hand. We will then answer your questions individually.

Please do not, under any circumstances, ask your question(s) aloud. You are not permitted to give information of any kind to the other participants. You are also not permitted to speak to other participants at any time throughout the experiment. Whenever you have a question, please raise your hand and we will come to you and answer it. If you break these rules, we may have to terminate the experiment.

Once everyone has read the instructions and there are no further questions, we will conduct a short quiz where each of you will complete two short tasks on your own. We will walk around, look over your answers, and solve any remaining comprehension problems. The only purpose of the quiz is to ensure that you thoroughly understand the crucial details of the decision-making problem.

As a matter of course, your anonymity and the anonymity of the other participants will be guaranteed throughout the entire experiment. You will neither learn about the identity of the other participants, nor will they learn about your identity.

1. General

The experiment consists of several rounds in which decisions must be made and information must be processed. With your decisions, you can earn points. These points represent your income and will be converted into euros at the end of the experiment and paid out in cash. The exact sequence of the stages of the experiment, the different decisions, and the payment modalities will be explained in detail in the following.

2. The allocation of roles

You will find yourself in a situation where you have to make decisions. This situation will be repeated for 30 rounds. This situation can be compared to a simple stock market. In this stock market, there is one single company issuing shares. You can buy shares of this company and thus take on the role of a shareholder. The amount of dividends paid out on the shares depends on how good or bad the manager of the company is. Chance plays an important role here: it determines whether the manager of the company is good or bad. The computer takes on the roles of company, manager, and it performs the chance moves.

3. Two possible stock market conditions

At the beginning of *each round*, the computer draws the quality of the manager randomly. You can visualize this as a drawing of one ball out of a hat that contains five balls labeled with the words "good manager" and another five labeled with the words "bad manager." Neither you nor any of the other participants know the quality of the manager. You only know the following: there is a 50% probability of a good manager, and a 50% probability of a bad manager. The quality of the manager influences the probability that the company will make a profit. We first consider the situation that arises in the case of a good manager.

4. The stock market condition in the (unobservable) case of a good manager

If the manager is good (which neither you nor any of the others know), there is an 80% probability that the company will make a profit. You can visualize the situation with a good manager as if the computer picked a ball randomly out of a hat containing eight balls labeled with the words "profit", and two balls labeled with the words "no profit." Whether or not the company makes a profit is important for you only because it affects the dividend payments of the shares.

If the company makes a profit, the dividends on shares amount to 20 points per share. If the company does not make a profit, however, the dividends amount to 0 points per share.

Now we will look at the situation in the (also unobservable) case of a bad manager.

5. The stock market condition in the (also unobservable) case of a bad manager

If the manager is bad, there is a 20% probability that the company will make a profit. You can visualize the situation with a bad manager as if the computer picked a ball randomly out of a hat containing two balls labeled with the words “profit”, and eight balls labeled with the words “no profit.“ Whether or not the company makes a profit is important for you only because it affects the dividend payments of the shares.

If the company makes a profit, the dividends on shares amount to 20 points per share, as before. If the company does not make a profit, however, the dividends amount to 0 points per share.

Obviously, a dividend of 20 points per share is more likely if the manager is good. Conversely, a dividend of 0 points per share is more likely if the manager is bad.

Please keep in mind that the quality of the manager is unknown to all participants and that both qualities are equally likely at the beginning of each round.

6. The auctioning of shares

There are two types of shares: type-A shares and type-B shares. The next section will explain the difference between them. The dividends are the same for both types.

In every round, five type-A shares and five type-B shares are sold.

Apart from you, there are seven other persons who can buy shares of the company: namely, the other participants in the experiment. So in total, there are eight persons in the market who can bid for the shares. All these persons are subject to the same rules. These rules will be explained to you in the following.

You can buy a maximum of one share of each type per round. In total, therefore, you can buy a maximum of two shares per round: one type-A share and one type-B share. You can try to buy the shares of your choice by taking part in two auctions that are conducted simultaneously. In one auction, type-A shares are sold, and in the other auction, type-B shares are sold.

You will be asked to make a bid for each share type. In each of the two auctions, the following rule applies: the five participants in the experiment who submit the five highest bids for the type of shares offered in that auction will each receive one share of that type. The price they will each pay for their share will be the amount of the sixth-highest bid in that auction. (If two or more bids in one auction are identical, the computer will randomly determine their order.) Those participants who made the sixth-to-eighth-highest bids will not receive any share of the type offered and also will not pay anything in this auction.

The most sensible thing you can do in both of these auctions is to submit a bid that corresponds to your true valuation of the share in question, in other words, the maximum amount you would be willing to pay for it.

After all participants have placed their bids in the two simultaneous auctions, everyone will be informed about the price of type-A and type-B shares, and about the dividends per share (which is the same for both types of shares). You will always be given this information, no matter whether you have purchased shares or not. Furthermore, everyone will be told which share, if any, he or she has acquired. You will not receive any information on which shares, if any, others have acquired.

The winners of the auction will then receive the five type-A shares and the five type-B shares. If you have purchased at least one share, your interim earnings will amount to, in points:

The *dividends* on the shares you purchased, multiplied by the *number* of shares you purchased, minus the *price(s)* you had to pay.

You can also have negative earnings.

If you did not acquire any share, your interim earnings amount to zero.

You (and only you) will be told your interim earnings.

In the next section, the difference between A shares and B shares will be explained.

<u>7. The share types</u>

When you purchase a type-A share, you acquire the right to participate in a vote. You do not acquire such a right with type-B shares, however.

All five participants who have purchased a type-A share participate in a vote whose outcome determines whether or not the company manager will be retained. This vote takes place after all share purchases have been made and after you have been told your interim earnings from that round. At this point in time, you therefore know whether the shares paid out dividends of 0 or 20 points.

If the majority of the participants who own a type-A share are in favor of keeping the same manager, she will be retained. Retaining the same manager means that the computer does not again randomly generate the quality of the manager. If retained, the manager has the same quality as before the vote. If the majority of participants who have a type-A share vote to fire the manager, she will be fired and a new manager will be hired. Firing means that the computer will again randomly generate the quality of the new manager. Then there is again a 50% probability that the new manager is good and a 50% probability that the new manager is bad.

8. The second dividend payout on shares

After the vote on the manager, the company will again become active on the market, either with the old or with a new manager depending on the outcome of the vote.

Depending on the quality of the manager and the corresponding probability of the company's success, the computer again determines the dividends on the shares. The dividends again amount to 20 points in the case that the company is successful and 0 points in the case that the company is unsuccessful. As before, the probability of earning 20 points is higher, when the manager is good (namely, 80% for a good manager in comparison to 20% for a bad manager).

You will then be told your final earnings from that round. In the next round, the situation will be repeated with a new manager. So all rounds have the same structure.

9. Your finances

At the beginning of the experiment, you receive an initial budget of 150 points. You will also be paid a fixed amount of 16 points each round, in addition to your profits (or losses) in that round. Your final payout consists of the sum of the payouts from all rounds. Furthermore, you receive 3 euro if you arrived 10 minutes before the beginning of the experiment. The exchange rate used to convert points into cents is:

1 point = 3 cents.

10. The sequence of events of one round at a glance

1. The manager's ability is determined randomly but not disclosed. The auctions for type-A shares and type-B shares take place.
2. All participants are informed about the prices and dividends of the shares. Furthermore, each of you individually receives information about which share(s) you have acquired.
3. The dividends of 0 or 20 points per share are announced. You are told your interim earnings from that round.
4. The vote on retaining or firing the manager takes place among all holders of type-A shares. Depending on the results of the vote, either the same manager is retained or a new manager is hired.

5. The result of the vote is announced to all participants.
6. The second dividend payout of 0 or 20 points per share is announced. You receive the total payout in this round, which is made up as follows: if you did not purchase any shares, you only receive the fixed amount of 16 points in this round. If you purchased one or two shares, your profits from this round consist of the dividends of the shares that you own, minus the price(s) you had to pay for these share(s), plus the fixed payment of 16 points.

This procedure is repeated 30 times.

After the end of the 30th round, you will be asked to fill in a questionnaire containing questions on your behavior during the experiment. After everyone has completed the questionnaire, you will be told your total earnings. You will not learn anything about the earnings of the other participants.

Please remain seated and wait quietly until we come to you and pay out your total earnings in cash. Please do not talk to the other participants. After your total earnings have been paid out, please leave the room quietly.

If there was anything you did not understand, please let us know by raising your hand. We will answer your questions on an individual basis.

Thank you for participating!