Risk Taking and Investing in Electoral Competition*

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Abstract

We analyze a two-stage electoral contest game between two candidates that differ in quality. At the first stage, the challenger decides on the topics of his political program. He can choose either a more risky or a less risky agenda. At the second stage, both the challenger and the incumbent politician observe the given level of risk and simultaneously spend resources in political campaigning. The electoral contest game is solved theoretically and then tested by using a laboratory experiment. According to theory, there are three effects that determine risk taking at stage one – a discouragement effect, a cost effect and a likelihood effect. Not only the worse candidate takes high risk (i.e., "gambling for resurrection"). Also the better candidate may prefer a rather risky agenda to prevent aggressive campaigning of both candidates or to discourage his political opponent. For the likelihood effect, risk taking and investments in the lab are clearly in line with theory. Pairwise comparison of the corresponding treatments shows that the cost effect seems to be more relevant than the discouragement effect. Our experimental findings also show that, for given risk, investments are mostly in line with theory under all three effects. Hence, subjects indeed adjust their investment levels to risk taking.

Key Words: Electoral Competition, Gambling for Resurrection, Risk Taking, Tournaments

JEL Classification: C72, C91, D72

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1 Introduction

United States presidential elections offer interesting examples for risk taking of a challenger that runs for office against an incumbent politician. When competing against Ronald Reagan in 1984, Walter Mondale addressed many non-risky topics. However, he also took risk by nominating Geraldine A. Ferraro as first female vice presidential candidate and by announcing tax increases in order to signal honesty. Twelve years later, Robert Dole challenged the incumbent President Bill Clinton. During his campaign, Dole hit a hot topic by promising to tighten immigration legislation. In particular, he announced to change the Constitution of the United States so that children of illegal immigrants should not automatically become state residents any longer. In the 2004 electoral competition between President George W. Bush and his challenger John Kerry, the latter one proclaimed to raise minimum wages from \$5.15 to \$7 per hour when being elected. While this policy might be popular for low-income earners or people with low vocational training, others became afraid of a looming economic disaster. In all these cases, the candidates typically first determined their political programs and then invested into campaigning by spending millions of dollars for informative advertising about their political plans. For example, during the 2004 presidential election campaign, President Bush and the Republicans spent \$1.14 billion, while expenditures of challenger Kerry and the Democrats amount to \$1.08 billion.[1]

The anecdotal evidence above illustrates the typical two steps in political campaigning between an incumbent politician and his challenger. The candidates first decide on their political programs and, thereafter, spend expenditures during the electoral competition. The incumbent already stands for a certain well-known agenda, which cannot be substantially changed without loosing credibility. However, his challenger is rather free whether to start with an innovative and risky set of topics or not. Hence, in a first step of political campaigning the challenger decides on the risk of his agenda. In a second step, both the incumbent and the challenger invest resources in the course of the election campaign.

In our paper, we theoretically and experimentally discuss this two-step winner-take-all competition between an incumbent politician and his challenger. Our model is based on the theory of rank-order tournaments,[2] which is extended by a risk-taking stage. At the first stage, the challenger decides between a risky and a more conservative political program. At the second stage, for given risk, the challenger and the incumbent compete by simultaneously investing resources in a political campaign. These resources are used

[1] See Edsall and Grimaldi (2004).

[2] Rank-order tournaments have been first analyzed by Lazear and Rosen (1981), Nalebuff and Stiglitz (1983), Green and Stokey (1983) and O'Keeffe et al. (1984). Another strand of the literature on tournaments and contests builds on the work by Tullock (1980) with a focus on rent-seeking competition. On the suitability of contests for modelling electoral competition and for a comprehensive overview see Konrad (2009).

to persuade the voters from being the right candidate that should be elected. The more a politician has invested the higher will be his likelihood of being elected.

It is important to emphasize that although only the challenger chooses risk at stage one, this risk taking influences both politicians since relative performance is decisive in winner-take-all competition. If, on the one hand, the risk taking challenger has good luck ex post, this outcome will enhance his own relative performance and worsen that of the incumbent. On the other hand, in case of bad luck the risk taking challenger suffers but the incumbent benefits in terms of relative performance.

We consider an asymmetric electoral contest game with discrete choices to derive several hypotheses which are then tested in a laboratory experiment. Asymmetry in our context means that politicians differ in quality. For example, they are associated with different reliability from the voters' point of view, or they have different skills or abilities, which are common knowledge (e.g., politicians differ in vocational qualifications). Hence, a leading or more able politician (the "favorite") competes against a trailing or less able opponent (the "underdog"). The different qualities of the candidates have important implications for funding by interest groups. The higher the quality of a politician the easier (e.g., less time-consuming) it will be for him to obtain financial resources from sponsors.

Suppose that the challenger is the underdog. He might strictly benefit from a high risk since he has nothing to lose but good luck may compensate for the competitive disadvantage ("gambling for resurrection").[3] Accordingly, if the challenger is the favorite, one would expect that the challenger does not prefer a high risk which can jeopardize his favorable position. Our analysis shows that this guess is not necessarily true. We identify three effects that determine the challenger's risk taking: Consider, for example, the situation with the challenger being the favorite.[4] First, risk taking at stage 1 of the game may influence the equilibrium investments and, hence, investment costs at stage 2 (*cost effect*). Following the cost effect, the challenger (as well as the incumbent) prefers a high-risk strategy so that the outcome of the competition is mainly determined by luck. High risk reduces overall incentives and, therefore, expenditures at the second stage. Here, high risk serves as a commitment device for the politicians at the second stage, leading to a kind of implicit collusion. Second, the choice of risk by the challenger also influences both politicians' likelihood of winning. If equilibrium investments do not react to risk taking the more able challenger will prefer a low-risk strategy to hold his predominant position (*likelihood effect*). Third, if only the equilibrium investments of the incumbent do react to risk taking, the more able challenger may choose a high risk to discourage the less able incumbent (*discouragement effect*). In this situation, high risk destroys the

[3]See, for example, Downs and Rocke (1994) and Carrillo and Mariotti (2001) on this strategy.

[4]Of course, if the challenger is the underdog, the following three effects just turn around from his perspective.

incumbent's incentives at the second stage: It does not pay for him to invest as he would bear high costs but the outcome of the electoral contest is mainly determined by luck. However, the challenger still invests at the second stage as he has to bear significantly less costs, being the more able player. Such discouragement will be very attractive for the challenger if the gain of winning the election is rather large (e.g., the politicians compete for becoming president or governor).

Altogether, the three effects point out that the favorite should not always prefer a rather safe agenda. On the contrary, both cost effect and discouragement effect make high risk a rational choice for the favorite. According to the cost effect, high risk prevents both politicians from aggressively investing during the campaign. Following the discouragement effect, the favorite should put very risky topics to his agenda in order to further demoralize his already trailing opponent.

The experimental part of the paper tests whether these effects are relevant for real decision makers. The theoretical results show that – in our discrete setting – all three effects will be decisive if the challenger is the favorite whereas taking high risk becomes dominant when the challenger is the underdog ("gambling for resurrection"). For this reason, our experimental analysis focuses on risk taking by the favorite and the subsequent investment choices by both politicians. For each effect we ran one treatment with four sessions – labeled discouragement treatment, cost treatment, and likelihood treatment.

Descriptive results indicate that both the cost effect and the likelihood effect are relevant for the subjects when choosing risk, but they do not often make use of the discouragement effect. The results from non-parametric tests and probit regressions reveal that the likelihood effect turns out to be very robust. The two other effects are not confirmed by a sign test, but a pairwise comparison of the treatments shows that the findings for the cost effect are more in line with theory than our results for the discouragement effect. As theoretically predicted, favorites choose significantly more investment than underdogs in the discouragement treatment and the likelihood treatment. In the cost treatment, players' behavior does not significantly differ given low risk, which follows theory, but for high risk underdogs spend more resources than favorites, which contradicts theory. The subjects' investment choices as reactions to given risk are very often in line with theory. Hence, subjects do react to different amounts of risk. This means that the fundamentals of the three effects are confirmed by our data, but subjects do not make use of them as often as predicted by theory, which particularly holds for the discouragement effect.

We can also interpret our theoretical and experimental findings in a broader context. At the risk-taking stage, the likelihood effect turns out to be very robust in the lab, whereas the two other effects get less support. From society's point of view, this means that a high-potential politician (i.e., a favorite) cannot be expected to be innovative (i.e., choose high risk) when challenging an incumbent in political competition. Instead, the challenger will rely on his quality advantage and prefer not to jeopardize his favorable position when competing with the incumbent. If now the high-potential challenger wins the campaign and sticks to his initially chosen political program he will not introduce any substantial or radical changes for society. However, if the challenger is of rather low talent (i.e., an underdog) he will try to win the election campaign by a strict gambling-for-resurrection strategy. Hence, radical changes or substantial reforms in politics can only be expected under less talented politicians. But then it is questionable how mature and, therefore, beneficial these reforms are for society.

Our results have also implications for other real-world situations where competition can be characterized as a winner-take-all contest or tournament. For example, in sports contests there is only one winner who gets the high winner prize (Konrad 2009). When arranging a singing contest, only one participant wins the final round (Amegashie 2009). In job-promotion tournaments, workers compete for a more attractive and better paid position at the next hierarchy level (Baker et al. 1994 and Orrison et al. 2004). Firms often compete in R&D (Loury 1979 and Zhou 2006) and invest resources for advertising to become the market leader (Schmalensee 1976 and Schmalensee 1992). Moreover, firms are involved in litigation contests for brand names or patent rights (Waerneryd 2000). Finally, oligopolistic competition in new markets often looks like a tournament: only the firm that implements a new technical standard as a first-mover can realize substantial profits from network externalities (Besen and Farrell 1994).

In all these situations, a two-stage game can arise that is similar to the case of political competition between an incumbent and a challenger. For example, participants of a singing contest choose the difficulty and, hence, the risk of their songs before they start training.[5] Athletes decide whether to switch to a new – and often more risky – training method or not; thereafter they invest in training intensity. Prior to the choice of their advertising expenditures, firms have to decide on radical product innovation or new marketing concepts, which would be a quite risky strategy. The last example can also be used to illustrate that often only one party chooses risk at a certain point of time: Consider, for example, a market where an incumbent firm decided on product and market concept innovation in the past and now offers its well-known product. If, in this situation, a new firm enters the market, this new entrant first has to decide on the supply of a new kind of product and on an innovative marketing strategy.[6] Thereafter, both

[5] Note that in case of singing and sports contests, investments are the training intensities of the players and not the direct efforts chosen in the contest. Of course, during the contest each player exerts maximum effort. However, when deciding on training intensity individuals typically trade off the opportunity costs of time against the increased likelihood of winning the contest.

[6] Often, a new entrant introduces a radical product innovation whereas the incumbent is not able to react in the same way. Chandy and Tellis (2000) call this phenomenon the "incumbent's curse". See also Rosenbloom and Christensen (1994) and Hill and Rothaermel (2003). As a typical example, IBM used product innovation to challenge Apple in the business market for personal computers. However, as we can see from the discussion in Schnaars (1986) and Shankar et al. (1998), challengers sometimes do not choose an innovative strategy but prefer aggressive advertising in a second step after market entry.

firms compete for market leadership by choosing their advertising expenditures.

Our paper is related to two fields in the economic literature – the work on electoral competition and the work on risk taking in rank-order tournaments. There is a huge literature that addresses the problem of *electoral competition*. Like our paper, Banks (1990) directly focuses on the strategic behavior of the players during the election campaign. However, he considers a signaling game where voters are uncertain about the candidates' true political positions. The voters try to infer from the announced policies how the candidates would behave in case of being elected. Our model abstracts from voters as active players but concentrates on the candidates' investment (and risk-taking) behavior during the campaign to highlight three important strategic effects that have to be taken into account by new politicians when challenging an incumbent. Coate (2004) also considers spending of resource expenditures during electoral competition. He discusses a model with different parties that select their candidates and are supported by interest groups contributing resources that are used for informative political advertising. Assuming three types of voters (leftists, rightists and swing voters), Coate analyzes the welfare effects of contribution limits. Lizzeri and Persico (2008) also address the problem of risk-taking by political candidates. However, they use their model for a comparison of majoritarian and proportional electoral systems.

Baron (1994) and Grossman and Helpman (1996) analyze a model where candidates for a political position choose policies that can benefit interest groups as well as voters. There are two types of voters – those who observe the chosen policies and uninformed voters. The candidates need the interest groups to obtain financial resources for their campaign in order to persuade uninformed voters and they need the majority of votes for being elected. In this context, candidates face a trade-off if certain policies attract informed voters but not the interest groups, or vice versa. Contrary to these papers, we abstract from the behavior of interest groups and address the role of voters only indirectly by the contest-success function, which describes the outcome of the electoral competition. This restricted view allows to get deeper insights into the strategic behavior of the candidates during the election campaign. Messner and Polborn (2004), Mattozzi and Merlo (2008) and Gersbach (2009), among others, investigate the problem of heterogeneous candidates. In particular, they show under which conditions bad candidates more likely run for office and/or win the political competition than high-quality individuals. Our paper also considers heterogeneous candidates, but the problem of misselection is not an issue: Since low-ability politicians do not choose higher expenditures than high-ability ones in equilibrium, the likelihood of being elected is at least as large for high-ability candidates as for low-ability ones.

There are also parallels to the paper by Carrillo and Mariotti (2001). In their paper, the selection of more risky candidates may be preferred by parties since gambling for resurrection is optimal in certain situations. This outcome corresponds to the likelihood effect for the underdog in our model. However, our results point out that gambling for resurrection is not the only motive for choosing high risk. According to the discouragement effect, the *high-quality* candidate prefers high risk in order to discourage his political opponent. Carrillo and Mariotti (2001) model risk-taking by choosing candidates that are more or less uncertain but do not analyze investment behavior during the campaign. They suggest this issue as a promising extension (p. 20). Our analysis adds to the literature by offering a first attempt to fill this gap.

The second field of related literature addresses *risk taking in tournaments*. Most of this work either fully concentrates on the players' risk choices by skipping the investment decisions, or considers symmetric investment choices within a two-stage game. The first strand of this literature is better in line with risk behavior of mutual fund managers or other players that can only influence the outcome of a winner-take-all competition by choosing risk (see, for example, Gaba and Kalra 1999, Hvide and Kristiansen 2003 and Taylor 2003). The second strand of the risk-taking literature is stronger related to our paper. Hvide (2002) and Kräkel and Sliwka (2004) consider a symmetric two-stage tournament between two workers that compete for job promotion or bonuses within a firm. The workers decide on risk taking at stage 1 and subsequently choose efforts at stage 2. However, symmetry of the equilibrium at the effort stage renders one of the three main effects impossible, namely the discouragement effect. Nieken (2010) experimentally investigates only the cost effect within a symmetric setting with bilateral risk taking. On the one hand, her results show that subjects rationally reduce their efforts when risk increases. On the other hand, subjects do not behave according to the cost effect very well as only about 50% (instead of 100%) of the players choose high risk. Altogether, her findings indicate that subjects are overstrained by a strategic situation with bilateral risk taking, which further justifies our simplified setting with unilateral risk taking. Our paper is also related to Kräkel (2008), who analyzes the three effects in an asymmetric two-stage tournament model with bilateral risk taking. Unfortunately, that setting is so complex that closed-form solutions can hardly be derived.

The paper is organized as follows. The next section introduces the game and the corresponding solution. In Section 3, we point out the three main effects of risk taking – the discouragement effect, the cost effect, and the likelihood effect. In Section 4, we describe the experiment. Our testable hypotheses are introduced in Section 5. The experimental results are presented in Section 6. We discuss three puzzling results in Section 7. Section 8 concludes.

2 The Game

We consider a two-stage electoral contest game with two risk neutral candidates. At the first stage (risk-taking stage), one of the candidates – the challenger – chooses the variance of the underlying probability distribution that characterizes risk in the contest. At the second stage (investment stage), both candidates – the challenger and the incumbent politician – observe the chosen risk and then simultaneously decide on their resource expenditures. The politician with the better relative performance is elected and receives the benefit $B > 0$, whereas his opponent gets nothing. Relative performance does not only depend on the investment choices but also on the realization of the underlying noise term.

The two candidates are heterogeneous in quality. These quality differences are modeled via the politicians' individual costs. The high-quality candidate F ("favorite") has low personal costs, whereas investing in the political campaign entails rather high personal costs for the low-quality candidate U ("underdog"). Let, for example, the high-quality candidate have higher reliability or higher vocational qualification than his opponent so that it is easier for the former one to collect funds from interest groups for his political campaign. However, the worse candidate has to spend more time and effort to obtain the same amount of funding. In our model, both candidates can only choose between the two expenditure levels $e_i = e_L$ and $e_i = e_H > 0$ $(i = F, U)$ with $e_H > e_L$ and $\Delta e := e_H - e_L > 0$. Roughly, this simplified picture sketches the case of George W. Bush and John Kerry mentioned in the introduction: Both acquired and spent the huge amount of about \$1 billion to run for the Oval Office. That is, each one opted for e_H but one of the candidates more easily established fund-raising than his opponent. For simplicity, player i's costs of choosing $e_i = e_L$ are normalized to zero, but choosing high expenditures $e_i = e_H$ involves positive costs c_i $(i = F, U)$ with $c_U > c_F > 0$. Relative performance of challenger i is described by[7]

$$RP = e_i - e_j + \varepsilon \tag{1}$$

with ε as noise term which follows a symmetric distribution around zero with cumulative distribution function $G(\varepsilon; \sigma^2)$ and variance σ^2.

At the risk-taking stage, the challenger has to decide between two variances or risks. He can either choose a high risk $\sigma^2 = \sigma_H^2$ (i.e., a more risky agenda) or a low risk $\sigma^2 = \sigma_L^2$ (i.e., a less risky political program) with $0 < \sigma_L^2 < \sigma_H^2$. Challenger i prevails in the political competition and is elected if and only if $RP > 0$. Hence, his winning probability is given by

$$\text{prob}\{RP > 0\} = 1 - G\left(e_j - e_i; \sigma^2\right) = G\left(e_i - e_j; \sigma^2\right) \tag{2}$$

where the last equality follows from the symmetry of the distribution. In analogy, we

[7]Note that, technically, our investment stage equals the rank-order tournament model introduced by Lazear and Rosen (1981) with ε as difference of the two players' i.i.d. noise terms.

obtain for incumbent j's winning probability:

$$\text{prob}\{RP < 0\} = G\left(e_j - e_i; \sigma^2\right) = 1 - G\left(e_i - e_j; \sigma^2\right). \tag{3}$$

The symmetry of the distribution has two implications: first, each candidate's winning probability will be $G(0;\sigma^2) = \frac{1}{2}$ if both choose the same expenditure level. Second, if both candidates choose different levels, the one with the higher expenditure has winning probability $G(\Delta e;\sigma^2) > \frac{1}{2}$, but the one choosing low expenditure only wins with probability $G(-\Delta e;\sigma^2) = 1 - G(\Delta e;\sigma^2) < \frac{1}{2}$. Let

$$\Delta G\left(\sigma^2\right) := G\left(\Delta e; \sigma^2\right) - \frac{1}{2} \tag{4}$$

denote the *additional winning probability* of the candidate with the higher expenditure level *compared to a situation with identical expenditures* by both candidates. Note that $\Delta G(\sigma^2) \in \left(0, \frac{1}{2}\right)$. We assume that increasing risk from σ_L^2 to σ_H^2 shifts probability mass from the mean to the tails so that $G(\Delta e;\sigma_L^2) > G(\Delta e;\sigma_H^2)$, implying

$$\Delta G\left(\sigma_L^2\right) > \Delta G\left(\sigma_H^2\right). \tag{5}$$

When looking for subgame-perfect equilibria by backward induction we start by considering the investment stage. Here, both candidates observe $\sigma^2 \in \{\sigma_L^2, \sigma_H^2\}$ and simultaneously choose their expenditures according to the following matrix game:

	$e_F = e_H$	$e_F = e_L$
$e_U = e_H$	$\frac{B}{2} - c_U$, $\frac{B}{2} - c_F$	$B \cdot G(\Delta e;\sigma^2) - c_U$, $B \cdot G(-\Delta e;\sigma^2)$
$e_U = e_L$	$B \cdot G(-\Delta e;\sigma^2)$, $B \cdot G(\Delta e;\sigma^2) - c_F$	$\frac{B}{2}$, $\frac{B}{2}$

The first (second) payoff in each cell refers to player U (F) who chooses rows (columns).

Note that $(e_U, e_F) = (e_H, e_L)$ can never be an equilibrium at the investment stage since

$$B \cdot G\left(-\Delta e; \sigma^2\right) \geq \frac{B}{2} - c_F \Leftrightarrow c_F \geq B \cdot \left(\frac{1}{2} - G\left(-\Delta e; \sigma^2\right)\right)$$
$$\Leftrightarrow \quad c_F \geq B \cdot \left(\frac{1}{2} - \left[1 - G\left(\Delta e; \sigma^2\right)\right]\right) \Leftrightarrow c_F \geq B \cdot \Delta G\left(\sigma^2\right)$$

and

$$B \cdot G\left(\Delta e; \sigma^2\right) - c_U \geq \frac{B}{2} \Leftrightarrow B \cdot \Delta G\left(\sigma^2\right) \geq c_U$$

lead to a contradiction as $c_U > c_F$. Combination $(e_U, e_F) = (e_H, e_H)$ will be an equilibrium at the investment stage if and only if

$$\frac{B}{2} - c_i \geq B \cdot G\left(-\Delta e; \sigma^2\right) \Leftrightarrow B \cdot \Delta G\left(\sigma^2\right) \geq c_i \Leftrightarrow B \geq \frac{c_i}{\Delta G\left(\sigma^2\right)}$$

holds for player $i = F, U$. In words, each candidate will not deviate from the high expenditure level if and only if, compared to $e_i = e_L$, the additional expected gain $B \cdot \Delta G\left(\sigma^2\right)$ is at least as large as the additional costs c_i. Similar considerations for $(e_U, e_F) = (e_L, e_L)$ and $(e_U, e_F) = (e_L, e_H)$ yield the following result:

Proposition 1 *At the investment stage, in equilibrium candidates U and F choose*

$$(e_U^*, e_F^*) = \begin{cases} (e_H, e_H) & \text{if} \quad B \geq \frac{c_U}{\Delta G(\sigma^2)} \\ (e_L, e_H) & \text{if} \quad \frac{c_U}{\Delta G(\sigma^2)} \geq B \geq \frac{c_F}{\Delta G(\sigma^2)} \\ (e_L, e_L) & \text{if} \quad B \leq \frac{c_F}{\Delta G(\sigma^2)} \end{cases} \tag{6}$$

Our findings are quite intuitive: the favorite chooses at least as much resources during the campaign as the underdog because of higher quality and, hence, lower costs. If the underdog's (and, thus, also the favorite's) costs are sufficiently small relative to the benefit B, it will pay off for both candidates to choose a high investment level. However, if the underdog's costs are sufficiently large and the favorite's ones sufficiently small relative to the benefit, only the favorite will prefer high expenditure. For sufficiently large costs of both candidates neither one chooses a high expenditure level.

At the risk-taking stage, the challenger selects risk σ^2. Equations (2) and (3) show that risk taking directly influences both candidates' winning probabilities. Furthermore, Proposition 1 points out that risk also determines the investment choices at stage 2. We obtain the following proposition:

Proposition 2 *(i) If $B \leq \frac{c_F}{\Delta G\left(\sigma_L^2\right)}$ or $B \geq \frac{c_U}{\Delta G\left(\sigma_H^2\right)}$, then the challenger will be indifferent between $\sigma^2 = \sigma_L^2$ and $\sigma^2 = \sigma_H^2$, irrespective of whether he is the favorite or the underdog. (ii) Let $B \in \left(\frac{c_F}{\Delta G\left(\sigma_L^2\right)}, \frac{c_U}{\Delta G\left(\sigma_H^2\right)}\right)$. When F is the challenger, he will choose $\sigma^2 = \sigma_L^2$ if $B < \frac{c_U}{\Delta G\left(\sigma_L^2\right)}$ and $\sigma^2 = \sigma_H^2$ if $B > \frac{c_U}{\Delta G\left(\sigma_L^2\right)}$. When U is the challenger, he will always choose $\sigma^2 = \sigma_H^2$.*

Proof: See Appendix.

The result of Proposition 2(i) shows that risk taking becomes unimportant if investment costs of both candidates are very large or very small compared to the benefit B. In the first case, it never pays for the candidates to choose a high investment level, irrespective of the underlying risk. In the latter case, both candidates prefer to exert high expenditures for any risk level since winning the electoral contest is very attractive. Hence, the risk-taking decision is only interesting for moderate parameter values that do not correspond to one of these extreme cases.

Proposition 2(ii) deals with the situation of moderate cost values. Here, the underdog always prefers the high risk when being the challenger. The intuition for this result comes from the fact that U is in an inferior position at the investment stage according to Proposition 1 (i.e., he will never choose more expenditures than player F), irrespective of the chosen risk level. Therefore, he has nothing to lose and unambiguously gains from choosing the high risk: in case of good luck, he may win the competition despite his inferior position; in case of bad luck, he will not really worsen his position as he has already a rather small winning probability. This high-risk strategy by the underdog has been called "gambling for resurrection" in the literature.[8] The favorite is in a completely different situation when being the challenger at the risk-taking stage. According to Proposition 1, he is the presumable winner of the contest (i.e., he will never choose less expenditures than candidate U) and does not like to jeopardize his favorable position by choosing high risk. However, Proposition 2(ii) shows that F's preference for low risk will only hold if the benefit is smaller than a certain cut-off value. If B is rather large, then it will pay for the favorite to choose high risk at stage 1. By this, he strictly gains from discouraging his rival U: given $\sigma^2 = \sigma_L^2$, we have $(e_U^*, e_F^*) = (e_H, e_H)$ at the investment stage, but $\sigma^2 = \sigma_H^2$ induces $(e_U^*, e_F^*) = (e_L, e_H)$.

3 Discouragement Effect, Cost Effect and Likelihood Effect

The results of Proposition 2 have shown that the risk behavior of player U is rather uninteresting as he has a (weakly) dominant strategy when being the challenger. Therefore, the remainder of this paper focuses on the strategic risk taking of player F.

Recall that risk taking may influence both the candidates' investment choices and their winning probabilities. As mentioned in the introduction, particularly three main effects determine the challenger's risk taking – a discouragement effect, a cost effect and a likelihood effect. These three effects depend on the relationship between the benefit B and the four cutoff values $\frac{c_F}{\Delta G(\sigma_L^2)}$, $\frac{c_F}{\Delta G(\sigma_H^2)}$, $\frac{c_U}{\Delta G(\sigma_L^2)}$ and $\frac{c_U}{\Delta G(\sigma_H^2)}$. Obviously, the first cutoff value is the smallest and the last cutoff value the largest one. The ranking of the

[8] See, for example, Downs and Rocke (1994) and Carrillo and Mariotti (2001).

two other cutoffs is not clear so that we have to differentiate between two scenarios:

$$\begin{aligned}
&\text{scenario 1:} \qquad \frac{c_F}{\Delta G\left(\sigma_L^2\right)} < \frac{c_F}{\Delta G\left(\sigma_H^2\right)} < \frac{c_U}{\Delta G\left(\sigma_L^2\right)} < \frac{c_U}{\Delta G\left(\sigma_H^2\right)} \\
&\text{scenario 2:} \qquad \frac{c_F}{\Delta G\left(\sigma_L^2\right)} < \frac{c_U}{\Delta G\left(\sigma_L^2\right)} < \frac{c_F}{\Delta G\left(\sigma_H^2\right)} < \frac{c_U}{\Delta G\left(\sigma_H^2\right)}.
\end{aligned}$$

Whereas the discouragement effect is possible under either scenario, the cost effect only appears in scenario 2 and the likelihood effect only in scenario 1.

If F's incentives to win the electoral competition are sufficiently strong, that is if $B > \max\left\{\frac{c_F}{\Delta G\left(\sigma_H^2\right)}, \frac{c_U}{\Delta G\left(\sigma_L^2\right)}\right\}$, he wants to deter U from exerting high expenditures, which we call the *discouragement effect*. From the proof of Proposition 2, we know that low risk σ_L^2 leads to $(e_U^*, e_F^*) = (e_H, e_H)$, but high risk σ_H^2 induces $(e_U^*, e_F^*) = (e_L, e_H)$. Hence, when choosing high risk at stage 1, the favorite completely discourages his opponent and increases his winning probability by $G\left(\Delta e; \sigma_H^2\right) - \frac{1}{2} = \Delta G\left(\sigma_H^2\right)$, compared to low risk. This effect is shown in Figure 1. There, the cumulative distribution function given high risk, $G\left(\cdot; \sigma_H^2\right)$, is obtained from the low-risk cdf, $G\left(\cdot; \sigma_L^2\right)$, by flattening and clockwise rotation in the point $\left(0, \frac{1}{2}\right)$.

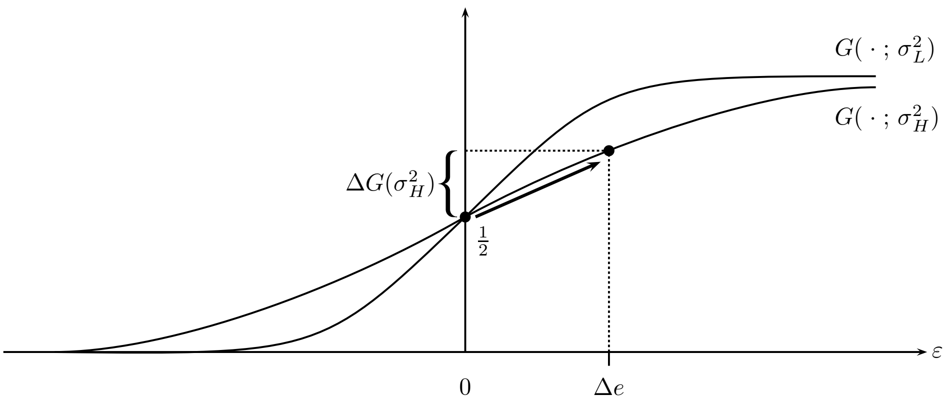

Figure 1: Discouragement effect

Low risk makes high expenditures attractive for both candidates since spending resources has still a real impact on the outcome of the electoral contest, resulting into a winning probability of $\frac{1}{2}$ for each player. Switching to a high-risk strategy σ_H^2 now increases the expenditure difference $e_F^* - e_U^*$ by Δe, which raises F's likelihood of winning by $\Delta G\left(\sigma_H^2\right)$ without influencing his costs.

The second effect can be labeled *cost effect*. In our discrete setting, this effect will determine F's risk choice if $\frac{c_U}{\Delta G\left(\sigma_L^2\right)} < B < \frac{c_F}{\Delta G\left(\sigma_H^2\right)}$.[9] In this situation, $\sigma^2 = \sigma_L^2$ leads to aggressive investments $(e_U^*, e_F^*) = (e_H, e_H)$ during the campaign at stage 2, but $\sigma^2 = \sigma_H^2$ implies overall low investments $(e_U^*, e_F^*) = (e_L, e_L)$. Hence, in any case the winning probability of either player will be $\frac{1}{2}$, but only under low risk each one has to

[9] See the proof of Proposition 2 in the Appendix.

bear positive costs. Consequently, the challenger prefers high risk at stage 1 to commit himself (and his rival) to choose minimal expenditures at stage 2 in order to save costs. Concerning the cost effect, both candidates' interests are perfectly aligned as each one prefers a kind of implicit collusion in the electoral competition, induced by high risk.

The third effect arises when $\frac{c_F}{\Delta G(\sigma_H^2)} < B < \frac{c_U}{\Delta G(\sigma_L^2)}$.[10] In this situation, the outcome at the investment stage is $(e_U^*, e_F^*) = (e_L, e_H)$, no matter which risk level has been chosen at stage 1. Here, risk taking only determines the candidates' likelihoods of winning so that this effect is called *likelihood effect.* If F chooses risk, he will unambiguously prefer low risk $\sigma^2 = \sigma_L^2$. Higher risk taking would shift probability mass from the mean to the tails. This is detrimental for the favorite, since bad luck may jeopardize his favorable position at the investment stage. By choosing low risk, his winning probability becomes $G(\Delta e; \sigma_L^2)$ instead of $G(\Delta e; \sigma_H^2)$ $(< G(\Delta e; \sigma_L^2))$. A technical intuition can be seen from Figure 2. At Δe the cdf describes the winning probability of player F, whereas U's likelihood of winning is computed at $-\Delta e$.

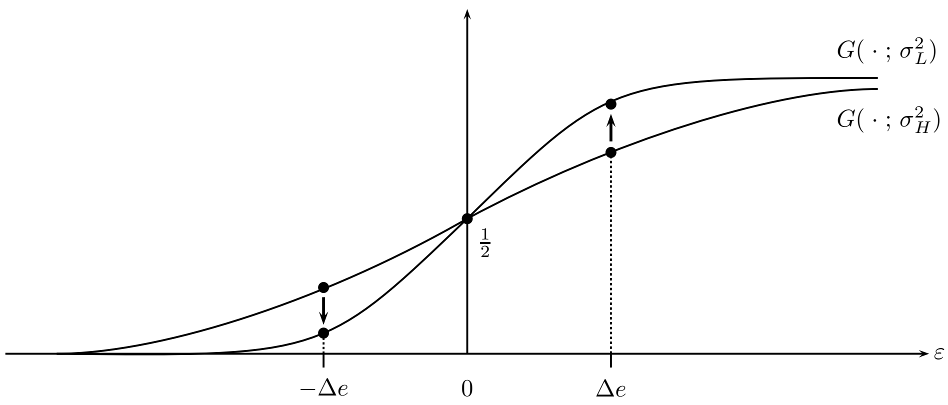

Figure 2: Likelihood effect

Thus, by choosing low risk instead of high risk, the favorite maximizes his own winning probability and minimizes that of his opponent. To sum up, the analysis of risk taking by the favorite points to three different effects at the risk-taking stage of the game. These three effects were tested in a laboratory experiment which will be described in the next section.[11] Thereafter, we will present the exact hypotheses to be tested and our experimental results.

[10] See again the proof of Proposition 2.

[11] Note that we will not consider the case $B < \min\left\{\frac{c_F}{\Delta G(\sigma_H^2)}, \frac{c_U}{\Delta G(\sigma_L^2)}\right\}$ in the lab. Here, low risk would imply a higher winning probability at higher costs for the favorite. Hence, we would have a mixture of the likelihood effect and the cost effect, which would not lead to additional insights when testing in an experiment.

4 Experimental Design and Procedure

We designed three different treatments corresponding to our three effects – the discouragement effect, the cost effect, and the likelihood effect. For each treatment we conducted four sessions, each including 5 groups of 6 participants. Each session consisted of 10 trial rounds and 5 rounds of the two-stage game. During each round, pairs of two players were matched anonymously within each group. After each round new pairs were matched in all groups. The game was repeated five times so that each individual interacted with each other individual exactly one time within a certain group. This perfect stranger matching was implemented to prevent reputation effects. Altogether, for each treatment we have 60 independent observations concerning the first round (15 pairs, 4 sessions) and 20 independent observations based on all rounds.

Before the 5 rounds of each session started, each participant got the chance to become familiar with the complete two-stage game of Section 2 for 10 rounds. During the trial rounds, a single player had to make all decisions on his own so that he learned the role of the favorite as well as that of the underdog. Within the 5 rounds of the experiment the participants got alternate roles. Hence, each individual either played three rounds as a favorite and two rounds as an underdog or vice versa.

In each session, the players competed for the same benefit ($B = 100$) and chose between the same alternative expenditure levels ($e_L = 0$ and $e_H = 1$). We used a uniformly distributed noise term ε for each session which was either distributed between -2 and 2 ("low risk"), or between -4 and 4 ("high risk"). Hence, we had $\Delta G(\sigma_L^2) = \frac{1}{4}$ and $\Delta G(\sigma_H^2) = \frac{1}{8}$. However, we varied the investment costs between the treatments. In the *discouragement treatment* (focusing on the discouragement effect) we used $c_U = 24$ and $c_F = 8$, in the *cost treatment* we had $c_U = 24$ and $c_F = 22$, and in the *likelihood treatment* we had $c_U = 60$ and $c_F = 8$. All parameter values B, e_L, e_H, c_U, c_F, as well as the intervals for ε were common knowledge. It can easily be checked that the three different parameter constellations of the treatments satisfy the three different conditions for the benefit corresponding to the discouragement effect, the cost effect and the likelihood effect, respectively. The subgame perfect equilibria can be summarized as follows:

	discouragement	cost	likelihood
risk choice	high risk	high risk	low risk
expenditures (e_U^*, e_F^*)	(e_L, e_H)	(e_L, e_L)	(e_L, e_H)

Table 1: subgame perfect equilibria

The experiment was conducted at the Cologne Laboratory of Economic Research at the University of Cologne in January 2008 and January 2009. Altogether, 360 students participated in the experiment. All of them were enrolled in the Faculty of Management, Economics, and Social Sciences. The participants were recruited via the online recruitment system by Greiner (2003). The experiment was programmed and conducted with the software z-tree (Fischbacher, 2007). A session approximately lasted one hour and 15 minutes and subjects earned on average 13.85 Euro.

At the outset of a session the subjects were randomly assigned to a cubicle where they took a seat in front of a computer terminal. The instructions were handed out and read aloud by the experimenters.[12] Thereafter, the subjects had time to ask clarifying questions if they had any difficulties in understanding the instructions. Communication – other than with the experimental software – was not allowed. To check for their comprehension, subjects had to answer a short questionnaire. After each of the subjects correctly solved the questions, the experimental software was started.

At the beginning of each session, the players got 60 units of the fictitious currency "Taler". Each round of the experiment then proceeded according to the two-stage game described in Section 2. It started with player F's risk choice at stage 1 of the game. He could either choose a random draw out of the interval $[-2, 2]$ ("low risk") or from the interval $[-4, 4]$ ("high risk"). When choosing risk, player F knew the course of events at the next stage as well as both players' investment costs. At the beginning of stage 2, both players were informed about the interval that had been chosen by player F before. Then both players were asked about their beliefs concerning the investment decision of their respective opponent. Thereafter, each player i ($i = U, F$) chose between score 0 (at zero costs) and score 1 (at costs c_i) as alternative expenditure levels. Next, the random draw was executed. In two of the four sessions for each effect, the final score of player F consisted of his initially chosen score 0 or 1 plus the realization of the random draw, whereas the final score of player U was identical with his initially chosen score 0 or 1. In the other two sessions, the final score of player U was the sum of his chosen score and the realization of the random draw. The final score of player F was his initially chosen score.[13] The player with the higher final score was the winner of this round and the other one the loser. Both players were informed about both final scores, whether the guess about the opponent's choice was correct, and about the realized payoffs. Then the next round began.

Each session ended after 5 rounds. At the end of the session, one of the 5 rounds was drawn by lot. For this round, each player got 15 Talers if his guess of the opponent's investment choice was correct and zero Talers otherwise. The winner of the selected round received $B = 100$ Talers and the loser zero Talers. Each player had to pay zero or c_i Talers for the chosen score 0 or 1, respectively. The sum of Talers was then converted

[12] The instructions can be obtained from the authors upon request.

[13] Note that both procedures lead to identical theoretic outcomes since exogenous noise is symmetrically distributed around zero. There are no significant differences between the behavior of the subjects in the different sessions for each treatment pooled over all rounds. Hence, in the following we pool the data of those sessions.

into Euro by a previously known exchange rate of 1 Euro per 10 Talers. Additionally, each participant received a show up fee of 2.50 Euro independent of the outcome of the game. After the final round, the subjects were requested to complete a questionnaire including questions on gender, age, loss aversion and inequity aversion. Furthermore, the questionnaire contained questions concerning the risk attitude of the subjects. These questions were taken from the German Socio Economic Panel (GSOEP) and dealt with the overall risk attitude of a subject. As Dohmen et al. (2010) have shown the general question about the willingness to take risks is a good predictor of actual risk-taking behavior.

The language was kept neutral at any time. For example, we did not use terms like "incumbent" and "challenger", "favorite" and "underdog", or "player F" and "player U", but instead spoke of "player A" and "player B". Moreover, we simply described the pure random draw out of the two alternative intervals without speaking of low or high risk. Instead favorites chose between "alternative 1" and "alternative 2".

5 Hypotheses

We tested four hypotheses, three of them deal with the risk behavior and one of them with the players' behavior at the investment stage.

The first three hypotheses test the relevance of the discouragement effect, the cost effect and the likelihood effect at stage 1 of the game. Since we designed three different constellations by changing one of the cost parameters, respectively, each effect could be separately analyzed in a single treatment. The cost treatment is obtained from the discouragement treatment by increasing the favorite's cost parameter, whereas the design of the likelihood treatment results from increasing the underdog's cost parameter in the discouragement treatment.

Hypothesis 1: *In the discouragement treatment, (most of) the favorites choose the high risk.*

Hypothesis 2: *In the cost treatment, (most of) the favorites choose the high risk.*

Hypothesis 3: *In the likelihood treatment, (most of) the favorites choose the low risk.*

In a next step, we test the players' chosen expenditures at the second stage of the game. Since in any equilibrium at the investment stage the favorite should not choose less expenditures than the underdog, we have the following hypothesis:

Hypothesis 4: *The favorites choose at least as much expenditures as the underdogs.*

6 Experimental Results

6.1 The Risk-Taking Stage

We test the hypotheses with the data of our experiment, starting with the risk choices of the favorites. Figure 3 shows the fraction of favorites who choose the high risk in the respective treatment.[14] Contrary to Hypothesis 1, most of the favorites choose low risk in the discouragement treatment. Furthermore, concerning Hypothesis 2, only slightly more than 50% of the favorites choose high risk in the cost treatment. In the likelihood treatment the majority of the favorites chooses low risk, which is in line with Hypothesis 3. The results of one-tailed sign tests confirm these first impressions: in the likelihood treatment significantly more favorites choose low risk than high risk ($p = 0.0002$), while we cannot reject the null hypothesis that 50% or less of the favorites choose high risk in the discouragement and cost treatment.

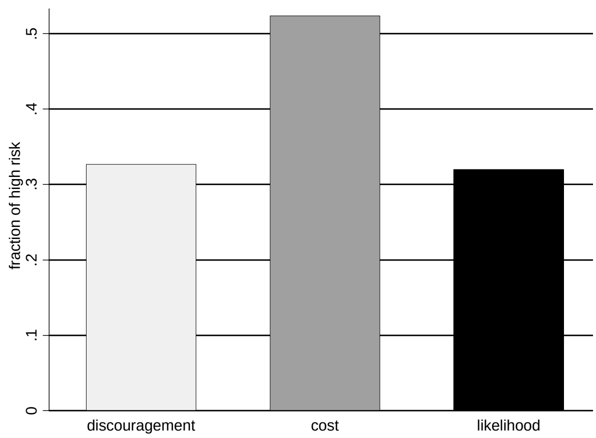

Figure 3: Choice of risk

Note that we pool our data over all rounds. To check whether our test results are distorted by learning effects, we run different regressions with risk choice as the dependent variable including round dummies (see Tables 2 to 4 in the Appendix). As the subjects play the game five times, we compute robust standard errors clustered by subjects. The regression results reveal that there are no significant learning effects over time in all treatments, since there is no significant influence of a certain round on risk taking.[15] This can be explained by the relatively large number of 10 trial rounds at the beginning of the experiment which helped the subjects to study the consequences of different strategies. If there are any learning effects, these should only be relevant in the trial phase.

[14] While all figures consider fractions relating to the whole number of observations of a particular situation, non-parametric tests take into account that we have one independent observation per group over all rounds.

[15] Additionally, we compare the risk taking in a particular round with the risk taking of the following round but do not find significant differences except a weakly significant result for the comparision of round 1 with round 2 in the discouragement treatment ($p = 0.065$, two-tailed sign test).

In addition, we pairwisely compare the risk choices of the three treatments. Whereas the sign test has shown that favorites do not prefer high risk significantly more than low risk in the cost treatment, the relative comparison and the results of Mann-Whitney-U tests support the initial impression from Figure 3: favorites seem to choose the high risk more often in the cost treatment compared to the discouragement treatment. Favorites' risk taking in the cost treatment significantly differs from that in the discouragement treatment (two-tailed U-test, $p = 0.001$). Therefore, the cost effect seems to be more relevant for subjects when choosing risk than the discouragement effect. Furthermore, the probit regressions with the risk choice as the dependent variable (see Table 2 in the Appendix) show that the dummy variable for the cost treatment is highly significant. This confirms our test result.

Favorites' risk taking in the discouragement treatment is not significantly higher than that in the likelihood treatment (one-tailed U-test). This test result is in line with our previous observation: in the likelihood treatment, favorites choose low risk as theoretically expected. Since, contrary to theory, they also often choose low risk in the discouragement treatment, risk taking is not significantly higher in the discouragement treatment.[16]

As predicted by theory, favorites' risk taking is significantly higher in the cost treatment than in the likelihood treatment (one-tailed U-test, $p = 0.000$). Further confirmation comes from the respective probit regressions (see Table 4 in the Appendix). Note that all probit regressions show that the subjects' risk attitude does not have a significant influence on the favorites' risk taking.

6.2 The Investment Stage

Given the favorite's risk choice at stage 1, the underdog and the favorite have to decide on their expenditures at the second stage of the game. According to the subgame perfect equilibria, we would expect that the favorite chooses a higher expenditure level than the underdog in the discouragement and the likelihood treatments, whereas both players' investments should be the same in the cost treatment. Altogether, in stage 2 favorites should be more aggressive (i.e., choose higher expenditures) than underdogs on average.[17] Figure 4 shows the fraction of players spending high expenditures over all treatments. In line with theory and our Hypothesis 4, favorites are clearly more aggressive than underdogs which is supported by a one-tailed sign test ($p = 0.000$). Recall that in the discouragement and the cost treatments different risk levels lead to different equilibria at the investment stage. Since both risk levels have been chosen at stage 1, we can test

[16] Again, the probit regressions in Table 3 in the Appendix confirm this result since we do not find a significant treatment dummy.

[17] Uneven tournaments in the notion of O'Keeffe et al. (1984) were also considered in the experiments by Bull et al. (1987), Schotter and Weigelt (1992) and Harbring et al. (2007). In each experiment, favorites choose significantly higher input levels than underdogs.

whether players rationally react to a given risk level. In the discouragement treatment, the favorite should always choose the large expenditure level independent of given risk, whereas the underdog should prefer small (large) investment if risk is high (low).

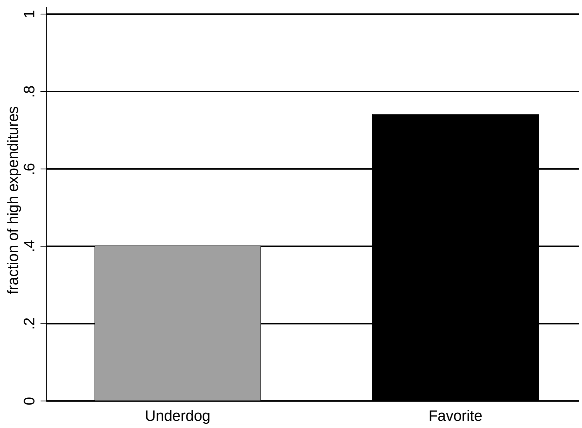

Figure 4: Expenditures over all treatments

Figure 5 shows the investment decisions of the favorites and underdogs for the different levels of risk in the discouragement treatment. In the high-risk as well as in the low-risk situation most of the favorites decide to choose high expenditures. Consequently we cannot find significant differences between the favorites' investment decisions (two-tailed sign test), which strictly confirms theory. If the risk is high, favorites spend significantly more expenditures than underdogs (one-tailed sign test, $p = 0.000$) which is also perfectly in line with theory. As can already be seen from Figure 5 favorites choose higher expenditures than underdogs if the risk is low, too (two-tailed sign test, $p = 0.000$).

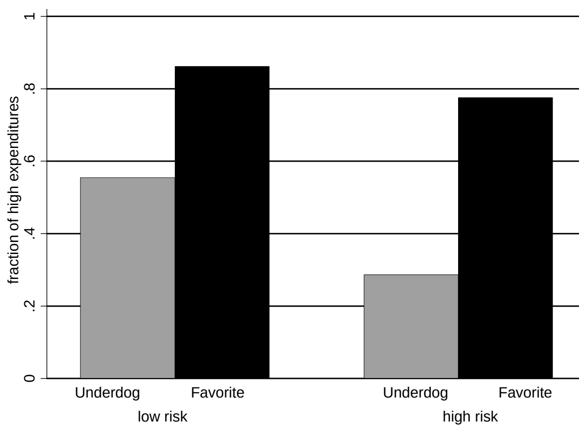

Figure 5: Expenditures in the discouragement treatment

Surprisingly many underdogs do not choose the high expenditure level although this would increase their chance of winning the competition. However, note that the underdogs show a clear reaction to the underlying risk: their expenditures are significantly higher if the favorite has chosen low risk (one-tailed sign test, $p = 0.021$). Altogether, our findings support the fundamentals of the discouragement effect at the investment stage, but the underdogs do not react strong enough and – as we have seen at the risk-taking stage – the favorites do not make use of the discouragement effect as often as theoretically predicted.

Additionally, we run probit regressions with chosen expenditures as the dependent variable and a dummy variable for the type of the player which are reported in Table 5 in the Appendix. These regressions qualitatively lead to the same results as the sign tests. We also control for learning effects in the regressions and compute robust standard errors clustered on subjects. Similar to the risk-taking stage, we do not observe learning effects.[18] Furthermore, we include a dummy variable for risk averse subjects and one for risk loving ones (so risk neutral is the control group) in the regression. The risk aversion of the subjects has no significant impact.[19]

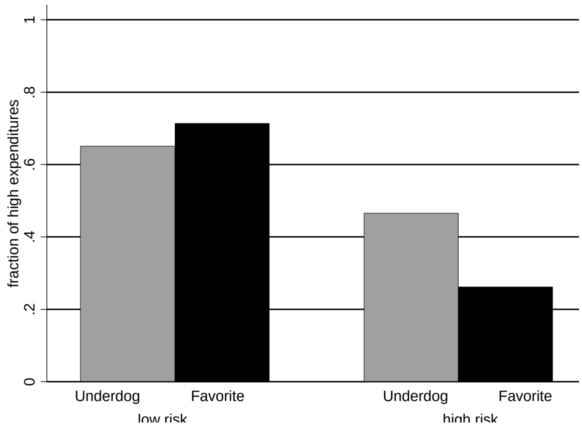

Figure 6: Expenditures in the cost treatment

In Figure 6 we report the investment decisions of the subjects in the cost treatment. It is obvious that they choose different expenditure levels depending on the chosen risk, as predicted by theory. This can be supported by the results of sign tests which show that underdogs as well as favorites choose more expenditures if risk is low (one-tailed, underdogs: $p = 0.002$, favorites: $p = 0.000$). In the situation with low risk both players should prefer aggressive behavior at the investment stage. Indeed we do not find significant differences when comparing expenditures of favorites and underdogs. However, underdogs supply weakly significantly more investment than their opponents if risk is high (sign test $p = 0.064$) which is not in line with theory. Interestingly, favorites are more sensitive to risk than underdogs although subjects change their roles after each round. Again we run probit regressions which confirm our findings (see Table 6 in the Appendix). Note that we do not find any learning effects and that the risk attitudes of the subjects have no significant influences on their investment decisions.

[18] Except for round 2 if risk is high.

[19] Only risk loving subjects spend more investment if the risk is high. However, only about 26% of the observations are from risk loving players which drive this result.

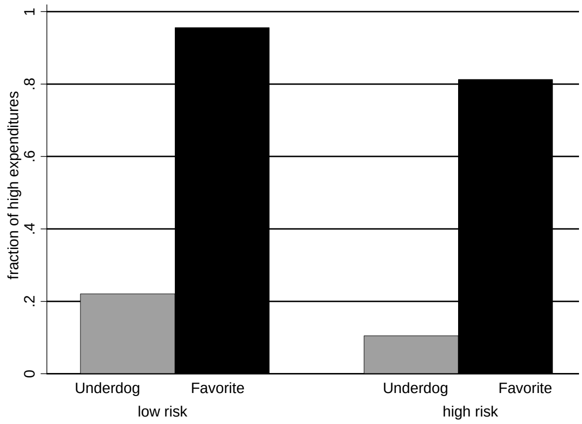

Figure 7: Expenditures in the likelihood treatment

As Figure 7 shows, the results for the likelihood treatment are perfectly in line with theory. In the likelihood treatment, for both risk levels favorites (underdogs) should choose high (low) expenditures. Indeed, we do not find significant differences between the underdogs' investment choices. The favorites' expenditures are higher if risk is low (two-tailed sign test, $p = 0.039$) but nevertheless the majority of the observations reveals a tendency to high expenditures. In both situations favorites spend significantly more resources in stage 2 than underdogs (one-tailed sign test, low risk $p = 0.000$ and high risk $p = 0.000$). The probit regressions reported in Table 7 in the Appendix lead to the same results and show that, similar to the cost treatment, neither learning effects nor risk attitude have significant effects on the chosen expenditures.[20]

7 Discussion

The experimental results of Section 6 show that individuals often behave rationally when deciding on risk and, in general, do react to risk when deciding on expenditures. However, our findings also point to three puzzles, which should be discussed in the following: (1) favorites significantly more often choose low risk than high risk in the discouragement treatment; (2) given low risk in the discouragement treatment, favorites spend significantly more expenditures than underdogs; (3) given high risk in the cost treatment, underdogs are significantly more aggressive than favorites at the investment stage.

We use the beliefs of the subjects and other characteristics such as gender or risk aversion to investigate these puzzles. Furthermore, we also conducted three additional treatments to shed light on the puzzles. These additional treatments have three purposes. First, they reduce the complexity of the subjects' tasks and second they decrease the decision power of the favorite. Third, one of the treatments varies the cost of expenditures

[20] To check if most of the subjects of a certain type choose the predicted investment level under a given risk, we used one-tailed sign tests. See Table 8 in the Appendix for the complete results.

for the underdog. Before we start examining our puzzles, we will briefly explain the design of the additional treatments, which we call "discouragement additional", "cost additional" and "discouragement small". The outline of each treatment was similar to the outline of the original treatments. In fact, at the investment stage all parameters were identical regarding the original discouragement treatment and the discouragement additional one or the original cost treatment and the cost additional one. Only in the discouragement small treatment the cost of the underdog for a high expenditure level was reduced from 24 to 18. In contrast to the original treatments, we simplified the risk-taking stage. The risk was no longer selected by the favorite but chosen exogenously by the experimental software. Hence, the game had only one stage where the players chose actions. This reduced the complexity of the game and forced the attention of the players to the expenditure decision. Besides, we cut the decision power of the favorite as he could no longer select the risk of the game. Hence, the only difference between the two player roles in the additional treatments was the cost advantage of the favorite.

We conducted all three treatments in the Cologne Laboratory of Economic Research in December 2009. Each treatment consisted of two sessions. Altogether 180 students participated in the additional treatments and none of the participants had played in the original treatments. Each session took on average one hour and 15 minutes.[21]

Now we start analyzing the puzzles concerning the discouragement treatment. Inspection of the subjects' beliefs concerning their opponents' expenditure decisions shows that puzzles (1) and (2) seem to be interrelated. It turns out that in the low-risk state of the discouragement treatment, favorites' equilibrium beliefs differ from their reported beliefs in the experiment. About 53.47% of the favorites expect the underdogs to choose low expenditures. Actually, about one half of the underdogs choose a low expenditure level. Given that the favorites already had these beliefs when taking risk at stage 1, puzzle (1) can easily be explained: a favorite expecting low expenditures by an underdog in both a low-risk and a high-risk state, should unambiguously prefer the high expenditure level in both states. The results of our sign tests from Subsection 6.1 show that indeed favorites highly significantly react in this way. When the favorites decide on risk taking at stage 1 and anticipate $(e_U, e_F) = (0, 1)$ under both risks, the underlying discouragement problem now turns into a perceived likelihood problem from the viewpoint of the favorites. Given a perceived likelihood problem, the favorites should optimally choose a low risk in order to maximize their winning probability (see Figure 2), which explains puzzle (1).

Concerning puzzle (2), some of the underdogs might choose low expenditures even in the low-risk state since they feel discouraged because of their cost disadvantage or their lower decision power. The underdogs have the same cost parameter in the discouragement and cost treatment. However, underdogs act more aggressively in the cost treatment than in the discouragement treatment. Therefore, one might suspect that the underdogs rather

[21] The translated instructions can be obtained from the authors upon request.

react to the cost difference between favorites and underdogs than to their absolute cost value. In order to check if this explanation is true, we use the results of the discouragement additional and the discouragement small treatments which are reported in Figures 8 and 9 in the Appendix. If we compare the expenditures of the original treatment with those of the discouragement additional one, we can check whether a reduction of complexity and decision power of the favorite has an impact on the level of expenditures. There are no significant differences regarding expenditures between the two treatments (two-tailed U test). Hence, simplification of the game and decision power do not help to solve puzzle (2).

When comparing the results of the discouragement additional treatment and the discouragement small one, we can investigate if a change in the cost structure affects expenditures. As expected, we do not find significant differences between the two treatments regarding the behavior of the favorites since their costs were not changed. Underdogs select significantly less expenditures if the costs are higher (i.e., in the discouragement additional treatment) in the high risk situation (two-tailed U test, $p = 0.0105$) but there are no significant effects of a change in the cost structure in the low risk situation. Hence, even lowering the cost difference does not solve puzzle (2).

Concerning puzzle (3), controlling for risk aversion, loss aversion, inequity aversion and the history of the game does not yield new insights. In particular, one might expect the players' history in the game to have explanatory power: intuitively, subjects might react to the outcomes of former rounds when choosing expenditures in the actual round. However, our results do not show a clear impact of experienced success or failure in previous tournaments.

As a possible explanation of puzzle (3), we suppose that underdogs react too strongly to the close competition with the favorites. In the cost treatment, costs for high expenditures were $c_U = 24$ and $c_F = 22$. Hence, the cost difference is rather small – particularly compared to the two other treatments –, and the underdogs might have chosen high expenditure due to perceived homogeneity in the tournament. Inspection of the players' beliefs reveals that about 60% of the favorites expect their opponents to choose low expenditure levels whereas about 52% of the underdogs believe the favorites will prefer low expenditures. Underdogs might select high expenditures because they expect favorites to choose high expenditure levels as well. 65% of the underdogs who believe the favorite to behave aggressively choose high expenditures, too. Similarly, about 71% of the underdogs who believe the favorite to choose low expenditures also choose low expenditures. These observations are supported by a probit regression in Table 9 in the Appendix. In this regression the expenditure decision of the underdogs is the dependent variable. Here the belief about the expenditure decision of the opponent has a significant impact on the own expenditure choice. However, in the concrete situation given $\sigma^2 = \sigma_H^2$ and $e_F = 1$, an underdog should prefer $e_U = 1$ to $e_U = 0$ if and only if

$\frac{B}{2} - c_U > B \cdot G\left(-\Delta e; \sigma_H^2\right) \Leftrightarrow B \cdot \Delta G\left(\sigma_H^2\right) > c_U$, and for our chosen parameter values this condition (12.5 Talers > 24 Talers) is clearly violated.

While in the cost treatment a considerable fraction of the underdogs do not act in line with theory favorites mostly play the equilibrium prediction at the investment stage. 87% of the favorites who believe the underdog to choose low expenditures also choose low expenditures while still about 55% of the favorites who believe the underdog to choose high expenditures choose low expenditures. This different behavior of underdogs and favorites is surprising because the players changed roles after each round. However, as the regression in Table 9 in the Appendix shows, underdogs that were in the role of favorites in the previous round and selected high risk act significantly less aggressively than others in the investment stage. It seems that subjects who understood the game as favorites and therefore selected high risk also acted in line with theory as underdogs. Favorites who preferred the low risk tend to play a suboptimal strategy as underdogs as well.

Another possible explanation might be that favorites play the more active part in this game as they select the risk which affects the outcome of the tournament. Therefore, we conducted two sessions where the random draw (risk choice) contributed to the final score of the favorite and two sessions where it contributed to the final score of the underdog. In the latter sessions the risk choice of the favorite has a direct impact on the final score of the underdog. However, we do not find significant differences between those sessions.

For a deeper analysis of the conjecture that the more active role of the favorite can explain our puzzling findings in the cost treatment, we inspect the results of the cost additional treatment. They are shown in Figure 10 in the Appendix. Indeed, underdogs select low expenditures significantly more often in the additional than in the original cost treatment in the high risk situation (two-tailed U test, $p = 0.0804$). We do not find other significant differences at the investment stage when comparing both treatments. Hence, the reduction of decision power of the favorite in the additional treatment has an impact on the expenditure decision of underdogs in the high-risk situation. If the favorite is no longer the player with more decision power, underdogs seem to feel no need to compensate their weaker position by choosing high expenditures in the high risk situation. To sum up, as we can see from Figure 6, underdogs do reduce their expenditures when risk increases, which is qualitatively in line with the cost effect, but due to their lower decision power underdogs do not react as strongly as favorites to different risks.

8 Conclusion

Typically, in an electoral competition between a challenger and an incumbent politician, the challenger first decides whether to use a more or less risky agenda. Thereafter, both candidates choose optimal levels of expenditures to be spent during the campaign. Risk taking at the first stage of the game determines both the candidates' optimal investments at stage two and their likelihoods of winning the election. In our model, we find three effects that mainly determine risk taking – a cost effect, a likelihood effect, and a discouragement effect. The normative findings on the three effects recommend the following rational behavior for the challenger: (1) if both candidates' optimal investments are sensitive to risk taking, the challenger should prevent mutually aggressive campaigning (i.e., high expenditures) by choosing a very innovative or risky political agenda (cost effect); (2) if optimal investments of both candidates are not sensitive to risk, the challenger should rely on his competitive advantage at the investment stage and prefer a rather conservative program (likelihood effect); (3) if only the incumbent's optimal investment is sensitive to risk and the political position is very attractive, the challenger should choose both to be elected: an innovative or risky political concept and aggressive investment during the campaign (discouragement effect).

Our experimental findings point out that subjects understand the implications of risk taking since investment decisions are mostly in line with theory under all three effects. In other words, the fundamentals of the three effects are confirmed by our data. However, the subjects do not make use of the three effects as often as predicted by theory, which is particularly true for the discouragement effect. The last result implies that high-potential newcomers (i.e., favorites) that challenge an incumbent politician tend to avoid risky and innovative political programs. Hence, comprehensive reforms will not be announced by a challenger and cannot be expected by society to be accomplished if the challenger wins the election. However, if the challenger is an underdog he will announce a risky set of political topics since he is the presumed loser in the contest. Such "gambling for resurrection" will now lead to significant reforms in case of the challenger's victory, but due to his relatively low quality society should be skeptical whether these reforms are really sophisticated.

Appendix

Proof of Proposition 2:

(i) Since we have two risk levels, σ_L^2 and σ_H^2, there are four cutoffs with $\frac{c_F}{\Delta G(\sigma_L^2)}$ being the smallest one and $\frac{c_U}{\Delta G(\sigma_H^2)}$ the largest one because of (5). According to (6), both players will always (never) choose high expenditure levels if $B \geq \frac{c_U}{\Delta G(\sigma_H^2)}$ ($B \leq \frac{c_F}{\Delta G(\sigma_L^2)}$), irrespective of risk taking in stage 1.

(ii) We have to differentiate between two possible rankings of the cutoffs:

$$\begin{array}{ll} \text{scenario 1:} & \dfrac{c_F}{\Delta G(\sigma_L^2)} < \dfrac{c_F}{\Delta G(\sigma_H^2)} < \dfrac{c_U}{\Delta G(\sigma_L^2)} < \dfrac{c_U}{\Delta G(\sigma_H^2)} \\ \text{scenario 2:} & \dfrac{c_F}{\Delta G(\sigma_L^2)} < \dfrac{c_U}{\Delta G(\sigma_L^2)} < \dfrac{c_F}{\Delta G(\sigma_H^2)} < \dfrac{c_U}{\Delta G(\sigma_H^2)}. \end{array}$$

If $B < \min\left\{\frac{c_F}{\Delta G(\sigma_H^2)}, \frac{c_U}{\Delta G(\sigma_L^2)}\right\}$, then in both scenarios the choice of σ_L^2 will imply $(e_U^*, e_F^*) = (e_L, e_H)$ at stage 2, whereas $\sigma^2 = \sigma_H^2$ will lead to $(e_U^*, e_F^*) = (e_L, e_L)$. In this situation, a F-challenger prefers $\sigma^2 = \sigma_L^2$ since

$$B \cdot G\left(\Delta e; \sigma_L^2\right) - c_F > \frac{B}{2} \Leftrightarrow B > \frac{c_F}{\Delta G(\sigma_L^2)}$$

is true. However, a U-challenger prefers $\sigma^2 = \sigma_H^2$ because of

$$\frac{B}{2} > B \cdot G\left(-\Delta e; \sigma_L^2\right).$$

If $B > \max\left\{\frac{c_F}{\Delta G(\sigma_H^2)}, \frac{c_U}{\Delta G(\sigma_L^2)}\right\}$, then in both scenarios the choice of σ_L^2 will result into $(e_U^*, e_F^*) = (e_H, e_H)$ at stage 2, but $\sigma^2 = \sigma_H^2$ will induce $(e_U^*, e_F^*) = (e_L, e_H)$. In this case, a F-challenger prefers the high risk σ_H^2 since

$$B \cdot G\left(\Delta e; \sigma_H^2\right) - c_F > \frac{B}{2} - c_F.$$

Player U has the same preference when being the challenger because

$$B \cdot G\left(-\Delta e; \sigma_H^2\right) > \frac{B}{2} - c_U \Leftrightarrow \frac{c_U}{\Delta G(\sigma_H^2)} > B$$

is true.

Two cases are still missing. Under scenario 1, we may have that

$$\frac{c_F}{\Delta G(\sigma_H^2)} < B < \frac{c_U}{\Delta G(\sigma_L^2)}.$$

Then any risk choice leads to $(e_U^*, e_F^*) = (e_L, e_H)$ at stage 2 and a F-challenger prefers

σ_L^2 because of

$$B \cdot G\left(\Delta e; \sigma_L^2\right) - c_F > B \cdot G\left(\Delta e; \sigma_H^2\right) - c_F,$$

but U favors σ_H^2 when being active at stage 1 since

$$B \cdot G\left(-\Delta e; \sigma_H^2\right) > B \cdot G\left(-\Delta e; \sigma_L^2\right).$$

Under scenario 2, we may have that

$$\frac{c_U}{\Delta G\left(\sigma_L^2\right)} < B < \frac{c_F}{\Delta G\left(\sigma_H^2\right)}.$$

Here, low risk σ_L^2 implies $(e_U^*, e_F^*) = (e_H, e_H)$, but high risk σ_H^2 leads to $(e_U^*, e_F^*) = (e_L, e_L)$. Obviously, each type of challenger prefers the choice of high risk at stage 1. Our findings are summarized in Proposition 2(ii).

	(1)	(2)
Dummy Cost Treatment	0.509***	0.506***
	(0.14)	(0.14)
Risk averse		0.0512
		(0.13)
Risk loving		−0.0621
		(0.14)
Dummy Round 2	0.134	0.131
	(0.19)	(0.19)
Dummy Round 3	0.0892	0.0887
	(0.12)	(0.13)
Dummy Round 4	0.0886	0.0877
	(0.15)	(0.15)
Dummy Round 5	0.0220	0.0206
	(0.16)	(0.16)
Constant	−0.517***	−0.516**
	(0.16)	(0.20)
Observations	600	600
Pseudo R^2	0.0303	0.0312
Log Pseudolikelihood	−396.71272	−396.35534

The dependent variable is risk choice. Dummy cost treatment is 1 for the cost treatment and 0 for the discouragement treatment. Robust standard errors in parentheses are calculated by clustering on subjects.

***p < 0.01, **p < 0.05, *p < 0.1

Table 2: Probit regression: comparison of discouragement and cost treatment

	(1)	(2)
Dummy Likelihood Treatment	-0.0191	-0.0233
	(0.14)	(0.14)
Risk averse		-0.146
		(0.14)
Risk loving		-0.0333
		(0.16)
Dummy Round 2	0.160	0.167
	(0.14)	(0.15)
Dummy Round 3	0.160	0.157
	(0.11)	(0.11)
Dummy Round 4	0.0235	0.0266
	(0.16)	(0.16)
Dummy Round 5	-0.148	-0.148
	(0.13)	(0.13)
Constant	-0.491^{***}	-0.433^{**}
	(0.14)	(0.17)
Observations	600	600
Pseudo R^2	0.0061	0.0079
Log Pseudolikelihood	-375.30969	-374.61791

The dependent variable is risk choice. Dummy likelihood treatment is 1 for the likelihood treatment and 0 for the discouragement treatment. Robust standard errors in parentheses are calculated by clustering on subjects.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 3: Probit regression: comparison of discouragement and likelihood treatment

	(1)	(2)
Dummy Cost Treatment	0.528***	0.539***
	(0.14)	(0.15)
Risk averse		0.0555
		(0.16)
Risk loving		0.193
		(0.19)
Dummy Round 2	−0.0660	−0.0473
	(0.15)	(0.14)
Dummy Round 3	0.109	0.119
	(0.12)	(0.12)
Dummy Round 4	0.0211	0.0237
	(0.12)	(0.12)
Dummy Round 5	−0.115	−0.0987
	(0.13)	(0.13)
Constant	−0.460***	−0.547***
	(0.11)	(0.17)
Observations	600	600
Pseudo R^2	0.0340	0.0367
Log Pseudolikelihood	−394.59834	−393.48415

The dependent variable is risk choice. Dummy cost treatment is 1 for the cost treatment and 0 for the likelihood treatment. Robust standard errors in parentheses are calculated by clustering on subjects.

***p < 0.01, **p < 0.05, *p < 0.1

Table 4: Probit regression: comparison of likelihood and cost treatment

	High risk	High risk	Low risk	Low risk
Dummy Favorite	1.330***	1.428***	0.957***	0.967***
	(0.19)	(0.19)	(0.17)	(0.18)
Risk averse		−0.123		−0.291
		(0.29)		(0.25)
Risk loving		0.640**		0.271
		(0.25)		(0.22)
Dummy Round 2	0.124	0.0698	0.356*	0.387*
	(0.28)	(0.28)	(0.21)	(0.21)
Dummy Round 3	0.153	0.115	0.167	0.175
	(0.21)	(0.23)	(0.15)	(0.16)
Dummy Round 4	0.238	0.130	0.210	0.255
	(0.32)	(0.33)	(0.18)	(0.19)
Dummy Round 5	−0.0976	−0.129	0.228	0.257
	(0.23)	(0.25)	(0.17)	(0.17)
Constant	−0.665***	−0.784***	−0.0481	−0.0388
	(0.23)	(0.26)	(0.16)	(0.21)
Observations	196	196	404	404
Pseudo R^2	0.1870	0.2215	0.1036	0.1264
Log Pseudolikelihood	−110.15352	−105.47966	−218.74212	−213.17795

The dependent variable is expenditures. Robust standard errors in parentheses are calculated by clustering on subjects.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 5: Probit regression Hypothesis 4: discouragement treatment

	High risk	High risk	Low risk	Low risk
Dummy Favorite	-0.555^{***}	-0.566^{***}	0.178	0.171
	(0.13)	(0.13)	(0.16)	(0.16)
Risk averse		-0.145		-0.120
		(0.20)		(0.24)
Risk loving		0.306		0.333
		(0.36)		(0.32)
Dummy Round 2	-0.0940	-0.0846	-0.0362	-0.0479
	(0.18)	(0.20)	(0.20)	(0.22)
Dummy Round 3	0.0880	0.0822	0.0223	0.0259
	(0.18)	(0.18)	(0.20)	(0.20)
Dummy Round 4	0.0633	0.0589	-0.357	-0.362
	(0.21)	(0.22)	(0.23)	(0.23)
Dummy Round 5	0.221	0.206	0.0251	0.0446
	(0.19)	(0.19)	(0.19)	(0.19)
Constant	-0.147	-0.160	0.456^{***}	0.430^{**}
	(0.17)	(0.23)	(0.13)	(0.21)
Observations	314	314	286	286
Pseudo R^2	0.0394	0.0533	0.0135	0.0266
Log Pseudolikelihood	-197.61873	-194.76213	-176.47632	-174.12409

The dependent variable is expenditures. Robust standard errors in parentheses are calculated by clustering on subjects.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 6: Probit regression Hypothesis 4: cost treatment

	High risk	High risk	Low risk	Low risk
Dummy Favorite	2.168^{***}	2.188^{***}	2.481^{***}	2.485^{***}
	(0.25)	(0.24)	(0.21)	(0.21)
Risk averse		0.321		0.0626
		(0.34)		(0.20)
Risk loving		0.187		−0.0348
		(0.32)		(0.25)
Dummy Round 2	−0.0365	0.00545	−0.270	−0.275
	(0.34)	(0.34)	(0.21)	(0.21)
Dummy Round 3	0.212	0.254	−0.0465	−0.0519
	(0.27)	(0.27)	(0.28)	(0.28)
Dummy Round 4	0.0921	0.101	−0.162	−0.165
	(0.32)	(0.32)	(0.23)	(0.23)
Dummy Round 5	−0.262	−0.213	−0.246	−0.253
	(0.30)	(0.29)	(0.24)	(0.24)
Constant	-1.296^{***}	-1.492^{***}	-0.627^{***}	-0.635^{***}
	(0.30)	(0.36)	(0.17)	(0.21)
Observations	192	192	408	408
Pseudo R^2	0.4145	0.4190	0.4802	0.4806
Log Pseudolikelihood	−77.528258	−76.933222	−143.69467	−143.57859

The dependent variable is expenditures. Robust standard errors in parentheses are calculated by clustering on subjects.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 7: Probit regression Hypothesis 4: likelihood treatment

	player: data	discouragement	cost	likelihood
high	F	$e_F = 1^{***}$	$e_F = 0^{***}$	$e_F = 1^{***}$
risk	U	$e_U = 0^{***}$	$e_U = 0$	$e_U = 0^{***}$
low	F	$e_F = 1^{***}$	$e_F = 1^{***}$	$e_F = 1^{***}$
risk	U	$e_U = 1^{**}$	$e_U = 1^{*}$	$e_U = 0^{***}$

($^{*}0.05 < \alpha \leq 0.1$; $^{**}0.01 < \alpha \leq 0.05$; $^{***}\alpha \leq 0.01$)

Table 8: Results on choice of expenditures (one-tailed sign tests)

	High risk	High risk
Lagged Favorite High Risk	-0.606^{***}	-0.545^{**}
	(0.224)	(0.240)
Belief Player		0.968^{***}
		(0.235)
Round 3	0.151	-0.000141
	(0.324)	(0.380)
Round 4	-0.136	-0.144
	(0.314)	(0.369)
Round 5	0.124	0.192
	(0.332)	(0.380)
Constant	0.198	-0.289
	(0.248)	(0.295)
Observations	126	126
Pseudo R^2	0.0437	0.1387
Log Pseudolikelihood	-83.502283	-75.205655

The dependent variable is expenditures. The dummy variable "lagged favorite high risk" is 1 if the underdog was in the role of a favorite one round before and selected high risk. Robust standard errors in parentheses are calculated by clustering on subjects. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 9: Probit regression cost treatment only underdogs

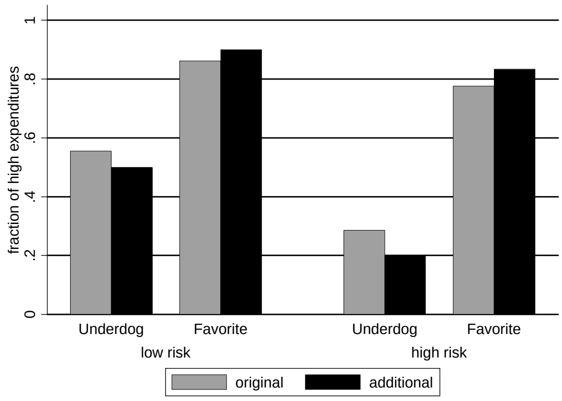

Figure 8: Comparision of expenditures in the original and additional discouragement treatment

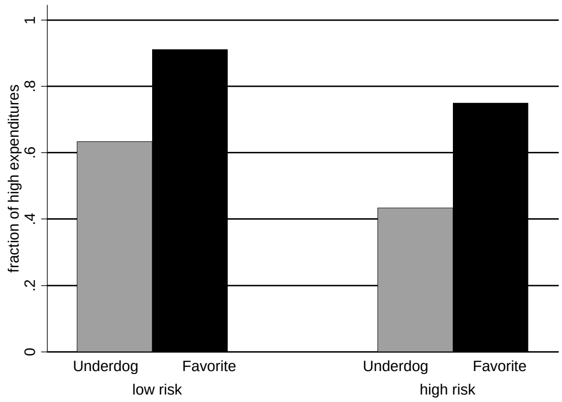

Figure 9: Expenditures in discouragement small treatment

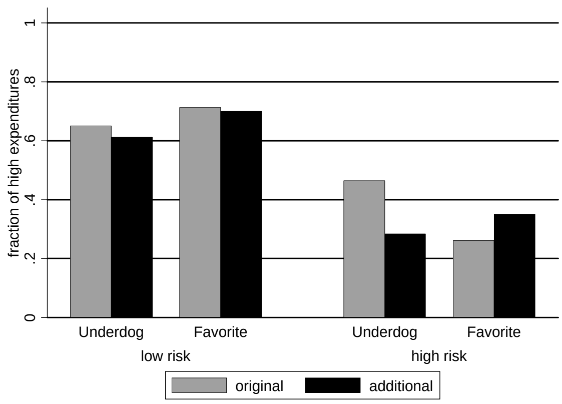

Figure 10: Comparision of expenditures in the original and additional cost treatment

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