Contest Design When Winners Gain Advantage*

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Abstract

We consider a principal who can distribute a prize fund over two consecutive contests. The winner of contest one gains an advantage in contest two; this win advantage affects his cost of exerting effort in the second contest and his effort productivity in the second contest. We find that, without discounting among contestants, the two aspects of the win advantage work the same, with the principal choosing to have the full prize fund in the second contest. This result is modified when contestants discount future payoffs.

Keywords: contest, win advantage, effort incentives, budget division.

JEL codes: D74, D72

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1 Introduction

Many contest situations have the features that (i) contestants meet more than once, (ii) winning in early rounds gives an advantage in later rounds, and (iii) the prize structure is such that the prize value in each stage differs.

Contest designers interested in keeping up overall efforts among contestants in such situations may be concerned with win advantages potentially creating discouragement among early losers, at the same time as they would like to take advantage of the increased efficiency of early winners. In this paper, we set up a model to study such a contest situation and the contest designer's optimum decision. In the model, there are two simple Tullock contests run in sequence among the same set of players, and the winner of the first contest has an advantage over the other players in the second one. The win advantage is two-fold: the winner of the first contest has both lower effort costs and more productive efforts than the others in contest two.

The win advantage from the early round introduces an asymmetry into the subsequent competition. The effort-maximizing contest designer has available a prize fund of fixed size that she can freely allocate between the two contests. We find that the optimum is for the designer to put the whole prize fund in the second contest, so that the first contest is merely a token one where the contestants have a pure fight for the win advantage – except possibly when contestants discount future payoffs heavily.

In the presence of a win advantage, losing the first-round contest may have one of two potential effects on a player before the second round: he may be discouraged by his earlier loss and the entailing disadvantage in effort costs and thus reduce his effort before the second contest relative to a case of no win advantage; or he may be encouraged to increase his effort in order to compensate for this disadvantage in the fight for the second-round prize. In our analysis, we find that the former effect dominates, so that the win advantage discourages the early losers. By putting a big prize in the late contest, the contest designer keeps up the suspense in the game, which helps in making total efforts across the two contests high.

An application of our analysis would be to the choice facing research councils when choosing how to distribute prize funds for a research programme over several rounds of awarding research money. It has been argued that there is a sizeable win advantage in science, dubbed a Matthew Effect by Merton (1968). According to Gallini and Scotchmer (2002, p. 54), competing for grants is easier for those who have won previously: "[F]uture grants are contingent upon previous success. The linkage between previous success and future funding seems even more specific in the case of the National Science Council". The principal, in this case a research council, may wish competitors to have most effort later on in order to allow the participating research teams to exploit the enhanced efficiency from the win advantage. Balancing this concern against the potential discouragement among non-winning research teams, our analysis shows that the research council would like to have the big research money late in the programme.

There are numerous other real-life situations, in areas such as business, politics, and sport, that have features resembling our set-up. Sequences of contests are also in frequent use in sales-force management, with seller-of-the-month awards and the like in order to provide motivation for the sales force. In such settings, it is not uncommon for the more successful agents to be given less administrative duties, better access to back-office resources, more training than the less successful, and better territories; see, *e.g.*, Skiera and Albers (1998), Farrell and Hakstian (2001), and Krishnamoorthy, *et al.* (2005). These factors may reduce the successful salesperson's cost of effort and/or increase his/her efficiency. In many organizations, promotion games may have the same multi-stage structure, and in a number of sports, teams meet repeatedly throughout the season. The winner of a pre-election TV debate may be seen as obtaining a win advantage in the ensuing election (Schrott, 1990). In a quite different setting, students are subject to a number of tests throughout the year, with the final ranking being based on an exam in the end. A further source of win advantage may be psychological (Krumer, 2013). Cohen-Zada et al. (2017) find a significant psychological advantage in men's professional judo competitions; they link this to biological literature in which performance-enhancing testosterone increases following victory and falls after defeat. Evidence pointing to the presence of a win advantage in sequential competition is found in experimental studies carried out by Reeve, *et al.* (1985) and Vansteenkiste and Deci (2003). These studies show that winners feel more competent than losers, and that winning facilitates competitive performance and contributes positively to an individual's intrinsic motivation.

The study closest to ours is that of Möller (2012). Like us, he posits a sequence of contests in which the principal can choose how to distribute the prize fund across the contests. His win advantage differs from ours, though, since his contest designer can use prizes to fine-tune the amount of heterogeneity between competitors in the second contest. He posits a smooth relationship between the first-contest prize and the ability to compete in the second period, so that a designer can choose exactly which types of player compete in the second contest. Such power is often out of the scope of a contest designer. Our model captures a situation where there is a discrete advantage from winning, and where a loser gains nothing. Moreover, the size of the win advantage in our model is not related to the size of the prize on offer in the first contest; a psychological advantage of beating an opponent is, for example, not necessarily related to the immediate prize. Hence, the principal cannot fine-tune the opponents that meet in the second contest. Our work easily extends to many players, as can be seen in the analysis below, whereas contest design in Möller (2012) would be difficult in this case.

The win advantage in the work of Megidish and Sela (2014) is, on the other hand, more similar to ours. The winner of the first contest in a sequence of two competes for a different prize in the second contest, whilst the prize of the loser is the same in both rounds. The advantage to winning is thus that a higher prize is available, whereas in our model, effort cost is lower.[1] Their focus is on the effect of budget constraints on the temporal decisions of the contestants, whereas our perspective is that of contest design, where we discuss how to divide a prize mass

[1] Megidish and Sela (2014) also consider the case where the prize after winning is lower than the initial prize, i.e., a win disadvantage.

over two contests.

Also related is the study of Beviá and Corchón (2013), who look at the evolvement of strength in two sequential contests with identical prizes. The initial Tullock probability function (interpreted by the authors as a share) is augmented with a weight for each of two players showing *ex-ante* strength. The share of the prize gained by a player in the first contest translates into a strength in the second one by an increasing transition function.[2] Since effort influences the share of the prize in a continuous way, and the share then increases the strength continuously, the Beviá-Corchón paper is more similar to Clark and Nilssen (2013), who consider a direct correspondence between current effort and the effort cost in a subsequent contest. Schmitt, *et al.* (2004), Casas-Arce and Martínez-Jerez (2009), and Grossmann and Dietl (2009) also discuss such dynamic *effort* effects, whereby early efforts create later advantages. In Kovenock and Roberson (2009), it is the *net* effort, *i.e.*, a winner's effort over and above that of the other player's effort, that creates an advantage in a later contest. Yildirim (2005) looks at a single contest in which efforts can be made over two rounds before the winner is decided; first-round efforts are observed before second-round efforts are made.

More generally, our work is related to studies of dynamic battles; see the survey by Konrad (2009, ch 8). One such battle is the race, in which there is a grand prize to the player who first scores a sufficient number of wins. A related notion is the tug-of-war, where the winner of the grand prize is the one who first gets a sufficiently high lead. Early formal analyses of the race and the tug-of-war were done by Harris and Vickers (1987). A study of a race where there, as in our model, also are intermediate prizes in each round, in addition to the grand prize of the race, is Konrad and Kovenock (2009).

Another variation of a dynamic battle is the elimination tournament, where the best players in an early round are the only players proceeding to the next round (Rosen, 1986). Thus, in an elimination tournament, the number of players decreases over time. Although this is a different setting to ours, the same types of issue are investigated. Fu and Lu (2012) find, in line with our result, that it is optimal for the contest designer to put the whole prize mass in the final round. Delfgaauw, *et al.* (2015) correspondingly find, in a field experiment, that increasing late prizes leads to higher total effort.

Mago, *et al.* (2013) find that intermediate prizes increase efforts of both winner and loser in their theoretical and experimental analyses. This is contrary to our finding that it is optimal to shift prizes to the final round. However, in their work there is no win advantage. Krumer (2013) and Clark and Nilssen (2018a, 2018b, 2018c) carry out analyses related to ours, where each stage contains an all-pay auction with a win advantage, whereas the present analysis is based on a Tullock contest at each stage. Klein and Schmutzler (2017) analyze a series of contests in which the effort in each period may be weighted when deciding on the final prize. They show, in line with our results, that the bulk of the prize mass should be distributed to the final round.

[2] The equilibrium with two-players is symmetric, whereas this feature does not hold in an n-player model.

Our analysis concerns a setting where the win advantage is exogenous while the prize distribution across contests is decided by the principal. Still, there is a clear link to the analyses of Meyer (1992), Ridlon and Shin (2013), Franke, *et al.* (2013), and Franke, *et al.* (2018) who discuss situations where the size of the win advantage, and therefore the asymmetry between players in the second contest, is decided upon by a contest designer. Similarly, Esteve-González (2016) shows, in a setting with repeated services procurement, that mitigation of a moral hazard problem in service provision may be achieved through introducing a bias in the second period contest based on past performance.

The paper is organized as follows. In Section 2, we present the model. In Section 3, we present the analysis of the model and our main result on the principal's optimum distribution of the prize fund across the contests. Section 4 concludes.

2 Model

Consider a set N of $n \geq 2$ players who compete with each other in two interlinked sequential contests. The players compete by making non-refundable outlays and determine their efforts in each contest, each with the aim to maximize own expected payoff. As in Beviá and Corchón (2013) and Möller (2012), players are assumed to discount future payoffs with a discount factor $\delta \in [0, 1]$. A principal has a prize mass of size one, and distributes $1 - v$ of this in contest one, and v in contest two, where $v \in [0, 1]$.

Let $x_{i,t}$ be the effort exerted by player i in contest t, and let $p_{i,t}$ be the probability that player i wins it, where $i \in N$ and $t \in \{1, 2\}$. In contest one, the winner is determined by a regular Tullock contest success function:[3]

$$p_{i,1} = \frac{x_{i,1}}{\sum_{j=1}^{n} x_{j,1}}. \tag{1}$$

The winner of the first contest obtains an advantage before contest two. We model two ways by which a win in contest one provides an advantage for a player in contest two: it enhances the effect of his contest-two efforts, and it reduces his contest-two effort costs.[4]

Consider first the effect from winning the first contest on the winner's marginal cost of effort in the second contest. At the start of the first contest, each player has a marginal cost of effort of 1. The winner of contest one has, however, a lower cost of effort in the second contest, with a marginal cost of effort equal to $\alpha \in (0, 1]$; the smaller is α, the larger is the win advantage. The losers of the first contest continue to the second contest with a marginal cost of effort of 1.[5]

Consider next the effect of winning contest one that enhances the winner's probability of winning contest two. This win effect works through a change in the form of the contest success function: if player $i \in N$ wins contest one, then he

[3] As axiomatized by Skaperdas (1996) and used in numerous contest applications; see, for example, Konrad (2009).

[4] The latter is easily seen to be equivalent to a win making the contest-two prize more valuable.

[5] Möller (2012) has continuous cost adjustment between two contests in his two-player model.

has an input to the Tullock contest success function of contest two of $\beta x_{i,2}$, where $\beta \geq 1$ is a favorable bias that multiplies up the contestant's effort in contest two. We have that

$$\begin{aligned} p_{i,2} &= \rho_i(i) = \frac{\beta x_{i,2}}{\beta x_{i,2} + \sum_{k=1,k\neq i}^{n} x_{k,2}}, \\ p_{j,2} &= \rho_j(i) = \frac{x_{j,2}}{\beta x_{i,2} + \sum_{k=1,k\neq i}^{n} x_{k,2}}, \;\; i,j \in N, \;\; j \neq i, \end{aligned} \tag{2}$$

where $\rho_j(i)$ denotes the win probability of player j in contest two after player i has won contest one.

Note that the winner of contest one gains an advantage in contest two that is associated with the act of winning and not with the margin of victory. The win effect clearly is stronger the higher is β and the lower is α. A useful measure of the size of the win effect is therefore $\frac{\beta}{\alpha}$, which equals 1 when there is no win effect and increases as the win effect gets stronger, through either a higher β or a lower α.

A one-shot contest using a form similar to (2) has been investigated by Franke, *et al.* (2018). Beviá and Corchón (2013) investigate a two-player model in which the outcome of the first contest affects contestants' strength in a second contest. There, the bias parameters of the players evolve continuously according to the probability that each rival wins the first contest. Our approach, whether the effect of winning contest one is through the second-contest cost function of through the second-contest contest success function, emphasizes the winner-take-all nature of contests.

3 Analysis

In contest two, suppose that player i has won the first. Then the expected payoff of this player, denoted $\pi_{i,2}(i)$, and of the $n-1$ losers, $\pi_{j,2}(i)$, are

$$\pi_{i,2}(i) = \rho_i(i)\, v - \alpha x_{i,2}; \text{ and} \tag{3}$$

$$\pi_{j,2}(i) = \rho_j(i)\, v - x_{j,2}, \; j \neq i. \tag{4}$$

Let $X_t^*(v)$ denote total equilibrium efforts in contest $t \in \{1,2\}$, where we put in v as an argument to emphasize that efforts depend on how the principal splits the prize budget between the two contests. From the first-order conditions of (3) and (4), we find equilibrium efforts in contest two:

$$x_{i,2}^*(i) = \frac{\beta(n-1) - \alpha(n-2)}{[\alpha + \beta(n-1)]^2}(n-1)\, v; \tag{5}$$

$$x_{j,2}^*(i) = \frac{\alpha\beta}{[\alpha + \beta(n-1)]^2}(n-1)\, v, \;\; j \neq i; \tag{6}$$

$$X_2^*(v) = \frac{\beta(n-1)(1+\alpha) - \alpha(n-2)}{[\alpha + \beta(n-1)]^2}(n-1)\, v. \tag{7}$$

From (5) and (6), we see that the contest-one winner always exerts more effort in the second contest than a loser does.[6] Note the subtle effect that the number of players has on the second-contest effort of the first-contest winner. When $n > 2$, the effort of the first-contest winner is modified by a negative term that disappears for $n = 2$; essentially, the effect stems from the fact that a contestant losing in contest one faces $(n-2)$ other such losers in contest two, in addition to the contest-one winner. Note also that the second-contest equilibrium is symmetric for any $\beta \geq 1$ when $\alpha = 1$ and $n = 2$, but not otherwise.[7]

From (5), we have that

$$\frac{\partial x_{i,2}^{*}(i)}{\partial n} > 0 \Leftrightarrow \frac{\beta}{\alpha} > 1 + \frac{n-2}{n-1},$$

so that, if the win advantage is large enough (i.e., $\frac{\beta}{\alpha}$ is high), then the second-contest effort of the first-contest winner is increasing in the number of competitors. The second-contest effort of each first-contest loser, in (6), is decreasing in n, but the total amount of efforts by i's rivals in contest two is still increasing in n. The combined effect is that total contest-two effort, in (7), is always increasing in n: $\frac{\partial X_2^*}{\partial n} > 0$.

The equilibrium probability that the winner of contest one wins also the second contest is

$$\rho_i^*(i) = \frac{\beta(n-1) - \alpha(n-2)}{\alpha + \beta(n-1)},$$

which is decreasing in n.

Expected equilibrium payoffs for the contest-one winner and the losers, respectively, in the second contest are

$$\pi_{i,2}^{*}(i) = \left(\frac{\beta(n-1) - \alpha(n-2)}{\alpha + \beta(n-1)}\right)^2 v; \tag{8}$$

$$\pi_{j,2}^{*}(i) = \left(\frac{\alpha}{\alpha + \beta(n-1)}\right)^2 v, \ j \neq i; \tag{9}$$

where, clearly, $\pi_{i,2}^{*}(i) \geq \pi_{j,2}^{*}(i)$, implying that there is in fact a value in contest two to being the winner in contest one. And this value is larger the larger is the contest-two prize v.

Turning attention to contest one, the expected payoff of the players is symmetric, since all players are identical and have the same possibility of winning contest

[6]We have that $x_{i,2}^{*}(i) \geq x_{j,2}^{*}(i)$. This is because $\beta(n-1) - \alpha(n-2) \geq \alpha\beta$, which is equivalent to

$$\beta \geq \frac{\alpha(n-2)}{n-1-\alpha},$$

which always holds because

$$\beta \geq 1 \geq \frac{\alpha(n-2)}{n-1-\alpha},$$

where the second inequality is equivalent to $(n-1)(1-\alpha) \geq 0$.

[7]Recall that both Möller (2012) and Beviá and Corchón (2013) consider only $n = 2$.

one. The expected payoff for player k is

$$\pi_{k,1} = p_{k,1}\left[1 - v + \delta\pi^*_{k,2}(k)\right] + (1 - p_{k,1})\,\delta\pi^*_{k,2}(j) - x_{k,1},\ \ k \neq j, \tag{10}$$

where $p_{k,1}$ is given by (1). Winning the first contest yields an immediate benefit of the stage prize $1 - v$, but also the promise of the discounted leader payoff $\pi^*_{k,2}(k)$ in contest two given by (8). Losing the first contest gives no stage prize, only the promise of the discounted loser payoff in contest two, $\pi^*_{k,2}(j)$, from (9); this guaranteed payoff is lower, the larger the win advantage. In the symmetric equilibrium of contest one, total effort in that contest is

$$X^*_1(v) = \frac{n-1}{n}\left(1 - v + \frac{\delta(\beta-\alpha)(n-1)\left[\beta(n-1) - \alpha(n-3)\right]}{\left[\alpha + \beta(n-1)\right]^2}v\right).$$

Total effort in the n-player contest series is then given by

$$\begin{aligned}
& X^*(v) = X^*_1(v) + X^*_2(v) \\
= \; & \frac{n-1}{n}\left(1 - v + \frac{(\alpha-\beta)(n-1)(-3\alpha+\beta+n\alpha-n\beta)\delta}{\left[\alpha+\beta(n-1)\right]^2}v\right) \\
& + \frac{\beta(n-1)(1+\alpha) - \alpha(n-2)}{\left[\alpha+\beta(n-1)\right]^2}(n-1)v \\
= \; & \frac{n-1}{n}\left(1 + v\frac{Y}{\left[\alpha+\beta(n-1)\right]^2}\right),
\end{aligned} \tag{11}$$

where

$$\begin{aligned}
Y \;:\; &= \delta(\beta-\alpha)(n-1)\left[\beta(n-1) - \alpha(n-3)\right] \\
& - (n-1)^2\beta^2 + (n-1)\left[n + \alpha(n-2)\right]\beta - \alpha\left[n(n-2) + \alpha\right].
\end{aligned} \tag{12}$$

Expected payoffs from the contest series for each player can be worked out as

$$\pi^*_1 = \frac{1}{n^2}\left(1 - \left(1 - \delta\frac{\left[\alpha(n-2) - \beta(n-1)\right]^2 + \alpha^2(n^2-1)}{\left[\alpha+\beta(n-1)\right]^2}\right)v\right). \tag{13}$$

From (11), we see that total effort is linear in v. This implies that the principal's optimal choice of v is either 0 or 1, depending on the sign of Y in (12). When $\delta = 1$, we have that $Y > 0$.[8] Thus, the optimal choice for the principal when the players do not discount future payoffs is to have all the prize fund in the second contest, by putting $v = 1$.

In the case of discounting, however, there is a subtle difference between the two types of win advantage. Setting $\beta = 1$, so that the win advantage only affects cost, as in Möller (2012), we can readily determine that $Y > 0$ for any value of the

[8] To see this, note first that the expression for Y in (12) is positive for $n \in \{2, 3\}$. For $n \geq 4$, the expression is a convex function of α which at $\alpha = 0$ has a positive value and a negative slope. It can be shown that it has no positive root below 1. It follows that it is positive.

discount factor, and hence $v = 1$ is optimal always. This means that total effort will be

$$X^*(v = 1; \alpha) = \frac{n-1}{n}\left(\frac{\delta(1-\alpha)(n-1)[(n-1)-\alpha(n-3)] + n(n-1+\alpha)}{[\alpha + (n-1)]^2}\right)$$

When $\alpha = 1$ and $\beta \geq 1$, so that the win advantage affects the contest success function (as in Beviá and Corchón, 2013), then $Y > 0$ – again implying $v = 1$ – for

$$\delta > \frac{\beta - 1}{\beta - \frac{n-3}{n-1}} := \widetilde{\delta}(n, \beta). \tag{14}$$

It is straightforward to verify that $\widetilde{\delta}(n, \beta) < 1$ and that it is increasing in both arguments. Hence, in the two-player case, $\widetilde{\delta}(n, \beta)$ is at its lowest level, and the principal is most likely to save the whole prize for the second contest; the more players there are, the less likely this becomes when the win advantage affects only the contest success function. With only this type of win advantage, the maximal amount of effort elicited is

$$X^*(v; \beta) \in \left\{\frac{n-1}{n}, \frac{n-1}{n}\left(\frac{\delta(\beta-1)(n-1)[\beta(n-1)-(n-3)] + 2n(n-1)\beta - n(n-2)}{[1+\beta(n-1)]^2}\right)\right\}.$$

When the win advantage only affects the contest success function, and players' valuation of the future is sufficiently low, the principal prefers to run a single contest rather than the series in which the first contest winner becomes stronger in the second. In contrast, the principal will always run two contests when the win advantage only affects the winner's cost parameter.

We summarize our results as follows.

Proposition 1 *(i) If $\delta = 1$, then, for any $\alpha \in (0, 1]$, $\beta \geq 1$, and $n \geq 2$, the principal's optimum choice is to put $v = 1$ and have the full prize fund in the second contest.*

(ii) If $\beta = 1$, then, for any $\delta \in (0, 1]$, $\alpha \in (0, 1]$, and $n \geq 2$, we get the same: $v = 1$.

(iii) If $\alpha = 1$, then the principal's optimum choice is to put $v = 0$, thus having the full prize fund in the first contest and in practice running only a single contest, if $\delta \leq \widetilde{\delta}(n, \beta)$, where $\widetilde{\delta}(n, \beta)$ is defined in (14), i.e., if the contestants are sufficiently impatient; otherwise, if $\delta > \widetilde{\delta}(n, \beta)$, then the optimum is to put $v = 1$.

When there is a pure cost advantage, setting $\beta = 1$ into (7) reveals that total effort in contest two increases in the win advantage (i.e. as α falls). This total effect is comprised of an increase in effort by the favoured player (who has won the first contest), and a decrease in effort by all rivals. The former effect dominates, and introducing a win advantage in the second contest is not detrimental to total effort. Intuitively, reducing the cost of a single player affects only the reaction function of this player; the others react to this change by decreasing their own effort as an optimal response, although the actual best response function will not change. Hence the principal prefers to save the whole prize for the second contest, inciting effort in contest one for position, and then in contest two where the asymmetry increases effort.

On the other hand, when the win advantage affects the contest success function of all players, each player's optimal response function will adapt to the win advantage.[9] Setting $\alpha = 1$ in (5) shows that the favoured player in contest two can increase effort for small values of the bias parameter, but will eventually use his extra productivity to reduce effort and save cost. Likewise, from (6) with $\alpha = 1$, we see that increasing the productivity of a single player reduces efforts from all rivals. In sum, (7) with $\alpha = 1$ reveals that the total effect of introducing bias for a single player on contest two effort is negative. By saving the prize until the second contest, the principal incites effort in the first contest among players who want to win the advantage, but this yields less effort in the second contest. The heavier the players discount the future, the less effort is carried out in the first contest. Hence there is a critical level of the discount factor above which there is sufficient effort in the first contest to outweigh the negative effect of the asymmetry in the second.

4 Conclusions

In this paper we have discussed a sequence of two Tullock contests where there is a gain to a player in the second contest from winning the first. In particular, we have focused on two different ways of modelling such a gain that can be found in the literature: one making second-contest efforts less costly, and one making efforts more productive in terms of winning the second contest. We have focussed particularly on the contest designer's choice of how to split a fixed prize fund between the two contests. One finding is that, without discounting among the contestants, there is no difference between the two kinds of win advantage: the optimum is to have all the prize fund in the second contest. This result is upheld even with discounting among contestants, as long as the win advantage is purely through costs. When the win advantage is through productivity, however, the optimum may be to have all the prize fund in the first contestant instead, if contestants are impatient; a single contest is most likely to be optimal when there are many players.

Our results indicate that, at least when contestants are patient, a contest designer, such as a research council running a research program, would make the best out of the presence of win advantages by having most of the prize fund, i.e., the research budget, towards to the end of the competition.

A number of extensions of the model might be worth pursuing. Let us just name a few. We might, for example include a general Tullock contest function, where, instead of (1), we would have

$$p_{i,1} = \frac{x_{i,1}^r}{\sum_{j=1}^n x_{j,1}^r},$$

[9] Refer to (2), (3), and (4).

where $r > 0$, with an equivalent modification of (2). Subject to restrictions ensuring the existence of a pure-strategy equilibrium, also in the asymmetric game in contest two,[10] the analysis of such a model would offer a non-linear outcome that would not have the bang-bang flavor of the principal's optimum choice that we have in the current analysis, which might give rise to interesting comparative-statics results.

Another interesting extension might be to allow for loss disadvantages in addition to a win advantage. A loss disadvantage would mean negative effects on costs and productivity from losing a contest. Experiments we have done of a model incorporating such loss disadvantages indicate that they work in much the same way as discounting, making contestants more concerned about current payoff, and therefore making the principal more interested in placing the prize fund in the first contest.

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[10] See, e.g., Nti (1999).

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